PARLIMEN MALAYSIA
BANGUNAN PARLIMEN
JALAN PARLIMEN
50680 KUALA LUMPUR

DOKUMEN SEBUT HARGA

SEBUTHARGA NO : PAR.2/367 SH.7/2025

TAJUK KERJA

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

TARIKH TUTUP : 30 APRIL 2025

Nama Kontraktor :.....

Alamat:.....

.....

.....

Kelas :.....Tempoh Daftar :.....

SENARAI SEMAKAN
(BEKALAN/PERKHIDMATAN/KERJA)

Sila tanda [√] bagi dokumen-dokumen yang disertakan

Bil.	Perkara/Dokumen	Untuk Ditanda Oleh Syarikat	Untuk Ditanda Oleh Jawatankuasa Pembuka Sebut harga
1.	Dokumen No. 1: Arahan Kepada Penyebutharga	☐	☐
2.	Dokumen No. 2: Syarat-Syarat Sebut Harga Untuk Kerja	☐	☐
3.	Dokumen No. 3 : Skop Kerja	☐	☐
4.	Dokumen No. 4: Spesifikasi	☐	☐
5.	Dokumen No. 5 : Jadual Harga	☐	☐
6.	Dokumen No. 6 : Ringkasan Jadual Harga	☐	☐
7.	Dokumen No. 7 : Borang Sebut Harga Kerja & Surat Akuan Pembida	☐	☐
8.	Dokumen No. 8 : Keterangan Mengenai Penyebutharga	☐	☐
9.	Dokumen No. 9 : Keterangan Mengenai Sub-Kontraktor Elektrik	☐	☐
10.	Dokumen No. 10 : Dokumen Sokongan	☐	☐

SENARAI SEMAKAN
(BEKALAN/PERKHIDMATAN/KERJA)

Sila tanda [√] bagi dokumen-dokumen yang disertakan

Bil.	Perkara/Dokumen	Untuk Ditanda Oleh Syarikat	Untuk Ditanda Oleh Jawatankuasa Pembuka Sebut harga
10.	Dokumen sokongan		
	(i) Profil Syarikat Kontraktor Utama beserta rekod pengalaman bekerja yang lepas dan semasa	☐	☐
	(ii) Salinan Penyata Bank tiga (3) bulan terkini Januari 2025, Februari 2025 & Mac 2025. ***sila pastikan dokumen tersebut mendapat pengesahan dari bank berkaitan.**	☐	☐
	(iii) Salinan bukti surat tawaran kerja dan bukti siap kerja yang berkaitan dengan sebutharga ini	☐	☐
	(iv) Salinan Sijil Perakuan Pendaftaran Kontraktor (PPK)	☐	☐
	(v) Salinan Sijil Perolehan Kerja Kerajaan (SPKK)	☐	☐
	(vi) Salinan Salinan Sijil Taraf Bumiputera (STB) dari Pusat Khidmat Kontraktor (Kerja) – jika ada	☐	☐
	(vii) Salinan Sijil SSM	☐	☐
	(viii) Brosur Katalog Produk (kerangka bumbung, bumbung, cat, tiles, *sanitary fixtures* dan lain-lain yang berkaitan)	☐	☐
	(ix) Salinan Surat Pendaftaran dengan Jabatan Kastam Diraja Malaysia (JKDM) di bawah Cukai Perkhidmatan / SST (jika ada)	☐	☐
	(x) Sijil *product and performance warranty* cat daripada pihak pembekal dan kontraktor (*applicator* bertauliah)	☐	☐

SENARAI SEMAKAN
(BEKALAN/PERKHIDMATAN/KERJA)

Sila tanda [√] bagi dokumen-dokumen yang disertakan

Bil.	Perkara/Dokumen	Untuk Ditanda Oleh Syarikat	Untuk Ditanda Oleh Jawatankuasa Pembuka Sebut harga
	Dokumen sokongan (Sub Kontraktor Elektrik)		
	(i) Tiga (3) cadangan profil syarikat sub-kontraktor Elektrik beserta rekod pengalaman yang lepas dan semasa.	☐	☐
	(ii) Salinan Sijil Pendaftaran dengan Suruhanjaya Tenaga (ST), Borang Q	☐	☐
	(iii) Salinan Sijil Perakuan Kekompetenan sebagai Pendawai & Penjaga Jentera (PW4 dan ke atas)	☐	☐
	(iv) Senarai peralatan pengujian & aset syarikat (beserta salinan sijil pemilikan kenderaan syarikat)	☐	☐
	(v) Melampirkan katalog/brosur setiap peralatan yang dicadangkan oleh penyebutharga di dalam lampiran tambahan sebutharga ini.	☐	☐
	(vi) Salinan Sijil Perakuan Pendaftaran Kontraktor (PPK)	☐	☐
	(vii) Salinan Sijil Perolehan Kerja Kerajaan (SPKK)	☐	☐
	(viii) Salinan Salinan Sijil Taraf Bumiputera (STB) dari Pusat Khidmat Kontraktor (Kerja) – jika ada	☐	☐
	(ix) Salinan Sijil SSM	☐	☐

PENGESAHAN OLEH SYARIKAT			**UNTUK KEGUNAAN JABATAN**		
Dengan ini saya mengesahkan bahawa saya telah membaca dan memahami semua syarat-syarat dan terma yang dinyatakan di dalam dokumen sebut harga. Semua maklumat yang dikemukakan adalah benar.			Jawatankuasa Pembuka Sebut Harga mengesahkan penerimaan dokumen bertanda kecuali bagi perkara bil. ..... (jika ada)		
Tandatangan	:		Tandatangan	:	
Nama	:		Nama	:	
Jawatan	:		Jawatan	:	
Tarikh	:		Tarikh	:	
			Tandatangan	:	
			Nama	:	
			Jawatan	:	
			Tarikh	:	

KERAJAAN MALAYSIA

PARLIMEN MALAYSIA

DOKUMEN SEBUT HARGA

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

JADUAL KANDUNGAN

PERKARA	NO DOKUMEN	MUKA SURAT
ARAHAN KEPADA PENYEBUT HARGA	1	
SYARAT-SYARAT AM	2	
DOKUMEN NO. 3 : SKOP KERJA	3	
DOKUMEN NO.4 : SPESIFIKASI	4	
DOKUMEN NO. 5: JADUAL HARGA	5	
DOKUMEN NO. 6 : RINGKASAN JADUAL HARGA	6	
DOKUMEN NO. 7 : BORANG SEBUT HARGA KERJA & SURAT AKUAN PEMBIDA	7	
DOKUMEN NO. 8 : KETERANGAN MENGENAI PENYEBUTHARGA	8	
DOKUMEN NO. 9 : KETERANGAN MENGENAI SUB-KONTRAKTOR ELEKTRIK	9	

DOKUMEN NO.1

ARAHAN KEPADA PENYEBUT HARGA

DOKUMEN NO. 1

ARAHAN KEPADA PENYEBUT HARGA

NO. SEBUT HARGA: PAR.2/367 SH.7/2025

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

1. Tawaran adalah dipelawa Syarikat yang berdaftar dengan Kementerian Kewangan Malaysia dengan Kod Bidang Pendaftaran (Bekalan Dan Perkhidmatan) seperti berikut :-

Gred	**G3**
Kategori	**B dan CE**
Pengkhususan	**B04 (Kerja -Kerja Pembinaan Bangunan)** **B14 (Kerja-Kerja Cat)** **B15 (Pemasangan Bumbung)** **B24 (Kerja Penyenggaraan Bangunan)** **CE 21 (Kejuruteraan Awam)**

Yang mana pendaftaranya masih lagi berkuatkuasa, mempunyai alamat pendaftaran di **Wilayah Persekutuan Kuala Lumpur dan Selangor** adalah layak membuat tawaran bagi sebut harga berikut :-

KERJA-KERJA PENYELENGGARAAN DAN PEMBAIKAN AM SERTA LAIN-LAIN KERJA BERKAITAN UNTUK KUARTERS JKR 2930 PARLIMEN MALAYSIA

2. Lawatan tapak adalah sebagaimana yang dinyatakan di dalam iklan sebutharga. Penyebut harga adalah **DIWAJIBKAN** untuk menghadiri

lawatan tapak tersebut pada masa dan tempat yang telah ditetapkan. Kegagalan penyebut harga untuk menghadiri lawatan tapak akan menyebabkan penyebut harga gagal untuk memasuki sebutharga tersebut.

3. Penyebut harga hendaklah menyerahkan sampul tawaran sebut harga **secara manual** ke dalam peti sebut harga pada atau sebelum **30hb. April 2025 (Rabu)** jam **12.00 tengah hari.** Dokumen tawaran yang diterima selepas dari tarikh dan masa akan **ditolak.** Sampul hendaklah dilabelkan dengan nombor sebut harga dan nombor tawaran sebut harga dan hendaklah dimasukkan ke dalam Peti Sebut harga **No.Satu (1)** di Seksyen Kewangan dan Akaun, Aras Aras 4, Blok Ahli Parlimen Dan Pentadbiran, Parlimen Malaysia, Jalan Parlimen, 50680 Kuala Lumpur.

4. Jika Dokumen Sebut Harga tidak diserahkan dengan tangan, Penyebut Harga hendaklah menghantar Dokumen tersebut dengan pos supaya tiba pada atau sebelum masa dan di tempat yang ditetapkan. Kerajaan tidak bertanggungjawab di atas apa-apa kehilangan dokumen semasa perjalanan pos/perkhidmatan hantar cepat *(courier service)* dan sebagainya.

5. Tawaran sebut harga yang dikemukakan adalah diwajibkan mengandungi dokumen-dokumen berikut:-

a)	Skop Kerja	Dokumen No. 3
b)	Spesifikasi	Dokumen No. 4
c)	Jadual Harga	Dokumen No. 5
d)	Ringkasan Jadual Harga	Dokumen No. 6
e)	Borang Tawaran	Dokumen No. 7
f)	Keterangan Mengenai Kontraktor Utama	Dokumen No. 8
g)	Keterangan Mengenai Sub-Kontraktor Elektrik	Dokumen No. 9

h) Dokumen sokongan:

(i) Profil Syarikat;

(ii) Salinan Penyata Bank tiga (3) bulan terkini

(iii) Salinan sijil pendaftaran Kementerian Kewangan, CIDB & BPKU

(iv) Brosur produk yang berkaitan

(vi) Salinan Sijil Perakuan Pendaftaran Kontraktor (PPK);

(vii) Salinan Sijil Perolehan Kerja Kerajaan (SPKK);

(viii) Salinan Sijil Taraf Bumiputera (STB) dari Pusat Khidmat Kontraktor (Kerja);- jika ada

(ix) Salinan Sijil SSM;

(x) Sijil *product and performance warranty* cat daripada pihak pembekal dan kontraktor (*applicator* bertauliah)

(xi) Profil tiga (3) cadangan syarikat sub-kontraktor Elektrik

(xii) (Salinan Sijil Pendaftaran dengan Suruhanjaya Tenaga (ST) - Borang Q

(xiii) Salinan Sijil Perakuan Kekompetenan sebagai Pendawai & Penjaga Jentera (PW4 dan ke atas)

(xiv) Senarai peralatan pengujian & aset syarikat (beserta salinan sijil pemilikan kenderaan syarikat)

(xv) Melampirkan katalog/brosur setiap peralatan yang dicadangkan oleh penyebutharga di dalam lampiran tambahan sebutharga ini.

Semua borang hendaklah diisi dengan lengkap seperti yang ditentukan dan ditaip dengan kemas dan terang. Jika ruangan yang disediakan tidak mencukupi, penyebut harga dibenarkan menaip maklumat-maklumat di muka surat tambahan.

6. Dokumen tawaran sebut harga hendaklah dikemukakan secara manual sebelum waktu dan tarikh tutup yang ditetapkan.

7. Tawaran sebut harga ini sah selama **sembilan puluh (90)** hari dari tarikh tutup bidaan.

8. Penyebut harga yang enggan menandatangani kontrak yang telah disetuju terima atau yang menarik balik tawaran bidaan sebelum dipertimbangkan atau menolak tawaran setelah tawaran dibuat, akan dikenakan tindakan penggantungan pendaftaran seperti berikut:

i) Dua (2) tahun bagi kesalahan pertama;

ii) Lima (5) tahun bagi kesalahan kedua; dan

iii) Pendaftaran akan dipotong terus bagi kesalahan berikutnya.

9. Penyebut harga yang tawarannya disetujuterima dikehendaki memberi perkhidmatan membekal semua barang tersebut pada tarikh yang ditetapkan oleh Kerajaan atau mana-mana tarikh lain seperti ditentukan oleh Kerajaan. Sekiranya Penyebut harga gagal berbuat demikian, tawaran yang disetujuterima akan dibatalkan dan nama Kontraktor serta nama pengarah-pengarah termasuk pemegang-pemegang saham terbesar akan disenarai hitamkan.

10. Kerja ini hendaklah disiapkan dalam tempoh tidak melebihi **180 hari .**

11. Kerajaan tidak terikat untuk menerima tawaran yang terendah atau mana-mana tawaran. Tiada sebarang alasan perlu diberikan oleh Kerajaan untuk sebarang penolakan tawaran. Keputusan mengenai tawaran yang diterima adalah muktamad. Sebarang surat menyurat mengenai keputusan tidak akan dilayan.

12. PERINGATAN MENGENAI KESALAHAN RASUAH DALAM DOKUMEN PEROLEHAN KERAJAAN

12.1 Sebarang perubahan atau percubaan rasuah untuk menawar atau memberi, meminta atau menerima apa-apa suapan secara rasuah kepada dan daripada mana-mana orang berkaitan perolehan ini merupakan suatu kesalahan jenayah di bawah Akta Suruhanjaya Pencegahan Rasuah Malaysia 2009 (Akta 694).

12.2 Sekiranya mana-mana pihak ada menawarkan atau memberi apa-apa suapan kepada mana-mana anggota pentadbiran awam, maka pihak yang ditawarkan atau diberi suapan dikehendaki membuat aduan dengan segera ke pejabat Suruhanjaya Pencegahan Rasuah Malaysia atau balai polis yang berhampiran. Kegagalan berbuat demikian adalah merupakan suatu kesalahan di bawah Akta Suruhanjaya Pencegahan Rasuah Malaysia 2009 (Akta 694).

12.3 Tanpa prejudis kepada tindakan-tindakan lain, tindakan tatatertib terhadap anggota perkhidmatan awam dan menyenarai hitamkan kontraktor atau pembekal boleh diambil sekiranya pihak-pihak terlibat dengan kesalahan rasmi di bawah Akta Suruhanjaya Pencegahan Rasuah Malaysia 2009 (Akta 694).

12.4 Mana-mana kontraktor atau pembekal yang membuat tuntutan bayaran berkaitan perolehan ini walaupun tiada kerja-kerja dibuat atau tiada barangan dibekal mengikut spesifikasi yang ditetapkan atau tiada perkhidmatan diberi dan mana-mana anggota perkhidmatan awam yang mengesahkan tuntutan berkenaan adalah melakukan kesalahan dibawah Akta Suruhanjaya Pencegahan Rasuah Malaysia (Akta 694).

13. PELAKSANAAN CUKAI JUALAN DAN CUKAI PERKHIDMATAN (CJCP) YANG BERKUATKUASA 1 SEPTEMBER 2018

13.1 Semua tawaran harga oleh Pembekal hendaklah dikemukakan dengan dinyatakan harga tawaran tanpa Cukai Jualan dan Cukai Perkhidmatan (CJCP).

13.2 Senarai yang dikenakan Cukai Perkhidmatan seperti yang terdapat dalam Akta Cukai Perkhidmatan 2018. Sekiranya pembekal yang berjaya berdaftar CJCP dan perkhidmatan tersebut adalah termasuk dalam senarai yang dikenakan Cukai Perkhidmatan, Kerajaan akan menawarkan nilai perolehan termasuk kenaan Cukai Perkhidmatan.

13.3 Pembekal hendaklah memaklumkan pada bila-bila masa setelah berdaftar dengan JKDM kepada Kerajaan supaya Cukai Perkhidmatan boleh dibayar. Kegagalan atau kelewatan syarikat untuk memaklumkan kepada Kerajaan mengenai status pendaftraan dengan JKDM akan menyebabkan syarikat perlu menanggung CJCP dan tidak layak menuntut apa-apa bayaran daripada Kerajaan.

14 PELAKSANAAN PROGRAM *PROFESSIONAL TRAINING AND EDUCATION FOR GROWING ENTREPRENEURS* (PROTEGE) DALAM PEROLEHAN KERAJAAN (1PP/PK1.2)

14.1 Penyebut harga adalah dikehendaki melaksanakan program PROTEGE dalam perolehan kerajaan mengikut had nilai ambang (threshold value) dan sektor seperti berikut :

Bil	Sektor	Nilai Ambang (RM)
1	Pembinaan	10 juta
2	Perkhidmatan / Penyelenggaraan Bangunan / Infrastruktur / Jalan	5 juta
3	Teknologi Informasi dan Komunikasi	10 juta
4	Perkhidmatan Perunding	5 juta
5	Perubatan dan Farmasi	10 juta
6	Perkhidmatan Sokongan Kesihatan	10 juta
7	Perkhidmatan Penyenggaraan, Pembaikan dan Baik Pulih	10 juta
8	Pengangkutan dan Logistik	10 juta
9	Pertahanan Strategik	10 Juta
10	Perkhidmatan Kawalan Keselamatan	4 juta
11	Sektor Lain	10 juta

14.2 Syarikat hendaklah memperuntukkan sekurang-kurangnya 1% daripada keseluruhan kos projek bagi melaksanakan program PROTEGE.

14.3 Syarikat yang mendapat kontrak Kerajaan di bawah nilai ambang digalakkan untuk melaksanakan program PROTEGE, namun tidak tertakluk kepada penetapan 1% daripada nilai kontrak keseluruhan.

14.4 Penetapan bilangan minimum peserta PROTEGE-RTW bagi sesuatu kontrak dikira berdasarkan formula berikut :

$$\frac{1\% \text{ X Kos Keseluruhan Projek / Prolehan}}{\text{RM24,000*}}$$

* Elaun PROTEGE (RM2,000 seorang X 12 bulan)

14.5 Syarikat yang mengemukakan sijil atau surat pengesahan daripada Sekretariat PROTEGE, akan diberi **keutamaan** tidak kira sama ada program PROTEGE dilaksanakan bagi perolehan Kerajaan atau program PROTEGE dilaksanakan oleh inisiatif syarikat sendiri.

15. BON PELAKSANAAN

(a) Bagi kontrak kerja yang bernilai melebihi RM200,000.00, Kontraktor hendaklah mengemukakan bersama-sama dengan Surat Setuju Terima, Bon pelaksanaan sebanyak 5% daripada jumlah harga kontrak.

(b) Kontraktor yang dilantik hendaklah mengemukakan Bon Pelaksanaan dalam Ringgit Malaysia dalam bentuk :

i. Jaminan Bank/Syarikat Kewangan yang dikeluarkan oleh bank/syarikat kewangan berlesen di bawah Akta Perkhidmatan Kewangan 2013 [Akta 758] yang beroperasi di Malaysia;

ii. jaminan Bank Islam yang dikeluarkan oleh bank berlesen di bawah Akta Perkhidmatan Kewangan Islam 2013 [Akta 759] yang beroperasi di Malaysia;

iii. jaminan Insurans yang dikeluarkan oleh syarikat insurans yang berlesen di bawah Akta Perkhidmatan Kewangan 2013 [Akta 758] yang beroperasi di Malaysia;

iv. jaminan Takaful yang dikeluarkan oleh Syarikat Takaful yang berlesen di bawah Akta Perkhidmatan Kewangan Islam [Akta 759] yang beroperasi di Malaysia; atau

v. jaminan yang dikeluarkan oleh Bank Pembangunan Malaysia Berhad (BPMB) dan Bank Perusahaan Kecil & Sederhana (SME Bank).

Bon Pelaksanaan dalam bentuk yang tidak dilesenkan di bawah akta seperti di Perkara (b) di atas termasuk di bank pesisir pantai dan bank luar negara adalah tidak dibenarkan.

(c) Kontraktor boleh memilih kaedah Wang Jaminan Pelaksanaan. Wang Jaminan Pelaksanaan ialah satu kemudahan bagi memenuhi

keperluan Bon Pelaksanaan. Wang Jaminan Pelaksanaan bermaksud sejumlah wang yang dipegang oleh Kerajaan bagi memastikan kontraktor mematuhi dan melaksanakan obligasinya di bawah kontrak yang ditandatangan.

i. Jumlah Wang Jaminan Pelaksanaan adalah 5% daripada harga keseluruhan kontrak. Kemudahan ini hanya dibenarkan kepada kontraktor kerja tempatan sahaja. Walau bagaimanapun, Wang Jaminan Pelaksanaan tidak dibenarkan untuk Sub Kontraktor Dinamakan bagi Kerja.

ii. Kontraktor yang memilih / dikenakan kaedah Wang Jaminan Pelaksanaan akan dikenakan potongan sebanyak 10% daripada bayaran kemajuan pertama dan seterusnya sehingga ia mencapai jumlah 5% peratus daripada nilai keseluruhan kontrak.

(d) Tempoh sah laku Bon Pelaksanaan bagi perolehan kerja adalah berdasarkan nilai projek seperti berikut :

Nilai Projek	Tempoh Sah Laku Bon Pelaksanaan
Kos Projek sehingga RM10 juta	• Dari tarikh kuat kuasa kontrak sehingga 12 bulan selepas tamat tempoh Tanggungan Kecacatan (DLP)
Kos Projek melebihi RM10 juta	• Dari tarikh kuat kuasa kontrak sehingga 24 bulan selepas Tempoh Tanggungan Kecacatan (DLP)

(e) *LIQUIDATED & ASCERTAINED DAMAGES* (LAD)

15.1 Sebaik sahaja arahan dikeluarkan untuk memulakan perkhidmatan, syarikat dikehendaki melaksanakan perkhidmatan tersebut mengikut jadual dan spesifikasi yang telah ditetapkan.

15.2 Sebarang kegagalan syarikat dalam mematuhi perkara tersebut (lewat/gagal/kurang kualiti atau lain-lain) boleh mengakibatkan tindakan diambil ke atas syarikat dengan pengenaan LAD, Denda atau Tolakan mengikut formula berikut :

(PR / 365 hari) x nilai kontrak

15.3 Sekiranya syarikat gagal menyempurnakan perkhidmatan yang telah ditetapkan dalam tempoh kontrak yang dipersetujui, maka syarikat dikehendaki membayar denda dalam tempoh 30 hari setelah menerima notis denda daripada Kerajaan dengan menggunakan formula di atas.

16. HARGA INDIKATIF JABATAN

16.1 Harga Indikatif Jabatan bagi sebut harga ini adalah Ringgit Malaysia: Lapan Ratus Enam Ribu Tiga Ratus Sebelas Sahaja (RM806,311.00).

16.2 Harga Indikatif Jabatan ini merupakan suatu anggaran sahaja dan amaun tersebut tidak mengikat Kerajaan atau mana-mana pihak lain juga bagi maksud mengelakkan kekeliruan yang mungkin berbangkit.

16.3 Pihak Kerajaan tidak menjamin bahawa syarikat akan dipilih atau boleh menyiapkan kerja dengan bersandarkan Harga Indikatif Jabatan.

17. LEVI

Semua tender/sebut harga yang bernilai RM500,000 ke atas, levi sebanyak 0.25% daripada nilai harga kontrak akan dikenakan ke atas petender yang berjaya, seperti yang ditetapkan di bawah seksyen 34(2) Akta Lembaga Pembangunan Industri Pembinaan Malaysia (CIDB) 1994 (Akta 520).

DOKUMEN NO.2

SYARAT-SYARAT AM

DOKUMEN NO.2

SYARAT-SYARAT AM

Tertakluk kepada apa-apa syarat khas yang ditetapkan di tempat lain dalam pelawaan ini, syarat-syarat am yang berikut hendaklah dipakai, melainkan setakat mana syarat-syarat am itu ditolak atau diubah dengan khususnya oleh pembida.

1. HARGA

Harga belian yang ditawarkan hendaklah harga bersih termasuk semua diskaun, kos penghantaran, kos pemasangan dan kos membuka.

2. TEMPOH MENGEMUKAKAN TUNTUTAN BAYARAN

Penyebut harga diberi peringatan supaya mengemukakan tuntutan pembayaran yang lengkap dalam tempoh 14 hari daripada tarikh pengesahan siap kerja untuk membolehkan bayaran dibuat dengan segera. Kerajaan tidak akan bertanggungjawab di atas kelewatan pembayaran kepada **Kontraktor** jika tuntutan pembayaran tidak dihantar dengan segera dalam tempoh 14 hari.

3. PERSETUJUAN

Kerajaan tidak terikat untuk setuju terima tawaran harga yang terendah atau mana-mana tawaran daripada mana-mana kontraktor.

4. PEMERIKSAAN

Kerajaan sentiasa berhak melantik seseorang pegawai untuk memeriksa bekalan itu semasa atau sebelum pemasangan dibuat atau pada bila-bila masa lain sebelum pentauliahan dan penyerahan sistem tersebut.

5. PERAKUAN MENYATAKAN SPESIFIKASI TELAH DIPATUHI

Penyebutharga dikehendaki memperakui bahawa bekalan yang dibekalkan oleh mereka adalah mengikut kehendak atau piawai (jika ada) yang dinyatakan di dalam pelawaan ini.

6. KEGAGALAN KONTRAKTOR MEMULAKAN KERJA

Sekiranya kontraktor gagal memulakan kerja selepas tujuh (7) hari dari tarikh akhir tempoh mula kerja yang dinyatakan dalam Inden, tanpa sebab-seba yang munasabah, Inden akan dibatalkan oleh Pegawai Inden dan tindakan tatatertib akan diambil terhadap kontraktor.

7. SUB-SEWA DAN MENYERAHHAK KERJA

Kontraktor tidak dibenarkan mengsubkan-sewakan Kerja kepada kontraktor-kontraktor lain. Kontraktor tidak boleh menyerahhak apa-apa faedah dibawah Inden ini tanpa terlebih dahulu mendapatkan persetujuan bertulis daripada Pegawai Inden.

8. PENOLAKAN BAHAN, BARANG DAN MUTU HASIL KERJA OLEH PEGAWAI INDEN

8.1 Pegawai Inden atau wakilnya berhak menolak bahan, barang dan mutu hasil kerja dan jenis piawaian tidak menepati seperti diperihalkan dalam spesifikasi. Kontraktor hendaklah, apabila diminta oleh Pegawai Inden, memberi kepadanya baucar-baucar dan/atau perakuan ujian pengilang untuk membuktikan bahawa bahan-bahan dan barang-barang itu mematuhi Spesifikasi. Bahan, barang dan kerja-kerja yang ditolak hendaklah diganti dan sebarang kos tambahan yang terlibat hendaklah ditanggung oleh kontraktor sendiri.

8.2 Kontraktor hendaklah dengan sepenuhnya atas perbelanjaan sendiri menyediakan sampel bahan dan barang-barang untuk ujian.

8.3 Tiada penggantian untuk peralatan, bahan dan cara kerja yang telah ditenrtukan didalam spesifikasi atau ditawarkan dan telah diterima, dibenarkan kecuali mendapat persetujuan daripada Pegawai Inden secara bertulis.

9.0 RINGKASAN SEBUT HARGA

9.1 Ringkasan Sebut harga hendaklah menjadi sebahagian daripada Borang Sebut harga ini dan hendaklah menjadi asas Jumlah Harga Sebut harga.

9.2 Harga-harga dalam Ringkasan Sebut harga hendaklah mengambilkira semua kos termasuk pengangkutan, cukai, duti, bayaran dan caj-caj lain yang perlu dan berkaitan bagi penyaiapan Kerja dengan sempurnanya.

9.3 Tiada sebarang tuntutan akan dilayan bagi pelarasan harga akibat daripada perubahan kos buruh, bahan-bahan dan semua duti dan cukai Kerajaan, sama ada dalam tempoh sah sebutharga atau dalam tempoh Kerja.

9.4 Harga-harga dalam Ringkasan Sebut harga yang dikemukakan oleh kontraktor hendaklah tertakluk kepada persetujuan sebelumnya daripada Pegawai Inden tentang kemunahsabahannya. Persetujuan sebelumnya itu dan apa-apa pelarasan kemudiannya kepada harga-harga dalam Ringkasan Sebut harga hendaklah dibuat sebelum Inden Kerja dikeluarkan.

9.5 Apa-apa pelarasan harga dalam Ringkasan Sebut harga dan apa-apa kesilapan hisab dalam Ringakasan Sebut harga hendaklah dilaras dan diperbetulkan sebelum Inden Kerja dikeluarkan. Jumlah amauan yang dilaraskan hendaklah sama dengan amaun jumlah harga pukal dalam Borang Sebut harga. Amaun jumlah harga pukal dalam Borang Sebut harga hendaklah tidak berubah.

9.6 Sekiranya sebut harga berasaskan senarai kuantiti sementara, pengukuran semula hendaklah dibuat dan harga diselaraskan.

10.0 PERCANGGAHAN DAN KECUKUPAN DOKUMEN SEBUT HARGA

10.1 Dokumen Sebut harga adalah dikira sebagai saling jelas-menjelas antara satu sama lain. Kontraktor hendaklah mengadakan segala yang perlu untuk melaksanakan kerja dengan sewajarnya sehinggalah siap mengikut tujuan dan maksud sebenar. Dokumen Sebut harga pada keseluruhannya sama ada atau tidak tujuan dan maksud itu ada ditunjuk atau diperihalkan secara khusus, dengan syarat bahawa tujuan, maksud itu hendaklah difahamkan dengan munasabahnya dari Dokumen Sebut harga itu.

10.2 Jika kontraktor mendapati apa-apa percanggahan dalam Dokumen Sebut harga , maka hendaklah merujuk kepada Pegawai Inden untuk mendapatkan keputusan.

11.0 KEGAGALAN KONTRAKTOR MENYIAPKAN KERJA DAN PENAMATAN PERLANTIKAN KONTRAKTOR

Pegawai Inden berhak membatalkan Inden sekiranya Kontraktor berada dalam keadaan berikut dan setelah menerima surat amaran daripada Pegawai Inden;

a) Sekiranya kontraktor masih gagal menyiapkan Kerja dalam tempoh yang telah ditetapkan.
b) Kemajuan kerja terlalu lembab tanpa apa-apa sebab yang munasabah.
c) Penggantungan pelaksanaan seluruh atau sebahagian kerja, tanpa apa-apa sebab yang munasabah.
d) Tidak mematuhi arahan Pegawai Inden tanpa apa-apa alasan yang munasabah.
e) Apabila kontraktor diisytiharkan bankrap oleh pihak yang sah.

12.0 PERUBAHAN KERJA

12.1 Perubahan kerja dibenarkan sekiranya perlu tertakluk kepada syarat-syarat berikut;

a) Peruntukan mencukupi.

b) Kelulusan Jawatankuasa Sebut harga diperolehi dahulu sebelum perubahan kerja dilaksanakan. Seorang daripada ahli Jawatankuasa Sebut harga hendaklah terdiri daripada Pegawai Teknikal.

c) Jumlah perubahan kerja terkumpul yang dicadangkan tidak melebihi 20% daripada nilai kontrak atau tidak melebihi RM100,000 mengikut mana yang terendah. Cadangan perubahan kerja terkumpul melebihi 20% daripada nilai kontrak atau RM 100,000 hendaklah dirujuk kepada kelulusan Kementerian Kewangan terlebih dahulu.

12.2 Pegawai Inden hanya boleh mengeluarkan arahan perubahan kerja sekiranya mendapat kelulusan daripada jawatankuasa sebut harga.

13.0 TEMPOH TANGGUNGAN KECACATAN (DLP)

13.1 Tempoh Tanggungan Kecacatan bagi sebut harga hendaklah sekurang-kurangnya dua belas (12) bulan dari tarikh kerja diperakukan siap.

13.2 Kontraktor dipertanggungjawabkan untuk membaiki kecacatan, ketidaksempurnaan, kekecutan atau apa-apa jua kerosakan lain yang mungkin kelihatan dan yang disebabkan oleh bahan atau barang atau mutu hasil kerja yang tidak menepati sebut harga ini apabila diarahkan oleh Pegawai Inden dan dalam masa yang berpatutan. Kontraktor hendaklah membaiki kecacatan, ketidaksempurnaan, kekecutan atau apa-apa jua kerosakan lain atas kos kontraktor sendiri.

13.3 Sekiranya kontraktor gagal membaiki kecacatan, ketidaksempurnaan, kekecutan atau apa-apa jua kerosakan lain seperti yang diarahkan, Pegawai Inden berhak memotong kos membaiki dari baki wang yang akan dibayar kepada kontraktor atau, jika baki itu tiada/tidak mencukupi, mengeluarkan surat pengesyoran kepada Pusat Khidmat Kontraktor untuk menggantungkan pendaftaran kontraktor, dan menghantar salinan-salinan surat tersebut kepada Pengarah Kerja Raya Negeri/ Ketua jabatan, Bahagian Pembangunan Kontraktor Dan Usahawan, Kementerian Pembangunan Usahawan dan Lembaga Pembangunan Industri Pembinaan (CIDB).

14.0 TUNTUTAN BAYARAN KEMAJUAN

Pegawai Inden dibenarkan membuat bayaran interim sehingga 50% kemajuan kerja siap dilaksanakan. Bayaran akhir/muktamad hanya akan dibayar setelah kontraktor menyiapkan kerja dengan sempurnanya dan Perakuan Siap Kerja dikeluarkan. Kontraktor hendaklah mengembalikan Borang-Borang Inden Kerja Asal iaitu Borang Perjanjian Inden Kerja dan Borang Pengesahan Inden Kerja kepada Pegawai Inden.

15.0 PERAKUAN SIAP KERJA

Pegawai Inden hendaklah mengeluarkan Perakuan Siap Kerja sebaik sahaja kerja disiapkan dengan sempurna dan memuaskan. Tarikh siap kerja ini bermulanya Tempoh Tanggungan Kecacatan.

16.0 PERAKUAN SIAP MEMPERBAIKI KECACATAN

Pegawai Inden hendaklah mengeluarkan Perakuan Siap Membaiki Kecacatan sebaik sahaja kontraktor telah membaiki kecacatan, ketidaksempurnaan, kekecutan atau apa-apa jua kerosakan lain.

17.0 PEMATUHAN KEPADA UNDANG-UNDANG OLEH KONTRAKTOR

Kontraktor hendaklah memantuhi segala kehendak Undang-Undang Kecil dan Undang-Undang Berkanun dalam Malaysia semasa pelaksanaan kerja. Kontraktor tidak berhak menuntut sebarang kos dan bayaran tambahan kerana pematuhannya dengan syarat-syarat ini.

18.0 TAFSIRAN

Tawaran ini dan apa-apa kontrak yang timbul daripadanya hendaklah diertikan mengikut dan dikawal oleh undang-undang Malaysia, dan Penyebut harga bersetuju tertakluk hanya kepada bidang kuasa Mahkamah Malaysia sahaja dalam apa-apa pertikaian atau perselisihan jua pun yang mungkin timbul mengenai tawaran bidaan ini atau apa-apa kontrak yang timbul daripadanya.

19.0 CUKAI

Harga yang ditawarkan adalah diertikan sebagai termasuk cukai jika berkenaan.

20.0 MATA WANG

Tawaran bidaan hendaklah dinyatakan dalam Ringgit Malaysia (RM).

21.0 PERLANTIKAN SUB-KONTRAKTOR UNTUK KERJA-KERJA ELEKTRIK

Bagi kerja-kerja Elektrik Kontraktor hendaklah mengemukakan sekurang-kurangnya **tiga** (3) cadangan Syarikat Sub-Kontraktor dalam kategori E (Elektrik) yang mempunyai pengkhususan berikut untuk kelulusan Pegawai Inden antaranya :-

1. E04 (Pemasangan Voltan Rendah)
2. E11 (Kerja Am Elektrik)
3. E17 (Kabel Bawah Tanah Voltan Rendah)

Pegawai Inden berhak untuk menolak mana-mana Syarikat Sub- Kontraktor yang dicadangkan oleh pihak Kontraktor Utama jika ianya tidak memenuhi mana-mana syarat yang telah ditetapkan.

DOKUMEN NO.3

SKOP KERJA

DOKUMEN NO. 3

SKOP KERJA

BIL	KETERANGAN	Mandatori Nyatakan YA/TIDAK	Lain-lain Kenyataan
A.	**KERJA-KERJA PEMBAIKAN DALAM BANGUNAN** *(sila rujuk bill of quantities bagi butiran terperinci)*		
1.	Kerja Aluminium / Besi	_____	_____
2.	Dinding Bata	_____	_____
3.	Kerja Siling	_____	_____
4.	Kerja Menjubin	_____	_____
5.	Pintu	_____	_____
6.	Penggantian Tangga	_____	_____
7.	Kerja Mengecat	_____	_____
8.	Perabot Dalaman *(Built-In)*	_____	_____
9.	Ruang *Laundry*	_____	_____

BIL	KETERANGAN	Mandatori Nyatakan YA/TIDAK	Lain-lain Kenyataan
B.	**KERJA-KERJA LUAR** *(sila rujuk bill of quantities bagi butiran terperinci)*		
1.	Ruang Parkir & Kaki lima	_____	_____
2.	Jerejak *(Grilled)* Keselamatan	_____	_____
3.	Bumbung	_____	_____
4.	Paip Retikulasi Air	_____	_____
5.	Paip Kumbahan	_____	_____
6.	Kerja Kemasan Dinding Luar	_____	_____
7.	Siling Luar	_____	_____
8.	Premix	_____	_____
9.	Pagar & Longkang Kawasan	_____	_____

BIL	KETERANGAN	Mandatori Nyatakan YA/TIDAK	Lain-lain Kenyataan
C.	***SANITARY FITTING*** *(sila rujuk bill of quantities bagi butiran terperinci)*		
1.	Bekal dan pasang *sanitary appliances* dan *accessories*	_____	_____
D.	**PEMASANGAN PERPAIPAN BEKALAN AIR SEJUK DALAMAN**		
1.	Paip Masuk ke Tangki Air	_____	_____
2.	Paip Keluar dari Tangki Air 1	_____	_____
3.	Paip Keluar dari Tangki Air 2	_____	_____
4.	Bilik Air Utama	_____	_____
5.	Bilik Air 2	_____	_____
6.	Bilik Air 1	_____	_____
7.	Sinki Dapur & *Garden Tap*	_____	_____
8.	Bilik Mandi & Tandas 2	_____	_____
9.	Sinki Ruang Jemuran & *Laundry Tap*	_____	_____
10.	Tangki Simpanan Air	_____	_____

BIL.	KETERANGAN	Mandatori Nyatakan YA/TIDAK	Lain-lain Kenyataan
E.	**PEMASANGAN PERPAIPAN SANITARI** *(sila rujuk bill of quantities bagi butiran terperinci)*		
1.	Bilik Air Utama	_____	_____
2.	Bilik Air 2	_____	_____
3.	Tandas 1	_____	_____
4.	Sinki Dapur	_____	_____
5.	Bilik Mandi & Tandas 2	_____	_____
6.	Sinki Ruang Jemuran & *Laundry Tap*	_____	_____
7.	Pemasangan Perpaipan Sanitari		
8.	Paip *Vitrified Clay Pipes* dan kelengkapan yang memiliki kelulusan SIRIM/SPAN.	_____	_____
9.	Perangkap Parit *(Gully Trap)*	_____	_____
10.	Ruang *Pemeriksaan (Inspection Chamber)*	_____	_____
F.	**PENGUJIAN DAN PENTAULIAHAN** *(sila rujuk bill of quantities bagi butiran terperinci)*		
1.	Pemasangan Perpaipan Bekalan Air Sejuk Dalaman	_____	_____
2.	Pemasangan Perpaipan Sanitari	_____	_____

G.	**KERJA-KERJA ELEKTRIK** *(sila rujuk bill of quantities bagi butiran terperinci)* Membekal dan memasang semua bahan mengikut spesifikasi piawai JKR dan Suruhanjaya Tenaga.		
1.	Pendawaian Elektrik Aras Bawah	_____	_____
2.	Pendawaian Elektrik Aras Atas	_____	_____
3.	Pendawaian Elektrik Lampu Kawasan	_____	_____
4.	Pendawaian Elektrik Lampu Pagar	_____	_____
5.	Pendawaian Elektrik Lampu Limpah	_____	_____
6.	Pemasangan Lampu LED Aras Bawah	_____	_____
7.	Pemasangan Lampu LED Aras Atas	_____	_____
8.	Pemasangan Lampu Kawasan LED	_____	_____
9.	Pemasangan Lampu Pagar LED	_____	_____
10.	Pemasangan Lampu Limpah LED	_____	_____
11.	Pemasangan Soket Aras Bawah	_____	_____
12.	Pemasangan Soket Aras Atas	_____	_____
13.	Pemasangan Suis Aras Bawah	_____	_____

14.	Pemasangan Suis Aras Atas	_____	_____
15.	Pemasangan Kipas Siling Aras Bawah	_____	_____
16.	Pemasangan Kipas Dinding Aras Bawah	_____	_____
17.	Pemasangan Kipas Pelawas Aras Bawah	_____	_____
18.	Pemasangan Kipas Siling Aras Atas	_____	_____
19.	Pemasangan DB Aras Bawah	_____	_____
20.	Pemasangan DB Aras Atas	_____	_____
21.	Pemasangan dan Pendawaian Elektrik Loceng	_____	_____
22.	Pemasangan Sistem Pembumian	_____	_____
23.	Pengujian dan Pentauliahan i) Sistem Elektrik ii) Sistem Pembumian	_____	_____

DOKUMEN NO.4

SPESIFIKASI

DOKUMEN NO. 4

SPESIFIKASI

SILA LIHAT LAMPIRAN B
SPESIFIKASI KERJA BERKAITAN

DOKUMEN NO.5

JADUAL HARGA

DOKUMEN NO. 5

JADUAL HARGA

SILA LIHAT LAMPIRAN C

JADUAL HARGA

DOKUMEN NO.6

RINGKASAN JADUAL HARGA

DOKUMEN NO. 6

RINGKASAN JADUAL HARGA

BIL	BUTIRAN	AMAUN (RM)
A	KERJA-KERJA AWALAN	
B	KERJA-KERJA DALAMAN	
C	KERJA-KERJA LUAR	
D	SANITARY FITTING	
E	KERJA-KERJA PERPAIPAN BEKALAN AIR SEJUK DALAMAN	
F	KERJA-KERJA ELEKTRIK	
G	WANG PERUNTUKKAN SEMENTARA *(PROVISIONAL SUMS)*	50,000.00
	Jumlah Keseluruhan (RM)	

Ringgit Malaysia :

.....

.....

NILAI INI HENDAKLAH SAMA DENGAN NILAI YANG DITAWARKAN, JIKA TIDAK SEBUT HARGA YANG DIKEMUKAKAN TIDAK AKAN DIPERTIMBANGKAN.

Tempoh kerja yang ditawarkan : ..... **hari**

.....
Tandatangan Kontraktor

Nama Penuh:.....
Atas Sifat :.....
No. Kad Pengenalan:.....
Alamat :.....
.....
.....

Tarikh :.....

.....
Tandatangan Saksi

Nama Penuh:.....
Atas Sifat:.....
No. Kad Pengenalan:.....
Alamat :.....
.....
.....

Tarikh :.....

DOKUMEN NO.7

BORANG TAWARAN

DOKUMEN NO. 7

Pekeliling Perbendaharaan Malaysia
PK 2 Lampiran 2.6

BORANG SEBUT HARGA KERJA
Sebut Harga No. **PAR.2/367 SH.7/2025**

Ketua Pentadbir
Parlimen Malaysia
Bangunan Parlimen
Jalan Parlimen
50680 Kuala Lumpur.

Tuan,

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

Di bawah dan tertakluk kepada Arahan Kepada Penyebut Harga, Syarat-syarat Sebut Harga, Spesifikasi Kerja dan pelan-pelan, saya yang bertandatangan di bawah ini adalah dengan ini menawarkan untuk melaksanakan dan menyiapkan kerja-kerja tersebut bagi jumlah harga pukal sebanyak Ringgit Malaysia:-

.....

.....

(RM:.....)

2. Saya bersetuju menyiapkan kerja-kerja ini dalam masa ..... hari dari tarikh akhir tempoh mula kerja seperti yang diarahkan oleh Pegawai Inden. Bertarikh pada ..... Haribulan ..... 2025.

.....	.....
Tandatangan Kontraktor	Tandatangan Saksi
Nama Penuh:.....	Nama Penuh:.....
Atas Sifat :.....	Atas Sifat:.....
No. Kad Pengenalan:.....	No. Kad Pengenalan:.....
Alamat :.....	Alamat :.....
.....	.....

.....
Meterai atau Cap Kontraktor

DOKUMEN NO.8

KETERANGAN MENGENAI PENYEBUT HARGA

DOKUMEN NO. 8

KETERANGAN MENGENAI PENYEBUT HARGA

1. Nama Syarikat Penyebut harga : .....

   1.1 Alamat Pejabat : .....

   .....

   .....

   1.2 No.Telefon : .....

   1.3 No. Pendaftaran Syarikat : .....

   1.4 No. Pendaftaran Kementerian Kewangan (sertakan salinan sijil) : .....

2. Modal Dibenar : .....

   Modal Berbayar : .....

3. Ahli-ahli Syarikat :

(i) Ahli-ahli Lembaga Pengarah

NAMA	JAWATAN	SAHAM DIPEGANG

(ii) Ahli-ahli Pengurusan

NAMA	JAWATAN

4. Butiran pengalaman firma/syarikat penyebut harga dalam membekalkan perkhidmatan yang serupa dengan apa yang ditawarkan di dalam pelawaan Sebut harga/Tender kepada Kerajaan dalam tempoh lima (5) tahun yang terakhir.

TAHUN	PENGALAMAN PEMBEKALAN PERKHIDMATAN

5. Jika penyebut harga pernah mengikat kontrak dengan mana-mana Jabatan Kerajaan atau Badan-badan Berkanun, nyatakan sama ada Firma/Syarikat

kontraktor pernah atau sedang mengalami penggantungan atau penamatan kontrak dengan Kerajaan oleh kerana pelanggaran syarat-syarat Kontrak.

.....

.....

.....

.....

.....

.....

6. Lain-lain Keterangan Mengenai Penyebut harga :-

.....

.....

.....

.....

.....

.....

Saya perakui bahawa segala keterangan di atas adalah benar.

Tandatangan :.....

Nama :.....

No. K/P :.....

Jawatan :.....

Tarikh :.....

Cop Firma/
Syarikat :.....

Tandatangan Saksi : .....

Nama Saksi :.....

No. K/P :.....

Jawatan :.....

Tarikh :.....

Cop Firma/ Syarikat :.....

Nota : Jika didapati keterangan/maklumat di atas adalah tidak benar, pihak Kerajaan berhak menolak/membatalkan tawaran syarikat tuan.

BAHAGIAN B

Senarai Sepuluh (10) Kerja-Kerja Yang **TELAH** Disiapkan

Nama Projek	Jabatan/Agensi/ Perunding Yang Mengawas Projek	Harga	Tempoh	Tarikh Siap Sebenar

BAHAGIAN C

Senarai Kerja Yang **SEDANG** Disiapkan

Nama Projek	Jabatan/Agensi/ Perunding Yang Mengawas Projek	Harga Kontrak	Tempoh Kontrak	Peratusan Kemajuan	Ulasan Pegawai Yang Menilai sebut harga*

BAHAGIAN D

Ahli-ahli Syarikat

1. Ahli-ahli Lembaga Pengarah

Nama	Jawatan	Saham Modal Dipegang

2. Ahli-ahli Pengurusan

Nama	Jawatan	Kelulusan Akedemik/Iktisas

DOKUMEN NO.9

KETERANGAN MENGENAI SUB-KONTRAKTOR ELEKTRIK

DOKUMEN NO. 9

KETERANGAN MENGENAI SUB-KONTRAKTOR ELEKTRIK

MAKLUMAT SUB-KONTRAKTOR UNTUK KERJA-KERJA ELEKTRIK

KETERANGAN MENGENAI SUB-KONTRAKTOR ELEKTRIK

1. Nama Syarikat : .....
   1.1 Alamat Pejabat : .....
   .....
   .....
   1.2 No.Telefon : .....

1. No. Pendaftaran Syarikat : .....
2. No. Pendaftaran Kementerian Kewangan (sertakan salinan sijil) : .....

3. Modal Dibenar : .....
   Modal Berbayar : .....
4. Gred Pengkhususan

BIL	KOD BIDANG	PENGKGUSUSAN	YA / TIDAK
1.	E04	Pemasangan Voltan Rendah	
2.	E11	Kerja Am Elektrik	
3.	E17	Kabel Bawah Tanah Voltan Rendah	

.....
Tandatangan Kontraktor Utama

Nama :
No. K/P :

....
Tandatangan Sub-Kontraktor

Nama :
No. K/P :

LAMPIRAN 6

SURAT AKUAN PENYEBUT HARGA

LAMPIRAN 6
(PK 1.6 Lampiran 6)

SURAT AKUAN PEMBIDA

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR BAGI TEMPOH SEPANJANG PELAKSANAAN PROJEK TERMASUK 12 BULAN TEMPOH TANGGUNG KECACATAN - PAR.2/367 SH.7/2025

Saya, ...
No. Kad Pengenalan ..... yang mewakili ..... nombor Pendaftaran ..... dengan ini mengisytiharkan bahawa saya atau mana-mana orang yang mewakili syarikat ini:

i. tidak akan menawarkan, menjanjikan atau memberikan apa - apa suapan kepada mana-mana orang dalam mana-mana Kementerian/Agensi atau mana-mana orang lain, sebagai suapan untuk dipilih dalam mana-mana perolehan; dan

ii. tidak akan melakukan atau terlibat dengan tipuan bida dalam mana-mana perolehan.

Bersama ini dilampirkan Surat Perwakilan Kuasa bagi saya mewakili syarikat seperti tercatat di atas untuk membuat pengisytiharan ini.

2. Sekiranya saya, atau mana-mana individu yang mewakili syarikat ini didapati terlibat dalam pakatan tipuan bida dengan syarikat lain berkenaan perolehan di atas atau menawarkan, menjanjikan atau memberikan apa-apa suapan kepada mana-mana orang dalam **PARLIMEN MALAYSIA** atau mana-mana orang lain sebagai dorongan untuk dipilih dalam perolehan seperti di atas, maka saya sebagai wakil syarikat bersetuju tindakan-tindakan berikut boleh diambil:

2.1 Hilang kelayakan untuk dinilai dan dilantik bagi perolehan di atas; dan

2.2 Lain-lain tindakan undang-undang/tatatertib mengikut undang-undang/peraturan perolehan Kerajaan yang berkuat-kuasa.

3. Saya sesungguhnya faham bahawa tindakan berikut akan diambil :

3.1 Didakwa bagi kesalahan** di bawah Akta Suruhanjaya Pencegahan Rasuah Malaysia 2009 *[Akta 694]* dan Kanun Keseksaan [Akta 574] serta boleh dihukum di bawah undang-undang masingmasing untuk kegagalan saya atau mana-mana orang yang mewakili syarikat ini untuk mematuhi perkara (i); atau

3.2 tindakan boleh dikenakan ke atas syarikat di bawah Akta Persaingan 2010 *[Akta 712]* atas kegagalan saya atau mana-mana orang yang mewakili syarikat ini untuk mematuhi perkara (ii) dalam Surat Akuan ini. Sekiranya syarikat didapati melanggar peruntukan seksyen 4(2)(d) Akta 712, syarikat boleh didenda tidak melebihi sepuluh peratus (10%) daripada pusing ganti (*turn over)* seluruh dunia sepanjang tempoh suatu pelanggaran itu berlaku.

4. Sekiranya terdapat mana-mana orang cuba memperolehi atau meminta apa-apa suapan daripada saya atau mana-mana orang yang berkaitan dengan syarikat ini sebagai dorongan untuk dipilih dalam perolehan seperti di atas, maka saya berjanji akan dengan segera melaporkan perbuatan tersebut kepada pejabat Suruhanjaya Pencegahan Rasuah Malaysia (SPRM) atau balai polis yang berhampiran. Saya sedar bahawa kegagalan saya berbuat demikian adalah merupakan suatu kesalahan di bawah seksyen 25 (1) Akta Suruhanjaya Pencegahan Rasuah Malaysia 2009 *[Akta 694]* dan boleh dihukum di bawah seksyen 25 (2) akta yang sama, apabila disabitkan boleh didenda tidak melebihi RM100,000 atau penjara selama tempoh tidak melebihi sepuluh tahun atau kedua-duanya.

5. Saya sesungguhnya faham bahawa syarikat melakukan kesalahan jika seseorang yang bersekutu dengan syarikat*** memberikan, menjanjikan atau menawarkan suapan untuk memperoleh atau mengekalkan perniagaan atau faedah dalam menjalankan perniagaan di bawah Seksyen 17A, Akta Suruhanjaya Pencegahan Rasuah Malaysia 2009 *[Akta 694],* apabila disabitkan kesalahan boleh didenda tidak kurang daripada sepuluh kali ganda jumlah atau nilai suapan, atau RM1 juta, atau dipenjarakan selama tempoh tidak melebihi dua puluh tahun atau kedua-duanya.

Yang benar,

Tandatangan :

Nama :

No.KP :

Tarikh :

Cop Syarikat :

Catatan:

(i) **termasuk kesalahan ditetapkan dalam Jadual (Perenggan 3 (a), takrif "kesalahan ditetapkan") Akta Suruhanjaya Pencegahan Rasuah Malaysia 2009 [*Akta 694*] yang boleh dihukum di bawah Kanun Keseksaan.

(ii) ***seseorang yang bersekutu dengan syarikat merujuk kepada seksyen 17A (6) Akta Suruhanjaya Pencegahan Rasuah Malaysia 2009 [*Akta 694*], iaitu seseorang itu bersekutu dengan organisasi komersial jika dia seorang pengarah, pekongsi atau pekerja organisasi komersial itu atau dia ialah orang yang melaksanakan perkhidmatan untuk atau bagi pihak organisasi komersial itu.

(iii) Surat Akuan ini hendaklah dikemukakan bersama surat perwakilan kuasa.

(iv) Takrifan perusahaan di bawah Akta 712 merangkumi syarikat yang terlibat dengan perolehan Kerajaan.

LAMPIRAN A

LAPORAN KEROSAKAN DAN SKOP KERJA

LAMPIRAN A

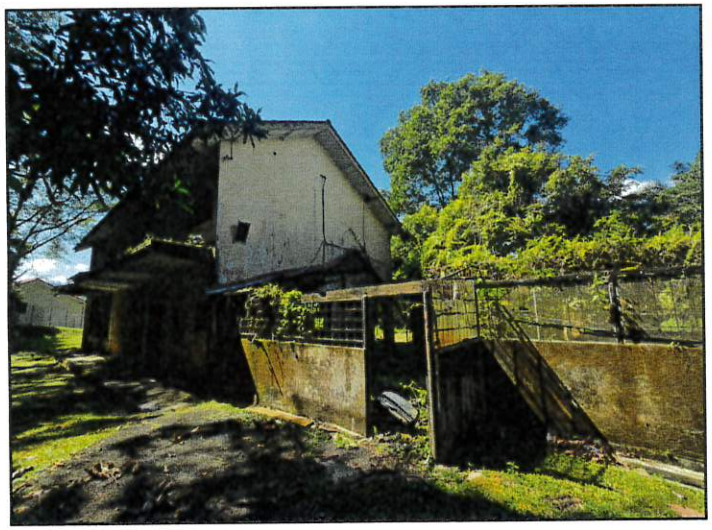
PARLIMEN MALAYSIA
BANGUNAN PARLIMEN
JALAN PARLIMEN
50680 KUALA LUMPUR

LAPORAN KEROSAKAN

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

DISEDIAKAN OLEH :
BAHAGIAN SENGGARA FASILITI DAN LANDSKAP, PARLIMEN MALAYSIA

KEADAAN BAHAGIAN KUARTERS YANG TERBAKAR

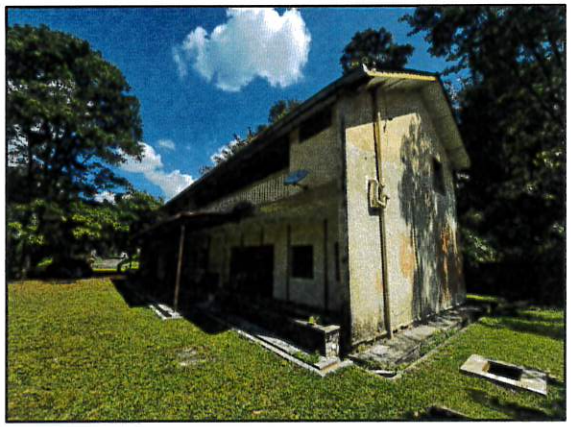






Kerosakan:
Keadaan bahagian kuarters yang terbakar

KEADAAN PERSEKITARAN LUAR KUARTERS







Kerosakan:
Keadaan persekitaran luar kuarters yang telah usang dan terbiar

SKOP PERKHIDMATAN

BIL	KETERANGAN
1.	**KERJA-KERJA PEMBAIKAN DALAM BANGUNAN***(sila rujuk bill of quantities bagi butiran terperinci)* a. Kerja-kerja mencungkil, membuka dan membuang segala bingkai, kerangka dan panel-panel aluminium atau besi & tingkap termasuk pintu gelangsar di seluruh bangunan (Aras bawah : i) Ruang Tamu; ii) Bilik Air; iii) Bilik Tidur& Stor), (Aras atas : i) Ruang Langkah; ii) Dua (2) Bilik Air; iii) Tiga (3) Bilik Tidur; iv) Stor) b. Bekal dan pasang bingkai / frame tingkap dari jenis powder Coated lengkap dengan panel tingkap jenis kesmen dan panel pintu jenis gelangsar (sliding door) dari jenis aluminium termasuk cermin jernih gelap 6 mm tebal dan segala kelengkapan yang terlibat (hinges, lockset, fittings, etc..) c. Kerja meroboh,memecah dinding dari sebarang tebal dan membuang keluar tapak dengan arahan Pegawai Penguasa. d. Pembinaan 125mm X 250mm tebal RC konkrit grade 25 lintol, mengandungi 4 nos. T10 dan R6 sebagai link dengan sela 150mm c/c termasuk segala acuan dan kemasan di setiap permukaan. e. Pembinaan tiang penguat 150mm X 150mm(RC Stiffner) dengan grade 25 konkrit mengandungi 4 nos T12 dan R6 sebagai link dengan sela 150mm c/c termasuk segala acuan dan kemasan di setiap permukaan. f. Membekal & melepa lapisan skim coat plaster system dengan arahan pegawai menguasa. g. Kerja-kerja mencungkil, membuka, memecah dan membuang segala kemasan siling sedia ada termasuk cornice, dan kerangka dari pelbagai jenis di ruang-ruang dalam bangunan h. Bekal dan Pasang 9.5 mm tebal Unispan Gypsum Plasterboard with RONDO Keylock ceiling lengkap dengan sistem gantung besi dan kelengkapan rangka, hangers with joints flushed finish mengikut arahan dan cadangan pembekal dan mestilah mendapat kelulusan Pegawai Penguasa. i. Kerja-kerja mencungkil, membuka, memecah dan membuang segala kemasan lantai sedia ada termasuk kambi, dan kemasan dinding (untuk

	tandas dan dapur) pelbagai saiz dan corak dan lapisan skrid di ruang-ruang dalam bangunan j. Kerja membancuh dan meratakan skrid dan lapisan kalis air untuk menerima (bekal & pasang) jubin LANTAI yang baru bersaiz 600mm X 300mm dari jenis homogeneous atau setara di ruangan tingkat bawah & atas sepertimana kelulusan dan arahan Pegawai Penguasa. k. Kerja-kerja menanggal, membuka dan membuang pintu dari sebarang jenis dan tebal termsauk aksesori pada panel pintu sepertimana arahan Pegawai Penguasa. l. Bekal dan pasang frame & panel pintu seperti lukisan termasuk kerja mengecat kedua permukaan pintu dengan satu lapisan asas dan dua lapisan gloss finish sepertimana butiran pembekal dengan kelulusan dan arahan Pegawai Penguasa m. Menanggal, membuka, mencabut dan membuang tangga kayu sedia ada termasuk membersihkan sisa-sisa dan habuk dengan arahan Pegawai Penguasa. n. Staircase concrete o. Kerja-kerja mengikis, membersih, distemper, basuh dan tampal semua retak cat lama pada permukaan - permukaan seperti arahan Pegawai Penguasa p. Menyediakan permukaan dan satu (1) lapisan cat alas, dua (2) lapisan cat kemasan dari jenis emulsi pada dinding partition bahagian dalam seperti arahan Pegawai Penguasa. q. Kerja meroboh, mencabut, dan membuang Almari lama termasuk bekal dan pasang Almari baru dari jenis kayu atau setara termasuk kerja pengukuran,pengemukaan rekabentuk, dan mengambil kira kos penghantaran & pemasangan ke tapak. r. Kerja-kerja memecah sebahagian counter top di ruang dapur dan lantai sedia ada termasuk kerja-kerja pembaikan dinding yang terlibat. Anggaran keluasan 4m2 s. Kerja bekal dan pasang floor trap termasuk kerja-kerja pemasangan paip buang (PVC) hingga ke longkang luar bangunan **t.** Bekal dan pasang Stainless Steel Wall-Mounted Retractable Drying Rack termasuk segala aksessori dengan kelulusan pegawai penguasa.

BIL	KETERANGAN
2.	**KERJA-KERJA PEMBAIKAN LUAR BANGUNAN***(sila rujuk bill of quantities bagi butiran terperinci)* a. Pecah & Buang kemasan lantai & simen skrid termasuk longkang separuh bulat disepanjang kaki lima (apron) . Buka, tanggal & buang kerangka bumbung termasuk bumbung metal deck dan segala aksessori berkaitan. b. Kerja-kerja membina lapisan kemasan lantai dari konkrit imprint atau setara dengan kelulusan Pegawai Penguasa. c. Kerja-kerja pembinaan kerangka bumbung lengkap dengan tiang sokongan dan asas pad 1.0m X 1.0m (200mm tebal dengan T10-200-B/W) dengan kemasan bumbung menggunakan metal deck . d. Bekal & Pasang longkang separa bulat mengikut kecerunan laluan air seperti keadaan tapak termasuk dinding longkang. e. Bekal dan pasang papan manis (fascia Board) dari jenis aluminium lengkap dengan pemasangan valley Gutter termasuk RWDP & segala kelengkapan penutup, liku, kepala air keluar dan lain aksesori seperti arahan Peg. Penguasa. f. Menanggal,membuka dan membuang jeriji keselematan di pintu gelangsar, tingkap-tingkap dan pintu-pintu sedia ada di tingkat bawah dan atas bangunan. g. Kerja-kerja membekal mengecat (kilat) & memasang jerejak keselamatan dari jenis besi sederhana keras termasuk kunci jenis mortice dua tuas (untuk pintu) dan satu bahagian boleh laras beserta kunci selak (untuk tingkap)dan lain-lain kelengkapan lengkap dengan cat kilat di ruang buka tingkat atas dan bawah banguna h. Menanggal, membuka dan membuang kerangka, penutup bumbung pada keseluruhan bangunan i. Bekal dan Pasang penutup bumbung dari jenis Jubin Tanah liat termasuk memasang satu lapisan penebat aluminium foil dua muka di atas kasau termasuk segala aksesori- aksesori berkaitan. j. Bekal dan pasang perabung atau limas bumbung dari jenis tanah liat lengkap dengan fillet simen dan pasir. k. Bekal dan pasang flashing bumbung pada setiap sambungan bumbung

	l. Bekal dan pasang papan manis (fascia Board) dari jenis aluminium lengkap dengan pemasangan valley Gutter termasuk segala kelengkapan penutup, liku, kepala air keluar dan lain-lain aksesori seperti arahan dan kelulusan Pegawai Penguasa. m. 100mm diameter salur tegak air hujan dengan menggunakan sambungan pelipit dan dipasang pada dinding dengan pemegang paip atau pendakap. Paip air hujan hendaklah ditanam pada lantai apron. n. Menggali, mengeluarkan, mengambus, menanam tanah termasuk menentukan aras, mamadatkan tanah, trim sides, planking and strutting dan membawa lebihan tanah keluar dari tapak sebagaimana arahan Pegawai Penguasa. Kerja-kerja penanam paip baru hendaklah pada kedalaman melebihi 600mm dengan bedding yang sesuai (pasir atau konkrit) bergantung keadaan di tapak. o. Bekal dan pasang paip retikulasi air dari jenis HDPE 100mm paip atau setara termasuk sambungan, bends, concrete thrust blok lengkap dengan aksesori berkaitan. p. Kerja pengujian sistem retikulasi air semasa, dan setelah kerja siap dengan kelulusan Pegawai Penguasa. q. Menggali, mengeluarkan, mengambus, menanam tanah termasuk menentukan aras, mamadatkan tanah, trim sides, planking and strutting dan membawa lebihan tanah keluar dari tapak sebagaimana arahan Pegawai Penguasa. Kerja-kerja penanam paip baru hendaklah mengikut aras (Invert level) lurang-lurang sedia ada dengan bedding yang sesuai (pasir atau konkrit) bergantung keadaan di tapak r. Bekal dan pasang paip kumbahan air dari jenis Vitrified Clay Pipe, VCP atau setara termasuk sambungan, bends, bedding berdiamer 225mm lengkap dengan aksesori berkaitan. s. Bekal dan Pasang tangki septik individu berkapasiti 5 P.E dari jenis HDPE atau setara lengkap dengan sambungan dan pembinaan mainhole, termasuk kerja-kerja penggalian dan menentukan aras dan membina tapak lantai yang terdiri dari satu lapis BRC A8 dengan konkrit gred 25kN/mm2 dengan arahan dan kelulusan Pegawai Penguasa.

	t. Mengikis, menyadak, dan membuang kesemua lapisan plaster (kemasan kasar) di permukaan dinding u. Membekal & melepa lapisan skim coat plaster system termasuk kerja-kerja menutup semua lubang udara dengan arahan pegawai menguasa. v. Menyediakan permukaan dan satu (1) lapisan cat alas, dua (2) lapisan cat kemasan dari jenis wheater shield pada permukaan dinding bahagian luar seperti arahan Pegawai Penguasa. w. Kerja membuka dan membuang siling luar dari apa-apa jenis kemasan dari tingkat bawah dan atas. Kerja-kerja bekal dan pasang siling 12.7mm USG Boral Securerock Glass-Mat Sheathing Plasterboard with RONDO Stud System to withstand wind load and moisture and mold resistance. x. Resurfacing works - Bersih, Membekal, menghampar dan memadatkan 50mm premix (ACW14) dengan menggunakan mesin Roller 3 Tan sebagai wearing course termasuk tack coat (0025-0.55liter/m2 jenis RS-1K) pada permukaan jalan sedia ada sepertimana arahan Pegawai Penguasa. y. Pembinaan konkrit kerb 100mm sepanjang pagar kawasan (anti-climb) dibahagian atas rasuk tanah.(anggaran panjang < 550m) z. Pembaikan longkang sedia ada menutup mana-mana lubang yang terdedah sama ada pada permukaan longkang & dinding longkang.

BIL	KETERANGAN
3.	**SANITARY FITTING** *(sila rujuk bill of quantities bagi butiran terperinci)* a. Bekal dan pasang sanitary appliances dan accessories termasuk menyimpan, memasang, bedding, plugging and screwing with matching screws, cutting and pinning or building in brackets, jointing dan sambungan dan soil pipe and making good all work disturbed all as per S.O. instruction and approval.
4.	**KERJA-KERJA PERPAIPAN BEKALAN AIR SEJUK DALAMAN DAN SANITARI** *(sila rujuk bill of quantities bagi butiran terperinci)* a. Bekal dan pasang paip Acrylonitrile Butadiene Styrene (ABS) pelbagai saiz bersama kelengkapan seperti yang telah dinyatakan untuk digunakan untuk paip pengagihan termasuk semua penggalian yang diperlukan, sambungan antara penyambungan ke tangki simpanan air, kelengkapan paip yang diperlukan, stopcock dan bukaan yang diperlukan di bumbung, semua lantai yang diperlukan mengikut laluan paip sedia ada. b. Bekal dan pasang High Density Polyethylene (HDPE) seperti yang dinyatakan lengkap dengan aksesori serta kelengkapan, alas tangki pada bumbung yang memiliki kelulusan SPAN/SIRIM. Tangki air dinaikkan dan diletakkan pada kedudukan mengikut arahan pengilang. c. Paip waste water, soil dan vent beserta kelengkapan yang diperlukan daripada kelengkapan sanitari dan perangkap lantai juga jeriji alur keluar ke lubang penyambung atau longkang saluran air termasuk semua penggalian yang diperlukan, selongsong konkrit di sekeliling kerja pemasangan paip, sambungan dengan penyambung yang diperlukan kepada peralatan sanitari, bukaan yang diperlukan, keperluan untuk pengaliran di bumbung, lantai, rasuk dan dinding. d. Menjalankan pengujian pada semua pemasangan paip bekalan air sejuk dalaman, kelengkapan dan aksesori. Membaiki kerosakan serta menyerahkan dalam keadaan yang sempurna dan teratur seperti mana kelulusan dan persetujuan Pegawai Penguasa. e. Menjalankan pengujian pada semua pemasangan paip sanitari, kelengkapan dan aksesori. Membaiki kerosakan serta menyerahkan dalam keadaan yang sempurna dan teratur seperti mana kelulusan dan persetujuan Pegawai Penguasa.

BIL	KETERANGAN
3.	**KERJA-KERJA ELEKTRIK** *(sila rujuk bill of quantities bagi butiran terperinci)* a. Sistem elektrik di luar dan dalam bangunan : membekal dan memasang semua bahan mengikut spesifikasi piawai JKR dan Suruhanjaya Tenaga secara pendawaian permukaan atau terbenam dengan menggunakan kabel PVK di dalam G.S. konduit (berwarna oren) l/d aksesori berkaitan melainkan dinyatakan. b. Membaiki/menyelenggara/mengganti/membaikpulih sebagaimana asal kelengkapan sistem elektrikal sedia ada di dalam bangunan l/d aksesori berkaitan mengikut spesifikasi standard JKR L-S1 yang terkini dan Suruhanjaya yang ditetapkan. c. Kerja-kerja membekal, memasang, menyambung, mematerai penghujung kabel, menggali parit, menabur pasir, menyusun batu-bata / penutup d. kabel perlindungan uPVC (uPVC cable protective covers), mengambus, memantak, merentang tali nylon 6 mm g.p, batu penanda kabel dan memampatkan selaras dengan peraturan standard JKR termasuk harga tenaga kerja, jentera dan bahan. Kabel PVC/SWA/PVC jenis KUPRUM 6.0mm persegi 2 teras.

LAMPIRAN B

SPESIFIKASI KERJA BERKAITAN

SPESIFIKASI
CONCRETING

1. General

This section shall apply to the construction of all structures or parts of structures to be composed of concrete with or without steel reinforcement. The work shall be carried out all in accordance with this specification and the lines, levels, grades, dimensions and cross-sections shown on the Drawings and as required by the S.O..

1.1. Classification of Concrete Mixes

Concrete mixes are classified into designed concrete, prescribed concrete and proprietary concrete.

1.1.1. Designed Concrete

1.1.1.1. Designed concrete shall comply with *MS EN 206, MS 523-2, MS 523-3* and the drawings. The exposure classes, durability recommendations, minimum cement content and maximum free water to cement ratio to be used shall be as shown on **Table D9, Table D10, Table D11** and **Table D12**. Durability recommendation for buildings is specified in **Table D9** and **Table D10**.

1.1.1.2. Designed concrete may be produced at a certified concrete plant or a non-certified concrete plant.

(i) A certified concrete plant is certified by an agency that is accredited by Department of Standards Malaysia or certification body complying with *MS ISO/IEC 17065*.

(ii) A non-certified concrete plant is not certified by an agency that is accredited by Department of Standards Malaysia or certification body complying with *MS ISO/IEC 17065* due to its temporary set up based on the nature of the site.

1.1.1.3. The Contractor shall comply with the following requirements:

(i) Notify the S.O. the name of the supplier, location of the plant, journey time taken to transport the concrete to the site and production capacity of the plant.

(ii) Submit a designed concrete report covering all concrete mixes to the S.O. for approval. The designed concrete shall comply with the requirements specified in **Table D9, Table D10, Table D11** and **Table D12** as stated in the drawings.

(iii) The Contractor shall ensure that the S.O. be permitted to visit or station his representative at the plant at any stage of the concrete production.

1.1.1.4. When other than CEM I cement is specified to be used, the concrete mix shall be of designed concrete only.

1.1.2. Prescribed Concrete

1.1.2.1. Prescribed concrete shall conform to *MS EN 206, MS 523-2* and

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MS 523-3. Prescribed concrete shall be as detailed in **Table D7** and **Table D8**. The result in **Table D7** and **Table D8** is achieved without the use of admixture.

1.1.2.2. Prescribed concrete is not allowed for all structural works except for remote sites prior approval of the S.O.. A site is considered remote when the journey from the source of the concrete supply is having difficult access by land.

1.1.2.3. Prescribed concrete shall only be produced at site as stated in sub-section 1.2.4..

1.1.2.4. Only CEM 1 cement is specified to be used for prescribed concrete.

1.1.3. Proprietary Concrete

1.1.3.1. Proprietary concrete shall conform to *MS EN 206, MS 523-2 and MS 523-3*.

1.1.3.2. Where proprietary concrete is specified, the constituent material and requirement of concrete shall comply with Item 2.

1.1.3.3. The Contractor shall provide the information of the proprietary concrete to the approval of the S.O. as follows:

(i) Name of supplier and proprietary concrete.

(ii) The type and standard strength class.

(iii) Product warranty.

(iv) Any other identification deemed necessary.

1.1.3.4. The specification for proprietary concrete shall contain the following requirements:

(i) Verification of product conformity by an agency that is accredited by Department of Standards Malaysia or certification body complying with *MS ISO/IEC 17065*, to confirm that the proprietary concrete satisfies performance requirement and the limiting value that are specified or declared.

(ii) The proprietary concrete plant must be certified by an agency that is accredited by the Department of Standards Malaysia.

1.1.3.5. The Contractor shall verify the performance of the proprietary concrete after completion of works as follows:

(i) Product warranty.

(ii) Testing result of product.

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(iii) Non-Destructive Test such as Ultrasonic Pulse Velocity (UPV) or Windsor Probe as when instructed by the S.O..

(iv) Any other verification deemed necessary by the S.O..

1.2. Production of Concrete

1.2.1. General

1.2.1.1. All concrete shall be subjected to production control under the responsibility of the Contractor.

1.2.1.2. Production control comprises all measures necessary to maintain the properties of concrete in conformity to specified requirements. It includes:

(i) Selection of materials.

(ii) Concrete design.

(iii) Concrete production.

(iv) Inspection, sampling and testing.

(v) The use of the results of tests on constituent materials, fresh and hardened concrete and equipment.

(vi) Inspection of equipment used in transporting for fresh concrete.

1.2.2. Production Control System

Production Control System shall contain adequately documented procedures and instructions. These procedures and instructions shall, where relevant, be established in respect of the control requirement as given in the **Table D21, Table D22, Table D23** and **Table D31.**

1.2.3. Designed Concrete

1.2.3.1. Designed concrete shall comply with the requirements as stated in the drawings, *MS EN 206, MS 523-2* and *MS 523-3.*

1.2.3.2. Designed concrete is batched, either dry or wet. Wet batching is the primary mixing of the concrete is performed in a plant mixer, and the secondary mixing is done in the truck mixer before the concrete is discharged from the truck mixer. Dry batching is the primary mixing and secondary mixing of the concrete is performed in a truck mixer before the concrete is discharged from the truck mixer. No extra water or admixtures are allowing to be added after the concrete left the plant.

1.2.3.3. Designed concrete delivered to the Site shall be accompanied by delivery ticket and manufacturer's batching record stating the details of mix proportions by weight, the grade of concrete, type and size of aggregate, date and time of loading at plant, type

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and dosage of chemical admixtures and other relevant production details such as, but not limited to, details listed in **Table D31** in suitable format. If the Contractor fail to provide this information, the S.O. or his representative shall immediately reject the total load of the concrete. The S.O. or his

representative and the Contractor shall ensure the information provided in the delivery tickets and the manufacturer's batching record complies a requirement as in sub-section 1.1.1. before discharging the concrete.

1.2.3.4. Rejected concrete shall be removed from the Site. The delivery ticket shall be marked 'REJECTED'.

1.2.4. Prescribed Concrete

1.2.4.1. The quantities of cement, fine aggregate and various sizes of coarse aggregate shall be measured by weight unless otherwise approved by the S.O.. A separate weighing machine shall be provided for weighing the cement. Alternatively, the cement may be measured by using a whole number of bags in each batch. The quantity of water shall be measured by volume or by weight. Any solid admixtures to be added shall be measured by weight, liquid or paste admixtures shall be measured by volume or weight.

1.2.4.2. The batch weight of aggregate shall be adjusted to allow for the moisture content of the aggregate being used. All measuring equipment shall be calibrated on site or their calibration status established by certificates from accredited laboratories.

1.2.4.3. The mixing time shall be not less than two minutes and not more than five minutes or any other time recommended by the concrete supplier after all the ingredients have been placed in the mixer.

1.2.4.4. The mixer shall be thoroughly cleaned before any fresh concrete is mixed.

1.2.4.5. The water content of each batch of concrete may be adjusted so as to produce concrete of the workability required. However, care shall be taken to ensure the free water - cement ratio is maintained. The total amount of water added to the mix shall be recorded.

1.2.5. Proprietary Concrete

1.2.5.1. Proprietary concrete is batched, either dry or wet, at a ready-mixed plant and transported in purpose-made agitators operating continuously or truck mixers to the Site.

1.2.5.2. Proprietary concrete shall comply with the requirements as stated in the drawings, *MS EN 206, MS 523-2* and *MS 523-3*. All concrete materials, including water and admixtures shall be mixed in the plant and delivered to Site in purpose made truck mixers.

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1.2.5.3. Proprietary concrete delivered to the Site shall be accompanied by delivery ticket and manufacturer's batching record stating the details of the grade of concrete, name of proprietary concrete, date and time of loading at plant, and other relevant production details. If the Contractor fails to provide the information, the S.O., or his representative shall immediately reject the total load of the concrete. The S.O., or his representative, and the Contractor

shall ensure the information provided in the delivery tickets and the manufacturer's batching record complies a requirement as in sub-section 1.1.3. before discharging the concrete

2. Material

2.1. Cement

2.1.1. The cement to be used throughout the Work shall be cement obtained from SIRIM-certified manufacturer. The cement shall be described and complied with *MS EN 197-1* as shown in **Table D1** and **Table D2.**

2.1.2. Certificates of Test

2.1.2.1. Manufacturers' certificates of test shall in general be accepted as proof of soundness. Additional tests shall be carried out on any cement which appears to have deteriorated through age, damage to containers, improper storage, or any other reason. The test shall be carried out at any approved laboratory in accordance with *MS EN 196* at the expense of the Contractor. Any batch of cement that has been sampled and tested and found not to have complied with the requirements shall be rejected and removed from the Site.

2.1.2.2. The S.O. may, without tests being made, order that any bag of cement, a portion of the contents of which has hardened, or which appears to be defective in any other way, be removed from the Site.

2.1.3. Transportation and Storage

The cement shall be transported to the Site in covered vehicles adequately protected against water. It shall be stored in a weatherproof cement store to the approval of the S.O.. Cement stored in bags shall not be laid directly on the ground. It shall be taken for use in the Work in the order of its delivery into the store. Cement delivered in bulk shall be stored in purposely built silos of an approved design.

2.2. Aggregates

2.2.1. Aggregates shall be naturally occurring sand or granite crushed or uncrushed, except as otherwise specified, and shall comply with *MS EN 12620*. They shall be obtained from a source approved by the S.O.. Marine aggregates shall not be used.

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2.2.2. Coarse Aggregates

Coarse aggregates shall comply with *MS EN 12620* and tests shall be carried out according to *MS 30*. For work below ground level, only crushed granite shall be used. unless otherwise specified in the Drawings. The property limits shall be as specified in **Table D3**. The maximum nominal size of aggregate shall be as specified in the Drawings.

2.2.3. Fine Aggregates

Fine aggregates shall comply with *MS EN 12620*. In the context of *MS EN 12620*, the term 'sand' is used to means 'fine aggregate'. Unless otherwise specified in the Drawings, tests shall be carried out in accordance with *MS 30*. The property limits shall be as specified in **Table D3.**

2.2.4. Grading

2.2.4.1. Coarse Aggregates

The grading of coarse aggregates shall be analysed as described in *MS 30* and shall be within the limits specified in **Table D4**.

2.2.4.2. Fine Aggregates

The grading of fine aggregates shall be analysed as described in *MS 30* and shall be within the limits specified in **Table D5**. However, for prescribed concrete Grading Limit M shall only be used.

2.2.5. Sampling and Testing of Aggregates

Where site mixing is used, samples of fine and coarse aggregates approved by the S.O. shall be kept on Site. These samples shall give a fair indication of the general quality of the aggregates for comparison with the aggregates delivered during the course of executing the work. Tests shall be carried out on samples of the latter, taken at intervals as required by the S.O., or whenever there is a change of source. The appropriate method of sampling and testing shall be in accordance with the standards as specified in **Table D3.** Any batch of aggregate rejected by the S.O. shall be removed from the Site.

2.2.6. Storage of Aggregates

2.2.6.1. Separate storage facilities with adequate provision for drainage shall be provided for each different size of aggregate used.

2.2.6.2. Aggregate shall be handled and stored to minimize segregation and contamination.

2.3. Water

Water shall comply with the requirements of *MS EN 1008*. It shall be clean and free from materials deleterious to concrete in the plastic and hardened state and shall be from a source approved by the S.O.. The S.O. may instruct the Contractor to carry out chemical tests at any approved laboratory at the expense of the

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Contractor. The Contractor shall make adequate arrangement to supply and store sufficient water at the Site for use in mixing and curing of concrete.

2.4. Admixtures

2.4.1. No admixtures to be allowed for use in prescribed concrete.

2.4.2. The admixtures, the sampling and testing of the admixtures and the information to be provided with the admixture supplied shall comply with *MS EN 934* and requirements specified in **Table D6**.

2.4.3. All admixtures shall be used strictly in accordance to manufacturer's recommendation.

2.4.4. For admixture to be used in design concrete, the Contractor shall carry out initial test to verify the concrete mix as required in sub-section 3.1.2..

2.5. Requirements for Concrete

2.5.1. Concrete Grade

The grade of concrete to be used in the works shall be as stated in the Drawings and/or in the Bill of Quantities. Normal concrete shall be designated as C X/Y; light weight concrete shall be designated as LC X/Y, where X is minimum characteristic cylinder strength (N/mm^2) and Y is minimum characteristic cube strength in (N/mm^2). Prescribed concrete shall be designated as YP where a suffix P shall be added after its minimum characteristic cube strength (N/mm^2).

2.5.2. Cement Content

2.5.2.1. Cement content in this specification shall refer to the total quantities of cement as approved in sub-section 2.1., or the total quantities of cementitious materials comprising CEM I and other constituents complying to *MS EN 197-1*.

2.5.2.2. Minimum Cement Content

The minimum cement content shall be in accordance with **Table D9, Table D10** and **Table D11**, unless otherwise shown on the Drawings.

2.5.3. Consistence

2.5.3.1. The consistency of the fresh concrete shall comply to *MS EN 206* and suitability for the condition of handling and placing so that after compaction, it surrounds all reinforcement, tendons and ducts and completely fills the formwork. Consistency of the concrete shall be within one of the following limits:

(i) Slump classes (Refer **Table D13**)

(ii) Compacting classes (Refer **Table D14**)

(iii) Vebe classes (Refer **Table D15**)

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(iv) Flow classes (Refer **Table D16**)

2.5.3.2. Unless otherwise specified in the Drawings, consistency values expressed as slump and flow classes appropriate to different uses of concrete shall be as given in **Table D17.**

2.5.4. Total Chloride Content

The Total Chloride Content of the concrete mix arising from the aggregate or any other source shall not in any circumstances exceed the limits in **Table D18** expressed as a percentage relationship between chloride ions and weight of cement in the mix. The tests shall be carried out in accordance with *BS 1881-124* for each grade of concrete, to demonstrate that these limits are not exceeded.

2.5.5. Maximum Sulphate Content

The total estimated sulphate content of any mix, including that present in the cement shall not exceed 4% by weight of cement in the mix. Where necessary, tests shall be carried out in accordance with *BS 1881-124* for each grade of concrete to demonstrate that this limit is not exceeded.

3. Concrete Conformity and Identity Testing

3.1. Evaluation of Conformity

3.1.1. General

3.1.1.1. The Contractor is responsible for the evaluation of conformity of specified requirements of the concrete. For this purpose, the Contractor shall refer to *MS EN 206* to carry out the following task:

(i) Initial test.

(ii) Production control including conformity control.

3.1.1.2. All tests shall refer to concrete compressive strength test (cube or cylinder).

3.1.1.3. The designed concrete testing flow chart can refer in **Figure D1.**

3.1.2. Initial Test

3.1.2.1. Initial test is required for designed concrete only and the Contractor shall be responsible for the test.

3.1.2.2. In the case of using a new concrete composition, initial test shall be performed to provide a concrete that achieves the specified properties or intended performance with a margin of 1.64 x standard deviation.

3.1.2.3. The concrete composition shall be reviewed periodically to provide assurance that all concrete designs are still in accordance with the actual requirements, taking into account of

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the chances in properties of the material and the result of testing.

3.1.2.4. Initial test shall be repeated if there has been a significant change either in the constituent materials, admixtures or in the specified requirements on which the previous test was based on.

3.1.2.5. Test Conditions

(i) In general, initial test shall be carried out on fresh concrete with a temperature 27±3°C.

(ii) For the initial test of single concrete composition, at least three (3) specimens from each of three (3) batches, totalling nine (9) specimens shall be tested at 28 days.

(iii) The compressive strength of a concrete composition shall be taken to be the average of the nine (9) specimens.

3.1.2.6. Criteria for Adoption of Initial Tests

(i) The compressive strength of the concrete with the composition to be adopted for the actual case shall exceed the values f_{ck} of **Table D19** or **Table D20**. The margin should be at least 6N/mm2 to 12N/mm2 depending on the production facilities, material and the available background information about the variation. If there are insufficient data, the margin for the initial mix design shall be taken as 6N/mm^2.

(ii) The consistency of the concrete shall be within the limits of the consistency class as in **Table D17**, at the time at which the concrete likely to be placed or delivered.

(iii) For assessing the properties of concrete, in particular those of fresh concrete, the differences between the type of mixer and mixing procedure applied during the initial test and those applied during actual production shall be taken into account.

(iv) For other properties that are specified, the concrete shall meet the specified values with an appropriate margin.

3.1.3. Conformity Control for Designed Concrete

3.1.3.1. General

(i) For normal-weight and heavy-weight concrete of strength classes from C8/10 to C55/67 or light-weight concrete from LC8/9 to LC55/60, sampling and testing shall be performed on concrete compositions.

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(ii) In the sampling and testing plan and the conformity criteria of concrete compositions distinction is made between initial production and continuous production, where:

a) Initial production covers the production until at least 35 test results are available.

b) Continuous production is achieved when at least 35 test result are obtained over a period not exceeding 12 months.

(iii) If the production of a concrete composition has been suspended more than 12 months, the criteria, sampling and testing plan given for initial production shall be adopted.

(iv) If the strength is specified for a different age, the conformity is assessed on specimens tested at the specified age.

(v) During continuous production, the sampling and testing plan and the criteria for initial production may be adopted if approved by the S.O..

(vi) Identity testing shall be carried out in accordance to Item 3.3 in order to verify that a defined volume comes from a conforming population.

3.1.3.2. Sampling and Testing

(i) Samples of concrete shall be randomly selected in accordance with *MS 26-1-1*. The minimum rate of sampling and testing of concrete shall be in accordance with **Table D21** at the rate that gives the highest number of samples for initial or continuous production.

(ii) The samples shall be taken after any water or admixtures are added to the concrete, but sampling before adding plasticizer to adjust the consistence is permitted where there is proof by initial testing that the plasticizer or super plasticizer in quality to be used has no negative effect on the strength of the concrete.

(iii) The test result shall be obtained from an individual specimen or the average of the results when two or more specimens made from one sample are tested at the same age.

(iv) Where two or more specimens are made from one sample and the range of the test values is more than 15% of the mean, the result shall be disregarded.

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3.1.3.3. Conformity Criteria for Compressive Strength

(i) Conformity assessment shall be made on test results taken during an assessment period that shall not exceed the last twelve (12) months.

(ii) Conformity of concrete compressive strength is assessed on specimens tested at 28-days in accordance with:

a) Groups of n overlapping consecutive test results f_{cm} (Criterion 1).

b) Each individual test result f_{ci} (Criterion 2).

(iii) Conformity is confirmed if both the criteria given in **Table D22** for either initial or continuous production are satisfied

(iv) Initially, the standard deviation (σ) shall be calculated from at least 35 consecutive test results taken over a period exceeding three (3) months and which is immediately prior to the production period during which conformity is to be checked. This value shall be taken as the estimate of the standard deviation (σ) of the population. The validity of the adopted value shall be verified during the subsequent production using Method 1 as stated below. However, Method 2 may be used if approved by the S.O..

a) Method 1

The initial value of standard deviation may be applied for the subsequent period during which conformity is to be checked, provided the standard deviation of the latest 15 results (s_{15}) does not deviate significantly from the adopted standard deviation. This is considered valid provided:

$0.63\sigma \leq s_{15} \leq 1.37\sigma$

Where the value of s_{15} lies outside these limits, a new estimate of σ shall be determined from last available 35 test results.

b) Method 2

The new value of standard deviation (σ) may be estimated from a continuous system and this value is adopted. The sensitivity of the system shall be at least that of Method 1.

3.1.4. Permeability Requirement

For marine structures, a Chloride Diffusion Test shall be carried out according to standard test method for determining the apparent chloride diffusion coefficient of cementitious mixtures by bulk diffusion *(ASTM-C1556-11a)*. The chloride content of a concrete, expressed as the percentage of chloride ions by mass of cement, shall not exceed the value for the selected class given in **Table D18** according to *MS EN 206*.

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3.2. Identity Test

3.2.1. General

3.2.1.1. Identity testing indicates whether the defined volume of concrete under review belongs to the same population as that verified as conforming with the characteristic strength via conformity assessment.

3.2.1.2. Identity testing is conducted at the Site upon the delivery of concrete.

3.2.2. Sampling and Testing

3.2.2.1. Designed Concrete

(i) The sampling rate for identity testing specified in **Table D24**.

(ii) A sample is made up of three (3) specimens.

(iii) Samples shall be taken from different batches in accordance with *MS 26-1-1*. Test specimens shall be prepared and cured in accordance with *MS EN 12390-2*. The compressive strength of the specimens shall be determined in accordance with *MS EN 12390-3*.

(iv) One (1) specimen from the sample shall be tested for the 7-days compressive strength. The compressive strength shall not fall below two-third (2/3) of the 28-days compressive strength as given in **Table D19** and **Table D20**.

(v) The remaining two (2) specimens shall be tested at 28-days. The compressive strength of the specimens shall be obtained from the average of the results of the two specimens.

(vi) For 28-days compressive strength test, if the difference between the two (2) test result divided by their mean exceed 15%, the test result, shall be deemed invalid.

3.2.2.2. Prescribed Concrete

(i) A sample is made up of three (3) specimens.

(ii) Samples shall be taken from different batches in accordance with *MS 26-1-1*. Test specimens shall be prepared and cured in accordance with *MS EN 12390-2*. The compressive strength of the specimens shall be determined in accordance with *MS EN 12390-3*.

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(iii) One (1) specimen from the sample shall be tested for the 7-days compressive strength as given in **Table D23.**

(iv) The remaining two (2) specimens shall be tested for 28-days. The compressive strength of the specimens shall be obtained from the average of the results of the two specimens.

(v) For 28-days compressive strength test, if the difference between the two (2) test result divided by their mean exceed 20%, the test result, shall be deemed invalid.

3.2.3. Conformance identity criteria for compressive strength

3.2.3.1. Concrete under production control certification

(i) Identity of concrete is assessed for each individual strength test result and the average overlapping discrete results as identified in **Table D25.**

(ii) Concrete is deemed to come from a conforming population if both the criteria in **Table D25** are satisfied for n results derived from strength tests on samples taken from the defined volume of concrete.

3.2.3.2. Concrete not under production control certification

(i) At least three (3) samples shall be taken for testing from the defined volume of concrete.

(ii) Concrete is deemed to come from a conforming population if both the criteria in **Table D26** are satisfied for n results derived from strength tests on samples taken from the defined volume of concrete.

3.2.3.3. Prescribed concrete

(i) A sample is made up of three (3) specimens.

(ii) One (1) specimen from each sample shall be tested for 7-days cube compressive strength. The test result shall not fall below the corresponding values given in **Table D23.**

(iii) The remaining two (2) specimens from the sample shall be tested for the 28-days cube compressive strength. The strength requirement shall be considered complied if <u>at least one</u> of the following conditions is satisfied with:

a) None of the two test cubes is below the specified compressive strength as specified in **Table D23.**

b) The average strength of the two test cubes is not less than the specified compressive strength.

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3.2.4. Identity Testing for Slump and Flow

3.2.4.1. Sampling and Testing

(i) Sampling fresh concrete using a spot sample obtained from the initial discharge, if concrete is delivered in a truck mixer or agitating equipment. The spot sample shall be taken after a discharge of approximately 0.3 m^3 by taking six increments from the moving stream of the concrete. Take at least 1.5 times the quantity estimated required for the tests in accordance to *MS 26-1-1*.

(ii) The sample shall be remixed on a non-absorbent surface before carrying out the test.

(iii) For slump test, the test is only valid if it yields a true slump. The slump value (h) is measured in accordance to *MS 26-1-2* and shown in **Figure D2**.

(iv) For flow test, the maximum dimension of the concrete spread shall be measured in the two direction as shown in **Figure D3**. The flow value (f) is the average dimension of the two direction in accordance to *MS 26-1-5*.

3.2.5. Conformance Identity Criteria for The Slump and Flow of an Individual Batch

3.2.5.1. If the measured slump meets the requirements specified in **Table D27** or is within the tolerance specified in **Table D28**, the identity test confirms that the batch conforms to *MS EN 523-2* with respect to its consistency.

3.2.5.2. If the measured flow meets the requirements specified in **Table D29** or is within the tolerance specified in **Table D30**, the identity test confirms that the batch conforms to *MS EN 523-2* with respect to its consistency.

3.3. Action to be Taken for Non-Conformity of the Product

3.3.1. The following actions shall be taken by the Contractor in the event of non-conformity:

3.3.1.1. Check test results and if invalid, take action to eliminate errors

3.3.1.2. If non-conformity is confirmed e.g. by retesting, take corrective actions including a management review of relevant production control procedures.

3.3.1.3. Where there is confirmed non-conformity with the specification that was not obvious at delivery, notice shall be given to the S.O. in order to avoid any consequential damage.

3.3.1.4. Record actions on the items above.

3.3.2. In the event that the compressive strength results of the test do not meet

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the specified requirements mentioned in sub-section 3.2., the S.O. shall determine the action to be taken:

3.3.2.1. If the 7-days concrete strength is less than the specified strength requirements (2/3 of characteristic strength), no more concrete shall be placed on the suspect concrete and no removal of propping on the affected area shall be allowed until the 28-days strength result compliance is available, or unless otherwise approved by the S.O. in writing.

3.3.2.2. For non-compliance of 28- days compressive strength, the S.O. may direct other measures to be taken to make the work secure.

3.3.2.3. The S.O. may instruct the additional tests be carried out on the hardened concrete to determine the quality of the suspected concrete. The test may include non-destructive and destructive tests. All methods of testing shall conform to MS EN 12504 and results shall be assessed according to MS EN 13791 and MS 1242.

3.3.2.4. If the results from the additional test did not meet the requirements, the S.O. may instruct the Contractor the following actions:

(i) The section which fail the test shall be removed; or

(ii) The Contractor shall submit the recommendations for repair and strengthening the suspected concrete. All the recommendations shall certify by a Professional Engineer.

3.3.3. All works instructed under this item shall be at the Contractor's expense and no extension of time shall be granted for such works.

4. Handling of Concrete

4.1. Supervision

The Contractor shall ensure the required standard of control over materials and workmanship. The S.O. shall be afforded all reasonable opportunities and facilities to inspect the constituent materials and the production of concrete and to take samples for testing.

4.2. Transporting

Concrete shall be transported from the mixer to the formwork as rapidly as practicable by methods, which will prevent segregation or loss of any constituents or ingress of foreign matter or water and maintain the required workability. It shall be deposited as near as practicable in its final position to avoid rehandling or moving the concrete horizontally by vibration. The concrete shall be conveyed by chutes or concrete pumps only with permission from the S.O..

4.3. Placement

4.3.1. Placement of Concrete in Dry Condition

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4.3.1.1. For all concrete whether mixed on or off the site of the Work, each batch shall be placed and compacted within two (2) hours of adding the cement to the dry aggregates and within 45 minutes (or any other period of time based on the initial test as sub-section 2.4. and sub-section 3.1.2. and approved by the S.O. if an admixture is used) of adding water to the cement and aggregate. Concrete shall not be placed in any part of the structure until the approval of the S.O. has been obtained. If concreting is not started within 24 hours of approval given, approval shall again be obtained from the S.O..

4.3.1.2. All formwork and reinforcement contained in it shall be clean and free from standing water immediately before the placing of concrete. Concreting shall be carried out continuously between and up to predetermined construction joints in one sequence of operation. It shall be thoroughly compacted by either hand tamping or mechanical vibration or both and shall be thoroughly worked into the corners. After tamping into place, the concrete shall not be subjected to disturbance other than such as incidental to compaction by vibration. In the event of unavoidable stoppage in positions not predetermined, the concreting shall be terminated on a horizontal plane and against vertical surfaces using stop boards. The location for termination shall be subjected to the approval of the S.O..

4.3.1.3. Fresh concrete shall not be placed against in-situ concrete which has been in position for more than 45 minutes unless a construction joint is formed in accordance with sub-section 5.1.. When in-situ concrete has been in place for four hours, no further concrete shall be placed against it for a further 20 hours. Where retarding admixture has been used, the S.O. may approve variation to this limit.

4.3.1.4. Except where otherwise approved by the S.O., concrete shall be deposited in horizontal layers to a compacted depth not exceeding 450mm when internal vibrators are used or 300mm in all other cases. The surface of the concrete shall be maintained reasonably level during placing.

4.3.1.5. Concrete shall not be dropped into place from a height exceeding 1.5m. However, higher drops may be allowed provided the mix has been well designed and proportioned. When trunking or chutes are used, they shall be kept clean and used in such a manner as to avoid segregation.

4.3.1.6. The Contractor shall maintain an experienced steel fixer at the site of reinforced concrete works during the placing of concrete to reposition any reinforcement which may be displaced.

4.3.2. Placement of Concrete Under Water

4.3.2.1. No concrete shall be placed in flowing water. Underwater concrete if deemed unavoidable, shall be placed in position by Tremie pipes from the mixer. During and after concreting under water, pumping or dewatering operations in the immediate vicinity shall be suspended until the S.O. permits them to

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continue. Where the concrete is placed by a Tremie pipe, the following requirements shall be applicable:

(i) The hopper and Tremie pipe shall be a closed system. The bottom of the Tremie pipe shall be kept as far as practicable beneath the surface of the placed concrete.

(ii) The Tremie pipe shall be large enough with due regard to the size of aggregate. For 20mm aggregates, the Tremie pipe shall be of a diameter not less than 150mm and for larger aggregates, a bigger diameter Tremie pipe approved by the S.O. shall be used.

(iii) Unless otherwise agreed by the S.O., the first charge of concrete shall be placed with a sliding plug pushed down the Tremie pipe ahead of it to prevent mixing of concrete and water.

(iv) The Tremie pipe shall always penetrate well into the concrete with an adequate margin of safety against accidental withdrawal if the pipe is surged to discharge the concrete.

(v) The concrete shall be deposited wholly by Tremie pipe and the method of deposition shall not be changed part way up to prevent the laitance from being entrapped within the structure.

(vi) All Tremie pipes shall be properly cleaned after use.

4.4. Placement Temperature

4.4.1. Placement temperature shall comply with *MS 523-3* to prevent premature setting and loss of water during placing of concrete in the formwork.

4.4.2. At the time of placing, no part of the fresh concrete shall have a temperature exceeding 36°C.

4.4.3. After placement of the concrete, the temperature of the concrete shall not be more than 70°C.

4.4.4. The procedure used to measure the temperature of the fresh concrete shall be as follows:

4.4.4.1. Within 2 min of taking the sample at delivery, insert a Type A 100mm immersion thermometer having a range of -5°C to +110°C, graduated in intervals of 1°C and conforming to *BS 1704*, in the sample to a depth of not less than 100mm. When steady conditions have been maintained for 1 min, record the temperature to the nearest 1°C; and

4.4.4.2. Use an alternative form of temperature measurement device with a precision at least that of a thermometer conforming to *BS 1704*, to record the steady-state temperature to the nearest 1°C.

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4.4.5. Freshly placed concrete shall be protected from direct sunlight and from loss of moisture by covering, shading or other means.

4.4.6. The Contractor shall provide the method statement for temperature control in the case of large volume or continuously concrete pour exceeding 100m^3 or as deemed necessary by the S.O. for approval before commencement of works.

4.5. Compaction

4.5.1. Unless otherwise approved by the S.O., concrete shall be thoroughly compacted by vibration and thoroughly worked around the reinforcement, tendons or duct formers, around embedded fixtures and into corners of the formwork to form a dense, homogenous mass, free from voids and which will have the required surface finish when the formwork is removed. Vibration shall be applied continuously during the placing of each batch of concrete until the expulsion of air has practically ceased and in a manner, which does not promote segregation of the ingredients.

4.5.2. The concrete maintained between the two walls of formwork shall be compacted by internal or external vibrators. Concrete in slabs with no formwork on its upper surface shall be compacted either by vibrators of the pan type or by a vibrating screen.

