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END OF SECTION

1 PART 1 – GENERAL

1.1. GENERAL

This Part specifies procedures and requirements for demolition and removal of buildings, structures and related service utilities.

1.2. GENERAL REQUIREMENTS

1. Unless otherwise indicated in the Project Documentation or directed by the Engineer, the Contractor is to complete the demolition and removal of buildings and structures together with all foundations and retaining walls, piers, partitions and columns, and associated service utilities.
2. Demolition work in alterations are to be undertaken with the maximum consideration for the surrounding structure and are to be limited to the minimum required in order to carry out the work. The manner and order of the work, including the design and provision of any supports and other safety precautions, will be the Contractor's responsibility and shall be fully detailed in the method statement.
3. The design of any shoring and supports necessary to maintain the stability of any structure retained after the demolition of adjoining property are to be submitted to the Engineer for approval. The responsibility for the sufficiency of the design is to rest with the Contractor, notwithstanding the approval of the Engineer.
4. The demolition is to be carried out in a planned and safe sequence, generally in reverse order of erection, reducing the shell of the building in small lifts.
5. The Contractor is responsible for the removal and disposal of all debris resulting from demolition work.
6. Upon hand over of the Site to the Contractor, the Contractor is to take over all responsibility of the buildings to be demolished.
7. The Contractor is to inspect each building he is to remove and determine for himself the work involved and the equipment and the materials required for the specified demolition

1.3. METHOD STATEMENT

1. The Contractor is to prepare a method statement which shall detail all aspects proposed demolition work and associated procedures before commencing any demolition work. The method statement shall be approved by the Engineer before any demolition work commences.
2. The Contractor shall establish whether any stressed components are present in the structure. The Contractor shall include a complete statement of his proposed method of demolition of the such components in his method statement.
3. The Contractor shall establish whether any of the walls of the structure to be demolished are load bearing and shall establish whether cross walls are bonded into the abutting walls. The Contractor shall identify such walls in his method statement.

1.4. EXECUTION

1. The Contractor shall demolish and remove buildings and structures, as indicated in the project documentation
2. Debris, including brick, concrete, stone, metals and similar materials are to become the property of contractor and be disposed of by him, off the Site. Concrete slabs below grade that do not require removal from the site are to be broken up into pieces not exceeding 60 cm².
3. The Contractor is to conduct his operations in such a manner as to avoid danger to persons and property. Once demolition work has started on any building, the work on that building is to be continued to completion, promptly and expeditiously.
4. The Contractor is responsible for removing any additional small “out” buildings or miscellaneous structures that have not been indicated in the Project Documentation unless otherwise instructed by the Engineer.
5. Operations necessary for the removal of an existing structure or obstruction, which may damage new construction, are to be completed prior to placing the new work unless otherwise specified in the Project Documentation.
6. Where trees have been designated to remain, but are a hindrance to demolition work, the Contractor is to, at his own expense, temporarily relocate such trees and provide all maintenance as necessary until such time as replanting is feasible.

1.5. UTILITY & SERVICE

1. The Contractor is to arrange for the disconnection of all utilities that serve buildings in accordance with the respective requirements and regulations.
2. The Contractor is to disconnect and properly seal, in a manner approved by the relevant authority and the Engineer, all sewer outlets that serve buildings to be demolished. The Contractor will keep the Engineer informed of his plans for the performance of any

work in connection with the sealing off of such outlets in order that proper inspection may be provided at the time the work is performed.

1.6. SPECIAL PRECAUTIONS

1. The Contractor is to follow and implement all procedures defined or required by related environmental or public safety authorities. These precautions will be taken at all times during the removal or confinement of hazardous materials, whether known or suspected.
2. The Contractor is to have present at the Site, a representative of the related approval authority during removal or confinement work, if it is a requirement the approval authority.
3. The Contractor is to be responsible for processing and approval of any documentation relating to procedures required by governmental or agencies related to procedures for removal or containment of hazardous materials.

END OF SECTION

2. EXCAVATION AND FILLING

1.0. GENERALLY

0. **SITE INVESTIGATION:** No site investigation has been carried out and the Contractor shall be responsible for establishing the sub-ground conditions. All foundations have been designed for a safe ground bearing pressure of 100 KN/m^2 at 0.8m below ground level and the Contractor shall be responsible for establishing the adequacy of this strata by means of all necessary site and laboratory testing, if required to do so. The Contractor shall provide a written report on his site investigation. The foregoing work shall be carried out immediately upon the award of the Contract and the Contractor shall make allowance in his programme for time to re-design the foundations in the event of the safe ground bearing pressure being less than 100 KN/m^2 .
0. The Contractor shall consult local knowledge for information on ground water. He shall take into account that the site may contain reclaimed land formed from crushed coral and is therefore porous. This means that ground water level will be dependant upon adjoining sea levels and any tidal fluctuations.
0. A substantial part of the excavation is under seawater. When excavating under the seabed, the contractor must ensure that all environmental and statutory requirements are adhered and if required must use silt screen to protect the fragile corals. A detailed method statement must be submitted prior to the execution of any excavation work.

1.0. EXCAVATING FOR STRUCTURES

Excavation Support System

0. Prior to Commencing any structural excavation work which is 1.5 m or greater in depth, the Contractor shall design an excavation support system.
0. Details of the excavation support system shall be submitted to the Engineer for review and approval before any excavation work commences.
0. Details of the excavation support system shall be complete with, but not limited to, the following:
 - Drawings of the structural support members showing materials, sizes and spacing,
 - Calculations showing the maximum theoretical deflection of the support member.
0. The system is to be designed so that no members extend through surfaces exposed in the finished construction, and no shoring or bracing is placed under permanent structures.

Site Clearance

0. Before commencing any excavation or fill, the area shall be cleared of all trees, stumps, roots, bushes, vegetation, debris, materials or other obstructions.
0. Before removal of any trees or shrubs the Contractor shall obtain written consent from the Supervising Engineer in advance of the planned removal.
0. All bushes, undergrowth, etc. to be removed shall be grubbed up and disposed of in a manner as agreed with the Supervising Engineer. Holes left by stumps or roots shall be filled with suitable material, compacted to the Supervising Engineer's satisfaction in accordance requirements of this Section.
0. MATERIALS ARISING from the excavations and surplus to requirements for filling are to remain the property of the Client unless the Contractor:
 - Is instructed to remove them from the site, or
 - Purchases them at a price to be agreed.
0. BENCHING: Surfaces of excavations with a gradient greater than 1 in 5 which are to receive filling must have horizontal benches cut to match the depths of compacted layers of filling.
0. ACCURACY - Permissible deviations from formation levels:
 - Beneath mass concrete foundations: +/-25mm
 - Beneath ground bearing slabs and R.C. foundations: +/-15 mm
0. Make advance arrangements with the Supervising Engineer for inspection of formations for the following:
 - Foundations and ground slabs,
0. Remove the last 150 mm of excavations just before inspection. Trim excavations to required profiles and levels, and remove all loose material.
0. Unless otherwise instructed seal formations within 4 hours of inspection with concrete or other specified fill.
0. FOUNDATIONS GENERALLY: Obtain instructions if:
 - The formation contains soft or hard spots or highly variable material.
0. EXCESS EXCAVATION: Backfill any excavations taken:
 - Wider than required or deeper than required with well graded granular material or mass concrete, all as instructed by the Supervising Engineer.

1.0. DISPOSAL OF MATERIALS

0. SURPLUS SUBSOIL - Remove from site, surplus excavated material, which is not required to be spread, levelled or stockpiled.
0. WATER: Keep all excavations free from water.

1.1 FILLING

0. **HAZARDOUS, AGGRESSIVE OR UNSTABLE MATERIALS:**

Do not import or use fill materials which would, either in themselves or in combination with other materials or ground water, give rise to a health hazard, damage to building structures or instability in the filling.

1. Ensure that excavations and areas to be filled are free from loose soil, rubbish and standing water.
1. Take all necessary precautions to ensure stability of adjacent structures. Place and compact fill against structures, membranes or buried services in a sequence and a manner that will ensure stability and avoid damage.
1. Plant employed for transporting, laying and compacting must be suited to the type of material.
1. Lay differing materials separately so that only one type of material occurs in each layer.

Benching In Fill:

1. Where, during the progress of the work, the difference in level between adjacent areas of filling exceeds 600 mm, cut into edge of higher filling to form benches having a minimum width of 600 mm and a height equivalent to the depth of a layer of compacted filling. Spread and compact new filling to ensure maximum continuity with the previous filling.

1.1 **HARDCORE UNDER CONCRETE GROUND BEARING SLABS, INFILL WITHIN FOUNDATIONS, AND UPFILL**

1. Fill to be compacted by a suitable plate type vibrator, pedestrian operated vibrator roller, small tandem roller or other approved compaction plant.
1. The material is to be placed in layers within the effective range of compaction of the plant, however the maximum unconsolidated thickness of each layer will not exceed 250 mm irrespective of plant type.
1. The material is to be watered and mixed as necessary to ensure that prior to compaction the moisture content of the whole layer is $\pm 3\%$ of the optimum moisture content.
1. Compaction of each layer is to continue until a density of at least 95% of the maximum dry density has been achieved.
1. The dry density/moisture content relationship will be determined by the heavy compaction test (4.5% rammer method) of BS 1377.

Defective Compaction

1. As soon as possible after any part of the work is known or suspected to be defective, submit proposals for testing, inspection or replacement and obtain instructions.

END OF SECTION

1 PART 1 – GENERAL

1.1. GENERAL

1. This Section includes the requirements for concrete work for structures, water retaining structures, foundations and bases for structures and equipment
2. This Part includes relevant standards, definitions, abbreviations, and requirements for testing facilities, rejected materials, and record keeping.

1.2. REFERENCES

The following standard is referred to in this Part:
BS 6100: Building and civil engineering terms.

1.3. DEFINITIONS

Definitions used in this Section follow the requirements of BS 6100.
The following are terms and abbreviations used:

°C	degree Celsius
cal	calorie
cm	centimetre
d	day
f_{cu}	characteristic cube strength of concrete
GGBFS	ground granulated blast furnace slag
GUTS	guaranteed ultimate tensile strength
h	hour
kg	kilogram
kJ	kilojoule
kN	kilonewton
l	litre
m	metre
m^2	square metre
m^3	cubic metre
mg	milligram
min	minute
mm	millimetre
mm^2	square millimetre
months	months
MPa	mega pascal
MSRPC	moderately sulphate resisting Portland cement
OPC	ordinary Portland cement
PFA	pulverised fuel ash
PVC	polyvinylchloride
s	second
SRPC	sulphate resisting Portland cement
ton	1000 kg

1.4. IMPLEMENTATION

1. The Contractor shall carry out the test procedures required by this Section and any other tests and test procedures as directed by the Supervising Engineer from time to time. The test procedures shall be carried out using the facilities of an approved independent testing laboratory.
2. The Supervising Engineer may also require the Contractor to take samples of materials and deliver them to a Materials Laboratory for additional tests to be carried out by the Employer. Sampling procedures and sample sizes shall conform to the requirements shown in Table 1.1.
3. All equipment required for testing on Site shall be maintained on Site at all times during concreting operations together with the necessary scoops, buckets, sample containers, and other items required for sampling.