4.5.3. The internal vibrators shall be inserted and withdrawn slowly and at a uniform pace of approximately 100mm per second. Compaction shall be deemed to be completed when cement mortar appears in an annulus around the vibrator. Over vibration leading to segregation of the mix must be avoided. The internal vibrators shall be inserted at points judged by the area of mortar showing after compaction, with a certain allowance made for overlapping and they shall not be allowed to come into contact with the formwork or the reinforcement and shall be inserted at a distance of not less than 75mm from the formwork.

4.5.4. The pan vibrator shall be placed on the surface of the concrete, which shall have previously been tamped and levelled leaving an allowance in height for compaction until the cement mortar appears under the pan. The vibrator shall then be lifted and placed on the adjoining surface and this operation shall be repeated until the whole surface has been compacted. Alternatively, a vibrating screen spanning the full width of the surface may also be used.

4.5.5. Whenever vibration must be applied externally, the design of formwork and disposition of vibration shall receive special consideration to ensure efficient compaction and to avoid surface blemishes. The vibration shall be such that there will be no excess water on the top surface on completion of compaction.

4.5.6. External vibrators shall be firmly secured to the formwork which must be sufficiently rigid to transmit the vibration and strong enough not to be damaged by it. Internal vibrators shall be capable of operating at not less than 10,000 cycles per minute and external vibrators at not less than 3,000 cycles per minute. Sufficient vibrators in serviceable condition shall be on Site so that spare equipment is always available in the event of breakdowns. Vibrators shall be operated by workmen skilled in their use.

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4.5.7. Concrete shall not be subjected to any disturbance within 24 hours after compaction. No standing or flowing water shall be allowed to come into contact with exposed concrete surfaces during the first two (2) hours after placing and compaction of the concrete.

4.5.8. In the event where inadequate or improper compaction is suspected, the S.O. has the right to inspect and to carry out further tests. The tests may include non-destructive and destructive methods. All expenses incurred in carrying out such sampling, testing and remedial works shall be borne by the Contractor irrespective of whether the tests prove the structure to be sound or otherwise.

4.6. Curing and Protection

4.6.1. All concrete work shall be cured for the full period of curing which shall not be less than five (5) days for F1, F2, F3 and F4 surfaces, but not less than three (3) days for F11, F12, F13, F14 and F15 surfaces.

4.6.2. Curing and protection shall start immediately after compaction of the concrete to protect it from:

4.6.2.1. Impact damage such as shock, overloading or falling earth which may disrupt the concrete and interface with its bond to reinforcements.

4.6.2.2. Premature drying out from direct sunlight and wind.

4.6.2.3. Leaching out by rain and flowing water.

4.6.2.4. High internal thermal gradients.

4.6.3. Normal Curing and Protection

4.6.3.1. Concrete, after it is placed and until the expiration of the curing duration, shall not be allowed to dry out. Provision shall be made for adequate protection against direct sunlight and wind to allow the process of curing to complete within the specified period.

4.6.3.2. Curing and protection shall be accomplished by covering the exposed concrete surface with an impermeable material such as polyethylene sheet, which should be well sealed and fastened and if required, this treatment can be continued efficiently throughout the whole period of curing.

4.6.3.3. When the concrete has attained its final set, one of the following curing methods shall be adopted:

(i) Water curing shall be accomplished by keeping the surface of the concrete continuously wet by ponding with water.

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(ii) Curing may be accomplished by sealing in the water as specified above by covering with an approved waterproofed curing paper or plastic sheeting laid with airtight joints. It must be securely positioned to prevent displacement by wind and protected from tearing or other injury.

4.6.3.4. The use of other methods of curing may be deemed necessary when the concrete is subjected to high internal thermal gradient, or with large exposed surface area. The Contractor shall submit a method statement to the approval of the S.O..

4.6.3.5. In the event where the Contractor does not do proper curing, the S.O. has the right to inspect and to carry out further tests which may include destructive methods. All expenses incurred in carrying out such sampling, testing and remedial works shall be borne by the Contractor irrespective of whether the tests proved the structure to be sound or otherwise.

4.6.4. Accelerated Curing

4.6.4.1. Steam curing may be used for precast concrete element at the factory.

4.6.4.2. After the completion of the placing of concrete, four (4) hours shall elapse before its temperature is raised, unless the Contractor is able to prove that curing can start earlier by furnishing all the relevant supporting data to the S.O.. The rise in temperature within any period of 30 minutes shall not exceed 10°C and maximum temperature attained shall not exceed 70°C unless it can be proven that any deviation from this provision shall not result in any detrimental effect to the concrete work. The rate of subsequent cooling shall not exceed the rate of heating.

4.6.4.3. The use of accelerated curing methods for concrete containing other types of cement or any admixture or any additional materials shall be to the approval of the S.O..

5. Construction with Concrete

5.1. Construction Joints

5.1.1. Construction joints shall be made at the location as shown on the drawing and concreting work shall be carried out continuously up to the construction joints. If the position and detail of any construction joints is not described in the drawings, the Contractor shall propose and obtain the approval of the S.O. prior to commencement of concreting. The construction joints shall be made as few as possible with reasonable precautions against shrinkage. The joints shall be at right angles to the general direction of the member and shall take due account of shear and other stresses.

5.1.2. Concrete shall not be allowed to run to a feather edge and vertical joints shall be formed against a stop end. The top surface of a layer of concrete

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shall be level and flat unless design considerations make this undesirable. Joint lines shall be so arranged that they coincide with features of the finished work, wherever possible.

5.1.3. At horizontal construction joints, gauge strips about 25mm width shall be placed inside the forms along all exposed surfaces to ensure a straight joint on those surfaces. Where a kicker (that is a starter stub) is used for the construction of walls and columns, it shall be at least 75mm high, to be constructed monolithically with the base concrete.

5.1.4. Where vertical construction joints are necessary in mass concrete structures, reinforcing bars shall be placed across the joints so as to make the structure monolithic, all to the approval of the S.O..

5.1.5. Prior to recommencement of concreting on a joint, the surface of the concrete against which new concrete will be cast shall be free from laitance and shall be roughened to the extent that the coarse aggregate is exposed but not disturbed. Care shall be taken to avoid damaging the lines of the joint. Care shall also be taken that the joint surface is clean and damp but not wet and the exposed adjoining surfaces shall be of consistent colour. Immediately before the fresh concrete is placed against the joint, fresh rich cement mortar (1:2) shall be applied to the exposed surface.

5.1.6. Where the S.O. considers that special preparation is necessary, e.g. for an in-situ structural connection, preparation shall be carried out, preferably when the concrete has set but not hardened, by spraying with a fine spray of air and water or brushing with a stiff brush sufficiently to remove the outer mortar skin and expose the larger aggregates without disturbing them. Where this treatment is impracticable, sand blasting or a needle gun shall be used to remove the surface skin and laitance. Hardened surfaces shall be chipped manually or mechanically to be free from laitance and properly roughened to the extent that the coarse aggregates are being exposed.

5.2. Fixing Blocks, Brackets, Built in Bolts, Holes, Chases, Et Cetera

5.2.1. All fixing blocks, brackets, built in bolts, holes, chases, et cetera shall be accurately set out and formed and carefully sealed prior to the concrete being placed. It is the responsibility of the Contractor to obtain all such information for these items of work and to obtain the approval of the S.O. before incorporating such work prior to the concrete being placed.

5.2.2. Bolts and other inserts to be cast into the concrete shall be securely fixed to the formwork in such a way that they are not displaced during the concreting operations and that there is no loss of materials from the wet concrete through holes in the formwork.

5.2.3. Unless otherwise shown on the Drawings or instructed by the S.O., reinforcement shall be locally moved so that the minimum specified cover is maintained at the locations of inserts, holes, chases, et cetera. In the event where the minimum cover cannot be maintained, the Contractor shall take the necessary precautions to protect the reinforcements against corrosion by applying an approved coating material to the reinforcements and the concrete cover.

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5.2.4. Temporary plugs shall be removed and the threads of built in bolts shall be cleaned and greased before handing over any part of the Work.

5.3. Movement Joints.

5.3.1. Movement Joints, Expansion joints, contraction joints or other permanent structure joints shall be provided in the positions and constructed and sealed with waterproofing materials as detailed in the Drawings.

5.3.2. When forming movement joints, joint filler shall be fixed firmly to the first-placed concrete. If more than one strip is used within a joint, it is essential to butt the ends tightly or tape them together to prevent grout leakage restricting the closure of the joint.

5.3.3. It is essential that the concrete on both sides of the joint, when placed, is thoroughly compacted to form a dense uniform mass. Where stop ends comprise more than one element, particular care is necessary to ensure that joints between elements are sufficiently tight to allow no grout loss through them during compaction of the concrete.

5.3.4. Where flexible water stops are used, they shall be fixed so as to ensure that they are not displaced from their intended position during compaction of the concrete and that the concrete surrounding them is fully compacted. The design of the water stop should be practical and take account of the problems often associated with integral water stop construction in difficult placing conditions.

5.3.5. Water stops laid horizontally and located within the concrete mass shall be avoided since they attract the greatest risk of local honeycombing.

5.3.6. Unless otherwise shown on the Drawings, all exposed expansion joints shall be covered with 0.7mm thick aluminium cover strips fixed with masonry nails at 300mm centres.

5.4. Sealants and Special Materials

5.4.1. General

The installation method and the selection, mixing, application and curing of all joint waterproofing materials shall be in accordance with the manufacturer's recommendations. The Contractor may propose to use alternative joint waterproofing materials by submitting supporting technical information, test reports and samples of the proposed waterproofing materials to the S.O. for approval.

5.4.2. Waterproofing Materials

All waterproofing materials used at public access areas shall be protected with non-shrink grout covering.

5.4.3. Water stops

5.4.3.1. The material for water stop can be made of rubber or flexible plastics in accordance with *MS 1292*.

5.4.3.2. Water stops shall be as specified in the Drawings and shall be installed in accordance with *BS EN 1992-3* and the

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manufacturer's recommendation to the approval of the S.O..

5.4.3.3. Water stops shall be securely positioned in the formwork to prevent displacement during concreting.

5.4.3.4. The selection and requirements of a water stops are as below:

(i) The overall width of water stops shall be greater than the smallest structural concrete cast.

(ii) The distance between the surface of the concrete and the water stops shall be greater than half the width of the water stops.

(iii) The width of the water stops shall be more than 150 mm.

(iv) The distance between the water stops and steel reinforcement shall be more than 50 mm.

5.4.4. Two-part Polysulphide or Two-part Polyurethane Sealant

5.4.4.1. Two-part Polysulphide or Two-part Polyurethane Sealant for external use shall comply with the following requirements:

(i) Conformance to *BS 4254*.

(ii) Minimum joint movement capacity of ± 27.5% of joint width at 27.5°C;

(iii) Shore 'A' Hardness of 25 ± at 27.5°C;

(iv) Resistance to dilute acids, alkali and all kind of fuel.

5.4.5. Preformed Flexible Strip Sealant

5.4.5.1. Preformed flexible strip sealant shall comply with the following requirements:

(i) Shall only be used in horizontal joints and be subjected to pressure.

(ii) Throughout its length;

(iii) Good adhesion.

(iv) Water resistant.

(v) Non-staining.

5.4.6. Bitumen/Rubber Cold Applied Membrane

5.4.6.1. Bitumen/rubber cold applied membrane shall comply with the following requirements:

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(i) Minimum joint movement capacity of ±10% of joint width at 27.5°C.

(ii) 90% solid content;

(iii) Resistant to dilute acid and alkali.

5.4.7. Hot-Poured Rubber/Bitumen Sealing Compound.

5.4.7.1. Hot-poured rubber/bitumen sealing compound shall comply with *BS 2499*.

5.4.8. Bituminous Sheeting

5.4.8.1. Bituminous sheeting with non-asbestos fibre shall comply with the following requirements:

(i) Resistant to lime water (no visual effect after two (2) weeks immersion).

(ii) Maximum water absorption of 10% of dry weight.

(iii) Minimum tensile strength of 50kg/cm².

(iv) Ozone and ultraviolet resistant.

5.4.9. Neoprene Bearing Pads

5.4.9.1. Neoprene bearing pads shall comply with the following requirements:

(i) Shore 'A' Hardness of 60 ± 5 at 27.5°C.

(ii) Minimum rupture strength of 105kg/cm².

(iii) Minimum rupture elongation of 300%.

5.4.10. Polyurethane Foam Backing Rods

5.4.10.1. Polyurethane foam backing rods used as sealant stops in panel joints shall have the following properties: -

(i) Minimum compressibility of 75% of original volume at 27.5°C.

(ii) Excellent resilient properties.

(iii) Density between 35kg/cm³ and 45kg/cm³.

(iv) Total resistance to common acids, lubricants and detergents.

(v) Total resistance to water infiltration by capillary action.

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(vi) Suitability for up to 70°C.

5.5. Measurement of Concrete Cover

5.5.1. General

The Contractor shall ensure all concrete cover thickness to comply with the requirement during the construction as stated in the drawing. Measurement shall be done after removed of formwork and before plastering works begins.

The nominal cover, C_{nom} shall be specified in the drawing and defined as below:

$C_{nom} = C_{min} + \Delta_{Cdev}$

$\therefore \Delta_{Cdev} = 10mm$

5.5.2. Tolerance

The allowable tolerance for minimum concrete cover (C_{min}) shall be as follows:

5.5.2.1. ±1mm for cover depths ≤ 40mm.

5.5.2.2. ±2mm, for cover depths > 40mm.

5.5.3. Frequency and Verification of Measurement

5.5.3.1. Definition of Stage

Stage is defined as a group of the elements casted or install in the same day.

5.5.3.2. Definition of Element

Element is defined in two type which are individual element (one type of the element) and group of elements which consist different type of element (column, beam, slab, wall, footing). The S.O. shall determine the total number of the element to be measured.

5.5.3.3. The frequency of the measurement shall be in accordance to the stages and measured as follows:

(i) For single storey building, the measurement shall be conducted after the completion of construction of the building elements.

(ii) For multiple storey building, the measurement shall be conducted progressively after the completion of each floor of the building.

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5.5.3.4. Method of Measurement & Calibration of the Equipment

The measurement of concrete cover shall be done by using Electromagnetic Cover Meter in accordance with *BS 1881-204*. The cover meter must be fully calibrated by an accredited certification body.

5.5.3.5. Measurement Location & Sampling

The location chosen to be measured shall consist of all critical element such as beam, slab, column and wall. The S.O. shall identify all critical elements before measurement is done. The sampling of measurement for the elements shall be as shown in **Table D34**.

5.5.4. Compliance Criteria

5.5.4.1. The compliance criteria shall be based on each stage measured. All measurements are to be tabulated and to determine the numbers of measurements lower than minimum concrete cover (C_{min}) and sample size, x and N respectively.

5.5.4.2. For compliance criteria, **Figure D4** shall be referred. However, the chosen compliance is dependent on the total number of measurements per stage.

For N > 10, the 5th percentile shall be use
N ≤ 10, the 10th percentile shall be use

5.5.5. Non-Compliance of the Product

5.5.5.1. The following actions shall be taken by the Contractor in the event of non-compliance of sub-section 5.5.4.:

(i) Check test results and if invalid, take action to eliminate errors.

(ii) If non-compliance is confirmed, take corrective actions.

(iii) Record actions on the items above.

5.5.5.2. The Contractor shall submit to the S.O. the recommendations for repair corrective works to be done with the approval of the S.O..

5.5.5.3. All works instructed under subsection 5.5.5. shall be at the Contractor's expense and no extension of time shall be granted for such works.

6. Steel Reinforcement

6.1. General

The Work shall consist of furnishing and placing reinforcing steel in accordance with this specification and in conformity with the Drawings or as directed by the S.O..

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6.2. Materials

6.2.1. Hot rolled mild steel and high yield bars shall comply with the requirements of *MS 146*. Cold worked steel bars shall comply with the requirements of *BS 4461*. Hard drawn mild steel wire shall comply with the requirements of *MS 144*.

6.2.2. Steel fabric reinforcement shall comply with the requirements of *MS 145* and shall be delivered to the Site in flat sheets, unless otherwise specified.

6.2.3. Dowel bars shall be plain, round bars conforming to the requirements of *MS 146*. They shall be free from burring or other deformations restricting slippage in the concrete. Dowel bar sleeves used for debonding shall be of approved synthetic material. The closed end of the sleeve shall be filled with 25mm thick compressible foam fillers and the sleeve shall fit tightly over the length of the bar to be debonded.

6.2.4. Before any reinforcement steel is brought to Site, the Contractor shall furnish the mill certificates of tests and these shall be submitted for acceptance by the S.O.. In addition, Contractor shall on request, furnish the S.O. with a test sheet from approved laboratories for any batch of bars, giving the results of each of the mechanical tests and/or chemical composition analysis required under the MS or any equivalent international standards approved by the S.O.. The specified characteristic strength of steel reinforcement shall be as given in **Table D32**.

6.2.5. During the course of the work, any reinforcement found to be not in accordance with the MS or BS may be rejected by the S.O. notwithstanding any previous acceptance on the strength of the test certificates. The S.O. may call for additional tests to be made at the Contractor's expense on samples taken from the batch of the defective reinforcement. If the samples do not comply with the MS or BS, then the S.O. may reject the whole batch and instruct its removal from the Site.

6.2.6. Steel reinforcement shall be stored in clean and dry conditions. When placed in the work it shall be clean and free from loose rust, mill scale, oil, grease, paint, dirt or anything which may reduce its bond with concrete. If directed by the S.O., the steel bars shall be brushed or otherwise cleaned before use, at the Contractor's expense.

6.2.7. Binding wire shall be 1.6 mm diameter soft annealed steel wire complying with the requirements of *BS 1052*.

6.3. Construction Methods

6.3.1. Cutting and Bending of Reinforcement

6.3.1.1. Bars shall be of their correct lengths and bent to the exact shapes required before being fixed in the work.

6.3.1.2. Bars shall be cut and bent cold by the application of slow, steady pressure or in an approved bar-bending machine. Bending at temperatures in excess of 100°C may only be carried out with the S.O.'s approval and under his supervision. Except where otherwise indicated in the Drawings, bars shall be bent and measured in accordance with *MS 1438*.

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6.3.1.3. Cold worked and hot rolled bars shall not be straightened or bent again once having been bent. Where it is necessary to bend the free end of mild steel reinforcement already cast in the concrete, the internal radius of the bend shall not be less than twice the diameter of the bar.

6.3.1.4. Special care shall be taken that the overall length of bars with multiple bends is accurate and that after bending and fixing in position the bars remain in place without wrap or twist.

6.3.2. Fixing of Reinforcement

6.3.2.1. The number, size, length, shape, type and position of all reinforcing bars, links, spacer bars and other parts of the steel reinforcement, shall be in accordance with the Drawings.

6.3.2.2. Reinforcements shall be secured against displacement. Unless specified otherwise, the actual concrete cover shall be taken as the distance between face of concrete and the nearest steel surface. All intersecting bars shall be tied together with binding wire and the ends of the wire shall be turned into the main body of the concrete.

6.3.2.3. Reinforcement temporarily left projecting from the concrete at construction or other joints shall not be bent out of position during the periods in which concreting is suspended except with the approval of the S.O..

6.3.2.4. The Contractor shall take particular care that the reinforcement is laid out correctly in every aspect and temporarily suspended by annealed wire or supported on concrete blocks or other approved spacers in the forms to prevent displacement during the placing and compacting of concrete. Links shall tightly embrace the longitudinal reinforcement to which they shall be securely wired or spot welded. The top reinforcement in slabs shall be rigidly supported on mild steel 'chairs' or equivalent spaced in each direction to prevent sagging during concreting.

6.3.2.5. No concrete shall be placed until the reinforcement has been inspected and approved by the S.O..

6.3.3. Splicing

6.3.3.1. Joints to reinforcement bars shall be in accordance by lapping of bars at positions shown in the Drawings. Where other types of joints are to be used, it shall be strictly in accordance with manufacturer's recommendation, at the positions approved by the S.O..

6.3.3.2. Splicing or lapping of bar shall no impair the flow of concrete surrounding the reinforcement bar including the concrete cover.

6.3.4. Supporting and Spacer Blocks

6.3.4.1. The size of supporting and spacer blocks required for ensuring that the reinforcement is correctly positioned shall be not more

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than 50mm x 50mm consistent with their purpose, of a shape approved by the S.O., and designed so that they will not overturn when the concrete is placed.

6.3.4.2. The nominal size of aggregates used shall be 10mm. The concrete spacers shall be of at least the same strength and material's source as the concrete to be poured. Wires cast in these blocks for the purpose of tying them to the reinforcement shall be free from any corrosion or any other elements that may affect the integrity of the reinforcement bars.

6.3.4.3. Spacers left in situ shall not impair the desired appearance or durability of the structure by causing spalling, rust staining or allowing the passage of moisture.

6.3.4.4. Other types of spacers may be used only with the approval of the S.O..

6.3.5. Welding of Reinforcement Bar

6.3.5.1. Welding workmanship, including welder qualification shall comply with the *Specification for Structural Steelworks JKR No. 20601-0191-12*.

6.3.5.2. Reinforcement bar in structures shall not be welded except where detailed in the Drawings or permitted in this specification.

6.3.5.3. Welding shall be carried out in accordance with *BS EN 1011* and *BS EN 60974*. Butt welds shall be of the double V type and two butt weld bond tests shall be carried out on a specimen prepared to represent each form of the butt welded joint used in welding the reinforcement and for each position of welding. The method of making butt weld tests shall be as laid down in *BS EN 17637*. The specimen shall pass the test to the approval of the S.O. before using the joint, which the specimen represents. Welded joints shall not be made at bends in reinforcement. Unless otherwise approved by the S.O., joints in parallel bars of the principal tensile reinforcement shall be staggered in the longitudinal direction at a distance not less than the end anchorage length for the bar.

6.3.5.4. The S.O. shall be informed in advance of when welding is to be carried out so that he may supervise and inspect the work. Welding shall not be performed in the field during rain or other adverse conditions.

7. Formwork and Surface Finish for Structure

7.1. Design and Construction

7.1.1. Description

7.1.1.1. Formwork shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support.

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7.1.1.2. The Contractor is deemed to have made a study of the Drawings at tender stage and is aware of all areas of construction, requiring heavy and specially designed propping to provide the support and the necessary bracing for the stability of such propping.

7.1.1.3. The design and construction of formwork shall be carried out by a competent person. The Contractor shall identify all critical formwork design and submit the strength and deflection calculations and Drawings or the proposed design, certified by a Professional Engineer to the S.O. for prior approval. Notwithstanding any approval by the S.O. with respect to the design submitted by the Contractor, the responsibility or the adequacy and safety of the design shall remain with the Contractor. The Contractor shall also appoint a competent formwork coordinator whose duties would be similar to those outlined in *BS 5975*.

7.1.1.4. When the use of proprietary type of formwork is proposed by the Contractor, the design shall be certified by a Professional Engineer.

7.1.1.5. The formwork shall be sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages of construction and shall be appropriate for the methods of placing and compacting.

7.1.1.6. Formwork (including supports) shall be sufficiently rigid to maintain the forms in their correct position, shape, profile and dimensions. The supports shall be designed to withstand the worst combination of forces due to self-weight, formwork weight, formwork forces, reinforcement weight, wet concrete weight, construction and wind loads, together with all incidental dynamic effects caused by placing, vibrating and compacting the concrete. Guidance on these loadings is given in *The Concrete Society Manual Formwork - Guide to good practice*, and in *CIRIA Report 108, Concrete Pressure in Formwork*, and in *BS 5975*. Vertical propping to formwork shall be carried down sufficiently far to provide the necessary support without overstressing the completed concrete structure.

7.1.1.7. Metal ties may only be used with the prior approval of the S.O.. Where metal ties are permitted, the use of storey height steel soldiers shall be used to reduce the number of tie bolts required. Tie bolts with rubber or plastic cone against the form face are to be used to prevent unsightly grout loss. No metal part of any device for maintaining formwork in the correct location shall remain permanently within the specified concrete cover to the reinforcement. Except for ties used for anchoring void formers, all ties shall be at least 1.2m apart and through bolts will not be permitted on exposed form finished faces. All holes left by ties shall be made good within one day of the removal of the formwork using a mortar of the same strength as the cast concrete. Metal ties which allow for holes through the concrete being cast shall not be permitted to be used in concrete for water-retaining structure, roof slabs and walls.

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7.1.1.8. The formwork shall be so arranged as to be readily dismantled and removed from the cast concrete without shock, disturbance or damage. Where necessary, the formwork shall be so arranged that the soffit form, properly supported, can be retained in position for such period as may be required by the condition of the maturing concrete or the specification. If a component is to be prestressed whilst still resting on the soffit form, provision shall be made to allow for elastic deformation and any variation in weight distribution. As far as practicable, formwork joints shall coincide with construction joints.

7.1.2. Form Lining

7.1.2.1. The type and treatment of any lining (plywood, metal, plastic, Controlled Permeability Formwork liner, et cetera) of the forms shall be appropriate to the concrete finish required.

7.1.2.2. The Controlled Permeability Formwork (CPF) liner shall have the following requirements:

(i) The requirement for a special finish shall be as for traditional formwork finishes except that the formwork shall be covered by a CPF liner.

(ii) CPF liner shall be used on all surfaces as detailed on the Drawings.

(iii) The CPF liner shall be a Water Bylaws Scheme - Approved Product for use with potable water in accordance with *BS 6920.*

(iv) The CPF liner shall have the following properties:

a) Compression of less than 10% under a pressure 200kPa.

b) Maximum pore size of less than 0.030mm.

c) Minimum water retention capacity of 0.35 l/m^2.

d) Result in bleed water from the liner which is free from cement and fine aggregate particles.

(v) The concrete cast against the CPF liner shall have an even uniformly textured matt finish and shall be free of blowholes and other surface blemishes. The use of the CPF liner shall meet the following performance requirements which should be demonstrated by the supply of test certificate:

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a) The mean surface strength for the CPF cast face shall exceed that for the control face by at least 70%.

b) The mean 10 minute ISAT result for the CPF cast face shall be not more than 15% of that for the control face.

c) The mean depth of carbonation for the CPF cast face shall be not more than 15% of that for the control face.

d) The mean concentration of chlorides at a depth of 11mm from the CPF cast face shall be not more than 15% of that for the control face.

(vi) The CPF liner shall be used once only. Release agents shall not be used with the liner and any residual release agent remaining on forms from previous use shall be removed.

(vii) To ensure conformity with the performance requirements, the CPF liner is to be used in accordance with the manufacturer's technical guidelines.

(viii) The CPF liner shall unless otherwise directed, be left in place on the concrete after formwork removal for the curing period specified by the S.O.. It shall be kept wet and covered with plastic sheeting to promote efficient curing.

7.1.3. Projecting Reinforcement, Fixing Devices

Where holes are needed in form to accommodate projecting reinforcement or fixing devices, care shall be taken to prevent loss of grout when concreting or damage when removing forms.

7.2. Surface Finishes for Concrete

7.2.1. Control of Colour

When specified in the Drawings, the Contractor shall obtain each constituent material from a single consistent source. The aggregates shall be free of any impurities that may cause staining. The mix proportions and the grading, particularly of the fine aggregate, shall be maintained constant. The same type of plywood or timber shall be used in formwork throughout similar exposed areas.

7.2.2. Formed Surfaces

7.2.2.1. Formed concrete surfaces shall have one of the following classes of finish.

7.2.2.2. Unless otherwise specified, all exposed concrete surfaces shall be of Class F12, all unexposed surfaces shall be of Class F1. Other classes of finishes shall be used only where shown on the Drawings:

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(i) Class F1

This finish shall be obtained using properly designed forms of closely joined sawn timber or other approved material. Small blemishes caused by entrapped air or water may be expected but the surface shall be free from voids and honeycombing.

(ii) Class F2

This finish shall be obtained using properly designed forms of closely jointed wrought boards, approved plywood or other approved material. Only very minor surface blemishes shall occur, with no staining or discoloration.

(iii) Class F3

a) This finish shall be obtained using properly designed steel forms or plastic coated plywood or wrought boards or other approved material that can be used not less than 20 times.

b) The surface shall be improved by carefully removing all fins and other projections, thoroughly washing down and then filling the most noticeable surface blemishes with a cement and fine aggregate paste to match the colour of the original concrete. Form release agents shall be carefully chosen to ensure that the surface shall not be stained or discoloured. After the concrete has been properly cured, the surface shall be rubbed down where necessary, to produce a smooth and even surface.

(iv) Class F4

The requirements for Class F4 are as for Class F3 except that internal ties and embedded metal parts will be permitted. The ties shall be positioned only in rebates, or in other positions as shown on the Drawings or as agreed by the S.O..

(v) Class F11

The requirements for Class F11 surface finish are identical to those for Class F1 except that it shall be achieved using Controlled Permeability Formliners.

(vi) Class F12

The requirements for Class F12 surface finish are identical to those for Class F2 except that it shall be achieved using Controlled Permeability Formliners.

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(vii) Class F13

The requirements for Class F13 surface finish are identical to those for Class F3 except that it shall be achieved using Controlled Permeability Formliners.

(viii) Class F14

The requirements for Class F14 surface finish are identical to those for Class F4 except that it shall be achieved using Controlled Permeability Formliners.

(ix) Class F15

The requirements for Class F15 are as for Class F4 except that plywood shutters lined with an approved patterned formliner shall be used to produce a patterned profile finish. Where possible, full height formliners shall be employed so that no horizontal joints in the liners are required. Tie holes shall be spaced so that they occur at overlap joints in the lining sheet.

7.2.3. Unformed surfaces

7.2.3.1. Class U1

The concrete shall be uniformly levelled and screened to produce a plain, ridged or broom roughened surface. No further work shall be applied to the surface unless it is used as the first stage for a Class U2 or Class U3 finish.

7.2.3.2. Class U2

After the concrete has hardened sufficiently, the concrete Class U1 surface shall be floated by hand or machine to produce a uniform surface free from screed marks.

7.2.3.3. Class U3

When the moisture film has disappeared, and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, a Class U1 surface shall be steel trowelled under firm pressure to produce a dense, smooth uniform surface free from trowel marks.

7.2.3.4. Class U4

This finish is for surfaces that are to receive waterproofing systems. The concrete shall be levelled and floated to produce a uniform surface and immediately before the waterproofing operation this surface shall be water jetted or grit blasted to provide a lightly textured finish. The finished surface shall not deviate from the required profile by more than 5mm over a 3m gauge length or have any abrupt irregularities of more than 3mm.

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7.2.4. Trial Panels for Exposed Form Finished Surfaces

7.2.4.1. In order to ensure that the specified formed finishes can be obtained by the method of construction proposed and to provide a standard by which the finishes in the Works can be assessed, trial panels shall be cast on Site. These panels shall be subjected to the S.O.'s approval before similar casting is permitted in the Works.

7.2.4.2. The trial panels shall employ the materials, plant and concrete mix proposed for the Works. They shall be at least a storey height and 1m wide. They shall be of similar thickness and similarly reinforced as the elements they represent and shall incorporate all features which contribute to the final appearance of the Works.

7.3. Preparation of Forms Before Concreting

7.3.1. Before concreting, all forms shall be thoroughly cleaned out, free from sawdust shavings, dust, mud or other debris. The inside surfaces of forms shall, unless otherwise approved by the S.O., be coated with an approved non-staining form oil or other approved material to prevent adhesion of the concrete Such release agents shall be applied strictly in accordance with the manufacturer's recommendation and shall not come into contact with the reinforcement or prestressing tendons and anchorages. For any exposed surface only one release agent shall be used throughout the entire area.

7.3.2. All formwork shall be inspected by the S.O. after preparation and immediately prior to depositing concrete and no concrete shall be deposited until approval of the formwork has been obtained.

7.4. Removal of Forms

7.4.1. The Contractor shall inform the S.O. and obtain his approval before striking any formwork, but such approval shall not relieve the Contractor of his responsibilities for the safety of the work.

7.4.2. Formwork shall be removed without such shock or vibration as would damage the concrete. A period of time shall elapse between the placing of the concrete and the removal of the formwork for various parts of the structure so as to suit the requirements for its curing.

7.4.3. The minimum periods between concreting and the removal of forms are given in **Table D33.** The periods stated in this table are based on the use of CEM 1. They may be changed with the approval of the S.O., if other types of cement as described in sub-section 2.1., admixtures as described in sub-section 2.4. are used. The result of the compressive strength obtained from cube strength at 7 days as described in sub-section 3.2. may also be used for early removal of forms provided always the Contractor provide proof of calculation to the S.O. for approval.

7.4.4. For prestressed in-situ components, temporary supports shall not be removed until the components is stressed to the approval of the S.O..

7.4.5. Where it is intended that forms are to be reused, they shall be cleaned

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and made good to the approval of the S.O..

7.4.6. Following the removal of forms, no further loads shall be imposed upon the concrete until at least after the completion of the curing period or until such later time as in the opinion of the S.O. the concrete shall have attained sufficient strength to safely withstand such loads. Full design loads shall not be applied to any structure until all load bearing concrete is at least 28 days old.

7.5. Inspection and Making Good

7.5.1. The surface of the concrete shall be inspected for defects and for conformity to the surface finish specified and where appropriate, with approved sample finishes.

7.5.2. Subject to the strength and durability of the concrete being unimpaired, the making good of surface defects may be permitted but the level of acceptance shall be appropriate to the type and quality of the finish specified and ensure satisfactory permanence and durability.

7.5.3. Any remedial treatment of surfaces shall be approved by the S.O. following inspection immediately after removing the formwork and shall be carried out without delay.

8. Mass and Lean Concrete

Mass and lean concrete shall consist of cement, fine aggregate and coarse aggregate in the nominal ratio by volume of 1:3:6 and 1:4:8 respectively. However, where a denser and more workable concrete can be produced by a variation in the ratio of the fine aggregate to that of coarse aggregate, this ratio may be varied within the limits (1:1½) and (1:3), provided that the volumes of fine and coarse aggregate, each measured separately, shall nevertheless equal the sum of the volumes of fine and coarse aggregate appropriate to the nominal mix. The concrete shall be mixed as described for reinforced concrete.

9. Building Accuracy

After removal of formwork, the Contractor shall take measurements as directed by the S.O. to check the deviation of the reinforced concrete works from specified dimensions shown on the Drawings. All measurements shall be recorded and submitted to the S.O.. Any deviation in building accuracy shall comply with *BS EN 13670*.

10. Apparatus

The Contractor shall provide the following apparatus for use on the Site at all times:

10.1. Concrete slump test apparatus and flow test apparatus complying with *MS 26*. One set of the apparatus shall be provided for each concreting location.

10.2. At least twelve (12) numbers of steel or cast iron moulds for casting 150mm concrete test cubes and six (6) numbers of prismatic specimen 40 x 40mm in cross section and 160mm in length for mortar or grout test moulds in accordance to *BS EN 445*. A minimum number shall be provided such that no stripping of cubes is required prior to 24 hours setting and hardening period.

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10.3. Three (3) measuring cylinders of 250ml capacity, graduated to measure to the nearest 2.0ml., for determination of silt content (field setting method).

10.4. An approved apparatus for measuring moisture content in fine aggregate.

10.5. One (1) electronic calculator with statistical functions.

10.6. One (1) 300 mm steel rule.

10.7. One (1) set of sieves in compliance with *BS ISO 3310.*

10.8. Scale or balance 25kg maximum capacity and weights.

10.9. Trowel, shovel, spanner and other tools.

10.10. One (1) Electromagnetic Concrete Cover Meter.

11. Precast Concrete Works

11.1. The Contractor shall employ manufacturers registered with CIDB to supply or cast on site precast component to the respective project. All precast concrete components to be used in the works shall be approved by the S.O./P.D. prior to installation. The full requirement is outlined in the *Specification for Precast Concrete Works (JKR 20601-0251-18).*

11.2. Industrialized Building System (IBS) Requirements

The calculation shall comply based on the latest version of *Manual for Industrialized Building System (IBS) Content Scoring System (IBS Score): Construction Industry Standard, CIS 18 published by the Construction Industry Development Board (CIDB) Malaysia.*

11.3. Assembly Drawing

11.3.1. All assembly drawing produced by the manufacturer and verified by a Professional Engineer (P.E.) to the S.O./P.D. for approval before the commencement of the manufacturing of the component. The list of drawings that needs to be endorsed are as below:

11.3.1.1. Layout drawing.

11.3.1.2. Section drawing.

11.3.1.3. Connection details.

11.3.1.4. Element types.

11.3.1.5. General drawing.

11.3.2. Assembly Drawings shall show all necessary details and dimensions to enable assembly of components to proceed.

11.4. Installation

11.4.1. The Contractor shall inform the S.O./P.D. at least one month in advance

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of launching or installation operation and submit the following documents to the S.O. for acceptance:

11.4.1.1. Method statement including launching systems and transportation.

11.4.1.2. Proposal for traffic diversion, if appropriate.

11.4.1.3. Detailed program of launching and installation operation.

11.4.1.4. Installation operation safety program.

11.4.2. Inspection of Precast Unit.

The elements shall be inspected for cracking and other defects or damage. The dimensional properties of the components shall be checked in accordance in the drawings.

11.4.3. Lifting and Handling

A lifting method statement shall be prepared by the Contractor and submitted for approval. The elements shall be lifted from the mould according to the locations of the lifting devices and instructions on the production drawings. The recommended minimum concrete strength for lifting and handling are shows in **Table D35.**

11.5. Connection

11.5.1. The Contractor shall be responsible to ensure the connection between components (in situ and precast / precast and precast) are properly installed in accordance to the drawings and method statement.

11.5.2. Designed mixes of grout shall be submitted to the S.O./P.D. for approval. The grout shall be of high fluidity and cohesive at plastic and non-shrinkage during hardening.

11.5.3. The grout shall be a mixture of CEM I cement, water and approved admixture. The water/cement ratio shall be between 0.4 to 0.6 or such other proportion as approved by the S.O./P.D.

11.5.4. If the Contractor chooses to use proprietary product, he shall submit to the S.O./P.D. the name of manufacturer/supplier, type and specification of the product for approval. The grout shall be mixed on site in accordance with the manufacturer's requirements.

11.5.5. The grout shall be tested in accordance to the following method:

11.5.5.1. Fluidity Test by using Cone Method (*BS EN 445*) or;

11.5.5.2. Fluidity Test by using Grout Spread Method (*BS EN 445*) or;

11.5.5.3. Flowability Test using Flow Cone Method (*ASTM C939*) and;

11.5.5.4. Compressive Strength Test (*BS EN 445*).

11.5.6. Placement

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11.5.6.1. Vertical Placement (Pressure Grouting)

Grout shall be pumped into each sleeve until grout pours out of the outlet and pumping shall be continued until a pressure of minimum 100kN/m² is attained. The high pressure cork shall remain closed and in position for a period of one hour after grouting.

11.5.6.2. Vertical Placement (Gravity Flow)

This method shall only be allowed for shallow sleeve, such as the connection between corbel and precast beam, nib and precast beam. The diameter of corrugated sleeve and the appropriate dowel bar size shall be as shown in **Table D36**.

11.5.6.3. Horizontal Placement (Gravity Flow Grouting)

Gravity flow grout shall be applied to areas that convenient and easy for grouting works such as, longitudinal joint between precast component. It can be poured by hand directly along the joint and swept into the gap with suitable tools.

12. Other Concrete Works

12.1. Foundation

12.1.1. All reinforced concrete footings and pile caps shall be constructed according to the Drawings and to the exact depths required. The Contractor shall supply, maintain and remove any necessary planking and strutting, sheet piling and coffer dams, and shall by pumping or other approved means keep the excavation free from water.

12.1.2. The bottom of excavation shall be cleaned or if in loose or disturbed ground shall be well rammed, and the whole shall be approved before it is covered with a blinding layer of lean concrete not less than 50mm thick. The required cover of concrete under the reinforcement shall be entirely above the blinding layer.

12.2. Pile Caps

12.2.1. Before commencing to construct pile caps, the Contractor shall check and verify the eccentricities and the cut-off levels of all piling works in the ground are as provided in the Drawings and shall notify the S.O. in the event of any discrepancy.

12.2.2. The Contractor shall straighten the steel reinforcement projecting above the piles for anchoring pile caps, carry out excavation, erect formwork and temporary timbering for the construction of pile caps and ground beams.

12.3. Structural Elements Below Ground Level

12.3.1. For structural elements, lift shaft and lift pits below ground level, the concrete in the base slab and walls shall be of reinforced concrete with minimum cement content and maximum free water to cement ratio in accordance with the exposure XC3 in **Table D9, Table D10, Table D11**

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and **Table D12** shall be constructed in operations which shall ensure water tightness.

12.3.2. All external or internal wall surfaces of lift pits shall be waterproofed with three (3) coats of bitumen solution complying with *BS 3416* or any other type of waterproofing material as approved by the S.O.. The concrete surface shall be thoroughly cleaned and dried before application of the waterproofing material.

12.3.3. Lift shaft and structural wall enclosures shall be made of reinforced concrete on all sides and constructed using steel formwork to ensure the accuracy of the structure in terms of verticality, shape, profile and dimensions. Refer to **Figure D5.**

12.3.4. For lift shaft enclosure, all the inner surfaces shall form a continuous flush surface without projection or recesses. Refer to **Figure D5.**

12.3.5. The lift shaft shall have a high degree of verticality. The limit of accuracy of shaft plumb for the full stretch of the lift shaft shall not exceed ±30mm. Refer to **Figure D6.**

12.3.6. The structural openings shall be vertically aligned one above the other for the full travel of the lift.

12.3.7. The structural opening shall be accurate to the specified dimensions. Deviations from the specified dimensions shall not exceed +12.5mm, -0mm. Refer to **Figure D7.**

12.4. Floors

12.4.1. After initial set, the upper surface of cast-in-situ reinforced concrete floors shall be trowelled smooth with a steel float to true level and even surface. No screeding of any kind shall be applied to the floor slabs except where specified. Care shall be taken to ensure that the steel reinforcement is not displaced or lowered during trowelling.

12.4.2. For areas, which are to receive rendering or other finishes, the fresh concrete shall be trowelled to true level or as required using a long timber trowel. Before it hardens it shall be brushed with a stiff broom in one direction to give a rough and tidy surface.

12.4.3. The reinforced concrete ground floor slab shall not be laid directly onto earth surfaces. A blinding layer of 50mm minimum thick of lean concrete as specified in sub-section 8 shall be laid on well prepared firm ground. Plastic sheeting or other suitable material with sufficient overlaps at joints, shall be laid on the blinding layer before any reinforcement is placed in position.

12.5. Toilet Floors

12.5.1. The Contractor shall ensure that all suspended floor for toilet areas are constructed to be watertight and leak proof. All construction method or alternative details proposed by the Contractor must be based on his acceptance of and compliance with the requirements for water tightness. The Contractor shall ensure that holes and fixings are properly constructed.

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12.5.2. The floor must be concreted in one sequence of operation. No construction joints for toilet floor are to be allowed. All pipes and fittings encased in the concrete floor shall be provided with sleeves to the approval of the S.O and shall be built in-situ. No holes shall be left for later incorporation of fittings and no subsequent hacking of floor shall be made. Notwithstanding whatever shown on the Drawings, all toilet floor slabs shall have a minimum thickness of 150mm.

12.5.3. Testing for Water Tightness

The toilet floor areas should be ponded with water continuously over a period of 24 hours. During this period the exposed soffit shall show no signs of leakage and remain dry. If any area is found not to be watertight, the Contractor must repair at his own expense.

12.6. Roofs

12.6.1. Reinforced concrete roofs shall be constructed to fall as shown on the Drawings and finished with steel trowelling, leaving the surface smooth and free from mortar droppings.

12.6.2. The base slab shall be concreted as described for concrete generally, ensuring thorough compactions using a pan vibrator or a vibrating screen. Concrete shall be poured continuously between pre-determined construction joints as decided by the S.O., or as shown on the Drawings. Expansion joints, where applicable, shall be allowed and constructed exactly as indicated in the Drawings.

12.6.3. Unless otherwise specified or shown on the Drawings, waterproofing screed to reinforced concrete flat roof shall consist of a 32mm thick screed reinforced with temperature steel.

12.6.4. The waterproofing screed shall consist of one (1) part of cement and three (3) parts of clean well-graded sand (1:3) and shall be mixed with an approved waterproofing agent and approved plasticizer in the proportion recommended by the manufacturer.

12.6.5. The temperature steel shall consist of a mesh 6mm diameter mild steel bars at 150mm centres each way, or alternatively steel fabric of *MS 145*. The temperature steel shall be placed directly on top of the base slab, and a minimum cover of 19mm to top bars of the temperature steel shall be maintained.

12.6.6. The screed shall be laid after the base slab concrete has sufficiently hardened but not later than 36 hours after the concreting of the base slab, to obtain a thorough bond between the screed and the base slab. The surface shall be finished with a wood float and followed by a steel trowel to a smooth finish.

12.6.7. Unless otherwise specified or shown on the Drawings, joints in the screed shall be allowed and located over the main roof beams and shall be filled with approved bituminous compound as soon as possible.

12.6.8. After the screed has been placed, the full area shall be properly protected and cured for a period of at least seven (7) days. Alternatively, as soon as

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the screed has sufficiently hardened to withstand a man's weight without marking, an approved plastic sealing agent shall be sprayed in accordance with the manufacturer's recommendation.

12.7. Drips

Unless otherwise shown on the Drawings or directed by the S.O., a 15mm wide drip shall be formed along edges of soffits to concrete roof slabs, hoods, undersides of balconies, cantilevered beams and slabs and other parts of building where rainwater is likely to adhere in drops.

12.8. Refuse Chutes

Where shown on the Drawings, all cast-in-situ reinforced concrete refuse chutes shall be constructed without bolt holes made through the chute walls. If such holes are unavoidable then they shall be completely grouted with cement mortar as specified in sub-section 6.2. or sealed and waterproofed by other means to prevent leakage to the approval of the S.O.. Frames which shall not be of asbestos cement, shall be cast into refuse chute walls for fixing chute hoppers. Such frames shall be obtained from the same supplier of chute hoppers.

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Table D1. Cement and Combination Types[a]

Broad Designation[b]	Composition	Comprises cement and combination types (see Table D2)
CEM I	Portland cement	CEM I
CEM I-SR 0 CEM I-SR 3	Sulphate-resisting Portland cement	CEM I-SR 0 CEM I-SR 3
IIA	Portland cement with 6 % to 20 % fly ash, ground granulated blastfurnace slag, limestone, or 6 % to 10 % silica fume[c]	CEM II/A-L, CIIA-L, CEM II/A-LL, , CIIA-LL, CEM II/A-S, CIIA-S, CEM II/A-V, CIIA-V, CEM II/A-D
IIB-S	Portland cement with 21 % to 35 % ground granulated blastfurnace slag	CEM II/B-S, CIIB-S
IIB-V	Portland cement with 21 % to 35 % fly ash	CEM II/B-V, CIIB-V
IIB+SR	Portland cement with 25 % to 35 % fly ash	CEM II/B-V + SR, CIIB-V + SR
IIIA[d]	Portland cement with 36 % to 65 % ground granulated blastfurnace slag	CEM III/A, CIIIA
IIIA + SR	Portland cement with 36 % to 65 % ground granulated blastfurnace slag with additional requirements that enhance sulphate resistance	CEM III/A + SR[e], CIIIA + SR[e]
IIIB[f]	Portland cement with 66 % to 80 % ground granulated blastfurnace slag	CEM III/B, CIIIB
IIIB+ SR	Portland cement with 66 % to 80 % ground granulated blastfurnace slag with additional requirements that enhance sulphate resistance	CEM III/B + SR[e], CIIIB + SR[e]
IVB-V[g]	Portland cement with 36 % to 55 % fly ash	CEM IV/B-V, CIVB-V

Notes:

[a] There are a number of cements and combinations not listed in this table that may be specified for certain specialist applications. See BRE Special Digest 1 [1] for the sulphate-resisting characteristics of other cements and combinations. See IP 17/05 [5] for the use of high ggbs content cements and combinations in secant piling applications.

[b] The use of these broad designations is sufficient for most applications. Where a more limited range of cement or combinations types is required, select from the notations given in **TABLE D2.**

[c] When IIA or IIA-D is specified, CEM I and silica fume may be combined in the concrete mixer using the *k*-value concept; see MS EN 206:2016, 5.2.5.2.3.

[d] Where IIIA is specified, IIIA+SR may be used.

[e] "+SR" indicates additional restrictions on the chemical composition of cement or ggbs related to sulphate resistance. See **TABLE D2**, footnote d.

[f] Where IIIB is specified, IIIB+SR may be used.

[g] IVA cements and combinations with a siliceous fly ash should be classified as II-V.

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Table D2. General Purpose Cements and Combinations

Type	Notation	Standard	Broad designation	Grouping used in BRE SD1: 2005 [4]
Portland cement	CEM I	MS EN 197-1	CEM I	A
Portland silica fume cement[a]	CEM II/A-D	MS EN 197-1	IIA	A
Portland limestone cement	CEM II/A-L CEM II/A-LL	MS EN 197-1 MS EN 197-1	IIA IIA	B[b] or C[b] B[b] or C[b]
Portland slag cements	CEM II/A-S CEM II/B-S	MS EN 197-1 MS EN 197-1	IIA IIB-S	A A
Portland fly ash cements	CEM II/A-V CEM II/B-V CEM II/B- V+SR[c]	MS EN 197-1 MS EN 197-1 MS EN 197-1	IIA IIB-V IIB+SR	A A D
Blastfurnace cements	CEM III/A CEM III/A+SR[d] CEM III/B CEM III/B+SR[d]	MS EN 197-1 MS EN 197-1	IIIA IIIA+SR IIIB IIIB+SR	A D A F
Pozzolanic cement[e]	CEM IV/B(V)	MS EN 197-1 or BS EN 14216	IVB-V	E
Sulphate-resisting Portland cement	CEM I-SR 0 CEM I-SR 3	MS EN 197-1	CEM I-SR 0 CEM I-SR 3	G
Combinations conforming to Annex B manufactured in the concrete mixer from Portland cement and fly ash, ggbs or limestone fines:				
CEM I cement conforming to MS EN 197-1 with a mass fraction of 6 % to 20 % of combination of fly ash conforming to MS EN 450- 1	CIIA-V	Annex B MS 523-3	IIA	A
CEM I cement conforming to MS EN 197-1 with a mass fraction of 21 % to 35 % of combination of fly ash conforming to MS EN 450- 1	CIIB-V CIIB-V+SR[c]	Annex B MS 523-3	IIB-V IIB+SR	A D
CEM I cement conforming to MS EN 197-1 with a mass fraction of 36 % to 55 % of combination of fly ash conforming to MS EN 450- 1	CIVB-V	Annex B MS 523-3	IVB-V	E
CEM I cement conforming to MS EN 197-1 with a mass fraction of 6 % to 20 % of combination of ggbs conforming to MS EN 15167-1	CIIA-S	Annex B MS 523-3	IIA	A
CEM I cement conforming to MS EN 197-1 with a mass fraction of 21 % to 35 % of combination of ggbs conforming to MS EN 15167-1	CIIB-S	Annex B MS 523-3	IIB-S	A
CEM I cement conforming to MS EN 197-1 with a mass fraction of 36 % to 65 % of combination of ggbs conforming to MS EN 15167-1	CIIIA CIIIA+SR[d]	Annex B MS 523-3	IIIA IIIA+SR	A D

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Table D2. General Purpose Cements and Combinations

(continued)

Type	Notation	Standard	Broad designation	Grouping used in BRE SD1: 2005 [4]
CEM I cement conforming to MS EN 197-1 with a mass fraction of 66 % to 80 % of combination of ggbs conforming to MS EN 15167-1	CIIIB CIIIB+SR[d]	Annex B MS 523-3	IIIB IIIB+SR	A F
CEM I cement conforming to MS EN 197-1 with a mass fraction of 6 % to 20 % of combination of limestone fines conforming to MS 2653	CIIA-L CIIA-LL	Annex B MS 523-3	IIA IIA	B[b] or C[b] B[b] or C[b]

Notes:

[a] When IIA or IIA-D is specified, CEM I and silica fume may be combined in the concrete mixer using the *k*-value concept; see MS EN 206:2016, 5.2.5.2.3

[b] The classification is B if the cement or combination strength is class 42.5 or higher and C if it is class 32.5.

[c] With a minimum proportion of fly ash of 25 %.

[d] Where the alumina content of the slag exceeds 14 %, the tricalcium aluminate content of the Portland cement fraction shall not exceed 10 %.

[e] CEM IV/A cement with siliceous fly ash should be classified as either CEM II/A-V (6 % to 20 % siliceous fly ash) or CEM II/B-V (21 % to 35 % siliceous fly ash).

Table D3. Testing of Aggregates

Properties	Type of Aggregate	Test Methods	Limits
Grading	Both	MS30	Table D4 and Table D5
Elongation Index	Coarse	MS30	Not exceeding 30%
Flakiness Index	Coarse	MS30	Not exceeding 35%
Water Absorption	Both	MS30	Not exceeding 8%
Clay Lumps	Coarse	MS30	Not exceeding 1% by weight
Clay, Silt and Dust	Fine	MS30	Not exceeding 3% by weight or 8% by vol.
Organic Impurities	Fine	MS30	Not exceeding 0.4%
Aggregate Crushing Value	Coarse	MS30	Not exceeding 40%
Soundness Test	Coarse	MS30	Loss in mass after 5 cycles shall not be more than 12% for sodium sulphate or 18% for magnesium sulphate.
Chloride Content	Both	MS30	Not exceeding 0.06% by weight of chloride ions
Sulphate Content	Both	MS30	Not exceeding 0.44% by weight of SO3

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Table D4. Grading for Coarse Aggregate

Sieve size (BS410)	Percentage by mass passing BS 410 sieve for nominal sizes					
	Graded Aggregates			Single-sized Aggregate		
	40 mm to 5 mm	20 mm to 5 mm	14 mm to 5 mm	40 mm	20 mm	10 mm
50.0 mm	100	-	-	100	-	-
37.5 mm	90 to 100	100	-	85 to 100	100	-
20.0 mm	35 to 70	90 to 100	100	0 to 25	85 to 100	-
14.0 mm	25 to 55	40 to 80	90 to 100	-	0 to 70	100
10.0 mm	10 to 40	30 to 60	50 to 85	0 to 5	0 to 25	85 to 100
5.0 mm	0 to 5	0 to 10	0 to 10	-	0 to 5	0 to 25
2.36 mm	-	-	-	-	-	0 to 5

Table D5. Grading for Fine Aggregate

Sieve size (BS410)	Percentage by mass passing BS 410 sieve			
	Overall Limits	Additional limits for grading		
		C	** M	F
10.0 mm	100	-	-	-
5.0 mm	80 to 100	-	-	-
2.36 mm	60 to 100	60 to 100	65 to 100	80 to 100
1.18 mm	30 to 100	30 to 90	45 to 100	70 to 100
600 µm	15 to 100	15 to 45	25 to 80	55 to 100
300 µm	5 to 70	5 to 40	5 to 48	5 to 70
150 µm	0 to 15*	-	-	-

Notes:

* Increase to 20% for crushed rock fines, except when they are used for heavy-duty floors.
** For prescribed concrete only Grading Limit M is applicable.

Individual sands may comply with the requirements of more than one grading. Alternatively, some sands which satisfy the overall limits but may not fall within any one of the additional limit C, M or F may also be used provided that the supplier can satisfy the S.O that such materials can produce concrete of the required quality.

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Table D6. Admixtures Acceptance Test Requirements

Categories of Admixture	Water Reduction	Stiffening Time Time from completion of mixing to reach a resistance to penetration of:-			Minimum Strength as a percentage of the control mix	Age	Length change, Maximum shrinkage	
		0.5N /mm²	3.5N /mm²	27.5 /mm²	Compressive		% of control	Increase
Type 1: Accelerator	-	More than 1hr.	Within 1hr.and 3hrs. earlier than control mix	At least 1hr. earlier than control mix	125 125 100 100	24 hrs. 3 days 7 days 28 days	135	0.010
Type 2: Retarder	-	At least 1hr.later than control mix	Within 1hr.and 3hrs. later than control mix	Not more than 3hrs. later than control mix	90 90 95	3 days 7 days 28 days	135	0.010
Type 3: Normal water-reducing	At least 5%	Within + 1hr. and - 1hr.of control mix	Within + 1hr. and - 1hr.of control mix	Within + 1hr. and - 1hr.of control mix	110 110 110	3 days 7 days 28 days	135	0.010
Type 4: Accelerating water-reducing	At least 5%	More than 1hr.	Within 1hr.and 3hrs. earlier than control mix	At least 1hr. earlier than control mix	125 125 100 100	24 hrs. 3 days 7 days 28 days	135	0.010
Type 5: Retarding water-reducing	At least 5%	At least 1hr.later than control mix	Within 1hr.and 3hrs. earlier than control mix	Not more than 3hrs. later than control mix	110 110 110	3 days 7 days 28 days	135	0.010

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Table D7. Prescribed Mixes for General Use Per Cubic Meter of Concrete by Weight Batching

Grade of Concrete	28-day Strength of Concrete (N/mm²)	Nominal Maximum Size of Aggregate 20 (mm)			Max free water: cement ratio
		Workability	Medium	High	
		Consistence	25-75	75-125	
15P	15	CEM I (kg) Total aggregate(kg) *Fine aggregate (%)	280 1800 35-50	310 1750 35 - 50	0.60
20P	20	CEM I (kg) Total aggregate(kg) *Fine aggregate (%)	320 1800 25-40	350 1750 20 - 45	0.55
25P	25	CEM I (kg) Total aggregate(kg) *Fine aggregate (%)	360 1750 25-40	390 1700 30 - 45	0.50
30P	30	CEM I (kg) Total aggregate(kg) *Fine aggregate (%)	400 1700 25-40	430 1650 30 – 45	0.45

Note:
*Fine aggregate is crushed aggregate and is expressed as a percentage by weight to the total weight of the dry aggregate

Table D8. Proportions and Strength Requirements for Prescribed Mixes by Volume Batching

Proportion (Grade)	Slump Limits (mm)	Cubic Meters of Aggregate Per 50 kg of CEM I		Max. Free Water: Cement Ratio	Quantity Of Water (Litres)	Strength of Concrete	
		Fine	Coarse (20mm)			At 7 Days (N/mm²)	At 28 Days (N/mm²)
1:1:2(30P)	25 - 50	0.035	0.07	0.45	22.5	20	30
1:1.5:3(25P)	25 - 50	0.05	0.1	0.5	25	17	25
1:2:4(20P)	25 - 50	0.07	0.14	0.55 - 0.6	27.5 - 30	14	20
1:3:6(15P)	25 - 50	0.10	0.20	0.6	30*	11	15

Note:
* or as approved by S.O.

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Table D9. Durability Recommendations for Reinforced or Prestressed Elements of Structures with an Intended Working Life of at Least 50 Years

Nominal cover, (mm)	Compressive strength class, maximum w/c ratio and minimum cement or combination content for normal weight concrete with 20 mm maximum aggregate size											Cement/ combination types
	15 + Δc	20 + Δc	25 + Δc	30 + Δc	35 + Δc	40 + Δc	45 + Δc	50 + Δc	60 + Δc	70 + Δc	80 + Δc	
Corrosion induced by carbonation (XC exposure classes)												
XC1	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	All in Table D1
XC2	-	-	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	All in Table D1
XC3/4	-	C40/50 0.45 340	C32/40 0.55 300	C28/35 0.60 280	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	All in Table D1 except IVB-V
	-	-	C40/50 0.45 340	C32/40 0.55 300	C28/35 0.60 280	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	IVB-V
Corrosion induced by chlorides other than seawater (XD exposure classes) adequate for any associated carbonation induced corrosion (XC)												
XD1	-	-	C40/50 0.45 360	C32/40 0.55 320	C28/35 0.60 300	C28/35 0.60 300	C28/35 0.60 300	C28/35 0.60 300	C28/35 0.60 300	C28/35 0.60 300	C28/35 0.60 300	All in Table D1
XD2	-	-	-	C40/50 0.40 380	C32/40 0.50 340	C28/35 0.55 320	C28/35 0.55 320	C28/35 0.55 320	C28/35 0.55 320	C28/35 0.55 320	C28/35 0.55 320	CEM I, IIA, IIB-S, CEM I-SR0, CEM I-SR3
	-	-	-	C35/45 0.40 380	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	IIB-V, IIIA
	-	-	-	C32/40 0.40 380	C25/30 0.50 340	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	IIIB, IVB-V
XD3	-	-	-	-	-	C45/55 0.35 380	C40/50 0.40 380	C35/45 0.45 360	C35/45 0.45 360	C35/45 0.45 360	C35/45 0.45 360	CEM I, IIA, IIB-S CEM I-SR0, CEM I-SR3
	-	-	-	-	-	C35/45 0.40 380	C32/40 0.45 360	C28/35 0.50 340	C28/35 0.50 340	C28/35 0.50 340	C28/35 0.50 340	IIB-V, IIIA
	-	-	-	-	-	C32/40 0.40 380	C28/35 0.45 360	C25/30 0.50 340	C25/30 0.50 340	C25/30 0.50 340	C25/30 0.50 340	IIIB, IVB-V

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Table D9. Durability Recommendations for Reinforced or Prestressed Elements of Structures with an Intended Working Life of at Least 50 Years.

(continued)

Nominal cover (mm)	Compressive strength class, maximum w/c ratio and minimum cement or combination content for normal-weight concrete with 20 mm maximum aggregate size											Cement/ Combination types
	30 +Δc	35 +Δc	40 +Δc	45 +Δc	50 +Δc	55 + Δc	60 +Δc	65 + Δc	70 +Δc	75 + Δc	80 +Δc	
Corrosion induced by chlorides from seawater (XS exposure classes) adequate for any associated carbonation induced corrosion (XC)												
XS1	-	-	-	C45/55 0.35 380	C40/50 0.40 360	C35/45 0.45 360	C32/40 0.50 340	C28/35 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	CEM I, IIA, IIB-S
	C40/50 0.35 380	C32/40 0.45 360	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	IIB-V, IIIA
	C35/45 0.40 380	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	IIB-V ≥ 25 % fly ash, IIIA ≥ 46 % ggbs
	C32/40 0.40 380	C25/30 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	IV-B, IIIB
XS2	-	-	-	-	-	-	C45/55 0.35 380	C40/50 0.40 380	C40/50 0.40 380	C35/45 0.45 360	C32/40 0.50 340	CEM I, IIA, IIB-S
	-	-	C35/45 0.35 380	C32/40 0.45 360	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	IIB-V, IIIA
	-	C40/50 0.35 380	C32/40 0.45 360	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	IIB-V ≥ 25 % fly ash, IIIA ≥ 46 % ggbs
	-	C35/45 0.35 380	C28/35 0.45 360	C25/30 0.50 340	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	IV-B, IIIB
XS3	-	-	-	-	-	-	-	-	-	-	C45/50 0.35 380	CEM I, IIA, IIB-S
	-	-	-	-	C40/50 0.35 380	C35/45 0.45 380	C32/40 0.45 360	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	IIB-V, IIIA
	-	-	-	C40/50 0.35 380	C32/40 0.45 360	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C20/25 0.55 320	IIB-V ≥ 25 % fly ash, IIIA ≥ 46 % ggbs
	-	-	-	C35/45 0.35 380	C28/35 0.45 360	C25/30 0.50 340	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	IV-B, IIIB

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Table D10. Durability Recommendations for Reinforced or Prestressed Elements of Structures with an Intended Life of at Least 100 Years

Nominal cover (mm)	Compressive strength class, maximum w/c ratio and minimum cement or combination content for normal-weight concrete with 20 mm maximum aggregate size											Cement/ combination types
	15 + Δc	20 + Δc	25 + Δc	30 + Δc	35 + Δc	40 + Δc	45 + Δc	50 + Δc	55 + Δc	60 + Δc	70 + Δc	80 + Δc	
Corrosion induced by carbonation (XC exposure classes)													
XC1	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	C20/25 0.70 240	All in Table D1
XC2	-	-	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	All in Table D1
XC3/4	-	-	-	C40/50 0.45 340	C35/45 0.50 320	C30/37 0.55 300	C28/35 0.60 280	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	All in Table D1 except IVB-V
	-	-	-	-	C40/50 0.45 340	C35/45 0.50 320	C30/37 0.55 300	C28/35 0.60 280	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	C25/30 0.65 260	IVB-V
Corrosion induced by chlorides other than seawater (XD exposure classes) adequate for associated carbonation induced corrosion (XC)													
XD1	-	-	-	C45/55 0.40 380	C40/50 0.45 360	C35/45 0.50 340	C32/40 0.55 320	C28/35 0.60 300	C28/35 0.60 300	C28/35 0.60 300	C28/35 0.60 300	C28/35 0.60 300	All in Table D1
XD2	-	-	-	-	-	C35/45 0.45 360	C32/40 0.50 340	C28/35 0.55 320	C28/35 0.55 320	C28/35 0.55 320	C28/35 0.55 320	C28/35 0.55 320	CEM I, IIA, IIB-S, CEM I-SR0, CEM I-SR3
	-	-	-	-	-	C32/40 0.45 360	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	IIB-V, IIIA
	-	-	-	-	-	C28/35 0.45 360	C25/30 0.50 340	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	IIIB, IVB-V
XD3	-	-	-	-	-	-	-	-	C45/55 0.35 380	C40/50 0.40 380	C35/45 0.45 360	C35/45 0.45 360	CEM I, IIA, IIB-S CEM I-SR0, CEM I-SR3
	-	-	-	-	-	-	C40/50 0.35 380	C35/45 0.40 380	C32/40 0.45 360	C28/35 0.50 340	C25/30 0.50 320	C25/30 0.50 320	IIB-V, IIIA
	-	-	-	-	-	-	C32/40 0.40 380	C28/35 0.45 360	C25/30 0.50 340	C25/30 0.50 320	C25/30 0.55 320	C25/30 0.55 320	IIIB, IVB-V

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Table D10. Durability Recommendations for Reinforced or Prestressed Elements of Structures with an Intended Life of at Least 100 Years

(continued)

Nominal cover (mm)	Compressive strength class, maximum w/c ratio and minimum cement or combination content for normal weight concrete with 20 mm maximum aggregate size											Cement/ combination types
	30 +Δc	35 + Δc	40 +Δc	45 +Δc	50 + Δc	55 +Δc	60+Δc	65 +Δc	70 +Δc	75 +Δc	80 +Δc	
Corrosion induced by chlorides from seawater (XS exposure classes) adequate for associated carbonation induced corrosion (XC)												
XS1	-	-	-	-	-	-	-	C45/55 0.35 380	C40/50 0.40 380	C35/45 0.45 360	C32/40 0.50 340	CEM I, IIA, IIB-S
	-	C40/50 0.35 380	C40/50 0.35 380	C35/45 0.45 380	C32/40 0.45 360	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	IIB-V, IIIA
	-	-	C35/45 0.40 380	C32/40 0.45 360	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	IIB-V ≥ 25 % fly ash, IIIA ≥ 46 % ggbs
	-	-	C32/40 0.45 380	C28/35 0.45 360	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	
	-	-	C35/45 0.40 380	C30/37 0.45 360	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	IVB-V
XS2	-	-	-	-	-	-	-	-	-	-	-	CEM I, IIA, IIB-S
	-	-	-		C40/50 0.35 380	C35/45 0.40 380	C32/40 0.45 360	C28/35 0.50 340	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	IIB-V, IIIA
				C40/50 0.35 380	C35/45 0.40 380	C32/40 0.40 360	C28/35 0.50 340	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	C25/30 0.55 320	IIB-V ≥ 25 % fly ash, IIIA ≥ 46 % ggbs
				C35/45 0.35 380	C32/40 0.40 380	C28/35 0.45 360	C25/30 0.50 340	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	C20/25 0.55 320	IVB-V, IIIB
XS3	-	-	-	-	-	-	-	-	-	-	-	CEM I, IIA, IIB-S
	-	-	-	-	-	-	C40/50 0.35 380	C40/50 0.35 380	C35/45 0.40 380	C32/40 0.45 360	C28/35 0.50 340	IIB-V, IIIA
	-	-	-	-	-	-	C40/50 0.35 380	C35/45 0.40 380	C32/40 0.40 360	C25/30 0.55 320	C25/30 0.55 320	IIB-V ≥ 25 % fly ash, IIIA ≥ 46 % ggbs
	-	-	-	-	-	-	C35/45 0.35 380	C32/40 0.40 380	C28/35 0.45 360	C20/25 0.55 320	C20/25 0.55 320	IVB-V, IIIB

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Table D11. Minimum Cement and Combination Contents with Maximum Aggregate Sizes Other Than 20MM

Limiting values given for 20 mm maximum aggregate size		Maximum aggregate size		
Maximum w/c ratio	Minimum cement or combination content (kg/m^3)	≥ 40mm	14mm	10mm
0.70	240	240	260	280
0.65	260	240	280	300
0.60	300	280	320	340
0.60	280	260	300	320
0.55	300	280	320	340
	320	300	340	360
0.50	320	300	340	360
	340	320	360	380
0.45	340	320	360	360
	360	340	380	380
0.40	380	360	380	380
0.35	380	380	380	380

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Table D12. Exposure Classes

Class designation	Class description	Informative examples applicable in Malaysia
Corrosion induced by carbonation (XC classes) *(where concrete containing reinforcement or other embedded metal is exposed to air and moisture)*		
XC1	Dry or permanently wet	Reinforced and prestressed concrete surfaces inside enclosed structures except voided superstructures and areas of structures with high humidity Reinforced and prestressed concrete surfaces permanently submerged in non-aggressive water
XC2	Wet, rarely dry	Reinforced and prestressed concrete surfaces permanently in contact with soil not containing chlorides
XC3 and XC4 (XC3/4)	Moderate humidity or cyclic wet and dry	External reinforced and prestressed concrete surfaces sheltered from, or exposed to, direct rain Reinforced and prestressed concrete surfaces subject to high humidity (e.g. poorly ventilated bathrooms, kitchens) Reinforced and prestressed concrete surfaces exposed to alternate wetting and drying Interior concrete surfaces of pedestrian subways not subject to de-icing salts, voided superstructures or cellular abutments Reinforced or prestressed concrete surfaces protected by waterproofing
Corrosion induced by chlorides other than from seawater (XD classes) *(where concrete containing reinforcement or other embedded metal is subject to contact with water containing chlorides, including de-icing salts, from sources other than from seawater)*		
XD1	Moderate humidity	Concrete surfaces exposed to airborne chlorides Reinforced and prestressed concrete wall and structure supports more than 10 m horizontally from a carriageway Bridge deck soffits more than 5 m vertically above the carriageway Parts of structures exposed to occasional or slight chloride conditions
XD2	Wet, rarely dry	Reinforced and prestressed concrete surfaces totally immersed in water containing chlorides Buried highway structures more than 1 m below adjacent carriageway
XD3	Cyclic wet and dry	Reinforced and prestressed concrete walls and structure supports within 10 m of a carriageway Bridge parapet edge beams Buried highway structures less than 1 m below carriageway level Reinforced pavements and car park slabs
Corrosion induced by chlorides from seawater (XS classes) *(where concrete containing reinforcement or other embedded metal is subject to contact with Seawater or airborne salt originating from seawater)*		
XS1	Exposed to airborne salt but not in direct contact with seawater	External reinforced and prestressed concrete surfaces in coastal areas
XS2	Permanently submerged	Reinforced and prestressed concrete surfaces completely submerged and remaining saturated, e.g. concrete below mid-tide level
XS3	Tidal, splash and spray zones	Reinforced and prestressed concrete surfaces in the upper tidal zones and the splash and spray zones , including exposed soffits above seawater

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Table D13. Slump Classes

Class	Slump in mm
S1	10 to 40
S2	50 to 90
S3	100 to 150
S4	160 to 210
S5	≥ 220

Table D14. Compaction Classes

Class	Degree of Compactibility
C0	≥ 1.46
C1	1.45 to 1.26
C2	1.25 to 1.11
C3	1.10 to 1.04

Table D15. Vebe Classes

Class	Vebe Time In Seconds
V0	≥31
V1	30 to 21
V2	20 to 11
V3	10 to 6
V4	5 to 3

Table D16. Flow Classes

Class	Flow Diameter In mm
F1	≤ 340
F2	350 to 410
F3	420 to 480
F4	490 to 550
F5	560 to 620
F6	≥ 630

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Table D17. Consistence Suitable for Different Uses of In-Situ Concrete

Use of concrete	Form of compaction	Consistence class	
		Normal-weight concrete	Lightweight concrete
Cement-bound for reinstatement or base	Tamping, vibrotamper, vibrating plate or roller, roller-compaction	-	-
Kerb bedding and braking	Tamping	S1	-
Floors and hand placed pavements	Poker or beam vibration	S3	S2
Large or industrial floors		S3	S3
Machine placed pavements	Poker or beam vibration	S3	-
Strip footings	Poker or beam vibration and/or tamping	S4	-
Mass concrete foundations		S3	-
Blinding		S3	-
Normal reinforced concrete in slabs, beams, walls and columns		S3	S3
Sliding formwork construction		S2	S2
Pumped concrete		S3	F5
Vacuum processed concrete		S3	S3
Trench fill	Self-weight compaction	S4	-
In-situ piling		S4	-
Self-compacting concrete for applications such as congested reinforcement or intricate formwork	Self-weight compaction	SF2	SF2

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Table D 18. Maximum Total Chloride

Concrete Use	Chloride Content Class[a]	Maximum Cl- Content by Mass of Cement[b] %
Not containing steel reinforcement or other embedded metal with the exception of corrosion-resisting lifting devices	CL 1.00	1.00
Containing steel reinforcement or other embedded metal	CL 0.20	0.20
	CL 0.40[c]	0.40
Containing prestressing steel reinforcement in direct contact with concrete	CL 0.10	0.10
	CL 0.20	0.20

Notes:
[a] For a specific concrete use, the class to be applied depends upon the provisions valid in the place of use of the concrete.
[b] Where additions are used and are taken into account for the cement content, the chloride content is expressed as the percentage chloride ion by mass of cement plus total mass off additions that are taken into account.
[c] Different chloride content classes may be permitted for concrete containing CEM iii-cements according to provisions valid in the place of use.

Table D19. Compressive Strength Classes for Designed Concrete Normal Weight and Heavy Weight Concrete

Compressive strength class	Minimum characteristic cylinder strength $f_{ck,cyl}$ N/mm²	Minimum characteristic cube strength $f_{ck,CUBE}$ N/mm²
C6/8	6	8
C8/10	8	10
C12/15	12	15
C16/20	16	20
C20/25	20	25
C25/30	25	30
C28/35	28	35
C30/37	30	37
C32/40	32	40
C35/45	35	45
C40/50	40	50
C45/55	45	55
C50/60	50	60
C55/67	55	67
C60/75	60	75
C70/85	70	85
C80/95	80	95
C90/105	90	105
C100/115	100	115

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Table D20. Compressive Strength Classes for Light Weight Concrete

Compressive strength class	Minimum characteristic cylinder strength $f_{ck,cyl}$ N/mm²	Minimum characteristic cube strength $f_{ck,CUBE}$ N/mm²
LC8/9	8	9
LC12/13	12	13
LC16/18	16	18
LC20/22	20	22
LC25/28	25	28
LC28/31	28	31
LC30/33	30	33
LC32/35	32	35
LC35/38	35	38
LC40/44	40	44
LC45/50	45	50
LC50/55	50	55
LC55/60	55	60
LC60/66	60	66
LC70/77	70	77
LC80/88	80	88

Table D21. Minimum Rate of Sampling for Assessing Conformity

Production	Minimum rate of sampling for assessing conformity		
	First 50m³ of production	Subsequent to first 50m³ of production*	
		Concrete with production control certification	Concrete without production control certification
Initial (until at least 35 test results are recorded)	3 samples	1 per 200m³ or 1 per 3 production days	1 per 150m³ or 1 per production day
Continuous** (when at least 35 test results are recorded)		1 per 400m³ or 1 per 5 production days	

Notes:

* Sampling shall be distributed throughout the production and should not be more than 1 sample within each 25 m³

** Where the standard deviation of the last 15 results exceeds 1.37σ, the sampling rate shall be increased to that required for initial production for the next 35 test results

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Table D22. Conformity Criteria for Compressive Strength

Production	Number *n* of test results for compressive strength in the group	Criterion 1	Criterion 2
		Mean of n results (f_{cm}) N/mm²	Any individual test result (f_{ci}) N/mm²
Initial	3	$\geq f_{ck}+4$	$\geq f_{ck}-4$
Continuous	15	$\geq f_{ck}+1.48\sigma$	$\geq f_{ck}-4$

Table D23. Compressive Strength Requirements for Prescribed Mix

Grades of Concrete	28-day Strength of Concrete N/mm²	Cube Strength at 7 Days* N/mm²	Average Cube Strength at 28 Days* N/mm²
15P	15.0	11	15.0
20P	20.0	14	20.0
25P	25.0	17	25.0
30P	30.0	20	30.0

Note:

* Only for CEM1

Table D24. Sampling Rate for Identity Testing

Type of Structure	Minimum volume per sample	Maximum volume per sample
Prestressed concrete, masts, cantilevers, columns, pile caps	10.0 m³	50.0 m³ Or every group of 5 batches
Footing, shear wall and retaining wall, slabs, beams, raft foundation	20.0 m³	100.0 m³ Or every group of 10 batches
Mass concrete	50.0 m³	250.0 m³ Or every group of 25 batches

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Table D25. Identity Criteria for Compressive Strength of Certified Concrete

Number n of test results for compressive strength from the defined volume of concrete	Criterion 1	Criterion2
	Mean of n results (f_{cm}) N/mm²	Any individual test result (f_{ci}) N/mm²
1	Not applicable	$\geq f_{ck} - 4$
2-4	$\geq f_{ck} + 1$	$\geq f_{ck} - 4$
5-6	$\geq f_{ck} + 2$	$\geq f_{ck} - 4$

Note:
The identity criteria give probability that a conforming concrete volume is rejected.

Table D26. Identity Criteria for Compressive Strength of Non Certified Concrete

Number n of test results for compressive strength from the defined volume of concrete	Criterion 1	Criterion 2
	Mean of n results (f_{cm}) N/mm²	Any individual test result (f_{ci}) N/mm²
3	$> f_{ck} + 4$	$> f_{ck} - 4$

Table D27. Identity Criteria for Slump Specified as A Slump Class

Dimension in millimetres

Specified slump class	Requirement			
	For composite samples taken in accordance with MS 26-1-1		For spot samples taken from initial discharge	
	Not less than	Not more than	Not less than	Not more than
S1	0	50	0	60
S2	40	100	30	110
S3	90	160	80	170
S4	150	220	140	230
S5*	210	-	200	-

Note:
* Due to a lack of sensitivity of the slump test at slump values less than 10mm or greater than 210mm, it is recommended to only use the test for slump ≥ 10mm and ≤ 210mm.

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Table D28. Identity Criteria for Slump Specified as A Target Value

Dimension in millimetres

Specified target slump	Tolerance			
	For composite samples taken in accordance with MS 26-1-1		For spot samples taken from initial discharge	
	Not less than	Not more than	Not less than	Not more than
≤ 40	-10	+10	-20	+20
50 to 90	-20	+20	-30	+30
≥ 100*	-30	+30	-40	+40

Note:
* Due to a lack of sensitivity of the slump test at slump values less than 10mm or greater than 210mm, it is recommended to only use the test for slump ≥ 10mm and ≤ 210mm.

Table D29. Identity Criteria for Flow Specified as a Flow Class

Dimension in millimetres

Specified flow class	Requirement			
	For composite samples taken in accordance with MS 26-1-1		For spot samples taken from initial discharge	
	Not less than	Not more than	Not less than	Not more than
F1*	-	350	-	360
F2	340	420	330	430
F3	410	490	400	500
F4	480	560	470	570
F5	550	630	540	640
F6*	620	-	610	-

Note:
* Due to a lack of sensitivity of the slump test at slump values less than 340mm and less, or greater than 62 mm, it is recommended to only use the test for flow diameter > 340mm and ≤ 620mm.

Table D 30. Identity Criteria for Flow Specified as a Flow Value

Dimension in millimetres

Specified flow class	Requirement			
	For composite samples taken in accordance with MS 26-1-1		For spot samples taken from initial discharge	
	Not less than*	Not more than*	Not less than*	Not more than*
All values	-50	+50	-60	+60

Note:
* As permitted, these conformity criteria for target values of consistence take precedence over the values given in MS EN 206. The measured flow shall not differ from the specified target value by more than the amount shown.

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Table D31. Recorded Data and Other Documents, Where Relevant

Subject	Recorded data and other documents
Specified requirements	Contract specification or summary of requirements
Constituents	Name of suppliers, sources and declaration of performance
Tests on *mixing* water (not required for potable water)	Date and place of sampling Test results
Tests on constituents	Date and test results
Composition of concrete	Concrete description Record of masses of constituents in batch or load (e.g. cement content) Water/cement ratio Chloride content Code of family member
Tests on fresh concrete	Date and place of sampling Location in structure, if known Consistence (method used and results) Viscosity, if specified Segregation resistance, if specified Passing ability, if specified Density, if specified Fibre content, if specified Concrete temperature, if specified Air content, if specified Volume of concrete batch or load tested Number and codes of specimens to be tested Water/cement ratio, if specified
Tests on hardened concrate	Date of testing Code and ages of specimens Test results for density and strength Special remarks (e. g. unusual failure pattern of specimen)
Evaluation of conformity	Conformity/non-conformity with specifications of concrete
Additionally for ready-mixed concrete	Name of purchaser Location of work, e. g. the construction site Numbers and dates of delivery tickets related to tests Delivery tickets
Additionally for precast concrete	Additional or different data may be required by the relevant product standard

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Table D32. Characteristic Strength of Steel Reinforcement

Type	Nominal Sizes (mm)	Yield Strength, fy (N/mm²)
Steel Bar (MS 146)	All sizes	500
Steel Fabric (MS 145)	All sizes	500
Steel Wire (MS 144)	Up to and including 12	500
Cold Worked (BS 4461)	All sizes	460

Table D33. Minimum Periods Between Concreting and Removal of Forms

Vertical faces of beams, wall, columns, piles, foundation plinths and precast components	3 days
Slabs (props left under)	4 days
Removal of props to slab	10 days
Beam soffits (props left under)	8 days
Removal of props to beams	21 days

Note:
This table is applicable only for CEM1 cement. Where other types of cement, admixtures or additional material are to be used, the minimum periods between concreting and removal of forms shall be as approved by the S.O.

Table D34. Measurement Location and Sampling for Element

Element	Total Number of Element Per Stage (n_T)	No of Element To Be Measured	Surface	No. of Point
Column	<10	2	4 Sides	1 point at every 300mm height
	10≤ n_T ≤50	5		
	>50	5		
Beam	<10	2	2 Sides	3 points (2 point at support and 1 point at mid span)
	10≤ n_T ≤50	5		
	>50	5		
Footing	<10	2	2 Sides	1 point at every side
	10≤ n_T ≤50	5		
	>50	5		
Slab	One (1) point for every ten (10) m² (at bottom surface)			
Wall	One (1) point for every five (5) m²			

Note:
For surface that is contact with the ground, the test shall be done on top of the surface.

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Table D35. Recommended Minimum Concrete Strength for Lifting and Handling

Application	Minimum concrete strength $f_{c,cube}$
Lifting which involves significant impact or high acceleration	15N/mm²*
All units where concrete strength for lifting is specified in drawing	2/3 of required design concrete strength
Eccentrically pre-stresses elements (tees, deep flooring units)	25N/mm²

Notes:
* Dependent on anchor length or as recommended by insert manufacturer or otherwise specified

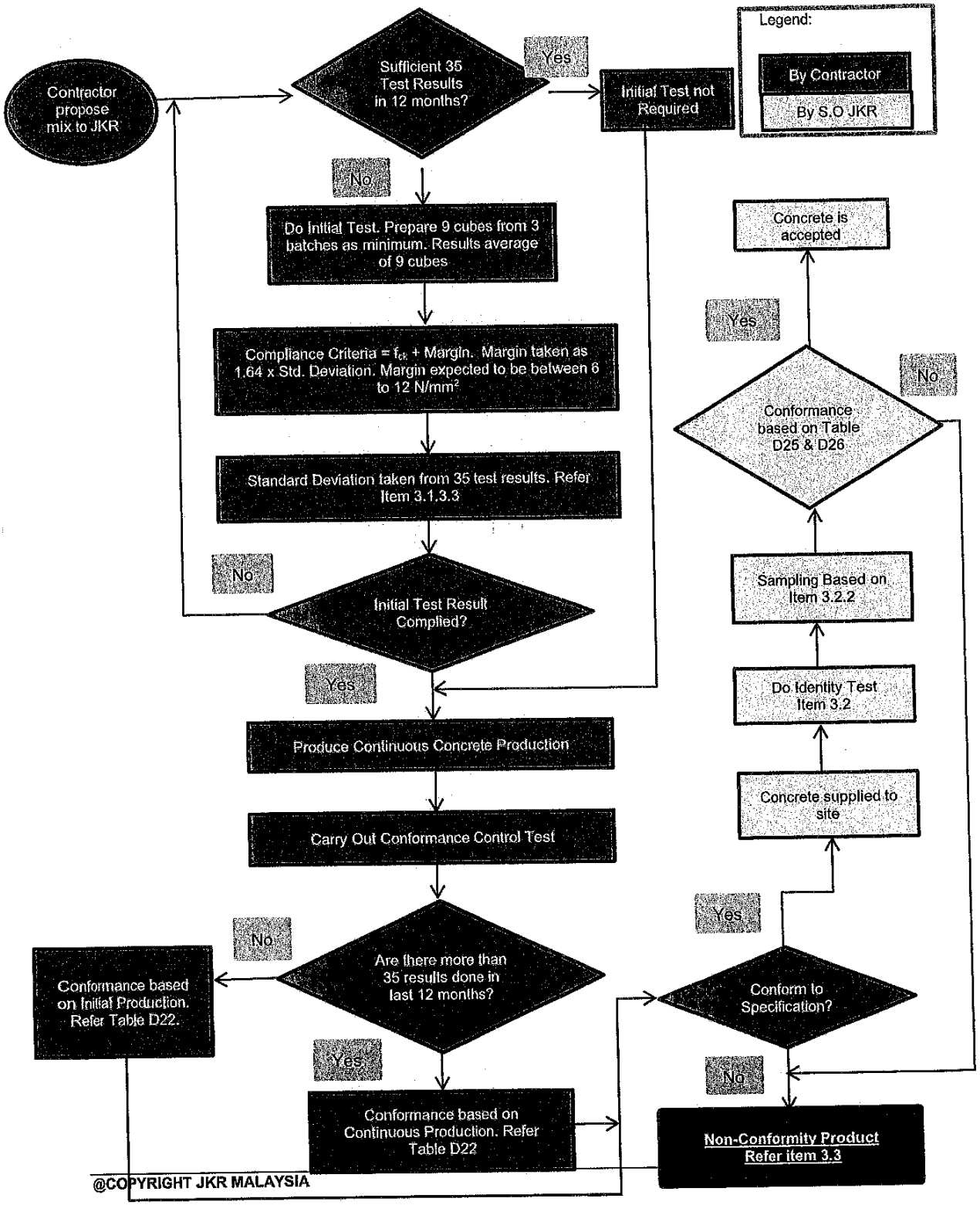
Special care shall be taken with pre-stressed elements to ensure lifting devices are anchored in compression zones, unless covered by specific design

Table D36. Recommended Corrugated Sleeve Diameter

Corrugated Sleeve Diameter (mm)	Dowel Bar Size (mm)
45	10, 12
55	16, 20, 25
65	25, 32
75	32

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Figure D1. Concrete Testing Flow Chart



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Figure D2. Slump Test Measurement

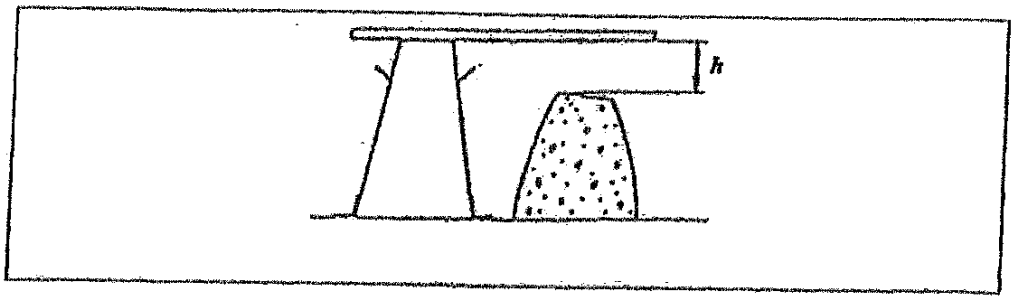
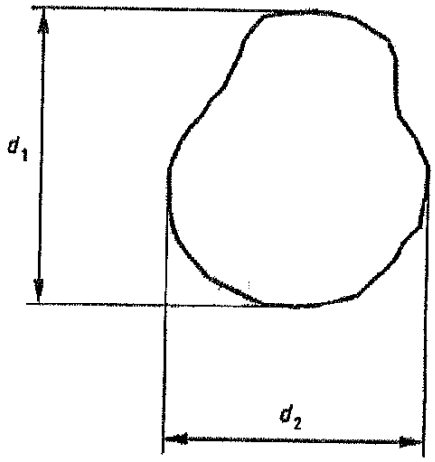


Figure D3. Flow Test measurement



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Figure D4. Qualitative Confirmation-Acceptance Limits for Measurement of Concrete Cover

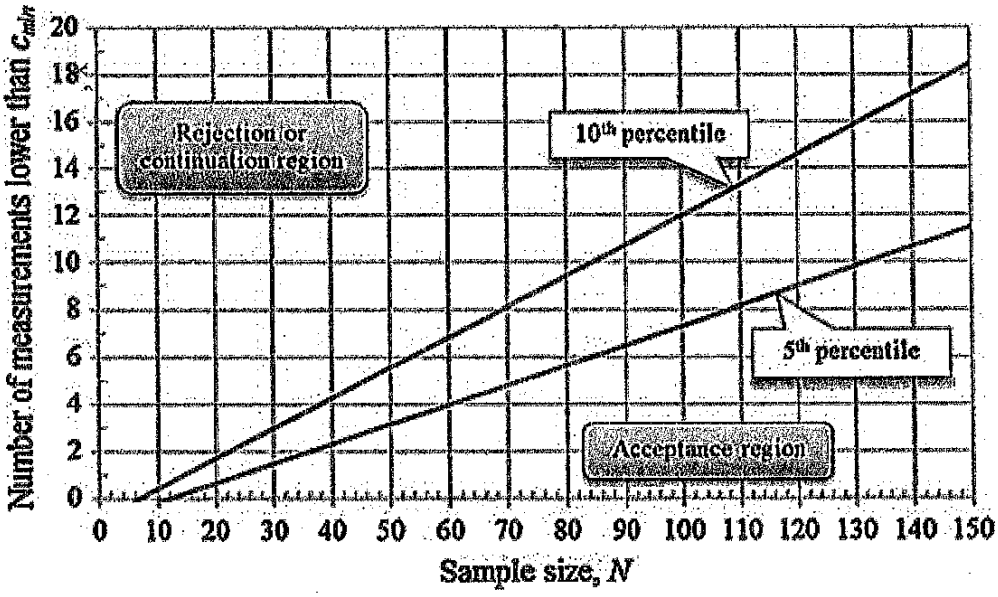
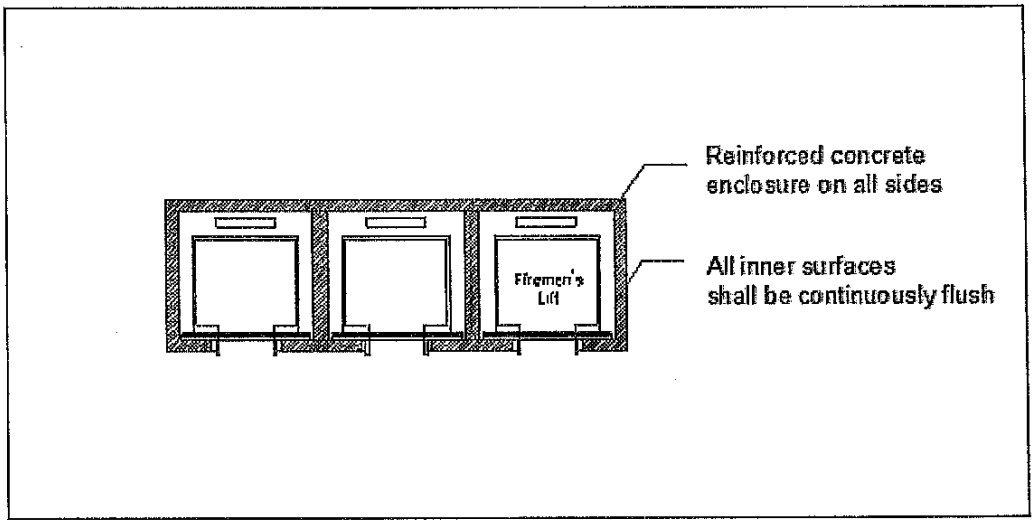


Figure D5. Lift Shaft Enclosure



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Figure D6. Limit of Accuracy of Shaft Plumb on All Sides of Shaft Enclosure

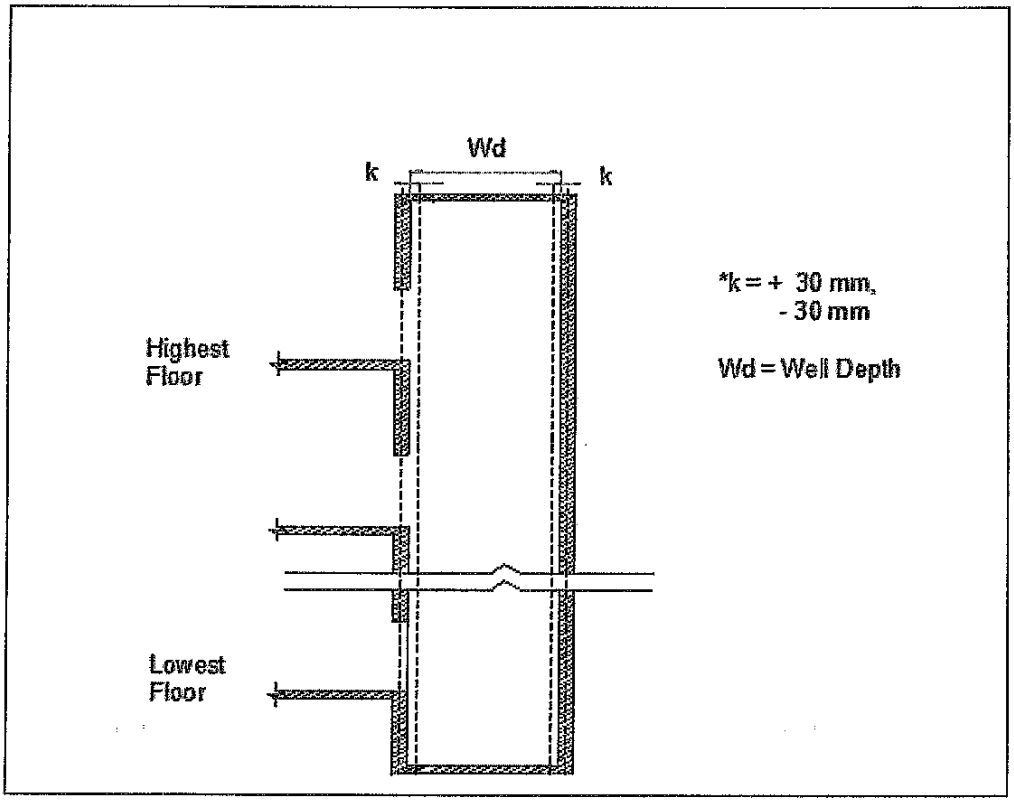
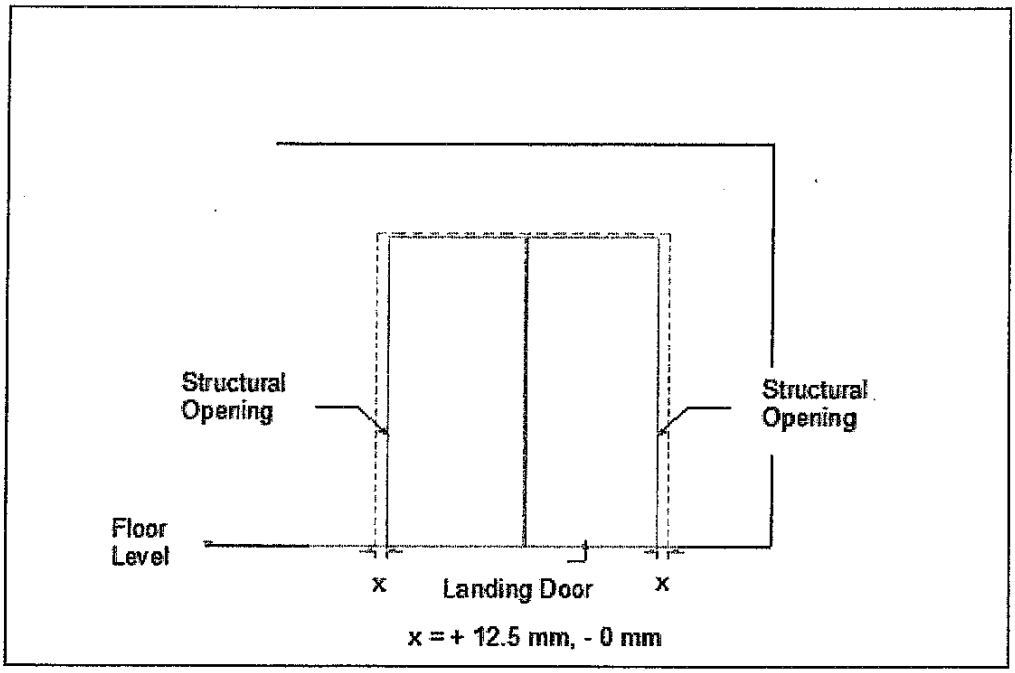


Figure D7. Accuracy of Structural Opening



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SPESIFIKASI
WALL SYSTEM

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1. General

1.1. Non-structural wall (NSW) system hereby refers to vertical building element designed as non-loadbearing internal wall which serve with functions as cited in Uniform Building By-Laws (UBBL), and not being a party wall inside a building.

1.2. Non-structural wall system shall refer to solid wall, lightweight drywall partition, pre-cast/pre-fabricated panels, etc.

1.3. Structural wall (SW) system hereby refers to vertical building element designed as loadbearing internal wall which serve with functions as cited in Uniform Building By-Laws (UBBL) and being a party wall inside a building.

1.4. Structural wall system shall refer to blockwork system stated in sub-section 4..

1.5. Unless otherwise specified, all non-structural walls or infill walls shall be constructed using proprietary blocks. Building materials considered for non-structural wall construction may refer to sub-section 2. below. Each material type shall comply with the respective standard or manufacturer's specification. Build-up or configuration of NSW shall be strictly based on recommendations or/and design by solution provider.

1.6. Unless otherwise specified, design considerations of NSW shall take into consideration the following functional features, any one or in combination, and comply with relevant parts of the current Building Code:

1.6.1. Structural stability. This includes consideration of external loadings, if any such as lateral wind or traffic pressure, heavy fixtures etc.;

1.6.2. Thermal & fire resistance;

1.6.3. Water resistance;

1.6.4. Acoustic performance; and

1.6.5. Impact resistance.

1.7. Design for Wall Performances

1.7.1. Loading

1.7.1.1. All NSW shall be constructed only for their intended purposes and any additional loadings shall be referred to the S.O. for approval.

1.7.1.2. Proprietary internal lightweight partition, including secondary framing shall be designed to meet specification requirement to ensure structural sufficiency and safety. The governing factor shall be based upon allowable deflection limit shall be of L/240 or L/360 @ 250Pa or equivalent design code. L refers to height of wall in metre (m). 250Pa refers to lateral uniform pressure applying perpendicular to wall surface.

1.7.2. Thermal and Fire Rating

1.7.2.1. Material used for wall construction shall be classified as Class O building material in accordance with BS 476 Part 4 (non-combustible) or Part 6 & 7 (limited combustible), or at least has an A2 rating in accordance with EN 13501 Part 1.

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1.7.2.2. Unless otherwise specified or shown on the Drawings, fire rated walls and partitions system shall be constructed and calculated according to requirements and approval of the DGFR and compliance to the Uniform Building By-Law (UBBL).

1.7.2.3. The glass wool, stone wool and cellulose insulation materials used shall comply with BS 476 - Fire tests on building materials and structures:

Part 4: Non-combustibility test for materials;

Part 6: Method of test for fire propagation for products; and

Part 7: Method of test to determine the classification of the surface spread of flame of products.

1.7.3. Water proofing

Where necessary, NSW shall be properly treated with proprietary water proofing system as per respective manufacturer's recommendation, along with warranty coverage if applicable.

1.7.4. Acoustic rating

1.7.4.1. Where necessary, NSW shall be designed to have specific sound insulation rating in accordance with ISO or equivalent as below:

ISO 140-3 – Laboratory measurements of airborne sound insulation of building elements; and

ISO 717-1 – Acoustics – Rating of sound insulation in buildings and of building elements – Part 1: Airborne sound insulation.

1.7.4.2. Unless otherwise specified, designing architect shall determine the required acoustic performance for the wall structure based on intended usage.

1.7.5. Security and impact rating

1.7.5.1. Where applicable, wall shall be designed with some degree of security and impact resistance feature. While solid wall structure is naturally to have high impact resistance capability, for drywall partition this shall be evaluated in accordance with BS 5234: Partitions (including matching linings) – Part 2: Specification for performance requirements for strength and robustness including methods of test, or equivalent.

1.7.5.2. Where necessary, designing architect shall decide grade of duty rating for wall structure making reference to recommendation in Table 1 – Partition grades by categories of duty in BS 5324: Part 2.

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2. Products, components and proprietary systems

2.1. Cement

The cement, unless otherwise described, shall be CEM 1 complying with MS EN 197-1 and as specified under SECTION D: CONCRETING.

2.2. Sand

Sand for mortar shall comply with MS EN 12620 and as specified in SECTION D: CONCRETING.