1.5. REJECTED MATERIALS

Any material rejected by the Supervising Engineer, in particular cement which has deteriorated or aggregates which have segregated or become contaminated, shall be immediately removed from the Site.

1.6. RECORDS

1. The Contractor shall maintain on the Site full records of all work carried out accurately related to the location of the work on site, which shall include:
 - (a) the time and date when all concrete was poured, formwork removed and when formwork props were fully removed
 - (b) all cubes and other tests
 - (c) daily maximum and minimum temperatures.
2. One copy of all test results shall be sent to the Supervising Engineer immediately upon completion of the tests.

Table 1.1
Sampling Procedure and
Minimum Sample Sizes for Central Materials Laboratory

MATERIAL	TEST	SAMPLE SIZE
Cement	Full range of tests	Composite sample of 7 kg taken from at least 12 bags
Aggregate	Full range of tests	200 kg
	Sieve analysis Chemical analysis Soundness test Specific gravity Water absorption Bulk density Flakiness index Dust content Abrasion value	50 kg
	Aggregate crushing value	25kg
	Ten percent fines	25kg
	Immersed rotational test	100kg
Reinforcement	Tensile test	500mm
	Bend test	300mm
Water	Full range of tests	1 litre

END OF SECTION

2 PART 2 - AGGREGATES

2.1 GENERAL

1. This part covers the requirements of aggregates for use in structural concrete.

2.2 REFERENCES

The following standard is referred to in this Part:

BS 812, Testing aggregates

BS 882, Specification for aggregates from natural sources

2.3 SOURCE APPROVAL

The Contractor shall submit to the Supervising Engineer for approval full details of the proposed sources of aggregate. These sources of aggregate supply shall be regularly and thoroughly investigated to ensure that the quality of the material supply is satisfactory and that it does not deteriorate during the performance of the project.

2.4 SAMPLING

1. Contractor shall provide samples of both fine and course aggregate to the Supervising Engineer, in accordance with the requirements of BS 812 Part 101, Guide to Sampling and Testing Aggregates, for testing at least two weeks before beginning deliveries to the Site.
2. All samples shall be taken in the presence of the Supervising Engineer.

2.5 QUALITY AND TESTING

1. Aggregates shall consist of tough, hard, durable and uncoated particles containing no harmful material in quantities sufficient to adversely affect the concrete or reinforcing steel, and shall contain no materials likely to cause staining or otherwise disfigure the concrete surface.
2. Aggregates which shall be obtained from a source approved by the Engineer, shall comply with the requirements of BS 882 except as modified here under. If required by the Supervising Engineer, and in order to comply with these requirements the aggregates shall be washed clean with potable water. The Contractor shall provide all data as specified in Appendix A of BS 882.
3. Contractor shall satisfy the Supervising Engineer that aggregates to be supplied will not give rise to alkali aggregate reaction with the cement.
4. Fine aggregates shall be natural sand or manufactured crushed rock sand. Crushed rock sand shall be the direct product of a manufacturing process, not the by-product of coarse aggregate production.

5. Beach sand shall not be permitted for use in concrete mixes. Aggregates shall meet the requirements of Table 2.1 Frequency of routine testing shall meet the requirements of Table 2.2. Samples of aggregates shall be tested in accordance with the requirements of Table 2.2.
6. No aggregate deliveries shall be made to the Site until the Supervising Engineer has approved the samples as complying with this specification.

2.6 STORAGE

1. The Contractor shall provide a means of storing aggregate at each point where concrete is made such that;
 - each nominal size of coarse aggregate and the fine aggregate shall be kept separated at all times
 - contamination of the aggregates by the ground or other foreign matter shall be effectively prevented at all times
 - each heap of aggregate shall be capable of draining freely
 - storage shall be such as to prevent segregation
 - stock piles shall be protected from direct sunlight
2. The preparation, location and size of any stockpiles, and the methods of segregation shall be to the approval of the Supervising Engineer

Table 2.1
Limits for physical, chemical and
Mechanical properties of Aggregates for Concrete

NO:	REQUIREMENT	TEST METHOD		PERMISSIBLE LIMITS	
		BS 812	ASTM	COARSE	FINE
1.	Grading	Part 103 (dry)		Standard	Standard
2.	Clay lumps & friable particles		C142	Max 3%	Max 2%
3.	Lightweight pieces		C123	Max 0.5%	Max 0.5%
4.	Organic impurities		C40	Colour standard not darker than Plate No. 3	
5.	Water absorption	Part 2	C128/C127	Max 2.3%	Max 2%
6.	Specific gravity	Part 2	C128/C127	Min 2.6	Min 2.6
7.	Acid soluble chlorides	Part 117		Max 0.6%	Max 0.3%
	Reinforced Concrete & Mass concrete				
8.	Acid soluble Sulphates	Part 118		Max 0.3%	Max 0.3%
9.	Drying shrinkage	Part 120			Max 0.05%
10.	Moisture content	Part 109			

Table 2.1
Limits for physical, chemical and
Mechanical properties of Aggregates for Concrete

ITEM NO:	REQUIREMENT	TEST METHOD	TEST FREQUENCY
1.	Grading	BS8102: Part 103	Daily
2.	Clay lumps & friable particles	ASTM C142	Daily
3.	Organic impurities	ASTM C40	Greater of : per month or per 200 cubic meter
4.	Water absorption	ASTM C128/C127	Weekly
5.	Specific gravity	ASTM C128/C127	Weekly
6.	Acid soluble chlorides	BS 812: part 117	Twice weekly
7.	Acid soluble Sulphates	BS 812: part 118	Twice Weekly
8.	Drying shrinkage	BS 812: part 120	Start of project or change of source
10.	Moisture content		Twice daily

2.7 FINE AGGREGATE FOR CONCRETE AND MORTAR

1. The gradation of fine aggregate for concrete and mortar shall be in accordance with the gradation designations shown in Table 2.3
2. Each batch of aggregate delivered to the Site shall be kept separate from previous batches, and shall be stored for at least three working days before use to allow for inspection and tests to be carried out.
3. The aggregate used shall be clean, sharp, natural or crushed sand or a uniform mixture of both.
4. The Contractor shall mechanically wash the aggregate to remove salts and other impurities in order to meet the specified requirements.

END OF SECTION

3 PART 3 - CEMENT

3.1 GENERAL

This Part covers the requirements for the testing and use of cement in structural concrete.

3.2 REFERENCES

The following standard is referred to in this Part:

BS 12, Portland cement
BS 146, Portland-blast furnace cement
BS 4027, Sulphate-resisting Portland cement
BS 4550, Methods of testing cement

3.3 SOURCE APPROVAL

1. The Contractor shall submit to the Supervising Engineer for approval full details of the proposed sources of cement. These sources of cement supply shall be regularly and thoroughly investigated to ensure that the quality of the material supply is satisfactory and that it does not deteriorate during the performance of the project.
2. The Contractor shall supply the Supervising Engineer with the manufacturer's test sheets for each consignment of cement, certifying that the cement is in compliance with the relevant standards.
3. The Contractor shall submit to the Supervising Engineer the date of manufacture and proof that the specifications have been complied with, certified by an independent agency in the country of origin.

3.4 SAMPLING

1. The methods of obtaining samples of cement for testing shall be carried out as described in BS 4550 Part 1.
2. The Contractor shall provide samples from each consignment of cement delivered to the Site, or as required by the Supervising Engineer. Seven days shall be allowed for the Supervising Engineer's review of these samples.

3.5 QUALITY AND TESTING

1. Ordinary Portland cement shall meet the requirements of BS 12.
2. Sulphate resisting Portland cement shall conform to the requirements of BS 4027.
3. The testing of cement shall be carried out in accordance with the provisions of BS 4550 Parts 2 and 3.

3.6 STORAGE

1. Cement shall be delivered to the Site in sealed and branded bags, or in the manufacturer's containers, bearing the manufacturer's name, cement type and date of manufacture, in batches not exceeding 100 tons.
2. Immediately upon arrival at the Site the Contractor shall store the cement in
 - silos designed for the purpose, or
 - dry, weather tight and properly ventilated structures with floors raised a minimum of 450 mm above the ground with adequate provision to prevent absorption of moisture.
3. Each consignment of cement shall be kept separately, and the Contractor shall use the consignments in the order in which they are received. Different types of cement shall be kept in clearly marked separate storage facilities.
4. During transport and storage the cement shall be fully protected from all weather elements.
5. Any consignment of cement not used within six months from the date of manufacture or cement which in the opinion of the Supervising Engineer is of doubtful quality shall not be used in the Works until it has been retested and test result sheets showing that it complies in all respects with the specification and relevant standards have been delivered to the Supervising Engineer.

END OF SECTION

4 PART 4 - WATER & ADMIXTURE

4.1 GENERAL

This Part includes the use of water and admixture for concrete mixes, washing of equipment, wetting of surfaces or ponding during curing or for wetting formwork and washing reinforcement.

4.2 REFERENCES

The following standard is referred to in this Part:

BS 12, Portland cement
BS 1377, Methods of test for soils for civil engineering purposes.
BS 3148, Water for making concrete (incl. notes on the suitability of the water)
BS 2690, Methods of testing water used in industry
BS 4550, Test for setting timer
BS 5075, Concrete admixtures
ASTM C494, Standard Specification for Chemical Admixtures for Concrete

4.3 QUALITY OF WATER & TESTING

1. Water shall be potable water and shall comply with the requirements of BS 3148 except as modified below.
2. The pH of water used in concrete works shall be between 7 – 9 when tested in accordance with BS 2690: Part 5
3. The concentration of chloride and sulphates shall not exceed 500mg/l and 1000mg/l respectively when tested in accordance with BS 1377 part 3.
4. The concentration of alkali carbonates and bicarbonates shall not exceed 500mg/l when tested in accordance with BS 2690 part 109.
5. The total dissolved ions including 3 and 4 above shall not exceed 2000mg/l when tested in accordance with BS 1377 part 3.
6. Temperature of water for concrete shall not be less than 5 °C and not more than 25 °C
7. Water may be cooled to not less than 5 °C by the gradual addition of chilled water or ice as follows:
 - no ice particles shall be present in the mix
 - alternatively, flaked ice may be used
 - ice to be used shall be crushed and shall be a product of frozen water which complies with the acceptance criteria of above.
8. Water for curing concrete shall not contain impurities in amounts to cause discoloration of the concrete.

9. Whenever required to do so by the Supervising Engineer the Contractor shall take samples of the water being used, or which it is proposed to use, for mixing concrete and test them for quality.
10. Samples of water of not less than 5l shall be taken, sealed and sent for testing at an approved independent laboratory, prior to the approval of any water source, and whenever the sources of water is changed periodically during the continuance of its use.