2.3. Mortar

2.3.1. Mortar shall consist of one (1) part of cement to six (6) parts of sand, with the addition of an approved mortar plasticizer used strictly in accordance with manufacturer's recommendation. The ingredients for mortar shall be measured in proper gauge boxes and shall be mixed on a clean boarded platform or in an approved mechanical batch mixer.

2.3.2. All mortar shall be used within forty-five (45) minutes of mixing and no remaking up of mortar shall be permitted thereafter.

2.3.3. Mortar for brickwork below damp proof course or ground floor level shall be in the proportion of one part of cement and three parts of sand.

2.4. Damp Proof Course

2.4.1. Unless otherwise shown on the Drawings, bituminous damp proof courses shall comply with BS 8215: Code of practice for design and installation of damp-proof courses in masonry construction. The bitumen damp proof membrane shall be two (2) ply with a nominal mass of 1840g/m².

2.4.2. Bitumen damp proof course shall be in rolls to suit the thickness of walls or brickwork. The damp proof course shall be bedded on a level bed of cement mortar (1:1) and lapped at least 150mm or the width of the damp proof course at running joints and intersections.

2.4.3. In all cases of doubt as to the exact location of the damp proof course, the Contractor shall refer to the S.O. before laying the damp proof course. The damp proof course above ground shall be continuous for the whole length and thickness of the wall and be at least 150mm above finished ground level to prevent moisture from the ground rising through the foundation to the wall above ground, which otherwise would make wall surfaces damp and damage wall finishes.

2.5. Bricks and Blocks

2.5.1. General

All brick walls shall have G.I expanded/exmet mesh reinforcement with 750mm x 5mm diameter brickwork dowel bar complete with 75mm right angle bent to hook onto brickwork at every 4th course.

2.5.2. Samples

Separate samples of each type of bricks and blocks taken at random from the load, shall be submitted to the S.O. for approval before the bricks and blocks

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are used. All subsequent deliveries shall generally be up to the standard of the samples approved. No soft, broken, twisted or otherwise defective bricks and blocks will be permitted to be used.

2.5.3. Clay Bricks

All ordinary clay bricks shall be machine-made, wire cut and shall be hard, well burnt, sound, square and clean all in accordance with MS 76.

2.5.4. Cement Sand Bricks and Hollow Blocks

2.5.4.1. All cement sand bricks and hollow blocks shall comply with MS 27.

2.5.4.2. The dimensions of blocks shall comply with MS 1064.

2.5.4.3. Wherever blocks are used, a modular sized block shall be used and constructed in accordance with the manufacturer's standards, requirements and method statements.

2.5.4.4. The composition of cement sand bricks and hollow blocks shall consist of a uniform mixture of sand and cement. The sand cement shall be mixed in the ratio of six (6) parts of sand to one (1) part of cement by volume in a mechanical mixer capable of taking one (1) bag of cement (50 kg of cement shall be taken as 0.035 cube). The sand used shall be as described hereinbefore and the maximum size shall pass through a 4.8 mm mesh BS sieve. The cement used shall be CEM 1 as described under SECTION D: CONCRETING.

2.5.4.5. The Contractor shall only use cement sand bricks and hollow blocks supplied by approved manufacturer.

2.5.4.6. The minimum permissible average compressive strength shall be 5.2N/mm² for bricks and 2.8N/mm² for hollow blocks per 10 samples taken at random from the Contractor's stock pile of 1000 or part thereof. All rejected or condemned bricks shall be removed from site at the Contractor's expense.

2.5.5. Light Weight Concrete Block

2.5.5.1. Light weight concrete blocks shall comply with BS EN 6073-1 and shall be used and laid strictly in accordance with the manufacturer's instructions.

2.5.5.2. Light weight concrete blocks shall be free from asbestos or toxic substances.

2.5.5.3. Where light weight concrete blocks are used in lieu of clay bricks, a modular sized block shall be used according to manufacturer's standards, requirements and method statements.

2.5.5.4. The light weight concrete blocks shall have the following performance criteria:

Dry density of between 500kg/m³ and 1500kg/m³;

Dimensional accuracy of ± 1.5mm on all faces;

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The permissible compressive strength shall be not less than 7N/mm² per 10 samples taken at random from the contractor's stock pile of 1000 or part thereof and tested at certified lab;

Ultimate tensile strength shall be 0.44 - 0.55 Mpa;

Thermal resistance (R-value) of not less than $1 m^2K/W$; and

Minimum working density for the blocks is 910kg/m³.

2.5.5.5. The infill wall thickness of light weight blocks shall be as follows:

100mm thickness for internal walls;

125mm thickness for external walls;

200mm thickness (fire rated) for party wall; and

Internal spaces with 24 hour air-condition should comply with the thermal resistance R-value of not less than $1 m^2K/W$.

2.6. Patented and Proprietary Brick and Block

2.6.1. Patented bricks and blocks shall comply with MS 2282 and shall be used and laid strictly in accordance with the manufacturer's instructions.

2.6.2. Cement Brick (Patented or Proprietary)

2.6.2.1. The cement brick wall partition system shall satisfy the performance requirements specified in Clause 5 of BS 476: Part 22, for non-load bearing wall partition for the following periods:

Integrity : 130 minutes
Insulation : 130 minutes

2.6.2.2. Minimum compressive strength shall be not less than 7 N/mm².

2.6.3. All patented or proprietary brick and block wall installation works shall strictly adhere to the manufacturer's method statement for installation works and to S.O.'s approval.

2.7. Large Prefabricated Panels.

Large prefabricated panels when used shall conform to MS 1313 and shall be installed strictly in accordance with the manufacturer's recommendations.

2.8. Gypsum Plasterboard

2.8.1. Gypsum plasterboard sheeting shall be a complete proprietary system, in accordance with the Product Data, approved sample and the relevant Standards.

2.8.1.1. BS EN 15283 (Series): Gypsum boards with fibrous reinforcement - Definitions, requirements and test methods; dan

2.8.1.2. BS EN 520: Gypsum plasterboards - Definitions, requirements and test methods.

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2.8.2. Provide moisture-resistant, impact-resistant, fire-resistant and acoustic-rated plasterboard systems where indicated or required.

2.8.2.1. Moisture-resistant grade (MR) plasterboard shall be suitable proprietary products for use in moisture-resistant construction in wet areas where normal plasterboard would be unsuitable.

2.8.2.2. Fire-resistant grade (FR) plasterboard shall be suitable proprietary products for fire-resistant construction.

2.8.2.3. Impact-resistant grade (IR) plasterboard shall be suitable proprietary products for construction of system requiring robustness feature.

2.9. Fibre Cement Sheet

2.9.1. Fibre-cement (FC) sheeting shall be a complete proprietary system, asbestos-free, in accordance with the Product Data, approved samples, and the relevant Standards.

2.9.1.1. MS 1224: Specification for fibre cement symmetrically corrugated sheet and fittings - product specification and test method; and

2.9.1.2. MS 1296: Fibre-cement flat sheets- product specification and test methods.

2.10. Insulation (Acoustical and Thermal)

2.10.1. Unless otherwise specified or shown on the Drawings, acoustic wall panel and/or systems shall be constructed and calculated according to requirements of acoustic specialist and approved by S.O.'s approval.

2.10.2. Thermal insulation system shall comply with MS1020. Samples of the insulation material shall be submitted to the S.O. for approval before they are used and subsequent delivery shall be up to the standard of samples approved.

2.10.3. Unless otherwise shown in the Drawings, glass wool insulation shall be made in Malaysia 50mm thick. It shall have a conductive value of maximum 0.035 W/m²K (tested at a mean temperature of 20°C based MS1020 tested according to ASTM C518). Unless otherwise specified the size of the glass wool insulation shall be 600mm x 1200mm. Glass wool insulation shall be fixed in accordance with the manufacturer's recommendation and to the approval of the S.O..

2.10.4. Where stone wool insulation is to be used, it shall be made in Malaysia 50mm thick. It shall have a conductive value of maximum 0.035 W/m²K (tested at a mean temperature of 20°C based MS1020 tested according to ASTM C518). Unless otherwise specified the size of the stone wool insulation shall be 600mm x 1200mm. Stone wool insulation shall be fixed in accordance with the manufacturer's recommendation and to the approval of the S.O..

2.10.5. The contractor shall submit the COO (certificate of origin) confirming made in Malaysia from the supplier/manufacturer to the S.O for approval prior to the commencement of the works. No installation works shall commence until approval is given in writing by the S.O..

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2.10.6. Recommended type of spray applied cellulose insulation shall be:

2.10.6.1. Thickness - 30mm;

2.10.6.2. Thermal conductivity (k-value) = 0.0029 W/m·K tested to ASTM C-177;

2.10.6.3. Fire retardant Class "O" complying with BS476 Part 6 & 7 and endorsed by FRDM;

2.10.6.4. Average moisture absorption of not more than 15% as per ASTM C739;

2.10.6.5. Tested Noise Reduction Coefficient of NRC 0.75 at 30mm thickness; and

2.10.6.6. Tested to be non-toxic and asbestos free, contain no carcinogenic materials and shall not cause any skin irritation to humans.

3. Type of Finishes to Walls and Partitions

3.1. Unless otherwise shown in the Drawings, all plastering works for brick walls shall include the wall surface area above ceiling finish level.

3.2. Unless otherwise specified or shown on the drawings, the appropriate type of finishes for walls and partitions shall be as specified in the Schedule of Finishes. Unless otherwise shown on the Drawings or described in the B.Q., The finishes and their dimensions shall be as specified in SECTION K: PLASTERING, PAVING, TILING AND CARPET and SECTION O: PAINTING.

4. Structural Wall (Blockwork System)

This clause shall apply to the construction of all load bearing blockworks with or without steel reinforcement. All lines, levels, grades, dimensions and cross-sections shall be as shown on the Drawings and/or directed by the S.O.. The full requirement is outlined in the *Specification for Load Bearing Blockwork System (JKR 20601-0252-18)* or the latest edition published by JKR.

4.1. Material

The block shall comply with the requirements of MS 2282 Part 3.

4.2. Compressive Strength

For all block units intended to be used in elements subject to structural requirements, the mean compressive strength shall not be less than 7N/mm^2. The manufacturer shall also declare the normalised compressive strength when relevant.

4.3. Density

The net dry density of the units shall be declared in kilogram per cubic meters (kg/m^3) by the manufacturer in accordance with MS 1933 Part 13. The minimum dry density of unit shall not be less than 1500kg/m^3.

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4.4. Structural Mortar

4.4.1. Recommended minimum compressive strength for prescribed mortar shall be class M6. The proportion of materials by volume shall be referred to **TABLE E1.**

4.4.2. The compressive strength of masonry mortar shall be determined in accordance with BS EN 1015 Part 11. The adhesion between the mortar and the masonry units shall be adequate for the intended use. The ingredients for mortar shall be measured in proper gauge boxes and shall be mixed on a clean boarded platform or in an approved mechanical batch mixer.

4.4.3. The characteristic compressive strength of masonry bonded with thin layer mortar shall be taken as the values given for mortar strength class M12 (mortar designation (i) in **TABLE E1**. The contractor shall submit the manufacturer's specification and method statement to the S.O. for approval prior to the commencement of works.

4.5. Mortar Testing

The use of mortars shall be in accordance with the recommendation given in BS EN 1996. When samples are taken from a designed mortar in accordance with BS EN 1015 Part 2 and tested in accordance with BS EN 1015 Part 11, the compressive strength of the mortar shall not be less than the specified compressive strength. **TABLE E1** shows the relationship of compressive strength classes and the compressive strength of mortar at 28 days.

4.6. Concrete Infill

Concrete infill for reinforced masonry shall be of minimum grade C25/30 (designed mix) or 30P (prescribed) with 10mm nominal size aggregates and specified in accordance with MS 523 Part 2. The minimum cement content, maximum free water/cement ratio and the concrete cover shall conform to the requirement in **Table E2.**

4.7. Blocklaying

4.7.1. Unless otherwise specified, all blockworks shall be laid on a full bed of mortar, and vertical joints shall be filled up fully. The average thickness of the vertical and horizontal joints shall be 10mm, exclusive of any key in the jointing surfaces of the units.

4.7.2. Unless specified, as work proceeds do not rack back corners and other advanced work higher than 1.2m above the general level. For facing work complete the whole lift within one period of operation. Except where permitted by a proprietary system or by the designer, do not carry up any one leaf more than 1.5m height in one day.

4.8. Block Masonry Bonds

The running or stretcher bond of blocks are shown in **FIGURE E1** and **FIGURE E2.**

4.9. Services Holes and Chases

4.9.1. In order to eliminate unnecessary cutting away and making good, sleeves and chases should be provided during the erection of the masonry. In external walls, all sleeves and pipes should preferably be laid with a fall toward the

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outside. The installation of services should be completed before plastering or other finishing work is begun.

4.9.2. Where chases have to be cut, suitable power tools which do not operate by heavy impact should be used so that the recommended depth is not exceeded. Fixing units (blocks) where required, should be built into the wall or partition in the correct positions for skirting, rails and other items of joinery, fittings, etc.

4.9.3. In walls or leaves constructed of solid units, the depth of horizontal chases should not exceed one-sixth of the thickness of the single leaf at any point whilst the depth of the vertical chases should not normally exceed one-third of the thickness of the single leaf at any point.

4.9.4. The cutting of holes up to approximately 300mm square in the wall to accommodate items of equipment may be permitted.

4.9.5. Where heavy fittings are to be fixed to a wall, the effect on the stability of the masonry should be considered.

5. Samples and Mock-up

5.1. Samples and mock-up of wall construction shall be provided and approved by the S.O. prior to the commencement of the actual construction works. The size of the samples shall be determined by the S.O..

5.2. The samples and mock-up for walls and partitions shall include connections between the following components where applicable:

5.2.1. Floor to floor to a minimum of 5m length;

5.2.2. Wall corners;

5.2.3. Lintels;

5.2.4. Stiffeners;

5.2.5. Door and window frames; and

5.2.6. All other walls between different materials.

5.3. Sample and Mock-Up Panels for Structural Wall (Blockwork System)

5.3.1. The contractor shall construct a mock-up panel for the project with total build-up area more than 100m^2 using load bearing blockworks system.

5.3.2. Sample panels shall be built on site in a protected position to provide an agreed standard for the work and treatment of joints before the commencement of the works subjected to the S.O. approval. Such panels shall be maintained throughout the contract and removed on completion.

5.3.3. The mock-up panel needs to be constructed to expose not less than 2m length x 1m height, selected as follows:

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6. Walling / Construction

6.1. Brick Walling

6.1.1. Unless otherwise specified or shown on the Drawings, the whole of the brickwork shall be constructed with standard size clay bricks in mortar as described and the surface left ready for plastering.

6.1.2. All clay bricks shall be soaked in a suitable tank or pit to be provided by the Contractor for at least half an hour before being laid and shall be kept wet whilst being laid. The top of walls left off shall be thoroughly wet before work is resumed. All constructed walling must be left wet and properly protected from the direct sunlight during the following day. The Contractor shall provide sufficient means to ensure that this is done.

6.1.3. Cement sand bricks shall not be soaked but dipped in water before being laid and all constructed brickwork shall be protected from direct sunlight during the day on which it is laid and also during the following day and the contractor shall provide sufficient means to ensure that this is done.

6.1.4. All bricks shall be properly bedded in mortar and all joints shall be thoroughly flushed up and raked out to a depth of 13mm as the works proceeds. No joint shall exceed 10mm in thickness.

6.1.5. Brickwork shall be carried up perfectly true and plumb in a uniform manner. No one portion being raised more than 1m above another at one time. No overhand work shall be permitted, and scaffolding shall be carried up as the work proceeds. The vertical points of every alternate course shall be kept perpendicular over one another, and all perpends, quoins, et cetera shall be kept strictly true and square.

6.1.6. All intersections and angles of walls shall be properly bonded together, and all walls and piers of lengths not multiples of brick sizes shall be cut and bonded in the best approved manner. No broken bricks shall be used except where required to form bonds.

6.1.7. All half brick (113mm) walls shall be reinforced at every fourth course with approved reinforcement (for example exmet) commencing two courses above floor level. For block walling, reinforcement shall be at every second course commencing one course above floor level.

6.1.8. All brick walls shall be constructed on reinforced concrete beams in accordance with the Drawings. No brick walls except lightweight partitions are allowed to be constructed on reinforced concrete slabs.

6.1.9. Unless otherwise specified, all toilet perimeter walls shall be constructed using clay bricks. Cement sand bricks shall not be used for toilet walls.

6.1.10. All half brick walls shall be built in Stretcher Bond.

6.1.11. All other brickwork shall be built in English Bond or as shown on the Drawings.

6.2. Facing Brickwork

6.2.1. All facing brickwork shall be executed in first quality approved facing bricks in Stretcher or Flemish Bond as shown on the Drawings, properly bonded into any backing walls, piers, et cetera. Joints shall be racked out to a depth of 13

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mm and point up in coloured cement mortar to approved tints, finished with a neat struck weathered joint.

6.2.2. Facing brickwork shall be kept perfectly clean and no rubbing down of brickwork will be allowed.

6.3. Stonework

6.3.1. Unless otherwise shown on the Drawings or described in the B.Q., all stone blocks used shall be of limestone or granite whichever is more readily available within the locality of the Site and shall be free from cracks, fissures or other defects to the approval of the S.O.. The stone blocks shall in general, have their largest faces parallel. Unless otherwise required, the maximum thickness of the stone blocks shall in no case exceed the thickness of the wall or portion of the structure into which it is being built.

6.3.2. Stone walling shall be laid random un-coursed or random coursed as shown on the Drawings. Through or bonded stones shall be used at one stone per meter square for random coursed. Where backing brick wall is shown, the through stone shall be properly bonded in such brick wall.

6.3.3. Unless otherwise shown on the Drawings, all stonework shall be bedded in cement and sand mortar (1:3) mix and finished with a flushed joint rubbed down with sacking. All interstices between individual stones shall be filled with mortar. Finish to exposed surfaces or random walling shall be hammer-dressed.

6.4. Hollow Block Walling

The cement sand block wall shall be laid in the manner specified for brick wall. The hollow block shall not be soaked but dipped in water before laying. The hollow block wall shall be reinforced at every second course with reinforcement commencing one course above floor level.

6.5. Autoclaved Aerated Concrete (AAC) Block Walling

6.5.1. Where shown on the Drawings and/or described in the B.Q. or as an alternative to clay bricks, the Contractor may use AAC blocks for non-load bearing walls and partitions. The AAC block work shall be constructed strictly in accordance with the manufacturer's recommendations. Any extra cost in connection therewith shall be borne by the Contractor.

6.5.2. Only proprietary thin bed adhesive shall be used assembling AAC block wall. The AAC block work shall be installed using an approved thin layer of proprietary thin bed adhesive mortar with minimum flexural strength of 0.44 MPa to all horizontals and perpends. The first course must be made true and level using a normal layer of mortar with thin layer of adhesive to fully seal the perpends. The thin layer of proprietary adhesive shall be applied using notched trowel to obtain an even distribution of adhesive to achieve joint thickness of 2mm to 3mm.

6.5.3. A damp-proof course slip-joint membrane shall be laid on top of the floor slab or beams before receiving the mortar bedding to allow for differential movement between the blocks and the supporting structure.

6.5.4. The AAC block work shall be laid in a manner that the vertical joint of the lower course shall be staggered at least 100mm relative to the vertical joint of the overlaying course.

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6.5.5. Unless otherwise directed and/or shown, where concrete block walls abut concrete faces, the face shall be flushed.

6.5.6. Control joints should be built into walls at spacing not greater than 8m centres, and at locations in accordance with manufacturer's recommendation.

6.5.7. Care must be taken to keep the walls clean, strictly in accordance with the manufacturer's recommendation. Excess adhesive must be removed progressively.

6.5.8. The wall surfaces may be finished with suitable surface coating that has the dual properties of being waterproof and water vapour permeable and shall be applied in accordance with the manufacturer's recommendation.

6.5.9. Only proprietary cement plaster of the same AAC block shall be used for external rendering of an external wall. The minimum thickness for the rendering of the external wall shall be 12mm thick.

6.5.10. Only proprietary skim coat base and skim coat finish of the same AAC block shall be used for internal wall application. The recommended thickness of the skim coat base shall be between 2 - 4mm thickness and the skim coat finish of an internal wall shall be of 1 - 2mm thickness. Both are coatings shall be applied as a two-coat system and applied according to manufacturer's instruction and to the S.O's approval.

6.5.11. All AAC block wall installation works shall strictly adhere to the manufacturer's method statement for installation works and to S.O.'s approval.

6.6. Parapet and Freestanding Wall

6.6.1. Any parapet and freestanding wall consisting of 155mm thick brick wall including plastering on both sides shall only be constructed to a maximum height of 900mm.

6.6.2. Where shown on the Drawings, freestanding walls above 900mm in height shall be constructed as per the engineer's detail Drawings or to the S.O.'s approval.

6.6.3. Precast reinforced concrete copings shall be constructed on all external parapet and free-standing walls. The reinforced concrete coping shall be laid to fall, complete with 12mm half round throating.

6.6.4. Freestanding walls more than 3m length vertically and horizontally shall be constructed with reinforced concrete stiffeners to engineer's detail and with the S.O.'s approval.

6.7. Lintel and Stiffener

6.7.1. Unless otherwise specified or shown on the Drawings, lintels shall be provided to all openings and to be sized accordingly by the Contractor to the S.O.'s approval.

6.7.2. Reinforced concrete stiffeners shall be constructed at every minimum of 3m vertically and horizontally to strengthen brick and block wall system construction according to engineer's detail.

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6.8. Fasteners

Unless otherwise shown on the Drawings, fasteners or cramps for frames, metal windows and precast units shall be built in at 1m centres on the vertical side of the frame. Mild steel cramps shall be 25mm x 3mm x 225mm long for fixing wooden frames, etc. One end of the cramp shall be turned up and screwed to back of the frame and the other end shall be split and fish-tailed for building in. Cramps which are to be fixed to concrete shall be embedded in concrete and built into brickwork as the work proceeds.

6.9. Cutting

All cuttings such as arches, sinks, setbacks, and projections shall be properly formed. Chases and holes through walls and slabs for the passage of pipes, wiring and the like shall be neatly cut or formed. Upon the installation of the services pipes, the chases and holes through walls shall be properly sealed (Fire Stop) to prevent fire spread as required by the DGFR and UBBL. Where plastering works are done on the cuttings, the surface shall be smooth and seamless.

6.10. Partitioning

6.10.1. Timber Framed Partition

6.10.1.1. All timber used for the timber stud framings for partition walls shall be as specified in SECTION H: TIMBER, JOINERY AND IRONMONGERY.

6.10.1.2. Wall partition consisting of timber frames shall consist of vertical and horizontal studs. The studs shall consist of approved timber hardwood with a minimum size of 50mm x 50mm unless otherwise specified. All horizontal and vertical studs shall be constructed at a maximum nominal spacing of 610mm centres.

6.10.1.3. The top most horizontal frame, referred to as the top plate shall be bolted or nailed to the ceiling and continuously erected using timber or metal stiffener securely fixed to the slab to the S.O.'s approval. The timber and metal stiffeners shall be spaced at 1220mm centres maximum.

6.10.1.4. The lowest horizontal frame, referred to as the bottom plate, shall be securely fixed using bolts or nails. Unless otherwise advised, all fixing to slabs, M12 expansion bolts shall be used at 1220mm centres maximum with galvanized mild steel strap, or equivalent, to the floor to the S.O.'s approval. All fixings to timber slabs shall be fixed at 600mm centres maximum.

6.10.1.5. Unless otherwise specified, dimension for timber panels shall comply with MS 1064.

6.10.1.6. Where proprietary timber partitions are used, they shall be constructed in accordance with the manufacturer's recommendations and to the S.O.'s approval.

6.10.1.7. Partitions, screens and vent panels, shall be constructed as detailed in the Drawings. Where shown, galvanized welded wire mesh or expanded metal of the required sizes and patterns shall be fixed to vent panels and window openings. The mesh shall be secured in position using rebated and mitred timber battens and screws.

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6.10.2. Metal Framed Partition

6.10.2.1. Steel sections such as, but not limited to metal framing and studs shall comply with ASTM C645, BS EN 14195, BS 7364 or other approved equivalent standards as appropriate, and to the approval of the S.O..

6.10.2.2. Unless otherwise specified, all metal framing for partitions shall be either galvanized or zinc alum coated steel 62mm C-Studs (vertical) and 64mm U-tracks (horizontal) of 0.5mm base metal thickness. The steel stud shall be manufactured from mild steel strip, with material specification complying to either one of the following:

Steel grade Z2 with minimum yield strength of 210N/mm^2 and zinc coating type Z275 minimum, complying with BS EN 10143;

Steel grade G300, with minimum yield strength of 300N/mm^2 and zinc-alum coating type AZ150 minimum, complying with AS 1397.

6.10.2.3. The stud which is to support a joint shall have a minimum fixing face width of 32mm for screw fixing and all other framing members shall not be less than 30mm. Drywall screws shall be at least 10mm longer than total thickness of plasterboards on each side of the partition wall. The plasterboards are laid staggered and fixed to the metal frames using drywall screws not exceeding 300mm centres.

6.10.2.4. The top most U-track (horizontal) shall be screwed to the ceiling and continuously erected using metal stiffener securely fixed to the slab. The metal studs directly supporting plasterboard sheets shall be spaced at 610mm centres maximum. The bottom U-track (horizontal) shall be securely fixed to the floor slab using bolts or screws. Unless otherwise advised, all fixing to slabs, M12 expansion bolts shall be used at 1200mm centres maximum with galvanized mild steel strap to the floor and to the S.O.'s approval.

6.10.2.5. Unless otherwise shown on the Drawings, the partitions shall not be erected more than 3000mm height. Partitions which are more than 3000mm height shall be supported by additional structural members, to structural engineer's detail and S.O.'s approval.

6.10.2.6. Partition above ceiling shall allow for cut out opening for service ducts or trunks and cable trays. The contractor shall coordinate with all subcontractors on the exact location and size of the openings. For fire rated partition, any gaps around any pipe ducts through the partition shall be properly sealed with approved fire/smoke stop system by the fire stopping specialist.

6.10.2.7. If full height partition has to be terminated below ventilation duct route parallel to the partitions, the stud of the partition shall be secured to the support frame of the duct or extended secondary frame support. In such cases, space between the duct and reinforced concrete soffit need not be sealed up, unless it is of fire rated type of partition.

6.10.2.8. The deflection of the metal frame partition system under service condition shall be controlled by the limit for the calculated deflection of the element chosen for the system and its intended use. The

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deflection shall not exceed L/240 or L/360 subject to the finishing material attached to the partition. Any system wall partition selected shall be installed strictly according to the manufacturer's specifications and details to the S.O.'s approval.

6.10.3. Plasterboard lining

6.10.3.1. The type of plasterboard used shall comply with BS EN 520. The specified plasterboard shall carry class 'O' approval from DGFR. Unless otherwise specified the plasterboards used for the works shall be minimum 12.5mm thick with standard length of 2440mm and shall be free of defects.

6.10.3.2. The deviations and tolerances shall be in accordance with BS 8212. When required, the deflection under load shall be determined in accordance with BS EN 520.

6.10.3.3. The appropriate type of sealant shall be used for the required type of plasterboard. Elastomeric sealants shall be used at the perimeter of the dry lining or partitioning to provide an airtight construction and to the approval of the S.O..

6.10.3.4. Jointing compound shall be of air drying or setting type, in accordance with BS EN 13963, and to the approval of the S.O.. Jointing compound shall be applied as per manufacturer's recommendation and S.O.'s approval. The use of any additives to modify any of the properties of compounds shall not be permitted.

6.10.3.5. Jointing tape for plasterboards shall not be less than 48mm wide and not exceeding 60mm in accordance with ASTM C475 or equivalent, and the approval of the S.O..

6.10.3.6. Control joints shall be provided for a long continuous run of plasterboard wall spaced at not more than 10m apart.

6.10.3.7. Corner beads shall be provided as reinforcement to permit construction of true, concealed angles with gypsum base and panels.

6.10.3.8. Provision shall be allowed for the plasterboard partition system to support surface mounted fixtures by incorporating independent support framing hidden behind or exposed on the partition surface to provide adequate and appropriate support and to the approval of the S.O..

6.10.3.9. Wherever possible, full length plasterboard sheets shall be used to eliminate the need for sheet end butt joints. Where possible, joints on opposite sides of framing should be arranged to occur between different framing members.

6.10.3.10. Plasterboard sheets shall be laid out to minimize butt joints and waste. Butt joints on adjoining sheets shall be staggered. Butt joints on opposite sides of the wall shall be staggered. The sheet shall be laid so that the vertical joints fall a minimum of 200mm from the edge of the opening.

6.10.3.11. Fire resisting systems comprising of more than one layer of plasterboards, the joints in successive layers should be staggered.

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In the case of walls sheeted on both sides' joints should be staggered on opposite sides of the wall.

6.10.3.12. Penetrations in the system shall only be allowed if installed in accordance to manufacturer's recommendation and tested at the Contractor's expenses. Penetration shall be strictly carried out in accordance with the requirements of the DGFR and to the approval of the S.O..

6.10.3.13. Fasteners shall have a corrosion-resistant finish and be appropriate for intended use, also in accordance with BS EN 14566 and BS 8212, or any relevant standards. The heads of fasteners shall be shaped so that they can be driven slightly below the surface of the plasterboard without punching through the paper liner.

6.10.3.14. Impact resistance of a partition system including gypsum plasterboard shall be determined in accordance with ISO 7892 and BS 5234-2.

6.10.3.15. The Contractor shall submit to the S.O., a manufacturer's warranty against any defect or damage to the proprietary plasterboard partition system which may arise during the period of five (5) years from the date of Certificate of Practical Completion. Terms of the warranty shall be such as shall be approved by the S.O..

6.11. Insulation Installation

6.11.1. Where necessary, insulation shall be installed so that:

6.11.1.1. It abuts or overlaps adjoining insulation other than at supporting members such as studs, noggings, joists, furring channels and the like where the insulation must butt against the member;

6.11.1.2. It forms a continuous barrier with ceilings, walls, bulkheads, floors or the like that inherently contribute to the thermal barrier; and

6.11.1.3. It does not affect the safe or effective operation of a service or fitting.

6.11.2. Reflective insulation shall be installed so that:

6.11.2.1. The necessary airspace to achieve the required R-value between a reflective side of the reflective insulation and a building lining or cladding;

6.11.2.2. The reflective insulation closely fitted against any penetration, door or window opening;

6.11.2.3. The reflective insulation adequately supported by framing members; and

6.11.2.4. Each adjoining sheet of roll membrane being overlapped not less than 50mm; or taped together.

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6.11.3. Bulk insulation shall be installed so that:

6.11.3.1. It maintains its position and thickness, other than where it crosses roof battens, water pipes, electrical cabling or the like; and

6.11.3.2. In a ceiling, where there is no bulk insulation or reflective insulation in the wall beneath, it overlaps the wall by not less than 50mm.

6.11.4. Fixing methods of insulation material shall be as below, or as recommendation of manufacturer:

6.11.4.1. Use proprietary fixing methods which prevent long term sag, collapse or dislodgement; and

6.11.4.2. Fasteners shall be suitable non-corrosive types.

6.12. Glass Partitions

6.12.1. Unless otherwise specified or shown on the Drawing, all fixed glass wall systems shall be 8mm thick minimum, erected with stainless steel framing system for sizes up to 1200mm x 4800mm maximum installed to manufacturer's recommendation and to S.O.'s approval. For sizes more than 4800mm, the panels shall be constructed according to manufacturer's recommendation and the installation shall be certified by a P.E.

6.12.2. Glass doors shall be installed complete with accessories as recommended by the manufacturer and to the S.O.'s approval.

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TABLE E1 – MASONRY MORTARS

	Mortar designation	Compressive strength class	Prescribed mortars (proportion of materials by volume) (see notes 1 and 2)		Compressive strength at 28 days N/mm²
			Cement **(a)**: sand with or without air entrainment	masonry cement **(b)**: sand	
Increasing ability to accommodate movement, e.g. due to settlement, temperature and moisture changes ↓	(i)	M12	-	-	12
	(ii)	M6	1 : 3 to 4	1 : 2½ to 3½	6

a. Cement, or combination of cements except masonry cements.

i) Combinations produced in the mortar mixer from Portland cement CEM I conforming to MS EN 197 Part 1 and ground granulated blastfurnace slag conforming to MS EN 15167 Part 1 where the proportions and properties conform to CEM II/A-S or CEM II/B-S of MS EN 197 Part 1, except Clause 9 of that standard.

ii) Combinations produced in the mortar mixer from Portland cement CEM I conforming to MS EN 197 Part 1 where the proportions and properties conform to CEM II/A-L or CEM II/A-LL of MS EN 197 Part 1, except Clause 9 of that standard.

iii) Combinations produced in the mortar mixer from Portland cement CEM I conforming to MS EN 197 Part 1 and pulverized fuel ash conforming to MS EN 450 Part 1, where the proportions and properties conform to CEM II/A-V or CEM II/B-V of MS EN 197 Part 1, except Clause 9 of that standard.

b. Masonry cement (inorganic filler other than lime)

NOTE 1 Proportioning by mass will give more accurate batching than proportioning by volume, provided that the bulk densities of the materials are checked on site.

NOTE 2 When the sand portion is given as, for example, 6 to 6, the lower figure should be used with sands containing a higher proportion of fines whilst the higher figure should be used with sands containing a lower proportion of fines.

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TABLE E2 - MINIMUM CONCRETE COVER FOR CARBON STEEL REINFORCEMENT

Exposure situations	*Concrete grade in MS EN 206 and MS 523 Part 2 & MS 523 Part 3*				
	C25/30	C28/35	C32/40	C35/45	C40/50
	Minimum cement content (kg/m^3)				
	300	320	340	360	380
	Maximum free water/cement ratio				
	0.65	0.6	0.55	0.50	0.45
	Thickness of concrete cover				
	mm	mm	mm	mm	mm
E1[a]	20	20	20[b]	20[b]	20[b]
E2	—	35	30	25	20
E3	—	—	40	30	25
E4	—	—	—	60	50

Exposure situation E1. Internal work and the inner skin of ungrouted external cavity walls and behind surfaces protected by an impervious coating that can readily be inspected, or external parts built.

Exposure situation E2. Buried masonry and masonry continually submerged in fresh water or external parts built.

Exposure situation E3. Masonry exposed to freezing whilst wet, subjected to heavy condensation oe exposed to cycles of wetting by fresh water and drying out or external parts built.

Exposure situation E4. Masonry exposed to salt or moorland water, corrosive fumes, abrasion or the salt used for de-icing.

a Alternatively, 1: 0 to ¼ : 3: 2 cement: lime : sand: 10 mm nominal aggregate mix may be used to meet exposure situation E1 when the cover to reinforcement is 15 mm minimum.

b These covers may be reduced to 15 mm minimum provided that the nominal maximum size of aggregate does not exceed 10mm.

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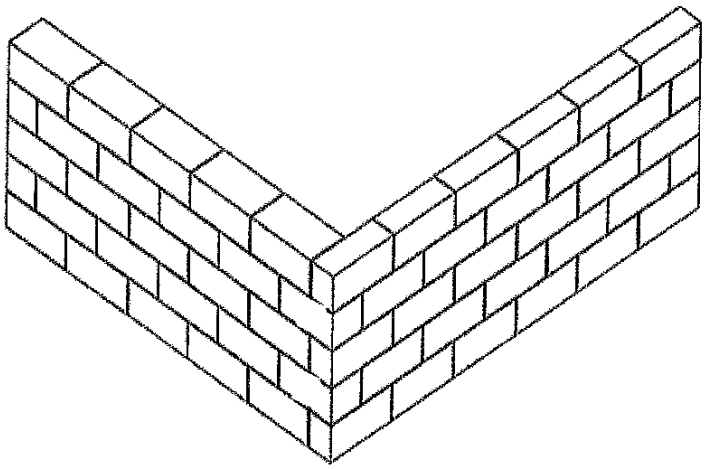


FIGURE E1: RUNNING OR STRETCHER BOND

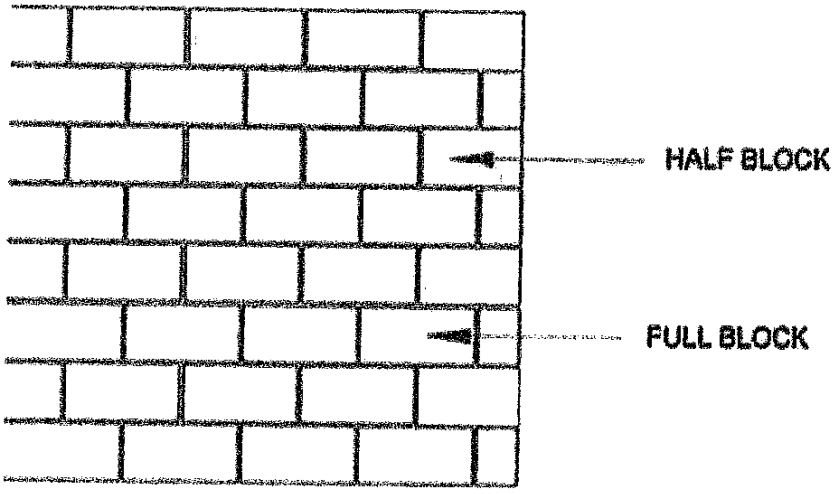


FIGURE E2: RUNNING OR STRETCHER BOND

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SEWERAGE

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1. General

The work to be done under this section unless otherwise shown or described in the B.Q.. shall consist of the supply, delivery, construction and testing of all sewerage works and ancillary works, and all necessary works up to the point of final discharge of the effluent. In the case of discharge into the public sewer or the package sewage treatment plant, the work shall terminate up to and including the last manhole or intercepting trap of the system. This section of the work shall be carried out strictly in accordance with the appropriate by-laws and to the approval of the S.O..

2. Material

2.1. Cement, Sand, Aggregates and Bricks

2.1.1. Cement, sand and aggregates shall be as specified in SECTION D: CONCRETING. All bricks used unless otherwise shown in the Drawings or described in the B.Q. shall be clay bricks as specified in SECTION E: WALL SYSTEM.

2.2. Sewerage Pipe

2.2.1. The Contractor shall only use sewer pipes from suppliers approved by SPAN and all materials shall be inspected and approved by the S.O. before being installed.

2.2.2. The Contractor shall submit the certificate and test report of sewer pipe to the S.O. for approval.

2.2.3. The Contractor shall make sure the sewer pipe is stored and/or stacked in such manner to prevent breakage.

3. Layout

The whole sewerage work shall be carried out according to the layout as shown on the Drawings.

4. Excavation

4.1. Generally, all excavation works in this section unless otherwise specified hereunder shall be as specified in SECTION B: EXCAVATION AND EARTHWORKS.

4.2. The Contractor shall carry out survey work to determine the sewer pipe alignment. Clearance from the building/road shall be 1m. The pipe alignment shall be approved by the S.O. before the contractor starts the excavation works.

4.3. The trench shall be excavated to the depths intended or as shown on the Drawings and shall be finished and trimmed to the correct level and grade. Unless indicated otherwise, the bottom of the trench shall be graded so that the pipe invert slopes evenly between the appropriate outlet invert of the preceding manhole and the inlet invert of the next manhole.

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4.4. The trench shall be excavated to such width so as to ensure that a minimum working space of 300mm will be available on each side of the pipe when properly aligned. At all joints, the trench shall be excavated to give a minimum working space of not less than 300mm all-round the joint.

4.5. The sides of all excavation unless otherwise approved by the S.O. shall be cut vertical and where necessary shall be protected against caving in by timbering to the approval of the S.O.. If the trench is more than 1.5m, the contractor shall provide support for the trench to avoid collapse, settlement or movement of the banks.

4.6. The trench excavation shall not advance more than 100m ahead of the completed backfilled pipeline. Pipe shall be laid in all trenches that have been excavated at the end of each day's work, unless the Contractor get approval from the S.O. to do otherwise.

4.7. It shall be the responsibility of the Contractor to protect and support all existing water pipes, gas and other conduits crossed by the excavation or work to be performed and to arrange for their temporary removal and subsequent replacement.

4.8. The trench should be excavated precisely to ensure the sewer pipe will be in the centre of the trench. The bottoms of the trenches for all sewers shall be carefully and truly graded, formed and lined according to the grades and dimensions as shown on the Drawings.

4.9. Should the ground be so wet or soft and does not form a firm base for the pipe, if it is necessary in the opinion of the S.O. then the trench shall be excavated 225mm below the level intended or shown on the Drawings and then brought to the correct level with good selected earth, quarry dust or sand well rammed into place. Such deepening of pipe trench and filling back shall be treated as a variation under the terms of the Contract. Should the bottom of the trench be inadvertently excavated below the specified level, it shall be brought back at the Contractor's expense to the correct level with good selected earth, quarry dust or sand carefully rammed into place.

4.10. The Contractor shall remove any water which collects in the trenches while sewer pipes are being laid. Water encountered shall be disposed of by the Contractor in a manner satisfactory to the S.O..

4.11. Excess material from the trench excavation shall be located 600mm (minimum) away from the trench.

4.12. When excavating pipe trenches in roadway or other paved surfaces, the Contractor shall first remove all metal, slabs or bricks forming the existing pavement to the width of the trenches and reinstate to the approval of the S.O. after the trenches have been backfilled. The Contractor must make sure that not more than half of the width of a roadway shall be disrupted at any one time during the sewerage work.

4.13. Generally, where rock is encountered in the trench excavation, it shall be removed to the approval of the S.O.. Where layer of rock is encountered along the bottom of the excavation, it shall be cut and trimmed to the required level of the trench. All voids formed at the bottom of the trench by the removal of rocks shall be back filled to the required level with Grade 20P concrete or other suitable materials well rammed and compacted all to the approval of the S.O.. Uneven surfaces of rocks at the bottom of the excavation due to the trimming shall be levelled and smoothen with sand blinding to the approval of the S.O..

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4.14. If the works required pipe jacking, the Contractor shall provide method statement for S.O.'s review and approval.

4.15. The Contractor shall ensure that the work performed is safe and in compliance with Occupational Safety and Health Act (OSHA).

5. Pipes and Fittings

5.1. Generally, all sewer pipes unless otherwise shown on the Drawings, shall be vitrified clay pipes (VCP) and fittings complying with *MS 1061* and *SPAN guidelines.*

5.2. Sewer pipes used for gravity types of sewer shall be a minimum size of 150mm for service connection and 225mm for public sewer complying with *Malaysian Sewerage Industry Guideline (MSIG).*

5.3. Sewer pipes for force mains (which require pump) shall comply with *Malaysian Sewerage Industry Guideline (MSIG).* The type and the diameter of pipe shall be of ductile iron (DI) as shown on the Drawings.

6. Joint for Sewer Pipes

6.1. Unless otherwise approved by the S.O., joints of flexible and watertight type shall be used on all sewer pipes. The spigot and socket of each pipe shall be cleaned and lubricated before the running of each joint.

6.2. Couplings shall be made either of the same materials as the pipe or other material to the approval of the S.O.. The pipes and coupling shall have accurately machined or moulded tapered ends, the internal taper of the couplings matching the external taper of the pipes.

7. Pipe Laying

7.1. All pipes shall be laid in compliance with *MS 1228* and in accordance with the sizes, locations, dimensions, grades and other particulars as shown in the Drawings. Each pipe shall be carefully inspected upon arrival at site. Sewer pipes shall be carefully stored. Defective pipes shall be marked and removed from the site forthwith.

7.2. Prior to fixing or laying all pipes and fittings shall again be carefully inspecting for damage and only those found to be sound in every aspect shall be fixed or laid. Any pipes, specials, et cetera found to be damaged in any way shall be clearly marked, set aside and removed from the site.

7.3. No pipe shall be laid until the trench has been inspected and approved by the S.O..

7.4. The pipes shall be gently lowered into the trench by means approved by the S.O.. No pipes shall be rolled or dropped into the trench. The pipe shall be laid true to alignment as shown in the Drawings or as instructed by the S.O.. Interior and exterior of each pipe at the joint shall be thoroughly cleaned before the joint is made. Pipes shall be laid from the downstream end towards the upstream end.

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7.5. To prevent the entry of earth and other materials into the pipes, the Contractor shall provide and fix suitable stops for efficiently closing all open ends of pipes in the trench while work is not actually being carried out at such open ends.

7.6. Socketed pipes shall be laid with the sockets laid against the direction of flow. At every position of pipe joint's, the bedding shall be recessed sufficiently.

7.7. Where sewer pipes are to be laid on concrete bed, hunched or encased in concrete surrounds, these shall be as shown on the Drawings and as specified hereinafter.

7.8. The gravity sewer pipes shall be laid to the gradients as shown on the Drawings. Where the gradients are not shown in the drawings, the pipe shall be laid to the following gradients as shown in the **Table F1**.

Table F1. Gradient of Sewer Pipes

Size diameter (mm)	Gradient
100	1 : 60
150	1 : 80
225	1 : 110
250	1 : 120
300	1 : 140
375	1 : 170
450	1 : 200

NOTE: Not applicable for force mains.

7.9. The invert level of each pipe laid shall be checked during laying and immediately after laying as shown on the Drawings.

7.10. Where sewer pipes are laid above ground, they shall be supported at intervals to the details as shown on the Drawings or to the approval of the S.O..

7.11. All external underground sewer pipes shall have a minimum cover of 450mm unless otherwise shown on the Drawings.

7.12. Sewers pipes shall not be laid above the water pipes. A minimum vertical clearance of 1.0m shall be provided between the crown of a sewer pipe and the bottom of a water pipe. The horizontal clearance between sewer and water pipelines shall be 3.0m where applicable unless otherwise shown on the Drawings.

7.13. Other requirements

7.13.1. For easy identification of underground forced sewer mains, the layout shall be planted with marker posts at every 200m length and at every change of pipe direction. Valve chambers provided shall have adequate access for operations and maintenance.

8. Bedding, Haunching and Surround

8.1. Concrete bed, haunching and surround shall be of concrete Grade 20P.

8.2. Typical bedding is to be used for all pipes under normal site condition unless directed by the S.O..

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8.3. Only approved materials are allowed to be used for pipe embedment.

8.4. The bedding material shall be placed as soon as possible after the base of the trench is prepared and excess water has been removed.

8.5. Whenever the bedding is disturbed, the pipe shall be raised to allow for repair works to be done.

8.6. Any pegs or other temporary aids for levelling works shall be removed before any pipe being laid.

9. Connections

9.1. The Contractor is to allow and provide for all bends, junctions, traps, gullies as shown on the Drawings or where necessary. If a gully is used, it shall be of the inlet type, and shall be set level on a concrete base, with a riser to finish 50mm above the surrounding surface level, complete with concrete surrounds rendered on all sides and galvanized iron grating. Bends turned up to receive various stacks shall be set on concrete bases to the approval of the S.O.. The bends at the foot of vertical stacks shall be of gentle radius type.

9.2. All underground fittings shall be completely surrounded in concrete and the Contractor shall allow for any additional excavation and jointing of pipes.

10. Manholes, Inspection Chambers and Valve Chambers

10.1. Manholes, inspection chambers and valve chambers shall be constructed with the sizes shown on the Drawings and *MSIG guidelines*. Unless otherwise shown or specified, all dimensions on the plan shall be the inside measurement.

10.2. Manholes and inspection chambers shall be protected by lining/coating to prevent corrosion of the concrete due to sulphide attack. Internal walls shall be either rendered with sulphate resistant cement mortar at least 20mm thick or lined with PVC, HDPE or epoxy coating.

10.3. Manholes

10.3.1. Manhole Covers and Frames

10.3.1.1. No manhole shall be constructed on the road and hard standing unless otherwise shown on the Drawings.

10.3.1.2. Manhole covers, and frames shall comply with Drawings and *MSIG guidelines*.

10.3.1.3. All surfaces of manhole's covers and frames supplied shall be coated as stated in *MSIG guidelines* with either:

(i) Hot applied bituminous material complying with BS EN 10300 (Steel tubes and fittings for onshore and offshore pipelines. Bitumen hot applied materials for external coating).

(ii) Cold applied bituminous material complying with BS 3416 (Specification for bitumen-based coatings for cold application, suitable for use in contact with potable water)

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10.3.2. Manhole Testing (Before Backfilling)

10.3.2.1. Water-tightness test shall be conducted where no visible leakage shall occur between the manhole cover and its seating in the frame when tested in accordance with *MSIG guidelines.*

10.3.2.2. A visual inspection shall be conducted on all the external and internal section of each manhole in accordance with *MSIG guidelines.* Particular attention shall be given to:

(i) The slope of benching.

(ii) Joints to pipes.

(iii) Transitions at entry and exits.

(iv) Joints in the structure.

(v) Quality of concrete finish.

(vi) Water-tightness of manhole covers and surround.

10.4. Inspection Chambers

Unless otherwise as shown on the Drawings, inspection chambers shall be constructed in brickwork in cement mortar (1:2) and the brickwork shall be of clay bricks and constructed on Grade 20P concrete foundation. The thicknesses and sizes shall be as shown on the Drawings. Each inspection chamber shall have channels and open channel junctions of sizes as shown on the Drawings. Concrete benching shall be to a gradient of 1:6 and shall be of Grade 20P concrete finished with 19mm steel troweled water proofed cement and sand (1:3) rendering. The internal sides of the inspection chambers shall be lined with 20mm thick PVC, HDPE or epoxy coating. Externally, the exposed concrete or brick surfaces shall be rendered with 12mm cement and sand mortar (1:3) and terminated 150mm below the finished ground level. All internal angles shall be rounded off. Inspection chambers shall be provided with covers and unless specified or as shown on the Drawings, covers shall be medium duty 450mm x 600mm cast iron covers with air tight frames.

11. Septic Tank and Sewage Treatment System

11.1. Septic tank and sewage treatment system shall be constructed as shown on the Drawings and to the approval of the S.O..

11.2. All septic tank and sewage treatment system shall be approved only by SPAN. Prefabricated system by the S.P. shall be from the updated Treasury Contract Circular.

11.3. The quality limit for sewage effluent at the discharge point shall comply with *Environmental Quality Act (EQA) 1974* or latest. The limit for sewage effluent at the discharge point shall comply with Standard A of *EQA* as in **Appendix F/1.**

11.4. Sewage Treatment System

11.4.1. Prior to the installation of the sewage treatment system, the Contractor shall submit to the S.O. the approved drawings duly endorsed by the authority, system design, method of statement including structural, foundation, external work and M & E work duly certified by a

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Professional Engineer with Practicing Certificate (P.E.P.C.) registered with the Board of Engineers Malaysia.

11.4.2. Sewage treatment system shall be approved by the Local Authority/Certified Agency before installation at site. The submission approval to the Local Authority/ Certified Agency is as per **Appendix F/1.**

11.4.3. The S.P. shall provide specification on construction and installation of the system and during these periods, the Local Authority/Certified Agency will carry out inspection to ensure the compliance of their requirements.

11.4.4. Upon the completion of the installation of the sewage treatment system and prior to the issuance of the Certificate of Practical Completion, the Contractor shall submit the following documents to the S.O. for information and record:

11.4.4.1. S.P.'s Guarantee against any defects or damages during a period of five (5) years from the date of Certificate of Practical Completion due to any defect, fault or insufficiency in design, material or workmanship or against any other failure which an experienced Contractor may reasonably contemplate but shall not include normal replacement and maintenance. The terms of the Guarantee shall be such as approved by the S.O..

11.4.4.2. As-built drawings and *Operation Manual and Maintenance (OMM)* of the sewage treatment system certified by a Professional Engineer with Practicing Certificate (P.E.P.C.) registered with the Board of Engineers Malaysia.

12. Connections to the Public Sewerage Line

Connections to the public sewerage line, if any, shall be strictly carried out in accordance with requirements of the *SPAN guidelines* and to the approval of the S.O..

13. Testing for Sewer Pipes Installation

13.1. The Contractor shall carry out tests to the sewer pipes installation in accordance with the method of statement and requirements as described hereinafter. The Contractor shall give reasonable notice in writing to the S.O. before such tests to be carried out.

13.2. Testing of pipework shall be carried out and wherever possible, such testing shall be carried out from manhole to manhole. Short branch pipes connected to a main sewer between manholes shall be tested as one system with the main sewer. Long branches and manholes shall be separately tested.

13.3. Subject to type of pipe and size, pipes shall be subjected to either low water pressure tests, CCTV test or any other test required by the *MSIG guidelines* and to the approval of the S.O..

13.4. Low water pressure test

13.4.1. The low water pressure test is commonly used for checking the water tightness of the joints and the integrity of the sewer pipes.

13.4.2. For the water test, the pipe shall be subjected to an internal test pressure of 2m head of water above the crown of the pipe at the higher end but

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not more than 7m at the lower end. Steeply graded pipe shall be tested in such a manner that the above maximum heads are not exceeded.

13.4.3. The test shall be carried out by filling the sewer with water slowly to the required head and bleed air from behind the upstream plugs. Maintain the water head for two (2) hours. Top up the water as required.

13.4.4. Check the leakage at the plugs and the test apparatus during the pressurizing period and the constant pressure holding period. Release the water pressure if leakage occurs. Make the necessary repairs and adjustments before pressurizing again.

13.4.5. Commence the test immediately after the last adjustment of water head in the preceding two (2) hours period.

13.4.6. Add water to maintain the starting water head every five (5) minutes during the test period of 30 minutes. Record the total amount of water required for readjustment.

13.4.7. The test is considered pass when:

13.4.7.1. The loss of water does not exceed 1 litre per hour linear meter per meter internal diameter for VCP and reinforced concrete pipes.

13.4.7.2. There shall be no loss of water for pipe other than VCP and reinforced concrete pipes.

13.4.7.3. There is no visible leakage at the joints for all pipe types.

13.5. Closed-circuit Television (CCTV) Testing (if required)

13.5.1. General

CCTV inspection where required shall be carried out to enable detection of sewer defects such as cracks, deformations, collapse, dislocation et cetera which are not detected by normal means.

13.5.2. Inspection Requirements

13.5.2.1. A CCTV Inspection Contractor registered with SPAN shall be appointed to carry out the inspection works.

13.5.2.2. General Inspection Coverage

Initial CCTV testing and inspection shall be conducted for a minimum 10% random selection of sewer pipes including all manholes and connections in accordance with *SPAN guidelines.*

13.5.2.3. High Risk Areas

(i) 100% CCTV inspection shall be conducted for sewer pipes including manholes laid in the ground with high risk of failure and having the following characteristics:

a) Crossing under buildings, roads, railway, rivers and lakes including their reserve.

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b) Crossing using pipe jacking method and horizontal drilling method.

13.5.3. Witness

Witness from the SPAN, S.O., consultant and contractor responsible for the construction of sewer shall be present during CCTV inspection.

13.5.4. Documentation

13.5.4.1. Within 7 days after completion of the inspection, the Contractor shall submit to the S.O. the following:

(i) Two (2) copies of digital records; and

(ii) One (1) copy of hardcopy report and recommendation

13.5.4.2. The format of the report and documentation shall be in accordance with *MSIG guidelines*. All documents shall be certified and duly signed by the qualified person responsible for the CCTV inspection declaring the authenticity of the recording submitted and done in accordance with the procedure stated in *MSIG guidelines*.

13.5.4.3. Documents shall be submitted to S.O. for the acceptance of completion of works.

(i) Photographs showing sewer pipe laying during and after construction.

(ii) Testing certificates.

(iii) Supervision report.

(iv) As–built drawings.

13.5.5. During Defects Liability Period

If any blockages, damages, seepages occur to the sewer networks during the Defects Liability Period, the S.O. may require the Contractor to carry out further CCTV inspection to determine the cause within 24 hours.

14. Backfilling

14.1. After the pipes have been tested and approved, the trench shall be backfilled with approved fill material, free from rock and other hard material, well compacted around the pipes up to a level of at least 300mm above the top of the pipes. After this has been approved, the remaining excavation shall be backfilled in 300mm layers, each layer being well compacted. The bedding details and the types of fill material shall in accordance to Drawings and *MSIG guidelines*.

14.2. Trench support shall be progressively removed during the backfill work.

14.3. There shall be at least 300mm of cover over the sewer pipe before light mechanical compaction can commence.

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14.4. There shall be at least 1000mm of cover (depth of backfill) over the sewer before heavy mechanical compaction can commence.

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APPENDIX F/1

Table F2. Parameter Limits for Sewage and Industrial Effluents

Parameter	Effluent discharge to rivers/stream				Effluent discharge to stagnant water bodies*			
	Standard A		Standard B		Standard A		Standard B	
	Absolute	Design	Absolute	Design	Absolute	Design	Absolute	Design
BOD5	20	10	50	20	20	10	50	20
SS	50	20	100	40	50	20	100	40
COD	120	60	200	100	120	60	200	100
AMN	10	5	20	10	5	2	5	2
Nitrate Nitrogen	20	10	50	20	10	5	10	5
Total Phosphorus	N/A	N/A	N/A	N/A	5	5	10	5
O&G	5	2	10	5	5	2	10	5

NOTES 1) N/A = not applicable.
2) All values in mg/l unless otherwise stated.
3) *Stagnant water bodies refer to enclosed water bodies such as lakes, ponds and slow-moving watercourses where dead zone occurs.
4) A: Discharge upstream of water supply sources.
5) B: Discharge downstream of water supply sources.

Table F3. Sewerage Work Submission

No.	Type of System	Allowable Population Equivalent (PE)	Document Requirement
1.	Individual Septic Tank (IST) Network Connection (Single Manhole directly connected to Existing Manhole)	6 - 30	Pre-Tender Sewerage Works Application (SWA) Post-Tender Sewerage Works Completion (SWC)
2.	Small Sewerage Treatment Plant (SSTS)	31 - 149	SWA (Pre-Tender) SWC (Post-Tender)
3.	Sewerage Treatment Plant (STP)	150 – 5,000	Refer Table F4

NOTE : The submission procedure might change due to authority requirement.

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Table F4. Sewerage Work Submission for STP

No.	Item	Description	Submitting Person / Person in Charge
1.	PDC 1	Planning Approval	HODT
2.	PDC 2	(i) Sewer pipe reticulation (ii) SSTS/STP Detail Design	(i) HODT (ii) S.O./Contractor
3.	PDC 3	Detail for Structural Plans and Design Calculations	S.O./Contractor
4.	PDC 4	Detail for Electrical Design and Drawing	S.O./Contractor
5.	PDC 5	Details for Equipment and Material Data Sheets (EMDS)	S.O./Contractor
6.	PDC 6	Notice of Commencement Sewerage Works/Septic Tank Works	S.O./Contractor
7.	PDC 7	Notice of Intermediate Inspection of Sewerage Works	S.O./Contractor
8.	PDC 8	Notice of Final Inspection	S.O./Contractor
9.	PDC 9	Declaration by Competent Person Who Supervised the Septic Tank Works.	S.O./Contractor

NOTES 1) PDC – Planning, Design and Construction
2) The submission procedure might change due to authority requirement.

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ROOFING

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1. General

1.1. Unless otherwise stated, the pitch and batten gauge for each type of roof covering shall be strictly in accordance with the manufacturer's recommendation.

1.2. Unless otherwise approved, all roof covering pieces or accessories such as eaves, hips, ridges, valley et cetera, shall be of the same material as the general covering.

2. Interlocking Concrete Tiles

2.1. Interlocking concrete roof tiles shall be laid on timber or steel battens approved for roofing at spacing and tightly nailed or screwed as recommended by the manufacturer.

2.2. Unless otherwise specified, the concrete roof tiles shall be laid to slope in accordance to the manufacturer's recommended pitch and to the S.O.'s approval. The roof tiles shall conform to MS797 and unless otherwise specified on the Drawings, it shall be laid on metal trusses system to engineer's detail and S.O.'s approval.

2.3. Water repellent materials backed with weatherproof self-adhesive compound for ridges and hips solution laid in accordance with manufacturer's instruction.

2.4. Verges, ridges, hips, valley tiles and complete with all roofing accessories shall be provided and laid to bond with the general roof tiling works in accordance with the manufacturer's recommendation.

2.5. Unless otherwise stated in the drawings, where skylight roofing sheets are to be used, they shall be of transparent skylight roofing sheets [acrylic/polycarbonate (PC)/unplasticized poly vinyl chloride (UPVC) multilayer/laminated glass] or translucent skylight roofing sheets [fibreglass reinforced polyester (FRP)] of concrete roof tiles profiles. The minimum thickness gauge and fixing system of the skylight roofing sheets is accordance with the manufacturer's recomendation.

3. Clay Tiles

3.1. Unless otherwise stated in the Drawings, clay tiles shall be of 425mm to 490mm (length) x 280mm to 300mm (horizontal width) pattern confirming to BS 402 or SS 70 and shall be free from cracks, chips and warps.

3.2. Clay tiles shall be laid with a minimum head lap of 75mm to 95mm on timber or steel battens approved for roofing at spacing as recommended by the tile manufacturer. The tiles shall be firmly screwed or nailed at intervals as recommended by the roofing tile manufacturer and as approved by the S.O..

3.3. Ridge capping, hip and valley tiles complete with all roofing accessories shall be provided to match the general tiling works in accordance with the manufacturer's recommendation. All these shall be bedded in matching water repellent materials backed with weatherproof self-adhesive compound.

3.4. Roofing components at roof eave to allow airflow and prevents the entry of birds and vermin into the batten cavity is recommended.

3.5. Unless otherwise stated in the drawings, where skylight roofing sheets are to be used, they shall be of transparent skylight roofing sheets [acrylic/polycarbonate (PC)/unplasticized poly vinyl chloride (UPVC) multilayer/laminated glass] or translucent skylight roofing sheets [fibreglass reinforced polyester (FRP)] of clay

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roof tiles profiles. The minimum thickness gauge and fixing system of the skylight roofing sheets is accordance with the manufacturer's recomendation.

4. Pre-painted Aluminium Roofing Sheet

4.1. Unless otherwise stated, where aluminium roofing sheets are to be used, they shall be of the type, gauge and finish as shown in the Drawings and to be fixed strictly in accordance with the manufacturer's recommendation.

4.2. Unless otherwise stated in the drawings, where skylight roofing sheets are to be used, they shall be of transparent skylight roofing sheets [acrylic/polycarbonate (PC)/unplasticized poly vinyl chloride (UPVC) multilayer/laminated glass] or translucent skylight roofing sheets [fibreglass reinforced polyester (FRP)] of aluminium roof sheets profiles. The minimum thickness gauge and fixing system of the skylight roofing sheets is accordance with the manufacturer's recomendation.

5. Concrete Flat Roofs

Concrete flat roofs shall be as specified under SECTION D: CONCRETING.

6. Pre-painted Steel Roofing Sheet

6.1. Unless otherwise stated, the metal roof decks shall comply with the following:

6.1.1. Materials

6.1.1.1. The roofing sheets shall be produced from zinc coated steel conforming to MS2385 and AS 1397:"Hot-Dip Zinc-Coated Carbon Steel Sheet of Commercial and Drawing Qualities", MS 2384:"Hot-Dip Zinc-Coated Carbon Steel Sheet of Structural Quality" and JIS G3302:"Hot-Dip Zinc-Coated Steel Sheet and Strip" OR be produces from aluminium/zinc alloy coated steel conforming to MS 1196:"Continous Hot-Dip Aluminium/Zinc Coated Steel Sheet of Commercial, Drawing and Structural Qualities" and AS 1397 "Steel Sheet and Strip-: Hot-Dip Zinc Coated or Aluminium/Zinc Coated".

6.1.1.2. The pre-painted finish over the zinc coated base steel OR aluminium/zinc alloy coated base steel shall conform to MS 2383: "Prefinished/Pre-painted Sheet Metal Products for Interior/Exterior Building Applications – Performance Requirements" under product type 3 conforming to ISO 9223 Category 3 (C3) environment. and AS/NZS 2728: "Prefinished/Pre-painted Sheet Metal Products for Interior/Exterior Building Applications – Performance Requirements".

6.1.1.3. The exterior finish coat shall have a nominal film thickness of 20µm over 5µm thick corrosion inhibitive primer on top side or weather side. The backing coat shall be with nominal film thickness of 5µm over 5 µm corrosion inhibitive primer.

6.1.1.4. Minimum steel yield strength shall be 300 or 550MPa.

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6.1.1.5. The minimum aluminium/zinc alloy coating mass shall be 150g/m² (Coating Class AZ 150) on both surfaces conforming to ISO 9223 Category 3 (C3) environment.

6.1.1.6. The Contractor shall submit material warranty from the manufacturer in accordance with ISO 9223: "Corrosion of Metals and Alloys – Corrosivity of Atmosphere - Classification" of the project site and the format approved by the S.O. Material warranty shall be up to 25 years against perforation by corrosion, 15 years against flake and peel, 10 years against colour fading and 5 years against dirt staining.

6.1.1.7. The Contractor shall submit shop drawings for the S.O.'s approval prior to commencement of installation works.

6.1.1.8. Unless otherwise stated in the drawings, where skylight roofing sheets are to be used, they shall be of transparent skylight roofing sheets [acrylic/polycarbonate (PC)/unplasticized poly vinyl chloride (UPVC) multilayer/laminated glass] or translucent skylight roofing sheets [fibreglass reinforced polyester (FRP)] of steel roof sheets profiles. The minimum thickness gauge and fixing system of the skylight roofing sheets is accordance with the manufacturer's recomendation.

6.1.2. Metal Sheet Profiles

6.1.2.1. Unless otherwise specified or shown in the Drawings, the metal sheet profile shall be of a concealed fixing system complying with MS2500 as approved by the S.O.. The roofing sheets shall have the following-requirements:

(i) Base Metal Thickness (BMT) = 0.42mm.

(ii) Total Coating Thickness (TCT)= 0.47mm

(iii) Cover width = 430mm to 680 mm.

(iv) Rib height = 25mm to 43 mm.

(v) Coating = Pre-painted aluminium/zinc coated steel with AZ150 (150g/m²) or AZ200 (200g m²/) on both surfaces.

6.1.2.2. Where pierced fixing system complying with MS 2500 is specified or shown in the Drawings, the roofing sheet shall have the following requirements:

(i) Base Metal Thickness (BMT) = 0.42mm.

(ii) Total Coating Thickness (TCT) = 0.47mm

(iii) Cover width = 750 to 1015mm

(iv) Rib height = 16mm to 38mm

(v) Coating = Pre-painted aluminium/zinc coated steel with AZ150 (150g/m²) or AZ200 (200g m²/) on both surfaces.

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6.1.3. Fixing

6.1.3.1. Installation procedures shall conform to the recommendation of the manufacturer.

6.1.3.2. The roofing sheets shall be installed and fixed according to the following method:

(i) Concealed fixing using approved clips compatible with the roofing sheet.

(ii) Pierced fixing using approved fasteners compatible with the roofing sheet.

6.1.3.3. The roofing installer shall be registered with CIDB.

6.1.3.4. Metallic swarf and all other debris including nail, screws, mortar, construction materials et cetera shall be swept away from the roof area and gutters regularly, particularly at the end of each day's work and at completion of the installation works.

6.1.4. Clips and Fasteners

6.1.4.1. Fasteners type shall comply with AS 3566 Class 3 and be certified as such by the supplier of fasteners.

6.1.4.2. The recommended type of fasteners shall conform to the following test:

(i) Salt spray test - 1000 hours

(ii) Kesternich test - 15 cycles.

(iii) Humidity test - 1000 hours.

(iv) UV test - 2000 hours.

6.1.4.3. All fasteners and screws shall be of the self-drilling type either concealed or screwed fixing, complete with preassembled ethylene propylene diene monomer (EPDM) rubber washers.

6.1.5. Flashing and Capping

Approved 0.42mm BMT ridge capping, flashing, capping and trimming shall be manufactured to the required shape and sizes. The flashing and capping materials used shall be from the same material as the roofing sheets.

6.1.6. Sealants

Only neutral cure silicone rubber sealant type Dow Corning 780 or equivalent shall be used conforming to AS 3902.

6.1.7. Lightning Conductors

Aluminum lightning conductor is recommended for use on steel roof system.

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6.2. All fixing accessories shall be rust-resistant and of suitable design and construction as recommended by the manufacturer for the roofing system and as approved by the S.O.. All fasteners and screws shall be of the self-drilling type either concealed or screwed fixing, complete with preassembled EPDM rubber washers.

6.3. Identification, storage and packaging of alum/zinc steel roof decking shall be strictly in accordance with the manufacturer's recommendation and comply with the S.O.'s requirements.

6.4. All roof decking sheets, capping, flashing et cetera or wall cladding shall be new, clean, regular, straight and true to shape with sharp defined profiles, free from cracks, chips, bends and defects detrimental to practical use or from other surface imperfections.

6.5. At Site, the sheets shall be lifted from the transport carrier by a crane and properly stacked clear of the ground, ready to be lifted up to the roof structure for laying. Where sheets are to be manually lifted, care should be taken not drag the sheets to avoid scraping away the surface coating.

6.6. Where storage is necessary, stack heights shall be kept to a minimum and the sheets shall be stacked in a sloping position. Sheets shall be stacked off a dry firm ground, under cover by tarpaulin or polythene sheets but ventilated and away from building operations. Should the stack sheets become wet, they shall be immediately dried to prevent staining and degradation of the surface coatings.

6.7. The Contractor shall be responsible for the absolute water-tightness of the roof and must ensure that the method of installation, fixing and fastening decking sheets, caps, flashings et cetera including acoustical, insulation and expansion joints, whenever required shall conform strictly to the manufacturer's recommendation.

6.8. The completed portions of the roof shall be clear of all metallic particles such as blind rivet shanks, screws, nuts, nails et cetera and dirty foot prints should be wiped off to avoid early deterioration/corrosion and discolouration. Damages to the coating shall be repaired with touch-up paint as recommended by the manufacturer and approved by the S.O..

7. Roofing Sheet for Marine Environment (Coastal Areas)

7.1. The Contractor shall select the correct type of metal sheet profile to be installed for coastal areas as recommended by the roof manufacturer and approved by the S.O..

7.2. Unless otherwise specified or shown in the Drawings, the roofing sheet for marine environment shall be metallic coated steel with minimum zinc coating mass of 350g/m² (Coating Class Z350) OR minimum aluminium/zinc alloy coating mass of 200g/m² (Coating Class AZ 200) on both surfaces.conforming to ISO 9223 Category 4 (C4) and Category 5 (C5) environment.

7.3. Metallic coated steel with zinc or aluminium/zinc alloy shall be manufactured and certified by SIRIM according to MS2385:"Hot-Dip Zinc-Coated Carbon Steel Sheet of Commercial and Drawing Qualities"or MS 2384:"Hot-Dip Zinc-Coated Carbon Steel Sheet of Structural Quality" OR MS 1196 'Continuous Hot-Dip Aluminium/Zinc Coated Steel Sheet of Commercial, Drawing and Structural Qualities' or AS 1397 'Steel Sheet and Strip: Hot-Dip Zinc Coated or Aluminium/Zinc Coated'.

7.4. The pre-painted finish (super polyester paint or PVDF paint) type shall be used over the zinc coated base OR aluminium/zinc alloy coated base steel shall conform to MS 2383: "Prefinished/Pre- painted Sheet Metal Products for Interior/Exterior

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Building Applications - Performance Requirements" and AS/NZS 2728: "Prefinished/Pre-painted Sheet Metal Products for Interior/Exterior Building Applications - Performance Requirements" under product type 5 and 6 conforming to ISO 9223 Category 5 (C-5) environment.

7.5. Fasteners used shall comply with AS 3566 Class 4 and be certified as such by the supplier of fasteners and to the approval of the S.O..

7.6. All fixings and associated components shall be manufactured from compatible metals and coated conforming to ISO 9223 Category 4 (C4) and Category 5 (C5) environment. Flashings shall be made from the same material as the roofing sheets.

7.7. Unless otherwise stated in the drawings, where skylight roofing sheets are to be used, they shall be of transparent skylight roofing sheets [acrylic/polycarbonate (PC)/unplasticized poly vinyl chloride (UPVC) multilayer/laminated glass] or translucent skylight roofing sheets [fibreglass reinforced polyester (FRP)] of roof sheets profiles. The minimum thickness gauge and fixing system of the skylight roofing sheets is accordance with the manufacturer's recomendation.

8. Bituminous Corrugated Roofing Sheets

8.1. Unless otherwise shown on the Drawing, the bituminous corrugated roofing sheets shall have the following minimum requirements:

8.1.1.	Length	= 2000mm
8.1.2.	width	= 950mm
8.1.3.	cover width	= 855mm
8.1.4.	thickness	= 3mm
8.1.5.	weight of material	= 3.3kg/m^2
8.1.6.	thermal resistance R- value	= 0.04mK/W
8.1.7.	thermal conductivity	= 0.066W/mk

8.2. Unless otherwise shown on the Drawings, the Bituminous Corrugated Roofing Sheets shall be laid at a minimum roof pitch of 5° on timber battens at spacing and tightly nailed/screwed as recommended by the manufacturer.

8.3. Ridge capping, nails and screws shall be provided to match the roofing sheets while ridges, verges, eaves, hips, valleys, side-wall and end-wall details shall be fixed strictly in accordance with the manufacturer's recommendation.

9. Bituminous Corrugated Roofing Tiles

9.1. Unless otherwise shown on the Drawing, the bituminous corrugated roofing tiles shall have the following minimum requirements:

9.1.1.	Length	= 1060mm
9.1.2.	Width	= 400mm
9.1.3.	Wave Height	= 40mm

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9.1.4. thickness = 3mm

9.2. Bituminous roofing tiles shall be laid at a minimum roof pitch of 9° and on timber or steel battens approved for roofing at spacing and tightly nailed/screwed as recommended by the manufacturer.

9.3. Ridge capping, nails and screws shall be provided to match the roofing tiles while ridges, verges, eaves, hips, valleys, side-wall and end-wall details shall be fixed strictly in accordance with the manufacturer's recommendations.

10. Fibre-cement Corrugated Sheets

10.1. Fibre-cement corrugated sheets shall comply with MS 1224. The thickness of the sheets shall be 3mm thick for shallow corrugation and 4mm thick for medium corrugation. The cement shall comply with MS 522: Part 1. Asbestos processed or unprocessed shall not be added to fibre-cement sheets.

10.2. The surface intended to be exposed to the weather shall have a generally smooth finish. Variations of the surface appearance which do not impair the characteristics of the sheets as defined in MS 1224 are permitted.

10.3. Unless otherwise stated in the drawings, where skylight roofing sheets are to be used, they shall be of transparent skylight roofing sheets [acrylic/polycarbonate (PC)/unplasticized poly vinyl chloride (UPVC) multilayer/laminated glass] or translucent skylight roofing sheets [fibreglass reinforced polyester (FRP)] of corrugated roof tiles profiles. The minimum thickness gauge and fixing system of the skylight roofing sheets is accordance with the manufacturer's recomendation.

11. Heat Insulation

11.1. General

Heat insulation system shall comply with MS 1020 and MS 1525. Samples of the insulation material shall be submitted to the S.O. for approval before they are used, and subsequent delivery shall be up to the standard of samples approved.

11.2. Reflective Foil

11.2.1. Reflective foil shall be fire retardant double sided aluminium reflective foil bonded to reinforced high density polyethylene woven fabric comply with MS2095 : 2014

11.2.2. The reflective foil materials used shall conform to fire safety requirements and BS 476 Part 6 & Part 7 (Class O): Fire Test on Building Materials and Structures on the following test:

11.2.2.1. Part 6: Method of test for fire propagation for products conforming to BS 476

11.2.2.2. Part 7: Method of test to determine the classification of the surface spread of flame confirming to BS 476

11.2.3. Reflective foil properties shall conform to the following:

11.2.3.1. Thickness : 137 ± 20 micron thick.

11.2.3.2. Grammage : 163 ± 10g/m^2.

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11.2.3.3. Tensile strength : 500 N/ 50mm (MD), 500 N/50mm (Cross Direction) MD≥9.5 ; CD≥6.0.

11.2.3.4. Emissivity ASTM E408 ≤ 0.05(97±2%) / Reflectivity = 95% ASTM C1371 ≤0.05

11.2.3.5. Initial Tear resistance: ASTM D1004 >30N ≥65.0

11.2.4. Reflective foil material may be used on its own with all types of roofs except with metal decking roof. Where roof is of metal decking, the reflective insulation material shall be laid below stone wool or glass wool for effective thermal and acoustic performance.

11.2.5. The reflective foil material shall be installed strictly in accordance with the manufacturer's recommendation. A uniform air space of 20mm to 50mm between the tile roof covering and the insulation material shall be provided to ensure the effectiveness of the reflective surface. All punctures shall be effectively sealed with similar reflective material to prevent air leakage and moisture transfer.

11.2.6. The reflective foil surface shall be free from any thin film of oil, plastic or lacquer coatings. All dust and/or moisture, if any, shall be thoroughly cleaned prior to installation. All dust and/or trademarks shall be limited to a maximum of 5% of the total reflective area. The insulation material shall be fitted closely around electrical outlet boxes, plumbing and et cetera, and taped securely to eliminate gaps or voids through which air or water vapour might pass into the cooler space.

11.3. Glass Wool Insulation

11.3.1. Unless otherwise shown in the Drawings, It shall have R-Value @ R2.0 to R2.3 m²KW (tested at a mean temperature of 20°C based MS1020 and MS1525 tested according to ASTM C177/C518). The glass wool insulation material used shall conform to BS 476 for Fire tests on building materials and structures on the following:

11.3.1.1. Part 6: Method of test for fire propagation for products conforming to BS 476

11.3.1.2. Part 7: Method of test to determine the classification of the surface spread of flame confirming to BS 476

11.3.2. The glass wool insulation material used shall be of no added urea formaldehyde and as approved by the S.O.. Glass wool insulation shall be fixed in accordance with the manufacturer's recommendations and to the approval of the S.O..

11.3.3. Where single skin metal roof is applied, galvanized wire mesh BRC 3316 or equivalent shall be used to support the reflective foil and the glass wool insulation.

11.4. Mineral Wool Insulation

11.4.1. Unless otherwise shown in the Drawings, it shall have R-Value @ R2.0 to R2.3 m²KW (tested at a mean temperature of 20°C based MS1020 and MS1525 tested according to ASTM C177/C518). The mineral wool insulation material used shall conform to BS 476 for Fire tests on building materials and structures on the following:

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11.4.1.1. Part 6: Method of test for fire propagation for products conforming to BS 476.

11.4.1.2. Part 7: Method of test to determine the classification of the surface spread of flame confirming to BS 476.

11.4.2. The mineral wool insulation material used shall be of no added urea formaldehyde and as approved by the S.O.. Mineral wool insulation shall be fixed in accordance with the manufacturer's recommendations and to the approval of the S.O..

11.4.3. Where single skin metal roof is applied, galvanized wire mesh BRC 3316 or equivalent shall be used to support the reflective foil and the mineral wool insulation.

11.5. Stone Wool Insulation

11.5.1. Unless otherwise shown in the Drawings, stone wool insulation shall be 50mm thick minimum. It shall have R-Value @ R2.0 $m^2 \cdot KW$ (tested at a mean temperature of 20°C based MS1020 and MS1525 tested according to ASTM C177/C518). The stone wool insulation material used shall conform to BS 476 for Fire tests on building materials and structures on the following:

11.5.1.1. Part 6: Method of test for fire propagation for products conforming to BS 476.

11.5.1.2. Part 7: Method of test to determine the classification of the surface spread of flame confirming to BS 476.

11.5.2. The stone wool insulation shall conform to the following:

11.5.2.1. Thermal conductivity 0.034 - 0.036 W/mK at 20°C mean temperature tested in accordance to ASTM C518.

11.5.2.2. Noise reduction coefficients (NRC) of up to 1.0 tested to BS EN ISO354 at 50mm thickness.

11.5.2.3. Non-combustible according to BS 476 Part 4 or EN 13501-1 and melting point of at least 1000°C in accordance to ASTM E794.

11.5.2.4. No CFCs, HFCs, HCFCs or asbestos shall be used in the manufacture of the product.

11.5.2.5. No perceptible odor shall be present when tested in accordance to ASTM C665.

11.5.2.6. Not sustaining fungus growth under normal conditions according to ASTM C1338.

11.5.2.7. The metal plates (steel and aluminium) in contact with the insulation shall show no corrosion greater than that observed on the comparative plates in contact with sterile cotton according to ASTM C665.

11.5.2.8. Flame spread index less than zero (0) and smoke developed index less than five (5) according to ASTM E84.

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11.5.2.9. Total VOC emission shall be less than 0.25 mg/m3 and particles emission shall be less than 0.02 mg/m^3 tested according to ASTM D5116.

11.5.2.10. Moisture absorption shall be less than or equal to 0.04%vol. according to ASTM C1104/C1104M and water absorption shall be less than or equal to 0.5kg/m^2 (short-term immersion) according to EN1609.

11.5.3. The stone wool insulation material used shall be of no added urea formaldehyde and as approved by the S.O.. Stone wool insulation shall be fixed in accordance with the manufacturer's recommendation and to the approval of the S.O..

11.5.4. The insulation material must be protected from the exposure of rain, water immersion and chemical contamination during the storage and installation. If the insulation is in contact with water, adequate drying time must be allowed to ensure that the insulation is completely dried prior to covering of the roof covers.

11.5.5. The stone wool insulation shall be installed to the thickness specified and place butt jointed. Wherever possible the Contractor shall avoid the compression of the insulation material.

11.5.6. Where single skin metal roof is applied, galvanized wire mesh BRC 3316 or equivalent shall be used to support the reflective foil and the stone wool insulation.

11.6. Cellulose Insulation

11.6.1. Unless otherwise shown in the Drawings, spray applied cellulose insulation shall be 30mm thick minimum. It shall have K-Value of 0.029 W/mK based MS1020 and MS1525 tested according to ASTM C177. The spray applied cellulose insulation material used shall conform to BS 476 Part 6 &7 for Fire tests on building materials and structures on the following:

11.6.1.1. Method of test for fire propagation for products.

11.6.1.2. Method of test to determine the classification of the surface spread of flame.

11.6.2. Cellulose insulation shall be:

11.6.2.1. Thickness = 30mm

11.6.2.2. Thermal conductivity (k-value) = 0.0029 W/mK tested to ASTM C-177.

11.6.2.3. Fire retardant Class "O" complying with BS476 Part 6 & 7 and endorsed by Jabatan Bomba Dan Penyelamat Malaysia.

11.6.2.4. Average moisture absorption of not more than 15% as per ASTM C739.

11.6.2.5. Tested Noise Reduction Coefficient of NRC 0.75 at 30mm thickness.

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11.6.2.6. Tested to be non-toxic and asbestos free, contain no carcinogenic materials and shall not cause any skin irritation to humans

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SPESIFIKASI

TIMBER, JOINERY AND IRONMONGERY

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1. General

1.1. Unless otherwise specified or shown in the Drawings, the timber species used for the Works shall be as stated hereinafter in the **TABLE H1**: Schedule of Timber Grouping and Usage. The strength grouping for timber shall be in accordance with MS 544 as shown hereinafter in the **TABLE H2**: Schedule of Timber Species in Accordance with Strength Grouping.

1.2. All carpentry and joinery work shall include all necessary notching, halving, morticing and tenoning, wedging, scarfing, dovetailing, sinking for heads of bolts and nuts and trimming for opening.

1.3. All carpentry work shall be left with a sawn surface except where particularly described to be wrot. All joinery shall be wrot and finished with sand paper as required and all sizes stated are the finished sizes. Sizes for carpentry shall be within the tolerances stated in sub-section 2.1. and sizes for joinery shall be within the tolerances stated in sub-section 2.2..

1.4. Unless otherwise indicated in the Drawings, all fire protection materials and systems must show evidence that they have been subjected to the fire resistance test in accordance with BS 476 or other approved equivalent standards.

2. Timber Grades And Size Tolerances

2.1. Unless otherwise specified, sawn timber for carpentry work shall be as stated hereunder:

2.1.1. Select Structural Grade - for roof truss

2.1.2. Standard Structural Grade - for structural work

2.1.3. Sound Grade - for General Market Specification (GMS) and strips

2.1.4. Serviceable Grade - for scantling

2.2. Grading shall be carried in accordance with the Malaysian Grading Rules (MGR) by timber graders registered with the MTIB. Every timber consignment shall be accompanied by the Grading Summary and Certificate of Compliance certified by registered timber grader. The sample of Certificate of Compliance is shown in **Appendix H/2** as stipulated in MS 1714. Notwithstanding the certificate, the S.O. reserves the right to carry out independent tests at Makmal Anatomi Kayu, FRIM or Fibre and Biocomposite Centre (FIDEC), MTIB to determine the species and Strength Group (SG). The sizes of sawn timber, except where otherwise specified, shall be within the margin of permissible variations stated hereunder:

2.2.1. For widths, depths or thicknesses not exceeding 75mm - within 3mm of the specified size.

2.2.2. For widths, depths or thicknesses exceeding 75mm - within 5mm of the specified size.

2.3. The Contractor shall provide any necessary blocks, wedges or battens to compensate for irregular surfaces caused by any variations in size of timbers hereby permitted.

2.4. Unless otherwise specified or shown in the drawing, sawn timber for joinery work shall be of Sound Grade (General Market Specification (GMS) and Strips) and

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Serviceable Grade (Scantlings). The finished size for joinery, unless otherwise specified, shall be within the margin of permissible variation stated hereunder:

2.4.1. For widths, within 3mm of the specified finished size.

2.4.2. For thicknesses, within 2mm of the specified finished size.

2.5. Unless otherwise specified or shown in the drawing, the required actual dimensions shall be referred to the common commercial timber sizes given in **Table H6**.

3. Treatment of Timber

3.1. All timber except the heartwood of the naturally durable timbers as scheduled in **TABLE H2** hereinafter and timber for formwork, scaffolding, and other temporary works shall be impregnated by means of vacuum pressure processes in accordance with MS 360 using copper/chrome/arsenic (CCA) wood preservatives conforming to MS 733 in the treatment plant registered with the MTIB.

3.2. If a timber component has sufficient natural resistance to decay and insect attack by virtue of the natural durability of its heartwood, it may be used without treatment even where the hazard exists. The natural durability classification of Peninsular Malaysia and Sabah and Sarawak timbers for ground contacts can be found in MS 360 and as shown in **TABLE H4** and **TABLE H5**. Sapwood should not be used without preservative treatment.

3.3. All preservatives timber component for internal use and direct contact with humans shall be coated with a minimum of two coats of protective coating and shall be applied in accordance with the manufacturers' specification to S.O.'s approval.

3.4. Unless otherwise specified, the average moisture content for all timber shall not exceed 25% in accordance with MS 360. The moisture content shall be determined in accordance with one of the methods given in MS 837.

3.5. All timber shall be sawn or planed before treatment to achieve the finished cross-section required. As far as possible, all cross-cutting, boring, drilling or other processing should be carried out before treatment.

3.6. The pH value of the treating solution shall not be higher than 3.0 when determined by a glass electrode or pH paper at ambient temperature in accordance with MS 360.

3.7. The net dry salt retention shall be determined in accordance with one of the methods given in MS 360 and MS 821. The minimum salt penetration shall be determined by one the test methods given in MS 833.

3.8. The material shall be collected by drilling to the required depth as recommended and shown in MS 360 -**TABLE 4**. It can also be collected by sawing to the required depths, and then chipped to the small size. Either sawdust or chipped materials shall be ground to fine powder.

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3.8.1. The minimum net dry salt retention for CCA shall be as shown in the table below.

No	Use	Minimum Net Dry Salt Retention For CCA
i)	Interior and above the ground	5.6 kg/m³
ii)	Exterior and above the ground	8.0 kg/m³
iii)	Exterior and in contact with the ground (other than foundation piles)	12.0 kg/m³

3.8.2. All sapwood shall be fully penetrated by the preservative and for heartwood, the depth of penetration shall be at least 6mm for the surface of the specimen and any cracked section which may appear.

3.9. The Contractor, when required by the S.O. shall produce a certificate from a preservative treatment plant which certifies that timber required to be impregnated by means of vacuum pressure processes has been impregnated and has achieved the necessary nett dry salt retention. Notwithstanding the certificate, the S.O. reserves the right to carry out independent tests to determine the nett dry salt retention and the result so obtained shall be conclusive.

3.9.1. Treatment certificate

3.9.2. A treatment certificate shall be produced for each batch of timber delivered from the treatment plant. The relevant charge sheets shall be attached with each treatment certificate. The following information shall appear on the certificate:

3.9.2.1. Name and address of buyer;

3.9.2.2. Project title/reference;

3.9.2.3. Name of treating company;

3.9.2.4. Name of preservative(s) used;

3.9.2.5. Average retention of preservative obtained;

3.9.2.6. Charge sheet number and date of treatment;

3.9.2.7. Species of timber treated together with sizes and volume;

3.9.2.8. Commodity and hazard class; and

3.9.2.9. Other registration number (where applicable)

3.9.3. The certificate shall be signed by authorized personnel of the treating company, certifying that the timber has been treated in accordance with MS 360.

3.9.4. Timber treatment with other type such as heat treatment are allowed in accordance to relevant standard.

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4. Moisture Content And Storage

4.1. At the time of installation, the moisture content of the timber for the various applications shall not exceed that as specified in **TABLE H3** in accordance with MS 544: Part 1.

4.2. Moisture content for foundation piles, formworks and temporary works is not critical for these applications and therefore is not specified.

4.3. Moisture content of timber shall be determined as follow as in accordance with MS 837. The summary of standard procedure are as follows:

4.3.1. For determination of the average moisture content of test specimens, immediately weigh each of the test specimens or sections which are required to be free from saw dust and any loose splinters.

4.3.2. In cases when it is not possible to weigh the test specimens or sections immediately after cutting, place them in previously tared packets of moisture-proof plastic films and tightly sealed.

4.3.3. Dry the weighed test specimens or sections at a temperature of 103°C ± 2°C for at least 24 hours. To ensure that the test specimens or sections have attained approximately constant mass, a repeated weighing of two or three control pieces is required after further 2 hours. The difference in mass between the two successive weighing shall be less than 0.2%.

4.4. On delivery to the site, all timber other than timber for foundation piles, formworks and temporary works shall be properly open-stacked, under cover. Kiln dried timber shall be properly wrapped and stored under cover if it is not used immediately.

4.5. Care should be taken on site to ensure that the timber is adequately protected from the weather. This is particularly important with material dried to below 19% moisture content, since the full design load should not be applied if the moisture content rises above 19%.

5. Structural Assemblies Of Timber

5.1. The workmanship and method of assembly of structural timber shall generally be in accordance with MS 544 and in particular, the following requirements:

5.1.1. The quality of the surface, as finished, shall be appropriate to the position and use of the timber.

5.1.2. When grade or other necessary marks are removed, provisions shall be made for remarking in accordance with *Malaysian Grading Rules*. Surfaces at any joint in an assembly shall be such that the parts may be brought into contact over the whole area of the joint before connectors are inserted or any pressure or restraint from the fastening is applied. These surfaces shall have a good sawn or planed finish.

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5.1.3. Bearing surfaces of notches and other cuttings shall be true and smooth and in appropriate relation to the other surfaces of the piece.

5.2. Notches other than at the ends of beams shall be U-shaped formed by parallel cuts to previously drilled holes. The diameter of the hole shall be equal to the width of the required notch.

5.3. Where splitting is likely to have a deleterious effect, end sealing is recommended. For timbers known to split and check especially after installation, the ends of the boards and scantlings shall be protected with a coating designed to minimise end checking and checking and splitting. In severe cases where the ends and sides of heavy joists of timbers are liable to excessive split and check due to exposure to windward slanting sunlight, appropriate skirting or cover with a thin timber board shall be necessary.

6. Timber Joints

6.1. When solid timber members are to be jointed together using mechanical fasteners, the workmanship and method of assembly shall be in accordance with MS 544: Part 5. The mechanical fasteners are as listed below:

6.1.1. Nailed Joint

Where necessary to avoid splitting, nails shall be driven into pre-drilled holes or diameter not greater than four-fifths of the diameter of the nails. Care shall be taken to avoid placing nails in any end split.

6.1.2. Screwed Joint

Lead holes shall be used to ensure good workmanship in making screwed joints. The diameter of the hole for the shank shall be equal to the diameter of the shank, and for the threaded portion, the diameter of the hole shall not be greater than seven-eighth of the diameter of the root diameter of the screw thread adjacent to the shank. Care shall be taken to avoid placing screws in any end split.

6.1.3. Bolted Joint

6.1.3.1. Bolt holes shall be drilled to diameters as close as possible to the nominal diameter of the bolt and in no case more than 2mm larger than the bolt diameter. Care shall be taken to avoid placing a bolt in any end split. A minimum of one complete thread shall protrude from the nut.

6.1.3.2. A washer shall be fitted under the head of each bolt and under each nut. The minimum sizes of washers are shown in **Table H7** as given in accordance with MS 544: Part 6. Where joints using split-rings are to be used, as shown in the Drawings, the members of the joints shall be fitted together in their appropriate positions and clamped or spiked together before drilling. Alternatively, drilling jigs or multiple head boring machines may be used, or individual members may be marked out from the setting-out or by use of prepared templates.

6.1.3.3. If either of the latter methods is employed, sample members (usually the first ones produced) shall be carefully checked against the setting-out.

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6.1.3.4. In all instances holes for bolt positions shall be accurately determined by reference to the point intersection of the centre lines of the member. Great care is necessary if the first set members marked out is to be used subsequently as drilling templates. Greater accuracy can usually be obtained by the use of special marking or drilling templates located by a pin at the intersection of the center lines.

6.1.3.5. Bolts holes shall be drilled at right angles to the surface of the joint. The contact surfaces of the members should be grooved to the appropriate dimensions as given in Part 6 of MS 544.

6.1.3.6. Drilling and grooving may be done in a single operation; alternatively, if the hole is predrilled the pilot of the grooving tool shall fit in the bolt hole, thus centering the groove about the hole.

6.1.3.7. Care shall be taken to ensure that all chips and shavings are removed, and rings shall be expanded before being placed in the grooves.

6.1.3.8. The joint shall be finally assembled and bolts inserted. Washers of the correct dimension shall be placed under the head of the bolt and the nut, and the nut tightened to hold the members together.

6.1.3.9. Recess for shear-plate connectors shall be accurately cut by means of a suitable tool to be appropriate dimensions as given in MS 544: Part 6.

6.1.3.10. Assembly of units shall be done on a level bed and in such a way as to avoid damage to any of the members and so that the finished structural units conform to detailed Drawings and specification supplied.

6.1.3.11. When assembly is to be performed on the site, one set of component parts shall be fitted together and dismantled prior to dispatch to the site, in order to ensure that the assembled structural units conform to the detailed Drawings and Specifications. Twisted or damaged members shall be replaced before erection on the site.

6.1.3.12. Before proceeding with bulk production, a complete assembly of one of each framed truss or other structural unit shall be checked to prove the accuracy of the templates, etc. A similar check shall be carried out from time to time to control the wear and tear on templates and gauges.

6.1.3.13. Timber members and built-up units shall be marked in accordance with a marking diagram.

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7. Prefabricated Timber Roof Truss System

7.1. All prefabricated components shall be manufactured only by reputable licensed truss suppliers listed in J-TRUSS system online (Application and Approval of Truss System Provider) and approved by the S.O.. This supplier duly termed as 'System Provider' is responsible for the analysis, design, detailing, drawing, manufacture, material, handling and erection of the roof members, and their ancillary fixing components. The full requirement is outlined in the *Specification for Prefabricated Timber Roof Trusses (JKR 20601-0190-12)* or the latest edition published by JKR.

7.2. All projects shall be registered through J-Truss Online System in accordance to the latest requirement imposed by JKR Malaysia.

7.3. System Provider

The System Provider (S.P.) is a supplier of a proprietary roof truss system appointed by the Contractor and approved by the S.O., which employs Quality Assurance procedures in the design, detailing, connection, bracing, erection criteria and manufacture of truss components for the structural roof truss system.

7.4. Duties of Professional Engineer

7.4.1. The S.P. shall appoint a Professional Engineer (P.E.) whose duties shall include the following:

7.4.1.1. Preparation of roof truss analysis and design;

7.4.1.2. Preparation of drawings;

7.4.1.3. Design changes in every stage of work;

7.4.1.4. Certification for completion of roof truss installation;

7.4.1.5. Final certification for roof truss installation prior to issuance of Certificate of Practical Completion for the whole Works to the Contractor.

7.5. Fabricator

All trusses shall only be assembled by licensed fabricators approved by the S.P. and registered with CIDB. A copy of the CIDB registration certificate shall be submitted to the S.O. for verification.

7.6. Installer

All installation works shall be executed and supervised by qualified personnel with valid certificates issued by CIDB. The S.O. shall verify the identification and qualification of the installer prior to the installation.

7.7. General Truss Limitation

7.7.1. Prior to any pre-fabricated timber roof trusses works, the following general limitation shall be applied:

7.7.1.1. Maximum unsupported truss span 12m with permitted deviation of ±0.05m.

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7.7.1.2. Maximum truss spacing of 1.2m with permitted deviation of ±0.025m.

7.7.1.3. The minimum basic wind speed shall be 35 m/s. However, the minimum basic wind speed shall be increased to 41 m/s for lightweight roof covering.

7.7.1.4. Maximum roof pitch shall be of 45°.

7.8. Analysis, Design Report and Drawings Submission

7.8.1. The S.P. through the Contractor shall propose to the S.O. or his approval a roof truss system which is safe, functional and conforming to design standard. Submission of proposal shall include truss analysis, design report, and construction drawings. The truss analysis shall indicate all loads, load combinations, connections criteria, bracings and tie-down of the truss. Design output of the truss members, battens, connections, tie-down and wall plates, anchors, bracings, truss accessories, splicing and stiffeners where related to the analysis shall be included in the design report. (In accordance to *Specification Pre-Fabricated Timber Roof Truss - JKR 20601-0190-12).*

7.8.2. All details in the construction drawings shall be sufficient to enable checking against the analysis and design report, by specifying and providing not limited to: the truss layout and configuration, timber grades, section properties of members, length of members in each truss configuration, properties of truss accessories, specification of fastener and anchor, tie-down and anchoring details and all types of connection details including the connection of all attachments to the trusses.

7.8.3. Technical specifications for fastener and anchor of which the design refers to shall also be submitted. Verification test certificate from an approved accredited laboratory on the technical parameter specified in the technical specifications shall be submitted upon request by the S.O..

7.9. Warranty

7.9.1. When a refabricated timber roof truss system is used, the Contractor shall submit to the S.O. a warranty from the S.P. certified by a P.E. with the following provisions:

7.9.1.1. All roof truss components shall be manufactured only by approved S.P. producing quality assured products and services.

7.9.1.2. System Provider's Warranty against any defects or damages which may arise during a period of ten (10) years from the Date of Practical Completion of Works due to any defect, fault or insufficiency in design, materials or workmanship or against any other failure which an experienced Contractor may reasonably contemplate but shall not include normal replacement and maintenance. (In accordance to *Specification Pre-Fabricated Timber Roof - JKR 20601-0190-12).*

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8. Engineered Timber Product (ETP) for Structures

8.1. General

8.1.1. This sub-section shall apply to the construction of all structures or parts of structures to be composed of engineered timber products which is glulaminated timber (Glulam), laminated veneer lumber (LVL) and cross laminated timber (CLT) (refer Figure H1). The work shall be carried out all in accordance with this specification and the lines, levels, grades, dimensions and cross-sections shown in the Drawings and as required by the S.O..

8.1.2. Glue-laminated timber (Glulam) is a structural timber product manufactured by gluing together individual pieces of dimensioned timber, having their grained essentially parallel and manufactured in accordance with the relevant Standards. The laminations thickness is allowed within 2mm up to 50mm.

8.1.3. LVL is a structural timber product manufactured by bonding together rotary peeled or sliced thin wood veneers under heat and pressure. The minimum numbers of veneer shall be five (5) and maximum thickness of each veneer shall be 6mm.

8.1.4. CLT is a solid wood board which is manufactured by gluing boards/battens crosswise in several layers.

8.2. Design Requirement

8.2.1. Design Data

8.2.1.1. Load Item

All loads shall be clearly itemised as below: -

(i) Dead Load

Dead load shall be specified as per requirement in MS EN 1991-1-1, whichever standard adopted. However, the actual weight of ceiling, mechanical and electrical (M&E) services shall not be less than 0.25kN/m2.

(ii) Imposed Load

The value and requirement of imposed load shall be as per MS EN 1991-1-1, whichever standard adopted. Notwithstanding to the value in the standard, the minimum value of imposed load shall be 0.25kN/m2 distributed uniformly over the whole area supported and 0.9kN concentrated over a length of 125mm (or in the case of coverings, over a square of 125mm side so placed as to produce maximum stresses in the affected members).

(iii) Wind Load

(a). The requirement of wind load shall be as per MS 1553 or MS EN 1991-1-4 , whichever standard adopted, with the minimum basic wind speed as

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per sub-section 2.2 of this specification or the value in MS 1553 whichever higher.

(b). Load combinations shall be clearly identified (as per MS EN 1991-1-1, MS 544 : Part 3 or other equivalent standards recognised internationally) and itemised to enable design checking to be carried out upon the most adverse conditions or the effect (of uplift) under consideration.

8.2.2. Design Standards

The design of ETP members, bracings, connections shall be in accordance with the following alternative of principal standards:

8.2.2.1. MS 544 Code of Practice for Structural Use of Timber

8.2.2.2. Any other equivalent standards recognised internationally

8.2.3. Eccentricity

The centroidal axes of the connected members should meet at a point, otherwise the effect of eccentricity of the connection should be taken into account in the design of the members and their connections.

8.2.4. Frame Stability

The analysis of ETP structure frame shall take the following requirements for frame stability:

8.2.4.1. Lateral forces i.e wind load, notional load, seismic load, whichever governs.

8.2.4.2. Identification of loadpath for lateral stability.

8.2.4.3. Bracing system i.e shear wall, steel brace etc.

8.2.4.4. Provision of ties for stability against progressive collapse

8.2.5. Designing to Avoid Tension Perpendicular to Grain

8.2.5.1. Whenever possible, joints should be designed to avoid causing tension perpendicular to grain stresses in ETP members.

8.2.5.2. Long lines of fasteners spaced together along the grain should be avoided, particularly if the bolts are in tightly drilled holes. These types of connections may induce tension perpendicular to grain stresses due prying actions from secondary moments.

8.2.6. Load Suspended from ETP Member

Loads suspended from ETP beams or girders should preferably be suspended from the top of the member or above the neutral axis.

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8.2.7. Jointing, Connection and Bracing

8.2.7.1. Appearance

All connections/joints of ETP members shall be designed as concealed to provide neat joint appearances on all glulam ETP timber frames. Column to foundation and main rafter to column shall be constructed with flanges bolted connections with concealed internal connection to flange plates.

8.2.7.2. Uplift and Anchorage Loads

In cases where the ETP framing members must carry uplift and/or horizontal loads resulting from wind, seismic or construction conditions, such members are required to be anchored against any horizontal or vertical movements or incidental forces. As such, connection design shall include anchorage resistance to uplift and lateral movement apart from providing adequate bearing alone. The steel plate base shall be designed to be sufficient enough to take moment forces due to the frame being free standing structure during installation stage. The installation of J-Bolt (if required) shall be part of works of the main contractor.

8.3. Detailing and drawings

8.3.1. Detailing Consideration

8.3.1.1. Consideration of Decay

(i) Where ETP member is exposed to the external weather conditions, all details shall ensure that water and moisture is dispersed and not allowed to pond or accumulate. Prevention of moisture and water entrapment can be achieved by measures such as the usage of moisture barriers, protective overhangs, flashings and other protective features.

(ii) Arch and column bases shall be elevated a minimum of 300mm above the concrete floor level to cater potential for wetting of the floor.

8.3.1.2. Consideration of Shrinkage and Swelling

Whenever possible, all connections/joints detailing shall take into consideration the effect of timber swelling and shrinking due to moisture content changes in service to avoid splitting of member.

8.3.2. Detail Drawings

Construction drawing shall consist of:

8.3.2.1. Layout Drawings

Layout drawings shall indicate the plan view of all ETP members together with ties, bracing etc.

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8.3.2.2. Design Detail Drawings

The design detail drawings shall clearly indicate the following:

(i) Shape of member

(ii) Span, height, spacing, pitch, overhang and camber

(iii) Designed wind load

(iv) Structural capacity of member i.e bending, shear, axial capacity etc

(v) Magnitude and direction of forces transferred to the supporting structure

(vi) Bracing

(vii) Cambering

Each member shall be clearly drawn on a separate drawing that clearly itemises all member sizes, grade, lengths, angles, connector sizes, orientations and positions.

8.3.2.3. Bracing

Bracing layout and details shall be provided for the total ETP structure, by specifying the type of bracing and the connection details.

8.3.2.4. Connection

The connection method and fixing type of each member to member connection shall be clearly detailed to enable checking, installation and inspection. Type of connections shall be in accordance with sub-section 6.

8.4. Material and testing

8.4.1. Timber for ETP

8.4.1.1. Grade and Strength Group

Timber used for manufacturing of ETP intended for structural use shall be graded to Hardwood Structural Grade as stated in Table 1 MS 1714 by timber graders registered with the MTIB. The strength group shall be a minimum of SG5 or equivalent, in accordance with MS 544: Part 2. The cost involved in the visual strength grading shall be borned by the Contractor. Notwithstanding the certificate, the S.O. reserves the right to carry out independent tests at Makmal Anatomi Kayu, FRIM or Fibre and Biocomposite Centre (FIDEC), MTIB to determine the species and Strength Group (SG).

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8.4.1.2. Mixture of species

Timber of single species shall be used in a ETP structure, and it is proven to be suitable for the manufacturing of ETP by the qualification test given in MS 758. Lamination of ETP member shall not be of a mixture of different timber species.

8.4.1.3. Moisture Content

The moisture content of the timber at the time of gluing, shall be within the range of 8% to 15% for non-treated timber and 11% to 18% for treated timber as stipulated in MS 758. The range of moisture content of the laminations in a ETP member shall be not greater than 4%. Method for the determination of the moisture content of is as stipulated in MS 837 or equivalent method. The summary of standard procedure to determine the moisture content is as stated in sub-section 4.4 of this section.

8.4.2. Preservative Treatment

8.4.2.1. The timber species should attain sufficient natural durability and resistance to decay and insect attack as stipulated in MS 544: Part 10.

8.4.2.2. Where it is not possible to use timbers which have sufficient natural durability, the timber shall be preservative treated. The treatment of timbers shall be in accordance with specification stipulated in in MS 544: Part 10. If the preservative chemical is Copper Chrome Arsenic (CCA), it shall conform to MS 733 and sub-section 3.0 of this section.. If any other preservative chemical is used, the main contractor shall provide necessary documents as may be required by the S.O representative to prove the efficiency of the chemical treatment. Timber treatment with other type such as heat treatment are allowed in accordance to relevant standard.

8.4.3. Adhesive

8.4.3.1. Selection of Adhesive

The adhesive shall be capable of producing strong and durable joints, ensuring that the integrity of the bond is maintained throughout the intended lifetime of the structure. The adhesive shall meet the requirement for adhesive Type 1 and Service Classes as stipulated in Table 1 MS 758:2001.

8.4.4. Verification of Design Properties of ETP

The finished ETP shall comply to the required design properties as stipulated in MS 758. Verification shall be provided through:

8.4.4.1. Qualification Tests

(i) The Contractor shall be fully responsible to carry out qualification tests which shall be witnessed by the S.O.. The Contractor shall carry out a qualification test whenever a new process or process change involving

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new adhesive, species combination, finger joint profile and lamination thickness.

(ii) Unless otherwise stated and approved by the S.O. in writing, a minimum of five (5) qualification tests shall be carried out before any actual manufacturing is allowed.

(iii) The Contractor shall provide in test report the information on the design properties which include; characteristics values for bending strength, modulus of elasticity, compression strength, shear strength and tension strength. These properties values to be declared are characteristic values as shown in drawing.

(iv) The test shall be carried out in accordance with BS EN 408 at any accredited approved laboratory at the expense by of the Contractor.

8.4.4.2. Quality Control Tests

The Contractor shall provide information on the glue line integrity, results of delamination tests and results of glue line shear test as stipulated in MS 758. Unless otherwise stated and approved by the S.O. in writing, a minimum of ten (10) quality control tests shall be carried out before any actual manufacturing is allowed.

8.4.5. Coating Specification

8.4.5.1. All ETP members shall be coated with a minimum of two coats of a clear construction sealer to provide a moisture resistant coating and shall be applied in accordance with the manufacturers' specification to the S.O.'s approval.

8.4.5.2. This should not be considered as a final finish as rectification of damage after erection shall be part of the Contract.

8.4.5.3. Details of the sealer used shall be documented and provided for on-going maintenance of the building.

8.4.5.4. All ETP members shall routinely receive a coat of protective sealer before shipping/transport and is wrapped for protection during shipping/transport and erection. The wrapping should be left in place as long as possible and ideally until permanent protection from the weather is in place.

8.5. Manufacturing

8.5.1. Manufacturing Requirement

8.5.1.1. All glued laminated timber building components shall be manufactured and assembled by licensed glued laminated timber manufacturers approved by the S.O.. The Contractor shall provide the necessary documents relating to the proposed manufacturer such as valid licenses or other certificates to the S.O. for approval prior to the commencement of any manufacturing work.

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8.5.1.2. All glued laminated timber members shall be manufactured in a factory which has quality control and quality assurance procedures in place as approved by the S.O.. The S.O. reserves the right to visit the factory before giving any approval.

8.5.1.3. The manufacturing of ETP shall conform to MS 758 and relevant standards which specifies all the requirements for the manufacture of ETP which include among others;

(i) Production conditions – premises, and equipment and workmanship, quality assurance programme.

(ii) Adhesives - The adhesive shall meet the requirement for adhesive Type I and minimum Service Class 2 as stipulated in MS 758.

(iii) (Manufacture – laminations, bonding, clamping, curing and conditioning.

8.5.1.4. When laminations are joined by finger joints these shall be produced in conformity with BS EN 385 or equivalent Malaysian standard. The finger joint of each lamella layer shall be laid in a staggered positions.

8.5.1.5. The maximum permitted deviation from the average thickness within a lamination length of 1m is 0.2mm. Where non-gap-filling adhesives are used the limit deviation shall no exceed 0.1 mm. The difference in thickness over the cross-sectional width of the lamination shall be less than 0.15% of the width and in no case exceed 0.3mm.

8.6. Fabrication

8.6.1. Prior to fabrication, the Contractor shall notify the S.O. the dates of tests that shall be carried out. The S.O. may appoint a representative in the event the S.O. cannot be present during the tests. The Contractor shall forward a copy of the test results jointly certified by the manufacturer for the S.O.'s acceptance and approval.

8.6.2. Prior to the manufacture and fabrication of the glued laminated timber, the Contractor shall provide two (2) copies of the following documents for the S.O.'s approval:

8.6.2.1. Particulars of the manufacturer

8.6.2.2. Quality assurance programme of the manufacturing process

8.6.2.3. Method statement for assembly, installation, handling and transportation

8.6.2.4. Manufacturer's fabrication drawings

8.6.2.5. Manufacturer's assembly drawings

8.6.2.6. Grading summary of timber to be used in the manufacturing of glued laminated timber, issued by timber grader certified by MTIB

8.6.2.7. Results of qualification tests

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8.7. Handling and Installation

The Contractor shall submit method statement of installation for the approval of S.O.. The method statement shall explain the sequence of erection of ETP structures and required safety measures.

8.7.1. Handling

8.7.1.1. At all stages of construction, all ETP structures components shall be properly protected to prevent damage.

8.7.1.2. During on-site storage, ETP members shall be stored off the ground with spacer blocks spaced between members. If construction delays occur, the wrapping shall be cut on the underside to prevent the accumulation of water condensation. Proper transit, storage and construction methods are required to avoid rapid changes in the moisture content of members.

8.7.1.3. During handling, correct lifting equipment shall be used. All ETP members must be protected from damages due to strap, chains and wire ropes.

8.7.1.4. When ETP are stored on-site, they should be placed above the firm ground on supporting block to protect them from water. If the ETP members are stored horizontally, the supporting block shall be spaced as such to prevent bending of the member. If the ETP members are stored vertically, they should be supported at the designed support location in a manner to prevent tipping or toppling.

8.7.2. Installation

8.7.2.1. The installation of ETP members shall be as the approved detail drawings.

8.7.2.2. During erection, ETP must be transversely braced to provide stability in accordance to method statement prepared by the Contractor and approved by S.O.. All other bracings shall be provided for this purpose. ETP gable ends shall be braced before installation of others internal frame.

8.7.2.3. The engagement of licensed surveyor to determine the accuracy of base plate and position of ETP structure shall be under the scope of work of the Contractor.

8.7.2.4. The Contractor shall inspect the prepared foundations and holding down bolts for position and level not less than seven days before erection of ETP work starts. He shall then inform the S.O.. If he finds any discrepancies which are outside the deviations specified in the drawing requesting that remedial work be carried out before erection commences.

8.8. Defects and alteration

8.8.1. Glued laminated timber structures shall not have any debonding. Glued laminated timber structures affected by debonding shall be marked as 'Rejected' and removed from site.

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8.8.2. No element of the ETP roof truss, roof frames or roof ancillary members shall be cut or notched or removed or otherwise altered from its original state without the prior written approval of the S.O..

8.8.3. Where defects exceeding the limits or permitted tolerances are detected, rectification works shall be carried out based on the recommendations made by the P.E. and to the approval of the S.O..

8.9. Warranty

8.9.1. The Contractor shall submit to the S.O. a performance warranty by the Contractor on the performance of the ETP member against debonding which may occur during a period of ten (10) years from the date of practical completion. The terms of the performance warranty shall be as stipulated in **APPENDIX H/1** and as approved by the S.O..

9. Carpentry Works

9.1. All carpentry shall be accurately set out in strict accordance with the Drawings and shall be framed together and securely fixed to the approval of the S.O.. Timber framing shall be properly braced and checked, halve, screwed or bolted together as required. Longitudinal joints in plates, ridge, fascias, et cetera shall be formed over supports. Those timber members with lapped joints shall lap at least 150mm or twice the depth of the timber whichever is the greater. The brads, nails, screws, spikes, plugs, bolts, framing anchors and timber connectors shall be provided wherever necessary and as detailed. Other than those detailed, no joints are permitted in structural work unless prior permission is obtained from the S.O.. No structural member shall be notched unless instructed by the S.O..

9.2. For the carpentry works, timbers shall, as far as possible be in piece between continuing lengths. At corners, timbers shall be halved for materials of the same thickness, and sufficiently lapped for materials of different thicknesses.

10. Joinery Works

10.1. All doors, windows, louvers, screens and the like shall be constructed as shown in the Drawings. Frames shall be assembled at the commencement of the work and all members shall be carefully morticed and tenoned together but no wedging, pinning or gluing shall be done until the framing is prepared in readiness for immediate fixing. All doors, windows, louvers, screens and the like shall be properly stored on site.

10.2. Immediately before fixing in its final position, joinery shall be wedge and pinned by drawn hole pinning with 10mm diameter Strength Group 1 and 2 timber dowels pins. The pins shall be left projecting until permission is given for flushing off. The methods of framing and putting together of all Works shall be approved by the S.O. before being executed. Any portions that warp, twist or develop any other defects shall be replaced before wedging up. All framed work shall be pinned before being framed together.

10.3. The choice of species for joinery should be based on working properties of timbers that is maximum percentage of shrinkage.

10.4. Jointing or connection for joinery that is nailed joint, screwed joint, coach screwed joint or bolted joint shall comply with MS 544 : Part 5.

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11. Timber Floor Finish

11.1. Unless otherwise shown in the Drawings, timber floors shall be constructed using 100mm x 38mm wrot, tongued and grooved boarding's, well cramped up and secret nailed to each joist or batten with 62mm wire nails. Floor boarding shall be in long lengths with splayed heading joints and no two adjacent joints shall occur over the same joist. On completion, the flooring shall be planed, sanded and all gaps sealed with an approved sealer. The floor shall then be cleaned off and unless otherwise specified, it shall be finished with three coats of approved polyurethane paint applied strictly in accordance with the manufacturer's instructions.

11.2. Wrot timber skirting shall be provided where shown and as detailed in the Drawings. Skirting shall be in long lengths with splayed heading joints and with mitres, returns and ends neatly cut and fitted and fixed to grounds.

11.3. Where engineered timber flooring are specified or shown in the Drawings, it shall be finished with high abrasive protective overlay and a moisture barrier balancing film to be applied on timber flooring backing in accordance with the manufacturer's recommendations and S.O.'s approval.

11.4. Timber strip and parquet flooring shall be as specified in SECTION K: PLASTERING, PAVING, TILING AND CARPET.

12. Ceiling Timber Battens

Where ceiling battens are used for ceilings, it shall be fixed to the frames with butt 'V' joint using nails or screws. Asbestos-free cement flat sheets for ceiling shall be 5mm thick fixed to frames using mitred profiled timber cover battens and brass screws with rounded edge beading. Ceiling panels shall be set out symmetrically from the centre line of the ceiling. Suspended ceiling systems shall be as specified in SECTION I: CEILING.

13. Timber Partitions

Non-structural timber partitions shall be as specified in SECTION E: WALL SYSTEM.

14. Fascia And Barge Boards

Unless otherwise shown on the Drawings, fascia and barge boards shall be 25mm thick wrot timber and supplied in long lengths. The boards shall be fixed in whole lengths and where joints are necessary, they shall be scarfed jointed and the joints shall occur only over the ends of roof framing members and mitred corners. Board, 250mm wide and less shall be in one width and those deeper shall be formed by multiple of boards jointed together by tongue and groove and 'V' joint.

15. External Boarding

15.1. Unless otherwise shown on the Drawings, all external boarding shall be formed with 150mm x 19mm horizontal, vertical or diagonal boarding in wrot pressure-treated timber in long lengths and to the sectional profile as detailed in the Drawings.

15.2. Unless otherwise shown, lapping for plain weather boarding shall be 38mm. Boarding shall be secured to the frames using 75mm galvanized steel nails and in the case of plain weather boarding, nails shall not be driven through the lapped

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portions. The exposed bottom ends of all external vertical boarding shall be splayed inward at an angle of 30° and treated with preservatives.

15.3. The timber boarding shall be cleaned off and unless otherwise specified, it shall be finished with approved polyurethane base paint with UV protection applied strictly in accordance with the manufacturer's recommendations. The strength grouping for external timber flooring shall be in accordance with the Properties of Malaysian Timber as shown hereinafter in **TABLE H8.**

15.4. For coastal environments and exposed weather applications subjected to airborne salts deposition, metal connectors and fasteners used shall comply with AS 3566 Class 4 and be certified as such by the supplier of fasteners and to the approval of the S.O..

15.5. All fixings and associated components shall be manufactured from compatible metals and coated conforming to ISO 9223 Category 4 (C4) and Category 5 (C5) environment. Flashings shall be made from the same material as the roofing sheets.

16. Staircase And Balustrades

16.1. Unless otherwise shown in the Drawings, the Contractor shall prepare Shop Drawings as required for the Works. Prior to the fabrication and installation works, the Contractor shall submit the Shop Drawings to the S.O.'s for approval.

16.2. The preferred sizes for modular staircase and stair openings shall comply with MS 1064: Part 3.

17. Timber Solid Panel Doors

17.1. All fire doors shall be of the appropriate Fire Resistance Period (FRP) in accordance with the Ninth Schedule of the Uniform Building By-Laws.

17.2. All fire doors including frames shall be constructed to a specification of the relevant FRP in accordance with MS 1073 and shall be tested by a laboratory, approved and certified by DGFR and have obtained a Product Certification Scheme from an accredited certification body.

17.3. All double leaf doors with rebated meeting stiles shall be provided with coordinating device so as to fit fully within the door openings with a gap of not more than 3mm between the frame and the edge of the door when closed

17.4. Where shown on the Drawings, approved vision panel of suitable size shall be incorporated in the Fire Rated Door.

17.5. Flush doors shall generally comply with MS 1506: Specification for Wooden Door with plywood facing and strength group 1 and strength group 2 timber lipping, mitred around all edges. The plywood and strength group 1-4 shall in all respects with the Specifications mentioned hereinbefore.

17.6. The preferred sizes for modular door sets shall comply with MS 1064: Part 4 and for modular windows shall comply with MS 1064: Part 5.

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18. PVC Doors

18.1. Unless otherwise specified in the Drawings, PVC doors shall be of strong impact resistance and waterproof/moisture resistant laminated timber finish on both sides. Unless otherwise shown in the Drawings, the door shall be 38mm thick.

18.2. PVC toilet doors shall be of full single panel of flush type. It shall be 100% waterproof, strong impact resistance and not be discoloured easily. Unless otherwise shown on the Drawings, the door shall be 38mm thick. PVC door shall be delivered to the site complete with ironmongery as listed in the '**TABLE 9**: SCHEDULE OF IRONMONGERY'.

19. Products And Materials

19.1. Plywoods

19.1.1. Unless otherwise specified, plywood used for interior and exterior purposes other than for formworks and temporary works shall be manufactured with Moisture Resistant (MR) bond and Weather and Boil Proof (WBP) bond respectively in compliance with MS 228. Boards which are to be painted or varnished shall be properly sanded down and holes and crevices filled with approved wood putty or filler.

19.1.2. Plywood intended for use as shuttering board shall be of the Weather and Boil Proof (WBP) type.

19.1.3. Plywood intended for structural use, shall be of Malaysian Basic Structural Grade (MBSG) rated or equivalent and shall comply with MS 544: Part 4.

19.1.4. Plywood to be used in marine environment or severe wet conditions shall be in accordance with MS 544: Part 4.

19.2. Blockboard

19.2.1. Blockboard shall comply with MS 1123. Fixing of blockboards shall generally be in accordance with the manufacturer's instructions.

19.2.2. Boards which are to be painted or varnished shall be properly sanded down and holes and crevices filled with approved wood putty or filler to the approval of the S.O..

19.3. Chipboards

19.3.1. Chipboards shall be of the type manufactured from wood chips or shavings combined with a thermosetting synthetic resin glue binder bonded and hot-pressed together and complying with MS 1036 for medium density chipboard. The type and quality of boards shall be approved by the S.O.. The boards shall be fixed as detailed in the Drawings with a minimum edge distance of 12mm for nailing.

19.3.2. Boards which are to be painted or varnished shall be properly sanded down and holes and crevices filled with approved wood putty or filler to the approval of the S.O..

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19.4. Fibre Building Boards

19.4.1. All fibre building boards namely, Hard Board, Medium Board and Medium Density Fibre Board (MDF) shall comply with MS 1429 and MS 1912. The type and quality of Fibre building boards shall be as approved by the S.O. Perforated hardboards shall be not less than 3.2mm thick with maximum of 4.8mm perforation at 19mm centers unless otherwise stated in the Drawings.

19.4.2. All fibre building boards shall be fixed strictly in accordance with the manufacturer's instruction. Unless otherwise detailed in the drawings, the ceiling boards shall be butt and 'V' jointed.

19.5. Composite Boards

19.5.1. The type and quality of composite boards shall be as approved by the S.O. and shall be fixed strictly in accordance with the manufacturer's instruction.

19.5.2. Fixing of timber base composite boards shall comply with the manufacturer's instructions. Panels which are to be painted or varnished shall be properly sanded down and holes and crevices filled with approved wood putty or filler to the satisfaction of the S.O.. Panels which are for wet prone area, shall comply with MS 1787.

19.6. Woodwool Slabs

Woodwool slab shall comply with MS 1036 and shall be of the type and quality as approved by the S.O.. Unless otherwise specified in the Drawings, the slab shall be laid with its length at right angles to support, fixed strictly in accordance with the manufacturer's instruction.

19.7. Wood Cement Boards

19.7.1. Wood cement boards shall comply with the requirements of MS 934 or MS 544: Part 4. In fixing, the board must be supported on all four edges and at immediate positions at centres not exceeding 610mm. Joints between boards shall occur on centers of supports. Minimum edge distance shall be 20mm.

19.7.2. Boards which are to be painted shall be lightly sanded and any dust shall be removed from the surface with a piece of clean coarse cloth. Any filling compounds used shall be alkali-resistant. Fixing of the board shall be in accordance with the manufacturer's instructions.

19.8. High Pressure Laminate (HPL)

High Pressure Laminate is a thermoset paper/plastic composite, where decorative papers impregnated with melamine are consolidated over phenolic-impregnated craft papers at high temperature and pressure to form a homogenous laminate. Unless otherwise specified, HPL shall comply with MS 1787: Part 1-15 for durability.

19.9. Wood Plastic Composite (WPC)

WPC shall be made from minimum 70% rice husk and balance recycled HDPE. WPC solid decking system shall be of 145mm (w) x 25mm (t) fixed onto 300mm c/c on Suspended Leveling System with hot dipped zinc-aluminium alloy coated steel with a minimum coating mass of AZ150 to AS/NZS 1397-2002 steel sheet

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grade G300 on to flat concrete slab with ENSS03 stainless steel clip, all in accordance with manufacturer's recommendation and S.O.'s approval.

20. Ironmongery

20.1. Unless otherwise shown on the Drawings, the Contractor shall supply and fix all ironmongery as listed in the **TABLE H9**: Schedule of Ironmongery attached hereinafter, complete with fixing screws of the same material and finish.

20.2. Proper sockets shall be provided for all bolts to fix flush in floors, cills and door and window frames. Each lock shall be provided with three keys and no locks shall have identical keys, unless specifically required by the S.O..

20.3. All doors, windows, gates, joinery, et cetera, shall be provided with anti-rust heavy duty ironmongery appropriate for its function, complete with fixing screws of the same material and finish

20.4. All doors shall be provided with door-stops, door-closers and other appropriate ironmongery where applicable or as shown on the Drawings.

20.5. The submission of ironmongery set shall have been tested and certified by Certification bodies accredited by Jabatan Standard Malaysia.

21. Built-in Furniture

21.1. General

21.1.1. Built-in furniture shall be constructed and properly framed in wrot timber as shown on the Drawings. Where fittings are not to be painted, unless otherwise specified, they shall be stained and varnished as described in SECTION O:PAINTING.

21.1.2. All interior furniture works shall be coordinated with mechanical and electrical works and as approved by the S.O..

21.1.3. All built-in furniture materials shall be protected wrapped in strong waterproof paper or polythene/polyethylene (PE) sheeting to protect against damp and scratching during transportation from the factory. The wrapping shall not be removed until installation starts.

21.1.4. Built-in furniture materials shall be unloaded and handled in a manner which will not result in damage, deformation or contamination to the built-in furniture materials.

21.1.5. Built-in furniture materials and loose furniture delivered to the site shall be properly stored by arranging them in stacks, keeping them properly wrapped and stored under cover if they are not used or assembled immediately.

21.2. Materials

21.2.1. All composite wood products, such as Medium Density Fibreboard (MDF) shall comply with MS 1429 and the use of Particleboards shall comply with MS 1912.

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21.2.2. The formaldehyde emission for all composite wood products and wood based panels shall comply with MS 1787.

21.2.3. Laminates used in composite wood products shall comply with MS ISO 4586.

21.2.4. Unless otherwise specified in the Drawings or Specification the resin used in composite wood products shall be phenol-formaldehyde (PF), melamine-urea-formaldehyde (MUF), melamine-urea-phenol formaldehyde (MUPF), polymeric diphenyl methane diisocyanate (PMDI) or polyurethane (PU).

21.2.5. Adhesive for wood and composite wood products shall be phenol-formaldehyde resin adhesive classified as weather-proof and boil-proof, in accordance with MS 908.

21.2.6. Thermoplastic fittings, such as handles and accessories, where applicable, shall be polyamide (PA) or polypropylene (PP). Thermoplastics shall comply with MS 2324.

21.2.7. Solid surface shall be non-porous, homogenous, stain and chemical resistant, fire resistant and with a composition of acrylic polymer, aluminium trihydrate filler and pigment.

21.2.8. Where timber species are used it shall be constructed and properly framed in wrot timber as detailed in the Drawings.

21.3. Component Assemblies

21.3.1. Unless otherwise stated in the Drawings, steel frames, where applicable, shall be square and flat with mitred, welded corners.

21.3.2. Screws shall have countersunk heads which shall comply with MS ISO 1482.

21.3.3. Hinges shall have a spring mechanism to lock the door in a close or open position, remain completely hidden behind the door and enable the door to open to 120°.

21.3.4. Drawer slides shall be epoxy powder coated metal, mounted from the bottom and provided with friction bearing-mounted nylon rollers.

21.3.5. Unless otherwise specified, drawers shall have the 'soft-close' and/or 'positive-close' functions, which are mechanisms enabling drawers to quietly shut, or which fully shut after being only partially pushed. Drawers can be lifted up and removed easily for cleaning purposes.

21.3.6. All drawers, unless otherwise specified, shall have ¾ extension and be able to sustain up to 25kg. Kitchen cabinet drawers shall have full extension and be able to sustain up to 45kg, which is suitable for large pots, pans and/or woks.

21.3.7. Drawers for storing small kitchen cutlery shall have thermoplastic inserts with subdivided compartments.

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21.3.8. Drawer handles and cabinet pulls shall be ergonomic. Thermoplastic handles and pulls shall recess into the door panels. Metal handles and pulls that extrude shall either be epoxy powder coated and/or anodized aluminium.

21.3.9. Solid surface worktops and countertops shall be 12mm thick, 600mm deep with backsplash 100mm high, with integral bowl, where applicable. Actual dimension of solid surface worktops shall be measured at site. Upon installation of the solid surface worktops, it shall be polished and set level to S.O.'s approval.

21.3.10. Unless otherwise specified, worktops and countertops shall have a flat edge finishing at the perimeter. Worktops and countertops shall be provided with holes and cut-outs for plumbing components, where applicable. All joints shall be inconspicuous and use the manufacturer's recommended adhesive and silicone sealant.

21.3.11. Built-in furniture sliding doors shall be fitted with guides or similar fittings, rollers or ball bearings, pull handles, stops and locking mechanisms.

21.3.12. Cabinet doors with glass inserts and/or panels shall be constructed with proper support to ensure that the glass remains securely fixed. Support shall be bedded in mastic with all interstices completely filled.

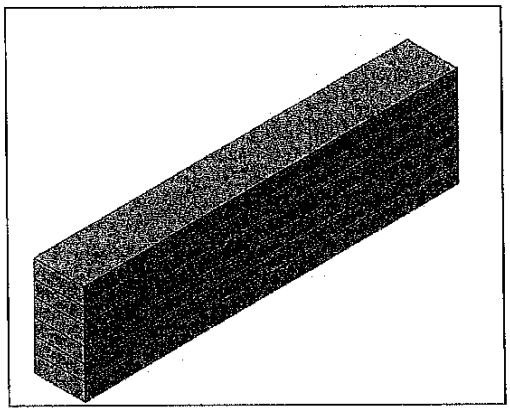
21.3.13. Glass inserts and/or panels and glass shelves, where applicable, which needs to be structurally strong shall be tempered glass. Tempered glass shall comply with MS 1498.

21.3.14. Cupboards, wardrobes, cabinets and shelves shall have peg-holes on either side internally, allowing for adjustable shelf height. Adjustable legs, if applicable, shall be of a proprietary system type as approved by the S.O..

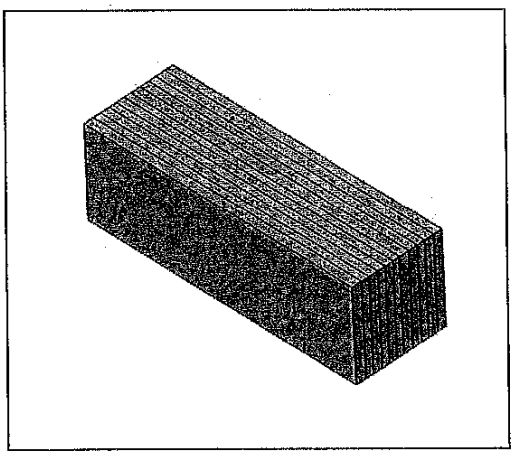
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FIGURE H1: ENGINEERED TIMBER PRODUCTS:

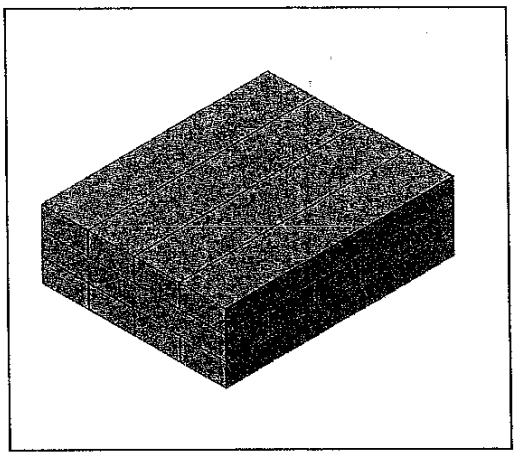
(a) Glued Laminated (Glulam) Timber



(b) Laminated Veneer Lumber (LVL)



(c) Cross Laminated Timber (CLT)



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Table H1. Schedule of Timber Grouping and Usage

No	Typical Usage	Species
1	**Structural frames**	
	1.1 All columns, stilts and beams	SG4
2	**Bearer to water tank**	SG5
3	**Staircase and component elements**	
	3.1 Stinger & treads/Riser	SG5
	3.2 Trimmer beams	SG5
	3.3 Balustrades, nosing and handrails	SG5
4	**Flooring**	
	4.1 Floor bearers, joists and strutting for joists	SG5
	4.2 Floor boardings	SG5
	4.3 Gymnasium floor boarding	SG4
	4.4 Parquet flooring	SG5
	4.5 Skirtings	SG5
5	**Walling**	
	5.1 Wall and partition framings	SG5
	5.2 External wall boardings	SG5
	5.3 Internal wall boardings	SG7
6	**Roof structures**	
	6.1 Roof trusses, rafters, purlins, wall plates and other roof members	SG1 - SG4
	6.2 Fascia boards	SG5
7	**Ceiling frames**	
	7.1 Ceiling joists and spacers	SG5
	7.2 Cover battens to joints of ceiling sheets	SG7
	7.3 Ceiling strips and soffit battens	SG7
8	**Door and window frames**	
	8.1 All doors, windows, vent frames, grounds, stops and architraves	
	8.1.1 External usage	SG5
	8.1.2 Internal usage	SG7
9	**Furniture fitting**	
	9.1 Built-in fittings and furniture in general	
	9.1.1 Carcassing	SG5
	9.1.2 Lining/Panelling	SG7
	9.1.3 Top	SG5
	9.2 Workshop furniture top	SG5
10	**Beading fillets and edgings in general**	SG5

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Table H2. Schedule of Timber Species in accordance with Strength Grouping (S.G)

S.G 1	S.G 2	S.G 3	S.G 4	S.G 5	S.G 6	S.G 7
A) Naturally Durable						
Balau	Belian	Bekak	Giam	Jati		
Bitis	Mata Ulat	Delek	Malabera	Tembusu		
Cengal	Kekatong	Keranji	Merbau			
Penaga			Resak			
B) Requiring Treatment						
	Dedaru	Agoho	Berangan	Alan Bunga	Bayur	Ara
	Kempas	Balau Merah	Dedali	Babai	Damar Minyak	Batai
	Merbatu	Kelat	Derum	Balik Angin Bopeng	Durian	Geronggang
	Mertas	Kembang Semangkuk	Kapur	Bintangor	Jelutung	Laran
		Kulim	Kasai	Brazil Nut	Jenitri	Pelajau
		Pauh Kijang	Keruntum	Gerutu	Jongkong	Pulai
		Penyau	Mempening	Kundur	Kasah	Sesenduk
		Perah	Meransi	Kedondong	Macang	Terentang
		Petaling	Meranti Bakau	Keledang	Medang	
		Ranggu	Merawan	Kerulng	Melantai/ Kawang	
		Ru	Merpauh	Ketapang	Meranti Merah Muda	
		Surian Batu	Nyalin	Kungkur	Meranti kuning	
		Tualang	Perupuk	Melunak	Mersawa	
			Punah	Mempisang	Sengkurat	
			Rengas	Mengkulang	Terap	
			Simpoh	Meranti Merah Tua		
				Meranti Putih		
				Nyatuh		
				Penarahan		
				Petai		
				Ramin		
				Kayu Getah		
				Sengkuang		
				Sepetir		
				Tetebu		

Notes :

1. For naturally durable timbers, sapwood should be excluded. If sapwood is included, preservative treatment is necessary.(Source: MS 360:1986)
2. For timber requiring treatment, they should be amenable to preservative treatment.

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Table H3. Schedule of Moisture Contents (M.C) of Timber for Various Positions in Building

Application	Maximum M.C. At Time Of Installation For Non Air-Conditioned Application	Maximum M.C. At Time Of Installation For Airconditioned Application (Kiln-Dried Timber)
Structural Components		
• Columns, beams, bearer, studs, joists, ties and struts	30% (Thickness >100mm) 25% (Thickness <100mm)	Not applicable Not applicable
Roofing		
• Rafters, ties, struts, purlins and bracing	25%	Not applicable
• battens	25%	Not applicable
Staircase		
• stringers, treads, trimmer beam and handrail	19%	12%
• balustrades	19%	12%
Flooring		
• floor boarding and parquetry	19%	12%
• skirtings	19%	12%
Walling		
• wall, partition framing	19%	12%
• external wall boardings	19%	Not applicable
• internal wall boardings	19%	12%
• fascia boards	19%	Not applicable
Ceiling Frames		
• cover battens to joints of ceiling sheets	25%	Not applicable
• ceiling strips and soffit battens	19%	12%
Door & Window Frames		
• door, window and vent frames including their stops and grounds	19%	12%
• door leaves, window and vent sashes	19%	12%
Furniture		
• built in fittings, furniture generally	19%	12%
• workshop furniture	19%	12%
• science laboratory tops	19%	12%
Beading fillets and edgings generally	19%	12%

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Table H4. Natural Durability[1] Classification of Peninsular Malaysia Timbers for Ground Contact

Class 1	Class 2	Class 3		Class 4	
Very durable (More than 10 years)	**Durable (5 to 10 years)**	**Moderately durable (2 to 5 years)**		**Not durable (Less than 2 years)**	
Chengal	Balau	Agoho[2]	Rengas	Api-api	Nyatoh[6c]
Giam	Bekak	Balau, red	Sepetir	Ara	Perapat
Penyau	Bitis	Bakau	Tumu	Berangan	Perah
Resak	Kasai	Bungor	Tualang	Balek angin	Perupok
Tempinis	Kapur[4a]	Derum	Telor buaya	Bintangor	Petai
	Nyatoh[6a]	Dedali	Pelong	Batai	Podo
	Merbau	Dedaru	Kerukup	Bayur	Pulai
	Mersawa	Delek	Brazil nut[2]	Damar minyak	Putat
	Merbau lalat	Dungun	Keruntum	Dungun paya	Ramin
	Delinsem[2]	Acacia[3]	Keruing[8a,b,c]	Durian	Samak
	Malabera	Pauh kijang	Keledang[9a,b]	Engkabang	Sena
	Medang[5a,b]	Kapur[4b]	Mata ulat	Jelutong	Sawa luka
	Penaga	Kelat	Medang[6c]	Gaham badak	Sepul
	Pelajau	Kembang semangkok	Meranti,[7a,b,c,d,e] dark red	Geronggang	Sesenduk
	Pelawan	Kempas	Mempening	Gerutu	Sentang[3]
	Ranggu	Keranji	Mengkulang	Gading	Simpoh
	Surian batu	Gegatal	Meransi	Gapis	Sempilor
	Teak	Kulim	Merbatu	Meranti bakau	Terentang
	Tembusu	Kungkur	Merawan	Meranti, light red	Tapus
		Leban	Merbau kera	Jenitri	Terap
		Nyalas	Meranti, white	Jongkong	Tuai
		Pauh kijang	Mertas	Kasah	Tulang daing
		Petaling	Nyatoh[6b]	Kekabu	Ketapang
		Punah	Nyireh	Kawang	Rubberwood
			Nipis kulit	Keledang[9c,d,e]	Pine[3]
				Kapur[4c]	Yemane[3]
				Kayu malam	Coconut
				Kedondong	Tengkurung
				Kungkur	Penarahan
				Meranti, yellow	Keruing[8d,e]
				Laran	Meranti tembaga
				Lelayang	Machang
				Lilin	Medang[5d, e]
				Limpaga[2]	Mempisang
				Ludai	Merbatu
				Merpauh	Melantai
					Minyak berok

NOTE:

For reference to source of data see Bibliography.

The results were obtained from the graveyard test from the Forest Research Institute Malaysia test site.

[1] All samples taken from heartwood area except for the timber which their sapwood and heartwood cannot be differentiated. Timber of the same species but from different regions in Malaysia may have different durability classifications.
[2] The timber is not Peninsular Malaysia origin.
[3] Plantation timber, originally from other countries.
[4a] *Dryobalanops aromatica*
[4b] *Dryobalanops rappa*
[4c] *Dryobalanops oblongifolia*
[5a] *Alseodaphne insignis*
[5b] *Dehaasia nigrescens*
[5c] *Cinnamomum porrectum*
[5d] *Litsea firma*
[5e] *Litsea megacarpa*
[6a] *Palaquium impressinervium*
[6b] *Palaquium maingayi*
[6c] *Palaquium gutta*
[7a] *Shorea uliginosa*
[7b] *Shorea platyclados*
[7c] *Shorea pauciflora*
[7d] *Shorea singkawang*
[7e] *Shorea curtisii*
[8a] *Dipterocarpus sublamellatus*
[8b] *Dipterocarpus crinitus*
[8c] *Dipterocarpus verrucosus*
[8d] *Dipterocarpus kerrii*
[8e] *Dipterocarpus lowii*
[9a] *Artocarpus interger*
[9b] *Artocarpus lanceifolius*
[9c] *Artocarpus dadah*
[9d] *Artocarpus rigidus*
[9e] *Artocarpus heterophyllus*

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Table H5. Natural Durability[1] Classification of Sarawak Timbers for Ground Contact

Class 1	Class 2	Class 3		Class 4	
Very durable (More than 10 years)	**Durable (5 to 10 years)**	**Moderately durable (2 to 5 years)**		**Not durable (Less than 2 years)**	
Belian	Kapur bukit	Baru	Kapur paji	Acacia	Bindang
Penyau	Kapur kelansau	Bedaru	Kapur paya	Alan	Geronggang
Selangan batu[2]	Kawi	Kandis	Luis/Chengal pasir	Asam	Jadap
	Luis	Kasai	Medang luis kasar	Bajan	Jelawai
	Lun runcing	Leban	Mengkulang	Bayur	Jelutong
	Mertama	Nylreh	Mersawa kunyit	Bengang	Kayu cina
	Nyatoh[3]	Pelajau	Petai belalang	Benuah	Kayu malam
	Rhu	Resak membangun	Sempilor	Binuang	Kelampayan
	Selangan batu[4a]	Seladah[4b, c]		Bintangor	Kembang semangkok
		Selumar		Bintawak	Kepayang babi
		Selunsur		Dungun	Keranji
		Tapang		Durian	Kerulng
		Urat mata		Empenit	Ketiau
				Entuyut	Kumpang
				Litoh	Legai
				Medang	Meranti, light red
				Menggris	Yellow flame
				Mersawa paya	Meranti, yellow
				Minggi	Mergasing
				Ngilas	Peran/bilat
				Nyatoh[5a, b]	Segera
				Pelai	Seladah[6a, b]
				Perah	Sentang
				Perupok	Simpoh Tampoi
				Petai	Tekalong
				Pitoh	Teruntum Ubah
				Ramin	Upi
				Resak paya	
				Sawih	

[1] The results were obtained from the graveyard test from Oya Road, Sibu test site. All samples taken from heartwood area except for the timber which their sapwood and heartwood cannot be differentiated. Timber of the same species but from different regions in Malaysia may have different durability classifications.

[2] *Shorea pulricostata*

[3] *Palaquium rivulare*

[4a,b,c] *Shorea flava, S. laecis, S. spp*

[5a,b] *Dacryodes incurvata, Santira laevigata*

[6a,b] *Palaquium pseudorostratum, Ganua motleyana*

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Table H6. COMMON COMMERCIAL TIMBER SIZES

Sizes and geometrical properties of Malaysian structural timbers

Shape	Nominal Size (mm x mm)	Minimum timber sizes (mm)		
		Fullsawn	Baresawn	Dressed Timber
Square	25 x 25 (1" x 1")	28 x 28	25 x 25	20 x 20
	50 x 50 (2" x 2")	55 x 56	50 x 50	45 x 45
	75 x 75 (3" x 3")	80 x 81	75 x 75	70 x 70
	100 x 100 (4" x 4")	106 x 106	100 x 100	90 x 90
	125 x 125 (5" x 5")	131 x 131	125 x 125	115 x 115
	150 x 150 (6" x 6")	159 x 159	150 x 150	140 x 140
Rectangle	25 x 50 (1" x 2")	28 x 56	25 x 50	20 x 45
	25 x 75 (1" x 3")	28 x 81	25 x 75	20 x 70
	25 x 100 (1" x 4")	28 x 106	25 x 100	20 x 90
	25 x 125 (1" x 5")	28 x 131	25 x 125	20 x 115
	25 x 150 (1" x 6")	28 x 159	25 x 150	20 x 140
	25 x 175 (1" x 7")	28 x 184	25 x 175	20 x 165
	25 x 200 (1" x 8")	28 x 212	25 x 200	20 x 190
	38 x 50 (1½" x 2")	41 x 56	38 x 50	33 x 45
	38 x 75 (1½" x 3")	41 x 81	38 x 75	33 x 70
	38 x 100 (1½" x 4")	41 x 106	38 x 100	33 x 90
	38 x 125 (1½" x 5")	41 x 131	38 x 125	33 x 115
	38 x 150 (1½" x 6")	41 x 159	38 x 150	33 x 140
	38 x 175 (1½" x 7")	41 x 184	38 x 175	33 x 165
	38 x 200 (1½" x 8")	41 x 212	38 x 200	33 x 190
	50 x 75 (2" x 3")	55 x 81	50 x 75	45 x 70
	50 x 100 (2" x 4")	55 x 106	50 x 100	45 x 90
	50 x 125 (2" x 5")	55 x 131	50 x 125	45 x 115
	50 x 150 (2" x 6")	55 x 159	50 x 150	45 x 140
	50 x 175 (2" x 7")	55 x 184	50 x 175	45 x 165
	50 x 200 (2" x 8")	55 x 212	50 x 200	45 x 190
	63 x 100 (2½" x 4")	68 x 106	63 x 100	58 x 90
	63 x 125 (2½" x 5")	68 x 131	63 x 125	58 x 115
	63 x 150 (2½" x 6")	68 x 159	63 x 163	58 x 140
	63 x 175 (2½" x 7")	68 x 184	63 x 175	58 x 165
	63 x 200 (2½" x 8")	68 x 212	63 x 200	58 x 190
	75 x 100 (3" x 4")	80 x 106	75 x 100	70 x 90
	75 x 125 (3" x 5")	80 x 131	75 x 125	70 x 115
	75 x 150 (3" x 6")	80 x 159	75 x 175	70 x 140

(Source : MS 544 : Part 2)

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Table H7. Minimum required size of Washers for Structural Bolted Joints

Bolt diameter (mm)	Washer size (mm)		
	Thickness	Min. diameter for round washers	Min. side length for square washers
M6	1.6	30	25
M8	2.0	36	32
M10	2.5	45	40
M12	3.0	55	50
M16	4.0	65	57
M20	5.0	75	65
>M20	6.0	85	75

(Source: MS 544 : Part 6)

Table H8. Properties of Malaysian Timber

Heavy Hardwoods				
No	Species	Strength	Tangential Movement	Air-dry density (kg/m^3)
1	Balau	Very strong	2.1 – 2.5%	850-1155
2	Merbau	Strong	2.1 – 2.5%	515-1040
3	Red Balau	Strong	2.1 – 2.5%	800-880
Medium Hardwoods				
1	Kelat	Strong	2.1 – 2.5%	495-1010
2	Kempas	Very strong	> 3.1%	770-1120
3	Keruing	Strong	2.6 – 3.0% 3.1%	690-945
4	Mengkulang	Strong	2.1 – 2.5%	625-895
5	Merpauh	Strong	1.5 – 2.0%	640-880
Light Hardwoods				
1	Bintagor	Moderately strong	1.5 – 2.0%	495-865
2	Dark Red Meranti	Moderately strong	< 1.5% 1.5 – 2.0%	560-865
3	Gerutu	Moderately strong	2.6 – 3.0%	575-880
4	Mersawa	Moderately strong	2.1 – 2.5%	515-735
5	Yellow Meranti	Moderately strong	1.5 – 2.0%	575-735

(Source: Choo KT, Gan KS & Lim SC, Movement of Seasoned Timber in Service, FRIM Technical Information Handbook No. 18)

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Table H9. Schedule Of Ironmongery

Type of Doors, Windows etc.	Ironmongery for each type of doors, windows etc.
1. Single Leaf Door	
1.1. Plywood Flush Door	a) 3 Nos. of 102mm x 76mm x 2mm galvanised steel hinges with nylon rings. b) 1 No. upright 3 lever mortice lockset with satin chrome lever handle furniture of approved manufacture with 2 Nos. chrome plated keys of different serial number for each building. c) 1 No. stainless steel door stopper.
1.2. Timber Panelled Door	a) 3 Nos. of 102mm x76 mm x 2mm stainless steel hinges with nylon ring. b) 1 No. medium duty cylindrical lockset, 5 pin tumbler with knob and rose of stainless steel with hairline finish complete with 3 Nos. nickle-plated brass keys of different serial number for each building. c) 1 No. stainless steel door stopper.
2. Double Leaf Door 2.1. Plywood Flush Door	a) 6 Nos. 102mm x 76mm x 2mm stainless steel hinges with nylon rings. b) 1 Set Hollow Lever Handle Stainless Steel Mortice Lock Body with single key thumb turn cylinder. c) 1 No. solid brass mortice lock rebated part. d) 1 Set of 150mm and 300mm Flush Bolt Lever Type Stainless Steel. e) 1 No. dust socket medium. f) 2 Nos. stainless steel door stopper.
2.2. Timber Panelled Door	a) 6 Nos. 102mm x 76mm x 2mm stainless steel hinges with nylon rings. b) 1 No. cylindrical lock stainless steel, 5 pin tumbler with knob and rose of stainless steel with 3 nos nickle-plated brass keys c) 1 No. solid brass mortice lock rebated part. d) 1 Set of 150mm and 300mm Flush Bolt Lever Type Stainless Steel. e) 1 No. dust socket medium. f) 2 Nos. stainless steel door stopper.
3. PVC Door To Toilet /Bathroom Cubicles	a) 3 Nos. 102mm x 76mm x 2mm stainless steel hinges with nylon rings. b) i) Residential Quarters - 1 No. stainless steel cylindrical lock with privacy locking device operated by turn from inside and knob handle. ii) Non-residential buildings - 1 No. stainless steel indicator bolt toilet. c) 1 No. hat & coat hook stainless steel.
4. Single Leaf Fire Rated Door	
4.1. Standard size of 800 mm x 2100 mm ½ hr & 1 hr fire rated door (Metal Frame & Timber Door)	a) 3 Nos. 127mm x 89mm x 2.5mm heavy duty stainless steel hinges. b) 1 Set Hollow Lever Handle Stainless Steel Mortice Lock Body with single key thumb turn cylinder approved by DGFR. c) 1 No. stainless steel door stopper. d) 1 No. door closer. e) 1 No. floor spring for double swing door.
4.2. Standard size of 900 mm x 2100 mm ½ hr & 1 hr fire rated door (Metal Frame & Timber Door)	a) 3 Nos. 12mm x 89mm x 2.5mm heavy duty stainless steel hinges. b) 1 Set Hollow Lever Handle Stainless Steel Mortice Lock Body with single key thumb turn cylinder approved by DGFR. c) 1 No. stainless steel door stopper. d) 1 No. door closer. e) 1 No. floor spring for double swing door.
4.3. Standard size of 900mm x 2100mm 2 hr fire rated door (Metal Frame & Timber Door)	a) 4 Nos. 127mm x 89mm x 2.5mm heavy duty stainless steel hinges. b) 1 Set Hollow Lever Handle Stainless Steel Mortice Lock Body with single key thumb turn cylinder approved by DGFR. c) 1 No. stainless steel door stopper. d) 1 No. door closer. e) 1 No. floor spring for double swing door. f) 2 Nos. of ball bearings. g) 1 No. of heavy duty stainless steel latch with 75 mm long backset.
5. Double Leaf Fire Rated Door	
5.1. Standard size of 1200mm x 2100mm	a) 4 Nos. 127mm x 89mm x 2.5mm heavy duty stainless steel hinges. b) 1 Set Hollow Lever Handle Stainless Steel Mortice Lock Body with single key thumb turn cylinder approved by DGFR. c) 1 No. solid brass mortice lock rebated part. d) 1 Set of 150 mm and 300 mm Flush Bolt Lever Type Stainless Steel. e) 1 No. dust socket medium.

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Type of Doors, Windows etc.	Ironmongery for each type of doors, windows etc.
	f) 2 Nos. stainless steel door stopper. g) 2 Nos. automatic door closer of hydraulically spring operated type (for swing doors) or of wire rope and weight type (for sliding doors). h) 2 Nos. floor spring for double swing door.
5.2. Standard size of 1800mm x 2100mm	a) 6 Nos. 127 mm x 89 mm x 2.5 mm heavy duty stainless steel hinges. b) 1 Set Hollow Lever Handle Stainless Steel Mortice Lock Body with single key thumb turn cylinder approved by DGFR. c) 1 No. solid brass mortice lock rebated part. d) 1 Set of 150 mm and 300 mm Flush Bolt Lever Type Stainless Steel. e) 1 No. dust socket medium. f) 2 Nos. stainless steel door stopper. g) 2 Nos. automatic door closer of hydraulically spring operated type (for swing doors) or of wire rope and weight type (for sliding doors). h) 2 Nos. floor spring for double swing door.
5.3. Standard size of 2400mm x 2100mm	a) 8 Nos. 127 mm x 89 mm x 2.5 mm heavy duty stainless steel hinges. b 1 Set Hollow Lever Handle Stainless Steel Mortice Lock Body with single key thumb turn cylinder approved by DGFR. c) 1 No. solid brass mortice lock rebated part. d) 1 Set of 150 mm and 300 mm Flush Bolt Lever Type Stainless Steel. e) 1 No. dust socket medium. f) 2 Nos. stainless steel door stopper. g) 2 Nos. automatic door closer of hydraulically spring operated type (for swing doors) or of wire rope and weight type (for sliding doors). h) 2 Nos. floor spring for double swing door.
6. Single Leaf Fire Escape Door	a) 3 Nos. of 127mm x 89mm x 2.5mm thick heavy duty stainless steel hinges. b) 1 complete set of approved make fire rated panic bolts.
7. Double Leaf Fire Escape Door	a) 6 Nos. of 127mm x 89mm x 2.5mm thick heavy duty stainless steel butt hinges. b) 1 complete set of approved make fire rated panic bolts.
8. Glass Door	a) 1 Set Floor Spring. b) 1 Set Patch Fitting, door bottom, door top, lock clamp, over panel. c) 1 pair Pull handle 600 mm.
9. Aluminium Door	a) 3 Nos. 102mm x 76mm x 2mm stainless steel hinges with nylon rings. b) 1 Set Hollow Lever Handle Stainless Steel Mortice Lock Body deadlock with single key thumb turn cylinder.
10. Kitchen Cabinet Door/ Workbench	a) Galvanised steel continuous 'piano' butt hinges. b) 1 No. 100mm aluminium 'D' handle. c) 1 No. bales catch. d) 1 No. galvanised steel cupboard lock in satin chrome finish.
11. Wardrobe	a) 3 Nos. of 75mm brass butt hinges (per door leaf). b) 2 Nos.100mm anodised aluminium barrel bolt (for double leaf doors) c) 1 No. 100mm aluminium 'D' handle. d) Chromium plated steel clothes hanger rail. e) Steel cylinder cupboard lock in satin chrome finish.
12. Drawer	a) 1 No. steel cylinder drawer lock in satin chrome finish. b) 1 No.100mm aluminium 'D' handle.
13. Sliding and Folding Door/ Partition	a) Top or bottom running set sliding and folding door gear, complete with tracks, channel, brackets, roller guides, hangers and all necessary butt hinges, flush bolts and flush door pulls, etc. as recommended by the manufacturer. b) 1 No. upright 3 lever rebated mortice lockset for sliding and folding door with satin chrome lever handle furniture with 2 Nos. keys of different serial number for each building.
14. Straight Sliding Door	a) Top or bottom running set straight sliding door gear complete with tracks, brackets, hangers, roller guides, channels, door stops, flush brass bolts, brass flush pull etc. as recommended by the manufacturer. b) 1 No. upright 3 lever mortice lockset with satin chrome finish for straight sliding door with 2 Nos. keys of different serial number for each building.
15. Timber Casement Window	a) 2 Nos. 400mm long approved electro-galvanised steel friction hinges. b) 1 No. approved brass with satin chrome finish combination handle and fastener.
16. Top Hung Casement Timber Window.	a) 2 Nos. 750mm long approved electro-galvanised steel friction hinges. b) 1 No. approved brass with satin chrome finish automatic locking fastener.

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Type of Doors, Windows etc.	Ironmongery for each type of doors, windows etc.
17. Top Hung Vent/Sashes	a) 2 Nos. 400mm long approved electro-galvanised steel friction hinges. b) 1 No. approved brass with satin chrome finish automatic locking fastener

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APPENDIX H/1

GLUED LAMINATED TIMBER PERFORMANCE WARRANTY (SPECIMEN)

1.0 Coverage of Performance Warranty

We ..... the glued laminated timber Manufacturer hereby warrant that for a period of **ten (10) years** from the date of Practical Completion, the glued laminated timber system shall not be affected by the following defect:

a) Debonding

This condition occurs when the individual laminations of a glued laminated timber member become separated.

2.0 Procedure for Claims

i) Any defect claims shall be made in writing and delivered by post or by hand to the Manufacturer.

ii) A technical team from the Manufacturer will be dispatched to evaluate the nature of the claim. Should our findings conclude the defects as within the scope of warranty, then the Manufacturer shall make good such defects.

iii) Should the Manufacturer's technical team conclude that the defects falls outside the scope of the warranty, the Manufacturer shall not be held responsible for the claim.

iv) Should the Government disagree with the conclusion of the technical team pertaining to the defects in particular, then an independent third party competent in such technical evaluation shall be appointed to investigate the disputed defects.

v) The appointment of independent third party competent in such technical evaluation shall only be appointed upon the mutual agreement between the Government and the Manufacturer.

vi) The findings of the third party shall be conclusive and mutually accepted by the Government and the Manufacturer.

vii) If the findings of the independent third party are within the coverage of this performance warranty, all cost shall be borne by the Manufacturer or otherwise such cost shall be borne by the Contractor.

viii) All claims for the defects must be received by the Manufacturer not later than fourteen (14) days from the expiry of the warranty period.

MANUFACTURER

.....

.....

.....
Company Stamp

.....
Signature
Name:
Date:

WITNESS

.....

.....

.....
Company Stamp

.....
Signature
Name:
Date:

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APPENDIX H/2

SAMPLE CERTIFICATE OF COMPLIANCE

CERTIFICATE OF COMPLIANCE

Certificate of Compliance

Certificate No. .....

This is to certify that the sawn timber below which is consigned to (name and address of consignee).....
.....

under purchase order number ..... has been graded by a qualified Timber Grader in accordance with the Malaysian Standard (MS XXX) that the timber is of the kind/strength group of timber and grade(s) shown in the summary below; and that the appropriate grade and other marks have been placed on the timber.

Descriptions

Cross section (Size)	Timber name/strength group of timber, grade, number of pieces and length	Pieces	Volume

Total number of pieces ..... KD/AD/SD

Total volume of timber .....m^3

THIS HARDWOOD WAS GRADED IN ACCORDANCE WITH REQUIREMENTS

OF MS .....

.....

Name & Signature of Timber Grader and
C.O.C. number

Date: .....

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SPESIFIKASI

CEILING

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1. General

1.1. Unless otherwise specified or shown on the Drawings, all ceilings shall be of gypsum plasterboards or as approved by the S.O. with class 'O' fire rating and all ceiling installation shall comply with the classification of fire spread as stipulated in the 8th Schedule Uniform Building By-Law 1984.

1.2. All conceal ceilings shall be provided with service access to the ceiling void for maintenance of services above the ceiling space in accordance to the Drawings and approval of the S.O..

1.3. All sprinkler heads (drops) shall have 12.5mm diameter oversize ring, sleeve or adaptor through the ceiling tile to allow for free movement of the sprinkler pipes. It shall also comply with the local fire regulations and to the S.O.'s approval.

1.4. The Contractor shall not commence the ceiling installation works until the building is effectively weather-tight and the work area of wet trades has been completed and dried.

2. Submittals

2.1. Unless otherwise specified, the Contractor shall submit manufacturer's shop drawings and design calculations for the complete proprietary ceiling system showing compliance to all specifications including the method of installation of the ceiling board/panels, hangers, fittings and all accessories duly certified by an Architect registered with the Board of Architects or a P.E. with practising certificate registered with the Board of Engineers Malaysia.

2.2. The contractor shall submit method statement from the proprietary ceiling system supplier/manufacturer of the installation works to the S.O. for approval prior to the commencement of the works at site. No installation of ceiling works shall commence until approval is given in writing by the S.O..

3. Setting Out

3.1. The ceiling layout shall be planned prior to installation to determine the grid configuration, direction et cetera to ensure that all fixings points are compatible with the structural members or other services, or both.

3.2. Mechanical and electrical services shall be completed before installation of the suspension systems. Mechanical services and electrical wiring systems, including cable trays, conduits, junction boxes, down-lights and other appurtenances shall be independently supported and independently braced from the ceiling support system. Suspension hangers may be installed before or during installation of services with the approval of the S.O..

3.3. The shop drawings used for the ceiling installation shall contain sufficient information to allow the installer to set out the ceiling grid. The finished height of the ceiling shall be shown clearly on the drawings.

3.4. Sufficient information should be clearly indicated on the drawings to enable the ceiling module and setting out points in each ceiling area applicable to all relevant trades to be established early. All trades shall work to the same setting out points and data.

3.5. The ceiling height in each area shall be marked in relation to the elevation benchmarks and then transferred by means of a water level, rotating laser or other

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approved devices. Setting out lines should be in both directions and squared accurately at the outset.

4. Acoustic Requirements

4.1. Acoustic requirements specified or shown on the Drawings, such as sound absorption, sound insulation and impact sound insulation shall be tested in accordance with BS EN 13964, BS EN ISO 140 or other acceptable standards.

4.2. A full test report shall be submitted to the S.O. as proof of compliance. It shall relate to the entire specified system. Any variations shall be endorsed by the test laboratory or field testing. Test reports, comments and the testing authority shall be stated in the manufacturer's trade literature or be made available upon request or both.

4.3. All acoustic ceilings shall be of proprietary system using mineral fibre boards or spray applied cellulose on ceiling and/or soffit of slab as approved by the S.O. and conforms to class 'O' fire rating classification comply with BS 476 Part 6 & Part 7.

5. Materials and Ceiling Components

5.1. Zinc-Coated and Aluminium/Zinc Coated Steel

Zinc-coated and aluminum/zinc-coated steel used for the construction of suspended ceiling components shall comply with MS 1196 or other equivalent Standards. The Contractor shall provide proof of compliance to the approval of the S.O.. Where sections have been cut from zinc-coated or aluminium/zinc-coated sheets, the cut edges shall be treated with protective anti-rust paint to prevent corrosion. All pre-painted finish for ceilings shall be as specified under SECTION G: ROOFING.

5.2. Linear Strip Ceiling

Unless otherwise specified or shown on the Drawings, linear strip ceiling shall be aluminium pre-painted anodized comprising of 150mm width x 12.5mm deep x 0.6mm thick panel fixed in accordance to manufacturer's recommendation and to S.O.'s approval.

5.3. Plasterboard

5.3.1. All plasterboards dimensions, its tolerances and flexural breaking load shall comply with BS EN 520. The board shall carry class 'O' approval from DGFR.

5.3.2. Unless otherwise specified in the Drawings the size for plasterboard ceiling shall be 600mm x 1200mm x 9mm thick minimum and shall be suspended from the soffit with adjustable hanger rods in accordance to manufacturer's recommendation and S.O.'s approval.

5.4. Plasterboard with improved core adhesion at high temperature (Type F)

The type of board and test requirements shall be in accordance with BS EN 520, and to the approval of the S.O.. The board shall carry Class 'O' approval from DGFR.

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5.5. Plasterboard with reduced water absorption (Type H)

The types of moisture resistance board to receive paint finish shall be in accordance with BS EN 520 and to the approval of the S.O.. The board shall carry Class 'O' approval from DGFR.

5.6. Mineral Fibre Boards

5.6.1. Unless otherwise specified, the board size shall be 600mm x 1200mm x 15mm thick square edges. The board shall carry Class 'O' approval from the DGFR and the minimum sag resistance shall be of RH 99.

5.6.2. Surface coating of the board shall be applied with vinyl latex paint in white colour at factory and the surface design/texture of the board shall be to S.O.'s approval.

5.7. Fibre Cement Ceiling Panel

Fibre cement ceiling panel shall be asbestos free and shall be an autoclaved cellulose fibre cement flat board. The basic composition consists of cement, refined sand and cellulose fibre. The material shall be classified as Class 'O' and shall be 'Fire- Listed' under SIRIM QAS Fire Listing Scheme.

5.8. Acoustic Glass Wool Ceiling Panel

Acoustic glass wool ceiling panel shall be lightweight fibre glass wool material with high acoustical sound absorption of NRC: 0.90-1.00 (ASTMC 423). Unless otherwise specified the size of the panel shall be 600mm x 1200mm x 20mm thick, square edge fixed to aluminium tee exposed grid systems, suspended from the soffit with adjustable hanger rods in accordance to manufacturer's recommendation and S.O.'s approval.

5.9. Glass Fibre Reinforced Gypsum (GRG)

5.9.1. GRG Boards are manufactured by glass fibre reinforced gypsum and comprise of non-combustible high-grade gypsum casting plaster with glass fibre membranes. Unless otherwise specified shall be in sizes of 1200mm X 900mm x 9mm thick. The board shall conform to the following:

Fire performance : GRG Boards are rated non-combustible as defined in BS 476: Part 4.
Dry Density : Approx. 1660kg/m²

5.9.2. GRG boards shall be installed in accordance to the manufacturer's recommendation and to S.O.'s approval.

5.10. Cornice

5.10.1. Unless otherwise specified, cornice shall be provided of the same ceiling material for all plaster ceiling materials.

5.10.2. Cornice shall be fixed to the walls and ceiling using proprietary adhesive or as recommended by the manufacturer and approved by the S.O..

5.10.3. Large cornices shall be fixed using screws together with cornice adhesive as recommended by the cornice manufacturer and to S.O.'s approval.

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5.10.4. Cornice should be carried and handled carefully to avoid cracking the core or wrinkling the paper liner. Where possible, the contractor shall use full lengths of cornice and mitre all joints.

5.10.5. The Contractor shall ensure accurate and level placement by marking ceilings and walls with a line at the cornice edge.

5.10.6. Cornice with shorter length shall be installed first followed by the longer lengths by bowing out to spring mitres fit into place.

5.11. Reinforcing/Jointing tape

The tape shall not be less than 50mm width paper tape in accordance with ASTM C475 from an approved manufacturer, and to the approval of the S.O..

5.12. Jointing compound

Jointing compound shall setting type or pre-mixed multi-purpose gypsum based air drying type compound, in accordance with BS EN 13963 and to the approval of the S.O..

5.13. Sealants

The application of fire sealant for plasterboard with improved core adhesion at high temperature (Type F) and wet area sealant for plasterboard with reduced water absorption (Type H) shall be in accordance with BS 8212 and to the approval of the S.O.. The appropriate type of sealant shall be used for the required type of plasterboard. Elastomeric sealants can be used at the perimeter of the dry lining or partitioning to provide an airtight construction and to the approval of the S.O..

5.14. Control joint

Unless otherwise specified, control joints shall be provided in a long continuous run of ceiling, spaced at not more than 12 meters centres maximum and recommended by the manufacturer and to the approval of the S.O..

5.15. Anchors and Fasteners

5.15.1. The Contractor shall submit the details of the proposed proprietary anchor to the S.O. for approval.

5.15.2. Notwithstanding the above, the alternative anchor proposed shall be made of carbon steel galvanized to minimum thickness of 5 µm or stainless steel in accordance to European Technical Approval Guideline ETAG 001 Metal Anchors for Use in Concrete.

5.15.3. The size of the anchor fixing shall not be less than 6mm diameter (M6) with effective anchorage depth of not less than 30mm measured from the soffit of the floor slab. The hole for the anchor shall be drilled using drill bit of corresponding size to the proprietary anchor. The design resistance in all load directions shall not be less than 1.10kN.

5.15.4. Shot-fired alternative anchors shall not be allowed. Shot-fired (hybrid-pin) alternative anchors shall not be used to install the suspended ceiling hangers to the concrete soffit. Screws with nylon wing plugs shall not be used as ceiling anchors to install the suspended ceilings.

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5.15.5. Fasteners shall have a corrosion-resistant finish and be appropriate for intended use, in accordance with BS EN 14566. The heads of fasteners shall be shaped so that they can be driven slightly below the surface of the plasterboard without punching through the paper liner.

5.16. Acoustical Cellulose Insulation

5.16.1. Spray Applied Acoustical Cellulose Insulation on ceiling and/or soffit of slab shall be:

5.16.1.1. Thickness – minimum 30mm

5.16.1.2. Thermal conductivity (k-value) = 0.0029 W/mK tested to ASTM C-177.

5.16.1.3. Fire retardant Class "O" complying with BS476 Part 6 & 7 and endorsed by Jabatan Bomba Dan Penyelamat Malaysia.

5.16.1.4. Average moisture absorption of not more than 15% as per ASTM C739.

5.16.1.5. Tested Noise Reduction Coefficient of NRC 0.75 at 30mm thickness.

5.16.1.6. Tested to be non-toxic and asbestos free, contain no carcinogenic materials and shall not cause any skin irritation to humans

5.16.2. Where required, appropriate surface preparation and treatment should be done on the surface of the substrate according to manufacturer's recommendation.

5.16.3. The application of cellulose insulation shall be applied strictly to manufacturer's method statement and to S.O.'s approval

6. Ceiling Suspension System

6.1. General

6.1.1. Batten system (furring channels) as vertical ceiling hangers shall not be allowed for the installation of proprietary ceiling system.

6.1.2. Where grid ceiling suspension system are installed exposed to wind condition (outside building), all lay-in ceiling panels/boards shall be secured to the suspension system with minimum two proprietary `hold-down clip' for each tile as recommended by the manufacturer and approved by the S.O..

6.1.3. Only proprietary adjustable butterfly type locking clips (rod joiner) shall be used with a minimum thickness of 0.48mm and galvanize coating mass of minimum 80g/sq.m. The locking clips shall be of minimum steel grade SK-5 or approved equivalent with a minimum pull off strength of 110kgs.

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6.2. Fixed Ceiling System

6.2.1. Timber framing or metal framing system shall be designed and installed to support the fixed ceiling panels/boards on the external or outside space of the building as shown on the Drawings.

6.2.2. All timber materials used shall be treated and as specified under SECTION H: TIMBER, JOINERY AND IRONMONGERY. Unless otherwise specified, ceiling boards fixed to the timber frames shall be with butt 'V' joint using nails or screws as recommended by the ceiling manufacturer and to S.O.'s approval.

6.2.3. Where conceal ceiling are used, all ceiling panels/boards fixed to the metal frames shall be screwed permanently to the metal framing system as recommended by the ceiling manufacturer and to S.O.'s approval.

6.2.4. All screw fixings of the ceiling panel/boards to the framing system shall be completely sealed to match with the ceiling surface. All external ceiling shall be painted with weather resistant paint as specified under SECTION O: PAINTING.

6.3. Grid Ceiling Suspension System

6.3.1. Vertical suspension members

6.3.1.1. Ceiling hangers shall be galvanized mild steel machine straightened hanger rods of minimum 4mm diameter consisting of 2 pieces length with a galvanization thickness of minimum 80g/sq.m and tensile strength of minimum 350MPa., held together by a galvanized rod joiner (adjustable type galvanized locking clips). Only proprietary adjustable locking clips (butterfly type) shall be used as a rod joiner.

6.3.1.2. Proprietary anchor fixing shall not be less than 6mm diameter (M6) with effective anchorage depth of not less than 30mm measured from the soffit of the floor slab. The hole for the anchor shall be drilled using drill bit of corresponding size to the anchor. The proprietary anchor is fixed to the structural soffit at a distance 200mm away from the wall and then spaced equal to or not more than 1200mm centre to centre (c/c) to form the grid of the ceiling hanger

6.3.1.3. One end of the hanger shall be attached to a pre-drilled galvanized mild steel L-shaped soffit cleat 25mm x 25mm x 50mm (width) and minimum base metal thickness of 2mm with a galvanization thickness of mimimum 80g/sq.m for suspending the pre-straightened hanger rod. The other end of the hanger shall be secured using proprietary locking clips to the primary T-section. The T-sections shall be fixed accordingly to the required ceiling level by adjusting the length of the ceiling hanger through the rod joiner.

6.3.1.4. One end of the pre-straightened hanger rod shall be hooked to the pre-drilled soffit cleat and the other end of the hanger shall be secured to the primary T-section using proprietary locking clips. The T-sections shall be fixed accordingly to the required ceiling level by adjusting the length of the ceiling hanger through the rod joiner

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6.3.1.5. The proprietary adjustable locking clips (butterfly type rod joiner) shall be 0.5mm minimum thickness with galvanize coating mass of minimum 80g/sq.m. The locking clips shall be of minimum steel grade SK-5 and with a minimum pull off strength of 110kgs.

6.3.2. Horizontal suspension members

6.3.2.1. The T-grid system shall be manufactured to a minimum 24mm width x 30mm height T-section rigidized (rotary stitching) on all T-sections and with a load carrying capacity of minimum 20kgs/m² per ASTM C635. All T-sections shall be in powder coated colour white. Installation shall refer to manufacturer's method statement.

6.3.2.2. Perimeter wall angles shall be securely fixed to the adjacent perimeter walls using appropriate fixings forming part of the grid ceiling system as recommended by the manufacturer and approved by the S.O..

6.4. Concealed Ceiling Suspension System (Soffit-ceiling distance < 1800mm)

Unless otherwise shown on the Drawings and when the distance between the concrete soffit and the suspended ceiling board is less than 1800mm in vertical height, the concealed ceiling suspension system shall be as follows:

6.4.1. Vertical suspension members

6.4.1.1. Ceiling hangers shall be rigidized galvanize mild steel 25mm x 25mm angle section with 0.5mm base metal thickness OR galvanized mild steel machine straightened hanger rods of minimum 4mm diameter with a galvanization thickness of minimum 80g/sq.m and tensile strength of minimum 350MPa. The rod shall be in 2 pieces and should be used in conjunction with the adjustable suspension (butterfly type) clip/rod joiner. Levelling of the ceiling shall be executed in accordance with manufacturer's method statement.

6.4.1.2. Proprietary anchor fixing shall not be less than 6mm diameter (M6 or ¼") with effective anchorage depth of not less than 30mm measured from the soffit of the floor slab. The hole for the anchor shall be drilled using drill bit of corresponding size to the anchor. The proprietary anchor shall be fixed to the structural soffit at a distance 200mm away from the wall and then spaced equal to or not more than 1000mm centre to centre (c/c) to form the grid of the ceiling hanger

6.4.1.3. Where hanger rods are used, one end of the hanger rod shall be attached to a pre-drilled galvanized mild steel L-shaped soffit cleat 25mm x 25mm x 50mm (width) with minimum base metal thickness of 2mm. The other end of the hanger shall be secured using proprietary locking clips to the primary channel (main runners).

6.4.1.4. Where mild steel angle sections are used as ceiling hangers, one end of the ceiling hanger shall be connected to the pre-drilled proprietary anchor fastener to the soffit slab. The other end of the hanger shall be secured using proprietary locking

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clips or suspension brackets to the primary channel (main runners).

6.4.2. Horizontal members

6.4.2.1. Primary rigidized galvanised steel channel (main runners) shall be 34mm x 12mm x 0.4mm minimum BMT at a distance of 100mm away from the wall and spaced equal to or not more than 1000mm c/c (the minimum thickness may varies according to the profile with larger cross section values with appropriate justification from manufacturer). Installation shall refer to manufacturer's method statement.

6.4.2.2. Secondary rigidized galvanize steel channel 34mm x 12mm x 0.4mm minimum BMT shall be secured using proprietary locking clips or suspension brackets to the primary channel.

6.4.2.3. The primary and secondary channels shall be connected using galvanized proprietary locking clips or suspension brackets with minimum thickness of 0.5mm (the minimum thickness may varies according to the profile with larger cross section values with appropriate justification from manufacturer) and screwed as recommended by the manufacturer. And no tilting movement are allowed on Primary channel once secured with locking clips.

6.4.2.4. Unless otherwise specified, a single layer 9mm thick gypsum plasterboard ceiling shall be screwed using galvanized wafer head dry wall screw Ø 4mm x 25mm length fixed at maximum distance of 200mm c/c to the secondary channel as recommended by the manufacturer.

6.5. Concealed Ceiling Suspension System (Floor-ceiling distance > 1800mm)

Unless otherwise shown on the Drawings or when the distance between the concrete soffit and the suspended ceiling board exceeds 1800mm in vertical height, the concealed ceiling suspension system shall be as follows:

6.5.1. Vertical suspension members

6.5.1.1. Ceiling hanger system shall be galvanized mild steel threaded rods of not less than 6mm diameter.

6.5.1.2. Fixing of vertical suspension hangers to soffit slab shall be by using threaded rod and proprietary anchor (drop in anchor or equivalent). Identify the actual location of suspended point on site, mark the position for drilling, the position should no more than 100mm away from the perimeter wall, drilling at least 28mm depth. Insert corresponding diameter drop-in anchor or equivalent, for best result hammer the "pin" slightly inside the drop-in-anchor. Cut threaded rod to require suspension length and screw fix the threaded rod into the corresponding diameter drop-in-anchor or equivalent. Slightly pull the threaded rod to check the fixing.

6.5.1.3. One end of the threaded ceiling hanger rod shall be connected to the pre-drilled anchor fastener (drop-in anchors or equivalent) and the other end of the threaded rod shall be secured to the proprietary locking clips or suspension

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brackets with two M6 nuts and locked to the primary channel (main runners).

6.5.2. Horizontal members

6.5.2.1. Primary channel shall be galvanised steel 38mm x 12mm x 1mm thick minimum placed at a distance of 100mm away from the wall and spaced equal to or not more than 1000mm c/c. The primary channel shall have the characteristic strength of at least 250N/mm². Installation shall refer to manufacturer's method statement

6.5.2.2. The dimension of the secondary channel shall be at not less than 50mm x 20mm x 0.5mm thick minimum place at 450mm c/c minimum for 9mm thickness board and 600mm c/c minimum for 12mm thickness board. The secondary channel shall have the characteristic strength of at least 250N/mm².

6.5.2.3. The primary and secondary channel shall be connected using galvanize proprietary locking clip with minimum thickness of 0.5mm (the thickness may vary according to the profile with larger cross section values with appropriate justification from manufacturer) and screw as recommended by the manufacturer.

6.5.2.4. Unless otherwise specified, a single layer 9mm thick minimum plasterboard ceiling shall be screwed using galvanized dry wall screw Ø4mm x 25mm length at maximum 200mm c/c to the secondary channel as recommended by the manufacturer.

6.6. Performance and Installation Requirements

6.6.1. Suspended ceiling systems are not designed for and shall not be regarded as structural elements. Electrical wiring systems, including cable trays, conduits, junction boxes, lighting fixtures, air-conditioning ducts, air diffusers and other appurtenances shall not be placed directly on the ceiling and shall be independently supported and independently braced from the structure.

6.6.2. Suspended ceilings shall be designed to ensure that detrimental levels of water and condensation are not formed within or on the surfaces of the ceiling and related components and the ceilings shall be designed according to Class C conditions of BS EN 13964.

6.6.3. Other steel components of the substructure such as supporting member, perimeter trim, et cetera shall have a characteristic strength of at least 250N/mm² and their tolerances shall comply with BS EN 13964. No bends or notches or drilling or other alterations from its original state are allowed on steel components unless allowed by the manufacturer.

6.6.4. Where not specified, tolerances for the ceiling shall comply with BS EN 13964. The maximum deflection between two suspension points shall not exceed L/500 where L is the suspension distance between the two points.

6.6.5. The top fixing of all suspension components shall be made to the primary structural framing element, unless specifically designed otherwise. The contractor shall ensure the fixings are of a corrosion-

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resistant material suitable for the intended application, and fixings shall be compatible with the material of the structure to which they are to be fitted.

6.7. Structural steel fixing

6.7.1. Self-drilling screws are not allowed for structural steel, unless specifically designed otherwise. These screws shall not be placed in tension unless specifically designed for that purpose.

6.7.2. Penetrations made into the structural steel by drilling shall be duly approved by the S.O..

6.7.3. Clips shall be installed strictly in accordance with the manufacturer's recommendations.

6.8. Cold formed truss/timber truss fixing

6.8.1. Suspended ceiling system fixings to cold formed trusses shall only be allowed by using steel plate straps. For the case of proprietary truss systems, the Contractor shall obtain written approval from the Truss System Provider and the S.O..

6.8.2. Fixings to timber joists shall be made into the side of the timber, with five times the diameter of the fastener clear edge distances.

6.9. Glued laminated timber fixing

Top fixing to glued laminated timber members shall only be allowed with the approval of a P.E. The glued laminated timber shall be fabricated as specified under SECTION H: TIMBER, JOINERY AND IRONMONGERY.

6.10. Concrete fixing

6.10.1. Shot-fired fasteners are not allowed to be installed directly to a concrete flat roof slab. Separate structural framing element for ceiling fixing shall be specifically designed if required, and it shall be approved by the S.O..

6.10.2. Fixing to aerated/lightweight concrete shall only be made in accordance with the manufacturer's recommendations.

6.11. Purlin fixing

6.11.1. Fixings shall be made of steel plate straps. No connections requiring drillings to the web/lip of the purlins are allowed, unless specifically designed otherwise.

6.11.2. Where flange connections are necessary, they should be made as close as possible to the web of the purlin, and design calculations shall be provided to ensure the structural capacity of the purlin is not compromised.

6.11.3. Fixings shall be selected and installed in accordance with the manufacturer's specification and approved by the S.O..

6.12. All concrete expansion bolts shall be installed in accordance with the manufacturer's recommendations taking due care to maintain minimum edge distances, spacing and embedment depth.

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6.13. Ceiling hangers shall be installed in accordance to the ceiling system manufacturer's recommendation. Bends as means of levelling the ceiling or to avoid plenum services, shall not be made in the ceiling hangers. Where ceiling hangers cannot be secured at the specified spacing, secondary members shall be installed to manufacturer's recommendation.

6.14. In areas where the suspended ceiling is adjacent to rooms or areas with twenty four (24) hours air-conditioning and the concrete soffits are applied with PU foam, the ceiling suspension hanger shall be secured to the concrete soffit using M6 x 30mm A4 stainless steel (DIN17440) anchor bolts as specified or shown on the Drawings.

6.15. Unless otherwise shown on the Drawings, plasterboard partitions shall be fixed to the primary framing members of the ceiling suspension system in accordance with of BS 8212.

6.16. Suspended Ceiling Exposed to Wind (Outside Building).

6.16.1. Wind Load

6.16.1.1. The minimum basic wind speed shall be 35 m/s. However, the minimum basic wind speed shall be increased to 41m/s for lightweight covering.

6.16.1.2. The requirement of wind load shall be as stated in the MS 1553 – Code of Practice on Wind Loading for Building Structures. The minimum basic wind speed shall be as specified above or as per the value stated in MS 1553 whichever higher.

6.16.1.3. Load combinations shall be clearly identified (as per MS EN 1993 Part 1 to Part 3 or other equivalent standards recognised internationally) and itemised to enable design checking to be carried out upon the most adverse conditions or the effect (e.g. effect of uplift) under consideration.

6.16.1.4. Where grid ceilings system is installed to areas exposed to wind condition (outside buildings), all lay-in ceiling panels/boards shall be secured to the suspension system with minimum two proprietary `hold-down clip' for each tile as recommended by the manufacturer and approved by the S.O.. Installation shall refer to manufacturer's method statement.

6.17. Testing and Inspection

6.17.1. The Contractor shall carry out in-situ Pull-Out Test for the complete ceiling suspension (hanger) system inclusive of the rod joiner and the anchors. The sampling rate shall be 5 samples for every 200 number of hangers installed and the points of testing shall be carried out subject to S.O.'s approval.

6.17.2. The minimum load for the pull-out test shall be 0.5 kN applied to each complete ceiling suspension sample inclusive of rod joiner where applicable. The test sample shall be left for the duration of 8 hours and the observation shall be recorded and submitted to the S.O. for approval.

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6.17.3. The Contractor shall inform the S.O. in writing to request for inspection and approval prior to closing up of the ceiling suspension system with ceiling panels.

6.18. Warranty

6.18.1. When a proprietary ceiling system is used, the Contractor shall submit to the S.O. a warranty from the manufacturer with the following provisions:

6.18.1.1. The products used are genuine and free from manufacturing defects;

6.18.1.2. The complete ceiling suspension (hanger) system are installed in accordance with the manufacturer's method statement, recommendation, guidance and specifications that will deliver the specified level of performance;

6.18.1.3. The warranty certificate shall cover a period of ten (10) years from the date of Certificate of Practical Completion against any defect or failure due to the installation and workmanship by the manufacturer's registered panel installer.

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SPESIFIKASI

STRUCTURAL STEEL AND METALWORKS

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1. General

This section provides the generally applicable requirements for steel and metal for the construction of structures, building components and related works. All materials shall conform to the relevant Malaysian or British or European Standards.

2. Hot Rolled Structural Steelworks

2.1. All hot rolled structural steelworks design, materials, drawings, workmanship, protective treatment, fire protection, Quality Assurance and Quality Control shall be in accordance with the *Specification for Structural Steelworks No. JKR 20601-0191-12.*

2.2. Quality Assurance and Quality Control (QA & QC)

The Contractor shall submit a Quality Assurance and Quality Control programme as specified in the Specification for Structural Steelworks as in sub-section 2.1..

2.3. Drawings and Design Calculations

2.3.1. The Drawings to be submitted by the Contractor based on construction drawings are as follows:

2.3.1.1. Fabrication drawings;
- Shop drawings;
- Erection drawings;

2.3.1.2. As-built drawings.

2.3.2. In the event that the Contractor is required to provide the design, he shall prepare Drawings with details in accordance with *MS EN 1993* or other relevant standards. The Drawings and design calculations shall be certified by a Professional Engineer. He shall also prepare Drawings and arrangements of temporary steelworks for the different stages of construction in compliance with the requirements specified in the *Specification for Structural Steelworks* as in sub-section 2.1..

2.4. Records

2.4.1. The Contractor shall submit to the S.O., document and records which shall include but not limited to:

2.4.1.1. Drawings as in sub-section 2.3. and documentation register;

2.4.1.2. Mill certificates for materials and certification for consumables;

2.4.1.3. Calibration of equipment;

2.4.1.4. Weld procedures, concessions et cetera;

2.4.1.5. Inspection and laboratory test reports;

2.4.1.6. Delivery schedules and method statements for fabrication and installation;

2.4.1.7. Surveys and final inspection results.

2.4.1.8. Completion of erection and hand over certification.

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2.5. Installation of Long Span Steel Trusses

The S.O. shall ensure that the installation of long span trusses more than 20m clear span is in accordance to the checklist of requirement and condition in **Appendix J/1.**

3. Prefabricated Cold Formed Steel Roof Trusses

3.1. All prefabricated components shall be manufactured only by reputable licensed truss suppliers listed in *J-TRUSS system online (Application and Approval of Truss System Provider)* and approved by the S.O.. This supplier duly termed as 'System Provider' is responsible for the analysis, design, detailing, drawing, manufacture, material, handling and erection of the roof members, and their ancillary fixing components. The full requirement is outlined in the *Specification for Prefabricated Cold Formed Steel Roof Trusses (JKR 20601-0186-11).*

3.2. System Provider

The System Provider (S.P) is a supplier of a proprietary roof truss system appointed by the Contractor and approved by the S.O, which employs Quality Assurance procedures in the design, detailing, connection, bracing, erection criteria and manufacture of truss components for the structural roof truss system.

3.3. Duties of Professional Engineer

3.3.1. The S.P. shall appoint a Professional Engineer (P.E.) whose duties shall include the followings:

3.3.1.1. Preparation of roof truss analysis and design;

3.3.1.2. Preparation of drawings;

3.3.1.3. Design changes in every stage of work;

3.3.1.4. Certification for completion of roof truss installation;

3.3.1.5. Final certification for roof truss installation prior to issuance of Certificate of Practical Completion for the whole Works to the Contractor.

3.4. Fabricator

All trusses shall only be assembled by licensed fabricators approved by the S.P. and registered with CIDB. A copy of CIDB registration certificate shall be submitted to the S.O. for verification.

3.5. Installer

All installation works shall be executed and supervised by qualified personnel with valid certificate issued by CIDB. The S.O. shall verify the identification and qualification of the installer prior to the installation.

3.6. General Truss Limitation

3.6.1. Prior to any prefabricated cold formed roof trusses works, the following general limitation shall be applied:

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3.6.1.1. Maximum unsupported truss span 13 m with permitted deviation of ±0.05m.

3.6.1.2. Maximum truss spacing of 1.2m with permitted deviation of ±0.025 m.

3.6.1.3. The minimum basic wind speed shall be 35m/s. However, the minimum basic wind speed shall be increased to 41m/s for lightweight roof covering.

3.6.1.4. Minimum base steel thickness for main truss member shall be:

a) 1mm for unsymmetrical section or open cross section;

b) 0.6mm for symmetrical machine-manufactured box or closed cross section.

3.6.1.5. Minimum base steel thickness for other truss element shall be:

a) 0.5mm for batten or purlin;

b) 1.2mm for wall plate;

c) 1mm for all bracings.

3.7. Analysis, Design Report and Drawings Submission

3.7.1. The S.P. through the Contractor shall propose to the S.O. for his approval a roof truss system which is safe, functional and conforming to design standard. Submission of proposal shall include truss analysis, design report, and construction drawings. The truss analysis shall indicate all loads, load combinations, connections criteria, bracings and tie-down of the truss. Design output of the truss members, battens, connections, tie-down and wall plates, anchors, bracings, truss accessories, splicing and stiffeners where related to the analysis shall be included in the design report. Refer to **Appendix 3** of *JKR 20601-0186-11.*

3.7.2. All details in the construction drawings shall be sufficient to enable checking against the analysis and design report, including specifying and providing the truss layout and configuration, steel grades, section properties of members, length of members in each truss configuration, properties of truss accessories, specification of corrosion protection, specification of fastener and anchor, tie-down and anchoring details and all types of connection details including the connection of all attachments to the trusses.

3.7.3. Technical specifications or mill certificates for base steel, fastener and anchor shall also be included in the submission. Verification test certificate from an approved accredited laboratory on the technical parameter specified in the technical specifications or mill certificates shall be submitted upon request by the S.O..

3.8. Warranty

3.8.1. When a prefabricated cold formed steel roof truss system is used, the Contractor shall submit to the S.O. a warranty from the S.P. with the following provisions:

3.8.1.1. The products used are genuine and free from manufacturing defects;

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3.8.1.2. The prefabricated cold formed steel roof truss system is installed in accordance with the S.P.'s instructions, guidance and specifications that will deliver the specified level of performance;

3.8.1.3. The warranty certificate shall cover a period of ten (10) years from the date of Certificate of Practical Completion against any defect or failure due to the installation and workmanship by the S.P.'s registered panel installer.

4. Metal Frames for Doors and Windows

4.1. Steel Frames

4.1.1. The Contractor shall supply, assemble and fix steel frames for doors and windows as shown on the Drawings. The steel frames shall comply with *BS 6510*, and shall be from an approved source and shop-primed with two coats of red lead oxide or other approved rust resisting primer.

4.1.2. The steel frames shall be manufactured from sections rolled from good commercial grade galvanized mild steel in single sections, mechanically straightened with all corners pre-cut with a 45 degrees mitre joint giving a snug and accurate fit, fully electrically welded, and carefully ground and cleaned, or shall be mechanically jointed by an approved method.

4.1.3. All screws, nuts, bolts and washers shall be of stainless steel.

4.1.4. Steel frames shall be painted as specified in SECTION O: PAINTING.

4.2. Aluminium Frames

4.2.1. The Contractor shall supply, assemble and fix aluminium frames for doors and windows as shown on the Drawings. Unless otherwise specified, all aluminium frames for windows shall be fabricated from sections extruded from aluminium alloy conforming to *MS 832*. All aluminium frames for glass sliding doors shall be fabricated from sections extruded from aluminium alloy and in compliance with *MS 1017*.

4.2.2. Unless otherwise shown on the Drawings or described in the Bills of Quantities, aluminium surfaces shall be natural anodised finish, free from alloy defects, dye marks, scratches and other surface blemishes in accordance with *BS 3987* with an anodic coating of 15μ minimum thickness complying with *BS EN 12373-1*.

4.2.3. All coloured anodized finish to aluminium exposed surfaces shall be subject to the S.O.'s approval.

4.2.4. All aluminium extrusion or sheet exposed surfaces after anodizing and after colouring, if required by the S.O., shall be sealed, and the adequacy of the sealing shall be given special emphasis.

4.2.5. All fasteners such as bolts and screws shall be of stainless steel type A2-70 (minimum) in compliance with *ISO 3506* or other suitable materials as specified in the Drawings. Rivets shall be stainless steel or aluminium alloy appropriate to the applications.

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4.2.6. Extruded aluminium framing members shall be fabricated from designated alloys complying with *MS 2289*. Ancillary members such as sills, couplings and the like formed from sheet materials, they shall be fabricated from designated alloys complying with *MS 2040*.

4.2.7. Where friction stays and hinges are fastened onto the framing section, the portion that receives the fastener shall not be less than 2.5mm thick.

4.3. Frames for Adjustable Louvre Windows

4.3.1. The Contractor shall supply, assemble and fix frames for adjustable louvre windows as shown on the Drawings in compliance with *MS 1057*.

4.3.2. Unless otherwise specified, the frames shall be of approved manufacture. The frames shall be supplied complete with weather seal and non-ferrous bearings, spring clips, locking device and weather stripping with all necessary spacing pieces. The frames, coupling mullions and spacer brackets shall be minimum 1.2mm thick (18 SWG) or otherwise specified cold-rolled steel strip galvanised with hot-dipped process. Unless otherwise specified on the Drawings, the clips and pivots to receive the louvres shall be of durable nylon material and sample submitted shall be to S.O.'s approval.

4.3.3. The operating rods shall be 2.13mm thick (14 SWG). The handle and lock shall be 2.642mm thick (12 SWG) steel.

4.3.4. Unless otherwise specified, the finish shall be anodized coating of 15 μ (average) minimum complying with *BS EN 12373-1*.

4.4. Accessories

4.4.1. Accessories for each steel or aluminium frame for doors and windows shall be supplied complete with:

4.4.1.1. Sufficient number of built-in stainless steel hinges as per Schedule of Ironmongery under SECTION H: TIMBER, JOINERY AND IRONMONGERY;

4.4.1.2. Two (2) rubber buffers per closing jamb, to reduce noise and vibration;

4.4.1.3. Welded mortar guard; Adjustable stainless steel striker plate with a gently curved lead-in edge; Removable spreader bars, to ensure a perfect square during transportation and installation; and

4.4.1.4. Minimum of eight (8) pieces of 4mm brick ties, to ensure a tight permanent fit.

4.5. Samples

Samples of steel or aluminium sections with complete accessories for the doors and windows, together with complete set of shop drawings of all works shall be submitted to the S.O.'s for approval prior to the commencement of any work.

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4.6. Installation

4.6.1. Unless otherwise specified or shown on the Drawings, all types of window and door frames shall be fixed or installed using the sub-frame method in accordance with the manufacturer's recommendation and to the S.O.'s approval.

4.6.2. All joints on the window and door frames shall be sealed using polyurethane (PU) type joint sealant.

4.6.3. Where buildings are located near to the coastal area, the bolts, nuts and screws used shall be of stainless steel unless otherwise specified.

4.6.4. Unless otherwise specified in the Drawings, the adjustable louvre side frames shall fix to the aluminium frames and shall be installed using the sub-frame method in accordance with the manufacturer's recommendation and to the S.O.'s approval.

5. Collapsible Gates, Roller Shutters and Et Cetera

The Contractor shall provide and fix approved collapsible steel gates, folding shutters, roller shutters and et cetera complete with all necessary accessories as approved by the S.O. to the sizes and positions as shown on the Drawings. Unless otherwise specified in the Drawings, they shall be galvanised and fixed in accordance with the manufacturer's instructions.

6. Sundries

6.1. Unless otherwise specified in the Drawings, mild steel shall be used for balustrades to staircases, verandahs, balconies, et cetera and shall be fixed as shown on the Drawings.

6.2. All iron and steel for the sundries shall be of the quality approved by the S.O.. Screws and bolts shall have washers where appropriate. Hooks for carrying ceiling fans shall be formed from 13mm diameter mild steel rods bolted to timber ceiling members or ragged into concrete.

6.3. Welded mesh, expanded metal, aluminium sheets et cetera shall be provided and fixed as shown on the Drawings.

6.4. Mild steel grilles, drain cover gratings shall be provided and fixed as shown on the Drawings. Unless otherwise stated, all steelworks shall be joined by continuous welding.

6.5. Ant caps shall be of 16 gauge galvanised iron sheets formed to shape as shown on the Drawing. The caps shall be fixed between concrete stumps/brick piers or walls and timber posts or plates as required. The caps shall project 60mm and inclined at 45^0 from the surface.

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APPENDIX J/1

CHECKLIST
FOR THE INSTALLATION OF LONG SPAN STEEL TRUSSES
(For Trusses exceeding 20m in Clear Span)

This checklist is to provide assistance to the S.O./Supervising Engineer prior to the commencement of any installation of long span steel roof trusses. Please tick and indicate whether all the items / conditions have been adhered fully.

No	ITEM	Compliance (√)
A	**DOCUMENTATIONS**	
A1	Approved Structural Drawings by the Designer	
A1.1	For JKR's in house design, the drawings must be approved and signed by the HODT.	
A1.2	For design by Consultants, all drawings must be approved and endorsed by the submitting Professional Engineer.	
A2	Shop drawings for erection purposes *issued* by the Steel Installer	
A2.1	The Professional Engineer (PE) appointed by the Steel Installer must ensure that, these shop drawings are in accordance to the design and any assumptions made for the design. Any additional joints/splicing and any other deviations required for the purpose of erections must be accompanied by the calculations and approved by this Professional Engineer.	
A2.2	Quality Assurance documentations for the fabrication of steel members must be approved by the PE appointed by the Steel Installer.	
A2.3	Competency certification from approved establishment for all erection supervisors and installers.	

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B.	METHODOLOGY	
B1	The Contractor shall prepare and submit the Method Statement to the S.O. for approval at least three (3) weeks prior to the erection commencement. A copy of the Method Statement must be submitted to the Designer's office for verification.	
B2	The Method Statement with the concurrence of the Designer shall be approved by the S.O.. (Item 12.4, Section A, *Standard Specification of Building Works, 2014*)	
B3	The Method Statement shall among others include the following:	
B3.1	Pre-erection survey and formal acceptance of site	
B3.2	Phased component delivery (if any)	
B3.3	Safety and environmental controls	
B3.4	Operative certification	
B3.5	Plant and equipment certification	
B3.6	Detailed Sequencing of installation, and showing the movements of any plant/machinery required for the installation. **The installation sequencing must be divided into several major/critical stages for the purpose of verification.**	
B3.7	Quality Assurance documentations required for the installation	
B4	Erection must adhere fully to the Method Statement. Each stages of erection must be verified and approved by the Supervising Engineer or the S.O..	

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C.	**SAFETY**	
C1	All internal or external temporary bracings required for the installation must be designed and approved by the P.E. appointed by the Steel Installer.	
C2	All temporary bracings must be shown in the Shop Drawings.	
C3	The Contractor shall prepare plan showing width and level of access, level of prepared working area for site traffic and plant movements, and areas available for temporary storage.	
C4	Unless required and approved by the S.O. otherwise, all welding works shall to be done at ground level.	
D	**CERTIFICATION OF COMPLETION**	
D1	The Contractor shall certify that he/she has made all the necessary inspections to ensure all steelworks and the corresponding connections has been erected and constructed in accordance with the work's drawings, specification and contract requirements.	

Saya telah menyemak dan bersetuju

.....

(Cop & Tandatangan oleh S.O./Wakil S.O.)

Tarikh .....

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SPESIFIKASI

PLASTERING, PAVING, TILING AND CARPET

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1. General

1.1. Cement

1.1.1. The cement, unless otherwise described shall be Ordinary Portland Cement, complying with MS EN 197-1 as specified in SECTION D: CONCRETING or Masonry Cement complying with MS EN 413-1.

1.1.2. White and coloured cement shall be of approved manufacture.

1.2. Plasticiser

The plasticizer shall be of approved manufacture and used strictly in accordance with the manufacturer's recommendation.

1.3. Plasterlime

The plasterlime shall be of approved manufacture and shall comply with BS 890 and shall be applied strictly in accordance with the manufacturer's recommendation.

1.4. Sand

The sand for external rendering, internal plastering and floor screeding shall comply with MS 30 for fine aggregates. Sand for plastering using gypsum shall comply with MS 701.

1.5. Water

Water for mixing shall be clear and free from harmful matter as specified in SECTION D: CONCRETING.

1.6. Mixing

1.6.1. All mixing of mortar for plaster and screed shall be done by machine. Hand mixing shall only be allowed for small quantities and with the approval of the S.O.. Hand mixing shall be done on a clean platform. The water content of the mix shall be only the minimum required to give a workable mix.

1.6.2. Mortar for plaster and screed shall be used up within forty five (45) minutes after mixing.

1.6.3. For gypsum plaster, mixes shall be used up within one (1) hour after mixing.

1.6.4. No remaking of the mix shall be permitted thereafter.

1.7. Surface Preparation

1.7.1. Where possible cement paving, screeding and rendering on concrete surface shall be laid while the concrete is still green that is after the final set but not later than twenty-four (24) hours of laying concrete. The concrete surfaces shall be brushed with a stiff broom before it has hardened to remove laitance and give a roughened surface. Hardened concrete surfaces shall be thoroughly hacked to form a key to the approval of the S.O..

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1.7.2. Before any paving, screeding or rendering is applied, all surfaces shall be thoroughly cleaned and wetted and be in damp state at the time the paving, screeding or rendering is applied.

1.7.3. Where plastering and rendering are to be applied in several coats, the surface of each preceding coat shall be scratched while still green to form key for the subsequent coat.

1.8. Bay

Paving and screeding shall be laid in alternate bays. On hardened concrete bases, each bay shall not exceed 15m^2. On the surface where the concrete is still green, each bay shall not exceed 30m^2. Where bays are not square, the ratio of the length between adjacent sides of each bay shall be approximately 1:1.5. The joints in paving screed shall coincide as nearly as possible with joints in the base.

1.9. Curing and Protection

Unless otherwise specified hereinafter, the screeds shall be cured for three (3) to seven (7) days after laying, and protected from rapid drying by covering with polyethylene sheets or tarpaulins and shall also be protected from any damage.

1.10. Making Good

1.10.1. Defective screeds shall be cut out and made good with fresh screed and sufficient time shall be allowed for the screed to dry prior to the laying of the floor finish.

1.10.2. Defective plastering and rendering shall be made good by cutting out the defective part to a rectangular shape, and the edges shall be undercut to form dovetail-key and finished flush with the surrounding work.

1.11. Samples

The Contractor shall supply the S.O. with samples of materials and/or sample of finished work for approval. Approved samples shall be kept at site for reference.

1.12. Tools

Proper tools shall be used for all scribing, scoring, splicing, smoothing edges, making angles et cetera of tiles, bricks and others so as to produce neat and fit joints.