4.4 USE OF ADMIXTURE

1. Admixtures shall mean materials added to the concrete materials during mixing for the purpose of altering the properties of the mix.
2. Where approved and or directed by the Engineer, admixtures shall be used as a means of:
 - enhancing concrete durability
 - increasing workability of the concrete without increasing the water:cement ratio
 - controlling and limiting retardation and setting.
3. The methods of use and the quantities of admixture used shall be in accordance with the manufacturer's instruction and subject to the Supervising Engineer's approval after evaluation in trial mixes and shall in no way limit the Contractor's obligations under the Contract to produce concrete with the specified strength, workability and durability.
4. The effects of accidental overdose, of the admixture and measures to be taken, if an overdose occurs, shall be provided by the Contractor to the Supervising Engineer.
5. No admixtures containing chlorides shall be used. In particular, the use of acceleration admixtures containing calcium chloride shall not be used.
6. The use of the admixtures shall be controlled; i.e., strict quality control to ensure correct dosages as prescribed by the manufacturer and justified by trial mixes to be used. A calibrated dispenser or flow meter shall be used to for the addition of the admixture.

4.5 ORGANIC CORROSION INHIBITORS

1. Where the concrete is deemed to be in a contact with salt water the Contractor must use an organic corrosion inhibiting admixture. The admixture shall be based on an aqueous emulsion of amines and esters and shall be capable of inhibiting chloride penetration through the capillary pores in addition to forming a protective corrosion resistant film around the steel reinforcement.
2. The admixture shall have no effect on either the slump or temperature development of the concrete in its plastic state.
3. In its hardened state the admixture shall not affect strength development or concrete-steel bond strengths in any way.

4. The corrosion inhibitor shall be capable of effecting protection to the steel where concrete has cracked and allows access to the elements responsible for corrosion.
5. The corrosion inhibitor is to be added at a rate of five litres per cubic metre at the time of mixing or as recommended by the manufacturer.

4.6 ANTI WASHOUT / UNDERWATER CONCRETE ADMIXTURE

1. All insitu concreting in or under water must use an anti washout /underwater concrete admixture. The admixture shall ensure that there is minimal loss of cement in the mix and there is no segregation of the particles.
2. The admixture shall have no effect on either the slump or temperature development of the concrete in its plastic state.
3. In its hardened state the admixture shall not affect strength development or concrete-steel bond strengths in any way.

4.7 QUALITY ASSURANCES

1. Manufacturer: Concrete admixtures shall be manufactured by a firm with a minimum of ten years experience in the production of admixtures for concrete. Manufacturers proposed for use shall submit evidence of their ability to meet all the requirements specified, and include a list of projects of similar design and complexity.
2. The manufacturer or distributor shall provide product certification, as required as to the products quality and source of manufacture. A representative of the distributor shall be present for project startup during initial concrete placement. This requirement may be waived if the Contractor provides sufficient evidence that the producer and finisher have adequate experience with admixtures.

END OF SECTION

5 PART 5 - CONCRETE MIXES

5.1 GENERAL

This Part includes Grades 15, 20, 25 and 30 of concrete to be used in the Works, and the requirements for workability, permeability, and drying shrinkage.

5.2 REFERENCES

The following standard is referred to in this Part:

BS 8007, Design of concrete structures for retaining aqueous liquids
BS 8110, Structural use of concrete
BS 1881, Methods of testing concrete
BS 812, Testing aggregates
BS 882, Aggregates from natural sources for concrete
BS 5328 Part 3,
BS 7542, Method of test for curing compounds for concrete.

5.3 GRADES OF CONCRETE

1. Grades of concrete to be used in the Works shall in general be as shown table below. Where different grades of concrete are required the design of the mix shall follow the requirements of this specification.

Concrete grade	Max Agg. size	Min Cement content (kg/m ³)	Water to cement ratio	Trial mix test (MPa)	Works test (MPa)
30	20	330	0.40 – 0.45	40	30
25	20	320	0.45 - .50	35	25
20	20	310	0.55	30	20
15	20	280	0.55	25	15

2. Where adequate workability is difficult to obtain at the maximum water:cement ratio allowed, the use of plasticisers or water reducing admixtures may be considered.
3. Cement contents in excess of 400 kg/m³ shall not be used unless special consideration has been given to reduce thermal stress in the concrete, and approval has been obtained from the Supervising Engineer.
4. At the start of the construction period, the Contractor shall design a mix for each grade of concrete listed above Table that is required to be built into the Works.
5. Each mix design shall be such that:
 - the aggregate shall comprise fine aggregate and coarse aggregate no greater than the maximum size specified in above Table.
 - the combined aggregate grading shall be continuous
 - the aggregate quantity shall be calculated by weight

- the mixes shall be designed to produce a concrete cube strength at twenty-eight days after manufacture of not less than the cube strength specified in above Table.

5.4 CONCRETE MIXES

All concrete mixes shall be designed to the relevant clauses of BS 5328: Parts 2, 3 and 4

1. NORMAL DESIGNED MIX FOR BLINDING CONCRETE
Grade: C15
Cement: Sulphate Resisting Portland Cement
2. NORMAL DESIGNED MIX FOR MASS CONCRETE UPFILL
Grade: C20
Cement: Sulphate Resisting Portland Cement
3. NORMAL DESIGNED MIX FOR ALL STRUCTURAL CONCRETE IN LAND:
Grade: C30
Cement: Sulphate Resisting Portland Cement (for below ground)
Cement: Ordinary Portland Cement (for above ground)
4. NORMAL DESIGNED MIX FOR ALL STRUCTURAL CONCRETE IN/OVER WATER:
Grade: C35
Cement: Sulphate Resisting Portland Cement (all areas in direct contact with seawater)
Cement: Ordinary Portland Cement (for all other areas)

5.5 TRIAL MIXES, TESTS AND SAMPLING

1. In order to ensure that the quality of materials and mix proportions are maintained throughout concreting operations, sampling and testing shall be carried out using the relevant procedures set out in BS 812, BS 882 and BS 1881 and all other relevant codes quoted in this specification in accordance with a routine testing program that shall be agreed with the Supervising Engineer before the start of concrete work.
2. The concrete mix shall have at least the required minimum cement content and mean strength greater than the required characteristic strength.
3. Test cubes shall be taken as specified from fresh mixed concrete which is being used in the Works and which has been prepared in the normal way.
4. Samples for works cubes tests shall be taken at the average rate one test per 10 m³ of concrete of a particular grade placed, with a minimum of one sample taken every day that the mix is used. A sample consists of six cubes, three to be tested at 7 d, three at 28 days.
5. If the average strength of the three works test cubes at 7 d indicate that the required strength at 28 d will not be achieved the Contractor shall immediately:
 - stop all concreting until checks are made on material and equipment

- rectify any defect which has become apparent as the result of checking.

At Contractor's option, defective concrete may be removed and replaced without awaiting the 28 d test results.

6. Slump tests shall be carried out at the rate of one test per 5 m³ of concrete produced. The maximum slump, measured at the point of placing the concrete shall not be less than 75 ±25 mm for general concrete work.
7. The workability of fresh concrete shall be suitable for the conditions of handling and placing so that after compaction concrete surrounds all the reinforcement, ducts and completely fills the formwork without voids or honeycombing. The design slump range of the concrete shall be the minimum necessary to ensure the correct placement and compaction of the mix.
8. All concrete shall be designed to be dense, durable and have a high impermeability to water.

END OF SECTION

6 PART 6 - CASTING & CURING

6.1 GENERAL

1. This part deals with the transportation, placing, compaction and the requirement for curing of concrete.

6.2 REFERENCES

The following standard is referred to in this Part:

BS 8110, Structural use of concrete
BS 1881, Methods of testing concrete
BS 5328 Part 3,
BS 7542, Method of test for curing compounds for concrete.

6.3 SUBMITTALS

1. Should the Contractor propose to use concrete pumps for the transportation and placing of concrete, he shall submit details of the equipment and operating techniques he proposes to use for the approval of the Supervising Engineer.
2. A method statement shall be submitted for approval for major concrete placements, which shall address;
 - the planned rate of placing
 - number of batching plants
 - number and positioning of pumps (if any)
 - pour sequence quality control measures
 - any other factors that might affect the placing of concrete
3. The Contractor shall submit to the Engineer the proposed method of curing for approval.

6.4 TRANSPORTING, PLACING AND COMPACTION

6.4.1 Transporting

1. Concrete shall be conveyed from the mixer to its place in the Works as rapidly as possible by methods which will prevent segregation or drying out and ensure that the concrete is of the required workability at the point and time of placing. Should segregation occur in the concrete then the materials shall be remixed to the satisfaction of the Supervising Engineer or discarded.
2. The Contractor shall ensure that the time between placing of different lifts or layers of concrete is short enough to prevent the formation of cold joints. Concrete shall be handled from the place of mixing to its place in the Works within 30 min unless retarders have been incorporated in the mix that have satisfactorily demonstrated that

workability and other properties can be retained, and that approval is obtained from the Supervising Engineer.

3. The Contractor shall obtain the approval of the Supervising Engineer to his proposed arrangements before beginning concreting.
4. All placing and compacting of concrete shall be carried out under the direct supervision of a competent member of the Contractor's staff with a minimum of five years of experience in concreting works, and in a manner to produce a watertight concrete of maximum density and strength.
5. For night concreting operations, the Contractor shall arrange adequate suitable lighting. The Contractor shall provide safe secure access for all personnel on concreting operations.
6. Where the thickness of the concrete section exceeds 600 mm the Contractor shall adopt special precautions, to be approved by the Engineer, to avoid thermal cracking due to external and core temperature differentials.
7. Concrete shall not be placed in adverse weather conditions such as heavy rain.
8. No concrete shall be placed until the Supervising Engineer has inspected and approved in writing the surfaces upon which the concrete is to be placed, the formwork, and reinforcing steel. The Contractor shall give the Engineer at least 24 hours notice to enable this inspection to be carried out.

6.4.2 Placing

1. Concrete shall be placed in its final position before initial set has commenced and shall not be subsequently disturbed. All concrete shall be placed within 15 min of mixing unless carried in purpose made agitators.
2. Concrete shall be carefully placed in horizontal layers which shall be kept at an even height throughout the work. The depth of layers and time between placement of layers shall be such that each layer can be properly merged into the preceding layer before initial set takes place, the depth of layer shall be determined from the type of plant the Contractor proposes to use.
3. Concrete shall be allowed to slide or flow down sloping surfaces directly into its final position from skips, down pipes or other placing machines or devices or, if this is not practical, it should be shovelled into position, care being taken to avoid separation of the constituent materials.
4. Concrete placed in horizontal slabs from barrows or other tipping vehicles shall be tipped into the face of the previously placed concrete.
5. Concrete dropped into place shall be dropped vertically. It shall not strike the formwork between the point of its discharge and its final place in the Work, and except by approval of the Supervising Engineer it shall not be dropped freely through a height

greater than 1.5 m. Chutes and conveyor belts shall be also designed so that there is no segregation or loss of mortar and shall be provided with a vertical tapered down pipe, or other device, to ensure that concrete is discharged vertically into place.