1.13. Types of Finishes

The appropriate type of finishes to be used in the various locations of the works shall be as shown on the Drawings or as tabulated in the schedule of finishes. Unless otherwise shown on the Drawings or described in the B.Q., the finishes and their dimensions shall be as specified hereinafter.

1.14. Cornices and Angles

1.14.1. The cornices and moulded work shall be clean and accurately formed to the section shown on the Drawings. All mitres, stops and enrichments and moulding shall follow the details as shown on the Drawings, all to the approval of the S.O..

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1.14.2. All rounded and moulded angles shall be of the same material mix as the adjacent finish. For narrow reveal, splays and returns under 30mm wide, Class D plaster to BS 1991 shall be used.

2. Plaster Work

2.1. Plain Plaster

2.1.1. Plain plaster shall consist of one (1) part masonry cement to six (6) parts sand by volume. Where CEM 1 is used, plasticizer or plasterlime shall be added to the mix in accordance with the manufacturer's instruction.

2.1.2. The plaster shall be applied in two coats generally to a total thickness of 20mm to brickwall and 12mm to soffits, beams, columns, brick-walls and other smooth surfaces.

2.1.3. The first coat shall consist of rough plastering to a thickness of 10mm for 20mm plainface, and 6mm for 12mm plainface. The second coat shall be finished with a steel trowel for internal surfaces and with a straight-edged wood float for external surfaces.

2.1.4. All external walls, unless otherwise specified shall be finished with rough surface cement plastering.

2.1.5. All internal walls, unless otherwise specified shall be finished with smooth skimmed surface cement plastering.

2.2. Granolithic Plaster

2.2.1. Granolithic plaster shall consist of by volume, two (2) parts cement, one (1) part sand, five (5) parts granite chipping passing 6mm mesh and retaining upon 3mm mesh, applied in two (2) coats to a total thickness of 10mm to a backing coat, finished smooth with wood float.

2.2.2. The backing coat shall consist of 12mm thick plain plaster as described herein before. The finished surface shall be brushed lightly to achieve the required texture after it has reach initial set.

2.2.3. Shanghai plaster shall consist of two (2) parts approved coloured cement, one (1) part sand and five (5) parts of selected lime-stone chipping passing 6mm mesh and retaining upon 3mm mesh by volume applied in two (2) coats to a total thickness of 10mm to the backing coat, finished smooth with wood float.

2.2.4. The backing coat shall consist of 12mm thick plain plaster as described hereinbefore. The finished surface shall be brushed lightly to achieve the required texture after it has reached initial set.

2.3. Shanghai Plaster

2.3.1. Shanghai plaster shall consist of two (2) parts approved coloured cement, one (1) part sand and five (5) parts of selected lime-stone chipping passing 6mm mesh and retaining upon 3mm mesh by volume applied in two (2) coats to a total thickness of 10mm to the backing coat, finished smooth with wood float.

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2.3.2. The backing coat shall consist of 12mm thick plain plaster as described hereinbefore. The finished surface shall be brushed lightly to achieve the required texture after it has reached initial set.

2.4. Textured Finish Plaster

2.4.1. Textured finish plaster shall consist of a 20mm thick backing coat of plain plaster as described hereinbefore ruled into a plain and even surface and a finishing coat as on the Drawings and described hereinafter.

2.4.2. For rough cast finish, the mix shall consist of selected cement, sand and aggregate in the proportion to give the required finish to the approval of the S.O..

2.4.3. For Tyrolean finish, the mix shall consist of one (1) part selected coloured cement, and two (2) parts sand by volume applied to the backing coat by means of a Tyrolean machine in accordance with the manufacturer's recommendation. The finish shall be built up in three (3) layers to a total thickness of not exceeding 6mm. Each coat shall be allowed to dry before the application of a subsequent coat.

2.4.4. For pebble-dash finish, the dry pebble for the finish shall be thrown onto the backing coat while the latter is still wet. The pebbles to be used shall be clean and of size and quality approved by the S.O..

2.4.5. For pebble-wash finish, the selection of pebbles shall be clean and of size, colour and quality approved by the S.O.. The selected pebbles shall be mixed with plain plaster and applied while it is still wet in a single coat generally to a total thickness of 12mm to a backing coat. The applied surface is tapped to set the pebbles in position. The pebbles shall be brushed and washed lightly to achieve the required texture after it has reached the initial set. Loose pebbles shall be placed back in position and by tapping the surface to set.

2.5. Gypsum Plaster

2.5.1. Gypsum plaster, or plaster of Paris, is produced as a proprietary dry plaster powder and when it is mixed with water, it re-forms into gypsum. The ratio of the gypsum powder mix to the amount of water shall be as recommended by the manufacturer.

2.5.2. The setting of unmodified plaster starts about ten (10) minutes after mixing and is complete in about forty-five (45) minutes; but not fully set for seventy two (72) hours. The total gypsum plaster thickness for vertical and horizontal masonry and concrete surfaces shall be 16mm.

2.5.3. The resulting paste hardens as it cools, forming a relatively soft, pliable finished product. Unlike mortar or cement, which dries much harder, gypsum plaster can be sanded or otherwise manipulated once cured, making it a good option for aesthetic, non-load bearing purposes.

2.5.4. Gypsum plaster is renowned for its use as an art medium and is often use in conservation works especially for decorative embellishment. It is also used to simulate the appearance of surfaces of wood, stone or metal.

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2.6. Lime Plaster

2.6.1. Typical lime plaster mix shall consist of one (1) part lime putty to three (3) parts of washed, well graded sand. The lime putty is mixed at one (1) to three (3) ratios, creates a compact plaster.

2.6.2. Water is added to produce slaked lime (calcium hydroxide), which is sold as a wet putty or white powder. Water is added to the white powder mix as per the manufacturer's recommendation.

2.6.3. Water is added to the proprietary lime plaster mix as per the manufacturer's recommendation to form a workable paste prior to use. Lime plaster is used as an alternative to or in combination with ordinary Portland cement. It is commonly used for decorative works such as mural paintings on walls, ceilings or any type of flat surface.

2.6.4. Once the water is mixed it shall be stored in an air-tight container. Once exposed to the atmosphere, the calcium hydroxide turns back into calcium carbonate, causing the plaster to set.

2.7. Barium Plaster

The plastering of internal surfaces of X-Ray room walls shall be of barium plaster consisting of one (1) part cement, one (1) part barytes (barium sulphate) fines and three (3) parts barytes sand by volume.

2.8. Plaster to Sides of Manholes, Inspection Chambers and Septic Tanks

Plastering to sides of manholes, inspection chambers and septic tanks shall be as specified under SECTION F: SEWERAGE.

3. Paving Work

3.1. Cement Paving

3.1.1. Unless otherwise shown on the Drawings or described in the B.Q., cement paving shall be 20mm thick consisting of one part cement to three parts sand by volume. The paving shall be thoroughly rammed within 30 minutes of laying and trowelled smooth after it has stiffened sufficiently to prevent laitance being brought to the surface. Paving to apron shall finish to a slight fall towards surface drains.

3.1.2. Unless otherwise shown on the Drawings or described in the B.Q., skirtings shall be formed to a height of 150mm and thickness of 20mm, coved at bottom and rounded at top.

3.2. Granolithic Paving

3.2.1. Granolithic paving shall be 20mm thick, consisting of two (2) parts cement and five (5) parts granite chipping passing 6mm mesh and retained upon 3mm mesh by volume.

3.2.2. The chipping shall be washed and free from dust. The paving shall be trowelled smooth to proper level or fall where appropriate. After initial set the surface shall be brushed lightly to achieve the required textured finish.

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3.2.3. Unless otherwise shown on the Drawings, granolithic skirting shall be 100mm high and 20mm thick, coved at bottom and slightly rounded at top.

3.2.4. Unless otherwise shown on the Drawings or described in the B.Q., the edge of threshold and treads of concrete stairs shall be finished with 150mm x 75mm x 12mm thick vitreous non-slip nosing tiles laid lengthwise bedded and pointed in 1:3 cement and sand mortar. The sides of open stringers shall be finished with granolithic plaster worked to profile of treads and risers to the approval of the S.O..

3.3. In-situ Terrazzo

3.3.1. In-situ terrazzo shall consist of one (1) part approved coloured cement and three (3) parts selected limestone chipping passing through 12mm mesh and retained upon 3mm mesh by volume.

3.3.2. The terrazzo topping shall be 20mm thick laid on 20mm thick cement and sand (1:3) screed. The concrete base to receive the screed shall be thoroughly cleaned and wetted.

3.3.3. While laying the screed, aluminium or brass strips of size 32mm wide x 3mm thick shall be set in vertically on edge into the screed to form panels. Each panel shall not exceed $4m^2$ with top edges of the strips standing sufficiently high to finish flush with the finished terrazzo floor level. The terrazzo shall be trowelled to a dense even finish.

3.3.4. When sufficiently hard but not less than two (2) days after being laid it shall be rubbed down to a smooth surface by means of carborundum stone.

3.3.5. Tile impregnator then shall be applied strictly in accordance to the manufacturer's recommendation onto the terrazzo surface to prevent future staining.

3.3.6. Unless otherwise shown on the Drawings or described in the B.Q., the edge of the threshold and treads of concrete stairs shall be finished with 150mm x 76mm x 12mm vitreous non-slip nosing tiles of approved colour laid lengthwise bedded and pointed. The sides of open stringers shall be finished with in-situ terrazzo working to profile of treads and risers to the approval of the S.O..

3.4. Waterproof Paving to Roof Slabs

Waterproof paving to roof slabs shall be as specified under SECTION D: CONCRETING.

3.5. Precast Concrete Paving

3.5.1. Unless otherwise shown on the Drawings or described in the B.Q., precast concrete paving slabs shall be of size 600mm x 600mm x 50mm thick each and made of 1:2:4-20mm concrete reinforced with `A6' fabric reinforcement to MS 145. The top surfaces of slab shall be brushed with stiff broom or wire brush after the initial set to give a rough finish.

3.5.2. Paving slabs shall be laid to the pattern as shown on the Drawings or approved by the S.O.. The slabs shall be bedded on 25mm thick semi-dry cement and sand (1:3) screed laid on 100mm thick properly compacted and blinded hardcore.

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3.5.3. The joints between the paving slabs shall be 20mm wide filled with cement mortar (1:3) and raked to a depth of 6mm.

3.6. Interlocking Concrete Paving

3.6.1. Taking the existing sub-grade/soil conditions and the anticipated traffic loading into consideration, an adequate thickness of well compacted base course must be provided to ensure good pavement performance. Unless otherwise specified, existing bitumen or concrete surfaces need not be removed and can act as good sub-grade.

3.6.2. Interlocking concrete paving blocks shall comprise of segmental interlocking concrete paving units laid on minimum 30mm thick sand bedding course.

3.6.3. A layer of sand should be loosely spread and screed to a uniform thickness such that its compacted thickness would be approximately 30mm thick. It is important that the sand layer remains undisturbed prior to the laying of blocks.

3.6.4. The grade of the concrete and thickness of the paving blocks shall be as detailed in the Drawings.

3.6.5. Concrete edge restraints shall be provided at the perimeter of the pavement to ensure the paving blocks are tightly abutted and to separate areas of different laying pattern.

3.6.6. The paving blocks are placed side by side on the sand bed with gaps of approximately 2mm between adjoining blocks. The gap between the paving blocks shall be filled with fine sand of different grading to that required for the bedding sand.

3.6.7. The paving blocks can be cut to fit edges and awkward corners. The pavement which has been laid shall be compacted with a hand-guided plate vibrator until it is firmly embedded in the sand layer.

3.6.8. The general specification of the precast concrete paving blocks shall comply with MS 1380.

3.7. In-situ Concrete Paving Footpath

3.7.1. In-situ concrete paving shall consist of 75mm thick concrete of 1:3:6-20mm mix by volume as specified in Section D: CONCRETING, laid on 100mm thick properly compacted and blinded hardcore to panels as shown on the Drawings or as approved by the S.O..

3.7.2. The concrete shall be well compacted and floated with a wooden float to smooth and even finish. After the concrete has achieved the initial set, the surface shall be brushed with stiff broom or wire brush to give a rough finish.

3.7.3. The joints between the panels shall be filled with approved cold-poured polyurethane joint filler.

3.8. Brick Paving

3.8.1. Bricks for paving shall be of semi-vitreous bricks 225mm x 75mm x 50mm thick of approved quality and colour.

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3.8.2. The bricks shall be soaked as specified in SECTION E: WALL SYSTEM before laying and shall be laid flat on 25mm semi-dry cement and sand (1:3) screed with 6mm spacing to the pattern as shown on the Drawings or as approved by the S.O..

3.8.3. The screed shall be laid on 75mm thick concrete (1:3:6-19mm) base founded on properly compacted and blinded 100mm thick hardcore. The joints shall be filled with cement mortar (1:2) and finish flush.

4. Tiling Work

4.1. Ceramic Tile

4.1.1. In general, all ceramic tiles manufactured locally are using the 'dry-pressed' manufacturing process and the ceramic tiles are categorized based on their water absorption rate as defined in the MS 1294, MS ISO 13006 or the International Standard Organization (ISO) Standards (ISO 13006).

4.1.2. The methods and materials used in the installation of ceramic tiles under normal internal conditions shall comply with MS 1294-1 and the installation of ceramic tiles under normal external conditions shall comply with MS 1294-2.

4.1.3. The installation of tiling works requires skilled operatives working safely using protective clothing and equipment where appropriate; workmanship shall comply with BS 8000-11 for ceramic tiles.

4.1.4. Unless otherwise shown on the Drawings, ceramic tiles to internal and external floor for heavy duty areas shall be vitrified with water absorption less than 0.5% [Classification Group BIa] also referred to as heavy duty tiles shall comply with MS ISO 13006 and the size shall be tiles 300mm x 300mm.

4.1.5. Unless otherwise shown on the Drawings, ceramic tiles to internal floor areas under normal condition shall be vitrified with water absorption less than 3% [Classification Group BIa or, BIb] shall be vitreous hard wearing non-slip glazed complying with MS ISO 13006 and the tile size shall be 300mm x 300mm.

4.1.6. Unless otherwise specified in the Drawings or described in the B.Q., ceramic tile skirting shall match the flooring tiles and shall be 300mm x 100mm laid lengthwise on cement and sand (1:3) screed as described. All angles to skirting shall be neatly cut to fit all abutments.

4.1.7. Unless otherwise specified in the Drawings, accessories such as skirting (bull nose or cove base), step tiles, step nosing, edging strips, angle tiles (internal and external), etc. shall be of an approved type standard manufacture from the same material to match flooring. Unless otherwise shown on the Drawings, skirting shall be 100mm high, stair nosing shall be minimum 20mm wide laid full length of the treads and of bull nose profile, and edging strips 25mm wide.

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4.1.8. Unless otherwise shown on the Drawings, ceramic tiles for internal walls shall be scuff-resistant glazed vitrified tiles with water absorption less than 6% [Classification Group BIb or BIIa] shall comply with MS ISO 13006. Unless otherwise specified, the minimum tile size shall be of 300mm x 300mm.

4.1.9. Unless otherwise shown on the Drawings, ceramic tiles for external walls up to first floor height shall be scuff-resistant glazed vitrified tiles with water absorption less than 3% [Classification Group BIa or BIb] and shall comply with MS ISO 13006. The tiles maximum size shall be of 300mm x 300mm.

4.1.10. Unless otherwise shown on the Drawings, ceramic tiles for external walls used above first floor height shall be scuff-resistant glazed vitrified tiles with water absorption less than 0.5% [Classification Group BIa] shall comply with MS ISO 13006. The tiles maximum size shall be of 300mm x 300mm.

4.1.11. Unless otherwise specified in the Drawings, all ceramic tiles for walls and floors shall be of 1st Grade or Grade A with approved surface finish & texture, colour and manufacture.

4.1.12. Ceramic tiles used for walls which have high water absorption characteristics shall be bedded with approved tile adhesive to the manufacturer's specification on 20mm thick cement and sand (1:3) render which has sufficiently cured. The tiles shall be laid with 2mm to 3mm gap and all joints shall be filled with approved tile proprietary grout to match. Exposed edges of tiling shall be finished with rounded on edge tiles. Ceramic tiles of Classification Group BIII with water absorption >10% shall not be used under any conditions.

4.1.13. Porous tiles shall be soaked before fixing to prevent rapid suction and subsequent failure in bonding with the mortar bed. Tiles should be removed from their cartons and completely immersed in clean water for at least thirty (30) minutes. After soaking, they should be stacked tightly together, with the end tiles face outwards, on a clean surface and allowed to drain. Tiles classified in MS ISO 13006 in Groups BIIb and BIII require this saturation treatment; soaking of tiles of Group BIa, BIb and BIIa is unnecessary, refer to MS 1294-1.

4.1.14. Unless otherwise instructed by the manufacturer, the tiles should be fixed dry. All tile installation shall use approved type cementitious adhesives. The selection and application of ceramic tile adhesives for internal and external tile installations on walls and floors shall comply with MS ISO 13007-1 and MS 1294.

4.1.15. Grouts used shall be of proprietary grout with good working characteristics, low shrinkage and good adhesion to edges of the tiles complying with MS ISO 13007-3. The selection of the type of grout shall be to the manufacturer's recommendation. Sanded grout shall be used for tile joint width of 4mm or more. Non-sanded grouts shall be used for installation in joints of 4mm width or less. The application of ceramic tile grouts for internal and external tile installations on walls and floors shall comply with MS 1294.

4.1.16. Tiles shall be laid with joints not exceeding 3mm wide to be filled with coloured grout. Admixtures shall be used in accordance with the manufacturer's recommendation and they shall not be added to the proprietary grout unless approved by the grout manufacturer. Admixtures

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are added for improving the resilience and reducing the water permeability of the hardened grout mortar.

4.1.17. Unless otherwise shown on the Drawings, movement joints should be located in the tiles installation to coincide and be continuous with all existing structural movement joints, although they are actually formed as separate joints isolated by suitable thickness of back-up material.

4.1.18. Unless otherwise shown on the Drawings, the movement joints with consultation with the designers shall be positioned at the following locations:

4.1.18.1. Over existing and/or structural movement joints;

4.1.18.2. Where tiling abuts other materials;

4.1.18.3. Where tiling is continuous across junctions of different background materials;

4.1.18.4. In large tile areas, at internal vertical corners and at 3m to 4.5m centers horizontally and vertically; and

4.1.18.5. Where stresses are likely to be concentrated, for example at changes of alignment.

4.1.19. Unless otherwise specified in the Drawings, joint sealant materials for movement joints shall be selected and applied in accordance with the guidance given BS 6213.

4.1.20. Where large format ceramic tiles are required for walls and to be fixed above first floor height, they shall be secured by mechanical means. When the thickness of tile exceeds 12.5mm and the weight of tile is more than 32kg/m^2, mechanical fixing is recommended. All mechanical fixing methods shall be certified by a competent Professional Engineer and to the approval of the S.O..

4.1.21. Pull-out test shall be carried out after twenty-eight (28) days installation for every maximum area 500m^2 or on the tiles that are suspected of hollowness, at the instruction of the S.O..

4.1.22. Adhesion strength of the pull-out test shall exceed 0.5 N/mm^2 for walls with cement: sand mortar bedding or 1.0N/mm^2 with adhesive bedding. Pull-out test shall be carried out in accordance to MS ISO 13007-2 and as recommended by the tile adhesive manufacturer. Location and number of test point for the pull-out test shall be as requested by the S.O..

4.2. Precast Terrazzo Tiles

4.2.1. Unless otherwise shown on the Drawings, precast terrazzo tiles of an approved manufacture shall be 100mm x 300mm x 20mm thick machine-pressed tiles comprising of 6mm limestone aggregate and coloured cement.

4.2.2. The tiles shall be soaked prior to laying and shall be laid butt jointed on 20mm thick semi-dry cement and sand screed. The laying shall be done while the screed is still green. All joints between the tiles shall be grouted with coloured cement to match.

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4.2.3. The tiles shall be rubbed down to a smooth surface after a minimum of two days or laying by means of Carborundum stone. Tile impregnator shall then be applied strictly in accordance with the manufacturer's recommendation on to the terrazzo surface to prevent future staining.

4.2.4. Unless otherwise stated in the Drawings, nosing and edging tiles to edges of flooring and treads of concrete stairs shall be of an approved type and to match with the flooring accessories such as skirting (bull nose or cove base), step tiles, step nosing, edging strips, angle tiles (internal and external), etc. shall be of an approved type from the same material to match flooring.

4.2.5. Unless otherwise shown on the Drawings, skirting shall be 100mm high, stair nosing shall be minimum 20mm wide laid full length of the treads and of bull nose profile, and edging strips 25mm wide.

4.3. Mosaic

4.3.1. Unless otherwise shown on the Drawings, mosaic tiling to floors shall be semi-glazed tiles and shall be of an approved colour and manufacture.

4.3.2. Unless otherwise shown on the Drawings, mosaic tiling to walls shall be fully glazed tile and shall be of approved colour and manufacture.

4.3.3. Unless otherwise shown on the Drawings or described in the B.Q., all skirting shall be 100mm high to match floor tiling. The tiles at the bottom of the skirting shall be set at 45^0 to the horizontal and the top finished with cove tiles or edging strips to manufacturer's recommendation. The tiles required to form angles to skirting shall be neatly cut and fit to all abutments.

4.3.4. Mosaic tiling to floors shall be bedded on 20mm thick semi-dry cement and sand (1:3) screed, laid on the concrete base which has been thoroughly cleaned and wetted.

4.3.5. Mosaic tiling to walls shall be evenly buttered with cement:sand mortar before bedding on 20mm thick cement and sand (1:3) screed which has sufficiently cured. Alternatively the tiling shall be bedded with approved proprietary adhesive to manufacturer's recommendation onto the cement screed.

4.3.6. During bedding, the surface of the mosaic shall be checked and any unevenness shall be made good. Any misaligned or defective tiles shall be adjusted or replaced. All joints shall be grouted with approved proprietary grout or coloured cement and sand grout to match. The tiling shall be allowed to mature under damp condition for at least four (4) days before cleaning down.

4.3.7. The selection and application of tile adhesives for internal and external mosaic installations on walls and floors shall comply with MS ISO 13007-1. The selection and application of tile grouts for mosaic installations on walls and floors shall comply with MS ISO 13007-3.

4.4. Quarry Tiles

4.4.1. Quarry tiles shall be of non-slip type 150mm x 150mm x 12mm thick complying with MS 1091. The tiles shall be bedded on 20mm thick semi-dry cement and sand (1:3) screed with joints about 2mm wide, laid on the

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concrete base which has been thoroughly cleaned and wetted. All tiles shall be soaked overnight before laying.

4.4.2. All skirting shall be 100mm high with rounded top edge to match the tiles flooring. The tiles required to form angles to skirting shall be neatly cut and fit to all abutments.

4.5. PVC Tiles/Sheets

4.5.1. PVC tiles or sheets shall be of approved type, pattern and colour. PVC tiles or sheets are to be of non-slip type and shall comply with MS 602. Tiles shall be 250mm x 250mm x 2mm thick minimum. Sheets shall be 2 m roll width x 2mm thick minimum.

4.5.2. Accessories such as skirting, stair nosing, edging strips etc. shall be of the same manufacture from similar material to match flooring. Unless otherwise described skirting shall be 100mm high; stair nosing shall be 60mm wide laid full length of the treads and of bullnose profiles; and edging strips shall be 25mm wide.

4.5.3. The final appearance and performance of the floor covering will be determined and affected, in part, by the condition of the subfloor. It is essential that all subfloors are solid, smooth, flat, even, permanently dry, clean and free from all foreign materials such as dust, paint, grease, oils, solvents, curing and hardening compounds, sealers, asphalt and old adhesive residue. The dryness of the subfloor is of the utmost importance and it must be determined by testing the moisture level in the subfloor. Enough drying time must be allowed in the building program to achieve a relative humidity (RH) reading of below 75% or in compliance to the manufacturer's RH recommendation.

4.5.4. Installation area for the flooring must be clean, fully enclosed, weathertight and maintained at uniform temperature at least forty-eight (48) hours prior to, during and after the installation is completed.

4.5.5. The tiles or sheet shall be laid and jointed on 20mm thick cement and sand (1:3) screed subfloor with an approved proprietary waterproof adhesive strictly in accordance with manufacturer's recommendation. The screed shall be finished smooth with a steel trowel to an even surface and shall be dry, clean and free from dust and sand before laying the tiles and sheets. A self-leveling sub-floor smoothing compound shall be applied on uneven surfaces to provide a quality finish to receive the floor coverings or as recommended by the manufacturer.

4.5.6. For ground floor or basement areas, an approved damp proof membrane shall be installed prior to the application of sand/cement screeds.

4.5.7. Adhesive; when not specified otherwise, type to be as recommended and approved by the PVC tile/sheet covering manufacturer. Use acrylic adhesive/solvent based adhesive on dry, dustless sub floors in areas not subjected to spillages. Use two parts polyurethane adhesive on the sub-floors in areas subject to excessive spillage of water. Floors must be kept free of traffic until the PU adhesive is fully set, recommended minimum eight (8) hours.

4.5.8. The floor coverings should be adhered in acrylic adhesive or approved equivalent. All joints on the floor must be cut in, grooved and hot welded. Cove up skirting shall be 100mm height, to enable the self-coving of the floor covering. In areas that are not subjected to spillages of water onto

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the wall surfaces, the top of the covering is to be finished with PVC capping seal. This should be adhered to the wall surface approximately 100mm-150mm high prior to self-coving floor covering. The material is than cut and fitted into the capping seal, capping seal should be adhered with contact adhesive.

4.5.9. In areas that are subjected to spillages of water onto the wall surfaces, the top of the covering is finished with aluminium trimming, a specially designed section for forming water-tight joint in conjuction with the surface of the wall finishes. It is recommended that the aluminium trim to be screwed on the wall surface.

4.5.10. Where area of excessive spillages of water, it is important that a watertight joint be achieved at junction of drains, gratings, access covers etc.

4.5.11. On completion, the flooring shall be well-cleaned and treated or polished in accordance with the manufacturer's recommendation.

4.6. Timber Strip Flooring

4.6.1. Unless otherwise shown on the Drawings, timber strip flooring shall be ready-made, laminated three (3) ply timber strips or floorboards of approved manufacture. The timber species for use in timber strip flooring shall be as specified in SECTION H: TIMBER, JOINERY AND IRONMONGERY.

4.6.2. The flooring shall be laid to the pattern as approved by the S.O., on 20mm thick cement and sand (1:3) screed with an approved waterproof adhesive applied in accordance with manufacturer's recommendation. The screed shall be finished smooth with a steel trowel to an even surface and it shall be dry, clean and dust free before laying the timber strip flooring. After the adhesive has set, the timber strip flooring shall be sanded to a true smooth and even surface using suitable sanding machine. Any misaligned or defective timber strip shall be adjusted or replaced.

4.6.3. Unless otherwise shown on the Drawings or described in the B.Q., skirting to timber strip flooring shall consist of 100mm x 12mm thick wrot timber skirting rounded at the top, and fixed to the wall or column using 38mm masonry nails spaced approximately at 600mm centres in two (2) rows 26mm away from the top and bottom edges. The nails shall be punched below the surface and the holes filled with approved putty. Any jointing of the skirting shall use splayed butt joints.

4.6.4. The face edges of the flooring shall be lined with wrot timber edging to match. The edging strips shall be 38mm wide approximately x 12mm thick fixed to the base using adhesive as specified hereinbefore, projecting 12mm from the finished sides of floor slabs. Edging strips shall be jointed using glued splayed butt joints.

4.6.5. After sanding the flooring shall be cleaned, any gap sealed with approved sealer, stained and finished with three (3) coats of approved polyurethane paint. Each coat shall be applied strictly in accordance with the manufacturer's recommendation.

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4.7. Parquet Tile Flooring

4.7.1. Unless otherwise shown on the Drawings, parquet tiles shall be ready-made 120mm x 120mm x 10mm thick consisting of 120mm x 25mm x 10mm pressure treated kempas, keruing or other approved medium hardwood timber battens. The timber species for use in parquet flooring shall be as specified in SECTION H: TIMBER, JOINERY AND IRONMONGERY WORKS.

4.7.2. The flooring shall be laid to the pattern as approved by the S.O., on 20mm thick cement and sand (1:3) screed with an approved waterproof adhesive applied in accordance with manufacturer's recommendation. The screed shall be finished smooth with a steel trowel to an even surface and it shall be dry, clean and dust free before laying the parquet flooring. After the adhesive has set, the parquet flooring shall be sanded to a true smooth and even surface using suitable sanding machine. Any misaligned or defective parquet shall be adjusted or replaced.

4.7.3. Unless otherwise shown on the Drawings or described in the B.Q., skirting to parquet flooring shall consist of 100mm x 12mm thick wrot timber skirting rounded at the top, and fixed to the wall or column using 38mm masonry nails spaced approximately at 600mm centres in two (2) rows 26mm away from the top and bottom edges. The nails shall be punched below the surface and the holes filled with approved putty. Any jointing of the skirting shall use splayed butt joints.

4.7.4. The face edges of the flooring shall be lined with wrot timber edging to match. The edging strips shall be 38mm wide approximately x 12mm thick fixed to the base using adhesive as specified hereinbefore, projecting 12mm from the finished sides of floor slabs. Any edging strips shall be jointed using glued splayed butt joints.

4.7.5. After sanding the flooring shall be cleaned, any gap sealed with approved sealer, stained and finished with three (3) coats of approved polyurethane paint and sanding between coats. Each coat shall be applied strictly in accordance with the manufacturer's recommendation. The required type of flooring finish shall be to S.O.'s approval.

4.8. Granite Slabs

4.8.1. Unless otherwise shown on the Drawings, granite slabs for flooring shall be 600mm x 600mm x 25mm thick shall be bedded with cement: sand mortar or alternatively with 9mm thick approved proprietary tile adhesive onto 25mm thick cement and sand (1:3) screed as described hereinbefore. The slabs shall be laid butt-joint. Any gap shall be filled with approved mixture of adhesive and grout powder. After grouting, the surface then shall be polished, buffered and finished with a layer of impregnator.

4.8.2. If used in wet or exposed areas, or on ground floor, waterproofing system shall be installed prior to the laying of granite slabs. The floors or the exposed wet areas shall be applied with two coats of approved waterproof coating.

4.8.3. The reverse side of granite slabs in contact with the ground floor or exposed wet wall surface shall be applied with approved waterproof coating.

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4.9. Marble Slab

4.9.1. Unless otherwise shown on the Drawings, marble slabs for flooring shall be 600mm x 600mm x 25mm thick shall be bedded with cement: sand mortar or alternatively with 9mm thick approved tile adhesive onto 25mm thick cement and sand (1:3) screed. The slabs shall be laid butt-joint. Any gap shall be filled with approved mixture of the adhesive and grout powder. After grouting, the surface then shall be polished, buffered and finished with a layer of impregnator.

4.9.2. If used in wet or exposed areas, or ground floor, waterproofing system shall be installed prior to the laying of marble slabs. The floors or the exposed wet areas shall be applied with two coats of approved waterproofing coating.

4.9.3. The reverse side of marble slabs in contact with the ground floor or exposed wet wall surface areas shall be applied with approved waterproof coating.

4.10. Vinyl

4.10.1. Vinyl sheet or vinyl tile flooring shall be high performance homogenous-heterogeneous type and specified in accordance to the following type and performances:

4.10.1.1. Vinyl Type 1: Heavy duty to withstand heavy traffic of trolleys.

4.10.1.2. Vinyl Type 2: Anti-static to cater for aseptic and dust free environment.

4.10.1.3. Vinyl Type 3: Anti-slip to cater for wet areas as well as slippery areas.

4.10.1.4. Vinyl Type 4: Heavy duty, fully flexible and resilient for sports flooring and children play areas (Designed specially that combines tough wear layer with a resilient backing for comforts and under floor sound deadening properties and attractive good looks).

4.10.1.5. Vinyl Type 5: High Resistant to Chemical.

4.10.2. All joints to be hot welded and matching coloured. The skirting to the vinyl floor must be of the same vinyl to 150mm high with approved cove former and finished with matching coloured UPVC capping strips with approved recommended acrylic adhesive strictly to manufacturer's method of installation.

4.10.3. Vinyl sheet shall have Polyurethane Reinforced (PUR) surface treatment for easy maintenance.

4.10.4. Colours and patterns of vinyl flooring shall be to the PD's concurrence. Approved metal dividing clips shall be installed when vinyl flooring meets with other floor finishes.

4.10.5. Prior to the application of vinyl floor covering, the contractor shall ensure that the floor substrate has a perfectly even surface, dry and free from. Vinyl sheets shall be installed onto floor flatness tolerance of not more than $\pm$ 3mm for every 3 m length floor area ready to receive vinyl flooring. Self-levelling compound of approved quality to be installed before

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finishing with vinyl flooring. The flatness tolerance shall strictly adhere to manufacturer's method of installation.

4.10.6. Types of adhesive with low VOC shall be used strictly in accordance with the recommendation of the manufacturer of the proposed type of vinyl flooring.

4.10.7. Laying of all type's vinyl flooring shall only be carried out by specialists from the approved supplier of the material.

4.10.8. The contractor shall incorporate damp proof treatment before laying the vinyl flooring to ensure that the floor slab/ or base screed is free from rising damp.

4.10.9. For waiting areas, corridors and other specific areas, the vinyl floors shall be completed with designed motifs, graphics and interplay of colours to the P.D.'s concurrence.

4.10.10. Stainless steel floor trap and gratings provided in vinyl flooring area shall be of special approved type that is suitable for vinyl flooring and shall be installed to manufacturer's specification and instructions.

4.10.11. Approved anti-slip nosing strips shall be used wherever vinyl is being laid on steps or staircases. Special approved type of metal grating suitable for vinyl flooring shall be used.

4.11. Indoor Sport Floors - Cushion PVC Sport Flooring

4.11.1. Unless otherwise specified on the Drawings, multi purposed game court surfaces shall be finished with Cushion PVC Sport Flooring sheets endorsed and recommended surfacing systems with excellent shock absorption, elasticity, flexibility, strong protective membrane, waterproof, resilience and slip resistance to ensure great sports performance.

4.11.2. Cushion PVC Sport Flooring sheets shall be minimum overall thickness of 7.5mm comprising of surface layer with protecsol treated, calendered and grained 100% PVC sheet.

4.11.3. Its reinforced by double layer of non-woven fiberglass grid and double density closed cell foam. Shall undergone Sanosol treatment for fungistatic and bacteriostatic, surface treated with Protecsol cross-linked dirt protection treatment.

Weight: 4.7kg/m2,
Shock Absoprtion (EN 14808): P1
Impact Protection Index (IPI) (AC-P90-205) =76%,
Vertical Deformation (EN 14809): < 2mm,
Energy Return (pr EN WI 217): 0.4 m/s,
Abrasion Resistance (EN ISO 5470-1):<350mg,
Sliding Coefficient (EN 13036-4): 80-100,
Indentation Resistance (EN1516) : < 0.5mm,
Abrasion resistance EN ISO 5470-1) < 350mg.
Ball bounce (EN12235) >90%
Fire (EN13501-1): Cfl-S1
Complied to GREEN Label/ Certificate
Low VOC

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4.11.4. Cushion PVC flooring sheets shall comply with approved or accredited by major sport federations, namely BWF, FIBA, ITTF, AFC, FIVB, IFF.

4.11.5. The final appearance and performance of the floor covering will be determined and affected, in part, by the condition of the subfloor. The general requirement for the subfloor must be absolutely hard, smooth finished level, dry, structurally sound, free from cracks and other irregularities, free from contaminated with paint, plaster, oil, grease or any substances that could affect the adhesion. A damp proof membrane must be laid under the concrete to act as a barrier against underlting hydrostatic pressure and moisture (for ground floor only). Cracks or hollowness must be repaired and filled with an appropriate material. The subfloor must be level with a tolerance of 3mm over 2 meter straight edge.

4.11.6. The floor covering should be underlayment 5mm self levelling compound (eg. CL 11 or NC146) with Primer and applied in accordance with manufacturer's instruction. The tensile Bending strength after 28 days is 6N/mm2 and Compressive Strenght after 28 days is 30N/mm2. Self levelling compound shall complied with green label certification.

4.11.7. The top of the covering is finished with Damp Proof Membrane (For Ground floor only) (eg. HydroEpoxy 300 or PE146), a 2 component water based epoxy polyamide membrane/barrier coating. The cured membrane shall withstand 250kPa hydrostatic pressure which is equivalent to a 25m head of water. Application is in accordance with manufacturer's instruction.

4.11.8. Cushion PVC Sport Flooring sheets installation shall only use low VOC adhesives.

5. Carpet

5.1. Carpet Tiles

5.1.1. Unless otherwise specified on the Drawings, all carpets shall be of high quality, durable, loop pile type of 100% Nylon type 6 fibre (ASTM D 629-72/ANSI), 1/12 gauge, minimum 7mm overall thickness of pile height and cushion backing, 16 oz per sq yard pile weight (normal traffic area), 24 oz per sq yard pile weight (heavy traffic area).

5.1.2. Carpets shall be coated with protective coating (eg. 3M Scotchgard™) for stain resistant and easier cleaning.

5.1.3. All ground floor areas, which are specified using carpet tiles, shall have approved damp-proof membrane on the ground floor slabs.

5.1.4. Unless otherwise specified on the Drawings, wall edges shall be with approved minimum 100mm height timber skirting.

5.1.5. The contractor shall be required to submit samples of the various colours/patterns and SIRIM Eco-Label certification.

5.1.6. Aluminium dividing strips or other suitable rust proof metal gripper strips shall be laid at junctions of different floor finishes and finishing flushed with flooring.

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5.1.7. Carpet tiles can be laid over any smooth, hard floor like parquet, laminated flooring and stone. Ensure the surface is clean, level and dry before installation.

5.1.8. All floor areas, which are specified using carpets, must be dry, level, and free from dirt, grease, oil, paint, sealer, old adhesives, and other residues.

5.1.9. Carpet tiles installation shall only use low formaldehyde water-based adhesive.

5.1.10. Carpet tiles used shall be laid with close butt joints, stretched and balanced so that all seams are parallel with minimum bows with suitable rustproof metal gripper strips securely installed. The carpets shall be installed in largest practical pieces and salvage shall be trimmed as required to assure color uniformity and pattern match at seams. All carpet shall have its edges trimmed and neatly fitted around all perimeters, openings and obstructions.

5.1.11. The carpets shall be installed in largest practical pieces and salvage shall be trimmed as required to assure color uniformity and pattern match at seams. All carpet shall have its edges trimmed and neatly fitted around all perimeters, openings and obstructions.

5.1.12. Warranty minimum 2 years on manufacturing defect. Supply and install by approved installer by manufacturer.

5.2. Broadloom Carpet (Roll Carpet / wall to wall carpet)

5.2.1. Machine Tufted Carpet

5.2.1.1. Unless otherwise specified on the Drawings, the machine tufted carpet shall be of high quality, durable, loop pile type or cut pile type or combination of both of 100% Nylon type 6 fibre (ASTM D 629-72/ANSI), 1/12 gauges, minimum 7mm overall thickness of pile height and PVC backing underlay, minimum 18 oz per sq yard pile weight (normal traffic area), minimum 24 oz per sq yard pile weight (heavy traffic area).

5.2.1.2. Broadloom carpets shall be coated with protective coating (eg. 3M Scotchgard™) for stain resistant and easier cleaning.

5.2.1.3. All ground floor areas, which are specified using carpets, shall have approved damp-proof membrane applied on the floor slabs. Unless otherwise specified on the Drawings, all carpets shall be laid with 6mm thick rubber-crumb underlay.

5.2.1.4. Unless otherwise specified on the Drawings, wall edges shall be with approved minimum 100mm height timber skirting.

5.2.1.5. All floor areas, which are specified using carpets, must be dry, level, and free from dirt, grease, oil, paint, sealer, old adhesives, and other residues.

5.2.1.6. The contractor shall be required to submit samples of the various colours/patterns and SIRIM Eco-Label certification.

5.2.1.7. Aluminium dividing strips or other suitable rust proof metal gripper strips shall be laid at junctions of different floor finishes and finishing flushed with flooring.

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5.2.1.8. Broadloom carpets used shall be laid with close butt joints with underlay, stretched and balanced so that all seams are parallel with minimum bows with suitable rustproof metal/ wood gripper gripper strips securely installed. The carpets shall be installed in largest practical pieces and salvage shall be trimmed as required to assure color uniformity and pattern match at seams. All carpet shall have its edges trimmed and neatly fitted around all perimeters, openings and obstructions.

5.2.1.9. The carpets shall be installed in largest practical pieces and salvage shall be trimmed as required to assure colour uniformity and pattern match at seams. All carpet shall have its edges trimmed and neatly fitted around all perimeters, openings and obstructions.

5.2.1.10. Warranty minimum 2 years on manufacturing defect. Supply and install by approved installer by manufacturer.

5.2.2. Axminster Carpet

5.2.2.1. Unless otherwise specified on the Drawings, the axminster carpet shall be of high quality, durable, cut pile type of 80% Wool 20% Nylon type 6 fibre (ASTM D 629-72/ANSI), 1/12 gauges 7/7 rows and pitch, minimum 7mm overall thickness of pile height and jute backing, minimum 32 oz per sq yard pile weight (normal traffic area), minimum 42 oz per sq yard pile weight (heavy traffic area).

5.2.2.2. Broadloom carpets shall be coated with protective coating (eg. 3M Scotchgard™) for stain resistant and easier cleaning.

5.2.2.3. All ground floor areas, which are specified using carpets, shall have approved damp-proof membrane applied on the floor slabs. Unless otherwise specified on the Drawings, all carpets shall be laid with 6mm thick rubber-crumb underlay.

5.2.2.4. Unless otherwise specified on the Drawings, wall edges shall be with approved minimum 100mm height timber skirting.

5.2.2.5. All floor areas, which are specified using carpets, must be dry, level, and free from dirt, grease, oil, paint, sealer, old adhesives, and other residues.

5.2.2.6. The contractor shall be required to submit samples of the various colours/patterns and SIRIM Eco-Label certification.

5.2.2.7. Aluminium dividing strips or other suitable rust proof metal gripper strips shall be laid at junctions of different floor finishes and finishing flushed with flooring.

5.2.2.8. Broadloom carpets used shall be laid with close butt joints with underlay, stretched and balanced so that all seams are parallel with minimum bows with suitable rustproof metal/ wood gripper gripper strips securely installed. The carpets shall be installed in largest practical pieces and salvage shall be trimmed as required to assure color uniformity and pattern match at seams. All carpet shall have its edges trimmed and neatly fitted around all perimeters, openings and obstructions.

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5.2.2.9. The carpets shall be installed in largest practical pieces and salvage shall be trimmed as required to assure colour uniformity and pattern match at seams. All carpet shall have its edges trimmed and neatly fitted around all perimeters, openings and obstructions.

5.2.2.10. Warranty minimum 5 years on manufacturing defect. Supply and install by approved installer by manufacturer.

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WATER RETICULATION

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1. General

The water reticulation and internal cold water plumbing works shall be executed by personnel with valid permits issued by SPAN as stipulated under Water Service Industry Act 2006. The Contractor shall be responsible for employing such personnel and all the work performed by them.

2. Products and Materials

2.1. All products and materials to be incorporated in the work shall be new and unused. Materials to be used within the scope of work shall be those approved by SPAN. When the quality of a material or process is not specifically set forth in the approved products and materials list, the Drawings, or the Specifications, the best available quality of the material or process shall be provided, subject to the approval of the S.O..

2.2. All products and materials shall be supplied by suppliers registered with SPAN. The Contractor shall provide proof to the S.O. in the form of a valid Confirmation Letter or Certificate of Registration issued by SPAN to the supplier. The products and materials shall also be subjected to other terms and conditions mentioned in these specifications.

2.3. All products and materials shall be of the makes and models tested and approved for use. It is the Contractor's responsibility to verify that products and materials received for the job conform to the current approved products and materials supplied by SPAN registered suppliers.

2.4. All products and materials furnished shall be subject to inspection for compliance with these specifications and all other appropriate specifications. The Contractor shall make application to the S.O. for inspection at least five (5) days in advance of starting any work.

3. Inspection

The S.O. shall at all times have access to the work wherever it is in preparation or progress and the Contractor shall provide proper facilities for such access and for inspection. The Contractor shall provide safe means to inspect the work. Failure or oversight of the S.O. or his representative to reject defective materials at the time of use, or to reject improper work at the time it is performed, shall not diminish the Contractor's obligations to comply with Drawings and Specifications. The Contractor shall remove and replace any faulty materials and work at no additional cost to the Government upon discovery of the defects or upon receipt of notice from the S.O. to do so.

4. Water Reticulation

4.1. Setting Out

All setting out for pipe laying works shall be performed by the Contractor's surveyor. Generally, stakes for alignment and grade shall be set at 10m intervals. The survey shall conform to the lines, grades, and dimensions shown on the Drawings. The Contractor shall preserve all monuments, benchmarks, survey markers and stakes. In case of their removal or destruction by the Contractor or his employees, agents or subcontractors, the Contractor shall be liable for the cost of their replacement.

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4.2. Excavation

4.2.1. General

All general excavation works shall be as specified in SECTION B: EXCAVATION AND EARTHWORKS.

4.2.2. Excavation for Pipe Trenches

4.2.2.1. Before commencing the excavation of pipe trenches, the routes of the pipelines shall be pegged out accurately. Strong sight rails shall be fixed and maintained at each change of gradient, and at as many intermediate points as may be necessary but not exceeding 100m apart. On these rails shall be marked the centre line and level to which the pipes are to be laid, and such rails shall be maintained in position and at the correct level from the time the excavation commences until backfilling is completed. The run of pipe trenches opened up ahead of pipe laying operations at any one time shall not be more than:

(i) 100m if the pipe laying operations are in an urban area,

(ii) 300m if the pipe laying operations are in the side tables of a trunk road, or

(iii) 600m if the pipe laying operations are in unoccupied land schemes or housing estates under development or are in the side tables of minor rural roads.

4.2.2.2. The S.O. may, at his absolute discretion, vary the distances stated above if he considers that traffic, road, weather or physical conditions warrant the variation.

4.2.2.3. Unless the S.O. permits otherwise, the trenches shall be excavated to the widths given in **TABLE L1.**

Table L1. Width of Pipe Trenches

External Pipe Diameter (D)	Width of Trench
Not exceeding 500mm	D+300mm
Exceeding 500mm	D+600mm

4.2.2.4. Where pipes are to be laid on a concrete bed, the width of the excavation at the bottom of the trench shall be the width of the underside of the concrete bed. At all joints the trench shall be so excavated as to give a working space of not less than 300mm all around the joint. Where bends are made by deflecting pipes at joints the trench shall be widen to permit this operation. The sides of the trench shall be cut vertical, and where necessary, shall be protected against caving in by timbering to the approval of the S.O..

4.2.2.5. The trench shall be excavated to the depths intended or shown in the Drawings and shall be finished and trimmed accurately to level and grade.

4.2.2.6. Should the ground be so wet or soft that, in the opinion of the S.O., it does not form a firm base for the pipe, or should rock be encountered at the bottom of the trench, the trench shall be

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excavated 250mm below the level intended or shown in the Drawings and then brought back to the correct level with good selected earth or sand well rammed into place. Such deepening of pipe trench and filling back shall be treated as a variation under the terms of the Contract. Should the bottom of the trench be inadvertently excavated below the specified level, it shall be brought back, at the Contractor's expense, to the correct level with good selected earth or sand carefully rammed into place.

4.2.3. Excavation of Road Crossings

4.2.3.1. No trench is to be excavated in the carriageway unless specific approval has been given by the relevant road authority. The whole operation of excavation and reinstatement of the trench shall be completed as quickly as possible. The Contractor shall ensure that minimum interference to traffic flow is maintained at all times.

4.2.3.2. A joint site inspection shall be arranged by the Contractor before commencement of work if so requested by the road authority. After pegging out, the Contractor shall inform the road authority and the police of the actual date of commencement at least one week in advance of and on the day of commencement.

4.2.3.3. If specific approval has been given to lay services across the road by open excavation, proper cutting of the metalled pavement shall be done and the Contractor shall ensure that the top edges of the excavation are neat and straight.

4.2.3.4. All materials from the excavation, if accepted for backfilling shall be neatly stacked outside the carriageway. Where there is no place to stack the excavated materials outside the carriageway, shall excavated materials shall be removed from the work site immediately after excavation.

4.2.3.5. Where specific approval has been given by the road authority for half width construction, the traffic lanes may be reduced to not less than 5.0m wide and where necessary, the shoulder should be strengthened to accommodate traffic load to the satisfaction of the S.O. by the Contractor and at the Contractor's cost.

4.2.3.6. Trenches shall be provided with adequate shuttering, walling and struts to prevent the adjoining road pavement from cracking and subsiding.

4.2.3.7. If a road diversion is required, the Contractor shall build it to the specifications of the road authority. It shall be maintained in good motorable condition until the reinstatement is completed.

4.2.3.8. Carriageway excavation across important and busy road and junctions shall be carried out during off-peak hours. The S.O. shall specify the appropriate times based on the merits of each case and such conditions shall be strictly adhered to by the Contractor.

4.2.4. Excavation of Rock in Trench

Rock shall mean those geological strata of hard material which necessitates the use of blasting or approved pneumatic tools for their

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removal. Solid boulders found in trench excavations and foundation pits shall be considered as rock if such boulders are of size each exceeding 0.08m³. Shale and clay boulders shall not be classified as rock. The S.O.'s decision as to whether or not the material of the excavation is to be classified as rock shall be final. The Contractor shall be entitled to extra payment for rock excavation only if reasonable notice is given to the S.O. to examine and measure such material prior to breaking up. The volume of rock excavated shall be taken as its volume in-situ before it is broken up.

4.2.5. Pipe Bedding

The pipe bedding and foundation shall be prepared according to the Drawings. No pipes shall be laid until the S.O. has inspected and approved the pipe bedding and foundation. Any work that has been carried out without the approval of the S.O. shall, on the instructions of the S.O., be uncovered or removed by the Contractor and reinstated to the S.O.'s approval at the Contractor's own expense

4.2.6. Crossing Water Courses

Where the pipeline crosses underneath streams, culverts and other water courses, the Contractor shall be deemed to have allowed for all additional measures necessary for the proper construction of the pipeline especially maintaining the flow of water.

4.2.7. Backfilling of Pipe Trenches

4.2.7.1. After the pipe laying has been approved by the S.O. and before the pipelines are tested, sufficient backfilling of the trenches will be permitted to prevent "snaking" and to maintain the pipes in position, but all joints shall be left exposed. In any other locality where the trench may be filled with water and cause flotation of the pipes, or elsewhere as may be decided by the S.O. the backfilling shall follow the pipe alignment as closely as possible.

4.2.7.2. In backfilling pipe trenches, only approved materials free from stones or rocks or other hard materials shall be carefully spread along the trench bottom between the pipes and the trench walls to a depth of about 150mm and shall be hand rammed. Further layers each of about 150mm thick of the same materials shall then be spread and rammed in the same manner up to the top of the pipes. The remainder of the backfilling may consist of coarse materials free from boulders and large earth clods. It shall be placed in layers each of 150mm thickness and hand or mechanically rammed until the backfill is 300mm above the top of the pipes. The rest of the trench backfill shall be in layers each of 300mm thickness and compacted by a mechanical vibrating tamper to finish off slightly proud of the surrounding ground. The degree of compaction of each layer shall not be less than 95 % of the dry density obtainable using the BS 1377 Compaction Test. The Contractor shall make good any settlement to avoid formation of drains or gullies within the refilled trenches.

4.2.7.3. Approved fill material to be used as backfill to the top of the pipes shall be uniform low plasticity granular material. The material shall be free from all organic or other materials subject to decay. Highly plastic or expansive soils or clay shall not be used. The filling material shall be readily compactable to its maximum density and must not form mud, or otherwise breakdown when wet.

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4.2.7.4. Should the material being placed as fill or backfill while acceptable at the time of selection, become unacceptable to the S.O. due to exposure to weather conditions or due to flooding or have become puddled, soft or segregated during the progress of the works, the Contractor shall, at his own expense, remove such damaged, softened or segregated material and replaced it with fresh approved material.

4.2.7.5. Where the pipeline crosses a road, approved sand shall be used as fill material up to the road formation level.

4.2.8. Backfilling of Excavations Other Than Pipe Trenches

4.2.8.1. Backfilling of all excavations shall not be carried out until the Works therein have been inspected and approved by the S.O.. In backfilling excavations other than pipe trench excavations, portions of the excavated materials may be used with the approval of the S.O.. Where required, approved materials shall be brought to the site for backfilling works. The materials shall be deposited and spread in layers of not more than 300mm deep, and each layer shall be thoroughly rammed by a mechanical vibrating tamper or smooth wheel roller and watered if required.

4.2.8.2. If so directed by the S.O., the backfilling shall be finished off slightly proud of the surrounding ground to allow for settlement, but the Contractor shall make good any settlement which may occur during the construction of the Works and during the Defects Liability Period of the Contract at his own expense.

4.2.9. Road Reinstatement

4.2.9.1. Road reinstatement works shall be carried out by the Contractor to a standard equivalent or superior to the road condition existing prior to excavation and to the requirements of the relevant road authority and approval of the S.O..

4.2.9.2. All backfilling shall be done by the Contractor with approved sand. No organic soil, broken pre-mix or stones are to be used. The sand shall be compacted in 225mm layers. The degree of compaction of each layer below the pavement course shall not be less than 95% of the dry density obtainable using the BS 1377 Compaction Test. The Contractor shall bear the cost of such tests and shall make good any works which are found to be unsatisfactory.

4.2.9.3. Sand material shall be deposited in layers on both sides of the pipe simultaneously and thoroughly compacted and around the pipe working alternately on either side of the pipe until the trench has been filled up to the base course formation level.

4.2.9.4. The Contractor shall reinstate the road pavement by replacing, in the proper sequence, any block or metalling removed, to the requirements of the relevant road authority and the approval of the S.O.. The road surface shall be reinstated with new materials of the type existing on site. Edges of the reinstated road pavement shall be straight and neatly finished to match the existing road to the satisfaction of the S.O..

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4.2.9.5. In the absence of any written requirement, all reinstatement works shall be carried out within 24 hours after backfilling.

4.2.9.6. If the Contractor fails to carry out the reinstatement to the requirements of the relevant road authority and the satisfaction of the S.O., the S.O. or the relevant authority may proceed with such repairs and the cost of such reinstatement shall be recouped by the S.O. from the Contractor.

4.3. Pipeworks

4.3.1. Handling and Laying Pipelines

All handling, laying and testing of pipelines shall comply to the latest technical specifications from SPAN or other relevant standards and also to the manufacturer's requirements:

4.3.1.1 The minimum cover for main pipelines shall be 1m. Under roads and hard standing the cover shall be 1.2m. Otherwise the pipes shall be encased with concrete grade 20P with minimum thickness of 150mm or as approved by the S.O..

4.3.1.2 The section of pipe line that runs across roads and culverts shall be made from Ductile Iron pipe (D.I) or mild steel pipe as approved by the local Water Authority.

4.3.2. Testing of Pipelines

4.3.2.1. The Contractor shall provide all water required for filling, testing and retesting the pipelines, and any pumps, pipework fittings and pressure gauges required for the purpose.

4.3.2.2. Whenever a section (which shall not exceed 1000m long in or adjacent to roads, or not exceeding 2000m long in open ground) of any pipeline has been laid, jointed and part backfilled as specified, it shall be prepared for testing by sealing the open ends temporarily with stop ends. The stop ends shall be of cast iron or steel. The stop end at the lower end of the section of the pipeline shall be fitted with a valved inlet pipe for use to fill the section of the pipeline with water and the stop end at the higher end of the section of the pipeline shall be fitted with a valved air release vent pipe. A pressure gauge shall be connected to the valved inlet pipe. The pressure gauge shall have a dial of not less than 150mm dia. and graduated to read up to 15 bars with 0.25 bar graduations. All pressure gauges shall be tested by the S.O. before use, and provisions shall be made for connecting the pressure gauge, if the S.O. so elects, to the valved inlet pipe.

4.3.2.3. The stop ends shall be braced to the satisfaction of the S.O. to withstand the end thrust which develops from water pressure. All weight, thrust and anchor blocks intended to prevent the vertical and lateral displacement of the pipes and specials shall have been properly completed and have attained an adequate strength before the tests are carried out. When gentle curves are effected by deflection pipes these pipes shall be securely packed with backfill to prevent movement.

4.3.2.4. The section of the pipeline to be tested shall be filled with water of fair quality, free from sediment and from a source approved by the

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S.O.. The water shall be introduced into the section of the pipeline through the valved inlet in the stop end at the lower end of the section. During filling, provision shall be made for the air to escape from all high spots in the section by properly installing all air valves and from the air released vent pipe in the stop end at the higher end of the section.The pressure/strength test shall be carried out first. Each section of the pipelines shall be tested to a pressure of 16.0 bars head of water.

4.3.2.5. After the section of the pipeline has been filled with water for a period of not less than seven (7) days, more water shall be pumped into the section to raise the pressure slowly in increments of 10m head of water with pause of one minute between each increment.

4.3.2.6. Should any appreciable drop in pressure be noted during one of these pauses the test shall be stopped until the cause of the pressure drop has been investigated and rectified. An engine driven pump may be used until 55m head pressure is attained, and thereafter only a hand operated pump shall be used.

4.3.2.7. The pressure/strength test shall be considered to have been passed when the pressure gauge shows no reduction in pressure during the specified one minute pause and also during the period of ten (10) minutes after full test pressure has been attained. If these conditions are not satisfied a thorough inspection of the section of the pipeline shall be made. All defects shall be repaired and the test shall be repeated.

4.3.2.8. The leakage test shall then follow. The pressure shall be reduced to 10.5 bars head of water and shall be maintained as constant as possible for a period of 24 hours. Make-up water shall be pumped into the section of the pipeline from time to time to maintain this pressure. The leakage test shall be considered to have been passed if the make-up water pumped into the section of the pipeline does not exceed the allowable leakage calculated as: 0.05l/mm of internal diameter per kilometer of pipe per 24 hours. If this specified rate of leakage is exceeded a thorough inspection of the section of the pipeline shall be made. All leaks discovered shall be repaired and the section shall be tested again.

4.3.2.9. Every section pipeline shall be tested as described above in the presence of the S.O.. Testing may be carried out between sluice valves but not against the gates of the sluice valves.

4.3.2.10. All permanent thrust block provided at bends shall be concreted and sufficiently cured prior to permission being given for testing. No temporary strutting or temporary bracing will be permitted in lieu of the permanent thrust blocks as the tests are also to subject these blocks to the transmitted pressures.

4.3.3. Flushing and Disinfecting Pipelines

When the final connections have been made and the pipeline has been tested to the satisfaction of the S.O. it shall be thoroughly cleaned, disinfected and flushed in sections by the Contractor. Water for this purpose shall be obtained from the Local Water Authority and the Contractor shall pay all the charges incurred in connection therewith.

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4.3.4. Non-Precast Valve chambers

4.3.4.1. Valve chambers shall be constructed to the size shown on the Drawings. Unless otherwise specified, all dimensions on plan shall be inside measurement. Manhole covers shall comply with BS EN 124.

4.3.4.2. Unless otherwise shown in the Drawings all manholes and chambers shall be brickwork in cement mortar 1:2. The brickwork shall be constructed on prescribed concrete mix Grade 20P foundation unless shown otherwise. The thicknesses and sizes shall be as shown on the Drawings. The inside of the chambers and manholes shall be lined with 12mm thick cement plaster (1:2). Externally, the exposed concrete or block brick surfaces shall be plastered with 12mm cement mortar (1:2) and terminated 150mm below the finished ground level. All internal angles shall be rounded off. Manholes and chambers shall provided with precast concrete cover unless otherwise specified on the Drawings. Approved typed wrought iron steps shall be built into the brick wall of all manholes and chambers of depth 2.0m or more and they shall be spaced not more than 300mm apart projecting 100mm over face of wall.

4.3.5. Precast Chambers

Precast valve chambers shall be as shown on the Drawings and in accordance with SECTION D: CONCRETING. Chamber covers shall comply with BS EN 124.

4.3.6. Washout (Scour Valves Location)

Washouts shall be constructed at locations specified in the Drawings or as may be directed by the S.O.. The washout branches shall be connected to the pipeline by special washout tees and sluice valves. From the washout sluice valves HDPE pipes shall be laid to the nearest drain or stream. The discharge point shall be downstream.

4.3.7. Indicator Post (Pipe and Valve Markers)

The Contractor shall provide and fix indicator posts close to the centre line of pipes, at valves, washout and other points as directed by the S.O.. The details of indicator posts are as shown on the Drawings.

4.3.8. Hot Tapping

4.3.8.1. The Contractor shall submit a method statement as how to conduct the hot tap that has been approved by the State Water Authorities to the S.O. prior to commencement of the works.

4.3.8.2. Hot tapping shall only be done in the presence of the State Water Authorities' representative. The tapping mechanism shall be of the self-purging type so that cutting chips are removed from the tapping machine and do not enter the pipeline.

4.3.8.3. All hot tap connections to existing pipelines, whether for mainline extension or service laterals, shall be performed by an authorised and qualified person.

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4.3.8.4. The tapping machine shall be cleaned and disinfected prior to attachment to the tapping valve and saddle.

4.3.9. Pipe Jacking

4.3.9.1. Placement of pipe by boring or jacking methods requires special S.O.'s approval for each instance. The methods and equipment used in boring and jacking operations shall be optional to the contractor, provided that the S.O. reviews them prior to any work.

4.3.9.2. The Contractor shall submit a method statement as how to conduct the pipe jacking operation to the S.O. for approval.

4.4. External Water Storage Tanks (Factory Fabricated Tanks)

4.4.1. The Contractor shall supply a new tank reservoir from a manufacturer specializing in the design, fabrication and erection of the approved water storage tanks.

4.4.2. The type of tanks that may be supplied and installed shall be only as shown in **Table L2.**

Table L2. Type of Water Storage Tank

No	Product Name	Specified conditions/ Requirements
1	Steel Tank with Lining or Coating (Non-Corrugated Type) (Glass Fused/Glass Coated/Epoxy Lining/HDPE) Lining	Maximum capacity allowed for elevated tanks is 2.3ML (500,000 gallons) and for ground storage tanks is 3.4ML (750,000 gallons). Maximum height allowed is 5m or 4 panels high whichever is lower. The minimum warranty period for the tank and sealant/lining shall be 10 years. The minimum thickness of PE/HDPE lining shall be 2.0mm.
2	Cylindrical Steel Tank - Double Fold System	Maximum capacity allowed is 4.5ML (1,000,000 gallons). Maximum height allowed is 5m. The minimum warranty period for the tank and sealant/lining shall be ten (10) years.
3	Polyethylene Storage Tanks (PE Storage Tanks)	Tanks shall have interlocking mechanisms. Tanks shall only be allowed up to 3,785.4L (1,000 gallons) capacity only. Multiple tanks on one tower structure shall be strictly not allowed.

4.4.3. The tank shown on the Drawings and specified herein shall be fabricated, supplied and installed by a manufacturer with a valid registration with SPAN.

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4.4.4. Installation of the tank shall be by the tank manufacturer or approved installer appointed by the manufacturer. The manufacturer shall be fully responsible for entire installation including tank erection, and the ultimate water tightness of the complete installation. Notwithstanding the above, the Contractor shall be fully responsible for the entire installation and completion of the final product.

4.4.5. Construction shall be governed by the Contract Drawings and specifications showing general dimensions

4.4.6. The water tank inclusive of all associated pipeworks shall be cleaned on completion, tested for watertightness and disinfected before it is commissioned.

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PAINTING

1. General

1.1. All paints to be used shall be those supplied by approved manufacturers. The quality of paints shall comply with MS 125 in respect of oil/enamel paints and MS 134 in respect of emulsion paints/acrylic paint.

1.2. Prior to commencing painting work, the Contractor shall submit the following to the S.O.:

1.2.1. Name of the paint manufacturer and the manufacturer's certification that the paint conform to the relevant standard as specified in sub-section 1.1 hereof together with the proof that such certification have been verified by tests carried out by SIRIM or ISO in the last three (3) years.

1.2.2. The performance warranty by the manufacturer to the Government on the performance of the paint against any peeling, cracking, fungus/ algae growth and discoloration which may arise during a period of five (5) years or more from the date of practical completion due to insufficiency in material or workmanship. The terms of the performance warranty shall be as stipulated in APPENDIX O/1 and as approved by the S.O..

1.2.3. Name of the painting applicator as approved by the paint manufacturer including written evidence of the current approval.

1.2.4. A copy of the method statement including procedure for the painting works in accordance with these specification and manufacturer's instructions.

1.3. All paints shall be delivered to the Site in the manufacturer's original sealed containers unopened and shall be used strictly in accordance with the manufacturer's instructions.

1.4. Paints shall not be adulterated and any paint that has deteriorated shall not be used and shall be removed from the Site forthwith.

1.5. Unless otherwise specified in the Drawings, the types of paints to be sued for the work on exposed surfaces shall be as stated in the `Schedule of Paint Finish' attached hereinafter.

1.6. The colours and tints of paints shall be selected by the S.O. and the priming, undercoats and finishing coats shall be of approved differing tints and shall be obtained from the same manufacturer.

1.7. No painting shall be done under conditions which may jeopardize the quality of finish paintwork.

1.8. During painting, care shall be taken to prevent stain or damage to other works.

1.9. Surfaces to be painted shall be dry, free from dirt, oil, grease, old loose paint and other deleterious matter. All cracks shall be raked out and stopped and all holes and dents shall be filled.

1.10. Unless otherwise specified in the manufacturer's instructions, each coat of paint applied on timber or metal surfaces shall be allowed to dry and subsequently rubbed down lightly with sandpaper before the next coat is applied. Any dirt or dust shall be removed from preceding coats immediately before proceeding with application of the next coat.

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1.11. All priming to shop fabricated components shall be done at shop.

1.12. All prime surfaces shall be inspected and approved by the S.O. before commencement of painting works.

1.13. Finish surfaces shall be uniform in finish and colour and be free from brush marks or other defects.

1.14. Sample areas showing all tints of paints to be used shall be prepared by the Contractor as and when required by the S.O..

2. Painting to Timber Work

2.1. Painting to New Timber Work

2.1.1. Unless otherwise as shown on the Drawings, all exposed wrot surfaces of timber shall be painted as specified hereinafter.

2.1.2. Before painting to new timber work, all knots shall be covered with knotting and all nail holes, cracks, et cetera shall be stopped with white lead and putty (1:3) and shall be primed with aluminium wood primer well brushed in.

2.1.3. Unless otherwise specified, the prepared surface shall be painted with one undercoat (alkyd undercoat) and shall be finished with two coats of premium semi-gloss fungus resisting alkyd paint or three (3) coats UV protection, low odour alkyd wood finish.

2.1.4. Timber decks shall be applied with three coats of scratch resistant, UV protection, fast drying urethane alkyd wood finish. Each preceding coat shall be allowed to dry thoroughly and rubbed down lightly with fine sand paper and thoroughly cleaned before applying the next coat.

2.1.5. All timber surfaces abutting concrete or brickwork shall be primed before fixing or assembling.

2.1.6. All ironmongeries except hinges shall be removed before painting begins and shall be carefully re-fixed.

2.2. Repainting Existing Timber Work

Where repainting to existing timber work is specified, the following procedure shall be adhered to. If the surface is intact, it shall be rubbed down with fine sand paper to the approval of the S.O.. Then one coat of undercoat shall be applied followed by two (2) coats of gloss enamel paint unless otherwise specified. Where cracking and flaking have occurred, the entire existing paint shall be removed by burning off or by use of paint remover as approved by the S.O.. The surfaces shall then be thoroughly cleaned and shall be applied with minimum one coat aluminum wood primer followed by one (1) undercoat and unless otherwise specified in the Drawings, shall be finished with two (2) coats of gloss enamel paint.

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3. Painting to Metal Work

3.1. Painting New Steel and Ironwork

The areas to be painted shall be cleaned down and be free from rust, scale, oil, grease, dirt and dust. One (1) coat of approved metallic primer shall be applied followed by one (1) coat of premium alkyd undercoat unless specified and shall be finished with two (2) finishing coats of gloss/semi-gloss fungus resisting alkyd paint.

Soil and vent pipes shall be primed as above and given two (2) coats of approved bituminous paint.

3.2. Repainting Existing Steel and Ironwork

3.2.1. Where repainting to existing steel or ironwork is stated in the Drawings, the following procedure shall be adhered to. Where a firm surface exists, it shall be scuffed with fine sand paper to the approval of the S.O. and spot primed if necessary, before the application of by one (1) coat of premium alkyd undercoat unless specified and shall be finished with two (2) finishing coats of gloss/semi-gloss fungus resisting alkyd or gloss enamel paint.

3.2.2. If the old paint is in a bad, deteriorated condition the whole paint shall be removed by the use of approved paint remover or by scraping as approved by the S.O.. The surface shall be thoroughly cleaned and shall be applied with one coat approved metallic primer, by one (1) coat of premium alkyd undercoat unless specified and shall be finished with two (2) finishing coats of gloss/semi-gloss fungus resisting alkyd or gloss enamel paint.

3.3. Painting New Galvanized Ironwork

Where painting to new galvanized ironwork is specified, the surfaces shall be applied with one coat of approved self-etching quick drying metallic primer unless otherwise specified and shall be finished with two finishing coats of gloss/semi-gloss fungus resisting alkyd paint or gloss enamel paint.

3.4. Repainting Existing Galvanized Ironwork

3.4.1. Where repainting to existing galvanized ironwork is specified, the following procedure shall be adhered to. If the surface is not corroded, it shall be slightly sanded and all dirt's, oil, and grease removed by washing with an approved solvent and applied with one (1) coat of approved metallic primer unless otherwise specified, shall be finished with two (2) finishing coats of gloss/semi-gloss fungus resisting alkyd paint or gloss enamel paint. If the surface has corroded, the whole paint shall be removed by the use of approved paint remover or by scraping as approved by S.O..

3.4.2. When the surface is completely clean, it shall be applied with one coat approved metallic primer, unless otherwise specified, shall be finished with two finishing coats of gloss/semi-gloss fungus resisting alkyd paint or gloss enamel paint.

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4. Painting to Masonry Work

4.1. Painting New Plastered/Masonry Surfaces

4.1.1. The new plastered or masonry surfaces shall be allowed to dry completely and shall be cleaned down to remove dust, dirt, plaster splashes, and the like. In case of old unpainted walls, all fungus, mosses, lichens and vegetative growth shall also be removed.

4.1.2. The cleaned surfaces of the external walls shall be applied with one coat of approved alkaline resisting primer and unless otherwise specified in the Drawings, followed with two (2) coats of ultra-violet (UV) weather resistant emulsion paint.

4.1.3. The external wall surfaces shall be applied with one (1) coat of approved alkaline resisting primer, unless otherwise stated in the Drawings, followed with two (2) coats of 100% acrylic with heat reflective and UV protected, and temperature reduction weather resistant acrylic emulsion paint for Green Ratings Certification as approved by the S.O..

4.1.4. The internal wall surfaces shall be applied with one (1) coat of approved modified acrylic sealer, and unless otherwise as shown on the Drawings, followed with two (2) coats of low VOC acrylic paint.

4.2. Repainting Existing Plastered or Masonry Surfaces

4.2.1. Where repainting to existing plastered or the masonry surface is specified, the following procedure shall be adhered to. All existing paint shall be removed by scraping and the surface shall be washed with high pressure water jet (for Non-Conservation Projects). All cracks and other imperfections shall be made good and the surface should be allowed to dry completely.

4.2.2. The surface shall then be applied with two (2) coats of any other type of water base emulsion paint as described hereinbefore for Painting New Plastered/Masonry Surfaces and as approved by the S.O..

4.2.3. However, for buildings which fall under heritage status, repainting works shall refer to *Garis panduan Pemuliharaan Bangunan Warisan 2016* (or latest version).

4.3. Textured Wall

4.3.1. Natural Spray Granite textured wall shall be applied with one (1) coat of approved alkaline resisting acrylic primer, unless otherwise stated in the Drawings, followed with two (2) layers natural fine stone and ceramic chips texture with high build acrylic resin and two (2) clear finish coats.

4.3.2. Spray Tile textured wall shall be applied with one (1) coat of approved alkaline resisting acrylic primer, unless otherwise specified in the Drawings, followed with one (1) coat of spray tiles texture and two (2) coats of pure acrylic based premium weather paint.

5. Treatment to Fair Face Surfaces

Surfaces that are to be left bare such as fair-face brickwork, fair-face concrete or stones and the like shall be thoroughly clean, dry and free from grease, dust and loose or flaking

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materials. The surfaces shall then be treated with an approved colourless silicon-based water repellent liquid applied in accordance with the manufacturer's instructions. The solution shall be applied in two (2) coats over the entire area and crevices by brushing.

6. Epoxy Coatings

Epoxy coatings shall be applied with one (1) coat of approved penetrative epoxy sealer, followed with two (2) coats epoxy topcoat.

7. Silicone Paint

Silicone paint for external walls and ceiling shall be applied with one (1) coat of Pigmented Water Base Penetration Water Repellent and two (2) finishing coats of Breathable Silicone Paint of approved colour applied strictly in accordance with manufacturer's instruction.

8. Painting on Floor Surfaces

8.1. Painting on concrete drive way shall be applied with one (1) coat of floor primer at 100 µm DFT, followed by one (1) coat of floor glass flake at 300 µm DFT or floor non-slip aggregate (fine/medium) and followed with two (2) coats of floor polyurethane (PU) topcoat at 50 µm DFT per coat.

8.2. Painting on car park parking bay floors shall be applied with one (1) coat of floor primer at 100 µm DFT, then followed with two (2) coats of floor polyurethane (PU) topcoat at 50 µm DFT per coat.

8.3. Painting on TNB sub-station internal floors shall be applied with one (1) coat of approved two-pack epoxy sealer, followed with two (2) coats of two pack epoxy floor coating at 50 µm DFT per coat, unless otherwise stated in the drawings.

9. Painting to Timber-based Products

9.1. Chipboard Surfaces

9.1.1. Before painting, all nail holes, crevices and the like shall be stopped with white lead and putty (1:3). The surface shall then be smoothened by rubbing down with fine sand paper and finally cleaned to remove dust. Where the board is to be finished with enamel paint, one (1) undercoat and two (2) finishing coats of gloss enamel paint shall be applied. If the board is to be finished with emulsion paint, one (1) undercoat and two (2) coats of emulsion paint shall be applied.

9.1.2. Where repainting to existing enamel paint finished chipboard is required, the following procedure shall be adhered to. If the paintwork is still intact, it shall be rubbed down with fine sand paper to the approval of the S.O.. Then one (1) coat of undercoat shall be applied followed by one (1) coat of gloss enamel paint.

9.1.3. Where cracking and flaking has occurred, the entire existing paint shall be removed by burning off, as approved by the S.O.. The surfaces shall then thoroughly clean and shall be applied with one (1) undercoat and finished with two (2) coats of gloss enamel paint.

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9.1.4. Where repainting to existing emulsion paint finished chipboard is required, the surface shall then be thoroughly cleaned and applied with two (2) coats of emulsion paint.

9.2. Hardboard Surfaces

Before painting to hardboard, all nail holes, crevices and the like shall be filled with approved putty. The surface shall then be applied with one (1) undercoat and two (2) coats of emulsion paint unless otherwise specified.

9.3. Wood Cement Board Surfaces

Before painting to wood cement board, all nail holes, crevices and the like shall be filled with approved filling compound of alkali resistant type. The surface shall then be lightly sanded, and any dust should be removed from the surface with a piece of clean, coarse cloth. The surface shall then be applied with one (1) undercoat and two (2) coats of emulsion paint unless otherwise specified.

10. Painting to Gypsum Board and The Like

10.1. Before painting the surfaces shall be clean and free from dirt. The surfaces shall then be applied with one (1) undercoat and two (2) coats of emulsion paint. Similar procedure shall be followed where repainting to existing painted surfaces is required.

11. Painting to Laboratory Bench Tops

11.1. Timber tops of benches in laboratories that are required to be painted shall be prepared as described hereinbefore for timber work. The surfaces shall then be applied with one (1) coat aluminum wood primer followed by one (1) coat approved chemical resistant primer and finished with two (2) coats of approved chemical resistant gloss enamel paint in accordance with manufacturer's instructions.

11.2. Where repainting to existing timber tops laboratory benches is required, the surfaces shall be rubbed down lightly with fine sand paper. The surfaces shall then be thoroughly cleaned and shall be applied with one (1) coat of approved chemical resistant primer followed by one (1) coat of approved chemical resistant gloss enamel paint.

12. Varnishing

12.1. Varnishing to New Timberwork

12.1.1. The surfaces to be varnished shall be smoothened with fine sand paper and all crevices, holes and the like, if any, shall be filled with approved whiting. It shall be clean, dry, free from dust, dirt and wax before the application of varnish. Unless otherwise approved by the S.O., the surfaces shall be applied with three (3) coats of approved UV protection, low odour alkyd wood finish or varnishing mixture used strictly in accordance with the manufacturer's instructions.

12.1.2. Where non patented products are allowed to be used, the varnishing mixture shall consist of methylated spirit, shellac and approved stain

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forming the first coat followed by one (1) coat of an approved mixture consisting of thinner and lacquer. The mixtures shall be of uniform consistency throughout. Unless otherwise specified in the Drawings, the finish shall be gloss and as approved by the S.O..

12.1.3. Timber deck surfaces shall be applied with three (3) coats of approved scratch resistant, UV protection, fast drying low odour urethane alkyd wood finish.

12.2. Re-varnishing To Existing Timberwork

Where re-varnishing to timberwork is specified in the Drawings or described in the B.Q., the surface shall first be thoroughly scuffed to remove the existing varnish. The surface shall then be smoothened with fine sand paper, cleaned, dried and free from dust, dirt and wax. It shall then be varnished as described hereinbefore for new timberwork.

13. Painting Works for Buildings in Coastal Areas.

13.1. External walls shall be applied with one (1) coat of approved pliolite based alkaline resisting primer sealer, unless otherwise specified in the Drawings, followed with two (2) coats of elastomeric weather resistant paint of approved colour applied strictly in accordance to manufacturer's instruction.

13.2. Unless otherwise specified in the Drawings, the internal walls shall be applied with one (1) coat of approved water based alkaline resisting acrylic wall sealer, followed with two (2) coats of low volatile organic compounds (VOCs), alkylphenolethoxylate (APEO) free, formaldehyde free acrylic premium emulsion paint of approved colour applied strictly in accordance to manufacturer's instruction.

13.3. Mild steel shall be applied with one (1) coat of zinc rich epoxy, one (1) coat of surface tolerance epoxy mastic and followed with two (2) coats of polyurethane topcoat.

13.4. Galvanized steel shall be applied with one (1) coat of surface tolerance epoxy mastic and followed with two (2) coats of polyurethane topcoat.

13.5. Roofing sheet coatings for marine environment shall refer to SECTION G: ROOFING.

13.6. Coatings of fasteners used shall comply with AS 3566 Class 4 and be certified as such by the supplier of fasteners and as approved by the S.O..

14. Painting Works to Clinical Areas (Hygienic Areas)

14.1. All external walls shall be applied with one (1) coat of approved siloxane primer sealer, unless otherwise stated in the Drawings, followed with two (2) coats of silicone emulsion water repellent paint applied strictly in accordance to manufacturer's instruction.

14.2. Internal walls shall be applied with one (1) coat of approved ultra-low VOCs alkaline resisting primer sealer, followed with two (2) coats of anti-bacteria, anti-fungus, low VOCs, 100% APEO free, formaldehyde free acrylic premium emulsion paint.

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14.3. Internal walls (clinical areas) shall be applied with one (1) coat of approved ultra-low VOCs epoxy primer sealer, followed with two (2) coats of anti-bacteria, anti-fungus, low VOCs, 100% APEO free, formaldehyde free epoxy paint.

14.4. Internal walls (clinical areas with 24 Hours Air-Conditioning) shall be applied with one (1) coat of approved ultra-low VOCs acrylic water-based primer sealer, followed with two (2) coats of anti-bacteria, anti-fungus, low VOCs, 100% APEO free, formaldehyde free Polyurethane paint.

14.5. Painting to Health Facility (Ministry of Health) Buildings shall also adhere to *Garis Panduan Skema Warna Luaran Bangunan Fasiliti Kesihatan* KKM.

15. Completion of Painting Works

On completion of paintwork, all paint marks inadvertently left on glass, floors, tiles and other surfaces shall be removed. Any stain or marking on finished paintwork shall be removed and touched up to the approval of the S.O..

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APPENDIX O/1

PAINT PERFORMANCE WARRANTY (SPECIMEN)

1. **Coverage of Performance Warranty**

We ..... the paint Manufacturer hereby warrants that for a period of **five (5) years** from the date of Practical Completion, the paint system shall not be affected by the following defects:

(i) Peeling
This condition is manifested when the paint film peels away or detaches from the substrate.

(ii) Cracking
This condition is manifested by any visible cracking on the paint film other than that caused by plastering cracks and structural defects.

(iii) Fungus/Algae Growth
This condition is established when there is a growth of micro-organisms on the surface of the paint films which would result in the marring of the appearance of the paint film through discoloration.

(iv) Discoloration
This condition occurs when the coating loses its original colour in patches and excessive discoloration appears.

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2. Procedure for Claims

(i) Any defect claims shall be made in writing and delivered by post or by hand to the Manufacturer.
(ii) A technical team from the Manufacturer will be dispatched to evaluate the nature of the claim. Should our findings conclude the defects as within the scope of warranty, then the Manufacturer shall make good such defects.
(iii) Should the Manufacturer's technical team conclude that the defects falls outside the scope of the warranty, the Manufacturer shall not be held responsible for the claim.
(iv) Should the Government disagree with the conclusion of the technical team pertaining to the defects in particular, then an independent third party competent in such technical evaluation shall be appointed to investigate the disputed defects.
(v) The appointment of independent third party competent in such technical evaluation shall only be appointed upon the mutual agreement between the Government and the Manufacturer.
(vi) The findings of the third party shall be conclusive and mutually accepted by the Government and the Manufacturer.
(vii) If the findings of the independent third party are within the coverage of this performance warranty, all cost shall be borne by the Manufacturer or otherwise such cost shall be borne by the Contractor.
(viii) All claims for the defects must be received by the Manufacturer not later than fourteen (14) days from the expiry of the warranty period.

MANUFACTURER

.....

Company Stamp

.....

.....

.....

Signature

Name:
Date:

WITNESS

.....

Company Stamp

.....

.....

.....

Signature

Name:
Date:

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ROADS AND HARDSTANDING

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1. General

1.1. The construction of roads and hardstanding shall generally be carried out only after completion of all drainage systems, services and ducts which may affect the Works, unless otherwise agreed by the S.O..

2. Flexible Pavement

2.1. Subgrade

2.1.1. Subgrade means that part of the embankment or existing ground in cutting which is immediately below the sub-base or lower sub-base of the road pavement and shoulders.

2.1.2. Material for the top 300mm of subgrade shall have a minimum soaked laboratory California Bearing Ratio (CBR) as shown on the Drawing when compacted to 95% of the maximum dry density determined in the *MS 1056* Compaction Test (4.5kg Rammer Method). In the event CBR value not mentioned on the Drawing, a minimum CBR value of 10% shall be adopted.

2.1.3. Throughout the top 300mm of subgrade, the materials shall be compacted to not less than 95% of the maximum dry density determined in the *MS 1056* Compaction Test (4.5kg Rammer Method).

2.1.4. In cut area, the top 300mm of the subgrade shall be scarified and recompacted to 95% of the maximum dry density determined in the *MS 1056* Compaction Test (4.5kg Rammer Method). If the S.O. is fully satisfied that the subgrade in its natural state possesses a density exceeding the requirements, then the surface of the subgrade shall be trimmed and rolled to obtain a smooth finish.

2.1.5. Where the material in cut area is found to be unsuitable for use in the top 300mm of subgrade or to a suitable level to be determined by the S.O., it shall be removed and replaced with suitable material which shall be compacted as indicated above. Alternatively, stabilizing agent may be used subjected to the S.O.'s approval.

2.1.6. The subgrade shall be finished in a neat and workmanlike manner, and the widths of embankments and cuts shall be everywhere at least of those specified or shown in the Drawings on both sides of the centre line. The top surface of the subgrade shall have the required shape, superelevation, levels and grades and shall be finished everywhere to within + 10mm and - 30mm of the required level.

2.1.7. Where subgrade construction encounters rock surfaces:

2.1.7.1. Rock surfaces extend over the whole width of the formation:

The rock surface shall be trimmed to a free draining profile, at or below formation levels. No high spot shall protrude above the formation level. Any voids or cavities more than 0.5m below the formation level shall be filled up with approved crusher run, gravel or lean concrete having cube strength greater than C8/10N/mm^2. The rock surface shall then be brought up to the formation levels with approved crushed rock or gravel, regulated and blinded.

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2.1.7.2. Rock outcrop occurs over part of the formation only:

The rock outcrop shall be cut down to a level not less than 300mm below the formation level. The surface shall then be brought up to level with suitable subgrade material.

2.2. Drainage Layer

2.2.1. This work shall consist of furnishing, placing, compacting and shaping drainage layer on a prepared and accepted subgrade in accordance with this Specification and the lines, levels, grades, dimensions and cross-sections as shown on the Drawings and/or as directed by the S.O..

2.2.2. Coarse aggregate shall be screened crushed hard rock and fine aggregate shall be screened quarry dust or sand. The aggregate shall be well graded and lie within the limits as shown in **Table P1.**

Table P1. Gradation Limits for Drainage Layer

B.S. Sieve Size (mm)	Percentage Passing by Weight
75.0	100
37.5	75 - 100
20.0	60 - 90
10.0	25 - 75
5.0	10 - 45
2.00	0 - 20
1.18	0 - 10

2.2.3. Notwithstanding any earlier approval of finished subgrade, the surface of the subgrade shall be, on completion of compaction and immediately before placing drainage layer, well closed and free from movement under the compaction plant and from ridges, cracks, loose material, pot holes, ruts or other defects. Any damage to or deterioration of the subgrade shall be made good in accordance with sub-section 2.1..

2.2.4. The material shall be transported, laid and compacted at a moisture content within the range + 1% to - 2% of the optimum moisture content determined in compliance with *BS 5835* and without drying out or segregation.

2.2.5. The drainage layer shall be placed and compacted to the required width and thickness as shown on the Drawings, in one single layer.

2.2.6. The material shall be spread and lightly compacted with tracked spreading plant or other approved equipment with consideration given to the protection of the subgrade.

2.3. Sub-base

2.3.1. This work shall consist of furnishing, placing, compacting and shaping sub-base material on a prepared and accepted subgrade in accordance with this Specification and the lines, levels, grades, dimensions and cross-sections as shown on the Drawings and/or as directed by the S.O..

2.3.2. Sub-base shall be a natural or artificial mixture of locally available materials such as sand, gravel, crushed aggregate, et cetera, free from organic matter, clay lumps and other deleterious materials. It shall be well

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graded and conform to **Table P2** and the following quality requirements:

2.3.2.1. The CBR of the sub-base shall not be less than 30% or as shown on the Drawings when compacted to 95% of the maximum dry density determined in the *BS 1377* Compaction Test (4.5kg rammer method) and soaked for 4 days under a surcharge of 4.5kg. This shall involve carrying out a series of CBR tests at various dry densities, using the field moisture content. The field density must then be measured at a number of points using the sand replacement method and the CBR deduced from the mean of the field density measurements.

2.3.2.2. If more than 10% of the material is retained on the BS Sieve Size 20.0mm, the whole material can be assumed without test to have a CBR value of 30% or more.

2.3.2.3. The plasticity index when tested in accordance with *BS 1377* shall be not more than 12.

2.3.2.4. The 10% fines value when tested in accordance with *MS 30* shall be not less than 30kN.

2.3.2.5. The sand equivalent of aggregate fraction passing the No. 4 (4.75mm) sieve when tested in accordance with *ASTM D 2419* shall be not less than 45%.

Table P2. Gradation Limits for Sub-Base

BS Sieve Size (mm)	Percentage Passing by Weight
75.0	100
37.5	85 - 100
20.0	65 - 100
10.0	45 - 100
5.0	25 - 85
0.600	8 - 45
0.075	0 - 10
The particle size shall be determined by the washing and sieving method of *BS 1377*.	

2.3.3. Prior to placing any sub-base material, the underlying subgrade (particularly the top 300mm of the subgrade) shall have been shaped and compacted in accordance with the provisions of sub-section 2.1. or sub-section 2.2. as appropriate. Notwithstanding any earlier approval of finished subgrade, the surface of the subgrade shall be, on completion of compaction and immediately before placing sub-base layer, well closed and free from movement under the compaction plant and from ridges, cracks, loose material, potholes, ruts or other defects. Any damage to or deterioration of the subgrade shall be made good in accordance with sub-section 2.1..

2.3.4. Sub-base material shall be transported, laid and compacted at a moisture content within the range + 1% to - 2% of the optimum moisture content without drying out or segregation.

2.3.5. Sub-base material shall be placed over the full width of the formation to the required thickness as shown on the Drawings or directed by the S.O. in one layer or more, each layer not exceeding 200mm compacted thickness. Where two or more layers are required, they shall be of

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approximately equal thickness and none shall be less than 100mm compacted thickness.

2.3.6. Each layer of sub-base shall be processed as necessary to bring its moisture content to a uniform level throughout the material suitable for compaction and shall then be compacted using suitable compaction equipment approved by the S.O. to not less than 95% of the maximum dry density determined in the *BS 1377* Compaction Test (4.5kg rammer method). Compaction shall be carried out in a longitudinal direction along the roadbed, and shall generally begin at the outer edge and progress uniformly towards the crown on each side in such a manner that each section receives equal compactive effort, all to the satisfaction of the S.O..

2.3.7. All loose, segregated or other defective areas shall be removed to the full thickness of the layer, and new sub-base material laid and compacted.

2.3.8. The sub-base shall be finished in a neat and workmanlike manner and shall have an average thickness over any 100m length not less than the required thickness. The top surface of the sub-base shall have the required shape, superelevation, levels and grades, and shall be everywhere within the tolerances as specified in sub-section 3.2..

2.4. Crushed Aggregate Roadbase

2.4.1. This work shall consist of furnishing, placing, compacting and shaping crushed aggregate roadbase material on a prepared and accepted subgrade or sub-base in accordance with this Specification and the lines, levels, grades, dimensions and cross-sections as shown on the Drawings and/or as directed by the S.O..

2.4.2. Crushed aggregate roadbase material shall be crushed rock, crushed gravel or a mixture of crushed rock and gravel, which shall be hard, durable, clean and essentially free from clay and other deleterious materials. The material shall conform to the following physical and mechanical quality requirements:

2.4.2.1. The plasticity index when tested in accordance with *BS 1377* shall be not more than 6.

2.4.2.2. The aggregate crushing value when tested in accordance with *MS 30* shall be not more than 25%.

2.4.2.3. The flakiness index when tested in accordance with *MS 30* shall be not more than 25%.

2.4.2.4. The weighted average loss of weight in the magnesium sulfate soundness test (5 cycles) when tested in accordance with *AASHTO Test Method T 104* shall be not more than 18%.

2.4.2.5. The material shall have a CBR value of not less than 80% when compacted to 95% of the maximum dry density determined in the *BS 1377* Compaction Test (4.5kg rammer method) and soaked for 4 days under a surcharge of 4.5kg.

2.4.2.6. The sand equivalent of aggregate fraction passing the No. 4 (4.75mm) sieve when tested in accordance with *ASTM D 2419* shall be not less than 45%.

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2.4.2.7. The gradation shall comply with the envelope as shown in **Table P3.**

Table P3. Gradation Limits for Crushed Aggregate Roadbase

B.S. Sieve Size (mm)	Percentage Passing by Weight
50.0	100
37.5	85 - 100
28.0	70 - 100
20.0	60 - 90
10.0	40 - 65
5.0	30 - 55
2.00	20 - 40
0.425	10 - 25
0.075	2 - 10
The particle size shall be determined by the washing and sieving method of *BS 1377.*	

2.4.3. Prior to placing any crushed aggregate roadbase material, the subbase shall have been constructed in accordance with the provisions of sub-section 2.3..

2.4.4. Crushed aggregate roadbase shall be placed to the required width and thickness as shown on the Drawings or directed by the S.O. in one layer or more, each layer not exceeding 200mm compacted thickness.

2.4.5. Where two or more layers are required, each layer shall be of approximately equal thickness and none shall be less than 100mm compacted thickness.

2.4.6. The material shall be spread using a motor grader of sufficient capacity or other approved mechanical spreader, at the optimum moisture content ± 1%.

2.4.7. Compaction shall be carried out using suitable approved equipment, in a longitudinal direction, and begin at the lower edges and progress towards the crown, or in the case of superelevation towards the upper edge, in such a manner that each section receives equal compactive effort, sufficient to produce a density of not less than 95% of the maximum dry density as determined by *BS 1377: Test 13.*

2.4.8. Throughout the placing, adjustment of moisture content and compaction of crushed aggregate roadbase material, care shall be taken to maintain a uniform gradation of the material and prevent its separation into coarse and fine parts, all to the satisfaction of the S.O..

2.4.9. The crushed aggregate roadbase width shall be everywhere at least that specified or shown on the Drawings on both sides of the centre-line; and its average thickness over any 100m length shall be not less than the required thickness.

2.4.10. The surface of the roadbase shall on completion of compaction and immediately before placing bituminous surfacing be well closed and free from movement under the compaction plant and from ridges, cracks, loose material, pot holes, ruts other defects.

2.4.11. All loose, segregated or otherwise defective areas shall be removed to the full thickness of the layer, and new material laid and compacted. The

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addition of fine material will not be permitted.

2.4.12. The surface shall be to the required level and grade and comply with the tolerances as specified in sub-section 3.2..

2.5. Wet-Mix Roadbase

2.5.1. This works shall consist of furnishing, placing, compacting wet-mix roadbase on a prepared and accepted sub-base in accordance with this Specification and the lines and levels as shown on the Drawings and/or as directed by the S.O..

2.5.2. Aggregate for wet-mix roadbase shall be crushed rock, crushed gravel or a mixture of crushed rock and gravel, which shall be hard, durable, clean and essentially free from clay and other deleterious materials.

2.5.3. The aggregate shall conform to the following physical and mechanical quality requirements:

2.5.3.1. The flakiness index when tested in accordance with *MS 30* shall be not more than 25%.

2.5.3.2. The aggregate crushing value when tested in accordance with *MS 30* shall be not more than 25%.

2.5.3.3. The weighted average loss of weight in the magnesium sulfate soundness test (5 cycles) when tested in accordance with *AASHTO Test Method T 104* shall be not more than 18%.

2.5.3.4. The sand equivalent of aggregate fraction passing the No. 4 (4.75mm) sieve when tested in accordance with *ASTM D 2419* shall be not less than 45%.

2.5.3.5. The gradation shall comply with the limits shown in **Table P4.**

Table P4. Gradation Limit for Wet-Mix Roadbase

B.S. Sieve Size (mm)	Percentage by Weight Passing
50.0	100
37.5	95 - 100
20.0	60 - 80
10.0	40 - 60
5.0	25 - 40
2.36	15 - 30
0.060	8 - 22
0.075	0 - 8
The particle size shall be determined by the washing and sieving method of *BS 1377*.	

2.5.4. Notwithstanding any earlier approval of finished sub-base, prior to placing wet-mix roadbase material, any damage to or deterioration of the sub-base shall be made good in accordance with sub-section 2.3..

2.5.5. Wet-mix roadbase material shall be placed to the required width and thickness as shown on the Drawings or as directed by the S.O. in one layer or more, each layer not exceeding 200mm compacted thickness. Where two or more layers are required, they shall be of approximately

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equal thickness and none shall be less than 100mm compacted thickness.

2.5.6. The material shall be laid using a paving machine at moisture content + 0.5% of the optimum which shall be maintained during the compaction operation.

2.5.7. Compaction shall be carried out using suitable approved equipment in a longitudinal direction, and begin at the lower edges and progress towards the crown, or in the case of superelevation towards the upper edge, in such a manner that each section receives equal compactive effort, sufficient to produce a density of not less than 95% of the maximum dry density as determined by *BS 1377: Test 13.*

2.5.8. Throughout the placing, and compaction of wet-mix roadbase material, care shall be taken to maintain a uniform gradation of the material and prevent its separation into coarse and fine parts.

2.5.9. All loose, segregated or otherwise defective areas shall be removed to the full thickness of the layer, and new wet-mix roadbase material laid and compacted, the addition of fine aggregate only shall not be permitted.

2.5.10. The wet-mix roadbase width shall be everywhere at least that specified or shown on the Drawings on both sides of the centre-line. The average thickness measured over any 100m length shall be not less than shown on the Drawings or specified and the minimum thickness measured at any one point shall be not less than the thickness shown on the drawing or specified **Table P5.**

2.5.11. The surface of the wet-mix roadbase shall, on completion of compaction and immediately before placing bituminous surfacing, be well closed and free from movement under the compaction plant and from ridges, cracks, loose material, pot holes, ruts or other defects.

2.5.12. The surface shall be to the required level and grade and comply with the tolerances specified in sub-section 3.2..

2.6. Bituminous Pavement Courses

2.6.1. Bituminous Prime Coat

2.6.1.1. This work shall consist of the careful and thorough cleaning of the surface of a prepared and accepted unbound roadbase and cement-treated base (CTB), and the furnishing and application to the cleaned roadbase and CTB surface of a bituminous prime coat, all in accordance with this Specification and the lines, dimensions and cross-sections as shown on the Drawings and/or as directed by the S.O..

2.6.1.2. The materials, equipment and construction methods shall be in accordance with *Standard Specification for Roadworks Section 4: Flexible Pavement JKR Specification No. JKR/SPJ/2008-S4.*

2.6.2. Bituminous Tack Coat

2.6.2.1. This work shall consist of the careful and thorough cleaning of the surface of a prepared and accepted bituminous or bitumen primed pavement course, and the furnishing and application to the cleaned surface of a bituminous tack coat prior to the

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construction of an overlying bituminous pavement course, all in accordance with this Specification and the lines, dimensions and cross-sections as shown on the Drawings and/or as required by the S.O..

2.6.2.2. The materials, equipment and construction methods shall be in accordance with *Standard Specification for Roadworks Section 4: Flexible Pavement JKR Specification No. JKR/SPJ/2008-S4.*

2.6.3. Asphaltic Concrete

2.6.3.1. This work shall consist of furnishing, placing, shaping and compacting asphaltic concrete binder course and/or wearing course on a prepared and accepted bituminous or bitumen primed pavement course, and shall include the careful and thorough cleaning of surfaces which are to be covered prior to the application of bituminous prime coat and tack coat. The work shall be carried out all in accordance with this Specification and the lines, levels, grades, dimensions and cross-sections as shown on the Drawings and/or as required by the S.O..

2.6.3.2. The materials, mix design, equipment and construction methods shall be in accordance with JKR Specification No. *JKR/SPJ/2008-S4.*

3. Horizontal Alignment, Surface Levels and Surface Regularity Of Pavement Courses

3.1. Horizontal Alignment

3.1.1. The horizontal alignment shall be determined from the centerline of the pavement surface shown on the Drawings. The edges of the pavement as constructed and all other parallel construction lines shall be correct within a tolerance of + 50mm and - 0mm from the centre-line, except for kerbs, channel blocks and edge lines which shall be laid with a smooth alignment within a tolerance of + 25mm and - 0mm from the centre-line.

3.2. Surface Levels of Pavement Courses

3.2.1. The design levels of pavement courses shall be calculated from the vertical profile, crossfall and pavement course thicknesses shown on the Drawings. Crossfall for hardstanding shall be constructed at a minimum of 2.5% gradient from the highest point of the area or as approved by S.O.. The level of any point on the constructed surface of a pavement course shall be the design level subject to the appropriate tolerances given in **Table P5.**

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Table P5. Tolerances in Surface Levels of Pavement Courses

Pavement Course	Tolerance
Wearing Course	± 5mm
Binder Course	± 5mm
Roadbase	+ 0mm to - 20mm
Sub-base	+ 10mm to - 20mm

3.2.2. The combination of permitted tolerances in the levels of different pavement courses shall not result in a pavement thickness less than that shown on the Drawings. Each pavement course shall have an average thickness not less than that shown on the Drawings.

4. Shoulders

4.1. This work shall consist of furnishing, compacting and shaping earth, gravel or paved shoulder material on a prepared and accepted sub-base or subgrade, all in accordance with this Specification and the lines, levels, grades, dimensions and cross-sections as shown on the Drawings and/or as required by the S.O..

4.2. Materials

4.2.1. Paved Shoulders

The bituminous surfacing and underlying pavement courses shall be constructed as described in the appropriate sections of this Specification.

4.2.2. Gravel Shoulders

Gravel shoulder material shall conform to the requirements for gravel surfacing material set forth in *Standard Specification for Roadworks Section 4: Flexible Pavement JKR Specification No. JKR/SPJ/2008-S4.*

4.2.3. Earth Shoulders

Earth shoulder material shall be suitable material as described in *Standard Specification for Roadworks Section 2: Earthworks JKR Specification No. JKR/SPJ/2013-S2.*

4.2.4. Construction

4.2.4.1. Shoulders shall be constructed in stages or in one operation as directed or approved by the S.O., but in no instance shall a shoulder be built up to a level higher than that part of the abutting carriageway structure which has been completed and accepted.

4.2.4.2. Prior to placing any shoulder material, the underlying sub-base or subgrade shall have been shaped and compacted in accordance with the provisions of *Standard Specification for Roadworks Section 2: Earthworks JKR Specification No. JKR/SPJ/2013-S2.* respectively, and the abutting carriageway structure course or courses shall likewise have been shaped and compacted in accordance with the provisions of the appropriate sub-sections of this Specification. Notwithstanding any earlier approval of the underlying and abutting pavement courses, any

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damage to or deterioration of these underlying and abutting pavement courses shall be made good to the satisfaction of the S.O. before shoulder construction proceeds.

4.2.4.3. Shoulders shall be placed to the required width and thickness as shown on the Drawings or as directed by the S.O. in one layer or more, each layer not exceeding 200mm compacted thickness at the point of maximum thickness. Where two or more layers are required, they shall be of approximately equal shape and thickness, and none shall be less than 100mm compacted thickness at the point of maximum thickness.

4.2.4.4. Each layer of shoulder material shall be processed as necessary to bring its moisture content to a uniform level throughout the material suitable for compaction and shall then be compacted using suitable compaction equipment approved by the S.O. to not less than 95% of the maximum dry density determined in the *BS 1377* Compaction Test (4.5kg rammer method). Compaction shall be carried out in a longitudinal direction along the shoulder and shall generally begin at the outer edge and progress uniformly towards the carriageway, except on super-elevated curves where rolling shall begin at lower edge and progress uniformly towards the higher edge. In all cases, compaction shall be carried out in such a manner that each section receives compactive effort appropriate to its thickness, all to the satisfaction of the S.O..

4.2.4.5. Throughout the placing, adjustment of moisture content and compaction of shoulder material, care shall be taken to maintain a uniform gradation of the material and prevent its separation into coarse and separate parts, all to the satisfaction of the S.O..

4.2.4.6. Where shown on the Drawings or directed by the S.O., earth shoulders shall be turfed in accordance with *Standard Specification for Roadworks Section 2: Earthworks JKR Specification No. JKR/SPJ/2013-S2.*

4.2.4.7. Shoulders shall be finished in a neat and workmanlike manner. The total width of carriageway and shoulder shall throughout be at least as specified or shown on the Drawings on both sides of the centre-line. The top surface of each shoulder shall throughout have the required shape, super-elevation, levels and grades, within 10mm of the required plane, and shall provide a flush joint with the carriageway surface and shall be uniformly free draining away from the carriageway, all to the satisfaction of the S.O..

5. Concrete Pavement

Concrete Pavement works shall be in accordance with *Standard Specification for Road Works JKR Specification No. JKR/SPJ/1988 Section 5: Portland Cement Concrete Pavement.*

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6. Road Furniture

6.1. Corrugated Sheet Steel Beam Guardrail

The supply and method of installation of guardrails shall be in accordance with *Standard Specification for Road Works Section 6: Road Furniture JKR Specification No. JKR/SPJ/2017-S6.*

6.2. Traffic Signs

The supply and method of installation of traffic signs shall be in accordance with *Standard Specification for Road Works Section 6: Road Furniture JKR Specification No. JKR/SPJ/2017-S6.*

6.3. Road Markings

The supply and application of road markings shall be in accordance with *Standard Specification for Road Works Section 6: Road Furniture JKR Specification No. JKR/SPJ/2017-S6.*

6.4. Concrete Kerb

The supply and installation of concrete kerb shall be in accordance with *Standard Specification for Road Works Section 6: Road Furniture JKR Specification No. JKR/SPJ/2017-S6.*

7. Street Lighting

The supply and installation of street lighting shall be in accordance with *Standard Specification for Road Works Secgtion 7: Street Lighting JKR Specification No. JKR/SPJ/2011-S7.*

8. Traffic Signal System

The supply and installation of traffic signal system shall be in accordance with *Standard Specification for Road Works Section 8: Traffic Signal System JKR Specification No. JKR/SPJ/2008-S8.*

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FENCING AND GATES

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1. General

1.1. Unless otherwise as shown on the Drawings, fencing shall be of chain link type as specified hereunder.

1.2. Unless otherwise as shown on the Drawings, the height of the fence shall be 1500mm from the ground up to the full height of the chain link.

1.3. The fence shall be erected to the extent and location as shown on the site plan. Where fencing is to be located on the boundary of the Site, the Contractor shall ensure that its construction shall not infringe the adjoining properties.

1.4. All trees, bushes, or other obstacles which interfere with the construction of the fence shall be removed prior to commencing fence construction.

2. Post and Bracings

2.1. Mild Steel Post

2.1.1. Unless otherwise as shown on the Drawings, mild steel angle posts and bracings shall be of size 60mm x 60mm x 6mm. All steel members for fencing and gates shall be free from rust, scales and other defects and shall be to the approval of the S.O.. Previously used steel members shall not be used in the construction of new fencing and gates. Before delivery to the Site, the steel members for fencing and gates shall be pre-cut and assembled at the Contractor's workshop and painted with one coat of approved metallic primer.

2.1.2. Where three strands of barbed wires are required, a mild steel angle arm 430mm long, of the same cross-sectional dimension as the post shall be welded at the top of the post at 450 inclinations. Where six strands of barbed wires are required, two pieces of mild steel angle arms as specified hereinbefore shall be welded to the top of each post forming the shape Y with each arm having three strands of barbed wires. The welding used shall be of continuous fillet welds. Necessary holes shall be made in the posts, arms and bracings for insertions of fixing bolts and clips.

2.2. Concrete Post

2.2.1. Concrete post and struts for fencing shall be of size 150mm x 150mm precast using Prescribed Mixes Grade 25P and shall be erected at 3000mm centres commencing from the gate post and the posts shall be embedded plumb in Prescribed Mixes Grade 25P concrete footings of size 250mm x 250mm x 600mm deep. The finish to the formed surfaces shall be Class F2 and the finish to the unformed surfaces shall be Class U2. The tops of the posts and all arises shall be rounded of chamfered.

2.2.2. Reinforcement for concrete posts and struts shall be Grade 250 plain round steel bars.

2.2.3. Post should be holed to allow the fixing of line wires, etc. the hole for top line wire shall be approximately 75mm below the top of the post. Holes for bolts shall allow the bolt to be freely inserted. All holes shall be free from obstructions and accurately positioned within ± 5mm.

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3. Chain Link Fencing

3.1. Chain Link Mesh, Straining

3.1.1. Chain link fences shall comply with *BS 1722: Part 1 Specification for Chain Link Fences.*

3.1.2. Chain link mesh, straining wires and barbed wires shall be made of galvanized steel and of approved quality. The mesh shall be of size 64mm made up of 3.25mm (10 gauges) diameter wire. Straining wires shall be of 4.06mm (8 gauges) diameters and barbed wires shall be of 2.64mm (12 gauges) diameters.

3.2. Fencing

3.2.1. Unless otherwise as shown on the Drawings, the mild steel angle posts shall be erected at 3000mm centres commencing from the gate post and the posts shall be embedded plumb in Prescribed Mixes Grade 25P concrete footings of size 250mm x 250mm x 600mm deep. Mild steel angle bracings of the same cross-sectional dimensions as the post shall be fixed at all corners, bends, junctions, gate posts and at every five bays of straight fencing.

3.2.2. The posts shall be set in holes to the required depth and stamped in a plumb and firm position to the line and spacing shown on the drawings or as directed by the S.O.. Post holes shall be large enough to allow for proper tamping. Backfill shall be placed in layers not exceeding 150mm, and compacted by hand tampers, machine tampers or other suitable equipment. Compacted backfill shall be crowned slightly to permit drainage away from the post.

3.2.3. The bracings shall be fixed at an inclination of 45^0 to the horizontal with top end bolted to the post, 300mm below the top of the post and the bottom end encased in concrete footing as described hereinbefore.

3.2.4. The chain link mesh shall be stretched or pulled tightly across the post with hand stretcher, or tensioning apparatus capable of adjustment and secured in place using approved fencing clips. The end of chain link fencing abutting mild steel gate posts shall be fixed by means of 19mm x 3mm mild steel flat straps drawn through the mesh and bolted using 10mm diameter mild steel bolts to 25mm x 25mm x 6mm mild steel plates welded to the posts at equal intervals of 300mm. Where gate posts are non-metal, the termination of the fencing at the gate shall be by means of another mild steel angle post fixed to one side of the gate post and strengthened by bracing as described hereinbefore. The chain link mesh shall then be strained by three strands of 4.06mm (8 gauges) diameter galvanized steel straining wires threaded through the mesh and fixed to the posts.

3.2.5. Each line wire and each line of barbed wire shall be secured to each intermediate post by one of the following methods;

3.2.5.1. A hairpin staple shall be passed through a hole in the post and secured to the wire by three complete turns on each side of the post.

3.2.5.2. The wire shall be threaded through a hole in the post.

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3.2.6. Where shown on the Drawings, the bottom of the chain link mesh shall be buried in continuous Prescribed Mixes Grade 25P concrete curbs. Unless otherwise detailed in the Drawings, the cross-sectional dimension of curbs shall be 125mm wide x 375mm high with 150mm protruding above the ground. The portion of the curb above the ground shall be rendered with 13mm thick 1:6 cement render to a wood float finish.

3.2.7. The ground surface around post shall be made good with the same material as the adjoining area.

4. Security Fencing

4.1. The security fencing shall be constructed and/or installed as shown on the Drawings and comply to requirement of relevant Authority.

4.2. All components shall be manufactured only by reputable licensed suppliers and approved by the S.O.. The supplier shall include special requirement such as mount CCTV Camera, lighting, barbed wire, razor wire etc. (if any) and responsible for the analysis, design, detailing, drawing, manufacture, material, handling and erection of the fence members and their ancillary fixing components.

4.3. All component shall be of hot dipped galvanised comply to *BS EN ISO 1461*.

5. Sports Fencing

5.1. The sports fencing shall be constructed and/or installed as shown on the Drawings and comply to requirement of Certified Body.

5.2. All components shall be manufactured only by reputable licensed suppliers and approved by the S.O.. The supplier shall include special requirement such as mount CCTV Camera, lighting, barbed wire, razor wire etc. (if any) and responsible for the analysis, design, detailing, drawing, manufacture, material, handling and erection of the fence members and their ancillary fixing components.

6. Gates

The gates shall be constructed and/or installed as shown on the Drawings.

7. Storage of Fencing

7.1. Gates, steel post and struts for fencing shall be stored off the ground on level supports and in manner which will not result in damage or deformation to the materials.

7.2. Fencing shall be protected from damage and damaged fencing shall not be use in the permanent works.

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8. Painting of Fence and Gates

The metallic primer previously applied to the steelwork at the workshop shall be touched up where necessary. Unless otherwise specified, the posts, bracings and gates shall be finished with two (2) coats of approved aluminium paint.

9. Re-erecting, salvage and dispose of existing fencing.

9.1. Taking Down and Re-Erecting of Existing Fencing

Where specified, existing fences shall be taken down, the materials carefully salvaged, and the fence re-erected, to the satisfaction of the S.O..

9.2. Remove and Salvage of Existing Fencing

Where removal and salvage of existing fences is specified, the Contractors shall carefully take down the fence, roll the wire, and place the material at locations as directed by the S.O.. Material that are not suitable for salvage shall be disposed of at locations as directed or acceptable to the S.O..

9.3. Remove and Dispose of Existing Fencing

Where removal and disposal of existing fences is specified, the Contractor shall completely remove the fence and dispose of all materials at locations acceptable to the S.O..

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SPESIFIKASI

LANDSCAPING AND TURFING

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1. General

1.1. All landscaping works shall be as shown on the Drawings. Turfing works and tree planting shall be carried out in such a manner as to minimize risks of damage to turfs and plants, and stunted growth. Turfing on all slopes shall be carried out immediately after slopes are formed. Tree planting shall be carried out as soon as practicable.

1.2. All landscaping works shall start as early as possible so that trees and plants are well- grown, and fully adapted to the new environment when the project concerned is handed over upon completion.

1.3. All landscaping works shall be furnished, installed and maintained by the Contractor as specified herein, or as shown on the Drawings, using the best horticultural management, giving special attention to planting practices, soil mixtures, and application of agricultural chemicals.

1.4. Existing water elements such as lakes, ponds and streams shall be incorporated into the landscape design. Unless otherwise specified, mature existing trees shall be retained and incorporated into the landscape design. Replantation and relocation of the trees removed shall be considered as part of the landscaping works.

2. Classifications and Characteristics of Plants

2.1. Plants shall mean trees, palms, shrubs, ground covers, and plants of other descriptions to be provided by the Contractor, as shown on the Drawings or listed in the plant schedules.

2.1.1. Each tree shall possess characteristics of its variety and growth typical to such tree. All trees shall be well-branched, with straight trunks characteristic of the species, with well-shaped top and intact leader. The height shall be measured from the stem's earth line to the top of the tree.

2.1.2. Palms shall have vigorous root system, crown of new leaves, proper color of leaves of adult palms, and sufficient hardlines. The height of palms shall be measured from the stem's earth line to the base of the first frond.

2.1.3. Shrubs and vines shall possess characteristics and growth habits typical of their species. All shrubs shall be well-shaped and bushy, with well-spaced branches, and not skinny. The height of shrubs or vines shall be measured from the stem's earth line to the top branches.

2.1.4. Ground cover is defined as any plant or groups of plant, other than grasses, which shall satisfactorily cover the ground, forming a compact and attractive cover.

2.2. All plants shall be in healthy growth condition, free from pests and diseases, and shall be representatives of their normal species or variety. All plants shall have well-branched heads and vigorous root systems and shall be injury-free. Unless otherwise shown or specified in the Drawings, only nursery-grown plants shall be used. Plants which are potted or plastic-bag-grown shall not be root-bound.

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3. Size of Plants

3.1. The size of plants refers to plant table size that is the size that is required for planting out on sites. All plants shall have the following sizes:

3.1.1. Ground Covers

Ground cover plants can be supplied in plastic bags. If supplied in 150mm - size bags they shall have at least nine (9) cuttings per bag, and not less than 150mm long.

3.1.2. Shrubs

Height of shrubs shall range between 150mm and 1000mm.

3.1.3. Trees

3.1.3.1. Trees shall be either container grown or grown on the open ground. They shall be of the following three types:

(i) Tree saplings

Tree saplings shall mean grown from seedlings or cuttings. They shall have straight main stems of not less than 1200mm in height from the soil level to the lowest branch, and a stem diameter of not less than 12mm, and a well-branching system.

(ii) Rooted Stump Cutting

These refer to plants which can be easily grown from stem cuttings instead of from seeds. They shall have straight main stems of 2400mm to 3000mm in height, with a diameter ranging from 37mm to 50mm.

(iii) Instant Trees

An instant tree is generally referred, to the semi-mature tree with a minimum trunk height of 2000mm for palms (measured from earth line to first frond) and 3000mm for other which shall have well-spread branches.

3.1.4. Palms

3.1.4.1. Palms shall be either container-grown on the open ground, and shall be of two types:

(i) Single-Stem Palm

These refer to palms with single main trunk. Their trunk height shall be not less than 1200mm measured from the earth line to the base of the first front.

(ii) Cluster Palms

The Palms referred to are those which grow in clusters. They shall have a minimum of three (3) palms clustered

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together, measuring 750mm to 1000mm from the earth line to the base of the first frond.

4. Handling and Planting

4.1. Handling

Plants shall be transported, handled and stored in such a manner as to prevent deterioration, damage or contamination. All plant materials shall be carefully protected and, if necessary, wrapped with hessian or gunny cloth during lifting, transportation, unloading and storage on site.

4.2. Planting

4.2.1. Pits/Holes

4.2.1.1. Generally, all pits for palms and trees shall not be less than 1000mm x 1000mm or 1/3 size bigger than the root ball, spaced at intervals as shown on the Drawings or approved by the S.O..

4.2.1.2. For shrubs, the pit size may be reduced to 500mm x 500mm deep (for big shrubs), or 300mm x 300mm x 300mm deep (for medium shrubs). Alternatively, continuous trench 500mm x 300mm deep respectively, shall be formed where required.

4.2.1.3. The bottom of all pits and trenches shall be forked loose to a depth of 300mm prior to backfilling with approved soil mixture before transplanting. All pits and trenches shall be soaked with water before planting.

4.2.1.4. Flower beds or trenches shall be made to the size as shown in the Drawings, and to a depth not exceeding 200mm.

4.2.1.5. The distance for planting trees and palms shall be between 3000mm to 5000mm unless otherwise specified.

4.2.1.6. The distance for planting shrubs shall be between 150mm to 300mm unless otherwise specified.

4.2.1.7. For ground covers, planting works shall be carried out in zig-zag manner at distance between 100mm to 150mm unless otherwise specified.

4.2.1.8. To install a minimum of 1000mm (H) x 750mm (L) x 750mm (W) of Polyethylene root barrier for trees planting at pavement/ hardscape area. eg parking, walkway and sidewalks.

4.2.2. Transplanting

4.2.2.1. Transplanting shall not be carried out in very hot, dry weather conditions which may result in initial drying out of the root system and/or scorching of leaves.

4.2.2.2. Immediately before transplanting, the plants shall be carefully removed from the nursery bags or pots. The plants shall be placed into the pits and the surround filled with approved black earth making sure that the roots are not excessively disturbed.

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The earth around the base of the stems shall be recessed slightly to facilitate watering.

4.2.3. Plants Supports

All newly plants shall be supported either by staking, tying or guying. Stakes shall be of wood, still or plastic of an approved type, driven into the ground before planting so as not to damage the root ball or aerial parts of plants. Stakes shall be long enough to the plants, with one (1) tie per stake set 150mm from the bottom.

5. Soil Mixture, Soil Conditioners and Chemical Fertilizers

5.1. Soil Mixture

Soil mixture for ground planting and backfill shall be in the ratio of 1:3, i.e. 1 part to soil conditioner or organic materials to three (3) parts of top soil. Planter box soil mixture shall be in the ratio of 1:2:3, i.e. one (1) part of sand of sand to two (2) parts soil conditioner or organic materials to three (3) parts top soil.

5.2. Top Soil

Top soil shall consist of fertile and friable topsoil obtained from a well-drained flood-free site excavated from not more than 300mm deep from ground level. It shall be of medium texture and without admixture of stones, lumps, plants or roots, and other extraneous matter. Topsoil material shall be obtained from excavated topsoil sourced or, if not available, from other sources as approved by the S.O..

5.3. Soil Conditioners (Manure and Compost)

Soil Conditioners shall be organic materials such as composed coconut, fiber, peat or other approved materials which shall be composed in a stable condition, free from toxic impurities and containing no substance injurious to plants. The organic matter with 45% - 55% moisture content and with Ph adjusted to 5.5 - 6.5 shall be used. All manure or compost used as additive to the soil mixture shall be procured from an approved source.

5.4. Chemicals Fertilizers

Chemicals fertilizers shall be granular slow release compound fertilizers with a minimum four (4) months release period at 32^0C. They shall be stored in waterproof sealed bags and kept under shelter. The Contractor shall submit manufacturer's technical data on the proposed fertilizer for the S.O.'s approval prior to the application of the fertilizer.

6. Turfing

6.1. Unless otherwise shown in the Drawings, turfing shall be provided to all exposed earth surfaces throughout the site. All surfaces to be turfed shall be completely cleared of all incidental Contractor's debris, stone and other obstructions.

6.2. The ground to be turfed shall be graded to fall toward surface water discharge line as shown in the Drawings, or approved by the S.O..

6.3. On level ground, minimum gradient of 1:60 shall be provided to eliminate ponding

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hollows. Any undesirable vegetation, debris, stumps or roots shall be grubbed up and removed from the site.

6.4. Top soil shall be provided on a prepared surface and compacted to provide a suitable tilt for the growth of the turf. Before spreading the topsoil, the ground is to be trimmed and leveled and all roots of bushes and undesirable growth grubbed up and removed from the site.

6.5. All turfs shall be of good, healthy, dense indigenous cow grass (Axon Opus Compresses) from an approved source. The grass shall be of even density, vigorous growth and green in color, forming a turf sufficiently fibrous to hold together when installed. They shall be free from mimosa, weeds or other foreign vegetation.

6.6. Each turf shall be approximately 300mm x 300mm x 50mm thick with roots still attached to the soil. They shall be kept moist and in shade and shall be planted within 24 hours of lifting. Samples of turfs to be used shall be submitted to the S.O. for approval before any turfs are brought in for use. The sources of material shall be stated by the Contractor.

6.7. Unless otherwise shown in the Drawings, close turfing shall be provided to slopes, and extending 2 m of the platform at the top and bottom of the slope, 1 m the sides of all drains, and 2 m wide of road shoulders, so that they cover the whole area without any space/gap between them.

6.8. Each sod shall be pegged in place with wooden/bamboo pegs 12mm diameter and 200mm long through the sod and into the soil base. These pegs shall be removed after the turf have firmly established. On steep slopes, netting in shall be laid onto the turfed areas for protection.

6.9. Unless otherwise shown in the Drawings, spot turfing shall be carried out on all level ground. The turf shall be laid at 450mm center, embedded 25mm in the top soil.

6.10. Turf shall be fertilized with approved slow release fertilizers high in Nitrogen content, one (1) month after planting at the rate of 60 gm/m^2 and evenly spread over the whole area. Turfs shall be well watered after each fertilizer application which shall be done once in every three months after grass cutting.

6.11. Grass cutting shall be done every three weeks after one (1) month growth/establishment by grass cutter/mover as often as in required to give a well trimmed sod not more than 25mm in height for flat surface and not less than 50mm on slope. All clippings shall be removed from the site before watering is carried out.

7. Football and Playing Fields

7.1. General

7.1.1. Unless otherwise specified hereinafter, turfing for football and playing fields shall be as specified hereinbefore. Turfing works shall start as soon as possible and shall be completed and fully established not later than three (3) months before the date of completion of the works.

7.1.2. The Contractor shall supply and install sub-soil drains as specified hereinafter at the locations and accordance with the lines, levels and grades shown in the Drawings and/or as directed by the S.O..

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7.2. Materials

7.2.1. Sub-soil Drain Pipes

Subsoil drain pipes shall be of high-Density Polyethylene (HDPE) perforated corrugated drainage pipe to DIN 16961 PT 1 and 2:1989 or equivalent, or Polyvinyl Chloride (PVC) pipes for subsoil drains complying with AS Specification 2439.1 or BS 3656 or equivalent, of diameter and lengths of pipe as shown on the Drawings.

7.2.2. Filter Materials

Filter Materials shall consist of an angular, clean, hard and durable crush rock with uniformly sized particle of 14mm, free form lumps of clay or organic matter.

7.2.3. Geo Textile Fabric

Geo textile fabric shall be of non-woven type thermally bonded with minimum weight of 100 g/m² or equivalent and shall be of approved manufacturer.

7.3. Site Preparation

The site area shall be completely cleared of all debris, large stones, discarded gravel and other unacceptable materials. The site shall then be graded to form a crown at the centre of the field with a minimum gradient of 1:300. The soil shall be of good texture and structure with the majority of the crumbs of size 1mm to 2mm and not contaminated with seeds, stolon or rhizomes of noxious weeds.

7.4. Trenching for Sub-soil Drain Pipes

Trenches shall be excavated and trimmed clean true to grade and alignment and the geo textile fabric shall be laid as shown on the Drawings. The fabric shall overlap the full width of the trench at the top. Where the fabric requires jointing along the trench, it shall overlap a minimum of 500mm at the joint.

7.5. Laying and Jointing Subsoil Drain Pipe

Subsoil pipe shall be laid and bedded as shown on the Drawings. Subsoil drain pipe shall be jointed according to the manufacturer's recommendations.

7.6. Backfilling

The trench shall be backfilled with the filter material in layers not exceeding 150mm loose thickness and uniformly compacted by suitable method approved by the S.O. to the level as shown in the Drawings. Care shall be taken that the pipe is not damaged or displaced.

7.7. Outlets

Outlets shall be constructed as shown in the Drawings and to the S.O.'s approval.

7.8. Laying of Sand and Turf Mixture

7.8.1. The prepared surface of the field shall be laid with a first layer of 100mm thick river sand or other suitable course grained granular materials and a second layer of 100mm thick turf mixture before receiving the turf.

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7.8.2. The Contactor surface shall carry out final gradient check prior to the turfing works.

7.8.3. Before turfing works commence, the Contractor shall submit samples of the turf mixture for the approval of the S.O.. The turf mixture shall be laid to the required formation level and gradient.

7.8.4. The turf mixture shall have the following composition by weight of 4% - 5% organic matter, 12% - 15% clay and 81% - 85% river sand. The PH value for the root zone medium shall be 5 to 7.5.

7.9. Inspections

7.9.1. The Contractor shall give not less than twenty-four (24) hour notice prior to the commencement and upon completion of the under mentioned works. The Contractor shall not proceed with the next succeeding operation until specific approval has been given for the following:

7.9.1.1. Trench excavation.

7.9.1.2. Trench lining with geo textile fabric and laying of subsoil drain pipe

7.9.1.3. Filter material backfill

7.9.1.4. Sand laying

7.9.1.5. Turf mixture

7.9.1.6. Turfing work

7.10. Levelling of Field

7.10.1. The Contractors shall water the turf at least twice a day or as instructed by the S.O.. The rate of application and frequency of watering shall be sufficient to maintain the turf mixture in a moist condition to ensure proper and healthy growth of the turf even during the dry weather.

7.10.2. Water shall be applied as fine spray by means of suitable pumps and hose or sprinkler or any other method approved by the S.O. so as not to disturb the turf mixture.

7.11. Weed Control

Weeding shall be carried out on the newly turfed area about ten (10) days after planting to get rid of foreign species and maintain a pure culture of Axonopus Compressus (Cow Grass). Weeding on a Continuous basis shall be carried out to prevent weeds from growing.

7.12. Fertilization

The first fertilization shall be carried out two (2) weeks after planting, using mechanical spreader. Subsequently, the fertilizer shall be applied at three (3) weeks interval.

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7.13. Mowing

7.13.1. Mowing shall be carried out using properly sharpened and adjusted machine tools so that the turf is out cleanly, and no tearing takes place.

7.13.2. The first cut shall be carried out when the turf reaches 50mm – 70mm in height. The turf shall be cut to 25mm – 30mm in height. Subsequently, mowing shall be done at least once in every two (2) weeks.

7.14. Top Dressing

The Contractor shall, from time to time or whenever directed by the S.O. check the flatness of the field and if found uneven, rectify by top dressing with turf mixture and followed by proper compaction.

7.15. Maintenance during Defect Liability Period

7.15.1. The Contractor shall be responsible for carrying out full-time intensive maintenance of the turfing works for the entire duration of the Defect Liability Period of the Works.

7.15.2. The maintenance includes watering, weed control, fertilization, moving and top dressing, all as specified hereinbefore.

7.16. Handing Over of the Works

On handing over of the works, the field shall be in good playable condition with all the full line markings to the dimensions as shown on the Drawings.

8. Relocation and Protection of Existing Tress

8.1. Relocation of Trees

8.1.1. Where shown in the Drawings or if directed by the S.O., all existing trees having girth of 300mm and below identified and marked for relocation, shall not be cut, but shall be dug up, prepared for, and relocated by the Contractor to other areas within, or in the vicinity of the site. In the event of any such trees being accidentally cut or damaged, the same shall be replaced with trees of equivalent size and species by the Contractor.

8.1.2. The Contractor shall protect and maintain the relocated trees by fencing to a height of 1.2m, watering, manuring, pruning, and other necessary treatments throughout the contract period (including the Defects Liability Period) until satisfactory, growth is established. Any relocated trees which damage are accidentally or fail to re-grow satisfactorily within the Defect Liability Period, shall be replaced accordingly at the Contractor own cost.

8.2. Protection of Trees Retained on Site

8.2.1. All existing trees having girth of 800mm and above identified and marked by the S.O. or as shown in the Drawings to be retained on site, shall be protected and maintained by fencing to a height of 1.2m, watering manuring, pruning and other necessary treatments throughout the contract (including the Defects Liability Period) so as not to jeopardize their growth.

8.2.2. The ground around the tree spread shall be protected to prevent contamination from materials and chemicals detrimental to plant growth.

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Method of protection shall be to the approval of the S.O. in the event of any such trees being accidentally or otherwise out or damaged, the same shall be replaced by the Contractor with trees equivalent size and species at his own cost.

9. Maintenance of Plant and Turf

9.1. General

9.1.1. After planting and prior to the onset of the maintenance period, the Contractor shall be responsible for carrying out all necessary measures to ensure that all plant materials and turfing thrive and become established, and that the landscaped areas are kept in a clean and tidy condition.

9.1.2. The Contractor shall protect and maintain the plants and turfing from any damage and destruction, by way of watering, manuring and tilling, any by staking and fencing, where necessary, to support and protect the plants, until the end of the Defects Liability Period. All plants and turfs which are defective and/ or fail to grow within the Defect Liability Period or as instructed by the S.O. shall be replaced immediately and/ or replanted accordingly, at the Contractor's own cost.

9.1.3. Unless otherwise specified, all maintenance works shall be carried out complying to the minimum standard as detailed out in the *'Garis Panduan Pengurusan Dan Penyelenggaran Projek Landskap' (latest edition)* by Jabatan Perancang Bandar & Desa, Kementerian Perumahan Dan Kerajaan Tempatan. During the Defects Liability Period, the Contractor is required to implement the maintenance works as follows;

9.1.3.1. Water the plants twice (2) per day.

9.1.3.2. Feeding the plants with fertilizers (NPK Green) 15:15:15 once (1) every month for the first six (6) months and as needed after six (6) months onwards. Application of the fertilizer shall be as specified hereinafter, and as recommended by the fertilizer manufacturer.

9.1.3.3. Weeding/Hoeing and Site Cleaning

9.1.3.4. Disease and Pest Control

9.1.3.5. Plants Replacement

9.1.3.6. Mulching

9.1.3.7. Trimming/Pruning

9.1.4. The Contractor shall provide persons who are competent and experienced for organizing and running the maintenance programs during the Defects Liability Period, at the Contractor's own cost.

9.1.5. The Contractor shall be responsible for the use of all materials, labour and equipment. Any injury to plants caused by such materials, labour and equipment shall be corrected and repaired at the Contractor's own cost.

9.1.6. The Contractor shall carry out all necessary measures to ensure that all plants thrive and become established within this period. All landscaped

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areas shall be inspected at monthly intervals and lists of remedial works shall be issued upon each inspection within seven (7) working days. All items on the remedial work list shall be executed before the next scheduled inspection.

9.2. Weeding and Hoeing

Weeding and hoeing shall be done frequently, depending on weed growth or whenever directed to do so by the S.O.. The Contractor shall be responsible for maintaining areas close the base of trees or shrubs. Weeding shall be done manually either by hand, hoe or garden tools at least once a month, with care taken not to wound plant stems.

9.3. Fertilizers and Application Rate

9.3.1. Feedings to plants shall be done with approved organic manure or slow release fertilizers at regular intervals to maintain healthy growth. The S.O. reserves the right to request the Contractors to use any kind of fertilizer, let it be straight mixture, complex or slow release, at the Contractor's own cost.

9.3.2. Six (6) applications shall be required during the maintenance period. The first shall be carried out during the second (2nd) month after planting. The second and subsequent applications shall be worked into the soil above the roots and lightly watered in. the fertilizer shall be applied, preferable, when the plants are in their active stage of growth.

9.3.3. Slow release fertilizers shall be applied strictly in accordance with the manufacturer's directions and recommendations.

9.3.4. The Contractor shall take note that plant feeding shall be carried out only after all other maintenance works like weeding, hoeing and trimming or pruning have been carried out.

10. Final Handing Over

10.1. Two weeks before the expiry of the Defects Liability Period a joint final inspection shall be held with the S.O. to review the requirements for any alteration or replacement in order to gain approval for Final Handing Over.

10.2. At the time of Final Inspection, all areas under this contract shall be free from weeds, neatly cultivated and raked, and all plant boxes in good order. Grass shall be neatly cut and all clippings removed. No bare patches of earth shall be visible in turf or planting areas unless otherwise specified.

10.3. If any portions of the works are found to be not acceptable, under the terms and intent of the Drawings and specifications, the Contractor shall carry out immediate remedial works to S.O.'s acceptance before the date of Final Handing Over. The cost of all remedial works shall be borne by the Contractor.

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SPESIFIKASI

DRAINAGE

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1. General

1.1. All drainage works shall be in accordance with the *JKR Standard Specification for Drainage Works in Building Projects No. 20601-0195-13* and conform to the requirements of the *Urban Stormwater Management Manual for Malaysia (MSMA)* and *MS 2526*.

1.2. The works shall include the construction of surface drains, sumps, culverts, subsoil drains, and other drainage structures in accordance with the above requirements or as directed by the S.O..

1.3. Drainage works shall be constructed to the lines, levels, grades and cross-sections shown on the Drawings or to suit the site as approved by the S.O..

1.4. Final discharge point shall be identified and approved by the relevant Local Authorities. Where necessary, the existing drainage system shall be upgraded in order to ensure they are fully functional.

2. Excavation and Backfilling

2.1. All general excavation works shall be as specified in SECTION B: EXCAVATION AND EARTHWORKS.

2.2. The Contractor shall notify the S.O. sufficiently in advance of the beginning of any excavation so that cross-section elevations and measurements shall be taken of undisturbed ground. The natural ground adjacent to the structure shall not be disturbed without permission of the S.O.. The excavation works shall be carried out so as not to cause any danger or obstruction to the traffic or public.

2.3. All excavation shall be inspected and approved by the S.O. prior to further work being carried out.

2.3.1. Excavation of Hard Materials/Rock

2.3.1.1. Hard materials/rock encountered in the trench excavation shall be removed to the approval of the S.O.. Layer of rock encountered along the bottom of the excavation shall be cut and trimmed to the required level.

2.3.1.2. Voids formed at bottom of the trench due to the removal of rocks shall be backfilled to the required level with 20mm Grade 20P concrete or other suitable materials, well rammed and compacted all to the approval of the S.O..

2.3.1.3. Jagged surfaces of rocks at the bottom of the excavation due to the trimming shall be levelled and smoothened with sand blinding to the approval of the S.O..

2.3.2. Excavation of Soft Materials

When, in the opinion of the S.O. the foundation material is soft or otherwise unsuitable, the Contractor shall remove and insert foundation fill material or concrete as specified or shown on the Drawings or directed by the S.O.. It shall be placed and compacted in layers not more than 150mm thick or as directed by the S.O..

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2.4. Excavation for Drain Trenches

2.4.1. The trench shall be excavated to a depth intended or shown on the Drawings. The blinding material shall be laid immediately after the excavation.

2.4.2. Should the bottom of the trench be inadvertently excavated below the specified level, it should be brought back at the Contractor's expense to the correct level with good selected earth or sand, carefully rammed into place.

2.5. Excavation for Culvert

2.5.1. The earthworks at the required location shall be constructed to a level at least 600mm above the top of culverts design levels or to the top of subgrade levels, whichever is lower. The culverts specified to be constructed in trench conditions shall be excavated in accordance with sub-section 2.6..

2.5.2. Where drainage conditions or other circumstances so require, the S.O. shall direct the Contractor to construct the culvert without first constructing the earthworks to the level specified above, in which case excavation, and foundation preparation shall be in accordance with sub-section 2.7..

2.6. Trench Method

2.6.1. The trench to receive culvert shall have sufficient width and depth to enable the placing of bedding material. The bottom of the trench shall be trimmed to suitably smooth plane surface which shall be kept free from water, all to the satisfaction of the S.O..

2.6.2. Rock or other hard material encountered shall be excavated to a depth as directed by S.O.. The excavated hard material shall be replaced with suitable material uniformly compacted in layers of not more than 150mm compacted thickness to provide satisfactory support for the culvert, all to the satisfaction of the S.O..

2.7. Open Ground Method

2.7.1. Where existing ground levels are above top bedding material design levels and firm foundation materials are encountered, excavation and foundation preparation shall be similar to the described in trench method above. Otherwise a firm foundation plane shall be prepared, which shall be essentially free draining along the line of the culvert by trimming the existing ground, or such fill as it is necessary to place and compact, over a width sufficient to permit satisfactory construction of the pipe bedding, all to the satisfaction of the S.O..

2.7.2. Where soft or unstable soil is encountered in the foundation, it shall be excavated over a width of at least 1.5 times the outside of each side of the culvert centre-line to the depth directed by the S.O., and replaced with suitable material uniformly compacted in layers of not more than 150mm compacted thickness to provide satisfactory support for the pipe, all to the satisfaction of the S.O..

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2.8. Backfilling

2.8.1. Drainage trenches shall be backfilled immediately after completion of drain laying or installation of culverts and as soon as the S.O. has inspected and given his approval.

2.8.2. Backfilling with approved fill materials shall be placed evenly in layers not exceeding 150mm. To provide uniform support, loose thickness of fill materials on both sides of the drain shall be thoroughly compacted with mechanical rammers. This procedure shall be followed for the whole depth of drain section.

2.8.3. All spaces excavated under this Specification and not occupied by a permanent structure shall be backfilled with material free from large lumps, wood and extraneous material.

3. Materials

3.1. Basic construction materials shall comprise the following;

3.1.1. Granular Bedding Material

The foundations shall be of granular bedding material suitably graded broken rubble, crushed stone, crushed gravel, sand or other material as shown on the Drawings or as directed by the S.O..

3.1.2. Concrete

Concrete for blinding, bedding and cast-in-situ drains shall be as shown in the Drawings and as specified in SECTION D: CONCRETING.

3.1.3. Ordinary Backfill Material

3.1.3.1. Ordinary backfill material shall be of suitable material as defined in SECTION B: EXCAVATION & EARTHWORK.

3.1.3.2. Materials from swamps, peats or top soils and other highly organic clay or silt, materials containing logs, stumps or boulders, which are susceptible to combustion, and any other materials which, by virtue of their physical or chemical composition or at their moisture content will not compact properly, shall not be used for filling.

3.1.4. Granular Backfill Material

3.1.4.1. Granular backfill material shall be sand, crushed stone, crushed gravel or a mixture of crushed and natural aggregates, shall be essentially free from vegetative and other organic matter and clay, and shall not contain lateritic or concretionary materials. The material shall conform to the following physical and mechanical quality requirements:

(i) The fines shall be non-plastic;

(ii) Sand shall have a gradation conforming to the envelope shown in **Table S1**;

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(iii) Material other than sand shall have a gradation conforming to one of the envelopes shown in **Table S2.**

Table S1. Grading Limits for Sand Backfill

B.S. Sieve Size	% Passing by Weight
10.0mm	100
5.0mm	90 - 100
1.18mm	45 - 80
300 µm	10 - 30
150 µm	2 - 10

Table S2. Grading Limit for Granular Backfill other than Sand

B.S Sieve Size	% Passing by Weight		
	A	B	C
37.5mm	100	-	-
28.0mm	70 -100	100	-
20.0mm	60 - 90	70 - 100	100
10.0mm	45 - 75	45 - 75	-
5.0mm	30 - 60	35 - 65	45 - 75
2.0mm	20 - 50	25 - 50	30 - 60
425 µm	10 - 30	10 - 30	15 - 35
75 µm	0 - 2	0 - 2	0 - 2

3.1.4.2. The granular backfill shall be placed in layers not to exceed 150mm in depth and each layer shall be thoroughly compacted by means of packers or mechanical tampers to a relative compaction of not less than 95% Standard Proctor Density for the backfill material at optimum moisture content.

4. Surface Drainage

4.1. Surface drains shall be constructed with regard to both operation and ease of maintenance and adequate gradient shall be provided to enable self-cleansing flow.

4.2. Where gradient designed is not practical or above the finished level, the Contractor shall submit their proposal for the approval of the S.O..

4.3. Reinforced concrete struts shall be provided for all drain side walls exceeding 0.9m height. Handrails shall be provided for open drains more than 1.2m width and / or maximum depth as specified in **Table S3.**

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Table S3. Maximum Depths of Open Drain

Cover/Handrail Fence Condition	Maximum Depth (m)
Without protective covering	0.6
With solid or grated cover	1.2

4.4. Types of Surface Drains

4.4.1. Surface drains of all types shown on the Drawings shall be constructed either unlined or lined using cast in situ concrete, precast or porous concrete drain sections or stone pitching.

4.4.2. Unlined (Earth) Drains

4.4.2.1. The Contractor shall refer to approved plans for location, extent and construction details as shown on the Drawing, or otherwise directed by the S.O..

4.4.2.2. Excavation for unlined/earth drains shall be trimmed to form a smooth, firm surface to the required lines, levels, grades and cross-sections as shown on the Drawings or as directed by the S.O..

4.4.2.3. Any areas of over excavation shall be made good to the satisfaction of the S.O., all at the contractor's own cost.

4.4.2.4. The sides of cut drain shall not be steeper than 1:1.5 (V:H), while fill slopes shall not be steeper than 1:2 (V:H). The surface water shall be discharges to a stable outlet such that soil erosion is prevented from occurring.

4.4.3. Lined Drain

4.4.3.1. Lined drains shall be constructed from material proven to be structurally sound and durable and have satisfactory jointing systems. Unless otherwise stated in the Drawings, the maximum steepness of the side slopes for lined open drains shall be as indicated in **Table S4**.

Table S4. Maximum Steepness of the Side Slopes

Drain lining	Maximum steepness of the maximum side slopes (V:H)
Concrete, brickwork and blockwork	Vertical
Stone Pitching	1:1.5
Grassed/Vegetated, rock riprap	1:2

4.4.3.2. All concrete works shall conform to the requirement in SECTION D: CONCRETING of this Specification or unless otherwise specified.

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4.4.3.3. Lined drains shall be constructed by the following means;

(i) Cast In Situ Concrete Drains

a) Cast in-situ concrete drains shall be Grade 25P concrete unless otherwise stated. Weep holes shall be cast in-situ as shown on the Drawings or as directed by the S.O..

b) Where the concrete grade is found to be of the lower grade, the S.O. shall request the Contractor to do the rectification work according to the requested proper method.

(ii) Precast Concrete Drain

a) Precast concrete block inverts shall be of the shapes and dimensions as shown on the Drawing and shall be of Grade C20/25 concrete or unless otherwise specified.

b) The joint shall be grouted with cement mortar (1:3) and weep holes shall be provided as shown on the Drawing or as directed by the S.O..

c) The S.O. shall have access to the casting yards where the proprietary precast concrete product are being utilized. A copy of the manufacturer's test certificate shall be provided to the S.O..

d) All inspections shall be conducted in the present of the S.O. and any rectification works shall be carried out any accordance to the method as approved by the S.O..

(iii) Cascade Drains

Cascade drains shall be constructed from precast concrete drain units and laid stepping on a 150mm thick bed of mass concrete of Grade 20P or as shown on the Drawings or as approved by the S.O..

5. Subsoil Drain

5.1. This work shall include supply and installation of subsoil drains, constructed in accordance with these Specifications at locations and in accordance with the lines, levels and grades as shown on the Drawing and/or to suit the site as approved by the S.O..

5.2. Minimum gradient of 1:200 shall be provided for the drain to discharge into existing stormwater system, open drain, creek or pond in the area unless otherwise stated on the drawings. The discharge shall not create an unwanted bog.

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6. Sumps

6.1. Sumps shall be constructed as accordance to the Drawing or as directed by the S.O. to facilitate changes in level and flow within a drainage system. All sumps shall be covered either by concrete slab or galvanized steel grating hinged to the seating frame on the sumps for safety purposes.

6.2. Unless otherwise as shown on the Drawings, sumps of depth less than 1.5m (internal depth) shall be made up of brickwalls of minimum 225mm thickness. Sump of depth (internal depth) more than 1.5m shall use reinforced concrete Grade 20P or otherwise specified in the Drawings.

7. Culverts

7.1. The work shall comprise of supply and installation of either reinforced concrete pipe culverts or precast box culverts, including the end treatment components such as headwall, wingwalls, aprons and sumps and channel protection works, all in accordance with these Specifications and details as shown on the Drawings.

7.2. Culvert Bedding

7.2.1. Type A bedding shall consist of Grade 20P concrete otherwise stated on the drawings and complying with SECTION D: CONCRETING.

7.2.2. Type B bedding shall consist of clean, natural sand or gravelly sand of suitable gradation and quality with maximum particle size of not more than 20mm.

7.3. Culvert Components

Culvert shall be constructed with barrel and end treatments including headwalls, endwalls, wingwalls, outlet protection, inlet improvement and debris control structures.

7.4. Pipe Culverts

7.4.1. Reinforced concrete pipes shall conform to the requirement of *MS EN 1916* and shall be approved by the S.O..

7.4.2. The S.O. reserves the right to request for test certificates and further tests to be carried out on samples, all at the Contractor's own cost.

7.5. Precast Box Culverts

7.5.1. Precast box culverts shall conform to the requirement of *MS 1293-1* and shall be approved by the S.O..

7.5.2. Unless otherwise shown on the Drawings, the precast box culvert shall be capable of withstanding a proof load test of 112.5kN applied over an area of 320mm x 320mm at any position on the cover slab.

7.5.3. The S.O. reserves the right to request for test certificates and further tests to be carried out on samples, all at the Contractor's own cost.

7.5.4. Individual sections of the precast box culvert shall be rejected because of such defects specified herein before for pipe culverts.

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7.5.5. Precast box culverts shall be laid on Type B bedding with layer of crushed aggregate of maximum particle size not exceeding 50mm as shown on the Drawings or directed by the S.O..

7.5.6. The maximum gap between each culvert shall not be more than 13mm and the difference in level shall less than 3mm. The gap shall be filled with cement mortar (1:3) with smooth finished.

7.5.7. To ensure uniform bearing, a layer of cement grout shall be spread along the top of the walls of the invert where the lid shall sit.

8. On-Site Detention

8.1. On-site detention (OSD) facilities shall be constructed in accordance to the Drawings and conform to the requirements of *MSMA* and *MS 2526*.

8.2. The construction of OSD facilities shall include the system components at the inlet, storage and outlet zone to cater outflow discharges without causing adverse effects on downstream properties. Fencing and warning signs shall be provided as shown on the Drawings.

8.3. Maintenance shall be done periodically or as and when the silt has accumulated to 0.3m thick. The desilted material shall be transported to disposal site approved by S.O..

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SPESIFIKASI

INTERNAL COLD WATER AND SANITARY PLUMBING SYSTEM

1. Scope of Work

1.1. The work to be performed under this contract shall comprise, but not limited to the supply, delivery, installation, testing, adjusting, balancing, commissioning and maintenance of the following principal services and the associated works and items:

1.2. Internal Cold Water Plumbing System

1.2.1. Internal Piping system complete with all bends, tees, sockets, valves, plugs, reducers, brackets, supports and other necessary accessories to complete the installation.

1.2.2. Water Tank (Suction and Storage Tank)

1.3. Internal Sanitary Plumbing System

1.3.1. Internal piping complete with all necessary bends, tees, sockets, branches, offsets, and other necessary accessories to complete the installation.

1.3.2. Internal inspection chamber, gully trap and grease trap.

1.4. The contractor shall at his own cost be responsible to appoint Suruhanjaya Perkhidmatan Air Negara (SPAN) certified personnel for the submission, supervision, construction, testing and certification of the completed works.

1.5. The Contractor shall prepare and submit working drawings to the Superintending Officer (S.O.) for approval within thirty (30) days from the date of acceptance of tender. In preparing these working drawings, the Contractor shall coordinate with the building layout and constructional details of the architectural, structural and electrical drawings.

1.6. The drawing shall be fully dimensioned and show all the precise locations, arrangement and loading of the equipment. The drawings shall also indicate location and details of all foundation, supports, chases, core holes, opening in partition wall, floors and roof and any other information required for works or services to be provided by others.

1.7. The drawings submitted shall be modified as necessary and, if requested by S.O., re-submitted for final approval. Six (6) sets of drawings shall then be submitted for distribution to all parties concerned.

1.8. The contractor shall submit method statement (upon S.O. request), samples of materials or execute samples of workmanship (mock-up) for S.O.'s approval, and for further samples as required until the samples submitted or executed are, in accordance with this specification.

1.9. Samples, after approval, shall indicate the standard of materials and workmanship to be maintained in the execution of the works.

1.10. After connection work is done, the Contractor shall ensure that all system to be operational as required.

1.11. The Contractor shall service and maintain the above-mentioned cold water and sanitary plumbing system during Defect Liability Period (DLP) from the date of Certificate of Practical Completion (CPC) in good operating condition until Certificate of Making Good Defect (CMGD).

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1.12. The Contractor shall submit the as-built drawing, Operation and Maintenance Manual (OMM) complete with Schedule of Maintenance before handing over subject to S.O.'s approval.

Exclusion:

The boundary of scope of work between mechanical works and civil works can be referred from Figure 1 to Figure 4 in the Appendix.

2. Internal Cold Water Plumbing System

2.1. General

All water supply plumbing and installation shall be executed in accordance with the latest edition of the following:

2.1.1 *Act 655 - Water Services Industry Act 2006*

2.1.2. *Water Services Industry (Water Reticulation and Plumbing) Rules 2014*

2.1.3. *BS 8558:2011 – Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages – Complementary guidance to BS EN 806.*

The Contractor shall submit method statement of installation if required by the S.O..

2.2 Pipework (Material Pipes Standards)

2.2.1 General

Pipework for water supply plumbing shall be to the dimensions shown in the drawings or as specified hereinafter and shall be complete with all bends, tees, sockets, plugs, reducers, brackets, supports and other accessories to complete the installation.

2.2.2 Standards

2.2.2.1. All pipes, fittings and equipment used for water supply plumbing and installation shall be of the type and make approved by SPAN and as mentioned in the drawings.

2.2.2.2. The standards stated in this specification shall comply with their latest edition issued or relevant standards approved by SPAN.

The details of the internal piping shall be referred to **Table X1.**

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Table X1. List of Internal Piping

Type of pipe	Minimum wall thickness & pressure rating	Standard	Fitting
High Density Polyethylene (HDPE)	PN 12.5 at 20°C (equivalent to 10 bar derated working pressure at 30°C)	MS 1058 or BS EN 12201 and marked with SIRIM certification numbers	Moulded integrally dezincified brass with BSP threads of BS EN 12420:2014 or BS EN 12165:2016. Nickel and Chromium plated to BS 1224 service condition NO. 2.
Acrylonitrile Butadiene Styrene (ABS)	PN 12 to MS 1419: Part 1: 2007	MS 1419: Part 1: 2007	MS 1419: Part 2: 2007 - Fitting MS 1419: Part 3: 2007 - Solvent cement. All ABS pipes, fittings and solvent cement shall be supplied by the same manufacturers.
Polybutylene (PB)	PN 15 at 20°C (equivalent to 15 bar derated working pressure at 30°C)	MS ISO 15876 or AS/NZS 2642	Moulded integrally dezincified brass with BSP threads of BS EN 12420:2014 or BS EN 12165:2016. Nickel and Chromium plated to BS 1224 service condition NO. 2.
Polypropylene random co-polymer (PP-R)	PN 14 at 70°C	MS 2286 or BS EN ISO 15874	Moulded integrally dezincified brass with BSP threads of BS EN 12420:2014 or BS EN 12165:2016. Nickel and Chromium plated to BS 1224 service condition NO. 2.
Stainless Steel (SS)	BS EN 10312: <Ø 12mm → Series 1 ≥Ø 12mm → Series 1 or Series 2 or ASTM A312/A312M: Ø ½" – Ø 2" → Schedule 40S (Threaded) Ø 2½" – Ø 8" → Schedule 10S (Welded)	MS 1841: 2010, BS EN 10312 ASTM A312/A312M or JIS G 3448	Stainless steel compression fittings to BS 4368 or SAS 322: 2003 Ø ½" – Ø 2" → (Schedule 40S) Threaded & screw fittings according to ISO 4144:2003 Ø 2½" – Ø 8" → (Schedule 10S) Butt weld fittings according to ASTM A 403 / A 403M
Copper Tubing	Type K	BS EN 1057 BS 2871	Brazing according to BS EN 1254: Part 1 or Compression joint according to BS EN 1254: Part 2 or Accelerated 'push fit' according to BS EN 1254: Part 2
Crosslinked Polyethylene (PE-X)	PN 12 at 70°C	MS 1736: Part 2	MS 1736: Part 3 - Fitting Moulded integrally dezincified brass with BSP threads of BS EN 12420:2014 or BS EN 12165:2016. Nickel and Chromium plated to BS 1224 service condition NO. 2.

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2.3 Pipe Installation

2.3.1. Pipes and fittings shall be cleaned and free from manufacturing burrs and site debris.

2.3.2. The pipes shall be adequately protected against damage during transit. Each delivery of pipes shall be accompanied by the manufacturer's testing certificate.

2.3.3. Internal Piping

2.3.3.1. All installation shall be done according to the approved drawings and pipe manufacturer's recommendation. Plumber shall be competent in various types of installation. Special care shall be taken in the arrangement of piping to ensure a neat finishing and alignment.

2.3.3.2. Services pipes and distribution pipes except those buried under ground level shall be concealed in wall, ceilings, boxed up or laid within the common trench, services shaft, etc provided where possible. All work shall be executed in such a manner to avoid cutting into finished work in walls, aprons, beam, etc. where practicable as the work proceeds. Pipe work to be buried or concealed shall not be covered or plastered before they are examined, tested and approved by the S.O..

2.3.3.3. Installation of valves and fittings shall be grouped where this will not affect their operation, to reduce the number of joints to a minimum.

2.3.3.4. All necessary isolating valves, check valves and other fittings as required are as shown in the approved drawings. Every section of major branch supply piping shall be installed a gate valve at the point of connection to the supply.

2.3.3.5. Minimum diameter for internal cold water plumbing system shall be 20mm (3/4") except for flush valve system where minimum diameter shall be 25mm (1"). Final branches to fittings shall be 20mm diameters and the sizes of feeders from which these branches are taken shall be as in **Table X2**:

TABLE X2. Diameter of Feeders to Number of Fitting Served

No of Fittings Served	Diameter of Feeders
1	20mm
2	20mm
3, 4	25mm
5, 6 ,7	32mm
8, 9, 10, 11, 12	40mm
13, 14, 15, 16, 17, 18	50mm

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2.3.4. Threaded Joints

2.3.4.1. Threaded end connections for plastic (ABS/PE/PB) pipes shall have tapered thread forms complying with **AS ISO 7.1-2008 and AS ISO 7.2-2008** or equivalent approved standard in accordance with manufacturer's instruction.

2.3.4.2. Where threaded joint is to be made between plastic (ABS/PE/PB) pipes and metal, the plastic (ABS/PE/PB) pipes should be the male component of the joint.

2.3.4.3. All screwed joints shall be made by using Teflon tape or approved jointing compound.

2.3.5. Flanged Joints

Flanged joints or other suitable methods can be used for pipe more than 50mm and working pressure more than 10 bar (PN10).

2.3.6. Bends

Bends of all piping shall have a radius of not less than 5 times the diameter and shall be of standard type.

2.4. Pipe Supports

2.4.1. Pipe supports, hangers, anchors, guides etc. shall be supplied and installed for proper support.

2.4.2. Vertical riser shall be supported at each floor with galvanized iron (G.I) riser clamps or other material subject to S.O.'s approval.

2.4.3. Horizontal pipe runs shall be supported on hangers of split ring adjustable type or clevis type. Where pipelines run along walls, columns or ceilings, brackets or clamps may be used.

2.4.4. Piping at all equipment, valve positions and at main junctions, shall be adequately supported to prevent any distortion or transmission of strain to connect equipment or valves.

2.4.5. Where pipe lines run in a common group, they shall be supported from a common hanger bar as indicated in the approved drawings.

2.4.6. Pipe supports and hangers shall be spaced at intervals as shown in **Table X3** and **Table X4**:

TABLE X3. Recommended Maximum Spacing of Support for Horizontal Cold Water Pipe

Pipe Size (mm)	Recommended Maximum Spacing of Support (m)	
	Non-metal	Metal
20	0.8	1.5
25	0.85	1.8
32	1.0	2.4
40	1.1	2.4
50	1.25	2.4

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80	1.65	3.0
100	1.9	3.0

Source: *British Standards Institude. (2010). BS EN 806-4: Specifications for installations inside buildings conveying water for human consumption. Installation*

TABLE X4. Recommended Maximum Spacing of Support for Vertical Cold Water Pipe

Pipe Size (mm)	Recommended Maximum Spacing of Support (m)	
	Non-metal	Metal
20	1.0	2.4
25	1.1	2.4
32	1.3	3.0
40	1.3	3.0
50	1.6	3.6
80	2.1	3.6
100	2.5	3.6

Source: *British Standards Institude. (2010). BS EN 806-4: Specifications for installations inside buildings conveying water for human consumption. Installation*

2.4.7. Vertical pipes shall be supported at least at the top and bottom of each riser, at each floor level, and at each isolating valve. In addition, a further support shall be provided between floor levels for pipes smaller than 32mm.

2.5. Pipe Sleeve and Cover Plate

2.5.1. Where pipes are required to be laid through structural beams or slabs, G.I/uPVC pipe sleeves shall be provided. All pipes shall be properly secured in place with brackets.

2.5.2. All exposed piping within occupied rooms shall be boxed up to S.O.'s approval.

2.5.3. Where pipe past through fire break walls or other partitions, clearance between pipes and sleeves shall be tightly pegged with suitable fire rated material to form a sound and fire barrier.

2.6. Valves and Fitting

2.6.1. All valves shall be of SPAN approved, manufactured and generally constructed in accordance with relevant standard. All valves shall be suitable for system operating pressure.

2.6.2. All valves and fittings necessary for the correct control, operation and maintenance of all services shall be provided and installed to the satisfaction of the S.O.. Samples shall be submitted for S.O.'s approval before installation. Valves shall be installed where they are easily accessible for maintenance and operating purposes.

2.6.3. Each valve shall be of the same nominal size as the pipeline in which it is installed, except for control, pressure reducing and similar valves which shall be correctly sized as per specific duty and functionality.

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Connection between each valve and adjacent piping or equipment shall be made either flange or threaded joints may be applicable.

2.6.4. Before installation, every valve shall be blown out with air to remove any foreign matter lodged in the valve.

2.6.5. Stop Valves / Gate Valves

2.6.5.1. Stop valves / gate valves are generally used as isolation valves.

2.6.5.2. Full bore copper alloy screw-down stop valves / gate valves of the same diameter as the pipe shall be provided and fixed for control in the following positions:

2.6.5.3. On the service pipe before it enters the building.

(i) On each branch of the service pipe.

(ii) On the inlet to each storage or feed cistern.

(iii) On the inlet to each flushing cistern.

(iv) On the outlet of each storage tank or feeder cistern.

(v) In other position on the pipe as shown or indicated, other than on overflow/warning pipe.

(vi) For system with pressure reducing valve (PRV), location of the gate valves shall be as indicated in the approved drawings.

2.6.5.4. Stop valve of 50mm and below shall be complied with *MS 1022* and stop valve of 50mm and above shall be complied with *BS EN 1213*.

2.6.5.5. Gate valve of various sizes shall be complied with *BS EN 12288* (copper alloy valves) and *BS EN 1171* (cast iron valves) (PN12 above).

2.6.5.6. Gate valve sized from 65mm to 100mm shall be either screwed or flanged end complied with above mentioned standards.

2.6.5.7. Valves with reduced flow areas shall not be used for water closet flush valves and flushing cistern.

2.6.5.8. All valves shall have hand-wheel with externally screwed bronze or stainless steel spindle.

2.6.6. Pressure Gauges

2.6.6.1. Dial type with 3-way gauge cock shall be supplied and installed where indicated in the approved drawings.

2.6.6.2. A pressure gauge shall be installed at every suction pipe, every delivery pipe and at the common header pipe.

2.6.6.3. Pressure gauges shall be minimum 100mm diameter dial face type and having ranges suitable for the service pressure

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encountered. The measuring range of the gauge should be 125% of the maximum pressure.

2.6.6.4. The gauges shall be industrial type shock proof, liquid filled, stainless steel casing and IP 65 Ingress Protection Rating.

2.6.6.5. The construction of pressure gauges shall comply with *BS EN 837-1*.

2.6.7. Pressure Reducing Valve (PRV)

2.6.7.1. Air vent and pressure reducing valve shall be installed at 30 meter intervals along downpipes to restrict the pressure sustained by the fittings to prevent water hammer and other effect.

2.6.8. Check Valves

2.6.8.1. Where shown in the drawings, non-slam-type check valves shall be supplied and fitted.

2.6.8.2. Valves shall be selected in relation to the velocity of the water in the pipe. In all cases, the valve is required to operate silently on reversal of water flow and if necessary, valves of the double or articulated clack type or the spring assisted type shall be fitted.

2.6.9. Water Meter

2.6.9.1. Suitable water meter approved by SPAN shall be supplied and installed as required.

2.7. Water Tank

2.7.1. Water Tank Material

2.7.1.1. All water tanks for water supply shall be of the type and capacity shown or stated in the drawings. The water tanks shall be watertight and properly supported.

2.7.2. Fibreglass Reinforced Plastic (FRP) Water Tank

2.7.2.1. The tanks shall be scribbled down and flushed out with clean water and sterilized with chemical containing chlorine before being put into use.

2.7.2.2. Water tank design shall comply with the following standards:

(i) MS 1241 - FRP Water Tank

(ii) MS 1390 – FRP Sectional Water Tank

(iii) Any other standards approved by SPAN

2.7.2.3. Materials for the construction of panels shall conform to MS 1241. The surface of FRP panels shall be manufactured with built-in stabilizer against embrittlement due to ultra-violet radiation.

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2.7.2.4. The panel shall be of hot press moulded and fabricated from fiberglass reinforced plastic (FRP) of dimension 1meter x 1meter square with maximum tolerance of 1.5mm. Each FRP panel will be manufactured with flanges at a right angle of 90° to all sides of each panel. The thickness of the flange for the side wall and base plates will not be less than 10mm and the landed width of each flange will not be less than 70mm for base and side panels.

2.7.2.5. Water storage tank of 10,000 litres or more shall have internal compartments to facilitate maintenance of the water tank. Alternatively, multiple tank may be employed. An equalizing pipe shall be provided between each compartment or between each separate storage tank supplying water to the same distribution pipe.

2.7.2.6. Physical Properties of the FRP Panel is as shown in **Table X5**:

TABLE X5. Physical Properties of FRP Panel

Parameter	Results
Tensile strength	>70 MN/m²
Bending strength	>100 MN/m²
Elastic modulus in bend	>6,000 MN/m²
Hardness	30% or 90% of the resin manufacturer specification whichever is higher
Glass content	>25%
Water absorption	1.0%

Source: *Malaysian Standard. (2010). MS 1390: Glass-Fibre Reinforced Polyester Panels and Panel Water Tanks – Specification (First Revision)*

2.7.2.7. Jointing Material

(i) The jointing material shall be synthetic rubber as sealant with stainless steel washer, nuts and bolts.

(ii) The holes for the bolts will be 12mm ± 1.5 to 2.0mm in diameter, suitable for M12 bolts and nuts.

2.7.2.8. Connections

(i) All holes and pipe connection made in wall, top and bottom of tanks shall be factory fabricated before delivery of tank to site. The positions and type pipe connections shall be carried out strictly in accordance with the manufacturer's recommendations.

2.7.2.9. Painting

(i) The internal face of the water tank shall be given two coats of non-toxic, non-corrosive paint and external one coat primer and two coats of non-corrosive paint to S.O. approval.

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2.7.3. High Density Polyethylene (HDPE) Tank

2.7.3.1. The HDPE tanks shall be constructed of physiologically safe, non-toxic, inert, visor-elastic, UV-resistant high density polyethylene of one-piece moulded seamless construction to *BS 4213* or *MS 1225* and *SIRIM* certified without welding or joint. The tanks shall be manufactured from 100% virgin food grade resins without the additional recycled or reworked material. The resin used must be certified by the resin manufacturer to be food grade compliance and suited for the potable water.

2.7.3.2. The tanks and all piping connections shall be installed strictly in accordance to manufacturer's instructions and specification and the installation shall be supervised and verified by the manufacturer.

2.7.3.3. The tanks shall come with a minimum 10 years warranty against defect in materials, manufacture and workmanship by the tank manufacturer. The warranty certificate shall be submitted to S.O. before handing over.

2.7.4. Stainless Steel Tank

2.7.4.1. Stainless steel tank design shall comply with the following standards shown in **Table X6**:

TABLE X6. Standard for The Respective Steel Tank

Type of water tank	Standard
Stainless steel storage tank	JKR 20200-0041-99
Pressed steel sectional rectangular tank panel	BS 1564

2.7.5. Stainless Steel Storage Tank

2.7.5.1. Material used in the fabrication of this tank shall be of Grade 304 stainless steel ASTM Designation: A240/A240M-94a or equivalent standards and supported by the respective mill certificates.

2.7.5.2. The finished surface of the materials used shall be of bright annealed (BA) and/or non-shining (2B) finished.

2.7.5.3. The tank shall be manufactured inclusive of the following components:

(i) Top cap

(ii) Top cover

(iii) Tank body

(iv) Bottom cover

(v) Stand (for round bottom & spherical types only)

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2.7.5.4. The stands (except for flat bottom type), fittings and accessories such as internal and external ladder, tank cover, screw nut, etc. of the tank shall be made of similar stainless steel materials of the above grade.

2.7.5.5. Each tank shall be marked / labeled on the external upper part of the tank body according to the following information:

(i) Manufacturer's name and/or trade mark

(ii) Date of manufacture

(iii) Serial number and model

(iv) Capacity

2.7.6. Pressed Steel Sectional Rectangular Tank Panel Water Tank

2.7.6.1. Material for the pressed steel sectional water tank shall be manufactured from 0.8mm thickness Grade 304 stainless steel plate inner surface composite with minimum of 5mm external surface of mild steel plate.

2.7.6.2. The reinforcement for pressed steel sectional water tank shall be reinforced using suitable support. Detail calculation for internal / external reinforcement design shall be submitted to S.O. for record.

2.7.6.3. All bolts, nuts and washers in contact with water shall be of stainless steel Grade 304. All external bolts, nuts and washers in contact with water shall be of hot dipped galvanized mild steel.

2.7.6.4. The cover for pressed steel sectional water tank shall be constructed 1.2m x 1.2m / 1m x 1m from 1.2mm thickness Grade 316 stainless steel plate.

2.7.6.5. Non-toxic PVC foam shall be used for jointing between flanges.

2.7.7. Tank Components and Accessories

2.7.7.1. The installation of storage / domestic tanks shall include but not limited to the following accessories and fitting to the tanks:

(i) Overflow / warning pipe, outlet tapping and scour pipes shall discharge outside the building or to a point shown or stated in the approved drawing.

(ii) Access manholes with cover, the number, locations and details of which shall be approved by S.O..

(iii) Mosquito-proof air vents to the tank cover at the positions and as per details approved by S.O..

(iv) Water tanks of two (2) metres depth or more shall be provided with internal and external ladders. The internal ladder and external ladder shall be made of stainless steel grade 304 unless otherwise specified. The ladder width shall not be less than 300mm and the length shall

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be suitable for the tank specified. The maximum height from floor finish level to the first ladder step shall be 300mm.

(v) Water level indicators and scales graduated in meters to suit the depth of the tank as shown in the approved drawings.

(vi) Float Operated / Ball Valves

a) Float operated valve shall comply with BS 1212. The combination of body pattern, seat number and size of float to suit the required pressure zone shall be as per standard.

b) All ball valves shall be supplied and fitted complete with back nuts, ball float, arm, etc. Ball floats may be of soldered copper or brass or alternatively polyethylene and PVC.

(vii) Pilot Operated Valve

a) Pilot-operated valve shall comply with AWWA C530-07. The configuration and material of main valve, vertical float rod and float shall be as per standard and specification.

(viii) Drain Cocks

a) Gunmetal drain cocks shall be provided as necessary to ensure that all sections of the pipework and plant can be effectively drained. The sizes of drain cocks shall be as follows: -

i. Tanks, plant and pipes above 6" diameter - ≥ 1" diameter

ii. Pipes 3" to 5" diameter - 0.75" diameter

iii. Pipes up to 2.5" diameter - 0.5" diameter

2.7.8. Water Tank Foundation

2.7.8.1. Panel Tank

(i) Unless otherwise shown in the approved drawings, the foundations shall be constructed to provide continuous support to all base panel joints in one direction at 1000mm nominal centres according to panel sizes. The concrete foundation shall have a width of at least 300mm and height of at least 600mm. All foundations shall be constructed according to JKR standard specifications.

(ii) If concrete slab is used, dwarf walls or steel beams shall be placed between the tank and the base level to allow a minimum clearance of 500mm to enable ease of tank

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installation and subsequent bolts tighten and adjustments after installation.

(iii) Whenever recommended by the tank manufacturer, the steel skid base shall be designed and constructed in accordance with manufacturer's instructions, and details. In such cases, the continuous support can be spaced at greater than 1000mm nominal centers as recommended by the manufacturer.

2.7.8.2. Round Tank

(i) The concrete plinth shall have minimum of 100mm height complete with 5mm mild steel base plate as per tank size.

2.7.9. Flange Joint (Nozzle)

2.7.9.1. Flange joint used for the inlet, outlet and scour of storage tanks shall be made of stainless steel grade 304 externally and internally. Joint gaskets shall be of 5mm thick, medium rubber reinforced with two-ply flexible fabric and complying with BS 6956, or approved silica sealant used in the FRP tanks. All bolts, nuts and washer used for flange nozzles shall be made of stainless steel grade 304.

2.8. Cleaning, Painting and Identification

2.8.1. Cleaning of Pipework

2.8.1.1. All pipes, fittings, etc., shall be kept closed against moisture and foreign matters when stored on site.

2.8.1.2. All pipes, fittings, valves and accessories shall be thoroughly cleaned internally and externally before their installation and again where necessary before closing up.

2.8.1.3. After installation and before putting into service, all pipework including fittings, valves shall be thoroughly cleaned internally.

2.8.2. Painting and Identification

2.8.2.1. All pumping equipment shall be factory painted according to the manufacturer's recommendations.

2.8.2.2. All thermoplastic pipes, fittings, valves, etc., exposed directly to sunlight shall be painted with water based exterior-grade latex paint.

2.8.2.3. All surfaces to be painted shall be first thoroughly cleaned to remove dirt, scales, grease spots etc. Surface shall be completely dry before painting.

2.8.2.4. All surfaces shall have minimum one coat primer and two coats finish subject to S.O.'s approval.

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2.8.3. Pipework Identification

2.8.3.1. All pipes installed shall be identified in accordance with their relevant standards.

2.8.3.2. Directional arrows shall be painted on the pipework in the plant rooms, tank room and vertical risers. Lettering and the direction of flow must be indicated by painting a black / white arrow on to the pipelines at appropriate intervals. These arrows shall be 3" long on pipes up to 50mm (2") diameter, 150mm (6") long for pipes over 50mm (2") diameter.

2.8.4. Labels for Valves and Controls

2.8.4.1. All control valves, relays, switches and instrumentation shall be identified by black or white engraved laminated plastic labels, securely attached to the item by means of non-corrodible screws or rivet or any other method approved by the S.O., or when such item is installed on or within panels or cubicle, the labels shall be located immediately below the item.

3. Sanitary Plumbing System

3.1. Rules and Regulation By Law

3.1.1. All the workmanship and material for the supply, installation, testing, adjusting, balancing & commissioning of all system and accessories shall comply with the following rules and regulation requirements:

3.1.1.1. Drainage, Sanitation and Sanitary Plumbing By-Laws of the Street, Drainage and Building Act. 1974;

3.1.1.2. Gravity Drainage Systems Inside Buildings - Sanitary Pipework, Layout and Calculation, BS EN 12056 Part 1, Part 2 & Part 5;

3.1.1.3. Code of Practice for Sanitary System in Buildings, MS 1402:2006;

3.1.1.4. Local Authority By-Laws in force at time of installation; and

3.1.1.5. Other relevant rules and regulations.

3.2. Material Standard

3.2.1. Pipework for sanitary plumbing shall be to the dimensions shown in the drawings or as specified hereinafter and shall be complete with all fittings, brackets, supports and other accessories to complete the installation.

3.2.2. All pipes, fittings and equipment used for sanitary plumbing and installation shall be of the type and make approved by SPAN and as mentioned in the drawings.

3.2.3. The standards stated in this specification shall comply with their latest edition issued or relevant standards approved by SIRIM.

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3.2.4. The following standards in their latest edition as shown in **Table X7** shall apply:

TABLE X7. Standard for Different Types of Sanitary Pipe

Item	Standard
Unplasticized polyvynil chloride (uPVC)	MS 1063, BS EN 1329-1, BS 4514, MS 628, BS EN ISO 1452-2:2009
Unplasticized polyvynil chloride (uPVC) (Underground)	MS 979: Part 1 (Ø100mm & Ø155mm) MS 979: Part 2 (Ø200mm and above) or BS EN 1401-1, MS 1085
Poly propylene (PP)	MS ISO 7671:2012
Cast Iron Pipes	BS 416 for heavy grade pipes BS 437 for spigot / socket drain
Galvanized Iron	BS EN 10255 "Heavy"

3.3. Definition of Sanitary Pipe

3.3.1. Soil (Black Water) Pipe

3.3.1.1. Pipes attached to a building and designed to convey sewage or waste matter from any water closet (W.C) or urinal.

3.3.2. Waste (Grey Water) Pipe

3.3.2.1. A separate waste pipe shall be provided for the following:

(i) Dirty water from baths, basins, wash troughs, ablution, floor trap and other waste containing a small proportion of soap and /or dirt; and

(ii) Greasy water from kitchen sinks and equipment where grease traps or interceptors are required.

3.4. Sanitary Discharge System

3.4.1. All main stacks shall be minimum 100mm diameter or subject to S.O.'s approval.

3.4.2. The discharge system can be classified as follows:

3.4.2.1. Single Stack System

(i) In this system, all appliances discharge separately into a single discharge stack. All traps are unventilated and those on pipes 50mm and below must have 75mm water seals (trap). The stack is directly connected to the manhole.

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3.4.2.2. Fully Ventilated System

(i) All appliances are directly discharged to a common stack and essential features of this system are the provision of 75mm deep seal traps on baths, basins and sinks as well as the provision of a ventilating pipe to which every appliance connected.

3.4.2.3. The Modified Single Stack System

(i) The modified single stack system basically similar to the single stack system, with the exception that the W.C.'s only are ventilated direct to the main ventilating pipe.

(ii) The depth of the water seal to all appliances, except W.C.'s shall 75mm.

(iii) The depth of the water seal to W.C.'s shall be 50mm to the main discharge stack.

3.4.2.4. Ventilated System

(i) The discharge from W.C.'s, urinal and other soil appliances are conveyed via a main discharge soil (soil pipe) and finally to the sewer line.

(ii) A separate waste pipe conveys the discharge from waste basins, baths, sinks to the waste water drain through a trapped gully.

3.5. Pipework Material

3.5.1. UPVC Soil, Waste and Vent Pipes

3.5.1.1. All pipes shall run in accordance with layout sizes shown in the approved drawings. The pipes shall be provided, fixed and connected to fittings and sanitary installation complete with all necessary bends, tees, sockets, branches, offsets, inspection pieces, etc. Pipes shall be joined with approved solvent in accordance with the manufacturer's instructions.

3.5.1.2. Pipes, fittings and the system of unplasticised polyvinyl chloride (uPVC) in the field of soil, ventilation and waste discharge (low and high temperature) inside buildings, for soil and waste discharge systems buried in ground within the building structure and for soil, ventilation and waste discharge for both inside buildings and buried in building structure shall complied to MS 1063 or BS EN 1329 Part 1 or BS 4514 (size Ø82mm only).

3.5.1.3. Pipes, fittings and the system of unplasticized polyvinyl chloride (uPVC) piping systems shall comply to MS 1063; or BS EN 1329: Part 1; or BS 4514 (size Ø82mm only)

(i) For soil, ventilation and waste discharge (low and high temperature) inside buildings (marked with "B").

(ii) For soil and waste discharge systems buried in ground within the building structure (marked with "D").

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(iii) For soil, ventilation and waste discharge for both inside buildings and buried in building structure (marked with "BD").

3.5.1.4. The pipes and the fittings shall be coloured through the wall. The colour of pipes and fittings shall be as follows:

(i) "B" code – white

(i) "D" code – brown

(i) "BD" code - white

3.5.1.5. All underground sewerage pipe and fittings of Ø 4" (100mm) diameter and Ø 6" (150mm) diameter shall be of uPVC Brown complied to MS 979: Part 1; and for size Ø 200mm and above complied to MS 979: Part 2 or BS EN 1401 Part 1 or BS 4660 (fitting of nominal size 110mm and 160mm only).

3.5.1.6. Main soil, waste and vent pipes shall be carried up to the roof level and protected by vent cowl and weather apron as per approved drawing.

3.5.1.7. All pipes shall be fixed in straight runs and all horizontal runs shall be laid to gradients in accordance with BS EN 12056 Part 2 and in any event not less than 18mm/m unless otherwise instructed.

3.5.1.8. UPVC Waste, Vent and Soil System (Inside building, buried in building structure and buried in ground within building structure)

(i) The uPVC pipes, fittings and system shall comply in all respects with the requirements of MS 1063 or other relevant standard certified by SIRIM / SPAN.

(ii) Pipes shall be supplied in plain-ended lengths and the minimum acceptable with thickness of pipe and fittings as shown in **Table X8**:

TABLE X8. Minimum Acceptable Thickness of UPVC Waste Pipe and Fittings

Nominal Sizes (mm)	Wall Thickness (mm)		
	Pipes (mm)	Fittings (mm)	Sockets (mm)
32	3.0	3.0	2.0
40	3.0	3.0	2.0
50	3.0	3.0	2.0
63	3.0	3.0	2.0
75	3.0	3.0	2.0
80	3.0	3.0	2.3
82	3.0	3.0	2.3
90	3.0	3.0	2.3
100	3.0	3.0	2.3
110	3.2	3.2	2.4
125	3.2	3.2	2.4
140	3.2	3.2 / 3.5*	2.4 / 2.6*

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160	3.2	3.2 / 4.0*	2.4 / 3.0*
180	3.6 / 4.4*	3.6 / 4.4*	2.7 / 3.3*
200	3.9 / 4.9*	3.9 / 4.9*	2.9 / 3.7*
250	4.9 / 6.2*	4.9 / 6.2*	3.7 / 4.7*
315	6.2 / 7.7*	6.2 / 7.7*	4.7 / 5.8*

Note * For soil and waste discharge systems buried in ground within the building structure and for soil, ventilation and waste discharge for both inside buildings and buried in building structure.

(iii) The method of jointing to be employed shall be that solvent welding using the manufacturer's approved cement. Seal ring fittings shall be used where necessary to accommodate thermal movement or the sockets of standard fittings shall be converted to seal ring adaptor.

(iv) Access shall be provided where necessary either by means of an integrally moulded door in an access fitting with an externally fitted rubber seal and secured with two-piece clamp type door fitted into the pipe run.

3.5.1.9. Underground uPVC Sewerage Pipes and Fittings

(i) The underground uPVC sewerage pipes and fittings shall comply in all respects with the requirement of MS 979: Part 1 (Ø100mm and Ø155mm) and MS 979: Part 2 (Ø200mm and above) or other relevant standard certified by SIRIM / SPAN.

(ii) Pipes shall be supplied in plain-ended lengths.

(iii) The minimum acceptable wall thickness of pipes and fittings shall be as shown in **Table X9**:

TABLE X9. Minimum Acceptable Thickness of Underground UPVC Pipe and Fittings

Nominal Sizes (mm)	Wall Thickness (mm)		
	Pipes	Fittings	Junctions
100	3.2	3.4	3.4
155	4.1	4.1	4.1
200	4.9	4.9	4.9
250	6.1	6.1	6.1

(iv) The method of jointing to be employed shall be strictly to manufacturer's recommendation.

3.5.1.10. Expansion Joints (Expansion Coupling for uPVC Pipes)

(i) Where pipework is constructed using solvent welded joints, expansion joints for uPVC pipes shall be carried out in accordance with the manufacturer's recommendations.

(ii) Expansion joints shall be provided at a maximum of 4 meter centre for soil, 2 meter centre for waste and between fixed points over 1 meter centre.

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3.5.1.11. Cast Iron/Galvanized Iron Pipe

(i) Where shown or stated in the drawing, 100mm diameter cast iron soil and vent pipes internally coated with anti-corrosive bituminous coating shall be provided, fixed and connected to the fittings and sanitary system.

(ii) All main and branch soil pipe and fittings shall be cast iron to BS 416 Heavy grade coated with an approved tar-based composition.

(iii) Main and branch vent pipe and fittings shall be cast iron to BS 416 Heavy grade factory coated with an approved certificate tar-based composition.

(iv) Branch vent pipe of 2" (50mm) diameter and below shall be galvanized to BS 10255: Heavy grade.

(v) Cast iron pipes shall be jointed with an approved certificate resin with molten lead and well-sealed. All necessary bends, tees, sockets, branches, offsets, inspection pieces, shall be provided where necessary.

3.5.1.12. Other Material

(i) All material not specifically mentioned above shall conform to the latest edition of their respective British Standard and/or Malaysian Standard or equivalent specification and shall be to the approval of SIRIM / SPAN.

3.6. Workmanship & Pipe Support

3.6.1. The installation, method of jointing and fixing shall comply in all respects to the manufacturer's recommendation and comply with latest relevant standards.

3.6.2. All soil, waste and vent pipes, pipe hooks clamps and clips shall be placed tight up against the head or underside of the collar. Extension clips shall be used where it is necessary to run the pipe clear of the wall.

3.6.3. Use only fixings that are compatible with the materials and system of pipework. Do not exceed the maximum spacing between fixings for sanitary pipes given below.

3.6.4. Maximum intervals between pipe supports shall be:

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3.6.4.1. Horizontal Position

TABLE X10. Recommended Maximum Spacing of Support for Horizontal Sanitary Pipe

Pipe Size (mm)	Recommended Maximum Spacing of Support (m)	
	Non-metal	Metal
32	0.5	2.1
40	0.5	2.4
50	0.6	2.7
80	1.0	3.0
100	1.0	3.0
150	1.2	NA

Source: British Standards Institude. (2000). BS EN 12056-2: Gravity drainage systems inside buildings. Sanitary pipework, layout and calculation

3.6.4.2. Vertical Position

3.7. Ventilating Pipe

3.7.1. Main ventilating stack pipe shall be discharge to the open air or connected to the discharge stack above the spillover level of the highest appliance on the stack. (Soil pipe or single stack system shall in all cases be vented by upward extension of the soil or combined pipe).

3.7.2. The upward vent pipe shall be straight and free from any bends or angles except where unavoidable. It shall be extended through the roof to the required height with the open end protected by means of copper wire globe or approved cowl. The distance of outlet is not less than 900mm above the head of any window or other opening into a building and within a horizontal distance of 3m.

3.7.3. All vent and branch vent pipes shall be graded 18mm/m (minimum 1°) to drip back to the soil or waste pipe by gravity. A branch vent must rise vertically or at an angle of not more than 45° from the vertical to a point 150mm above the fixture it is venting before running horizontally.

3.7.4. Main ventilating pipe shall not be less than 50mm dia. or 2/3 of the diameter of the main soil/waste pipe whichever the larger diameter is.

3.8. Anti-Syphonage

3.8.1. An anti-syphonage pipe shall be carried up from each fixture to the branch or main vent pipe above the level of the fixture to prevent the loss of the water seal in traps.

3.8.2. No fixture shall be connected to the soil, waste or combined pipe at any point between the trap and the anti-syphonage pipe, which it serves.

3.8.3. In special cases, anti-syphonage vent pipe could be connected to the waste, combined pipe or soil pipe on the opposite side of the water seal to the fixture at a point, which should be between 75mm to 300mm from the crown of the trap. In the case of bath and closet pan, the vent pipe shall not exceed 1.2m from the crown of the trap.

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3.8.4. Before connecting to the main vent pipe all anti-syphonage pipework shall rise above the floor level of the sanitary appliances.

3.8.5. Anti-syphonage pipework shall not be less than 32mm diameter.

3.9. Traps

3.9.1. Each sanitary appliance shall be fitted with a trap either as an integral part of the appliance or attached to and immediately beneath its outlet. All traps shall be accessible and provided with adequate facility for cleaning. The internal surface of the trap shall be smooth throughout. Generally, the trap shall be of the same material as the soil/waste pipe.

3.10. Floor Traps

3.10.1. Floor trap in all areas, unless otherwise specified, shall be 100mm diameter similar materials to the pipe traps complete with grating and self-tapping screw.

3.11. Testing Tees

3.11.1. Testing tees shall be located on the vertical stacks between floors to enable each floor to be tested independently as specified hereafter. Upon completion of testing, the tees shall be sealed up with lead joint or solvent joint where uPVC pipe is specified.

3.12. Grease Interceptors/Waste Drain Trap (Where Specified)

3.12.1. The body of the interceptor and baffles shall be made of Stainless Steel Grade 316. The baffles shall be of removable type.

3.12.2. Grease interceptors shall be certified by relevant authority. It shall be of floor mounted or fully recessed manual type complete with extension collar or extension piece to suit the structural requirement where required.

3.13. Reducing Fitting

3.13.1. Wherever reduction in pipe sizes takes place, reducing fitting shall be used.

3.14. Cleaning Eyes and Inspection Opening

3.14.1. To provide access for the proper inspection, cleaning and testing of the entire length of pipe, inspection openings and cleaning eyes shall be provided on all soil, waste and combined pipes at:

3.14.1.1. Each change of direction of piping; and

3.14.1.2. Based on each soil, waste or vent stack.

3.15. Temporary Closing of Pipeworks (Ingress of Contaminants)

3.15.1. As soon as pipes have been installed, all openings shall be capped or plugged to prevent the entrance of materials that would obstruct or choke the pipes. It is the responsibility of the Contractor to ensure that caps and plugs are left in place until removal is necessary for completion of installation.

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3.16. Inspection Chamber / Gully Trap

3.16.1. The works shall include the construction of all inspection chambers / gully trap generally as shown in the civil/tender/working drawings and specification. Inspection chamber and gully trap shall not be located in clinical areas, clean areas or any other areas that will affect the cleanliness, functionality and operability of the spaces.

3.17. Underground/Buried Pipe (For Sanitary)

3.17.1. All underground/buried pipes shall be carefully laid on beddings free from rocks, stones and other broken materials. Unless otherwise stated, all direct buried pipework shall be installed in open trench.

3.17.2. Excavation and Trenching for Piping

3.17.2.1. The Contractor shall perform all excavation to the depths indicated in the drawings or as specified in conformance with local authority requirements.

3.17.2.2. All excess excavation materials shall be removed from the site. The contractor shall prevent surface water from flowing into trenches or the excavations by using sheeting and shoring method thus ensuring the safety of personnel. Any water accumulating therein shall be removed.

3.17.3. Trench Excavation

3.17.3.1. Trenches shall be of necessary width for the proper laying of the pipe, and the banks shall be as nearly vertical as practicable. The bottoms of the trenches shall be accurately graded to provide uniform bearing and supports for each section of the pipe on undisturbed soil at every point along its entire length, or may be over excavated 100mm below depth indicated and filled with well tamped salt free coarse sand or other approved materials. Layers or brick, concrete base and angle blocks shall be used support for the laying of piping.

TABLE X12. Trenches Width for Different Pipe Diameter

Pipe Diameter Inches	Trenches Width Inches
3 and under	15 - 24
4 - 6	18 - 28
8	20- 30

3.17.4. Depth of Trench's Cover

3.17.4.1. The minimum depth of trenches covered with concrete slab shall be 450mm from top of pipe to finished ground level and trenches without concrete slab shall be 750mm.

3.17.5. Protection of Existing Utilities

3.17.5.1. Existing utility lines or other completed utility lines if damaged by the Contractor shall be repaired at his own expense.

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3.17.5.2. When connecting to existing utility lines, no section of the existing piping shall be abandoned unless it is specifically indicated on the drawings.

3.17.6. Backfilling of Trenches

3.17.6.1. Trenches shall not be backfilled until all required pressure and other tests have been performed. Backfill and compaction shall comply to Civil & Structural Engineer's requirements.

4. Testing, Adjusting, Balancing and Commisionning (TABC)

4.1. General

4.1.1. All work to be performed shall be in accordance with this specification and the commercial practice.

4.2. Internal Cold Water Plumbing System

4.2.1. The Contractor shall allow for the cost of all tests to the plumbing system to the satisfaction of the S.O.. The completed plumbing system shall be tested for hydraulic performance.

4.2.2. The cost for providing all testing, adjusting, balancing and commissioning as well as calibrated measuring equipment, all materials and consumables such as fuel, electricity, water etc. shall be borne by the Contractor.

4.2.3. All pipework which is to be encased or concealed shall be tested, approved and recorded before it is finally enclosed.

4.2.4. The Contractor shall give the S.O. a minimum of full seven (7) days notice of his readiness to carry out acceptance tests, completed testing sheet and schedule for S.O.'s approval.

4.2.5. Before the commencement of acceptance tests, the Contractor shall have completed all of his preliminary testing and adjusted the equipment to its proper running order.

4.2.6. During the testing period, no modification, adjustment or other work on the installation shall be carried out without the permission of the S.O.. Should there be any contravention of this requirement, the results of all tests completed may be rejected and a retest shall be carried out.

4.2.7. No acceptance test shall be carried out except in the presence of the S.O., the State Water Authority's representative (if required) and the Contractor or their respective representative appointed for the purpose.

4.2.8. If the installation fails to perform during testing in accordance with the requirements of the Specification or acceptance criteria, the S.O. may reject the whole or any part of it. The Contractor shall bear all costs and expenses for all retests and remedial works.

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4.2.9. Testing of Internal Pipework

4.2.9.1. Pressure Test

(i) Internal reticulation and main distribution pipes shall be slowly and carefully charged with water in order that all air is expelled from the system. The system shall be allowed to stand full for 24 hours. An air relief valve should be provided at the highest point in the system to bleed off any air that is present.

(ii) A test pressure of 1.5 times the maximum working pressure shall be applied for 24 hours.

(iii) No pipework shall be covered or concealed until it has been tested to the satisfaction of the S.O. or his representatives. Where arrangement of work makes necessary, the piping system shall be tested by sections to prove joints between sections.

(iv) The completed system shall be inspected for leaks during the test. Should any signs of leakage occur in the tanks or pipework, their positions shall be marked and the Contractor shall carry out remedial measures. The pressure tests procedure shall be repeated until the whole water system passes. The pipe installation is considered to have passed the pressure test if no visible leak and no drop in the pressure reading are observed during the test.

(v) All equipment not designed to withstand test pressure shall be disconnected during test, but shall be reconnected and tested under actual working pressure.

(vi) The permanently installed pumps shall not be used for pressure testing of the water system.

4.2.9.2. Flow Test

(i) During the flow test, all pumps shall be run with all valves fully open and the following data shall be recorded:

a) Flow at pump outlet into storage tank

b) Head at pump discharge outlet

c) Current consumed

d) Voltage

4.2.9.3. Flushing of Cold Water System

(i) After completion of the pressure tests to the satisfaction of the S.O., the whole piping and water storage system shall be thoroughly flushed with potable water before they are put into use.

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(ii) The Contractor shall ensure the system is fit for purpose and the water in the pipeline is safe for consumption after flushing.

(iii) The Contractor, at his own expense, shall use water supply for cleaning and flushing out of all the plumbing system that he had installed as per Contract.

(iv) Control valves and all equipment liable to damage, shall be disconnected before cleaning out. All strainers shall be thoroughly cleaned out during and at the completion of the clean out operation.

4.2.9.4. Balancing

(i) Prior to balancing, all isolation/gate valves shall be checked to be in the fully open position for the pumping system.

4.2.9.5. Records

(i) All pressure, flow and balancing tests shall be recorded by Contractor and certified by S.O. or S.O.'s representatives.

(ii) The S.O. reserves the rights to order a re-test if the Contractor fail to produce authentic test record.

4.2.10. Testing of Storage Water Tank

4.2.10.1. After flushing, the tank shall be filled with water to maximum operating capacity level and the level of water surface shall be carefully recorded. The tank shall be accepted as satisfactory if after a period of 48 hours there is:

(i) No measured reduction in water level, due allowance being made for evaporation from the surface of water;

(ii) No visible sign of leakage from any part of tank;

(iii) No deformation of any part of the surface.

4.2.10.2. If the test results do not satisfy the above conditions of test, the Contractor shall locate and rectify all defects and leakages and the test shall be repeated. The Contractor shall bear all costs and expenses for all tests and remedial works.

4.2.11. Testing of Pump (If Applicable)

4.2.11.1. All pumps and motors shall be checked for flow rates, pressures and RPM. The input signal device sensors and controllers shall be checked to ensure the pumps cut-in and cut-out at predetermined water levels.

4.2.12. Post Occupancy Testing, Adjusting, Balancing and Commissioning

4.2.12.1. Further adjustments to the system controls such as re-balancing, re-tuning, re-checking and re-adjustment etc. shall be made whilst the building is occupied and the installation is in

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use during the defects liability period. The cost of the adjustment shall be included in the tender.

4.3. Sanitary Plumbing System

4.3.1. The S.O. reserves the right to request for water, air or smoke tests as well as for hydraulic performance to be performed by the Contractor at his expense including the furnishing of the necessary equipment. The testing procedure shall be in accordance with MS 1402: Part 3.

4.3.2. Water Test

4.3.2.1. There is no justification for a water flood test to be applied to the whole of the plumbing system. The part of the system mainly at risk is that below the lowest sanitary appliances and this may be tested by inserting a test plug in the lower end of the pipe and filling the pipe with water up to the flood level of the lowest sanitary appliances, provided that the static head does not exceed 6m. This is a visual inspection.

4.3.3. Air Test

4.3.3.1. Air test may be performed by inserting expanding rubber testing plugs in the lower and upper ends of the main soil pipe and main ventilating pipes and sealing the plugs with water necessary. The water seals of all sanitary appliances shall be fully charged.

4.3.3.2. The testing plug at the upper end of the ventilation pipe should be fitted with a tee-piece with cock on each branch. A flexible tube manometer should be fixed to one branch while air pressure is being introduced into the system through the other branch until the desired pressure is indicated on the manometer scale.

4.3.3.3. The air test applied shall be 3.8 mbar (38mm water gauge) in period not less than 3 minutes without loss.

4.3.4. Smoke Test

4.3.4.1. Smoke can be introduced into the system by a small machine under the source pressure as for the air test. The whole system shall be filled with smoke before the openings are sealed with plugs.

4.3.4.2. The pressure on the smoke shall be maintained for three (3) minutes after the last opening has been sealed.

4.3.4.3. Smoke test is not recommended if UPVC pipe material is adopted. Rubber jointing components can also be adversely affected.

4.3.4.4. Smoke testing shall normally only be used instead of air test when an undetectable leak in the system occurs.

4.3.5. Hydraulic Performance

4.3.5.1. Hydraulic performance discharge tests shall be made from all appliances singly and correctively. Obstruction in any of the

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pipe lines shall be traced and the whole system examined for proper hydraulic performance including the retention of an adequate water seal in each trap.

5. Comprehensive Service and Maintenance for Internal Cold Water and Sanitary Plumbing System

5.1. General

All work to be performed shall be in accordance with this specification and the commercial practice.

5.2. Workmanship and Materials

5.2.1. The work described in this specification shall be performed by skilful workmen in the service, maintenance and repair of the internal cold water and sanitary plumbing system and shall be executed in accordance with the good engineering practice.

5.2.2. All materials to be supplied in connection with work under this Specification shall be new, unused, genuine, and shall generally be the best quality in manufacturing and performance.

5.3. Supervision

5.3.1. The Contractor shall have a competent Plumber in charge of the service, maintenance and repair work to be carried out under this Specification and shall be in the direct employ of the Contractor, and acceptable to the S.O..

5.3.2. The Contractor shall have in his direct employ workmen who are skilled in the service, maintenance and repair of internal cold water and sanitary plumbing system.

5.4. Scope of Work

5.4.1. The work covered under this Specification is to service and maintain all equipment comprising the complete internal cold water and sanitary plumbing system strictly accordance with the servicing and maintenance schedule as set out in sub-section 5.6..

5.4.2. The Contractor shall rectify any defects in any parts of the complete internal cold water and sanitary plumbing system observed during routine inspection and service, and shall repair such defects if required to do so by the S.O..

5.4.3. The Contractor shall also provide emergency repair service at any time if required to do so by the S.O..

5.5. Consumable Materials

5.5.1. The Contractor shall include in his service and maintenance contract for the supply of the following consumable materials as and when required.

5.5.1.1. All oils and greases required for the lubrication of motor bearing, packing, pivots and other moving parts.

5.5.1.2. All cotton waste, soap detergent and other cleaning materials required for cleaning purpose.

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5.5.1.3. All consumable filter elements.

5.5.1.4. All tap washers.

5.5.1.5. All electric contact points required to replace worn electric contact points in switchgears, electric control gears and electric relays.

5.5.1.6. All electric fuses required to replace blown or defective fuses.

5.5.1.7. All indicator lamps required to replace blown lamps.

5.5.2. The cost of these consumable materials shall not be charged for separately, but shall be included in the schedule quoted by the Contractor for the service and maintenance of the complete internal cold water and sanitary plumbing system.

5.6. Servicing and Maintenance Schedule

5.6.1. The Contractor shall inspect and service all equipment comprising the complete internal cold water and sanitary plumbing system periodically as scheduled in the approved check list except where otherwise directed by the S.O..

5.6.2. The Contractor shall report in writing to the S.O. any defect/s observed in any part or parts of the complete internal cold water and sanitary plumbing system. The technical report shall state the causes of the defects observed, and shall include the estimate of repairs required for non-consumable material or any part or equipment damaged by catastrophic event or vandalism.

5.7. Check List (Monthly Report)

5.7.1. Pumps (If Applicable)

5.7.1.1. Check all seals, glands and pipe line for leakage.

5.7.1.2. Check all pump bearing and lubricate with oil or grease.

5.7.1.3. Check the alignment and condition of coupling.

5.7.1.4. Check all bolt and nut for tightness.

5.7.1.5. Clean pumps casing and shaft.

5.7.1.6. Check and record pump running pressure.

5.7.2. Electric Motor Pumps (If Applicable)

5.7.2.1. Check motor bearing and rewinding.

5.7.2.2. Check carbon brush and slip rings and clean as necessary.

5.7.2.3. Check and record motor running amperes, voltages and resistance of cable.

5.7.3. All Electrical Starters, Electrical Control Gears, and Ancillary Electrical Apparatus (If Applicable)

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5.7.3.1. Clean and adjust all bearings, pivots and other moving parts as necessary.

5.7.3.2. Clean or renew electric contactors as necessary.

5.7.3.3. Renew electric fuse as necessary.

5.7.3.4. Check the performance of the complete pumping and associated equipment as necessary.

5.7.4. Cold Water Piping

5.7.4.1. Check water leakages in piping and rectify accordingly.

5.7.4.2. Check water leakages in valve and rectify accordingly.

5.7.4.3. Check excessive vibration of piping during pumping.

5.7.4.4. Clean strainer baskets.

5.7.4.5. Check all water taps for leakages and replace rubber washer as necessary.

5.7.4.6. Check ball float valves and adjust as necessary.

5.7.4.7. Check water level control indicator.

5.7.4.8. Check water leakage at any part of jointing of panel water tank.

5.7.5. Internal Sanitary Plumbing System

5.7.5.1. Check access covers, caps and cleaning eyes.

5.7.5.2. Check any water leakage at any part of jointing of internal sanitary pipe system.

5.7.5.3. Check discharge pipe systems:

(i) It shall be kept in a clean and sound condition.

(ii) Any blockages shall be removed by using hand operated rods and capable passing through the system without damaging the internal surfaces of pipes and fittings.

5.8. Inspection and Records

5.8.1. Inspect and check all other equipment under this Contract, whether or not these are specifically mentioned in the check list.

5.8.2. The Contractor is responsible for the operation of the plant and equipment on correct methods of operating the plant and equipment and on the maintenance points to be watched.

5.8.3. Report in writing to the S.O. any defects observed in any part or parts of the complete internal cold water and sanitary plumbing system. The report shall state the cause/s of the defect/s observed and shall include an estimate of the cost of repairs required.

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5.8.4. Service and maintenance records shall be properly updated and kept by Contractor or as instructed by S.O..

5.9. Sampling of Storage Water

5.9.1. The Contractor shall have deemed to have included the sampling and testing of water in storage tanks.

5.9.2. The Contractor shall be responsible for ensuring that water quality testing is regularly done on the cold or domestic water supply network to monitor the water quality provided to the end user against the most current revision of the State Water Authority guidelines for domestic and drinking water.

5.9.3. Samples for testing to be performed every six months shall include:

5.9.3.1. Chemical Analysis

5.9.3.2. Bacteriological Analysis

5.9.4. In the event the cold or domestic water quality does not meet the most recent revision of the State Water Authority guidelines for domestic and drinking water (the most current revision at the time of sampling), the Contractor shall immediately notify the S.O. and recommend appropriate action for approval.

5.9.5. The above mentioned tests shall be performed again until the approval of S.O. is obtained.

5.10. Repairs

5.10.1. The Contractor shall repair any defects in the complete internal cold water and sanitary plumbing system on the instruction of the S.O..

5.10.2. All repairs on the complete internal cold water and sanitary plumbing system shall be guaranteed by the Contractor against defects in workmanship and materials for a period of one year to take effect from date of completion of the repairs. During the guarantee period, the Contractor shall rectify defects in repairs carried out by him with no additional charge to the government.

5.11. Service and Maintenance Records

5.11.1. The Contractor shall provide a service and maintenance record book for the complete internal cold water and sanitary plumbing system being serviced and maintained by the Contractor. This record book shall be kept in the plant or maintenance room of internal cold water and sanitary plumbing system being serviced and maintained, and brief details of all services, maintenance and repairs carried out The address and telephone number of the Contractor's personnel and person in charge shall also be recorded into this record book to facilitate emergency service call.

5.11.2. The Contractor shall also keep an accurate detailed record in duplicate of all service, maintenance and repair work carried out by him on the complete internal cold water and sanitary plumbing system as well as ancillary equipment. This record shall be in the form of a Maintenance/Repair Sheet, and shall be countersigned by the S.O. each

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time the internal cold water and sanitary plumbing system as well as ancillary equipment is attended to by the Contractor.