6. Concrete shall not be placed in standing water in the formwork.

6.4.3 Compaction

1. Concrete shall be thoroughly compacted by vibration during the operation of placing and thoroughly worked around the reinforcement, around embedded fixtures and into corners or the formwork to form a solid mass free from voids.
2. When vibrators are used to compact the concrete, 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 that does not promote segregation of the constituents of the concrete.
3. Immersion type vibrators shall be capable of producing not less than 10 000 cycles per minute, and external vibrators not less than 3000 cycles per minute.
4. A sufficient number of vibrators in serviceable condition shall be on site to ensure that spare equipment is always available in the event of breakdown.
5. Immersion type vibrators shall be inserted into the uncompacted concrete vertically and at regular intervals. Where the uncompacted concrete is in a layer above freshly compacted concrete the vibrator shall penetrate vertically for about 100 mm into the previous layer.
6. Vibrators shall not come into contact with the reinforcement or the formwork. They shall be drawn back slowly from the mass concrete so as to leave no voids. Internal type vibrators shall not be placed in the concrete in a random or haphazard manner nor shall concrete be moved from one part of the work to another by means of the vibrators.
7. Operators shall be trained in the use of vibrators. Foremen shall have a minimum of five years of experience in the supervision of placing concrete.
8. Vibration of the concrete shall not be applied by way of the reinforcement.
9. Compaction shall commence as soon as there is sufficient concrete to immerse the vibrator and continue during the placing operations so that at no time shall there be a large volume of uncompacted concrete in the formwork.
10. The duration of vibration shall be limited to that required to produce satisfactory compaction without causing segregation. Vibration shall on no account be continued after water or excess grout has appeared on the surface.
11. During the placing of all reinforced concrete, a competent steel fixer and a competent carpenter shall be in attendance on each concreting gang. They shall ensure the reinforcement embedded fittings and forms are kept in position as work proceeds.

6.5 CURING

6.5.1 General

1. The Contractor shall ensure that curing is provided for 24 hours per day including holidays and that all related necessary plant and labour resources are also available.
2. Special attention shall be given to the curing of vertical and overhanging surfaces to ensure satisfactory curing.
3. The Contractor shall adopt curing measures that preclude the possibility of thermal shock to the concrete during curing. This may be achieved by ensuring that the temperature of the water used for curing does not differ from that of the concrete by more than 15 °C.
4. Water used for any curing purposes shall conform to the requirements of this specification.
5. All concrete shall be cured for a period of time required to obtain the full specified strength, but not less than seven consecutive days. The method of curing shall be by water for the first seven days and by water or membrane until the concrete has reached the full specified strength.
6. Exposed surfaces shall be protected from air blown contamination until 28 d after the concrete is placed.
7. The method of curing shall ensure that sufficient moisture is present to complete the hydration of the cement, and shall be to the approval of the Supervising Engineer the method of curing shall not :
 - disfigure permanently exposed surfaces
 - affect bonding of subsequent coatings
 - increase the temperature of the concrete.

6.5.2 Moisture Curing

8. Moisture curing shall be performed by :
 - a) covering the surface of the concrete with water and keeping it continuously wet
 - b) continuous use of fine fog water sprays
 - c) covering the surface with a saturated absorptive cover and keeping it continuously wet.

Where method (a) is employed, the bunds used shall not be made from fill from excavations or any other areas where there is the possibility of chloride contamination.

END OF SECTION

7 PART 7 - FORMWORK, REINFORCEMENT & JOINTS

7.1 GENERAL

1. This Part includes permanent forms, temporary formwork, and falsework for structural and architectural cast-in-place concrete including form liners, coatings, and accessories.
2. This Part includes tension, compression, and temperature reinforcing steel. The work includes furnishing, fabrication, and placement of reinforcement for cast-in-place concrete, including bars, welded wire fabric, ties, and supports.
3. This part deals with movement and construction joints, slip bearings, waterstops and associated sealants and filler materials.

7.2 REFERENCES

The following standard is referred to in this Part:

BS 5328, Concrete
BS 5975, Code of practice for falsework
BS 8110, The structural use of concrete
BS 4449, Carbon steel bars for the reinforcement of concrete
BS 4466, Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete
BS 2571, General purpose flexible PVC compounds for moulding and extrusion
BS 2782, Methods of testing plastics
BS 6093, Design of joints in building construction

7.3 SUBMITTALS

1. Shop drawings for formwork shall be produced, giving the following minimum information for each level:
 - (a) details of formwork for columns, beams, parapets, slab and kickers
 - (b) details of construction joints and movement joints
 - (c) details of retaining walls showing the position and size of ties, joints, soldiers and sheeting, together with detailed information on erection and casting sequences and construction joints
 - (d) general assembly details
 - (e) proposals at all penetrations through the concrete
 - (f) proposed sequence of shoring and re-shoring beams and slabs for different spans and floor heights and number of floors shored, and the stripping time for supported and
 - (g) suspended structural elements, clearly identifying the supported element and suspended element.
2. Product data including the manufacturer's specification and installation instructions for proprietary materials and reinforcement accessories shall be provided.

3. The Contractor shall submit for approval by the Supervising Engineer as soon as practicable and not less than three weeks before commencement of concreting, drawings showing his proposals for the position of construction joints having due regard to any that may or may not be shown on the Contract Drawings.
4. The Contractor shall prepare shop drawings that show the layout of the waterstops, specials and joints.

7.4 INSPECTION OF FORMWORK AND REINFORCEMENT

1. Inspection of formwork, reinforcing steel and the installation thereof will be conducted by the Supervising Engineer.
2. The Contractor shall give 24 hour notice to the Supervising Engineer before closing forms or placing concrete.
3. The Supervising Engineer may instruct the Contractor to break out and remove completely all sections of the work already constructed under any of the following circumstances:
 - reinforcing steel sample under test fails to meet the specification requirements at any time
 - the Supervising Engineer considers that samples which were presented to him for test were not truly representative
 - it becomes apparent that reinforcing steel which has not been approved has been used on the Works.

7.5 FORMWORK MATERIALS AND EXECUTION

7.5.1 Materials

1. Formwork for exposed concrete surface finish shall be lined with as large panels as possible of non-staining material with a smooth unblemished surface such as sanded plywood or hard compressed fibre board, arranged in a uniform approved pattern and fixed to back formwork by oval nails.
 - the same type of lining shall be used throughout any one structure
 - unfaced wrought boarding or standard steel panels shall not be permitted.
2. Formwork for external concrete below ground shall be constructed of timber, or of any suitable material which will prevent loss of grout when the concrete is vibrated.

7.5.2 Execution

1. The erection of formwork and associated falsework shall be executed and supervised by fully qualified personnel having a minimum of five years experience. The erected formwork shall be watertight from the ingress of external liquids and the egress of internal liquids.

2. Adjustable steel supports and shores shall allow form boards and framework to be accurately adjusted to line and level. The Contractor shall ensure that adequate ground support for falsework is available, and if not shall take measures to make them suitable.
3. Formwork shall be designed to be sufficiently rigid to maintain the correct position, shape and profile so that the final concrete structure is within the dimensional tolerances specified.
4. Formwork shall be designed to be demountable without causing shock, disturbance or damage to the concrete.
5. Soffit formwork, properly supported on shores only, shall be capable of being retained in position during the concrete maturing period.
6. The design shall allow free movement and accessibility under the formwork.
7. The forms shall be designed to incorporate 20 mm chamfers on exposed corners of columns, walls and beams.
8. Conduits or pipes shall be located so as not to reduce the strength of the construction. In no case shall pipes other than conduits be placed in a slab 125 mm or less in thickness.
9. Conduits may be embedded in walls provided they are not larger in outside diameter than one-third the thickness of the wall, are not spaced closer than three diameters on centre, and do not impair the strength of the structure.
10. Embedded pipes and conduits shall be supported independently from reinforcing steel in a manner to prevent metallic contact and thereby prevent electrolytic deterioration.
11. Pipes and conduits where embedded shall be placed as nearly as possible to the centre line of the concrete section. Conduits, piping, and other wall penetrations or reinforcements shall be subject to the Supervising Engineer's review and approval.
12. The following minimum periods (in days) for retaining formwork in position before striking apply to sulphate-resisting or ordinary Portland cement concrete with no cement replacement materials or admixtures:

Type of formwork	Days
Vertical to Columns, walls, beams	0.5
Soffits to slabs, beams and props to slabs	7
Props to beams	14

7.6 REINFORCEMENT MATERIALS, CUTTING & FIXING

7.6.1 Materials

1. Reinforcing steel shall conform to the requirements of BS 4449 and shall meet the following requirements for minimum yield stress

	Bars Yield Stress	Symbol
Plain round mild steel	250 N/mm ²	R
Deformed High Yield bars	410 N/mm ²	T
2. If in the opinion of the Engineer the steel has excessive surface rust, dust or other deleterious material then the steel shall be sand blasted. Sand for blasting shall not contain materials deleterious to the durability of the reinforcement or concrete.
3. All reinforcement shall be pressure washed with fresh water after erection and immediately before placing concrete.
4. Tie wire shall conform to the requirements of BS 4482. 1.6 mm. annealed steel wire shall be used for tie wire. No wires smaller than size D-4 shall be used.

7.6.2 Cutting And Bending

1. Cutting and bending of reinforcement shall be in accordance with BS 4466 and shall be done without the application of heat. Bends shall have a substantially constant curvature.
2. Reinforcement shall not be straightened or re-bent without the approval of the Supervising Engineer. If permission is given to bend projecting reinforcement care shall be taken not to damage the concrete and to ensure that the radius is not less than the minimum specified in BS 4466.

7.6.3 Fixing of Reinforcement

1. All reinforcement shall be securely and accurately fixed in positions shown on the Drawings to ensure that the reinforcement steel framework as a whole shall retain its shape. The framework shall be so temporarily supported as to retain its correct position in the forms during the process of placing and consolidating the concrete.
2. The ends of all tying wires shall be turned into the main body of the concrete and not allowed to project towards the surface.
3. No part of the reinforcement shall be used to support access ways, working platform or for the conducting of an electric current.
4. The Contractor's specific attention is drawn to the following general requirements:
 - lapped joints shall be as indicated on the Drawings and/or in accordance with the requirements of BS 8110
 - hooks shall be semicircular with a straight length of at least:

- i. four bar diameters for mild steel
- ii. six bar diameters for high yield steel

5. Welding shall not be used unless authorised by the Engineer and recommended by the reinforcement manufacturer.

7.7 CONSTRUCTION JOINTS

7.7.1 General

1. Where construction joints are required in slabs or beams these shall be made at the quarter point of the span and at right angles to the member except where otherwise approved by the Supervising Engineer. Where slabs are supported by beams then both beams and slabs shall be constructed in one operation.
2. In all cases vertical stop boards of a form to be approved by the Supervising Engineer shall be provided by at the end of each section of work which is to be concreted in one operation and the concrete shall be thoroughly compacted against these stop boards.
3. Where slabs, beams and walls incorporate construction joints, panels shall generally be constructed consecutively. Where this is not possible a gap not exceeding one metre shall be formed between adjacent panels. This gap shall not be concreted until a minimum interval of 7 d has expired since the casting of the most recent panel.
4. The size of bays for reinforced floors, walls and roofs shall be as shown on the drawings but in no event shall they exceed 7.5 m in either direction and 6 m when unreinforced or with nominal reinforcement.
5. Horizontal construction joints in walls will only be permitted when the wall is continuous with the floor slab. Walls shall be keyed on cast kickers 150 mm high or on the tops of walls meeting the soffits of suspended members.
6. Construction joints in monolithic structures shall be aligned with each other whenever practicable.
7. Before placing new concrete against concrete, which has already set the latter shall be treated to expose the aggregate over the full section and leave a sound irregular surface. This shall be done while the concrete is still fresh by means of water spray and light brushing or other means approved by the Supervising Engineer.
8. Immediately before the new concrete is placed all foreign matter shall be cleaned away and the surface moistened.
9. If during the course of the Contract it should become apparent that the Contractor's methods of forming construction joints are not proving effective the Supervising Engineer may order the Contractor to execute at the Contractor's expense such preventative measures as the Supervising Engineer may consider necessary to ensure the water tightness of the construction joints in further work.

Construction Joints in Water Retaining Structures

10. Waterstops shall be incorporated into construction joints in water retaining structures. The Contractor shall ensure that all such construction joints are watertight and any joints which may leak or weep shall be rectified by the Contractor to the Supervising Engineer's satisfaction.
11. The waterstops shall be a high performance system forming a continuous network. Site jointing is to be limited to butt joints and shall be performed strictly in accordance with the manufacturer's instructions.
12. Centrally placed waterstops shall employ centre bulbs/shutter stop with ribs on the web sections.
13. Externally placed waterstops shall have ribs on either side of the centre of the waterstops.
14. The water bar used at the location of expansion joints shall have a bulb in the centre to accommodate the movements.
15. Waterstops shall have a minimum thickness of 5 mm.
16. The minimum test performance data for PVC waterstops shall be as follows:
 - Tensile strength >12 MPa
 - Elongation at break 300 %
 - Hardness Shore 'A' 80 to 90
17. The materials shall tested in accordance with BS 2571 or BS 2782.

END OF SECTION

8 PART 8 – PROTECTION & WATER PROOFING FOR CONCRETE

8.1 GENERAL

This Part covers the materials and application requirements for the subgrade protection of concrete by waterproofing applications, epoxy coatings for concrete surfaces in harsh environments and waterproofing of concrete in immersed conditions.

8.2 REFERENCES

The following standard is referred to in this Part:

BS 1881, Testing of Concrete

8.3 SUBMITTALS

1. The Contractor shall submit manufacturers' specifications, installation instructions and other data to show compliance with the requirements of this part of the specification and the Contract Documents.
2. The Contractor shall submit samples of all materials to be used in the works before delivery of material to Site. Samples of membrane waterproofing shall be 300 mm square. Samples of liquid components shall be a minimum of one litre.
3. The Contractor shall submit comprehensive test results for the all coating and protection system as per the tests in the specification which shall clearly indicate whether the values are mean values measured in current production or minimum values which the property does not fall below.
4. If the Contractor wishes to propose alternative systems for protections or waterproofing to those specified here, a technical submission shall be made which shall include a comprehensive justification giving an explanation of why the proposed systems is equivalent or superior to the one designated.

8.4 QUALITY ASSURANCE

1. The protective coating system shall be supplied by a manufacturer who is certified to the ISO 9000 series of quality standards.
2. The works shall be executed by an approved specialist subcontractor having a minimum of 5 years successful experience in the installation of the specified material. Only tradesmen experienced with the installation of the materials specified shall be used.

8.5 EPOXY COATING

General

1. To be applied on all exposed concrete surfaces over water, the coating shall be a decorative flexible high solids, epoxy polyurethane coating applied in two coats to a dry film thickness of 400 microns minimum.

Surface Preparation

2. The surface of the concrete shall be free from oil, grease, loose particles, decayed matter, moss or algae growth and general curing compounds. All surface contamination and surface laitance shall be removed by high pressure water jetting or sweep blasting.
3. Blow holes and areas of substantial pitting shall then be filled with a solvent free thixotropic epoxy resin fairing coat. The mixing and application of the this coat shall be in accordance with the product manufacturer's recommendations.
4. Where surface cracking is apparent these cracks shall be chased, by an approved mechanical means, to the depth of the crack. A thixotropic epoxy resin shall be applied using a trowel, scraper or filling knife ensuring that full compaction is achieved into the chased section and providing a flush finish with the concrete surface. A minimum period of 24 h shall be allowed before applying any subsequent protective coating systems.

Materials

5. External above ground coating materials shall provide protection against chlorides and carbonation, and be UV and abrasion resistant.
6. The above ground coating shall be applied over the below ground coating and shall continue for a minimum of 150 mm above the ground level.
7. The epoxy coating shall be UV stable.
8. The finished coating shall be pinhole free and have a total minimum dry film thickness of 400 mm.
9. The materials used in the coating system shall comply with the following requirements:
 - Solids Content > 85 %
 - Service temperature -20 oC to 70 oC
 - Tensile strength (DIN 53504) 4 MPa
 - Extensibility (DIN 53504) greater than 110 %
 - Resistance against crack (DIN 53515) 6 MPa
 - Adhesion to concrete (ASTM D 4541) greater than 3.5 MPa

Application

10. The coating shall be applied by spray, roller or brush to achieve a finish acceptable to the Supervising Engineer.

8.6 BITUMINOUS BASED WATERPROOFING

General

1. To be applied on all subgrade concrete surfaces in contact with earth. The material shall be a liquid applied single component elastomeric coating applied to a dry film thickness of 500 microns minimum.

Materials

2. Membrane performance as follows;
 - Typical Moisture Vapour Transmission Rate $9.9 \text{ g/m}^2/24 \text{ hours}$ (ASTM E96)
 - Primer: As per manufacturer recommendations.
 - Recommended Application Temperature: -10°C to 35°C .

Workmanship

3. Apply materials carefully in accordance with manufacturer's recommendations to provide a continuous membrane.
4. Ensure that surfaces to be covered are clean, dry and free from standing water, voids and sharp protrusions.
5. Protect finished areas as recommended by the manufacturer to prevent puncturing damage or deterioration during following work.
6. Cover finished areas with permanent overlying construction as soon as possible, or as recommended by manufacturer.
7. Immediately prior to covering check for damage and repair as necessary.

Inspection

8. Inform the Supervising Engineer a reasonable length of time before covering any finished areas with overlying construction, to allow inspection.

8.7 CEMENT BASED WATERPROOFING

1. To be applied on all concrete surfaces immersed or in full contact with water. The material shall be a cement based, flexible 2 part waterproofing and sealing membrane appraised by an international accreditation organisation.
2. The workmanship and inspection of the finished surfaces shall be as per clause 8.6 items 3 to 8.

END OF SECTION

1. PART 1 - MASONRY

1.1 GENERAL

1. Work shall be complied with this specification or drawings unless otherwise stated. Any work not specified shall be discussed and as directed by the Supervising Engineer
2. Work is to be performed by experienced workers under the direction of a qualified supervisor who is fully aware of the requirements.
3. Stake-board shall be provided at each 5m in length and shall be inspected by the Supervising Engineer for the accuracy, firmness and secure ness. However, a suitable ruler, plumb bob and leveler may be provided for minor performance of cement block and bricks.

1.2 MATERIALS

1. Blocks: solid concrete blocks with all accessories
 - Minimum average compressive strength: 3.5N/mm²
 - Work size(s): 600/450 x 200 x 150/125
2. Mortar: 1:1:6 cement: lime: sand
3. Bond: Stretcher

1.3 MANUFACTURER OF CONCRETE MASONRY BLOCKS

1. Blocks are to be made with ordinary Portland cement unless used below ground floor at natural slab level in which case sulphate resisting cement should be used.
2. All blocks are to be manufactured, supplied and tested in accordance with BS 6073, Part 1.
3. The minimum compressive strength of the average of 10 blocks shall be as given in clause C1.4
4. Each block manufactured from sulphate resisting cement is to be colour coded with an identifying mark.
5. Blocks are to be manufactured in a vibrated/pressure block making machine using cement and aggregate in the proportions required to produce the minimum strengths given in C1.4
6. The materials to be mixed in a mechanical mixer and placed in the block-making machine in layers not exceeding 100 mm, each layer being thoroughly vibrated and compacted before the addition of the next.
7. Immediately after manufacture the blocks are to be stacked on clean, level, non-absorbent pallets in honeycomb fashion. The pallets are to be marked with the date of production and stored in a level curing and stacking area in such a manner that one day's production is separated from the next.

8. Blocks manufactured from mobile machines are to be cast on to a clean concrete hardstanding. Each day's production shall be easily identifiable and kept separate from the next.
9. All blocks, however manufactured, are to be immediately protected from the effects of the sun and wind by suitable moisture retaining coverings.
10. Care shall be taken for damage during transportation of materials and any defect of natural finished blocks shall be rejected.
11. Different size of material shall be stored separately and protected from dirt and other impurities.

1.4 SETTING OUT OF BLOCKWORK

1. All blockwork is to be fully set out before laying commences to ensure:
 - Correct bonding over all lengths of wall particularly at openings and piers
 - Minimum cutting
 - Compliance with Permissible deviation given below;

Dimension	Permissible deviation (mm)
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Position in plan of any point or specified fair face in relation to the nearest building grid line at the same level	+/-10
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Length (unless otherwise defined by adjacent construction):	
Up to 5 m	+/-15
5 to 10 m	+/-20

Height:	
Up to 3 m	+/-15
3 to 6 m	+/-20

Level of bed joints:	
Up to 5 m long	+/-10
5 to 10 m long	+/-15

Straightness in any 5 m length	+/-10
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Vertically:	
In any 3 m height	+/-10
In o/a height of building exceeding 6 m	+/-20

Thickness:	
Overall thickness of walls or width of piers (subject to the following)	+/-15
Difference in thickness of a wall or width of a pier at any two points 3 m apart	+/-10

2. The average thickness of both vertical and horizontal mortar joints is to be 10 mm exclusive of any key in the joint surfaces of the unit.

1.5 PLACING CONCRETE MASONRY BLOCKS

1. Do not wet concrete blocks before laying: use an approved water retaining admixture in the mortar to counteract suction.
2. Bonding mortar shall be used immediately after mix, and mixed mortar left for more than one hour shall be rejected.
3. Vertical and horizontal joint of blocks shall be filled completely and suitable with mortar on line shall not be moved or rearranged. Joint and surface of block of exposed finished block wall shall be cleaned immediately after joint is filled.
4. Mortar for joint shall be touched with steel trowel before hardened and exposed joint shall be finished with uniform width and planned without roughness or cavity.
5. Height for placing block per day shall be maximum 1.5 m unless otherwise specified.
6. Partitions shall be 100 mm thick unless otherwise noted. Partitions having lavatories or other plumbing fixtures secured to them back-to-back (or approximately so) are to be a minimum of 150 mm thick. Solid concrete masonry units shall be built in where full units cannot be used or where needed for the fixing of accessories. Bells or hubs of pipes must be completely enclosed.
7. Reinforced masonry partitions are to fully extend to the underside of slabs.
8. When pipes or conduits or both occur in plastered partitions, at least one web of the hollow masonry units must be retained.

1.6 JOINT REINFORCEMENT

1. Expanded steel mesh joint reinforcement, fabricated from 0.5 mm nominal thickness light coat galvanized steel to BS 2989, Z2 grade, coating type C or stainless steel to BS 1449, should be embedded in the horizontal mortar joints not closer than 20 mm from the external face of the wall and, except at movement joints, is to be continuous and lapped at least 75 mm at all passing. Full lap joints are to be provided at angles.