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APPENDIX X1

Limit of Mechanical Scope of Design (Civil and Mechanical)

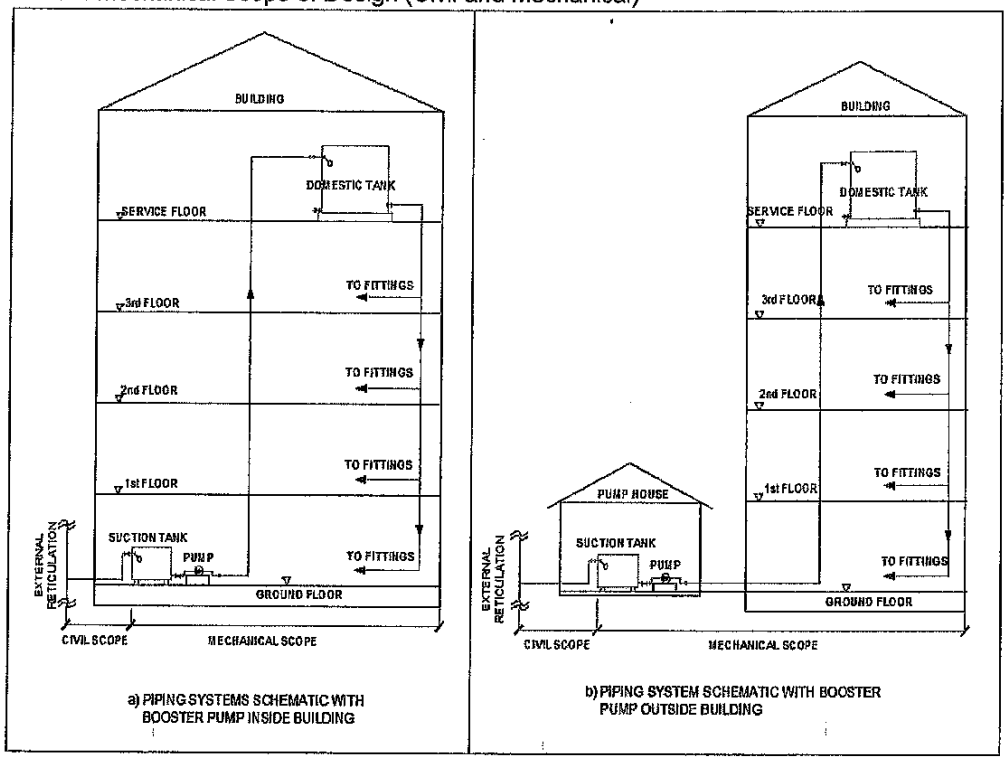


Figure X1. Indirect Feed System

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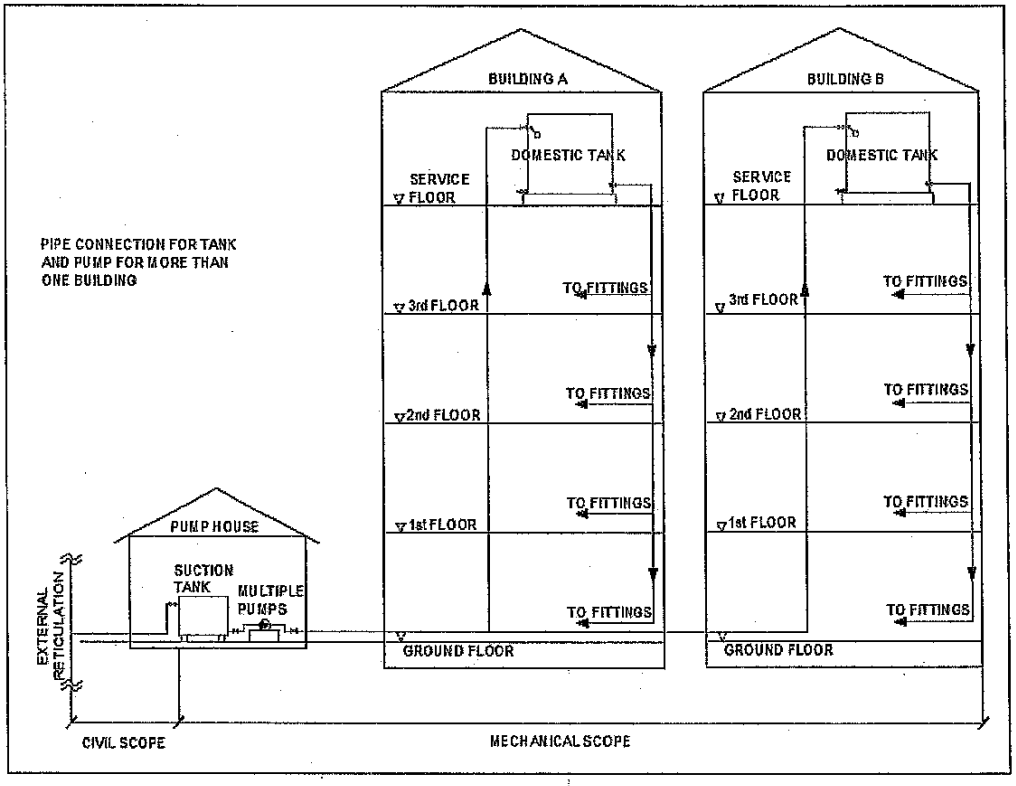


Figure X2. Pumping to Multiple Building Blocks

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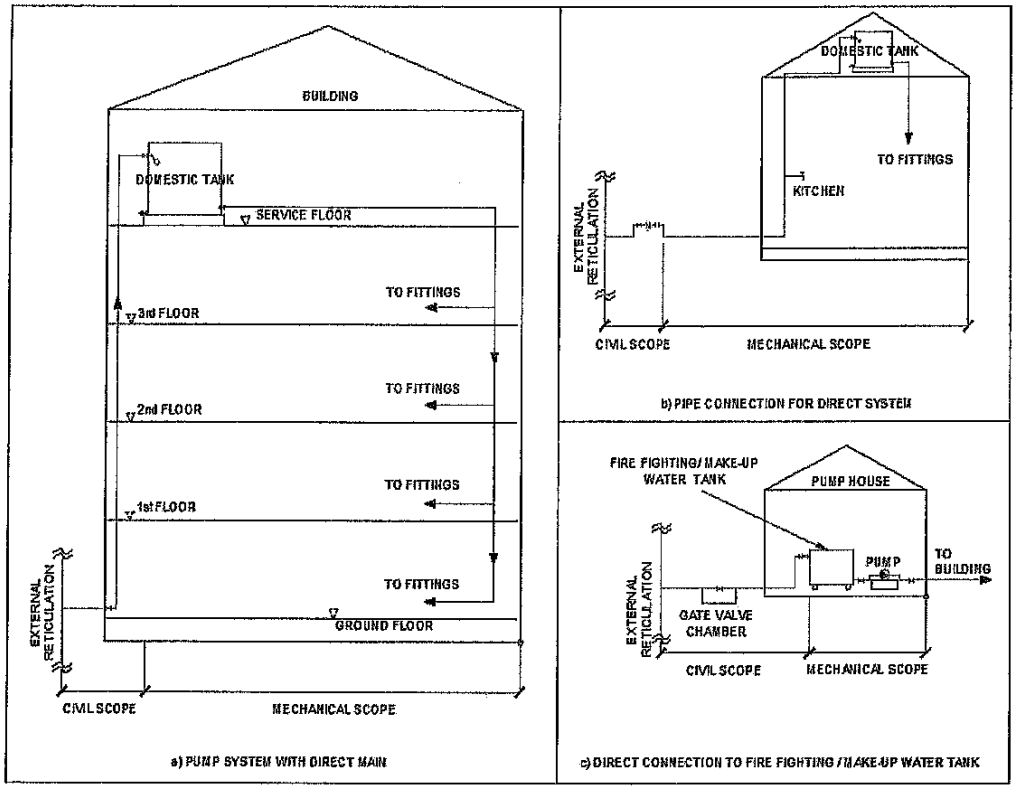


Figure X3. Direct Feed from Main Water Pipe

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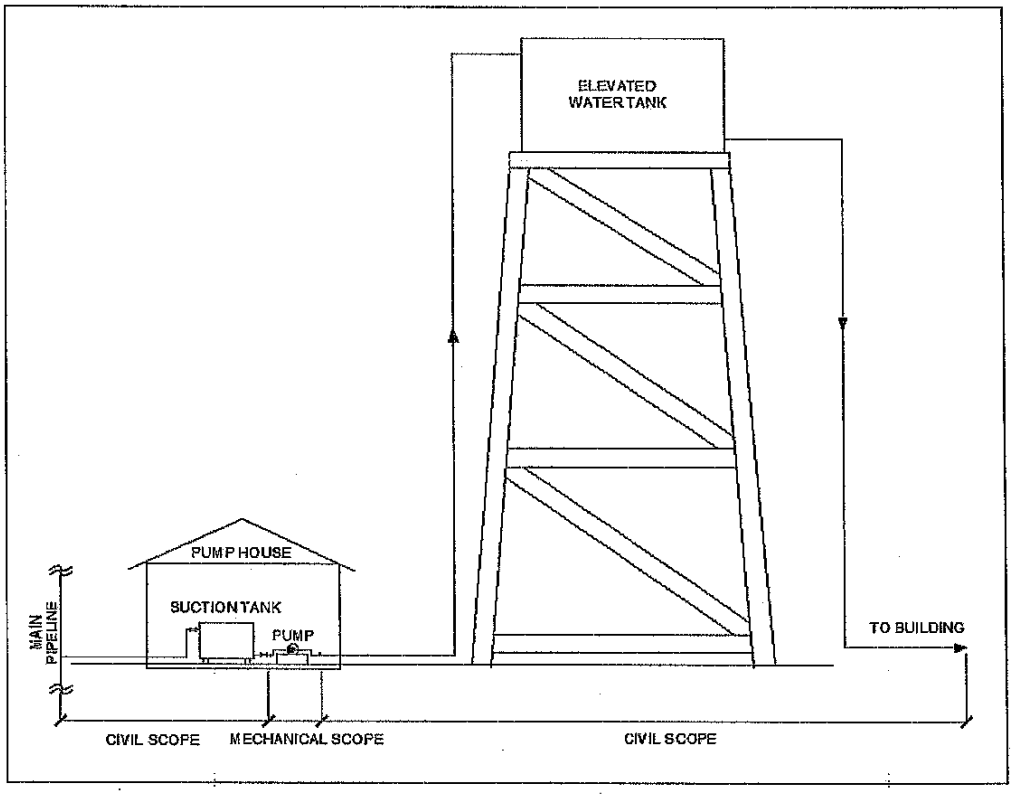


Figure X4. Pumping to Elevated Water Tank

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SPESIFIKASI
SANITARY FITTINGS

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1.	General	Y/1
2.	Products and Materials	Y/1
3.	Sanitary Fittings	Y/1

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1. General

The sanitary fitting works shall be executed by personnel with valid permits issued by SPAN as stipulated under *Water Service Industry Act 2006*. The Contractor shall be responsible for employing such personnel and all the work performed by them.

2. Products and Materials

2.1. All products and materials to be incorporated in the work shall be new and unused. Materials to be used within the scope of work shall be those approved by SPAN. When the quality of a material or process is not specifically set forth in the approved products and materials list, the Drawings, or the Specifications, the best available quality of the material or process shall be provided, subject to the approval of the S.O..

2.2. All products and materials shall be supplied by suppliers registered with SPAN. The Contractor shall provide proof to the S.O. in the form of a valid Confirmation Letter or Certificate of Registration issued by SPAN to the supplier. The products and materials shall also be subjected to other terms and conditions mentioned in these specifications.

2.3. All products and materials shall be of the makes and models tested and approved for use. It is the Contractor's responsibility to verify that products and materials received for the job conform to the current approved products and materials supplied by SPAN registered suppliers.

2.4. All products and materials furnished shall be subject to inspection for compliance with these specifications and all other appropriate specifications. The Contractor shall make application to the S.O. for inspection at least five (5) days in advance of starting any work.

3. Sanitary Fittings

3.1. Fittings

3.1.1. Unless otherwise shown on the Drawings, all fittings including all necessary brackets and accessories shall be as scheduled in **TABLE Y/1** hereinafter. The Contractor shall be responsible for determining the type of trap required for each fitting. All necessary concrete backing shall be provided to fittings secured to floors.

3.1.2. Unless otherwise shown on the Drawings, the colour of sanitary ware shall be in white.

3.2. Vanity tops

3.2.1. Unless otherwise shown on the Drawings, a minimum thickness of 12mm vanity tops of approved manufacture and colour shall be installed in accordance with the manufacturer's instructions. It shall be moulded as one solid piece with it's top sloping gently towards the wash hand basin and having a slight upturn or kerb as its outer edges including backsplash to prevent water damage to wall and vanity back.

3.2.2. It shall be manufactured from non-porous composite product composed of polyester resin and calcium carbonate marble dust with the permanence

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of stone and an aesthetic appeal of natural marble or granite. The slab surface shall have a glossy finish and protected by suitable polymer to ensure durability and impermeability. It shall be stain- and chemical-resistant, and UV stabilised.

3.3. Type of Sanitary Fittings and Description

3.3.1. Unless otherwise shown or/and specified in the Drawings, the sanitary fittings shall be of the following:

3.3.1.1. All sanitary fittings shall be of white in colour, from an approved manufacturer, generally ensuite and complete with all necessary fittings.

3.3.1.2. Waste and bath overflow, chains and stays, shall be chromium plated brass to BS EN 274 Part 1-3.

3.3.1.3. Taps and combination tap assemblies shall be chromium plated brass to BS EN 200.

3.3.1.4. All sanitary fittings shall comply with Water Services Industry Act 2006 and Water Services Industry (Water Reticulation and Plumbing) Rules 2014.

3.4. Wash Basin

3.4.1. Unless otherwise specified, wash basin for public buildings shall be 600mm x 410mm x 200mm earthenware plain edge sink in white fireclay complete with chromium plated tap, blank tap hole stopper, 30mm 'p' trap with 40mm seal, waste fittings, plug with chain and painted bracket supports to S.O.'s approval.

3.4.2. Where shown wash basins shall be to MS 147 of the following types as specified:

3.4.2.1. Under counter basin with overflow.

3.4.2.2. Wall hung basin with or without pedestal as specified.

3.4.2.3. Semi-recessed basin with or without overflow as specified.

3.4.2.4. Counter top basin with or without overflow as specified.

3.4.2.5. Handicap basin.

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TABLE Y1: Sanitary Fittings

No	Item	Description
1	Wash Basin	Wash basin for domestic purposes shall be 560mm x 410mm in approved colour vitreous china complete with chromium plated tap, blank tap hole stopper, 30mm 'p' trap with 40mm seal, waste fittings with chrome-plated brass pop up waste and painted bracket supports. Clinical wash hand basins shall be wall hung vitreous type and not less than 600mm in width complete with a wall mounted 175mm long elbow action lever mixer with premix function. Clinical wash hand basins shall not have any overflow outlet, soap recess nor basin plug.
2	Vanity tops	Vanity top as specified, with integrated sink as shown in the Drawings, complete with chromium-plated tap, blank tap hole stopper, 30mm 'p' trap with 40mm seal, waste fittings with chrome-plated brass pop up waste. Vanity top as specified, but with holes pre-punched to receive an under-counter vanity basin and tap respectively, as shown in the Drawings, complete with 555mm x 415mm under-counter vanity basin in vitreous china, complete with chromium-plated tap, 30mm 'p' trap with 40mm seal, waste fittings with chrome-plated brass pop up waste and painted bracket supports.
3	Sinks	915mm x 460mm, single bowl single drainer stainless steel sinks shall be to BS 1244, stainless steel grade 304 (0.8 to 0.9mm) minimum thick, with satin finish to the size and configuration shown on the drawings with overflow and sound deadening pads under the sink and drainers. Metal sinks in stainless steel to size and shape as shown in the Drawings, complete with chromium plated tap as required, 40mm waste water outlet, chrome-plated brass pop up waste and painted mild steel frames support.
4	Water closet	Unless otherwise specified, water closet shall be pedestal closet in white vitreous china conforming to MS 1522 complete with pedestal pan, 'p' trap and ventilation outlet, plastic hinged seat and rubber buffers. Squatting closet in white vitreous china conforming to MS 1522 complete with pair of raised foot treads in white fire clay with 'p' trap and 40mm diameter uPVC flush pipe.
5	Urinal	Single urinal bowl in white vitreous china conforming to MS 1799 and MS 147 complete with back inlets, hangers and steadying brackets, 40mm outlet with hinged gratings and 50mm uPVC waste pipe, chromium plated flush pipes and spreaders to suit the number of appliances. Urinal range of 2 or more bowls as (a) but with white vitreous china division between bowls.

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		Urinal shall give a single flush of not exceeding 2.5 litres per stall or per 600 millimetres width of slab and not exceeding 2.5 litres for wall hung urinals in compliance with Water Services Industry Act 2006 and Water Services Industry (Water Reticulation and Plumbing) Rules 2014.
6	Cistern for Water Closet	Dual-flush cistern with a nominal volume of a full and partial flush not exceeding 6 and 3 litres respectively in compliance with Water Services Industry Act 2006 and Water Services Industry (Water Reticulation and Plumbing) Rules 2014. WC Cistern shall conform to MS 795 with 40mm flush pipe, water inlet valve, 20mm diameter overflow for discharge externally and chrome flushing lever handle. WC shall be of vitreous china cistern conforming to MS 795 with 40mm flush pipe, water inlet valve, 20mm diameter overflow for discharge externally and chromed lever handle. Each flush cistern for w/c shall be tested as stipulated in the requirements of MS 795.
7	Cistern for urinal	Single flush 2.5 litre urinal flushing cistern in white vitreous china conforming to MS 795 complete with chromium plated flushing inlet pipe, 20mm diameter overflow for discharge externally and chrome lever handle in compliance with Water Services Industry Act 2006 and Water Services Industry (Water Reticulation and Plumbing) Rules 2014.
8	Flush valve for Water Closet	Unless specified, W/C flush valve shall be low pressure single flush 6 litres gravity flush water closet valve. It shall have a non-hold-open feature or an automatic shut-off system in compliance with Water Services Industry Act 2006 and Water Services Industry (Water Reticulation and Plumbing) Rules 2014. Vacuum Breaker is optional, only applicable to w/c flush valves intended to be connected to direct potable water mains. Its performance requires proper match of valve and w/c pan conforming to MS 1522. Each flush valve shall be made of metal (preferably copper alloy) and corrosion resistant. All exposed surfaces to the users shall be chromed plated or made of stainless steel.
9	Flush valve for urinal	Urinal flush valve shall be Single flush 2.5 litres gravity flush valve. It shall have a non-hold-open feature or an automatic shut-off system in compliance with Water Services Industry Act 2006 and Water Services Industry (Water Reticulation and Plumbing) Rules 2014. Each urinal flush valve shall be made of metal (preferably copper alloy) and corrosion resistant. All exposed surfaces to the users shall be chromed plated or made of stainless steel.

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10	Shower fittings	Shower fittings shall be approved chromium plated brass easy clean valve, with 3" diameter shower face and Chromium plated stainless steel grade 304 arm.
11	All types of taps	Unless otherwise specified, taps shall be approved chromium plated brass/ ABS chrome plated taps conforming to BS EN 200 - testing method and have SIRIM certification with minimum 5 years warranty. All taps shall be fitted with aerator in compliance with Water Services Industry Act 2006 and Water Services Industry (Water Reticulation and Plumbing) Rules 2014.
12	Hand Bidet	Unless otherwise specified, bidet shall be chromium plated copper alloy nozzle, 1.2 m heavy duty double interlock stainless steel grade 304 flexible hose, chromium plated ABS plastic wall hanger and quarter turn angle valve. OR Bidet shall be chromium plated ABS nozzle with 1.2 m heavy duty ABS flexible hose, chromium plated ABS plastic wall hanger and quarter turn angle valve.
13	Sanitary appliances	Unless otherwise specified or shown on the Drawings, the sanitary appliances shall be: Floor trap, Robe Hook, Towel Rail, Safety Grab Bar and Handicap Safety Grab Bar shall be in stainless steel grade 304 chrome plated. Soap Dispenser shall be in uPVC (LEAD-FREE). Soap holder and toilet roll holder shall be in white earthenware (ceramic).

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SPESIFIKASI
KERJA-KERJA ELEKTRIK

L-S1

SPECIFICATION FOR LOW VOLTAGE INTERNAL ELECTRICAL INSTALLATION

L-S3

SPECIFICATION FOR LOW VOLTAGE UNDERGROUND CABLE

SURUHANJAYA TENAGA

GARIS PANDUAN PENDAWAIAN ELEKTRIK PEPASANGAN DOMESTIK

LAMPIRAN C

JADUAL HARGA

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

RINGKASAN SEBUTHARGA *(FINAL SUMMARY)*

BILL NO.	KETERANGAN	ITEM	JUMLAH (RM)
1	ARAHAN AM	1.0 - 1.3	
2	KERJA-KERJA AWALAN	2.0 - 2.17	
3	KERJA-KERJA DALAMAN	3.0 - 3.9	
4	KERJA-KERJA LUAR	4.0 - 4.10	
5	*SANITARY FITTING*	5	
6	KERJA-KERJA PERPAIPAN BEKALAN AIR SEJUK DALAMAN	6.0 - 6.5	
7	KERJA-KERJA ELEKTRIK	7.0	
8	WANG PERUNTUKAN SEMENTARA	8.0	50,000.00
JUMLAH DIBAWA KE BORANG SEBUTHARGA			

(Ringgit Malaysia : .....)

(RM : .....)

.....
(Tandatangan Penyebutharga)

Nama : .....
No. K/P: .....
Jawatan : .....
yang diberi kuasa dengan sempurnanya
untuk menandatangani sebutharga ini

.....
(Meteri atau Cop Penyebutharga)

Tarikh : .....

.....
(Tandatangan Saksi)

Nama : .....
No. K/P: .....
Jawatan .....
Alamat :
.....
.....
.....
.....

Tarikh : .....

ITEM	BUTIRAN KERJA DAN SYARAT-SYARAT	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
	Nota Am: Sebarang butiran yang tidak diperhargakan adalah di anggap telah dimasukkan di dalam harga butiran-butiran lain. Penyebut harga adalah di anggap telah melawat tapak bina serta memahami Syarat-Syarat Kontrak, Spesifikasi Kerja Tambahan, Spesifikasi Piawai dan Lukisan-Lukisan Sebutharga untuk memastikan sendiri kerja yang terlibat sebelum menghargakan sebut harga kerana sebarang bayaran tambahan berhubung dengan perkara di atas tidak akan dipertimbangkan. **Semua kuantiti yang diberi adalah kuantiti sementara sahaja (kecuali kerja konkrit) Pengukuran semula akan dibuat setelah semua kerja-kerja siap dijalankan.**				
1.0	**ARAHAN AM**				
1.1 a)	**Taklimat Sebutharga / Lawatan Tapak** Penyebutharga adalah diminta mengambil perhatian terhadap Taklimat Sebutharga / Lawatan Tapak. Taklimat Sebutharga / Lawatan Tapak diadakan bagi memudahkan penyebutharga mendapat gambaran yang lebih jelas mengenai skop kerja yang akan dihargakan. Ini akan memastikan penyebutharga memahami dan menyedari risiko dan tanggungjawab serta dapat membantu penyebutharga di dalam menghargakan tawaran dengan lebih realistik.				
b)	Hanya Kontraktor /penama yang sah perlu menghadiri lawatan tapak yang DIWAJIBKAN pada tarikh dan masa yang ditetapkan melalui Borang Pendaftaraan Kehadiran Lawatan Tapak akan dibenarkan mengambil Dokumen Sebutharga.				
1.2 a)	**Katalog/Sampel/Bahan** Penyebutharga **DIWAJIBKAN** menyediakan dan memajukan setiap katalog serta contoh pengeluar/jenama cat dan warna yang dicadangkan mengikut harga yang ditawarkan bersama-sama Dokumen Sebutharga semasa menghantar Dokumen Sebutharga. Kegagalan Penyebutharga memajukan katalog/proposal/contoh bahan akan membolehkan sebutharga yang dimajukan tidak dinilai.				
b)	Semua katalog, proposal dan contoh bahan TIDAK AKAN DIPULANGKAN semula dan lanya akan MENJADI HAK RASMI PARLIMEN. Tidak ada tuntutan secara lisan atau bertulis akan dilayan.				
c)	Penyebutharga hendaklah melampirkan sekurang-kurangnya 1 (satu) proposal cadangan pengeluar/jenama cat dan warna bagi skop kerja yang dinyatakan.				
1.3 a)	**Hari dan Waktu Bekerja yang Dibenarkan** Hari dan waktu bekerja yang dibenarkan kepada penyebutharga yang berjaya adalah pada hari bekerja biasa iaitu dari jam 8.30 pagi sehingga 5.30 petang. Jika penyebutharga yang berjaya memerlukan kerja-kerja dilaksanakan melebihi hari dan waktu yang dibenarkan, kelulusan perlu diperolehi terlebih dahulu daripada Pegawai Penguasa/Pegawai Projek.				
ms.1	**JUMLAH DIBAWA KE MUKA SURAT 2**				

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
	JUMLAH DARI MUKA SURAT 1				
2.0	**KERJA-KERJA AWALAN** **Nota Am:** i) Semua bayaran adalah tertakluk kepada kuantiti yang ditetapkan ii) Sebarang butiran yang tidak dihargakan dianggap telah dimasukkan didalam butiran-butiran lain iii) Penyebutharga adalah dianggap telah melawat tapak bina dan membaca syarat-syarat sebutharga bersama-sama dengan pelan dan spesifikasi untuk memastikan sendiri liputan kerja-kerja yang terlibat sebelum menghargakan kerana sebarang tuntutan bayaran tambahan tidak akan dipertimbangkan iv) Sebarang kerosakan harta benda awam adalah menjadi tanggungjawab kontraktor				
2.1	Kerja-kerja permulaan (Preliminaries) mengikut spesifikasi am, spesifikasi tambahan,dan syarat-syarat sebut harga termasuk Bon Pelaksanaan, Insuran Tanggungan Awam, Pampasan Pekerja Dan No. Pendaftaran Pekerja (PERKESO) serta berdaftar dengan DOSH.	Pukal	Pukal		
2.2	Membekalkan, mendirikan, menyelenggara dan mengeluarkan peralatan setelah penyiapan kerja, perlindungan dan keselamatan yang mencukupi, perancah dan platform kerja dengan jaring keselamatan dan langkah keselamatan lain yang diperlukan untuk memastikan keselamatan pekerja, kakitangan, orang awam dan lain-lain di kawasan tapak kerja seperti mana arahan Pegawai Penguasa.	Pukal	Pukal		
2.3	Penyediaan kos pekerja mahir termasuk kos untuk memasang dan menggunakan *'anchor point'* untuk tujuan pemeriksaan sepanjang tempoh kerja dilaksanakan	Pukal	Pukal		
2.4	Kerja-kerja pembersihan, pembaikan dan pengangkutan sampah pukal apabila kerja-kerja siap dilaksanakan di tapak dengan mengikut arahan dari Pegawai Penguasa/Pegawai Projek PARLIMEN	Pukal	Pukal		
2.5	Penyediaan dokumen, gambar-gambar kemajuan kerja dan diserahkan kepada Pegawai Penguasa seperti yang dinyatakan dalam bentuk *hard copy* dan *soft copy* untuk rekod dan bayaran interim.	Nos	2 Set		
2.6	Kontraktor perlu menyerahkan kepada Pegawai Penguasa untuk kelulusannya seperti berikut : a) Jadual kerja b) Penyataan kaedah / Mock-up c) Carta organisasi kontraktor d) Shop Drawing				
2.7	Kontraktor perlu menyediakan kemudahan dan perkhidmatan sementara sepanjang tempoh kerja seperti berikut :				
	a) Menyediakan, mendirikan, dan menyelenggara papan tanda projek sepertimana lukisan **JKR/CA/P-PTB1M/30/PEL16/003/01B**	Nos	1		
	b) Menyediakan, menyelenggara dan mencabut *h oardings*	Pukal	Pukal		
	c) Menyediakan/menyambung bekalan kuasa dan air sementara yang mencukupi semasa pelaksanaan kerja di tapak termasuk membayar semua kos dan bayaran yang berkaitan	Pukal	Pukal		
	d) Penyediaan Kit Pertolongan Cemas, Pengawalan makhluk perosak termasuk menjaga kebersihan dan kering di tempat ini untuk mencegah pembiakan nyamuk, tikus, serangga dan jenis binatang semburan asap *(fogging)* secara berkala.	Pukal	Pukal		
ms.2	**JUMLAH DIBAWA KE MUKA SURAT 3**				

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
	JUMLAH DARI MUKA SURAT 2				
2.8	Menyediakan tong roro disepanjang kerja-kerja dijalankan di tapak. Kerja-kerja mengemas, membersih, mengangkut dan membuang sampah semasa (berkala) dan selepas selesai kerja (RO-RO Bin) termasuk membaiki segala kerosakan disekitar tapak kerja seperti arahan Pegawai Penguasa.	Nos	2		
2.9	Membekalkan S.O peralatan kemudahan penyenggaraan seperti di bawah :				
	'a) 5 unit but keselamatan (Red Wing atau setara denganya)	Nos	10		
	'b) 5 unit safety vest yang custom made	Nos	10		
2.10	Kontraktor perlu menyediakan beberapa set dokumen seperti di bawah dan dijilidkan sepertimana arahan Pegawai Penguasa.	Pukal	Pukal		
	a) Laporan Kemajuan Tapak (Bergambar) - setiap bulan b) Lukisan Terbina (As-built Drawing) - 3 set c) Sijil Jaminan Produk (Product Warranty)				
2.11	**Surat Jaminan**				
a)	Penyebutharga mestilah menghantar surat jaminan bagi setiap item atau bahan yang berkaitan. Minimum tempoh surat jaminan mestilah mengikut tempoh yang telah ditetapkan dalam Spesifikasi atau mana-mana bahagian di dalam dokumen bermula dari tarikh tempoh siap kerja. Penyebutharga perlulah mengambil kira hal ini dalam menghargakan item atau bahan tersebut.	Pukal	Pukal		
b)	Kontraktor dikehendaki mengemukakan jaminan *product and performance warranty* untuk kemasan cat luaran dan bumbung selama 5 tahun daripada pihak pembekal dan kontraktor (applicator) bertauliah.				
2.12	Melaksanakan proses permohonan naik taraf meter TNB 1 fasa ke 3 fasa melalui kontraktor pendawaian elektrik yg berdaftar dgn Suruhanjaya Tenaga (ST)	Pukal	Pukal		
2.13	Melaksanakan proses permohonan pemasangan *bulk meter* kepada pihak *utility* dan perlu mengambil kira kos-kos yang terlibat seperti kos sambungan, upah dah sebagainya.	Pukal	Pukal		
2.14	Penyediaan dokumen sebutharga termasuk kos - kos duti setem dan penjilidan 5 set dokumen sebutharga.	Nos	5		
2.15	Menyediakan peralatan dan kemudahan untuk keperluan tapak sepertimana tertakluk di bawah Akta Keselamatan dan Kesihatan Pekerjaan 1994.	Pukal	Pukal		
2.16	Pematuhan terhadap peraturan-peraturan kilang dan jentera (Kendalian bangunan dan kerja-kerja binaan kejuruteraan-KESELAMATAN) 1986 termasuk pendaftaran tapak bina dan lain-lain perkara berkaitan	Pukal	Pukal		
2.17	Perlaksanaan untuk melakukan ujian-ujian berkaitan serta penyediaan *Mock-up* bahan-bahan pembinaan termasuk dokumen berkaitan bagi tujuan pengesahan/kelulusan Pegawai Penguasa.	Pukal	Pukal		
ms.3	**JUMLAH DIBAWA KE RINGKASAN SEBUTHARGA**				

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
3.0	**KERJA-KERJA PEMBAIKAN DALAM BANGUNAN**				
a)	*Kerja-kerja yang dijalankan perlu mengambil kira keselamatan & keselesaan penghuni sedia ada. Pembida perlu meneliti, merancang dan mengambil kira kos-kos tambahan lain seperti kos kerja ulangan dan lain-lain sebelum,semasa dan selepas memulakan kerja. Pihak kontraktor disyor untuk melaksana kerja secara berfasa.*				
b)	*Pihak Kontraktor perlu mengemukakan method statement, bahan, spesifikasi untuk kelulusan Pegawai Penguasa. Pegawai Tatacara & kualiti kerja perlu merujuk dan mematuhi Standard Specification For Building Works 2020 yang dilampirkan bersama.*				
c)	*Pihak kontraktor perlu mengemukakan pengiraan reka bentuk, shop drawing dan diluluskan oleh Jurutera Bertauliah (Professional Engineer) bagi kerja SILING. Sistem sokongan kerangka siling TIDAK BOLEH disokong pada kekuda bumbung.*				
d)	*SEMUA kerja oleh Pihak kontraktor perlu la merujuk lukisan :* ***JPM/BPEM/ST/KUARTERSPARLIMEN/00/01-02*** ***PM/BSFL/KUARTERS2930/01/01-06*** ***PM/BSFL/KUARTERS2930/05/01-04***				
3.1	**Kerja Aluminium / Besi**				
a)	Kerja-kerja mencungkil, membuka dan membuang segala bingkai, kerangka dan panel-panel aluminium atau besi & tingkap termasuk pintu gelangsar di seluruh bangunan :				
	ARAS BAWAH : i) Ruang Tamu ii) Bilik Air iii) Bilik Tidur& Stor	Pukal	Pukal		
	ARAS ATAS : i) Ruang Langkah ii) Dua (2) Bilik Air iii) Tiga (3) Bilik Tidur iv) Stor	Pukal	Pukal		
b)	Bekal dan pasang **bingkai / frame** tingkap dari jenis powder Coated lengkap dengan **panel** tingkap jenis kesmen dan **panel** pintu jenis gelangsar (sliding door) dari jenis aluminium termasuk cermin jernih gelap 6 mm tebal dan segala kelengkapan yang terlibat (hinges, lockset, fittings, etc..) saiz anggaran seperti :				
	* Pihak kontraktor perlu merujuk lukisan yang dibekalkan **JPM/BPEM/ST/KUARTERSPARLIMEN/00/01-02** **PM/BSFL/KUARTERS2930/01/01-05**				
	i) T1- 2800 x 1200mm tingkap casement serta top hung	no	2		
	ii) T2- 2100 x 1200mm tingkap casement serta top hung	no	3		
	iii) T3 - 1400 x 1200mm tingkap casement serta top hung	no	18		
	iv) T4 - 1400 X 600mm tingkap top hung	no	5		
	v) P4 - 3600 x 2100mm pintu gelangsar	no	1		
	vi) P6 - 3000x2900mm pintu gelangsar	no	1		
ms.4	**JUMLAH DIBAWA KE MUKA SURAT 5**				

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
	JUMLAH DARI MUKA SURAT 4				-
3.2	**Dinding Bata**				
	** Pemasangan besi utama bagi lintol dan tiang penguat hendaklah ditanam di dalam struktur bangunan sedia ada menggunakan kaedah & gam yang diluluskan oleh Pegawai Penguasa.*				
a)	Kerja meroboh,memecah dinding dari sebarang tebal dan membuang keluar tapak dengan arahan Pegawai Penguasa.	m2	127		
b)	Pembinaan 125mm X 250mm tebal RC konkrit grade 25 lintol, mengandungi 4 nos. **T10** dan **R6** sebagai link dengan sela 150mm c/c termasuk segala acuan dan kemasan di setiap permukaan.	m	21		
c)	Pembinaan tiang penguat 150mm X 150mm(RC Stiffner) dengan grade 25 konkrit mengandungi 4 nos **T12** dan **R6** sebagai link dengan sela 150mm c/c termasuk segala acuan dan kemasan di setiap permukaan.	m	14		
d)	Pembinaan dinding bata tanah liat dengan lapisan simen mortar (1:3) termasuk pemasangan lapisan *exmet* dan *dowel bar* pada tiap -tiap lapisan bata keempat, lengkap dengan kemasan plaster pada kedua belah sisi.	m2	100		
e)	Pembinaan dinding *Autoclaved Aerated Concrete (AAC) Block* dan segala aksesori berkaitan dengan arahan pengilang yang diluluskan Pegawai Penguasa.	m2	46		
f)	Membekal & melepa lapisan skim coat plaster system dengan arahan pegawai menguasa.	m2	200		
3.3	**Kerja Siling**				
a)	Kerja-kerja mencungkil, membuka, memecah dan membuang segala kemasan siling sedia ada termasuk *cornice* , dan kerangka dari pelbagai jenis di ruang-ruang dalam bangunan :				
	ARAS BAWAH : ** Anggaran keluasan keseluruhan lantai adalah < 190m2* i) Ruang Tamu,Laluan Tangga & Ruang Makan ii) Bilik Persiapan, Tidur, Tandas dan Dapur.	Pukal	Pukal		
	ARAS ATAS : ** Anggaran keluasan keseluruhan lantai adalah < 180m2* i) Ruang Langkah ii) Dua (2) Bilik Air iii) Tiga (3) Bilik Tidur	Pukal	Pukal		
b)	Bekal dan Pasang 9.5 mm tebal *Unispan Gypsum Plasterboard with RONDO Keylock ceiling* lengkap dengan sistem gantung besi dan kelengkapan rangka, hangers with joints flushed finish mengikut arahan dan cadangan pembekal dan mestilah mendapat kelulusan Pegawai Penguasa.				
	i) Siling tinggi kurang dari 3.0 m ii) Tambahan *cornices* iii) 600mm x 600mm laluan akses panel	m2 m no	334 160 8		
c)	Sedia dan sapukan satu lapis cat primer beralkali dan dua lapisan cat i) Permukaan siling plaster ii) *Cornices*	m2 m	334 160		
ms.5	JUMLAH DIBAWA KE MUKA SURAT 6				

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
	JUMLAH DARI MUKA SURAT 5				
3.4	**Kerja Menjubin**				
a)	Kerja-kerja mencungkil, membuka, memecah dan membuang segala kemasan lantai sedia ada termasuk kambi, dan kemasan dinding (untuk tandas dan dapur) pelbagai saiz dan corak dan **lapisan skrid** di ruang-ruang dalam bangunan : ARAS BAWAH : ** Anggaran keluasan keseluruhan lantai adalah < 190m2* i) Ruang Tamu ii) Ruang Makan iii) Laluan Tangga iv) Bilik Persiapan & Bilik - bilik tidur v) Dapur, Bilik air dan Tandas- tandas. ARAS ATAS : ** Anggaran keluasan keseluruhan lantai adalah < 180m2* i) Ruang Langkah ii) Dua (2) Bilik Air iii) Tiga (3) Bilik Tidur	Pukal Pukal	Pukal Pukal		
b)	Kerja membancuh dan meratakan skrid untuk menerima (bekal & pasang) jubin **LANTAI** yang baru bersaiz **600mm X 600mm** dari jenis ***homogeneous*** di ruangan tingkat bawah & atas sepertimana kelulusan dan arahan Pegawai Penguasa. ARAS BAWAH : i) Ruang Tamu ii) Ruang Makan iii) Laluan Tangga iv) Bilik Persiapan & Bilik - bilik tidur ARAS ATAS : i) Ruang Langkah ii) Tiga (3) Bilik Tidur	m2	152.00		
c)	Kerja membancuh dan meratakan skrid dan lapisan kalis air untuk menerima (bekal & pasang) jubin **LANTAI** yang baru bersaiz **600mm X 300mm** dari jenis ***homogeneous*** atau setara di ruangan tingkat bawah & atas sepertimana kelulusan dan arahan Pegawai Penguasa. i) Dapur- dapur ii) Bilik-bilik Air iii) Tandas - tandas	m2	28.00		
e)	Kerja membancuh dan meratakan skrid untuk menerima **jubin Kambi *(skiriting)*** yang baru tinggi **100mm** dari jenis homogeneous atau setara di ruangan tingkat bawah & atas sepertimana kelulusan dan arahan Pegawai Penguasa. i) Ruang Tamu & Makan ii) Laluan Tangga iii) Bilik Persiapan & Bilik - bilik tidur	m	118.00		
f)	Kerja membancuh dan meratakan skrid dan lapisan kalis air untuk menerima jubin **DINDING** yang baru bersaiz **600mm X 300mm** dari jenis homogeneous atau setara di ruangan tingkat bawah & atas sepertimana kelulusan dan arahan Pegawai Penguasa. i) Dapur- dapur ii) Bilik-bilik Air iii) Tandas - tandas	m2	151.00		
ms.6	JUMLAH DIBAWA KE MUKA SURAT 7				

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
	JUMLAH DARI MUKA SURAT 6				-
3.5	**Pintu**				
a)	Kerja-kerja menanggal, membuka dan membuang pintu dari sebarang jenis dan tebal termsauk aksesori pada panel pintu sepertimana arahan Pegawai Penguasa.	Pukal	Pukal		
b)	Bekal dan pasang **frame & panel** pintu **seperti lukisan** termasuk kerja **mengecat** kedua permukaan pintu dengan satu lapisan asas dan dua lapisan *gloss finish* sepertimana butiran pembekal dengan kelulusan dan arahan Pegawai Penguasa				
	Aras Bawah & Atas:				
	i) Pintu Dua daun 2000mm X 2700mm	no	2		
	ii) Pintu Dua daun 900mm X 1000mm (Bawah Tangga)	no	1		
	iii) Pintu Satu daun 900mm X 2100mm	no	12		
	iv) Pintu Satu daun 800mm X 2100mm	no	7		
c)	Bekal dan pasang *ironmongery* pada pintu kayu termasuk kerja-kerja				
	i) 'Syngress' atau setara tombol pintu silinder	no	22		
	ii) "Syngress' atau setara 4" x 3" x 2mm tebal *hinges*	no	66		
3.6	**Penggantian Tangga**				
a)	Menanggal, membuka, mencabut dan membuang tangga kayu sedia ada termasuk membersihkan sisa-sisa dan habuk dengan arahan Pegawai Penguasa.	Pukal	Pukal		
	** Pihak kontraktor perlu menghantar lukisan shop drawing dan dokumen-dokumen yang berkaitan bagi tujuan kelulusan Pegawai Penguasa terlebih dahulu sebelum kerja-kerja pemasangan dilaksanakan di tapak. Pegawai Penguasa berhak menolak sebarang kerja tanpa kelulusannya.*				
b)	Staircase concrete	Pukal	Pukal		
	i) Lebar 1280 mm &Tinggi antara aras bawah dan atas 3000 mm ii) Ruang panjang tangga 5400 mm iii) Susur tangan dari jenis Mild steel Railing iv) Ukuran Tread : 260mm dan Riser : 175mm				
3.7	**Kerja Mengecat**				
a)	Kerja-kerja mengikis, membersih, distemper, basuh dan tampal semua retak cat lama pada permukaan - permukaan seperti arahan Pegawai Penguasa	Pukal	Pukal		
b)	Menyediakan permukaan dan satu (1) lapisan cat alas, dua (2) lapisan cat kemasan dari jenis emulsi pada dinding partition bahagian dalam seperti arahan Pegawai Penguasa.	m2	500		
ms.7	**JUMLAH DIBAWA KE MUKA SURAT 8**				

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
	JUMLAH DARI MUKA SURAT 7				-
3.8	**Perabot Dalaman *(Built-In)***				
	** Butiran (K1 & K2) dan spefikasi kabinet rujuk lukisan* ***JPM/BPEM /ST/KUARTERSPARLIMEN/00/02***				
a)	*Kitchen Cabinet* Kerja meroboh, membuang kabinet dapur lama termasuk bekal dan pasang kabinet dapur baru dari jenis kayu atau setara termasuk kerja pengukuran,pengemukaan rekabentuk, dan mengambil kira kos penghantaran & pemasangan ke tapak.				
	i) Kabinet lantai 550mm(L) X 2550mm (P) X 800mm(T)	set	1		
	ii) Kabinet atas 360mm(L) X 2290mm (P) X 600mm(T)	set	1		
	iii) Kabinet (tabel top) 600mm(L) X 3500mm(P) X 850mm (T)	set	1		
b)	Almari Kerja meroboh, mencabut, dan membuang Almari lama termasuk bekal dan pasang Almari baru dari jenis kayu atau setara termasuk kerja pengukuran,pengemukaan rekabentuk, dan mengambil kira kos penghantaran & pemasangan ke tapak.				
	i) Kabinet almari 1290mm (L) X 1070mm (D) X 3040mm (T)	set	2		
3.9	**Ruang Laundry**				
a)	Kerja-kerja memecah **sebahagian** *counter top* di ruang dapur dan lantai sedia ada termasuk kerja-kerja pembaikan dinding yang terlibat. Anggaran keluasan 4m2	Pukal	Pukal		
b)	Kerja bekal dan pasang *floor trap* termasuk kerja-kerja pemasangan paip buang (PVC) hingga ke longkang luar bangunan	m	5		
c)	Penggantian pintu cabinet *table top* dari jenis aluminium dengan ukuran 600mm X 900mm X 2300mm	Pukal	Pukal		
d)	Bekal dan pasang singki berkembar dari jenis stainless steel termasuk kerja perpaipan dan perangkap (bottle trap) dan Swan Neck dengan kelulusan pegawai penguasa.	Pukal	1		
e)	Bekal dan pasang *Stainless Steel Wall-Mounted Retractable Drying Rack termasuk segala aksessori dengan kelulusan pegawai penguasa.*	no	1		
ms.8	**JUMLAH DIBAWA KE RINGKASAN SEBUTHARGA**				

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
4.0	**KERJA-KERJA LUAR** ** Pihak kontraktor perlu la merujuk lukisan :* ***JPM/BPEM/ST/KUARTERSPARLIMEN/00/01-02*** ***PM/BSFL/KUARTERS2930/01/01-06*** ***PM/BSFL/KUARTERS2930/05/01-04***				
4.1	**Ruang Parkir & Kaki lima**				
a)	Pecah & Buang kemasan lantai & simen skrid termasuk longkang separuh bulat disepanjang kaki lima *(apron)* . Buka, tanggal & buang kerangka bumbung termasuk bumbung metal deck dan segala aksessori berkaitan.	pukal	pukal		
b)	Kerja-kerja membina lapisan kemasan lantai dari *konkrit imprint* atau setara dengan kelulusan Pegawai Penguasa.	m2	75		
c)	Kerja-kerja pembinaan kerangka bumbung lengkap dengan tiang sokongan dan asas pad 1.0m X 1.0m (200mm tebal dengan T10-200-B/W) dengan kemasan bumbung menggunakan *metal deck* .	m2	25		
d)	Bekal & Pasang longkang separa bulat mengikut kecerunan laluan air seperti keadaan tapak termasuk dinding longkang.	m	86		
e)	Bekal dan pasang papan manis (fascia Board) dari jenis aluminium lengkap dengan pemasangan valley Gutter termasuk RWDP & segala kelengkapan penutup, liku, kepala air keluar dan lain aksesori seperti arahan Peg. Penguasa.	m	19		
4.2	**Jerejak (*Grille*) Keselamatan**				
a)	Menanggal,membuka dan membuang jeriji keselematan di pintu gelangsar, tingkap-tingkap dan pintu-pintu sedia ada di tingkat bawah dan atas bangunan.	pukal	pukal		
b)	Kerja-kerja membekal mengecat (kilat) & memasang jerejak keselamatan dari jenis besi sederhana keras termasuk kunci jenis mortice dua tuas (untuk pintu) dan satu bahagian boleh laras beserta kunci selak (untuk tingkap)dan lain-lain kelengkapan lengkap dengan cat kilat di ruang buka tingkat atas dan bawah bangunan:				
	i) T1- 2800 x 1200mm tingkap *casement* serta *top hung*	no	2		
	ii) T2- 2100 x 1200mm tingkap *casement* serta *top hung*	no	3		
	iii) T3 - 1400 x 1200mm tingkap *casement* serta *top hung*	no	18		
	iv) T4 - 1400 x 600mm tingkap *top hung*	no	5		
	v) P4 - 3600 x 2100mm pintu gelangsar	no	1		
	vi) P3 - 2000 x 2700mm pintu dua daun	no	1		
ms.9	**JUMLAH DIBAWA KE MUKA SURAT 10**				

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
	JUMLAH DARI MUKA SURAT 9				
4.3	**Bumbung**				
a)	Menanggal, membuka dan membuang kerangka, penutup bumbung pada keseluruhan bangunan	pukal	pukal		
b)	** Reka bentuk, fabrikasi, bekal dan pasang ke tapak, mengangkat ke tempat-tempat yang berkenaan kekuda dan kerangka bumbung jenis coldform mengandungi aksessori seperti, rafters, chors, bearers, tie, strut, packing piece, mild steel purlin, truss connector, straps, painting dan kerja berkaitan mengikut kencerunan.* ** Pihak kontraktor hendaklah melantik pembekal yang hanya didaftarkan di dalam sistem provider JKR Malaysia (seperti dilampiran) dan perlu mengemukakan pengiraan reka bentuk & shop drawing yang direka bentuk dan disahkan oleh Jurutera Bertauliah (Professinal Engineer) sebelum diluluskan oleh Pegawai Penguasa.* ** Segala rekabentuk dan pemasangan perlu mengikut spesifikasi* ***SPECIFICATION PREFABRICATED COLD FORMED STEEL ROOF TRUSSES*** *yang dilampirkan*				
	i) Tinggi kekuda bumbung tidak melebihi 3.5m dan keluasan adalah 250m2 dikira mendatar.	pukal	pukal		
	ii) Bekal dan Pasang penutup bumbung dari jenis Jubin Tanah liat termasuk memasang satu lapisan penebat aluminium foil dua muka di atas kasau termasuk segala aksesori- aksesori berkaitan.	m2	250		
	iii) Bekal dan pasang perabung atau limas bumbung dari jenis tanah liat lengkap dengan *fillet* simen dan pasir.	m	55		
	iv) Bekal dan pasang *flashing* bumbung pada setiap sambungan bumbung	m	36.5		
	v) Bekal dan pasang papan manis (*fascia Board)* dari jenis aluminium lengkap dengan pemasangan *valley Gutter* termasuk segala kelengkapan penutup, liku, kepala air keluar dan lain-lain aksesori seperti arahan dan kelulusan Pegawai Penguasa.	m	110		
	vi) 100mm diameter salur tegak air hujan dengan menggunakan sambungan pelipit dan dipasang pada dinding dengan pemegang paip atau pendakap. Paip air hujan hendaklah ditanam pada lantai apron.	m	56		
4.4	**Paip Retikulasi Air** ** Menggali, mengeluarkan, mengambus, menanam tanah termasuk menentukan aras, mamadatkan tanah, trim sides, planking and strutting dan membawa lebihan tanah keluar dari tapak sebagaimana arahan Pegawai Penguasa. Kerja-kerja penanam paip baru hendaklah pada kedalaman melebihi 600mm dengan bedding yang sesuai (pasir atau konkrit) bergantung keadaan di tapak.*				
a)	Paip retikulasi air sedia ada.	m	200		
b)	Tanah kambus yang dipadatkan atau *imported granular material* termasuk penyediaan *bedding.*	m3	23.4		
c)	Bekal dan pasang paip retikulasi air dari jenis HDPE 100mm paip atau setara termasuk sambungan, *bends, concrete thrust blok* lengkap dengan aksesori berkaitan.	m	260		
d)	Kerja pengujian sistem retikulasi air semasa, dan setelah kerja siap dengan kelulusan Pegawai Penguasa.	pukal	pukal		
ms.10	**JUMLAH DIBAWA KE MUKA SURAT 11**				

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
	JUMLAH DARI MUKA SURAT 10				
4.5	**Paip Kumbahan** * Menggali, mengeluarkan, mengambus, menanam tanah termasuk menentukan aras, mamadatkan tanah, *trim sides, planking and strutting* dan membawa lebihan tanah keluar dari tapak sebagaimana arahan Pegawai Penguasa. Kerja-kerja penanam paip baru hendaklah mengikut aras (*Invert level*) lurang-lurang sedia ada dengan *bedding* yang sesuai (pasir atau konkrit) bergantung keadaan di tapak.				
a)	Paip kumbahan sedia ada.	m	120		
b)	Tanah kambus yang dipadatkan atau imported granular material.	m3	18		
c)	Bekal dan pasang paip kumbahan air dari jenis *Vitrified Clay Pipe, VCP* atau setara termasuk sambungan, *bends, bedding* berdiamer 225mm lengkap dengan aksesori berkaitan.	m	120		
d)	Bekal dan Pasang tangki septik individu berkapasiti 5 P.E dari jenis HDPE atau setara lengkap dengan sambungan dan pembinaan mainhole, termasuk kerja-kerja penggalian dan menentukan aras dan membina tapak lantai yang terdiri dari satu lapis BRC A8 dengan konkrit gred 25kN/mm2 dengan arahan dan kelulusan Pegawai Penguasa.	unit	1		
e)	Pembinaan penutup lurang dari jenis *reinforced concrete*	nos	7		
f)	Kerja pengujian sistem kumbahan air semasa, dan setelah kerja siap dengan kelulusan Pegawai Penguasa.	pukal	pukal		
4.6	**Kerja Kemasan Dinding Luar**				
a)	Mengikis, menyadak, dan **membuang kesemua lapisan plaster** (kemasan kasar) di permukaan dinding	pukal	pukal		
b)	Membekal & melepa lapisan skim coat plaster system termasuk kerja-kerja menutup semua lubang udara dengan arahan pegawai menguasa.	m2	468		
c)	Menyediakan permukaan dan satu (1) lapisan cat alas, dua (2) lapisan cat kemasan dari jenis ***wheater shield*** pada permukaan dinding bahagian luar seperti arahan Pegawai Penguasa.	m2	468		
4.7	**Siling Luar** ** Butiran dan spefikasi kabinet rujuk lukisan* ***JPM/BPEM /ST/KUARTERSPARLIMEN/00/02***				
a)	Kerja membuka dan membuang siling luar dari apa-apa jenis kemasan dari tingkat bawah dan atas.	m2	70.00		
b)	Kerja-kerja bekal dan pasang siling 12.7mm USG Boral Securerock Glass-Mat Sheathing Plasterboard with RONDO Stud System to withstand wind load and moisture and mold resistance.	m2	70.00		
ms.11	**JUMLAH DIBAWA KE MUKA SURAT 12**				

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
	JUMLAH DARI MUKA SURAT 11				-
4.8	**Premix**				
a)	*Resurfacing works* - Bersih, Membekal, menghampar dan memadatkan 50mm premix (ACW14) dengan menggunakan mesin Roller 3 Tan sebagai wearing course termasuk tack coat (0025-0.55liter/m2 jenis RS-1K) pada permukaan jalan sedia ada sepertimana arahan Pegawai Penguasa.	m2	190.00		
b)	*Road Construction* - Kerja-kerja mengorek dan membuang tanah sedia ada dengan kedalaman 300mm	m2	235.00		
c)	Membina dan menyiapkan jalan dalaman kawasan hadapan kuarters yang terdiri daripada 150mm Sub Base, 60mm *binder course*, 50mm (ACW 14).	m2	235.00		
4.9	**Pagar & Longkang Kawasan**				
a)	Pembinaan konkrit kerb 100mm sepanjang pagar kawasan (anti-climb) dibahagian atas rasuk tanah.(anggaran panjang < 550m)	pukal	pukal		
b)	Pembersihan longkang kawasan membuang tanah & selut dalam longkang kawasan.	m	250.00		
c)	Pembaikan longkang sedia ada menutup mana-mana lubang yang terdedah sama ada pada permukaan longkang & dinding longkang.	m	50.00		
4.10	**Anti Climb fence**				
a)	Kerja-kerja membekal dan memasang pintu pagar jenis 'anti-climb' dan tiang jenis 'Hot-dip Galvanised Iron' yang ditanam di dalam konkrit serta segala kelengkapan yang lengkap dengan kelulusan Pegawai Penguasa.	m	45		
ms.12	**JUMLAH DIBAWA KE RINGKASAN SEBUTHARGA**				

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
5.0	**SANITARY FITTING** *Bekal dan pasang sanitary appliances dan accessories termasuk menyimpan, memasang, bedding, plugging and screwing with matching screws, cutting and pinning or building in brackets, jointing dan sambungan dan soil pipe and making good all work disturbed all as per S.O. instruction and approval.*				
a)	'Johnson Suisse Bergamo Square' or approved equivalent water closet 6 liters dual flush system overall size 770mm x 365mm x 770mm high c/w 'S' or 'P' trap with internal flushing mechanism and medium duty seat cover in matching colour including all necessary accessories	no	5		
b)	'Johnson Suisse Boston 600 Clinical' or approved equivalent wall hung basin overall size 610mm x 410mm x 215mm high c/w 32mm PVC waste, stainless steel bottle trap size 226mm, plug and chain and fixing in position and jointing outlet to waste pipe	no	5		
c)	'Johnson Suisse Ferla-N' or approved equivalent pillar tap	no	5		
d)	'Johnson Suisse' or approved equivalent hand bidet c/w 1.2m flexible hose and wall bracket	no	5		
e)	Johnson Suisse Rivoli' or approved equivalent soap dispenser overall size 415mm x 580mm x 210mm high	no	5		
f)	Johnson Suisse ASTI-N' or approved equivalent chrome plated 1/2" concealed stop valve with flange	no	5		
g)	Johnson Suisse' or approved equivalent floor trap ceramic tile drainage size 130mm x 130mm	no	5		
h)	Johnson Suisse Colonial' or approved equivalent flexible hose double interlock hose length 1.5m c/w shower head	no	5		
i)	450mm x 600mm x 6mm thick mirror on and including 12mm ply backing to be clipped with 50mm wide stainless steel capping all around secure fixed to wall with dome headed screw	no	5		
j)	Stainless steel double bowl double drainer kitchen sink complete with 40mm waste, plug and chain, PVC bottle trap, pair of painted brackets including plugging to wall tiles.	no	3		
k)	Chrome plated wall mounted sink tap with high swivel apout and quarter turn cartridge including all necessary accessories	no	2		
ms.13	**JUMLAH DIBAWA KE RINGKASAN SEBUTHARGA**				

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
6.0	**KERJA-KERJA PERPAIPAN BEKALAN AIR SEJUK DALAMAN DAN SANITARI**				
a)	Kontraktor hendaklah menyediakan *shop-drawing* dan melantik orang yang berkelayakan untuk penyerahan, penyeliaan, pembinaan dan menyediakan spesifikasi kerja yang lengkap.	L.S	-		
b)	Menanggal, membuang dan melupus semua paip air bekalan, *waste*, *soil* dan *vent pipes* lama sedia ada di tapak.	L.S	-		
6.1	**PEMASANGAN *PERPAIPAN BEKALAN AIR SEJUK DALAMAN***				
	Bekal dan pasang paip *Acrylonitrile Butadiene Styrene* (ABS) pelbagai saiz bersama kelengkapan seperti yang telah dinyatakan untuk digunakan untuk paip pengagihan termasuk semua penggalian yang diperlukan, sambungan antara penyambungan ke tangki simpanan air, kelengkapan paip yang diperlukan, stopcock dan bukaan yang diperlukan di bumbung, semua lantai yang diperlukan mengikut laluan paip sedia ada.				
	Paip masuk dan paip agihan ditebuk melalui *dropper paip* masuk ke tandas/bilik mandi/dapur/peralatan secara individu termasuk kerja-kerja memecah dan membaikpulih kemasan serta semua aksesori yang diperlukan.				
	Paip Masuk ke Tangki Air				
a)	i. Diameter 25mm	M	45.00		
	Paip Keluar dari Tangki Air 1				
b)	i. Diameter 50mm	M	4.00		
	Paip Keluar dari Tangki Air 2				
c)	i. Diameter 32mm	M	3.00		
	BILIK AIR UTAMA				
d)	i. Diameter 25mm	M	30.00		
e)	ii. Diameter 20mm	M	26.00		
	BILIK AIR 2				
f)	i. Diameter 25mm	M	12.00		
g)	ii. Diameter 20mm	M	10.00		
	BILIK AIR 1				
h)	i. Diameter 25mm	M	12.00		
i)	ii. Diameter 20mm	M	15.00		
	SINKI DAPUR & *GARDEN TAP*				
j)	i. Diameter 20mm	M	15.00		
k)	ii *G.I Pipe* Diameter 20mm dan kepala paip - luar rumah	M	2.00		
	BILIK MANDI & TANDAS 2				
l)	i. Diameter 20mm	M	27.00		
	SINKI RUANG JEMURAN & *LAUNDRY TAP*				
m)	i. Diameter 20mm	M	4.00		
ms.14	**JUMLAH DIBAWA KE MUKA SURAT 15**				

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
	JUMLAH DARI MUKA SURAT 14				
6.2	**TANGKI SIMPANAN AIR**				
	Bekal dan pasang *High Density Polyethylene* (HDPE) seperti yang dinyatakan lengkap dengan aksesori serta kelengkapan, alas tangki pada bumbung yang memiliki kelulusan SPAN/SIRIM. Tangki air dinaikkan dan diletakkan pada kedudukan mengikut arahan pengilang.				
a)	Kapasiti : 4500liter (1000*gallons*) Diameter : 1755mm *Height Body* : 1760mm *Height Tank* : 2180mm	NO	1		
	Bekal dan pasang *High Density Polyethylene* (HDPE) seperti yang dinyatakan lengkap dengan aksesori serta kelengkapan, alas tangki pada bumbung yang memiliki kelulusan SPAN/SIRIM. Tangki air dinaikkan dan diletakkan pada kedudukan mengikut arahan pengilang.				
b)	Kapasiti : 1350liter (300gallons) *Top* : 1524mm x 1575mm *Base* : 1143mm x 1143mm *Height Body* : 1194mm *Height Top* : 1270mm	NO	1		
6.3	**PEMASANGAN PERPAIPAN SANITARI**				
	Paip *Soil, Waste* dan *Vent* jenis *Unplasticised polyvinyl cholide* (uPVC) dan kelengkapan yang memiliki kelulusan SIRIM/SPAN.				
	Paip *waste water, soil* dan *vent* beserta kelengkapan yang diperlukan daripada kelengkapan sanitari dan perangkap lantai juga jeriji alur keluar ke lubang penyambung atau longkang saluran air termasuk semua penggalian yang diperlukan, selongsong konkrit di sekeliling kerja pemasangan paip, sambungan dengan penyambung yang diperlukan kepada peralatan sanitari, bukaan yang diperlukan, keperluan untuk pengaliran di bumbung, lantai, rasuk dan dinding.				
	BILIK AIR UTAMA				
a)	i. *Soil Pipe / Soil Stack* Diameter 100mm	M	15.00		
b)	ii.*Vent Pipe* Diameter 50mm	M	8.00		
c)	iii.*Waste Pipe* Diameter 80mm	M	6.00		
d)	iii.*Waste Pipe* Diameter 32mm	M	5.00		
	BILIK AIR 2				
e)	i. *Soil Pipe / Soil Stack* Diameter 100mm	M	15.00		
f)	ii.*Vent Pipe* Diameter 50mm	M	8.00		
g)	iii.*Waste Pipe* Diameter 80mm	M	6.00		
h)	iii.*Waste Pipe* Diameter 32mm	M	5.00		
	TANDAS 1				
i)	i. *Soil Pipe* Diameter 100mm	M	8.00		
j)	ii. *Vent Pipe* Diameter 50mm	M	8.00		
ms.15	**JUMLAH DIBAWA KE MUKA SURAT 16**				

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
	JUMLAH DARI MUKA SURAT 15				
	SINKI DAPUR				
k)	i .Waste Pipe Diameter 100mm	M	8.00		
	BILIK MANDI & TANDAS 2				
l)	i. *Soil Pipe* Diameter 100mm	M	8.00		
m)	ii. *Vent Pipe* Diameter 50mm	M	8.00		
	SINKI RUANG JEMURAN & LAUNDRY TAP				
n)	ii. Soil *Pipe* Diameter 100mm	M	8.00		
o)	iii.*Waste Pipe* Diameter 100mm	M	10.00		
	PEMASANGAN PERPAIPAN SANITARI				
6.4	**Paip *Vitrified Clay Pipes* dan kelengkapan yang memiliki kelulusan SIRIM/SPAN.**				
	Paip *waste water, soil* dan *vent* beserta kelengkapan yang diperlukan daripada kelengkapan sanitari dan perangkap lantai juga jeriji alur keluar ke lubang penyambung atau longkang saluran air termasuk semua penggalian yang diperlukan, selongsong konkrit di sekeliling kerja pemasangan paip, sambungan dengan penyambung yang diperlukan kepada peralatan sanitari, bukaan yang diperlukan, keperluan untuk pengaliran di bumbung, lantai, rasuk dan dinding.				
a)	i. Diameter 100mm	M	20.00		
	Perangkap Parit (*Gully Trap*)				
b)	Perangkap Parit (Gully Trap) terdiri daripada ruang dalam saiz 300mm x 300mm x 760mm (kedalaman maksimum), dinding bata setebal 115mm lengkap dengan penutup perangkap besi tuang; penggalian lubang bermula dari aras tanah dan melupus sisa bahan yang digali.	NO	4.00		
	Ruang Pemeriksaan *(Inspection Chamber)*				
	Ruang Pemeriksaan (Inspection Chamber) mengikut saiz dan butiran seperti yang dinyatakan lengkap dengan penutup manhole dan rangka (diluluskan oleh pihak berkuasa tempatan); Papak konkrit RC dengan BRC, dinding bata dengan plaster simen, konkrit nipis dan termasuk penggalian lubang bermula dari aras tanah dan melupus semua sisa bahan dikorek, tetulang, acuan dan kerja-kerja lain yang berkaitan .				
c)	Saiz dalam 1050mm x 900mm; tidak melebihi 2.0m	NO	5.00		
6.5	**PENGUJIAN DAN PENTAULIAHAN**				
	Pemasangan Perpaipan Bekalan Air Sejuk Dalaman				
a)	Menjalankan pengujian pada semua pemasangan paip bekalan air sejuk dalaman, kelengkapan dan aksesori. Membaiki kerosakan serta menyerahkan dalam keadaan yang sempurna dan teratur seperti mana kelulusan dan persetujuan Pegawai Penguasa.	ITEM	-		
	Pemasangan Perpaipan Sanitari				
b)	Menjalankan pengujian pada semua pemasangan paip sanitari, kelengkapan dan aksesori. Membaiki kerosakan serta menyerahkan dalam keadaan yang sempurna dan teratur seperti mana kelulusan dan persetujuan Pegawai Penguasa.	ITEM	-		
	Lain-lain yang tidak dinyatakan di atas tetapi perlu untuk pemasangan lengkap;				
c)	i.				
d)	ii.				
e)	iii.				
ms.16	**JUMLAH DIBAWA KE RINGKASAN SEBUTHARGA**				

PARLIMEN MALAYSIA

SEBUTHARGA : PAR.2/367 SH. /2025

TAJUK KERJA : KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

Sebarang butiran yang tidak diperhargakan adalah di anggap telah dimasukkan di dalam harga butiran-butiran lain. Penyebut harga adalah di anggap telah melawat tapak bina serta memahami Syarat-Syarat Kontrak, Spesifikasi Kerja Tambahan, Spesifikasi Piawai dan Lukisan-Lukisan Kontrak untuk memastikan sendiri kerja yang terlibat sebelum menghargakan sebut harga kerana sebarang bayaran tambahan berhubung dengan perkara di atas tidak akan dipertimbangkan.

Semua kuantiti yang diberi adalah kuantiti sementara sahaja. Pengukuran semula akan dibuat setelah semua kerja-kerja siap dijalankan.

BIL.	BUTIRAN KERJA DAN SYARAT-SYARAT	UNIT	QTY	KADAR HARGA (RM)	JUMLAH (RM)
7.0	**KERJA-KERJA ELEKTRIK** **Kontraktor perlu mengemukakan *method statement*, bahan, spesifikasi dan dokumen-dokumen yang berkaitan untuk kelulusan Pegawai Penguasa. Pegawai Penguasa berhak menolak bahan yang dipasang di tapak sekiranya bahan tersebut tidak diluluskan. Segala kerugian terhadap perkara tersebut akan ditanggung oleh pihak kontraktor.** **Setiap Harga Kerja mestilah termasuk kos-kos logi dan pengangkutan, kos operasi, kos upah, wastage, keuntungan dan lain-lain.**				
A	**SISTEM ELEKTRIK DI DALAM BANGUNAN** **Membekal dan memasang semua bahan mengikut spesifikasi piawai JKR dan Suruhanjaya Tenaga secara pendawaian permukaan atau terbenam dengan menggunakan kabel PVK di dalam G.S. konduit (berwarna oren) l/d aksesori berkaitan melainkan dinyatakan.** **Membaiki/menyelenggara/mengganti/membaikpulih sebagaimana asal kelengkapan sistem elektrikal sedia ada di dalam bangunan l/d aksesori berkaitan mengikut spesifikasi standard JKR L-S1 yang terkini dan Suruhanjaya yang ditetapkan.** **Nota :** **i) Semua kabel hendaklah menggunakan material tembaga melainkan dinyatakan.** **ii) Semua penamatan kabel hendaklah l/d sistem pembumian selaras dengan standard dan piawaian JKR.** **iii) Semua barang dan peralatan yang digunakan mestilah mengikut spesifikasi dan diluluskan oleh JKR (Sila rujuk senarai kelulusan bahan EMAL JKR di website https://jmal.jkr.gov.my/emalv3/)** **iv) Semua lampu jenis LED mestilah mengikut spesifikasi L-S1 *(Specification for Low Voltage Internal Electrical Installation)* yang terkini.** **v) Minima *nominal lifetime* untuk T8 LED mestilah 30,000 hours** **vi) Semua tiub LED mestilah mematuhi *photobiological safety class, exempt group* sebagaimana IEC 62471** **vii) Semua kerja oleh Pihak Kontraktor perlu la merujuk lukisan :** ***PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/01-04*** ***PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/06-07***				
ms.17	JUMLAH DIBAWA KE MUKA SURAT 18				

	JUMLAH DARI MUKA SURAT 17				
7.1	**ARAS BAWAH**				
7.1.1	**PENDAWAIAN PERMUKAAN ATAU TERBENAM**				
a)	Mata lampu pendawaian 1 hala menggunakan kabel 2 x 1.5mm persegi jenis PVK l/d kabel perlindungan dan lain-lain aksesori berkaitan.				
	i) Ruang Tamu	Nos.	2		
	ii) Ruang Makan	Nos.	2		
	iii) Tandas 1	No.	1		
	iv) Stor 1	No.	1		
	v) Bilik 4	Nos.	2		
	vi) Bilik 5	Nos.	2		
	vii) Porch 1	Nos.	2		
	viii) Koridor 2	Nos.	3		
	ix) Foyer 2	Nos.	4		
	x) Porch 2	Nos.	2		
	xi) Koridor 3	Nos.	4		
	xii) Koridor 4	Nos.	3		
	xiii) Ruang Jemuran	Nos.	2		
	xiv) Ruang Keluarga	Nos.	2		
	xv) Stor 2	No.	1		
	xvi) Stor 3	No.	1		
b)	Mata lampu pendawaian 2 hala menggunakan kabel 2x1.5mm persegi jenis PVK l/d kabel perlindungan dan lain-lain aksesori berkaitan.				
	i) Bilik Penyediaan	No.	1		
	ii) Dapur	Nos.	2		
	iii) Koridor 1	Nos.	3		
	iv) Laluan 2	No.	1		
	v) Bilik Mandi	No.	1		
	vi) Tandas 2	No.	1		
	vii) Laluan 1	No.	1		
	viii) Foyer 1	No.	1		
c)	Mata kipas siling l/d penyambung 10A 3 hala dan cangkuk penggantung menggunakan kabel 2x1.5mm persegi jenis PVK l/d kabel perlindungan dan lain-lain aksesori berkaitan.				
	i) Ruang Tamu	No.	1		
	ii) Ruang Makan	No.	1		
	iii) Bilik 4	No.	1		
	iv) Bilik 5	No.	1		
	v) Ruang Keluarga	No.	1		
d)	Mata kipas lekapan dinding l/d ros siling menggunakan kabel 2x1.5mm persegi jenis PVK l/d kabel perlindungan dan suis kutub tunggal terlitup logam (metalclad) 10A 1 Gang 1 Hala l/d kotak pelekap serta lain-lain aksesori berkaitan.				
	i) Bilik Penyediaan	No.	1		
e)	Mata kipas pelawas l/d ros siling **(tidak termasuk menyediakan bukaan)** menggunakan kabel 2x1.5mm persegi jenis PVK l/d kabel perlindungan dan lain-lain aksesori berkaitan.				
	i) Dapur	No.	1		
	ii) Ruang Jemuran	No.	1		
f)	Mata soket alur keluar kuasa l/d suis soket alur keluar 13A 3 pin jenis suis terlitup logam (metalclad) l/d kotak pelekap menggunakan kabel 2x4mm persegi PVK l/d kabel perlindungan dan lain-lain aksesori berkaitan. **(Ketinggian 300mm dari aras lantai).**				
	i) Ruang Tamu	Nos.	6		
	ii) Ruang Makan	Nos.	4		
	iii) Stor 1	No.	1		
	iv) Bilik 4	Nos.	2		
	v) Bilik 5	Nos.	2		
	vi) Laluan 1	No.	1		
	vii) Stor 2	No.	1		
ms.18	JUMLAH DIBAWA KE MUKA SURAT 19				

	JUMLAH DARI MUKA SURAT 18				
g)	Mata soket alur keluar kuasa l/d suis soket alur keluar 13A 3 pin jenis suis terlitup logam *(metalclad)* l/d kotak pelekap menggunakan kabel PVK 2x4mm persegi l/d kabel perlindungan dan lain-lain aksesori berkaitan. **(Ketinggian 1450mm dari aras lantai).**				
	i) Bilik Penyediaan	Nos.	5		
	ii) Dapur	Nos.	6		
	iii) Koridor 1	Nos.	2		
	iv) Ruang Jemuran	Nos.	2		
h)	Mata penyaman udara sehingga 2 kuasa kuda l/d soket alur keluar 15A 3 pin jenis suis terlitup logam (*metalclad*) l/d kotak pelekap, suis dua kutub 30A terlitup logam (*metalclad*) dengan lampu penunjuk **(ketinggian 300mm di bawah aras siling dan berdekatan dengan unit penyaman udara)** menggunakan kabel 2x6mm persegi jenis PVK l/d kabel perlindungan dan lain-lain aksesori berkaitan.				
	i) Ruang Tamu	No.	1		
	ii) Bilik 4	No.	1		
	iii) Bilik 5	No.	1		
i)	Mata pemanas air sehingga 3.6kW l/d suis dua kutub 20A terlitup logam (*metalclad*) dengan lampu penunjuk dan suis soket alur keluar 15A 3 pin jenis suis terlitup logam (*metalclad*) l/d kotak pelekap **(ketinggian 300mm di bawah aras siling dan berdekatan dengan unit pemanas air)** menggunakan kabel 2x4mm persegi jenis PVK l/d kabel perlindungan dan lain-lain aksesori berkaitan.				
	i) Tandas 1	No.	1		
	ii) Bilik Mandi	No.	1		
j)	Mata loceng tekan/pembaz/chime l/d suis tekan loceng/ pembaz/ chime 10A jenis *waterproof* menggunakan kabel 2 x 1.5mm persegi PVC/SWA/PVC dan lain-lain aksesori berkaitan termasuk kerja-kerja menggali, menabur pasir dan memampat semula tanah.	No.	1		
k)	Membekal dan memasang kabel *submain* , di dalam konduit keluli bergalvani, trunking keluli bergalvani atau talam penatang kabel keluli bergalvani mengikut spesifikasi JKR yang berikut. **(Dari DB Aras Bawah ke DB Aras Atas)**				
	4 x 25mm persegi jenis PVK l/d pengalir perlindungan	Meter	20		
7.1.2	**MEMBEKAL DAN MEMASANG**				
a)	Lengkapan lampu LED jenis salur lengkap dengan tiub LED T8 2 pin jenis G13, ≤20W (1200mm) , 6500K serta lengkap dengan aksesori berkaitan.				
	i) Ruang Tamu	Nos.	2		
	ii) Ruang Makan	Nos.	2		
	iii) Laluan 1	No.	1		
	iv) Tandas 1	No.	1		
	v) Stor 1	No.	1		
	vi) Bilik Penyediaan	No.	1		
	vii) Dapur	Nos.	2		
	viii) Ruang Keluarga	Nos.	2		
	ix) Bilik 4	Nos.	2		
	x) Bilik 5	Nos.	2		
	xi) Tandas 2	No.	1		
	xii) Porch 1	Nos.	2		
	xiii) Koridor 2	Nos.	3		
	xiv) Foyer 2	Nos.	4		
	xv) Porch 2	Nos.	2		
	xvi) Koridor 3	Nos.	4		
	xvii) Koridor 4	Nos.	3		
	xviii) Foyer 1	No.	1		
ms.19	JUMLAH DIBAWA KE MUKA SURAT 20				

	JUMLAH DARI MUKA SURAT 19				
b)	Lengkapan lampu LED jenis salur lengkap dengan tiub LED T8 2 pin jenis G13, ≤11W (600mm), 6500K serta lengkap dengan aksesori berkaitan.				
	i) Koridor 1	Nos.	3		
	ii) Bilik Mandi	No.	1		
	iii) Laluan 2	No.	1		
	iv) Ruang Jemuran	Nos.	2		
	v) Stor 2	No.	1		
	vi) Stor 3	No.	1		
c)	Lengkapan kipas siling saiz 1524mm (60") g.p. l/d pengatur, rod gantung, kabel keselamatan, ciri-ciri keselamatan pemutus bekalan serta lengkap dengan aksesori berkaitan.				
	i) Ruang Tamu	No.	1		
	ii) Ruang Makan	No.	1		
	iii) Bilik 4	No.	1		
	iv) Bilik 5	No.	1		
	v) Ruang Keluarga	No.	1		
d)	Kipas lekapan dinding, 400mm.(16") g.p. l/d *pull cord switch* dan *speed control* serta lain-lain aksesori berkaitan.				
	i) Bilik Penyediaan	No.	1		
e)	Kipas pelawas 300mm. (12") g.p l/d penutup automatik dan lain-lain aksesori berkaitan.				
	i) Dapur	No.	1		
	ii) Ruang Jemuran	No.	1		
f)	Suis kutub tunggal terlitup logam (*metalclad*) l/d kotak pelekap serta lengkap dengan aksesori berkaitan untuk lampu dan kipas pelawas:				
	10A, 1 Gang 1 Hala				
	i) Tandas 1	No.	1		
	ii) Stor 1	No.	1		
	iii) Foyer 2	No.	1		
	iv) Koridor 4	No.	1		
	v) Dapur	No.	1		
	10A, 2 Gang 1 Hala				
	i) Koridor 3 & Porch 2	No.	1		
	ii) Koridor 2 & Porch 1	No.	1		
	iii) Ruang Jemuran	No.	1		
g)	Suis kutub tunggal terlitup logam (*metalclad*) l/d kotak pelekap serta lengkap dengan aksesori berkaitan untuk lampu:				
	10A, 1 Gang 2 Hala				
	i) Laluan 3	No.	1		
	ii) Bilik Penyediaan	Nos.	2		
	iii) Koridor 1	Nos.	2		
	iv) Dapur	Nos.	2		
	10A, 2 Gang 2 Hala				
	i) Laluan 1 & Foyer 1	Nos.	2		
	10A, 3 Gang 2 Hala				
	i) Laluan 2, Tandas 2 & Bilik Mandi	Nos.	2		
ms.20	JUMLAH DIBAWA KE MUKA SURAT 21				

	JUMLAH DARI MUKA SURAT 20				
h)	Suis pelit leper kutub tunggal serta lengkap dengan aksesori berkaitan.				
	(Untuk Suis Panel)				
	10A, 2 Gang 1 Hala				
	i) Bilik 4	No.	1		
	ii) Bilik 5	No.	1		
	iii) Ruang Keluarga	No.	1		
	10A, 3 Gang 1 Hala				
	i) Ruang Tamu & Ruang Makan	No.	2		
i)	Suis Panel (*metalclad*) l/d aksesori berkaitan.				
	280mm(T) x 130mm(P) x 50mm (L)				
	(untuk 1 pengatur dan 1 no. suis)				
	i) Bilik 4	No.	1		
	ii) Bilik 5	No.	1		
	iii) Ruang Keluarga	No.	1		
	280mm(T) x 260mm(P) x 50mm (L)				
	(untuk 2 pengatur dan 2 nos. suis)				
	I) Ruang Tamu & Ruang Makan	No.	1		
j)	Chime elektrik 2 nada, 8V a.u	No.	1		
7.2	**ARAS ATAS**				
7.2.1	**PENDAWAIAN PERMUKAAN ATAU TERBENAM**				
a)	Mata lampu pendawaian 1 hala menggunakan kabel 2x1.5mm persegi jenis PVK l/d kabel perlindungan dan lain-lain aksesori berkaitan.				
	i) Bilik Tidur Utama	Nos.	3		
	ii) Bilik Air Utama	No.	1		
	iii) Bilik Tidur 1	Nos.	2		
	iv) Bilik Tidur 2	Nos.	3		
	v) Stor 4	No.	1		
b)	Mata lampu pendawaian 2 hala menggunakan kabel 2x1.5mm persegi jenis PVK + kabel perlindungan dan lain-lain aksesori berkaitan.				
	I) Laluan 3	No.	1		
	ii) Bilik Air 2	No.	1		
c)	Mata kipas siling l/d penyambung 10A 3 hala dan cangkuk penggantung menggunakan kabel 2x1.5mm persegi jenis PVK l/d kabel perlindungan dan lain-lain aksesori berkaitan.				
	i) Bilik Tidur Utama	No.	1		
	ii) Bilik Tidur 1	No.	1		
	iii) Bilik Tidur 2	Nos.	2		
d)	Mata soket alur keluar kuasa l/d suis soket alur keluar 13A 3 pin jenis suis terlitup logam *(metalclad)* l/d kotak pelekap menggunakan kabel 2x4mm persegi PVK l/d kabel perlindungan dan lain-lain aksesori berkaitan. **(Ketinggian 300mm dari aras lantai).**				
	i) Bilik Tidur Utama	Nos.	4		
	ii) Bilik Tidur 1	Nos.	2		
	iii) Bilik Tidur 2	Nos.	3		
	iv) Stor 4	No.	1		
e)	Mata penyaman udara sehingga 2 kuasa kuda l/d suis dua kutub 30A terlitup logam (metalclad) dengan lampu penunjuk, soket alur keluar 15A 3 pin jenis suis terlitup logam (*metalclad*) l/d kotak pelekap **(ketinggian 300mm di bawah aras siling dan berdekatan dengan unit penyaman udara)** menggunakan kabel 2x6mm persegi jenis PVK l/d kabel perlindungan dan lain-lain aksesori berkaitan.				
	i) Bilik Tidur Utama	No.	1		
	ii) Bilik Tidur 1	No.	1		
	iii) Bilik Tidur 2	No.	1		
ms.21	JUMLAH DIBAWA KE MUKA SURAT 22				

	JUMLAH DARI MUKA SURAT 21				
f)	Mata pemanas air sehingga 3.6kW l/d suis dua kutub 20A terlitup logam (*metalclad*) dengan lampu penunjuk, soket alur keluar 15A 3 pin jenis suis terlitup logam (*metalclad*) l/d kotak pelekap **(ketinggian 300mm di bawah aras siling dan berdekatan dengan unit pemanas air)** menggunakan kabel 2x4mm persegi jenis PVK + kabel perlindungan dan lain-lain aksesori berkaitan.				
	i) Bilik Air Utama	No.	1		
	ii) Bilik Air 2	No.	1		
7.2.2	**MEMBEKAL DAN MEMASANG**				
a)	Lengkapan lampu LED jenis salur lengkap dengan tiub LED T8 2 pin jenis G13, ≤20W (1200mm), 6500K serta lengkap dengan aksesori berkaitan.				
	i) Laluan 3	No.	1		
	ii) Bilik Tidur Utama	Nos.	3		
	iii) Bilik Air Utama	No.	1		
	iv) Bilik Tidur 1	Nos.	2		
	v) Bilik Tidur 2	Nos.	3		
	vi) Bilik Air 2	No.	1		
	vi) Stor 4	No.	1		
b)	Lengkapan kipas siling saiz 1524mm (60") g.p. l/d pengatur, rod gantung, kabel keselamatan, ciri-ciri keselamatan pemutus bekalan serta lengkap dengan aksesori berkaitan.				
	i) Bilik Tidur Utama	No.	1		
	ii) Bilik Tidur 1	No.	1		
	iii) Bilik Tidur 2	Nos.	2		
c)	Suis kutub tunggal terlitup logam (*metalclad*) l/d kotak pelekap serta lengkap dengan aksesori berkaitan untuk lampu:				
	10A, 1 Gang 1 Hala				
	i) Bilik Air Utama	No.	1		
	ii) Stor 4	No.	1		
d)	Suis kutub tunggal terlitup logam (*metalclad*) l/d kotak pelekap serta lengkap dengan aksesori berkaitan untuk:				
	10A, 1 Gang 2 Hala				
	i) Laluan 3	No.	1		
	ii) Bilik Air 2	Nos.	2		
e)	Suis pelit leper kutub tunggal serta lengkap dengan aksesori berkaitan. **(Untuk Suis Panel)**				
	10A, 2 Gang 1 Hala				
	i) Bilik Tidur 1	No.	1		
	ii) Bilik Tidur 2	Nos.	2		
	10A, 3 Gang 1 Hala				
	i) Bilik Tidur Utama	No.	1		
f)	Suis Panel (*metalclad*) l/d aksesori berkaitan.				
	280mm(T) x 130mm(P) x 50mm (L)				
	(untuk 1 pengatur dan 1 no. suis)				
	i) Bilik Tidur 1	No.	1		
	ii) Bilik Tidur Utama	No.	1		
	280mm(T) x 260mm(P) x 50mm (L)				
	(untuk 2 pengatur dan 2 nos. suis)				
	i) Bilik Tidur 2	No.	1		
ms. 22	JUMLAH DIBAWA KE MUKA SURAT 23				

	JUMLAH DARI MUKA SURAT 22				
B	**SISTEM ELEKTRIK DI LUAR BANGUNAN** **Membekal dan memasang semua bahan mengikut spesifikasi standard JKR dan Suruhanjaya Tenaga secara pendawaian permukaan dengan menggunakan kabel PVK di dalam G.S. konduit (berwarna oren) l/d aksesori berkaitan melainkan dinyatakan.** **Membaiki/menyelenggara/mengganti/membaikpulih sebagaimana asal kelengkapan sistem elektrikal sedia ada di dalam bangunan l/d aksesori berkaitan mengikut spesifikasi standard JKR L-S1 yang terkini dan Suruhanjaya yang ditetapkan.** **Nota :** **i) Semua kabel hendaklah menggunakan material tembaga melainkan dinyatakan.** **ii) Semua penamatan kabel hendaklah l/d sistem pembumian selaras dengan standard dan piawaian JKR.** **iii) Semua barang dan peralatan yang digunakan mestilah mengikut spesifikasi dan diluluskan oleh JKR (Sila rujuk senarai kelulusan bahan EMAL JKR di website https://jmal.jkr.gov.my/emalv3/)** **iv) Semua kerja oleh Pihak Kontraktor perlu la merujuk lukisan :** ***PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/01*** ***PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/03*** ***PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/05-07***				
7.3	**KERJA-KERJA LUAR**				
7.3.1	**KERJA-KERJA PEMASANGAN LAMPU LIMPAH (*FLOOD LIGHT*) JENIS LED**				
a)	Mata lampu pendawaian l/d kotak pelekap, menggunakan kabel 2x2.5mm persegi jenis PVK dan geganti masa 24 jam l/d kabel perlindungan dan lain-lain aksesori berkaitan.				
	i) Aras Bawah	Nos.	2		
	ii) Aras Atas	Nos.	4		
b)	Membekal dan memasang 150W lampu limpah LED (CCT :6000K - 6500K, IP65) lengkap dengan SPD terbina dalam (*built in*).				
	i) Aras Bawah	Nos.	2		
	ii) Aras Atas	Nos.	4		
7.3.2	**KERJA-KERJA PEMASANGAN LAMPU PAGAR JENIS LED**				
a)	Mata lampu pendawaian menggunakan kabel 2x4mm persegi PVC/SWA/PVC dan lain-lain aksesori berkaitan termasuk kerja-kerja menggali, menabur pasir dan memampat semula tanah.	Meter	70		
b)	Membekal dan memasang minimum 16W lampu pagar jenis LED (CCT :3000K, IP55) l/d *loop in loop out box* pada *electrogalvanised junction box* jenis kalis cuaca (IP54) l/d *cable gland* termasuk 20mm diameter G.S. konduit dan lain-lain aksesori berkaitan.	Nos.	2		
7.3.3	**KERJA-KERJA PEMASANGAN LAMPU KAWASAN**				
a)	Kerja-kerja membekal, memasang, menyambung, mematerí penghujung kabel, menggali parit, menabur pasir, menyusun batu-bata / penutup kabel perlindungan uPVC (uPVC cable protective covers), mengambus, memantak, merentang tali nylon 6 mm g.p, batu penanda kabel dan memampatkan selaras dengan peraturan standard JKR termasuk harga tenaga kerja, jentera dan bahan. Kabel PVC/SWA/PVC jenis KUPRUM 6.0mm persegi 2 teras.	Meter	85		
b)	Membekal dan memasang semua bahan mengikut spesifikasi piawai JKR bagi Tiang Lipat Patah (*Mid-hinged Pole*) jenis bergalvani rendam panas (*hot dipped galvanised*) untuk ketinggian 7 meter l/d Service Box serta kerja-kerja berkaitan. [Tiang jenis bebibir (*Flange Type*)]	Nos.	2		
c)	Membekal dan memasang lampu kawasan mengikut spesifikasi JKR L-S20 (>100lm/w) jenis LED 100W lengkap dengan Kawalan Elektronik Gear (*Driver*) dan Perlindungan SPD terbina (*Built-in*)	Nos.	2		
d)	Membekal dan memasang asas konkrit untuk tiang lampu jenis berbibir (*flanged mounted*) yang berketinggian 7 meter mengikut spesifikasi yang telah ditetapkan oleh pengilang.	Nos.	2		
e)	Pendawaian dalam tiang menggunakan 2 x 2.5mm PVC/PVC l/d kabel perlindungan dan pemutus litar kecil (MCB) & neutral link untuk lantera perlampuan jalan atau kawasan.	Nos.	2		
ms.23	JUMLAH DIBAWA KE MUKA SURAT 24				

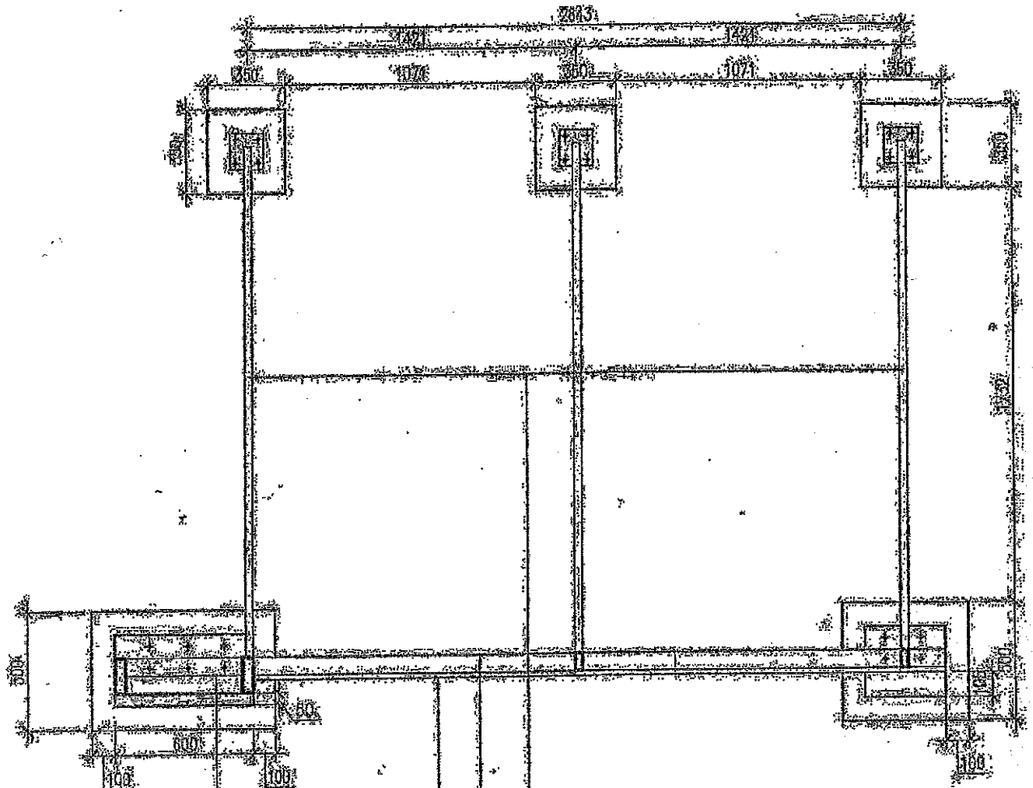
	JUMLAH DARI MUKA SURAT 23				
7.3.4	**Kerja-kerja membekal, memasang, menyambung, mematerí penghujung kabel, menggali parit, menabur pasir, menyusun batu-bata / penutup kabel perlindungan uPVC (*uPVC cable protective covers*), mengambus, memantak, merentang tali nylon 6 mm g.p, batu penanda kabel dan memampatkan selaras dengan peraturan standard JKR termasuk harga tenaga kerja, jentera dan bahan. Kabel jenis KUPRUM**				
a)	Kabel XLPE/SWA/PVC (dari Meter TNB ke DB Utama): 25mm persegi 4 teras	Meter	50		
7.3.5	Membekal dan memasang Papan meter terlitup logam (metalclad) l/d lapisan kepingan penebat untuk meter TNB 3 Fasa l/d aksesori dan kerja-kerja yang berkaitan.	No.	1		
C	**KERJA-KERJA PAPAN AGIHAN (DB) ELEKTRIK** **Membekal dan memasang semua bahan mengikut spesifikasi standard JKR dan Suruhanjaya Tenaga secara pendawaian permukaan dengan menggunakan kabel PVK di dalam G.S. konduit (berwarna oren)/ trunking (berwarna oren) l/d aksesori berkaitan melainkan dinyatakan.** **Membaiki/menyelenggara/mengganti/membaikpulih sebagaimana asal kelengkapan sistem elektrikal sedia ada l/d aksesori berkaitan mengikut spesifikasi standard JKR L-S1 DAN L-S3 yang terkini dan Suruhanjaya yang ditetapkan.** **Nota :** **i) Semua penamatan kabel hendaklah l/d sistem pembumian selaras dengan standard dan piawaian JKR.** **ii) Semua barang dan peralatan yang digunakan mestilah mengikut spesifikasi dan diluluskan oleh JKR (Sila rujuk senarai kelulusan bahan EMAL JKR di website https://jmal.jkr.gov.my/emalv3/)** **iii) Semua kerja oleh Pihak Kontraktor perlu la merujuk lukisan :** ***PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/01*** ***PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/03*** ***PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/06-07***				
7.4	**PAPAN AGIHAN (DB) ELEKTRIK**				
7.4.1	**ARAS BAWAH**				
a)	Membekal, memasang dan mengujiterima sehingga berfungsi papan agihan terlitup logam jenis electrogalvanised steel sheet, tiga kutub & neutral l/d pemutus litar kecil (MCB) berkadaran hingga 32A dengan beban memutus 6kA dan aksesori serta kerja-kerja berkaitan.				
i)	12 hala	No.	1		
b)	Membekal dan memasang pemutus Litar Kotak Teracu (MCCB) tiga kutub berkadaran 60A dan Neutral dengan beban memutus 25kA (Ics:50% Icu) dan aksesori pada peti agihan serta kerja-kerja berkaitan.	Nos.	3		
c)	Membekal dan memasang Pemutus Litar Arus Baki (RCCB) dwi kutub jenis satu fasa pada peti agihan serta aksesori dan kerja-kerja berkaitan.				
i)	RCCB 63A, 2P, 100mA	Nos.	4		
ii)	RCCB 63A, 2P, 30mA	Nos.	3		
d)	Membekal dan memasang Pemutus Litar Arus Baki dengan Perlindungan Arus Lebih (RCBO) 6kA dwi kutub jenis satu fasa kadaran arus 10A hingga 40A dengan kepekaan arus 10mA dan aksesori pada peti agihan serta kerja-kerja berkaitan	Nos.	2		
e)	Membekal, memasang dan mentauliah Surge Protection Device (SPD) Class III pada outgoing MCCB (Isc>3kA, Imax > 20kA, Up<1.2kV, Mode protection L-N, L-E & N-E) pada peti agihan serta kerja-kerja berkaitan.	No.	1		
f)	Membekal dan memasang geganti masa (Timer Switch 24 Hours C/W Battery Operated Timer) untuk Lampu Pagar, Lampu Limpah dan Lampu Kawasan pada peti agihan serta kerja-kerja berkaitan.	No.	1		
g)	Membekal dan memasang Sesentuh Tiga Kutub 20A untuk Lampu Pagar, Lampu Limpah dan Lampu Kawasan pada peti agihan serta kerja-kerja berkaitan.	No.	1		
ms.24	JUMLAH DIBAWA KE MUKA SURAT 25				

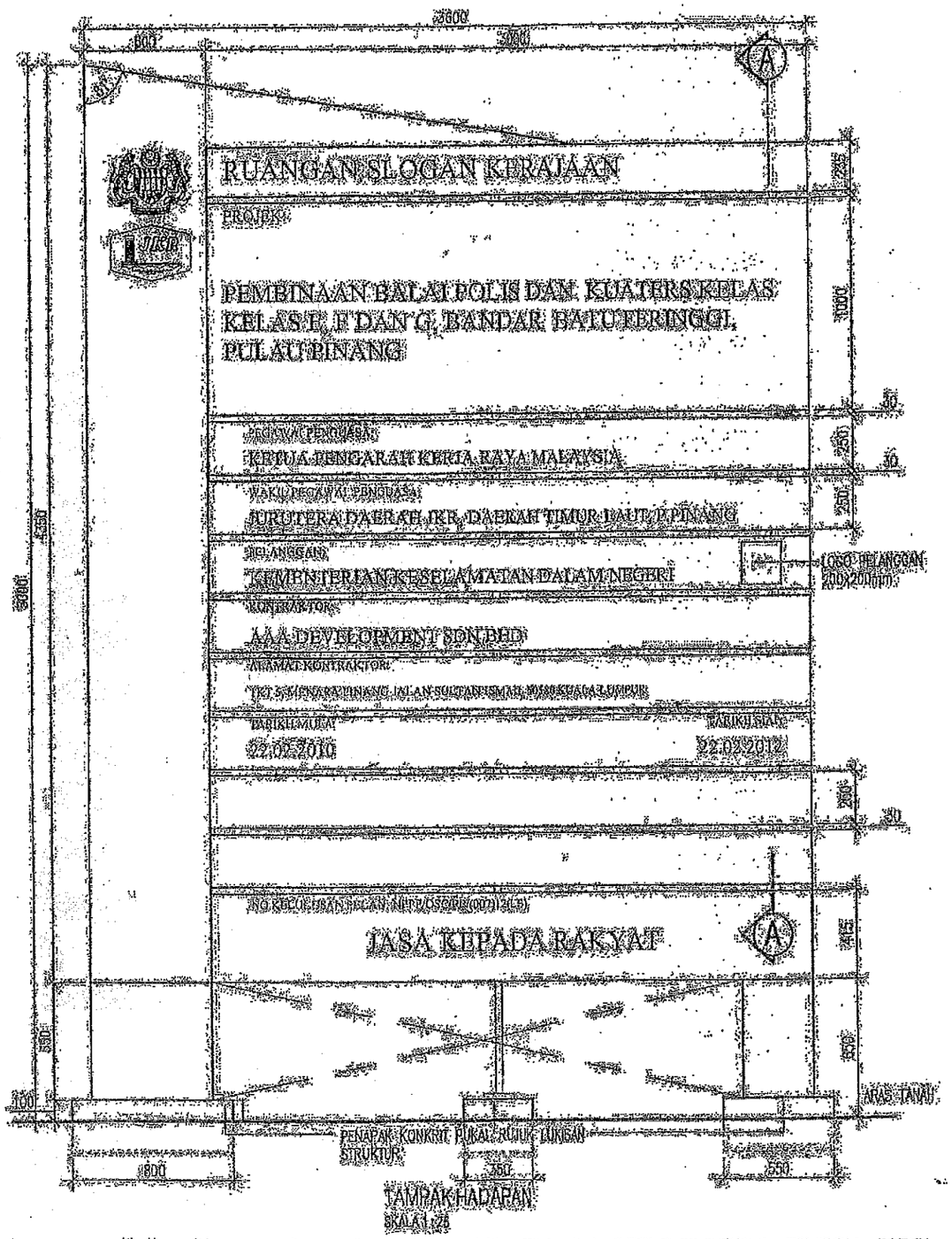
	JUMLAH DARI MUKA SURAT 24				
7.4.2	**ARAS ATAS**				
a)	Membekal, Memasang dan mengujiterima sehingga berfungsi papan agihan terlitup logam jenis electrogalvanised steel sheet, tiga kutub & neutral l/d pemutus litar kecil (MCB) berkadaran hingga 32A dengan beban memutus 6kA.				
i)	8 hala	No.	1		
b)	Membekal dan memasang pemutus Litar Kotak Teracu (MCCB) tiga kutub berkadaran 60A dan Neutral dengan beban memutus 25kA (Ics:50% Icu) dan aksesori berkaitan pada peti agihan serta kerja-kerja berkaitan.	No.	1		
c)	Membekal dan memasang Pemutus Litar Arus Baki (RCCB) dwi kutub jenis satu fasa pada peti agihan serta kerja-kerja berkaitan.				
i)	RCCB 63A, 2P, 100mA	Nos.	4		
ii)	RCCB 63A, 2P, 30mA	Nos.	3		
d)	Membekal dan memasang Pemutus Litar Arus Baki dengan Perlindungan Arus Lebih (RCBO) 6kA dwi kutub jenis satu fasa kadaran arus 10A hingga 40A dengan kepekaan arus 10mA pada peti agihan serta kerja-kerja berkaitan.	Nos.	2		
e)	Membekal, memasang dan mentauliah Surge Protection Device (SPD) Class III pada outgoing MCCB (Isc>3kA, Imax > 20kA, Up<1.2kV, Mode protection L-N, L-E & N-E) pada peti agihan serta kerja-kerja berkaitan.	No.	1		
f)	Membekal dan memasang geganti masa (Timer Switch 24 Hours C/W Battery Operated Timer) pada peti agihan serta kerja-kerja berkaitan.	No.	1		
g)	Membekal dan memasang Sesentuh Tiga Kutub 20A pada peti agihan serta kerja-kerja berkaitan.	No.	1		
D	**SISTEM PEMBUMIAN**				
	Membekal dan memasang semua bahan mengikut spesifikasi standard JKR dan Suruhanjaya Tenaga.				
	Nota : **i) Semua penamatan kabel hendaklah l/d sistem pembumian selaras dengan standard dan piawaian JKR.** **ii) Semua barang dan peralatan yang digunakan mestilah mengikut spesifikasi dan diluluskan oleh JKR (Sila rujuk senarai kelulusan bahan EMAL JKR di website https://jmal.jkr.gov.my/emalv3/)** **iii) Semua kerja oleh Pihak Kontraktor perlu la merujuk lukisan :** ***PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/06-07***				
7.5	Membekal dan memasang Sistem Pembumian l/d 1x16sqmm PVC green cable dan elektrod bumi kuprum 2 x [16mm garis pusat x 1500mm] termasuk penyambungan 'exothermic welding' dan ruang pemeriksaan konkrit dengan penutup boleh tanggal pasang jenis tahan lasak (heavy duty) termasuk pengujian serta semua aksesori berkaitan.	Lot	1		
E	**LAIN-LAIN**				
a)	Pengujian dan Pentauliahan oleh Orang Kompeten yang berdaftar dengan Suruhanjaya Tenaga.	Pukal			
b)	Laporan pengujian dan pentauliahan (Lampirkan Borang G & H)	Set	1		
c)	Membuat pemeriksaan dan pengujian pembumian oleh Orang Kompeten yang berdaftar dengan Suruhanjaya Tenaga. R ≤ 10Ω (Kemukakan 1 set salinan laporan pemeriksaan dan pengujian)	Pukal			
d)	Menyediakan Lukisan Kerja (*Shop Drawing*) dalam bentuk *softcopy* dan *hardcopy* bersaiz A1 beserta cop pengesahan Jurutera Elektrik Kompeten bagi sistem elektrikal untuk kelulusan Pegawai Penguasa sebelum kerja-kerja pemasangan sistem elektrikal baru dilaksanakan.	Set	1		
e)	Kerja-kerja membuka lengkapan elektrik sedia ada bagi menggantikan lengkapan elektrik yang baru. **(Tidak termasuk pendawaian lampu jalan, pendawaian sistem ELV, TEL dan lampu jalan)**	Pukal			
f)	Kerja-kerja *hacking, making good* dan lain-lain yang berkaitan yang melibatkan kerja-kerja C&S disebabkan oleh pemasangan sistem elektrik.	Pukal			
ms.25	JUMLAH DIBAWA KE RINGKASAN SEBUTHARGA				

ITEM	KETERANGAN	UNIT	KUANTITI	KADAR SEUNIT (RM)	JUMLAH (RM)
8.0	**Wang Peruntukan Sementara *(Provisional Sums)***				
	Nota: Penyebutharga hendaklah menspesifikasikan keterangan dengan perincian yang jelas pada keseluruah item *Provisional Sums* ini dengan mendapat kelulusan Pengawai Penguasa PARLIMEN terdahulu				
8.1	Wang Peruntukan Sementara sebanyak RM50,000.00 (Ringgit Malaysia : Lima Puluh Ribu Sahaja) untuk kerja-kerja pembaikan kerosakan bangunan, pembaikan bumbung dan kerja-kerja luar jangka yang diluluskan oleh Pengawai Penguasa PARLIMEN. (Skop akan diperincikan oleh Pengawai Penguasa PARLIMEN sekiranya terdapat keperluan dan akan dipotong jika tiada keperluan.	Pukal	Pukal	50,000.00	50,000.00
ms.26	**JUMLAH DIBAWA KE RINGKASAN SEBUTHARGA**				**50,000.00**

LAMPIRAN D

LUKISAN KONTRAK





CAWANGAN ARKITEK JKR: KEMENTERIAN KERJA RAYA MALAYSIA	PENGARAH REKABENTUK: ARKITEK KANAN:	ARKITEK PENGUASA KANAN: ARKITEK:	PROJEK: PAPAN TANDA PROJEK PIAWAI JKR (PROJEK KONVENSIONAL)	TAJUK LUKISAN: PELAN & TAMPAK HADAPAN	NO. LUKISAN: JKR/CA/P-PTB1M/30/PEL16/003/01B
					PINDAAN: B
					LUKIS: FAUZI; DISEMAK: WAF; SKALA: STP; DITUKUK; TARIKH: 07/02/2013

TERHAD

SPESIFIKASI KERJA-KERJA ROBOH KUARTERS PARLIMEN

SKOP KERJA ROBOH

KOD	TATACARA KERJA / SPESIFIKASI
	KEMASAN LANTAI
RL1	Membuka dan melupuskan kemasan lantai sedia ada jenis jubin homogenouse mengikut tatatcara kerja yang tidak merosakkan struktur lantai sedia ada dengan kelulusan arkitek/so.
RL2	Membuka dan melupuskan kemasan lantai sedia ada jenis panel jalur kayu mengikut tatatcara kerja yang tidak merosakkan struktur lantai sedia ada dengan kelulusan arkitek/so.
	KEMASAN DINDING / TIANG
R1	Dinding louvers batu bata sedia ada dirobohkan dengan berhati-hati tanpa merosakkan struktur tangga serta mengikut tatacara kerja yang diluluskan oleh SO.
R2	Dinding batu bata sedia ada dengan kemasan jubin dibuka dan dilupuskan kemasan sedia ada mengikut tatacara kerja yang diluluskan oleh SO
R3	Kemasan dinding panel kayu dirobohkan dan dilupuskan mengikut tatacara kerja yang diluluskan oleh SO
R4	Dinding gypsum sedia ada dirobohkan dan dilupuskan mengikut tatacara kerja yang betul dan diluluskan oleh SO
R5	Dinding panel kaca sedia ada dibuka dan dilupuskan mengikut tatacara kerja yang betul dan diluluskan oleh SO
RK1	kabinet Dapur dan serta sinki dan kelengkapan sedia ada dibuka dan dilupuskan mengikut tatacara kerja yang betul dan diluluskan oleh SO
RK2	kabinet kayu sedia ada dibuka dan dilupuskan mengikut tatacara kerja yang betul dan diluluskan oleh SO
	JENIS PINTU
RP1	Pintu papan lapis 2 daun sedia ada dibuka dan dilupuskan mengikut tatacara kerja yang diluluskan oleh arkitek/SO
RP2	Pintu papan lapis 1 daun sedia ada dibuka dan dilupuskan mengikut tatacara kerja yang diluluskan oleh arkitek/SO
RP3	Pintu gelengsar 1800mm x 2100mm sedia ada dibuka dan dilupuskan mengikut tatacara kerja yang diluluskan oleh arkitek/SO
RP4	Pintu gelengsar sedia ada dibuka dan dilupuskan mengikut tatacara kerja yang diluluskan oleh arkitek/SO
RP5	*Folding Door* 3000mm (L) sedia ada dibuka dan dilupuskan mengikut tatacara kerja yang diluluskan oleh arkitek/SO
	KEMASAN SILING
RS	Kemasan siling sedia ada dibuka dan dilupuskan mengikut tatacara kerja yang diluluskan oleh arkitek/SO
	JENIS TINGKAP
RT	Tingkap sedia ada dibuka dan dilupuskan mengikut tatacara kerja yang diluluskan oleh arkitek/SO
	KEMASAN BUMBUNG
DK	Kemasan bumbung dan struktur bumbung sedia ada dibaik pulih dan diganti baru serta secara keseluruhan, serta mengganti baru keseluruhan fascia board dan sistem talang air beserta Sistem RWDP rujuk butiran dan spesifikasi pembekal dgn. mengikut tatacara yg. diluluskan oleh SO.