1.7 CONNECTIONS BETWEEN WALLS OR PARTITIONS, COLUMNS AND SOFFITS

1. Blockwork shall be anchored to concrete columns, beams and walls, to steel stud construction and to masonry backup with ties and anchors in accordance with the relevant provisions of BS 5628.
2. All connections between blockwork walls or partitions and concrete or steel columns shall be reinforced at maximum 400 mm centres by means of stainless steel or zinc coated expanded metal as directed by the Supervising Engineer or approved proprietary ties shot fired to the column and built into and fully embedded in the mortar joints of the block walls or partitions.

1.8 MOVEMENT JOINTS

1. Movement joints to be 12 mm wide and formed where indicated or where continuous runs of block walling exceed 6 meters in length.
2. The joints are to be straight and vertically formed with uncut faces of the blocks to each side and filled with an approved compressible material manufactured specifically for building into movement joints.
3. External joints are to be sealed with mastic compatible with the joint filling material when the block walling is thoroughly dry and the joint surfaces have been cleaned with a wire brush or mechanical tool.
4. A primer is to be applied to the joint surface if specified by the manufacturer of the mastic.
5. Mastic sealing to unfilled movement joints to be on an approved foam backing strip placed to ensure the correct depth of sealant.

END OF SECTION

1. PART 1 - STRUCTURAL TIMBER

1.1. GENERAL

This part specifies requirements for wood framing, sheathing, sub flooring, trusses, light timber construction and rough hardware as used in buildings.

1.2. REFERENCES

The following standards are referred to in this Part:

BS 1088 Plywood for marine craft
BS 4079 Plywood for marine craft
BS 5756 Specification for tropical hardwoods graded for structural use
BS 1203 Synthetic resin adhesives (phenolic and amnioplastic) for plywood
BS 6566 Plywood
BS 5268 Structural use of timber
BS 4978 Timber grades for structural use

1.3. SUBMITTALS

1. The Contractor shall submit shop drawings showing framing connection details, fasteners, connections, dimensions, treatment and finishes in accordance with the relevant provisions of this specification.
2. Planed representative samples of each hardwood and softwood species specified here shall be submitted to the Supervising Engineer before the execution of any joinery work.

1.4. TIMBER GRADES & SIZES

1. Tropical hardwood for structural use shall be visual grade HS in accordance with BS 5756 and with following minimum grade stresses;

Bending parallel to grain:	13.7 N/mm ²
Tension parallel to grain:	8.2 N/mm ²
Compression:	
Parallel to grain:	13.4 N/mm ²
Perpendicular to grain:	3.1 N/mm ²
Modulus of elasticity (minimum)	7400 N/mm ²
2. Softwood for structural use shall be visual grade SS in accordance with BS 4978.
3. Unless otherwise specified, each piece of timber is to bear the grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which produced.

4. Size references, unless otherwise specified, are nominal sizes, and actual sizes to be within manufacturing tolerances allowed by the standard under which the product is produced.

1.5. MOISTURE CONTENT

1. All timber is to be kept in stores, properly stacked, for a minimum period of three months to ensure conditioning to a maximum moisture content from time of delivery and during site storage to be no more than the following:
 - (a) timber 50mm and less in thickness to have a moisture content of 19% or less
 - (b) boards to have a moisture content of 19% or less
 - (c) timber over 50mm thick to have a moisture content of 25% or less.
2. Particular care is to be taken to ensure that all carpentry and joinery timbers, plywood, blockboard and other timber based composite board, whether in prefabricated or loose form, are delivered and maintained at the required maximum moisture content stated. Refer to BS 6566 Part 5 for moisture content in plywood.
3. When instructed by the Supervising Engineer the Contractor is to make available a moisture meter for the testing of moisture content on site. The test is to be carried out according to the instrument manufacturer's instructions at a point not nearer than 600 mm from either end or at the centre if the length is less than 1200 mm.

1.6. PRODUCT DELIVERY, STORAGE AND HANDLING

1. Protect lumber and other products from dampness both during and after delivery at site.
2. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece. Stack plywood and other board products so as to prevent warping.
3. Locate stacks on a well-drained area, supported at least six inches above grade and cover as necessary for protection from driving rain and prolonged sun exposure whilst providing ventilation.

1.7. WORKMANSHIP FOR STRUCTURAL TIMBER

1. Timber for structural work is to be finished sawn to the sizes shown on the drawings. A tolerance of +3.0 mm to -0.5 mm is permissible.
2. Joints are to be constructed so that they will transmit the loads and resist the stresses to which they will be subjected. The surfaces should be in good contact over the whole area of the joint before fastenings are applied. Unless otherwise specified all joints are to be secured with a suitable type and sufficient number of nails.
3. Holes for bolts are to be drilled from both sides of the timber. No nails, screws or bolts are to be placed in split ends. If splitting is likely holes for nails are to be predrilled at diameters not exceeding four-fifths of the nail.
4. Temporary bracing is to be provided to maintain structural timbers in position and to ensure stability during construction.

5. All cutting for services to be the minimum required to accommodate the services and comply with the following:
 - notches shall be “U” shaped and be formed by straight cuts to drilled holes
 - notches and holes not to be positioned in a member where the remainder of the cross section contains a knot or other defect which would affect the strength
 - notches in joists are to be located at the top and not be deeper than one eighth of the depth of the joist located within one quarter of the span from the centre of bearing.
6. Holes in joists are to be located through the centre of the depth i.e., on the neutral axis.
7. Joists are to extend a minimum of 75 mm beyond the nearest edge of the supporting plate or member and be laid in parallel lines.
8. Where joists are to be notched over supports, the depth of the notch should not exceed two fifths of the depth of the joist. The bearing surface of the notch is to be cut smooth and true in relation to the surface on which it bears.
9. A clear 12 mm to be maintained around all joists if they extend into blockwork walls and they are to receive an additional liberal coating of preservative on all surface adjacent to walls. A 50 mm gap is to be left between joists and flanking walls.
10. Herring-bone strutting is to be constructed of 50 x 38 mm pieces nailed to form a system of crossing diagonals in a straight line transversely across the joists. Each diagonal strut is to be wedged tightly between the top and bottom edges of adjacent joists before being secured by nails.

1.8. PLYWOOD (USED FOR ROUGH CARPENTRY)

1. Each sheet of plywood is to bear the mark of a recognized association or independent inspection agency which will maintain continuing control over the quality of the plywood. The mark is to identify the plywood by veneer grade, group number, span rating where applicable, and glue type.
2. Plywood is to be free from bow, twist and warp.
3. The core in 3-ply is not to be more than 60% of the total thickness.
4. In plywood having more than 3 plies, the faces, and all plies with the grain running in the same direction as the faces, to have a combined thickness of between 40% and 60% of the total thickness of the plywood.
5. All plywood thicker than 10mm is to be made of not less than 5 plies.
6. No face ply to be thicker than 3mm and no inner ply to exceed 5mm.
7. The direction of the grain of the veneer is to be at right angles in adjacent plies except in the case of boards comprising an even number of plies, when the grain of the center is to follow the same direction.
8. All plywood which is to be installed externally is to be manufactured using Type WBP adhesives to BS 1203, BS 1088 and BS 4079.
9. All plywood which is to be installed internally is to be manufactured using Type BR adhesives to BS 1203.

10. Face plies for Class 1 finish are to be of one or two pieces of firm, smoothly cut veneer. When of two pieces, the joint should be approximately at the center of the board and the veneers are to be matched for color. The veneer is to be free from knots, unless specified as a feature, insect holes, splits, dots, glue stain, filling or inlaying or any other kind of defect. No end joints are permissible.
11. Face splits for Class 2 finish are to present a solid surface free from open defects.
12. Occasional splits not wider than 0.8mm at any point and not longer than one tenth of the length of any panel of slightly open joints may be filled with a suitable filler. Neatly made repairs consisting of inserts of the same species as the veneer, which present solid, level, hard surfaces and are bonded with an adhesive equivalent to that used for bonding the veneers are permissible. No end joints are permissible.

1.9. ROUGH HARDWARE - GENERAL

1. Rough hardware includes items for structural timber construction such as frame cramps, ties, anchors, framing connectors, joist hangers and similar items.

1.10. NON-STRUCTURAL FRAMING

1. Timber sections, stud partitions, bulkheads, etc., are to be accurately cut so that they fit together tightly without distortion. Each joint is to be fixed with at least two nails.
2. All timber sections to be fixed plumb, level and square to ensure that the lining material can be positioned accurately and securely to give flat surfaces, free from undulations.
3. The spacing of members should not exceed the permissible span of the lining material as recommended by the manufacturer. All edges of the lining material to be supported except where other methods of supporting the edges are provided e.g., tongued and grooved joints.
4. Holes for services to pass through the center of timber sections and the diameter of the hole should not exceed one third the width or thickness of the timber.
5. Additional supports are to be provided for appliances and fixtures.
6. Framing, grounds and bearers are to be fixed to the substrata at maximum 450mm centers using masonry nails unless described as “plugged and screwed” or “bolted”.

END OF SECTION

2. PART 2 – FASTENERS & ADHESIVES

2.1. GENERAL

This part deals with the specification of fasteners and adhesives.

2.2. REFERENCES

The following standards are referred to in this Part:

BS EN 635 Plywood

BS 729 Hot dip galvanised coatings on iron and steel articles.

BS 1202 Nails

BS 1210 Wood screws

2.3. FASTENERS - NAILS AND SCREWS

1. Nails and screws are to comply with BS 1202, Part 1 and BS 1210 respectively.
2. Fastenings in external areas are to be sheradised, galvanised or non-ferrous.
3. Nails shall not be less than 25 mm long or 2½ times the thickness of the member through which the nails are being driven whichever is the greater.
4. Screws shall not be less than 12 mm long or twice the thickness of the member through which the screws are being driven whichever is the greater.
5. The minimum lengths of nails and screws are not to be longer than the total thickness of the members being joined, less 5 mm.
6. Nail heads should be punched, and screw heads not required to be pellated to be countersunk, not less than 2 mm below surfaces which will be visible in the finished work, the holes filled with putty or a proprietary filler and sanded smooth and flush.
7. Plugs for screw fastenings into blockwork or concrete are to be of proprietary manufactured sized to suit the screw. Wooden plugs will not be permitted.
8. Screw heads which are to be pellated are to be countersunk 6 mm below the timber surface. Pellets to be cut from matching timber not less than 6 mm thick, glued in with the grain matched, planed and sanded off flush with the face.
9. Screw heads are to be pellated where the timber surface is to receive a clear finish.

2.4. ADHESIVES

Adhesives used in carpentry and joinery work should be synthetic resin adhesives complying with BS 1204, Parts 1 and 2 Type WBP for all external work and Type BR for internal work.