NOTA AM :

1. Kontraktor perlu membuat pengukuran semula di tapak dan sekiranya terdapat perbezaan antara pengukuran di tapak berbanding lukisan maka kontraktor perlu menggunakan pengukuran di tapak tanpa sebarang pertambahan skop dan kos. Persetujuan dari SO perlu diperoleh terlebih dahulu sebelum memulakan kerja.
2. Sekiranya berlaku kerosakan semasa kerja-kerja meroboh maka kontraktor perlu memperbaikinya semula tanpa sebarang penambahan skop dan kos.
3. Sekiranya terdapat spesifikasi yang tidak lengkap perlu dirujuk semula dengan SO sebelum memulakan kerja.
4. Semua kelengkapan 'sanitary fitting' dibuka dan dilupuskan mengikut tatacara kerja yang dikehendaki oleh SO
5. Setiap dinding dengan kemasan cat perlu dikikis terlebih dahulu sebelum dicat semula mengikut tatacara kerja yang diluluskan SO
6. Semua kerja-kerja meroboh perlu mendapat pengesahan terlebih dahulu daripada SO sebelum kerja-kerja roboh dan pembinaan boleh dilaksanakan
7. Pihak kontraktor perlu memastikan tapak bina selamat sebelum kerja dapat dilaksanakan
8. Pihak kontraktor perlu membaiki, membersih dan membuang sisa pembinaan serta memastikan tapak pembinaan telah sedia ada untuk kerja-kerja baru
9. Bilal sedia ada hendaklah dibuka dan disimpan dgn. baik ditempat yang selamat
10. Sebarang penyambungan dinding baru dengan sedia ada perlu mengikut tatacara kerja yang diluluskan oleh SO
11. Pihak kontraktor hendaklah membuka perabot pasang siap dgn. berhati-hati tanpa merosakkan kemasan dinding asal
12. Kerja-kerja memecah dinding atau lantai bagi pemasangan 'sanitary fitting' harusiah dipecahkan secara cermat dan ditutup semula dengan dinding/ lantai beserta kemasan yang diluluskan Arkitek
13. Pihak kontraktor hendaklah membuka dinding panel kaca dengan cermat dan menggantikan dengan kemasan baru mengikut tatacara kerja yang diluluskan oleh SO, manakala panel kaca sedia ada yang dibaikpulih dan dibersihkan dengan cermat, yang pecah diganti baru mengikut kepertuan dengan persetujuan dan kelulusan SO
14. Pelan kerja meroboh adalah termasuk kerja-kerja membuka & merobohkan perkhidmatan M&E sedia ada dengan kelulusan M&E/SO
15. Reka bentuk bagi kerja-kerja siling perlulah melalui pemilihan dan kelulusan SO
16. Keseluruhan kemasan siling sedia ada dibuka dan dilupuskan mengikut tatacara kerja yang diluluskan oleh SO

PETUNJUK:

Kerja-kerja meroboh

JABATAN PERDANA MENTERI

PEGAWAI PENGUASA UTAMA

DATUK JAZMANIE BIN SHAFAWI

WAKIL PEGAWAI PENGUASA UTAMA

Ir. SALAWATI BINTI ZAINUDDIN

PROJEK

CADANGAN KERJA-KERJA NAIK TARAF DAN BAIK PULIH KUARTERS PARLIMEN

TAJUK LUKISAN :

JADUAL SPESIFIKASI ROBOH

NO. LUKISAN

JPM/BPEM/ST/KUARTERSPARLIMEN/00/01

DILUKIS	DISEMAK	TARIKH	SKALA	PINDAAN
HAFIZAH	UZAIR / ASYRAF	MAC 2024	NTS	

SPESIFIKASI KERJA-KERJA BAHARU & PEMBAIKAN KUARTERS PARLIMEN

TERHAD

SKOP KERJA BAHARU

KOD	SPESIFIKASI
	KEMASAN LANTAI
CI	Lantai konkrit sedia ada dibaik pulih dan di ganti dengan concrete imprint mengikut tatacara kerja yang diluluskan oleh SO.
HT	600 x 300 x 8mm thk. Anti Slip Hoomogeneuos tiles Niro Granite tiles or equivalent up to ceiling height c/w waterproofing system at 300mm ht to manuf's detail and specification, patiem & color to SO Approval
HT1	600 x 600 x 8mm tbl jubin homogeneous *'Anti slip'* Niro Granite Tile atau setaraf dilengkapi dengan 100mm tinggi kambi yang serupa corak, spesifikasi dan warna tertakluk kepada kelulusan SO
	JENIS TINGKAP
T1	2800 x 1200mm tingkap *casement* berserta 400mm tingkap *top hung* di atas lengkap didatangi dengan grill dan engsel yang berkualiti rujuk spesifikasi dan butiran pembekal dgn. kelulusan SO.
T2	2100 x 1200mm tingkap *casement* berserta 400mm tingkap *top hung* di atas lengkap didatangi dengan grill dan engsel yang berkualiti rujuk spesifikasi dan butiran pembekal dgn. kelulusan SO.
T3	1400 x 1200mm tingkap *casement* berserta 400mm tingkap *top hung* di atas lengkap didatangi dengan grill dan engsel yang berkualiti rujuk spesifikasi dan butiran pembekal dgn. kelulusan SO.
T4	1400 x 600mm tingkap *top hung* lengkap didatangi dengan grill dan engsel yang berkualiti rujuk spesifikasi dan butiran pembekal dgn. kelulusan SO.
	JENIS PINTU
P1	900 x 2100mm pintu rata papan lapis satu (1) daun rujuk spesifikasi pembekal dan kelulusan SO
P2	800mm (w) x 2100mm (H) pintu rata papan lapis kalis air 1 daun dengan bingkai keluli zincalume rujuk spesifikasi pembekal tertakluk kepada kelulusan SO
P3	2000mm (w) x 2700mm (H) dua(2) daun pintu panel kayu dgn. bingkai keluli zincalume rujuk spesifikasi pembekal, warna dan corak tertakluk kepada kelulusan SO
P4	3600mm (w) x 2100mm (H) pintu gelengsar dgn. bingkai keluli zincalume lengkap didatangi dengan sistem lock set yang berkualiti rujuk spesifikasi pembekal, warna dan corak tertakluk kepada kelulusan SO
P5	900 x 1000mm pintu rata papan lapis satu (1) daun rujuk spesifikasi pembekal dan kelulusan SO.
P6	3000 (w) x 2900mm (H) pintu kayu gelengsar berlipat dgn. bingkai keluli zincalume dicat serta rujuk butiran dan spesifikasi pembekal tertakluk dgn. kelulusan SO.

KOD	SPESIFIKASI
	KEMASAN SILING
SU1	9.5mm thick Unispan Gypsum Plasterboard with RONDO Keylock and 9.5 mm thick USG BORAL Preformed Board Gypsum Plasterboard with RONDO Keylock System or equivalent to SO approval
SG1	12.7mm USG BORAL Securerock Glass-Mat Sheathing Plasterboard ceiling with RONDO Stud System to withstand wind Load USG BORAL suspended ceiling system comprising of 1 layers of 12.7mm thick USG BORAL Securock Glass-Mat Sheathing moisture and mold resistance plasterboard with staggered joints screw fixed onto RONDO zincalume coated steel studs (Size: 51mm x 0.50mm B.M.T) at 406mm c/c for horizontal members that fits snugly onto RONDO Wall Track (Size: 51mm x 0.50mm BMT) at perimeter wall fixed with 4 nos of 10-16g-14x25mm Flat Head Drill Point Screws to stud and M6 Anchor Bolt @ 600mm center max. to concrete (by others) with plastering on both sides. A vertical down strut RONDO Studs (Size: 51mm x 0.50mm BMT) @ 1200mm c/c spacing with back to back fixing at every intersection of horizontal studs member with 4 nos. 12g-14x25mm Hex Head Drill Point Screws at one end and the other end fasten to concrete slab using RONDO L Bracket (P/N 545) with M6 Anchor Bolt fastener (by others) fixed to concrete slab to withstand the uplift of wind. Board's surface to be flushed finish according ASTM C475/C475M by using 50mm width USG BORAL Perforated Paper Tape and 3 coats of USG BORAL Durabond 90 Jointing Compound and whole area of board surface to be skim coated with 2-3mm USG BORAL Durabond 90 Jointing Compound. All fixed in accordance to manufacturer's instruction and recommendation, structure & hanger system following to JKR Standard & specification & to be approved by structurer's Engineer/SO
SK1	Siling lepekan simen sedia ada dan dicat semula dengan lapisan Polyeurefane (P.U Coating) dan dicat dengan 2 lapisan cat emulsi mengikut kelulusan SO
	KEMASAN DINDING / TIANG
BB1	Membekal dan memasang dinding batu bata baru jenis AAC Block 5.5 mpa dgn. 5mm skim coat pada kedua belah permukaan dan di cat di kedua permukaan dgn.1 lapisan cat asas dan 2 lapisan emulsi atau cat tahan cuaca menikut tatacara kerja yang diluluskan SO.
BB2	Dinding batu bata sedia ada dibaikpulih dan dilepa dgn. 20mm tbl. lepaan simen di kedua permukaan dan di cat di kedua permukaan dgn.1 lapisan cat asas dan 2 lapisan emulsi atau cat tahan cuaca menikut tatacara kerja yang diluluskan SO,
BB3	Dinding batu bata sedia ada dgn. 20mm tbl. lepaan simen di kedua permukan dgn. kemasan 300 x 600mm jubin homogenous setinggi aras siling mengikut spesifikasi pembekal dan kelulusan SO.
BB4	Membekal dan memasang 112mm tbl. dinding yang mengandungi 9.0mm PRIMAliner gypsum seamless board dikedua- dua permukaan dan 50mm tbl. mineral wool @20kg/m3 density atau setaraf dgn. struktur kerangka yang diluluskan oleh Juruukur Struktur serta rujuk lukisan butiran dan spesifikasi pembekal serta tertakluk kepada kelulusan SO.
K1	Membekal dan memasang *New custom lower and wall hanging Kitchen Cabinet* dengan Concrete table top lengkap didatangai dengan 600x1200 jubin *porceline* dan dari para dan pintu plywood tahan lembab dengan kemasan HPL pada kedua belah permukaan, pintu dan laci dari *set of soft close hinges accessories, back splash, 2 bowl top mount stainless steel sink* lengkap dengan *swan neck tap* serta kerja berkaitan yang perlu dilengkapkan yang mengikut spesifikasi dan tatacara kerja yang diluluskan, warna & corak rujuk butiran dan spesifikasi pembekal serta tertakluk kepada pemilihan dan kelulusan SO
K2	Membekal dan memasang new custom kabinet kayu pasang siap dari plywood body dengan kemasan HPL with natural stain at both sides dari para plywood dengan kemasan HPL serta lengkap didatangi dengan struktur pemasangan, steel bracket dan aksesori lengkap dan kerja berkaitan yang perlu dilengkapkan, warna & corak rujuk butiran dan spesifikasi pembekal serta tertakluk kepada pemilihan dan kelulusan SO

SKOP KERJA PEMBAIKAN

KOD	TATACARA KERJA / SPESIFIKASI
	KEMASAN LANTAI
L1	Kemasan lantai jubin homogenous sedia ada dibaik pulih, diganti mana yang pecah dan digilap semula secara keseluruhan mengikut tatacara kerja yang diluluskan oleh SO
L2	Kemasan lantai lepaan simen sedia ada dibersihkan, dibaik pulih dan dirawat semula secara keseluruhan mengikut tatacara kerja yang diluluskan oleh arkitek/SO
L3	Kemasan lantai dan struktur tangga tangga sedia ada dibersihkan, dibaik pulih dan dirawat semula secara keseluruhan mengikut tatacara kerja yang diluluskan oleh SO
	KEMASAN DINDING / TIANG
1	Dinding dan struktur sedia ada dengan kemasan cat sedia ada perlu dikikis terlebih dahulu dibersihkan dan dilepa dgn. 20mm tbl. lepaan simen di kedua permukaan dicat semula dgn. 1 lapisan cat asas dan 2 lapisan cat emulsi atau cat tahan cuaca pada semua permukaan mengikut tatacara kerja yang diluluskan oleh SO

NOTA AM :

1. Kontraktor perlu membuat pengukuran semula di tapak dan sekiranya terdapat perbezaan antara pengukuran di tapak berbanding lukisan maka kontraktor perlu menggunakan pengukuran di tapak tanpa sebarang pertambahan skop dan kos dan persetujuan dari SO perlu diperolehi terlebih dahulu sebelum memulakan kerja.
2. Sekiranya berlaku kerosakan semasa kerja-kerja meroboh maka kontraktor perlu memperbaikinya semula tanpa sebarang penambahan skop dan kos.
3. Sekiranya terdapat spesifikasi yang tidak lengkap perlu dirujuk semula dengan SO sebelum memulakan kerja.
4. Semua kelengkapan 'sanitary fitting' dibuka dan dilupuskan mengikut tatacara kerja yang dikehendaki oleh SO
5. Setiap dinding dengan kemasan cat perlu dikikis terlebih dahulu dicat semula mengikut tatacara kerja yang diluluskan SO
6. Semua kerja-kerja meroboh perlu mendapat pengesahan terlebih dahulu daripada SO sebelum kerja- kerja roboh dan pembinaan boleh dilaksanakan
7. Pihak kontraktor perlu memastikan tapak bina selamat sebelum kerja dapat dilaksanakan
8. Pihak kontraktor perlu membaiki, membersih dan membuang sisa pembinaan serta memastikan tapak pembinaan telah sedia ada untuk kerja-kerja baru
9. Biral sedia ada hendaklah dibuka dan disimpan dgn. baik ditempat yang selamat
10. Sebarang penyambungan dinding baru dengan sedia ada perlu mengikut tatacara kerja yang diluluskan oleh SO
11. Pihak kontraktor hendaklah membuka perabot pasang siap dgn. berhati-hati tanpa merosakkan kemasan dinding asal
12. Kerja-kerja memecah dinding atau lantai bagi pemasangan 'sanitary fitting' haruslah dipecahkan secara cermat dan ditutup semula dengan dinding/ lantai beserta kemasan yang diluluskan SO.
13. Pihak kontraktor hendaklah membuka dinding panel kaca dengan cermat dan menggantikan dengan kemasan baru mengikut tatacara kerja yang diluluskan oleh SO,
14. Pelan kerja meroboh adalah termasuk kerja-kerja membuka & merobohkan perkhidmatan M&E sedia ada dengan kelulusan M&E/SO
15. Reka bentuk bagi kerja-kerja siling perlulah melalui pemilihan dan kelulusan SO.
16. Keseluruhan kemasan sling sedia ada dibuka dan dilupuskan mengikut tatacara kerja yang diluluskan oleh SO.

PETUNJUK:

Kerja-kerja baru.

JABATAN PERDANA MENTERI

PEGAWAI PENGUASA UTAMA

DATUK JAZMANIE BIN SHAFAWI

WAKIL PEGAWAI PENGUASA UTAMA

fr. SALAWATI BINTI ZAINUDDIN

PROJEK

CADANGAN KERJA-KERJA NAIK TARAF DAN BAIK PULIH KUARTERS PARLIMEN

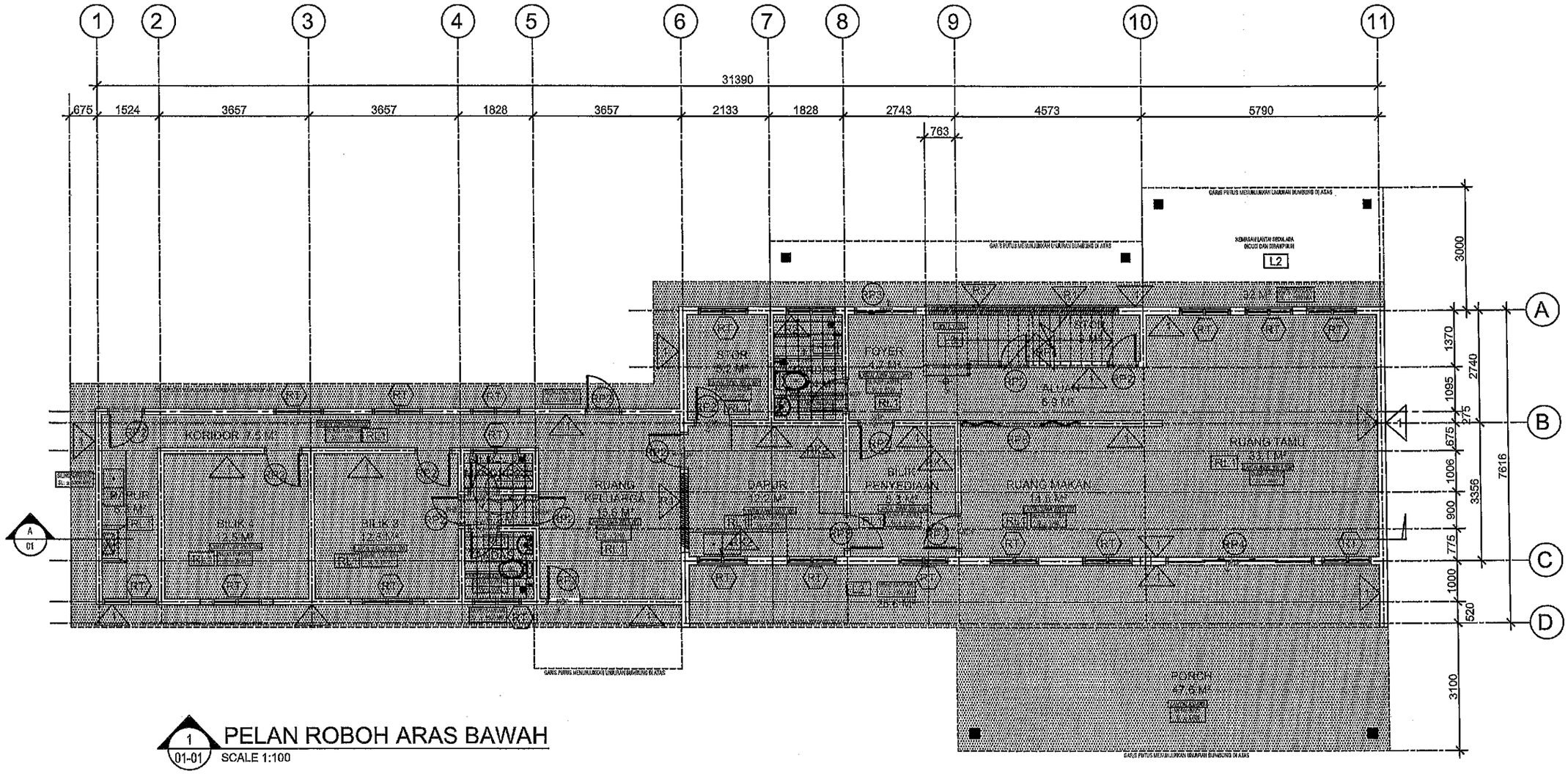
TAJUK LUKISAN :

JADUAL SPESIFIKASI BAHARU

NO. LUKISAN

JPM/BPEM/ST/KUARTERSPARLIMEN/00/02

DILUKIS	DISEMAK	TARIKH	SKALA	PINDAAN
HAFIZAH	UZAIR / ASYRAF	MAC 2024	NTS	



1 / 01-01 PELAN ROBOH ARAS BAWAH

SCALE 1:100

BAHAGIAN SENGGARA, FASILITI BANGUNAN DAN LANDSKAP

PEGAWAI PENGUASA	
Ir. ZULFAIZAL BIN MAT ZIN	
WAKIL PEGAWAI PENGUASA	
RIDZA HAFIZUDDIN BIN AB. MAJID	

PROJEK

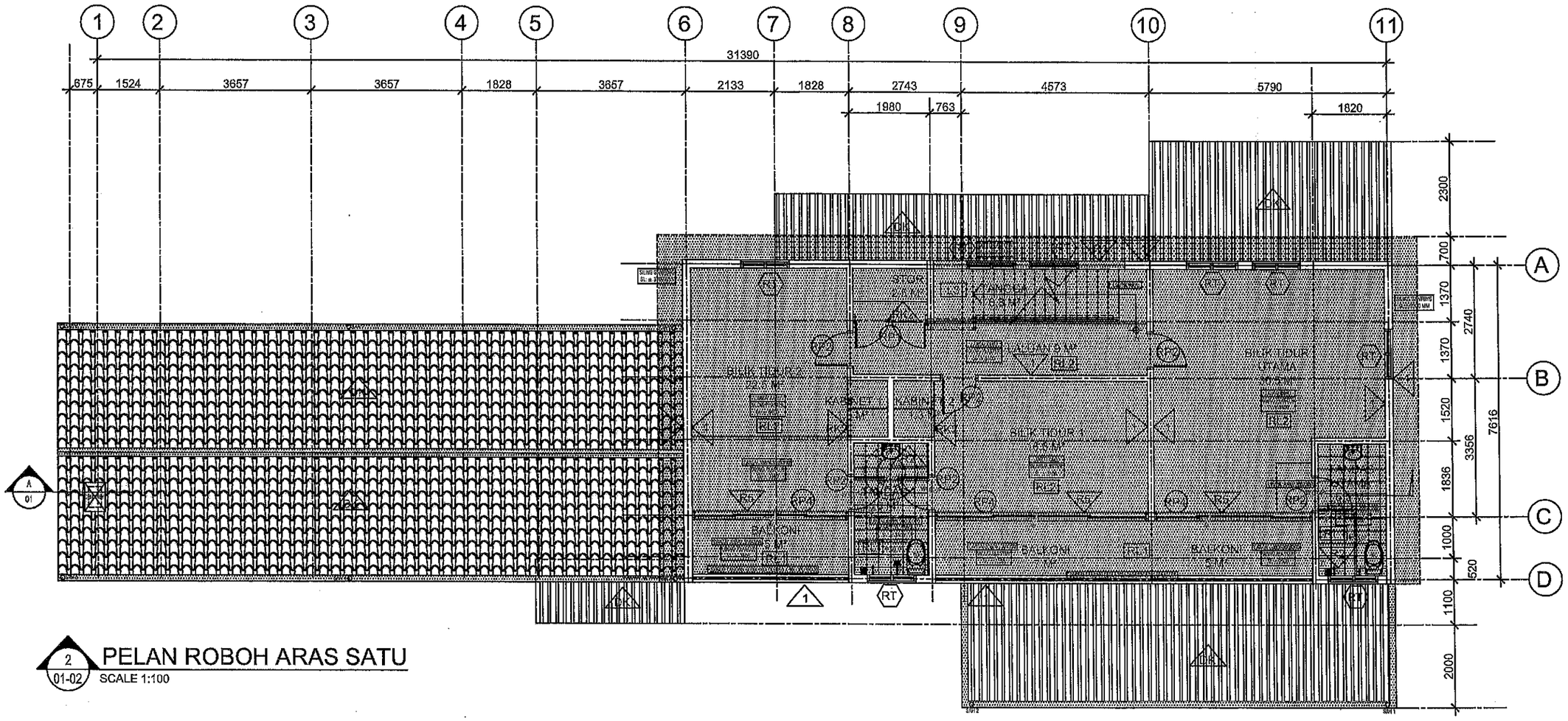
KERJA–KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN–LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK LUKISAN : PELAN ROBOH ARAS BAWAH

NO. LUKISAN: PM/BSFL/KUARTERS2930/01/01

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2024	NTS

PINDAAN



A
01

2
01-02

PELAN ROBOH ARAS SATU

SCALE 1:100

BAHAGIAN SENGGARA FASILITI BANGUNAN DAN LANDSKAP

PEGAWAI PENGUASA	
Ir. ZULFAIZAL BIN MAT ZIN	
WAKIL PEGAWAI PENGUASA	
RIDZA HAFIZUDDIN BIN AB. MAJID	

PROJEK

KERJA–KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN–LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK LUKISAN :

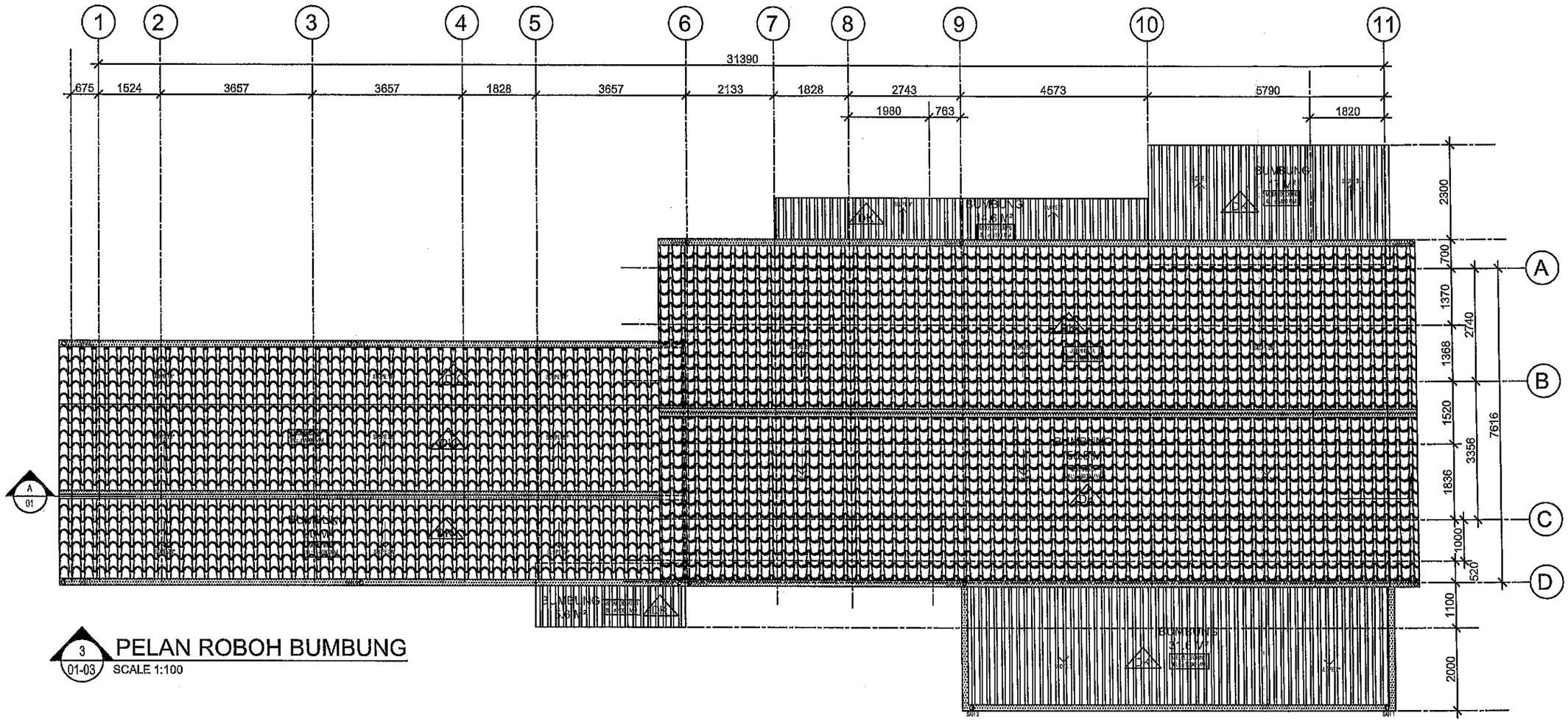
PELAN ROBOH ARAS SATU

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2024	NTS

NO. LUKISAN

PM/BSFL/KUARTERS2930/01/02

PINDAAN



3
01-03 PELAN ROBOH BUMBUNG
SCALE 1:100

BAHAGIAN SENGGARA FASILITI BANGUNAN DAN LANDSKAP

PEGAWAI PENGUASA	Ir. ZULFAIZAL BIN MAT ZIN
WAKIL PEGAWAI PENGUASA	RIDZA HAFIZUDDIN BIN AB. MAJID

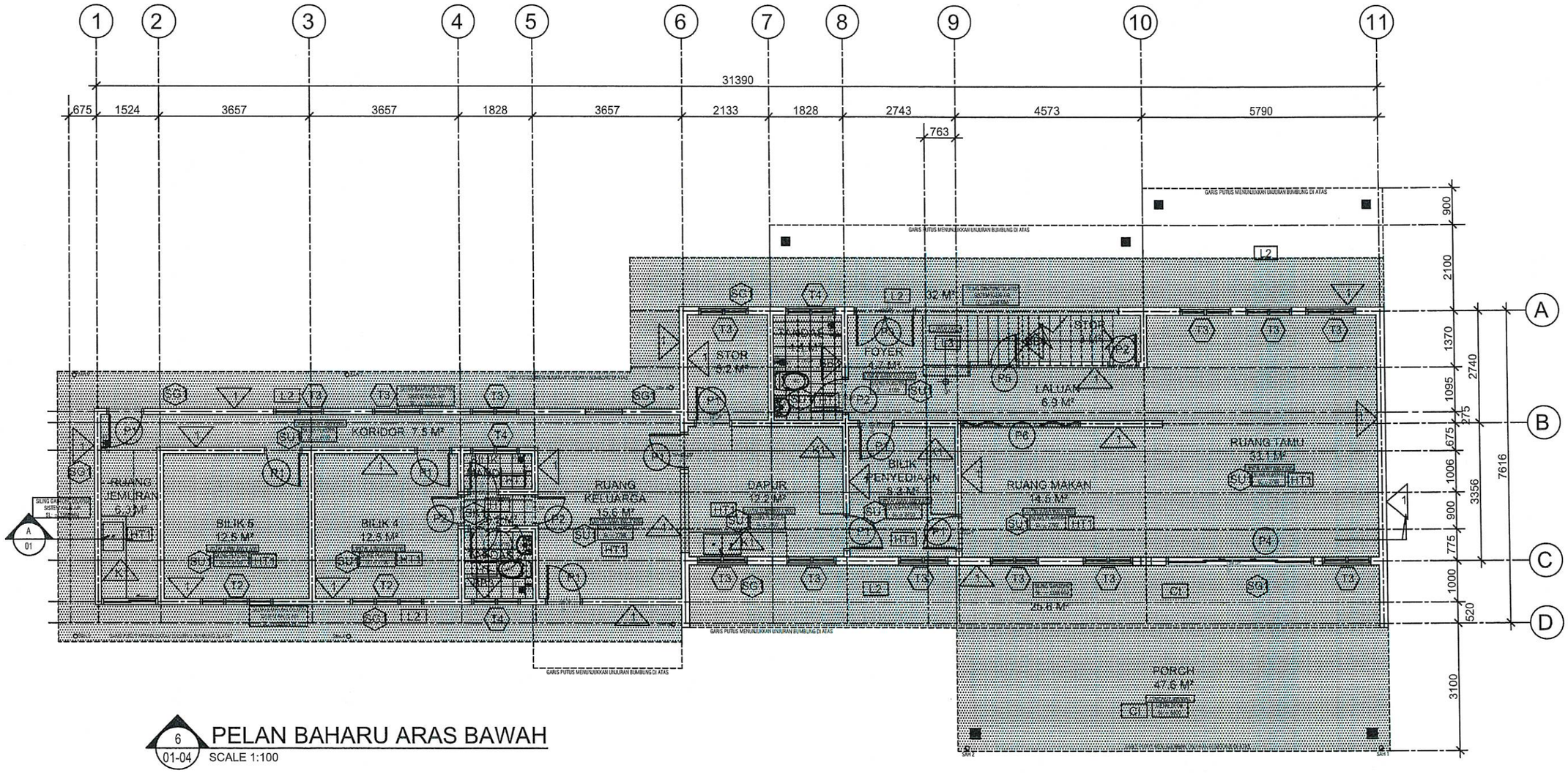
PROJEK: KERJA–KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN–LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK LUKISAN : PELAN ROBOH ARAS BAWAH

NO. LUKISAN: PM/BSFL/KUARTERS2930/01/03

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2024	NTS

PINDAAN



6
01-04

PELAN BAHARU ARAS BAWAH

SCALE 1:100

BAHAGIAN SENGGARA FASILITI BANGUNAN DAN LANDSKAP

PEGAWAI PENGUASA	
Ir. ZULFAIZAL BIN MAT ZIN	
WAKIL PEGAWAI PENGUASA	
RIDZA HAFIZUDDIN BIN AB. MAJID	

PROJEK

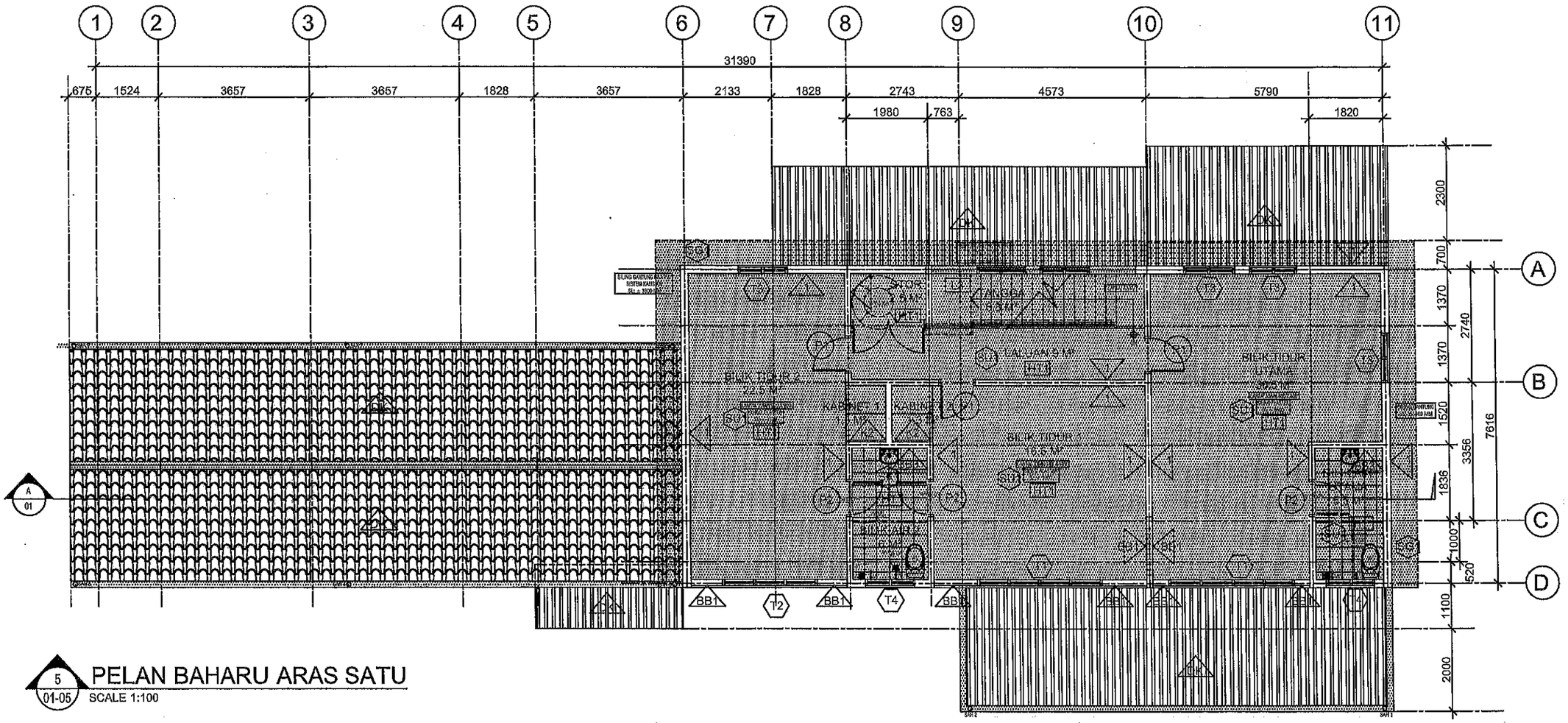
KERJA–KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN–LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK LUKISAN : PELAN BAHARU ARAS BAWAH

NO. LUKISAN PM/BSFL/KUARTERS2930/01/04

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2024	NTS

PINDAAN



A 01

5 01-05 PELAN BAHARU ARAS SATU

SCALE 1:100

BAHAGIAN SENGGARA FASILITI BANGUNAN DAN LANDSKAP

PEGAWAI PENGUASA	
Ir. ZULFAIZAL BIN MAT ZIN	
WAKIL PEGAWAI PENGUASA	
RIDZA HAFIZUDDIN BIN AB. MAJID	

PROJEK

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK LUKISAN :

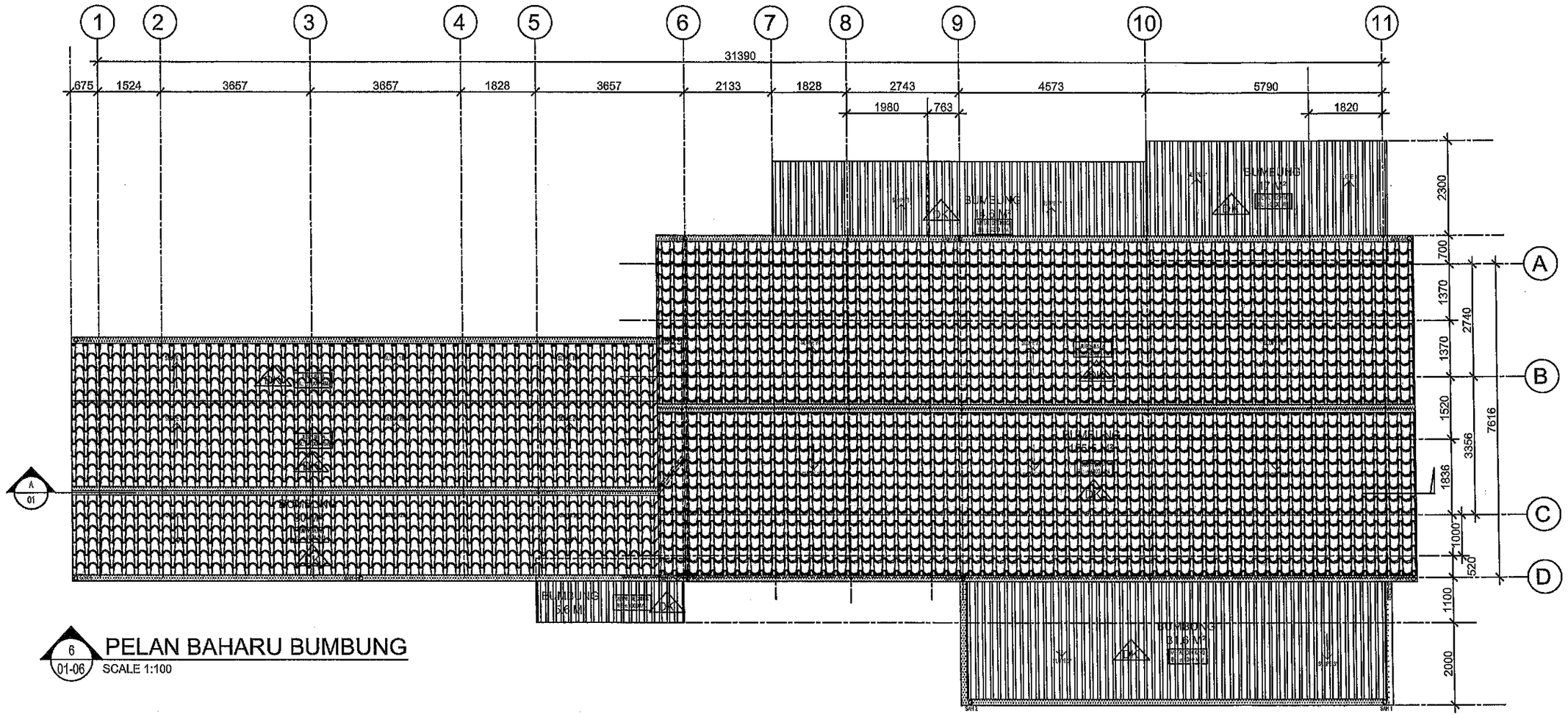
PELAN BAHARU ARAS SATU

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2024	NTS

NO. LUKISAN

PM/BSFL/KUARTERS2930/01/05

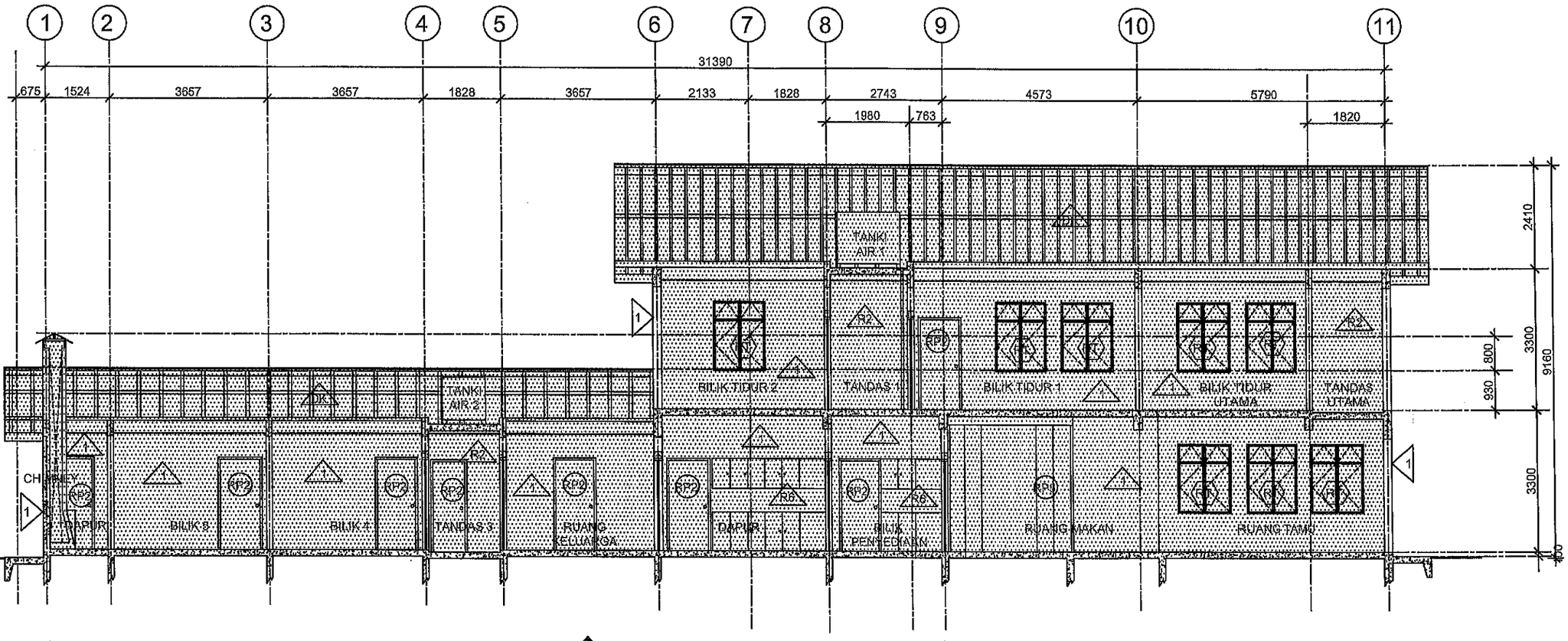
PINDAAN



6
01-06 PELAN BAHARU BUMBUNG
SCALE 1:100

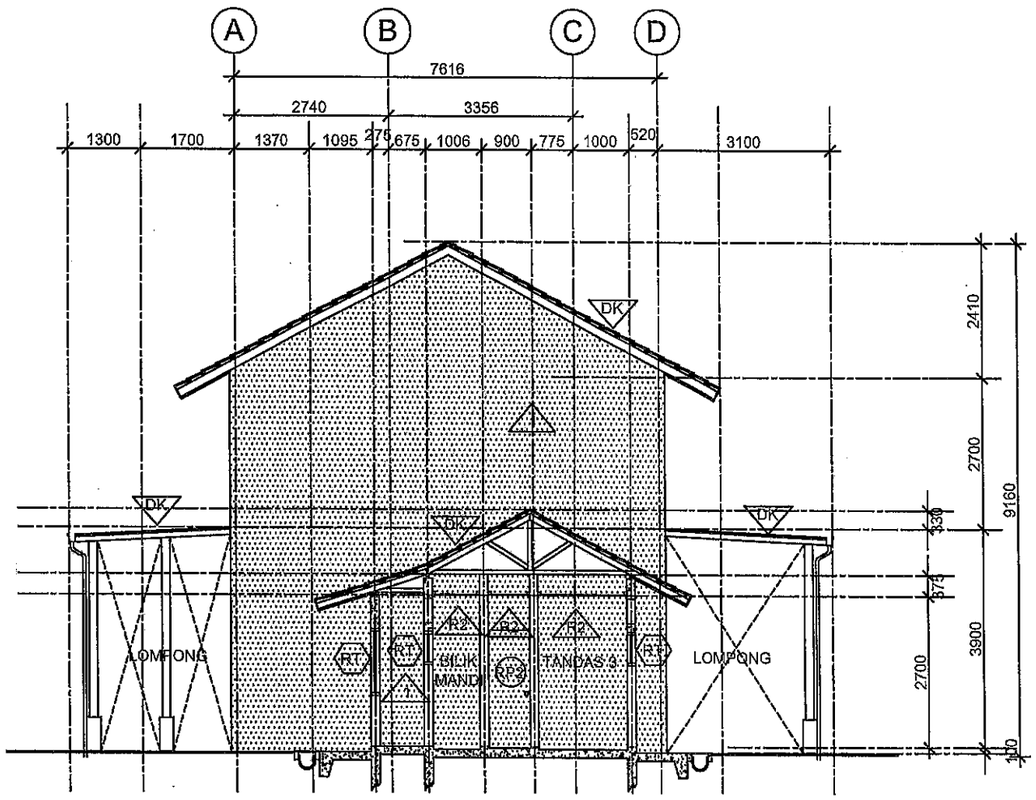
BAHAGIAN SENGGARA FASILITI BANGUNAN DAN LANDSKAP

PEGAWAI PENGUASA		PROJEK	TAJUK LUKISAN :				NO. LUKISAN
Ir. ZULFAIZAL BIN MAT ZIN		KERJA–KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN–LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR	PELAN BAHARU BUMBUNG				PM/BSFL/KUARTERS2930/01/06
WAKIL PEGAWAI PENGUASA			DILUKIS	DISEMAK	TARIKH	SKALA	PINDAAN
RIDZA HAFIZUDDIN BIN AB. MAJID					MAC 2024	NTS	



4 KERATAN A-A ROBOH
05-01 SCALE 1:100

BAHAGIAN SENGGARA, FASILITI BANGUNAN DAN LANDSKAP	PEGAWAI PENGUASA: Ir. ZULFAIZAL BIN MAT ZIN	PROJEK: KERJA–KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN–LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR	TAJUK LUKISAN : KERATAN A-A ROBOH
	WAKIL PEGAWAI PENGUASA: RIDZA HAFIZUDDIN BIN AB. MAJID		DILUKIS / DISEMAK / TARIKH: MAC 2024 / SKALA: NTS
			NO. LUKISAN: PM/BSFL/KUARTERS2930/05/01
			PINDAAN



5
05-02

KERATAN B-B ROBOH

SCALE 1:100

BAHAGIAN SENGGARA FASILITI BANGUNAN DAN LANDSKAP

PEGAWAI PENGUASA	
Ir. ZULFAIZAL BIN MAT ZIN	
WAKIL PEGAWAI PENGUASA	
RIDZA HAFIZUDDIN BIN AB. MAJID	

PROJEK

KERJA–KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN–LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK LUKISAN :

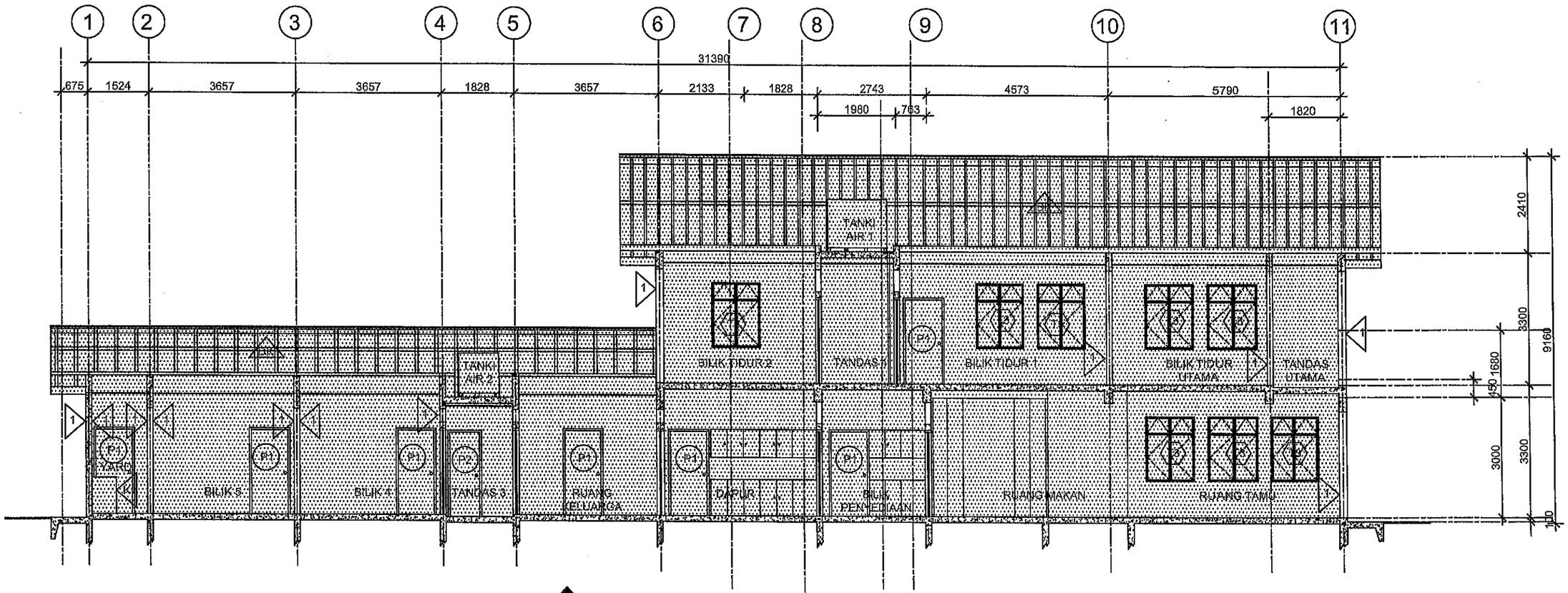
KERATAN B-B ROBOH

NO. LUKISAN

PM/BSFL/KUARTERS2930/05/02

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2024	NTS

PINDAAN



8 05-03 KERATAN A-A BAHARU

SCALE 1:100

BAHAGIAN SENGGARA FASILITI BANGUNAN DAN LANDSKAP

PEGAWAI PENGUASA	
Ir. ZULFAIZAL BIN MAT ZIN	
WAKIL PEGAWAI PENGUASA	
RIDZA HAFIZUDDIN BIN AB. MAJID	

PROJEK

KERJA–KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN–LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK LUKISAN :

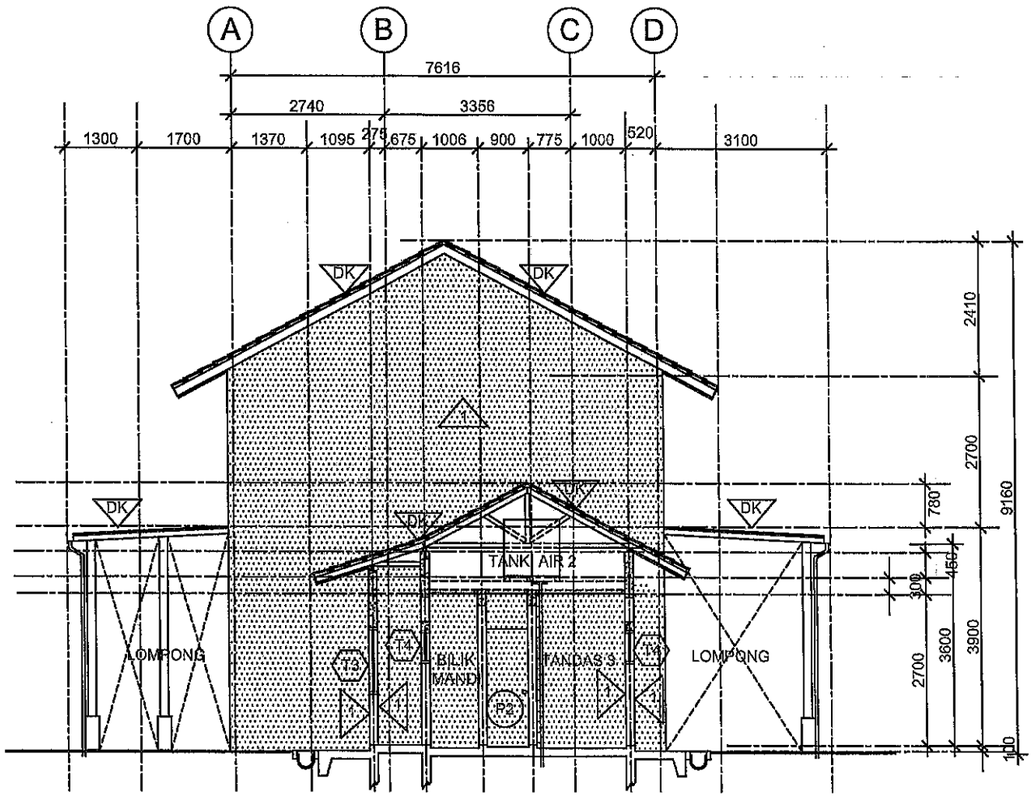
KERATAN A-A BAHARU

NO. LUKISAN

PM/BSFL/KUARTERS2930/05/03

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2024	NTS

PINDAAN

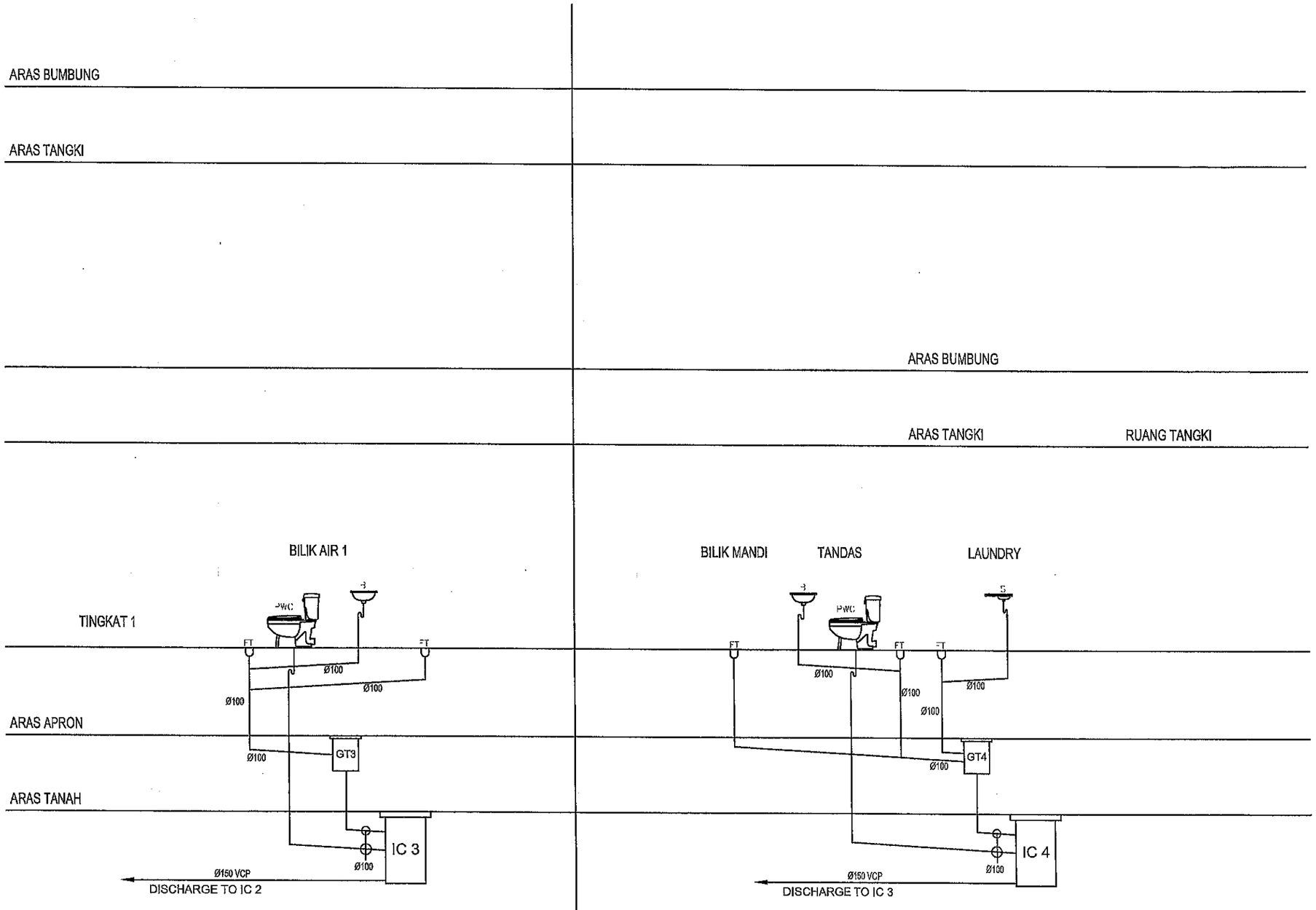


10 / 05-04 KERATAN B-B BAHARU

SCALE 1:100

BAHAGIAN SENGGARA FASILITI BANGUNAN DAN LANDSKAP

PEGAWAI PENGUASA	PROJEK	TAJUK LUKISAN :	NO. LUKISAN
Ir. ZULFAIZAL BIN MAT ZIN	KERJA–KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN–LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR	KERATAN B-B BAHARU	PM/BSFL/KUARTERS2930/05/04
WAKIL PEGAWAI PENGUASA		DILUKIS / DISEMAK / TARIKH / SKALA	PINDAAN
RIDZA HAFIZUDDIN BIN AB. MAJID		MAC 2024 / NTS	



LEGEND

- WP - WASTE PIPE UPVC
- SP - SOIL PIPE UPVC
- SWP - SOIL & WASTE PIPE UPVC
- VP - VENT PIPE UPVC
- VCP - VITRIFIED CLAY PIPE
- UPVC - UNPLASTICED POLYVINYL CLORIDE
- SK - SINK
- B - BASIN
- PWC - PEDESTAL WATER CLOSET
- AWC - ASIAN WATER CLOSET
- UR - URINAL
- PL - FLOOR TRAP
- GT - GULLY TRAP
- IC - INSPECTION CHAMBER
- MH - MANHOLE

BAHAGIAN SENGGARA FASILITI BANGUNAN DAN LANDSKAP

PEGAWAI PENGUASA

Ir. ZULFAIZAL BIN MAT ZIN

WAKIL PEGAWAI PENGUASA

RIDZA HAFIZUDDIN BIN AB. MAJID

PROJEK

KERJA–KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN–LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

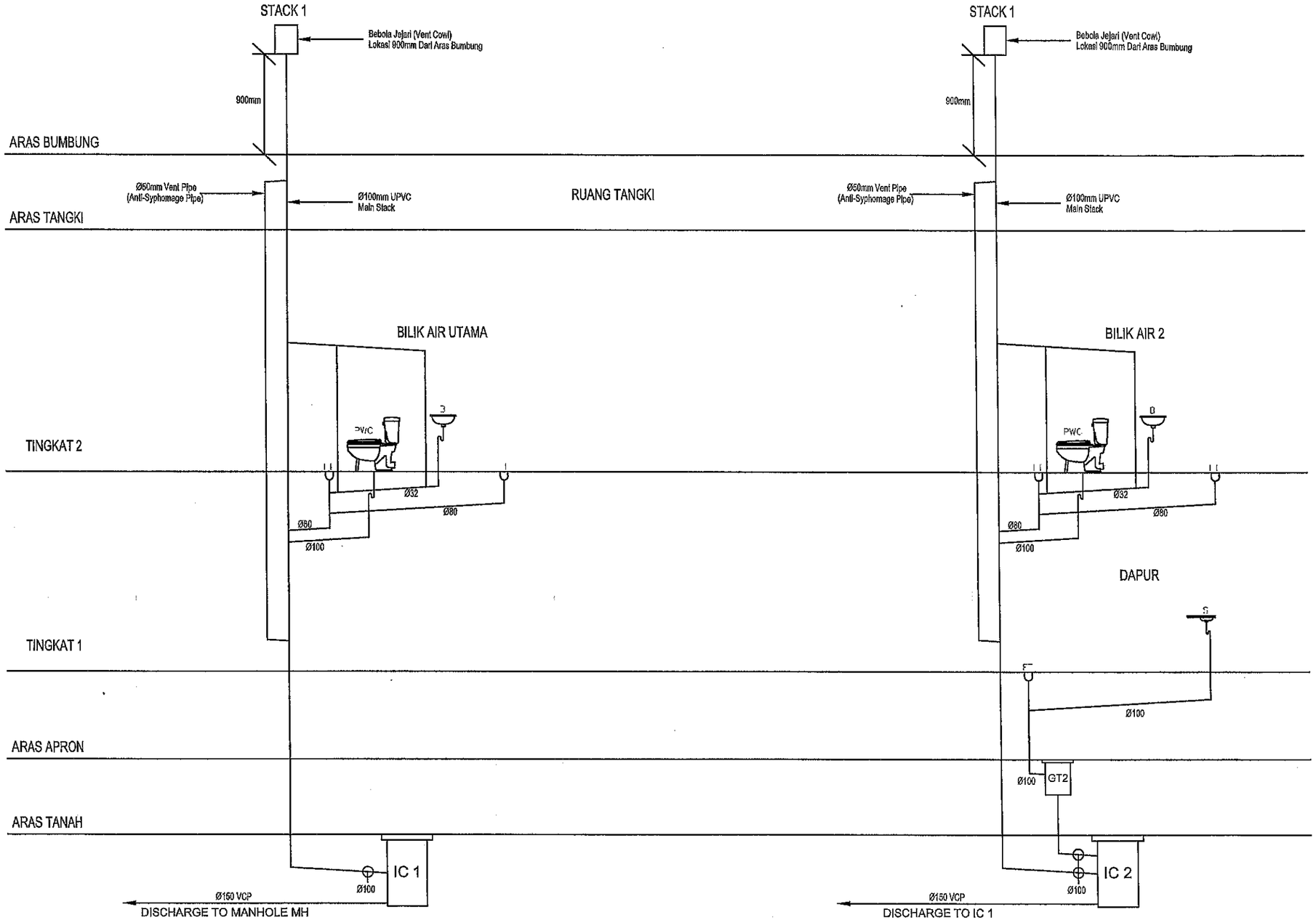
TAJUK LUKISAN :

SANITARI

NO. LUKISAN

PM/BSFL/KUARTERS2930/SN/01

DILUKIS	DISEMAK	TARIKH	SKALA	PINDAAN
		MAC 2024	NTS	



LEGEND

WP	-	WASTE PIPE UPVC
SP	-	SOIL PIPE UPVC
SWP	-	SOIL & WASTE PIPE UPVC
VP	-	VENT PIPE UPVC
VCP	-	VITRIFIED CLAY PIPE
UPVC	-	UNPLASTICED POLYVINYL CLORIDE
SK	-	SINK
B	-	BASIN
PWC	-	PEDESTAL WATER CLOSET
AWC	-	ASIAN WATER CLOSET
UR	-	URINAL
PL	-	FLOOR TRAP
GT	-	GULLY TRAP
IC	-	INSPECTION CHAMBER
MH	-	MANHOLE

BAHAGIAN SENGGARA FASILITI BANGUNAN DAN LANDSKAP

PEGAWAI PENGUASA	
Ir. ZULFAIZAL BIN MAT ZIN	
WAKIL PEGAWAI PENGUASA	
RIDZA HAFIZUDDIN BIN AB. MAJID	

PROJEK

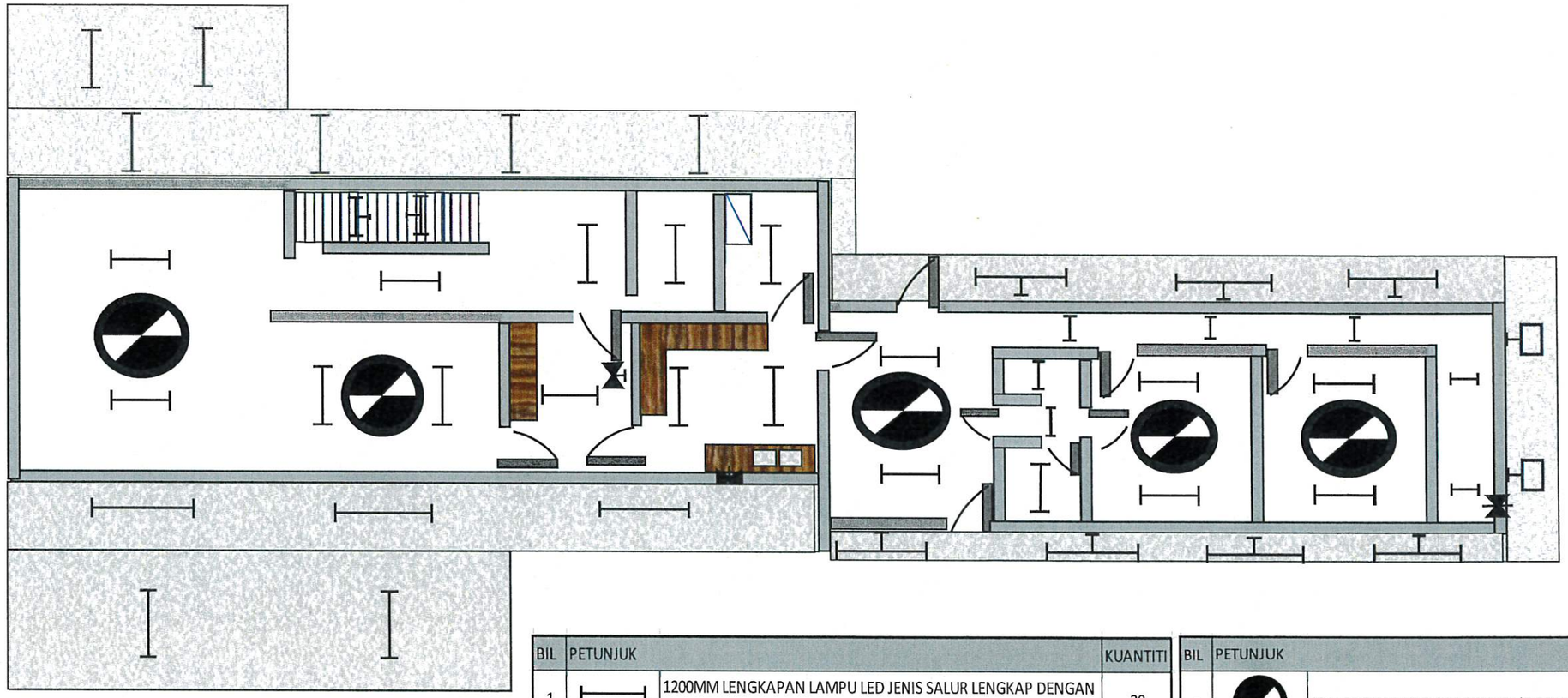
KERJA–KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN–LAIN KERJA BERKAITAN DI KUARTERS JKR. 2930, PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK LUKISAN : SANITARI

NO. LUKISAN: PM/BSFL/KUARTERS2930/SN/02

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2024	NTS

PINDAAN



BIL	PETUNJUK		KUANTITI
1		1200MM LENGKAPAN LAMPU LED JENIS SALUR LENGKAP DENGAN TIUB LED T8, 6500K (LENGKAPAN SILING)	29
2		1200MM LENGKAPAN LAMPU LED JENIS SALUR LENGKAP DENGAN TIUB LED T8, 6500K (LENGKAPAN DINDING)	7
3		600MM LENGKAPAN LAMPU LED JENIS SALUR LENGKAP DENGAN TIUB LED T8, 6500K (LENGKAPAN SILING)	7
4		600MM LENGKAPAN LAMPU LED JENIS SALUR LENGKAP DENGAN TIUB LED T8, 6500K (LENGKAPAN DINDING)	2

BIL	PETUNJUK		KUANTITI
5		60" LENGKAPAN KIPAS SILING I/D PENGATUR	5
6		12" KIPAS PELAWAS I/d PENUTUP AUTOMATIK	2
7		16" LENGKAPAN KIPAS DINDING I/d PULL CORD SWITCH & SPEED CONTROL	1
8		150W LAMPU LIMPAH LED I/d SPD TERBINA DALAM	2

PEGAWAI PENGUASA

Ir. ZULFAIZAL BIN MAT ZIN

WAKIL PEGAWAI PENGUASA

RIDZA HAFIZUDDIN BIN AB. MAJID

PROJEK

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR 2930 PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK

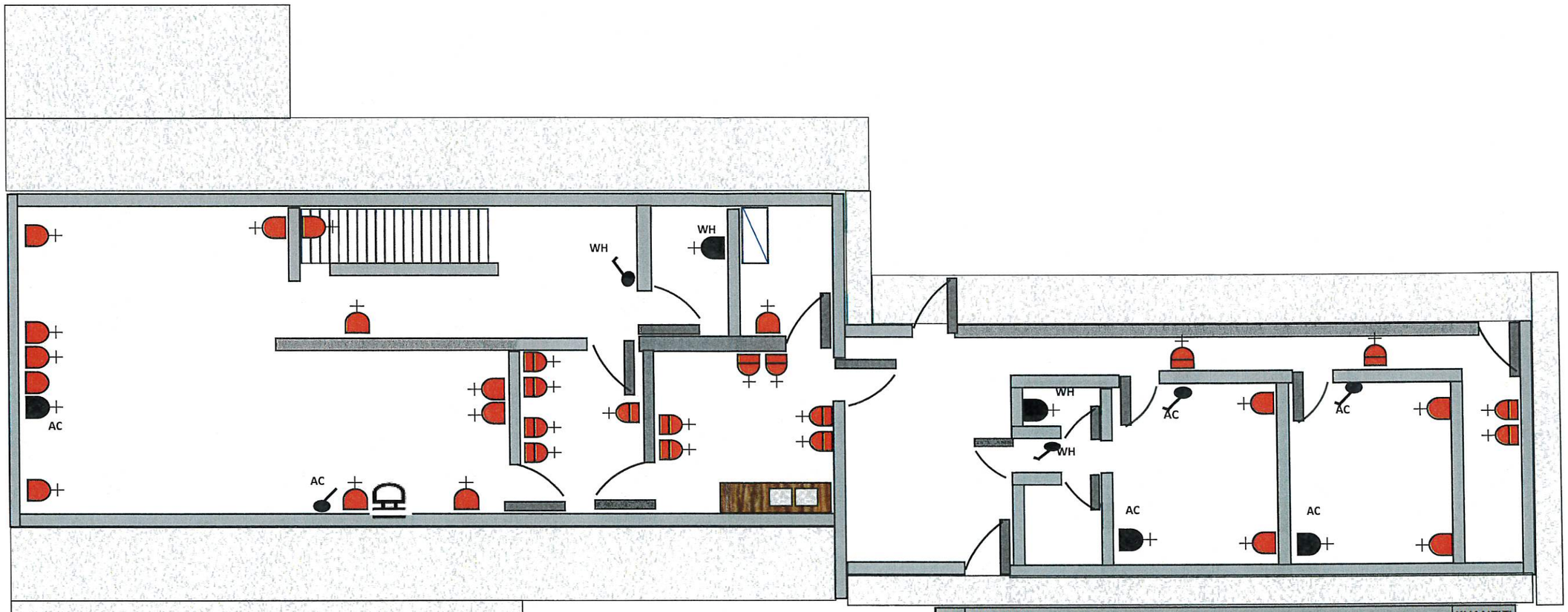
CADANGAN SUSUN ATUR LITAR LAMPU DAN KIPAS BAGI SKOP KERJA ELEKTRIK DI LOT 2930 ARAS BAWAH

NO. LUKISAN

PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/01

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2025	

PINDAAN



BIL	PETUNJUK		KUANTITI
1		13A 3 PIN SOKET ALUR KELUAR TUNGGAL JENIS METAL CLAD (300MM DARI KEMASAN LANTAI)	17
2		13A 3 PIN SOKET ALUR KELUAR TUNGGAL JENIS METAL CLAD (1450MM DARI KEMASAN LANTAI)	15
3	AC AC	15A 3 PIN SOKET ALUR KELUAR JENIS METAL CLAD c/w 30A DP METAL CLAD SWITCH (300MM DARI SILING)	3
4	WH WH	15A 3 PIN SOKET ALUR KELUAR JENIS METAL CLAD c/w 20A DP METAL CLAD SWITCH (300MM DARI SILING)	2
5		BELL CHIME	1

PEGAWAI PENGUASA

Ir. ZULFAIZAL BIN MAT ZIN

WAKIL PEGAWAI PENGUASA

RIDZA HAFIZUDDIN BIN AB. MAJID

PROJEK

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR 2930 PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK

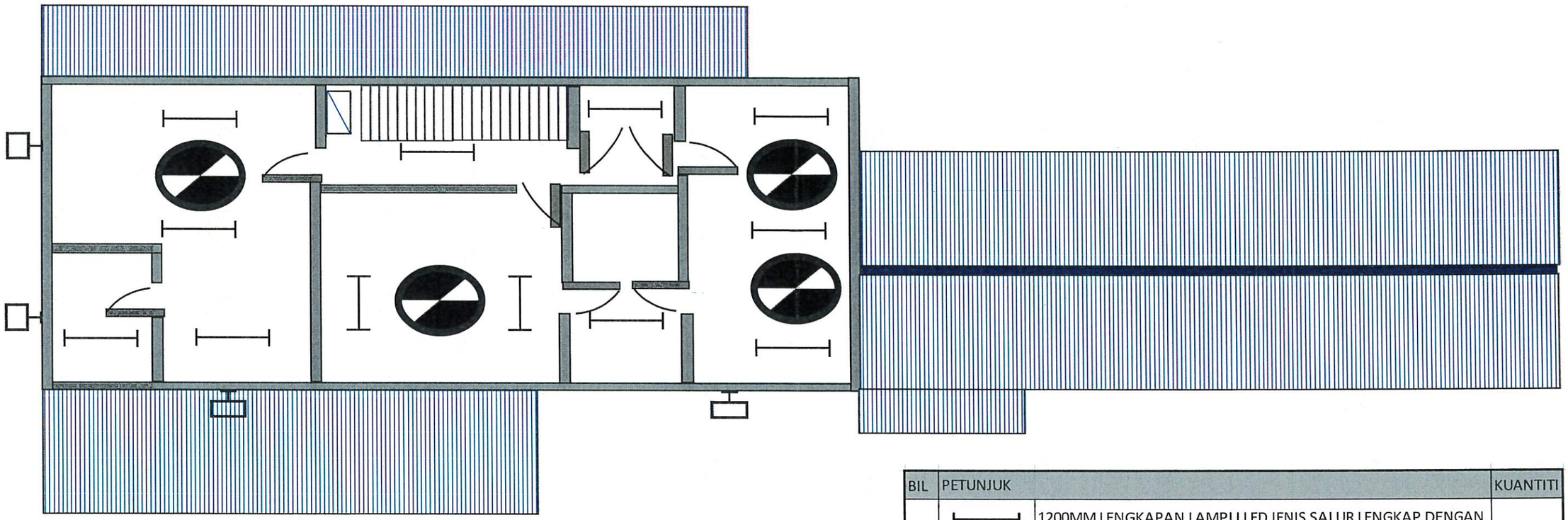
CADANGAN SUSUN ATUR LITAR KUASA DAN BELL CHIME BAGI SKOP KERJA ELEKTRIK DI LOT 2930 ARAS BAWAH

NO. LUKISAN

PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/02

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2025	

PINDAAN



BIL	PETUNJUK		KUANTITI
1		1200MM LENGKAPAN LAMPU LED JENIS SALUR LENGKAP DENGAN TIUB LED T8, 6500K (LENGKAPAN SILING)	12
2		60" LENGKAPAN KIPAS SILING I/D PENGATUR	4
3	H	150W LAMPU LIMPAH LED I/d SPD TERBINA DALAM	4

PEGAWAI PENGUASA

Ir. ZULFAIZAL BIN MAT ZIN

WAKIL PEGAWAI PENGUASA

RIDZA HAFIZUDDIN BIN AB. MAJID

PROJEK

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR 2930 PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK

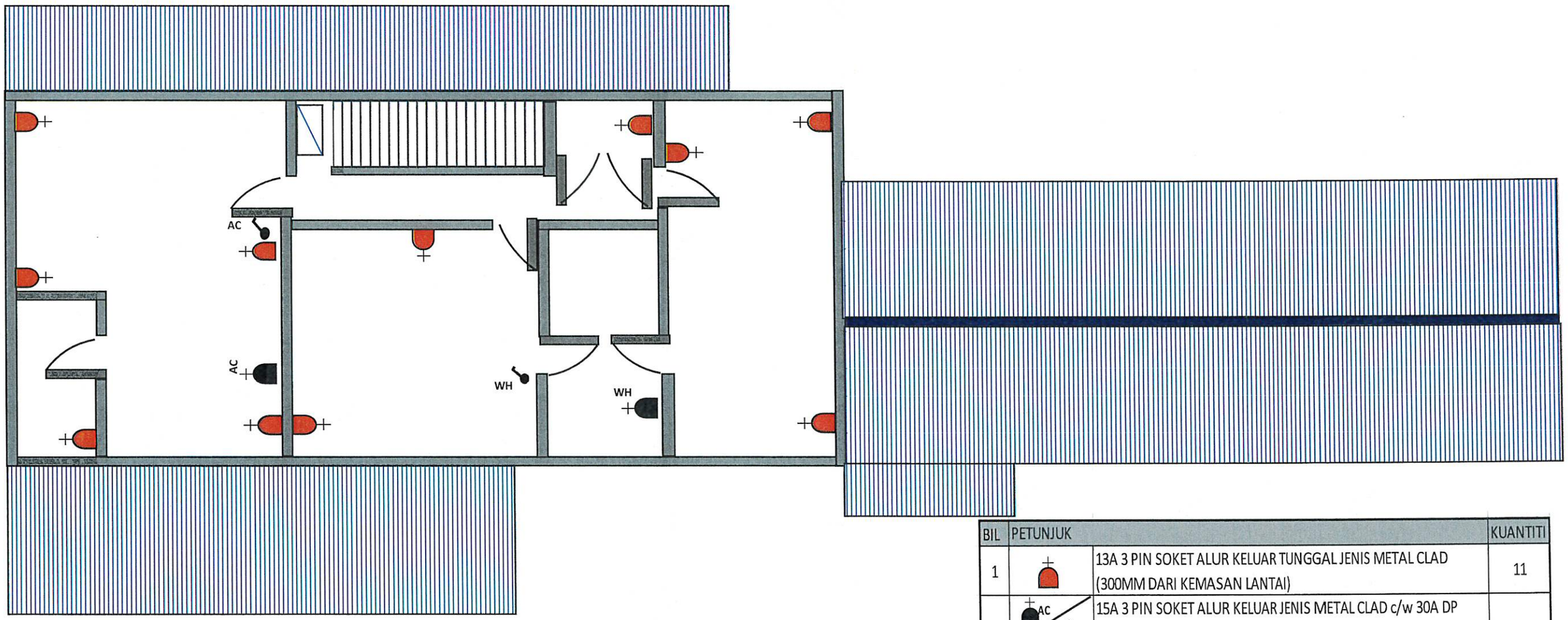
CADANGAN SUSUN ATUR LITAR LAMPU DAN KIPAS BAGI SKOP KERJA ELEKTRIK DI LOT 2930 ARAS ATAS

NO. LUKISAN

PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/03

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2025	

PINDAAN



BIL	PETUNJUK		KUANTITI
1		13A 3 PIN SOKET ALUR KELUAR TUNGGAL JENIS METAL CLAD (300MM DARI KEMASAN LANTAI)	11
2	AC / AC	15A 3 PIN SOKET ALUR KELUAR JENIS METAL CLAD c/w 30A DP METAL CLAD SWITCH (300MM DARI SILING)	1
3	WH / WH	15A 3 PIN SOKET ALUR KELUAR JENIS METAL CLAD c/w 20A DP METAL CLAD SWITCH (300MM DARI SILING)	1

PEGAWAI PENGUASA

Ir. ZULFAIZAL BIN MAT ZIN

WAKIL PEGAWAI PENGUASA

RIDZA HAFIZUDDIN BIN AB. MAJID

PROJEK

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR 2930 PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK

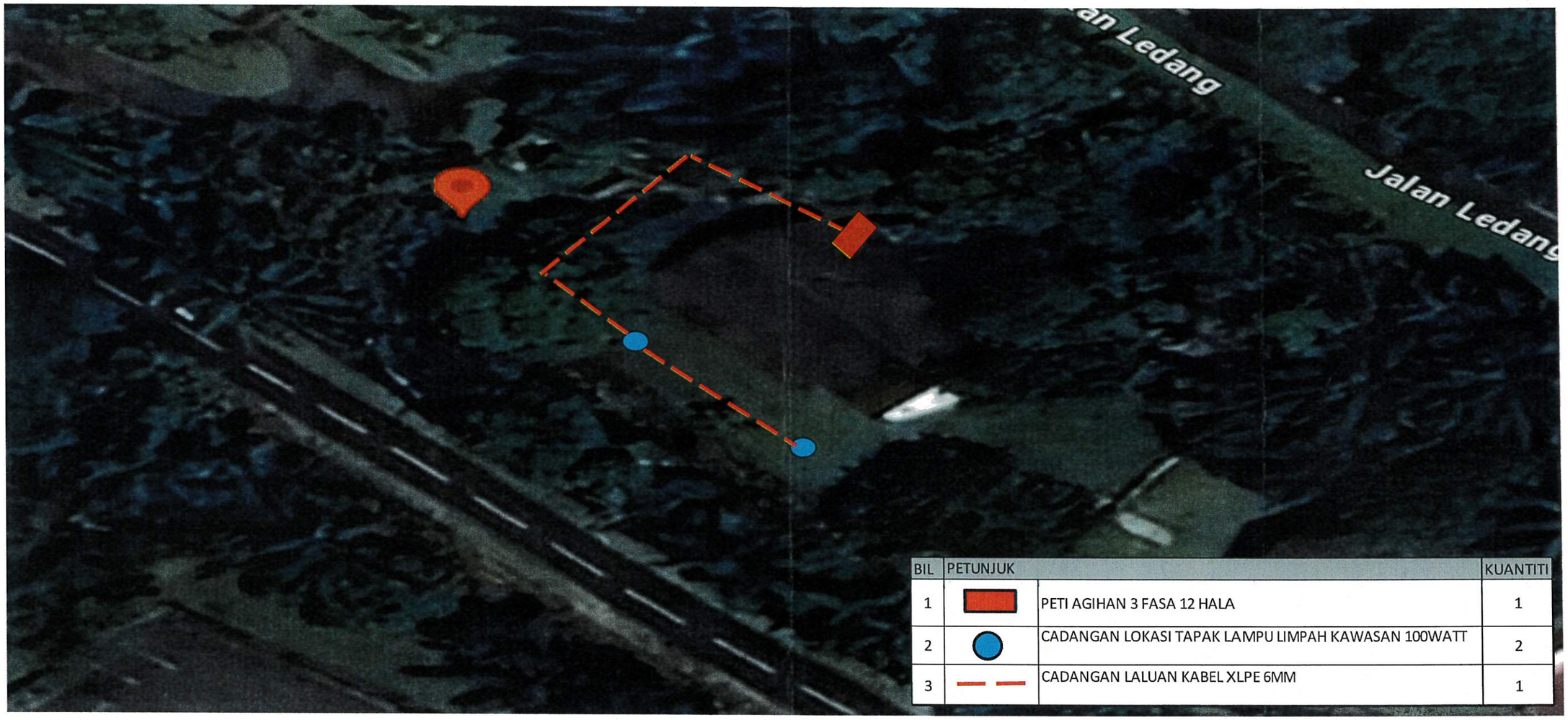
CADANGAN SUSUN ATUR LITAR KUASA BAGI SKOP KERJA ELEKTRIK DI LOT 2930 ARAS ATAS

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2025	

NO. LUKISAN

PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/04

PINDAAN



BIL	PETUNJUK		KUANTITI
1		PETI AGIHAN 3 FASA 12 HALA	1
2		CADANGAN LOKASI TAPAK LAMPU LIMPAH KAWASAN 100WATT	2
3		CADANGAN LALUAN KABEL XLPE 6MM	1

PEGAWAI PENGUASA

Ir. ZULFAIZAL BIN MAT ZIN

WAKIL PEGAWAI PENGUASA

RIDZA HAFIZUDDIN BIN AB. MAJID

PROJEK

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR 2930 PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK

CADANGAN KEDUDUKAN LAMPU KAWASAN 100WATT DI LOT 2930 PARLIMEN MALAYSIA

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2025	

NO. LUKISAN

PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/05

PINDAAN

CL (W)				SPARE	SPARE	SPARE					SPARE						SPARE	SPARE	SPARE			SPARE		SPARE		SPARE				
1200MM LENGKAPAN LAMPU LED JENIS SALUR LENGKAP DENGAN TIUB LED T8, 6500K (LENGKAPAN SILING)	4	3	4					5	4	5					3														
1200MM LENGKAPAN LAMPU LED JENIS SALUR LENGKAP DENGAN TIUB LED T8, 6500K (LENGKAPAN DINDING)			3							4																			
600MM LENGKAPAN LAMPU LED JENIS SALUR LENGKAP DENGAN TIUB LED T8, 6500K (LENGKAPAN SILING)		2														5													
600MM LENGKAPAN LAMPU LED JENIS SALUR LENGKAP DENGAN TIUB LED T8, 6500K (LENGKAPAN DINDING)															2														
60" LENGKAPAN KIPAS SILING I/D PENGATUR	2	1							2																				
16" LENGKAPAN KIPAS DINDING I/d PULL CORD SWITCH & SPEED CONTROL								1																					
12" KIPAS PELAWAS I/d PENUTUP AUTOMATIK								1							1														
BELL CHIME																1													
13A 3 PIN SOKET ALUR KELUAR TUNGGAL JENIS METAL CLAD (300MM DARI KEMASAN LANTAI)																				6	1		6	2			2		
13A 3 PIN SOKET ALUR KELUAR TUNGGAL JENIS METAL CLAD (1450MM DARI KEMASAN LANTAI)																					4			1			6	3		
15A 3 PIN SOKET ALUR KELUAR JENIS METAL CLAD c/w 30A DP METAL CLAD SWITCH (300MM DARI SILING)-AIRCOND											1	1	1																
15A 3 PIN SOKET ALUR KELUAR JENIS METAL CLAD c/w 30A DP METAL CLAD SWITCH (300MM DARI SILING)-WATER HEATR							1												1										
150W LAMPU LIMPAH LED I/d SPD TERBINA DALAM																												2	
16W LAMPU PAGAR JENIS LED																												1	
100W LAMPU KAWASAN																												1	

TO 8 WAY TPN DB (ARAS ATAS)

2 X 1.5mm persegi PVC KABEL
2 X 6.0 mm persegi PVC KABEL
2 X 6.0 mm persegi PVC KABEL
2 X 6.0 mm persegi PVC KABEL
2 X 4.0 mm persegi PVC KABEL
2 X 2.5 mm persegi PVC KABEL

25A RCBO (10mA) 20A DP SWITCH C/W INDICATOR LIGHT

25A RCBO (10mA) 20A DP SWITCH C/W INDICATOR LIGHT

10A 10A 10A 10A 32A 32A 20A — 6KA
10A 10A 10A 10A 32A 32A 32A — 6KA
10A 10A 10A 32A 32A 32A 20A — 6KA
32A 32A 32A — 6KA
32A 32A 32A — 6KA
32A 32A 32A — 6KA

C 32A 3pole Contactor
T Timer 24 Hours

20A TPN MCB
63 TPN RCCB (100mA)

63A DP RCCB
63A DP RCCB (100mA)
63A DP RCCB (100mA)
63A DP RCCB (30mA)
63A DP RCCB (30mA)
63A DP RCCB

60A TPN MCCB 25kA
60A TPN MCCB 25kA

4core x 25mm persegi XLPE/SWA/PVC CABLE

R Y B N

SPD

63A DP RCCB (100mA)

12 WAY TPN DB (ARAS BAWAH)

4core x 25mm persegi XLPE/SWA/PVC CABLE

FROM TNB

EARTHING

PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/06

PEGAWAI PENGUASA

Ir. ZULFAIZAL BIN MAT ZIN

WAKIL PEGAWAI PENGUASA

RIDZA HAFIZUDDIN BIN AB. MAJID

PROJEK

KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR 2930 PARLIMEN JALAN LEDANG, KUALA LUMPUR

TAJUK

CADANGAN KEDUDUKAN LAMPU KAWASAN 100WATT DI LOT 2930 PARLIMEN MALAYSIA

DILUKIS	DISEMAK	TARIKH	SKALA
		MAC 2025	

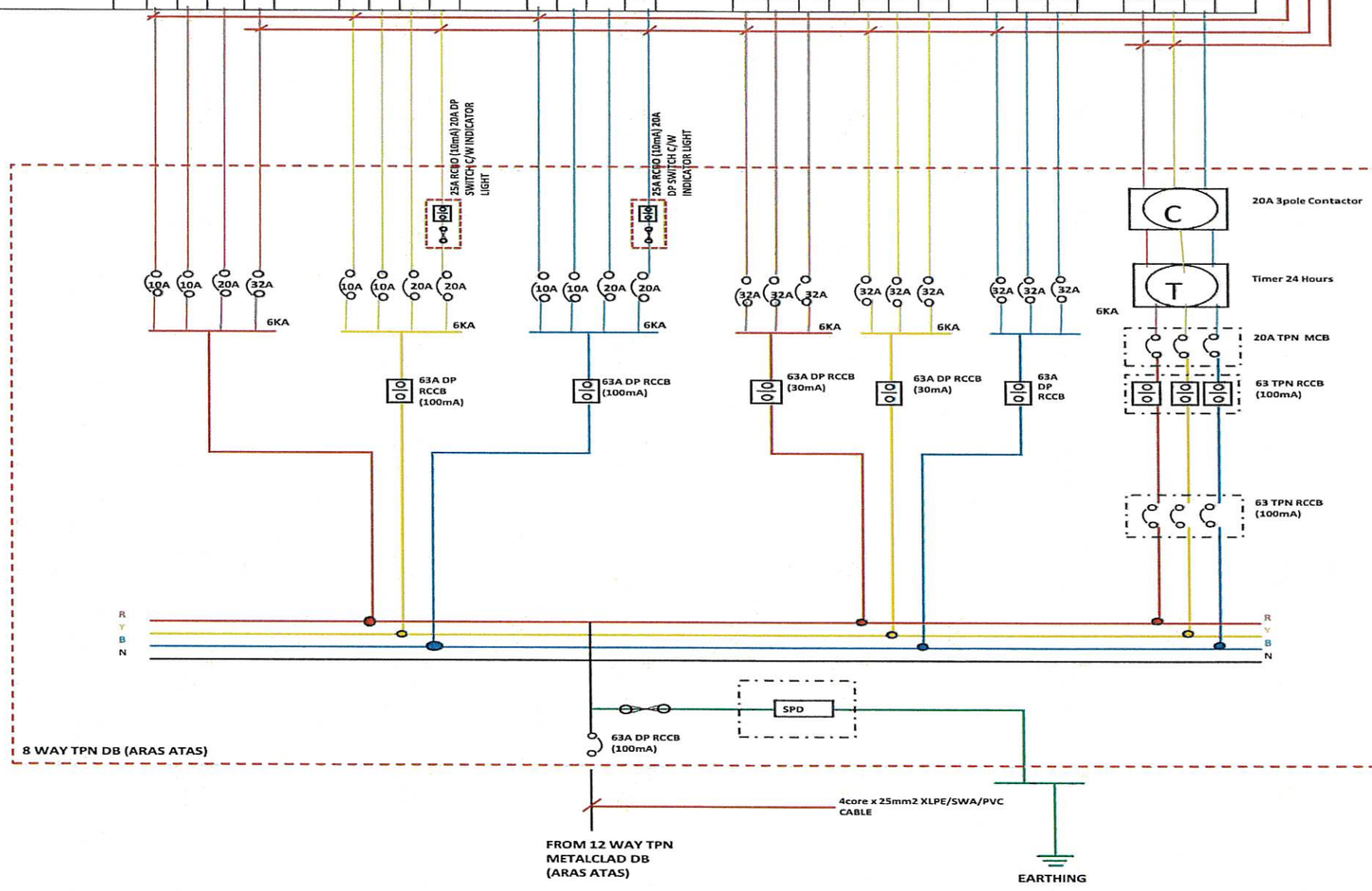
NO. LUKISAN

PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/06

PINDAAN

CL (W)		SPARE	SPARE			SPARE	SPARE			SPARE	SPARE			SPARE	SPARE			SPARE	SPARE			SPARE	SPARE			SPARE		
1200MM LENGKAPAN LAMPU LED JENIS SALUR LENGKAP DENGAN TIUB LED T8, 6500K (LENGKAPAN SILING)		4				3				4																		
60" LENGKAPAN KIPAS SILING I/D PENGATUR		1				1				2																		
13A 3 PIN SOKET ALUR KELUAR TUNGGAL JENIS METAL CLAD (300MM DARI KEMASAN LANTAI)														4				2				4						
15A 3 PIN SOKET ALUR KELUAR JENIS METAL CLAD c/w 30A DP METAL CLAD SWITCH (300MM DARI SILING)-AIRCOND					1																							
15A 3 PIN SOKET ALUR KELUAR JENIS METAL CLAD c/w 30A DP METAL CLAD SWITCH (300MM DARI SILING)-WATER HEATR									1				1															
150W LAMPU LIMPAH LED I/d SPD TERBINA DALAM																										2	2	

2 X 1.5mm persegi PVC
2 X 6.0 mm persegi PVC KABEL
2 X 2.5 mm persegi PVC KABEL



PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/07

PEGAWAI PENGUASA	PROJEK	TAJUK	NO. LUKISAN
Ir. ZULFAIZAL BIN MAT ZIN	KERJA-KERJA MEMBAIK PULIH, MENYELENGGARA, MENAIK TARAF DAN LAIN-LAIN KERJA BERKAITAN DI KUARTERS JKR 2930 PARLIMEN JALAN LEDANG, KUALA LUMPUR	CADANGAN KEDUDUKAN LAMPU KAWASAN 100WATT DI LOT 2930 PARLIMEN MALAYSIA	PM/BSFL/KUARTERSPARLIMEN/ELEKTRIK/07
WAKIL PEGAWAI PENGUASA			
RIDZA HAFIZUDDIN BIN AB. MAJID			

DILUKIS	DISEMAK	TARIKH	SKALA	PINDAAN			
		MAC 2025					