2.5. ROUGH HARDWARE AND FRAME CRAMPS

1. Cramps to be mild steel size 2 x 25 x 250 mm girth, galvanised after fabrication to BS 729, turned up at one end and drilled twice for 3 mm diameter screws and fishtailed at the other end for building in.
2. Furnish rough hardware, except nails, with standard plating, applied after punching, forming and assembly of parts. Galvanised anchors and bolts (with nuts and washers), straps, and hangers except bolts may be cadmium plated, or zinc-coated by electro galvanizing process. Aluminum-alloy nails, plated nails, or zinc-coated nails, for nailing woodwork exposed to weather are to be used. Bolt heads and nuts bearing on wood should be fitted with washers. For work exposed to the weather, washers of zinc or cadmium coated steel are to be used. Special nails as required for use with ties, anchors, framing connectors, joint hangers and similar items are to be used in accordance with the item manufacturers instructions or as directed by the Supervising Engineer.
3. Joist Ties: Are to be stainless steel or galvanised steel flats, 5 mm by 32 mm size with ends bent 30 degrees from horizontal, and extending at least 40 mm onto the framing. Each end to be punched for three spikes.
4. Wall anchors for Joists and Rafters: Provide a galvanised steel strap, 5 mm by 32 mm with wall ends bent 50 mm, or provide 9.5 mm by 127 mm pin through the strap and build into partition or masonry. Provide anchors parallel to framing long enough to extend at least 406 mm onto framing and punch for three spikes. Provide anchors at right angles to framing; long enough to extend onto three joists or rafters, punched for spiking at each bearing.

END OF SECTION

3. PART 3 – TREATMENT OF TIMBER

3.1. GENERAL

This Part specifies the use of preservative, insect protection and fire retardant treatment for wood construction, inclusive of Structural Timbers and Architectural woodwork. Unless stated otherwise, the guide to choice, use and application of wood preservatives is BS 1282.

3.2. REFERENCES

The following standards are referred to in this Part:

BS 1282 Guide to the choice, use and application of wood preservatives
BS 5268 Preservative treatments for constructional timbers
BS 5707 Solutions of wood preservatives in organic solvents
BS 6566 Plywood
BS EN 1014 Creosote and creosoted timber

3.3. SUBMITTALS

1. Provide certification as specified that required preservation treatment or fire retardant has been completed, or in the absence of specific requirement that at minimum the manufacturers required standard application has been used.
2. Provide a sample of woodwork as indicated by the Supervising Engineer with required coatings or treatment application for testing where required.

3.4. PRESERVATIVE TREATMENT

General Application

1. The preservative treatment is to be applied by pressure impregnation or the double vacuum process. Dipping, deluging, spraying, brushing or other methods which only provide shallow protection are not permitted.
2. The treatment to be carried out under factory conditions at the source of supply of the timber and the Contractor is to provide a Certificate of Impregnation when required by the Engineer.
3. Treatment is to be carried out after all cutting and shaping has been completed. If subsequent cutting of the timber is unavoidable all freshly exposed surfaces are to receive a liberal application of the preservative recommended in the relevant treatment specification.

Standard Pressure Treated Preservative

4. Wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, including wood framing of openings in exterior walls of concrete or

masonry, roofed structures; wood sills, sole plates, furring; and, wood members used in connection with roofing and flashing materials to be treated in accordance with BS 1282, BS 5268, BS 6566, and/or BS 5707.

Other Preservative Treatments

5. Creosote and creosoted timber where used as structural timber to be sampled or analysed to BS EN 1014.

3.5. FIRE RETARDANT TREATMENT

All main timber structural members (columns, floor joists, roof joists, rafters, wall studs) shall be impregnated by vacuum process with a fire retardant, and subsequently kiln dried. Each piece of treated material will bear identification of the testing agency and will show the performance rating. Treatment and an inspection, is to be carried out by an independent and qualified testing agency that establishes performance ratings.

3.6. INSECT TREATMENT

All hardwood and softwood for permanent incorporation in the Works is to be treated with preservative to provide protection against damage from insect larvae, termites and fungal decay to BS 6566, Part 7. Organic solvent type preservatives are to contain a water repellent. Certificates are to be provided confirming all necessary treatments required have been completed.

1 PART 1 – METALLIC COVERINGS

1.1 GENERAL

1. This part covers the requirements the use of metallic covering for buildings and structures.

1.2 REFERENCES

The following standard is referred to in this Part:

BS 1210 Wood Screws

BS 1474 Wrought aluminium and aluminium alloys for general engineering purposes.

Bars, extruded round tube and sections

BS 1494 Fixing accessories for building purposes

BS 3083 Hot-dip zinc coated and hot-dip aluminium/zinc coated corrugated steel sheets for general purposes

1.3 FITTINGS AND ACCESSORIES

1. Fittings are to match the profile of the specified sheet and shall be supplied by the same manufacturer.
2. Hook bolts and nuts shall comply with BS 1494, Part 1 and be 8 mm diameter cadmium or zinc coated steel with plastic sleeves or applied plastic coating, shaped to suit the sheets and roof members and complete with plastic washers.
3. Filler pieces at ridges and eaves are to be approved pre-moulded cellular plastic or rubber bitumen units to fit exactly the contours of the corrugations.
4. Sealant strip are to be approved flexible expanded polyurethane foam strip impregnated with waxes and/or resins having an elastic recovery of 98% minimum and a density of not less than 145 kg/m³.

1.4 METAL SHEETS

Metal sheets shall be zinc/aluminum alloy coated steel sheets and shall have a sheet thickness of 0.5 mm and minimum 550 g/m² zinc coating.

1.5 INSTALLATION OF ROOF COVERINGS

1. The sheeting is to be laid with the open joint of side laps away from the prevailing wind. The Contractor is to obtain the approval of the Supervising Engineer as to which end of the structure the laying is to commence before beginning sheeting work.
2. The eaves course are to be laid first and subsequent sheets laid in tiers up to the roof from eaves to ridge, aligning sheets on both slopes on double pitched roofs.
3. Corrugations or troughs are to be in line from eaves to ridge and eaves and verges are to maintain proper alignment.
4. Sheets are to be cut to clean, true lines with no distortion. All burrs, drilling swarf or dust and any other foreign matter to be removed before positioning sealing strips, filler pieces and washers.
5. Openings for outlets, vent pipes, etc., are to be cut to the minimum size necessary. Vent pipes and the like should always pass through the centre line of the crown and are to be offset below roof level if necessary.

6. Holes through the sheets are to be drilled 2 mm larger than the diameter of the bolt and always through the crown of the profile. No hole should be nearer than 40 mm to the end of the sheet. All fixings are to be of the specified type and size and be in the correct position true to line and secure.
7. Fittings are to be fixed, where possible, by the same bolts that secure the sheeting.
8. Filler pieces shall be installed between the corrugations or troughs and flat surfaces or supports at the end of sheet runs wherever necessary to ensure air tightness of the structure.

1.6 FLASHING AND APRONS

1. Flashings, aprons, and the like, are to be formed from sheets not more than 1800 mm long and to be lapped a minimum of 75 mm at intersections.
2. After folding and dressing, two coats of black bitumen coating solution are to be applied to all areas, which will come into contact with materials containing cement. Repeated folding and dressing should be avoided to prevent work hardening.
3. The top edge of flashings is to be provided with a 13 mm turn-back to act as a water-stop and recessed a minimum of 25 mm into the wall. The flashing are to be fixed with 20 x 20 mm strips of aluminum folded into a wedge shape, covered with two coats of bitumen solution and driven into the full depth of the recess at 400 mm centres. Upon completion of fixing the recess are to be pointed in cement mortar.

1.7 INSULATION

Install to all metallic roof coverings:

1. Material: Rockwool Rollbatt 23 kg/m³ density.
Thickness: 120 compressed to 100 mm. But to achieve a 'U' value of 0.45 w/m²/° C or better.
Install and secure as the work proceeds ensuring continuity and leaving no gaps. Keep dry.
2. Material: Aluminium Bubble foil insulation;
Thickness: 15mm, comprising of two reinforced aluminium external foil surfaces, with a centre core of foam, and with the upper foil surface being treated with anti-glare non-corrosive/non-oxidisation additive and non-slip protective coating membrane.

END OF SECTION

2 PART 2 – NON METALLIC COVERINGS

2.1 GENERAL

This part covers the requirements the use of non metallic covering for buildings and structures.

2.2 REFERENCES

The following standard is referred to in this Part:

BS 1210 Wood Screws

BS 1494 Fixing accessories for building purposes

BS 8000 Workmanship at building sites

2.3 SUBMITTALS

1. Full run of woven dried thatch palm leaves
2. Roof underlay - a breathable polypropylene underlay (Monoperm 700)
3. Galvanised netting.
4. Aluminum Bubble foil insulation
5. Reports, references and experiences previous work of the dried palm installer.

2.4 PERFORMANCE REQUIREMENTS

General

1. Provide installed 'dried woven palm leaves', breathable membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

Fire-Test-Response Characteristics

2. Provide 'dried woven palm leaves' and related roofing materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method below by UL or another testing and inspecting agency acceptable to Supervising Engineer.

Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A, ASTM E 108 or UL 790, for application and roof slopes indicated.

Wind Uplift Design

3. Provide roofing system that complies with the a basic wind speeds of 80mph.

2.5 INSTALLATION OF ROOF COVERINGS

UNDERLAYMENT INSTALLATION

Install breathable roof underlay wrinkle free, on roof structure. Comply with high temperature installation restrictions of underlay manufacturer if applicable. Install at locations indicated below and on Drawings, lapped in direction to shed water. Lap sides not less than 200mm Lap ends not less than 300 mm staggered 600mm between courses.

1. Hips: Extend bottom corner mm on each side 150 mm.

PALM THATCH INSTALLATION

Install 'woven dried palm leaves' in according to established practices.

First Course: Install first length 'palm leaves thatch' at the eave edge.

Second Course: Second Course: Install second length 'palm leaves thatch' from 50mm eave edge

Third Course: Install the remaining length of 'the thatch' diagonally across with installer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

At hips, install 'the thatch' spaced evenly to allow for two hip courses to one field course. Fasten 'the thatch' in binder strips as per established practices.

2.6 INSULATION

Install to all metallic roof coverings:

1. Material: Aluminium Bubble foil insulation;
Thickness: 15mm, comprising of two reinforced aluminium external foil surfaces, with a centre core of foam, and with the upper foil surface being treated with anti-glare non-corrosive/non-oxidisation additive and non-slip protective coating membrane.

2.7 FLASHING AND APRONS

Install flashings, aprons, and the like as per Part 1 of this Section.

END OF SECTION

1. PART 1 – TIMBER DOORS & WINDOWS

1.1. GENERAL

This Part specifies workmanship and special detail construction for doors, windows, architraves and beads.

1.2. REFERENCES

The following standards are referred to in this Part:

BS 476 Fire tests on building materials and structures

BS 729 Hot dip galvanised coatings on iron and steel articles

BS 1186 Quality of timber and workmanship in joinery

BS 1202 Nails

BS 1204 Synthetic resin adhesives (phenolic and aminoplastic) for wood

BS 1210 Wood screws

BS 4756 Ready mixed aluminium priming paints for woodwork

BS 5358 Solvent-borne priming paints for woodwork

1.3. TIMBER DOOR TYPES

Flush Doors

1. Minimum door leaf thickness is to be:
 - (a) internal door 40 mm
 - (b) external door 45 mm
 2. Solid core doors to be comprise of softwood timber battens laminated together with a minimum 4mm plywood skin. The core laminations softwood are to be a maximum 50 mm wide and are to be laid alternately to balance stresses.
 3. Exterior quality doors are to be constructed using Type WBP adhesives and an exterior quality plywood skin.
 4. All facing materials including veneered materials are to be such that the following defects do not appear on the finished surfaces:
 - (a) lifting at edges
 - (b) blistering
 - (c) sinking or raising of the surface due to knots or other defects in the core material
 - (d) ripple effect whereby the construction of the core is seen on the face of the door.
 - (e) to BS 3794
 5. Doors are to be hardwood lipped on both horizontal and vertical edges.
 6. If the construction of the door is such that the lock, hinges or bolts can only be fitted where blocks are provided to receive them, the position and extent of the blocks are to be indicated by a suitable markings on the edge of the door. Where a surface mounted closer or a flush bolt is specified, blocks shall also be suitably positioned to receive them.
 7. Where a flush or mortised door closer is specified a solid timber rail insert minimum 75 mm wide is to be provided for all door types. Closers are to not be fixed to the end grain of solid core doors.
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8. Openings for glazing or grilles in semi-solid core doors are to be formed with a sub-frame all round the opening minimum 36 mm wide.
9. The maximum deviation from a true plane on either face of a door when measured by a straightedge is to be:
 - (a) bow in length : 3 mm
 - (b) horizontal bow : 2 mm
 - (c) deviation from the true plane (twist) : 4 mm
 - (d) the ends of the braces are to be splay notched to the ledges and the ends of the ledges set back 15 mm from the edges of the door. The direction of the braces should be upwards from the hanging stile.

Fire Resisting Door Assemblies

1. Half-hour and one-hour fire resisting door assemblies are to have a minimum fire resisting performance when tested in accordance with BS 476, Part 8 of 30/30 and 60/60 respectively.
2. The door and frame of fire resisting door assemblies are to be supplied by the same manufacturer and be installed strictly in accordance with his instructions.
3. A copy of the Test Certificate shall be submitted to the Supervising Engineering for each type of door assembly supplied.
4. The doors to generally comply with the requirements of Part 5.2.1 and are to have a minimum 4 mm plywood skin.
5. The doors are to be marked on the hanging stile with an appropriate reference indicating the fire resisting performance of the door assembly.
6. Doors are to be fitted with an automatic self-closing device and be hung on a minimum of three hinges, manufactured from non-combustible material having a melting point in excess of 850°C. Rising butt hinges are not acceptable as an automatic self-closing device. No 'HOLD OPEN OPTION' is permitted unless the magnetic catch is operated by the fire alarm system.

Hanging Timber Doors

1. The maximum clearance between frames and door when hung is to be 3 mm.
2. The maximum clearance between an internal door and finished floor level is to be 6 mm (unless noted to be undercut) and between an external door and threshold or finished floor level to be 3 mm.
3. External doors and doors exceeding 20 kg in weight are to be hung on three 100 mm x 75 mm hinges as a minimum.
4. Hinges to be stainless steel or brass as noted in the project documentation or as directed by the Supervising Engineer and to BS 729 where applicable.

Door and Window Frames, Sub-frames and Linings

1. Frames, sub-frames and linings are collectively referred to as "frames" in this Part.
 2. Frames are to be manufactured with either mortise and tenon or tongued joints so as to be square and flat.
 3. The backs of frames are to be painted with two coats of primer to BS 5358, or BS 4756 before installation.
 4. Frames to be fixed plumb, level and securely to prevent deflection or movement.
 5. Frames built-in as the surrounding structure is constructed are to be fixed with cramps at maximum 600 mm centres. One cramp to be located 200 mm from the bottom of
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the frame and one 200 mm from the top or at the nearest adjacent bed joint. All cramps are to be secured to the frame by two screws. Alternative fixing methods are to be approved by the Supervising Engineer and to BS 1202, BS 1204, and BS 1210 as applicable.

6. Frames which are to be built-in, are to be temporarily braced sufficient to prevent distortion.
7. Frames to previously prepared openings are to be fixed with screw fastenings at maximum 450 mm centres. One fastening is to be located 200 mm from the bottom of the frame and one 200 mm from the top.
8. Packing between the frame and reveal to accurately position the frame in a previously prepared opening is to be hardwood, located only where the fastenings tighten against the reveal.
9. Screw fastenings are to extend into the structural reveal by at least 40 mm or the thickness of the frame excluding any stop whichever is the greater.
10. Door frames which occur in wet areas should not extend below the finished floor level.

1.4. PURPOSE MADE FITTINGS

General Requirements

1. Fittings to be constructed in accordance relevant sections of this specifications and are to be installed plumb and true.
2. Critical site dimensions are to be checked before commencing manufacture of the fittings and no fittings dimension is to be altered without the approval of the Supervising Engineer.
3. All surfaces are to be smooth and free from splinters and no parts to have exposed rough or sharp edges whether on the inside or outside of the fitting.
4. Where a door overlaps the frame or another door the face of the rebate is not to be more than 1.5 mm from the face of the frame or door at any point.
5. Where a door is fitted into the surrounding framework the clearance between each edge of the door and the frame or another door should not be more than 1.5 mm.
6. Door hinges or pivots are to be fitted in alignment.
7. Drawers should slide freely and be fitted with runners and guides so that there is no undue play in any direction which could produce wedging or jamming.
8. Where a drawer overlaps the frame, the face of the rebate is not to be more than 1.5 mm from the face of the frame at any point when the drawer is closed.
9. Where a drawer is fitted into the surrounding frame work the clearance around the edge of the drawer when closed is not to be more than 1.5 mm.

1.5. ARCHITRAVES, QUADRANTS, BEADS

1. Architraves, quadrants, beads and the like are to be in un jointed lengths between angles or ends of runs. Angle joints to be mitred.
 2. Architraves and quadrants should not be installed until after the wall coverings have been formed or constructed.
 3. Glazing beads where required are to be wrought splayed and rounded and be neatly mitred and fixed with small brads or lost-head nails.
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1.6. WORKMANSHIP

1. Timber used for joinery work is to be finished to the sizes indicated in the Drawings and to BS 1186.
 2. The joinery to be constructed exactly as shown on the drawings. Where types of joints are not specifically indicated they are to be recognised forms of joints for each position and shall be made so as to comply with BS 1186, Part 2.
 3. All joints are to be glued and screwed or doweled to BS 1204, BS 1210 or BS 1186 as applicable.
 4. Exposed and semi-concealed joinery is to be planed and sanded to remove all machinery and other surface defects so that after application of the specified finish imperfections in manufacture will not be apparent.
 5. Exposed edges and corners are to be sanded off to form a “ pencil rounded” arris.
 6. Architraves, cover fillets, skirtings and the like are to be accurately shaped to fit the contour of any irregular surface against which they are required to form a close connection.
 7. Joinery for painting on site is to be primed before delivery to the site to BS 4756, BS 5358.
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2. PART 2 – ALUMINUM DOORS & WINDOWS

2.1. GENERAL

1. This Part provides specification for supply and installation of aluminum doors and windows. Windows and doors are collectively referred to as “units” in this Section.

2.2. REFERENCES

The following standards are referred to in this Part:

BS 1474 Wrought aluminums and aluminum alloys for general engineering purpose bars, extruded round tubes and sections

BS 3987 Anodic oxide coatings on wrought aluminum for oxidation external architectural applications

BS 4254 Two-part poly sulphide-based sealants

BS 4255 Rubber used in pre-formed gaskets for weather exclusion from buildings

BS 4873 Aluminum alloy windows

BS 5368 Method of testing windows

BS 5707 Solutions of wood preservatives in organic solvents

BS 6213 Guide to selection of constructional sealants

BS 6375 Performance of windows

BS 6496 Powder organic coatings for application and stoving to aluminum alloy extrusion, sheet and pre-formed sections for external architectural purposes, and for the finish on aluminum alloy extrusions, sheet and pre-formed sections coated with organic coatings

2.3. DETAILED SPECIFICATION

1. Alternative alloys may be used where integral colour anodising is required provided the physical properties of the alloy meet relevant BS Standards for the specific material.
 2. All screws, nuts bolts, reverts, washers and other fastenings are to be aluminium or stainless steel (Type 316 S16).
 3. The units are to be fabricated at the manufacturer's works as far as possible and delivered complete and ready for installation. Aluminium windows shall be to BS 4873, BS 1474, BS 3987, and BS 6496.
 4. The overall sizes of assembled units are to be maintained within a tolerance of ± 1.5 mm. Frame assemblies to be square with a maximum difference in the diagonals of 4 mm.
 5. The finished units to be free from all sharp edges, burrs and the like.
 6. Joints in frames are to be made by screw spline, shear block or other approved system capable of accommodating the thermal movement of the unit and providing tightly fitting and inconspicuous joints.
 7. The main web of the aluminium outer frame should not be less than 1.2 mm thick. Frames to be self-draining and no holes for fastenings are to be located in the external channel at sill level.
 8. All opening units are to be fully weather stripped using siliconized woven polypropylene, wool pile or neoprene retained in dovetailed or undercut grooves formed in the aluminium extrusions. The weather-stripping should be capable of
-

- being removed without disturbing the glazing system and without removing the outer frame from the structure.
9. The design of the units should permit re-glazing without the need to remove the outer frame from the structure.
 10. All hardware is to be supplied and fixed by the unit manufacturer, and should match the finish of the surfaces of the units and be replaceable without removing the outer frame from the structure. Fasteners are to be designated so that they cannot be released from the outside by the insertion of a thin blade or other simple tool.
 11. Windows are to meet the performance requirements of “severe (a) exposure”, that is a maximum three second gust speed of 100 km/h and when tested in accordance with BS 6375, BS 5386.
 12. Horizontal sliding units are to be supported on rustproof and dustproof bearing devices that may easily be repaired or replaced and that prevent contact between the unit and the track. Horizontal and vertical sliding units to be separated and not slide upon each other.
 13. The mechanism for vertical sliding windows is to be accessible for adjustment, repair or replacement after the windows have been installed.
 14. No window is to be openable or removable from the outside when it is fastened in a closed position except by the use of special tools or by breaking part of the window or door.
 15. All unit surfaces which will be visible in the finished work, are to be protected after manufacture by low tack tape or other suitable means capable of being removed after exposure to the high temperatures, undamaged surfaces.
 16. Sill frames to slope outward (level frames are not allowed).
 17. Weepholes where required are to be as detailed in the shop drawings

2.4. FIXING ALUMINIUM WINDOWS AND DOORS

General Requirements

1. Windows are to be fixed with sufficient fastenings to comply with relevant clauses, and in no case will the number be less than the minimum specified in BS 6510 for the nearest applicable co-ordinating size.
 2. All units are to be fixed square, level and plumb without distortion.
 3. Where the method of fixing is by screw fastenings direct to concrete or blockwork surrounds, the screws are to extend a minimum of 25mm into the reveal and the plugs be of proprietary manufacture sized to suit the screw. Wooden plugs will not be permitted. Holes in the frames are to be predrilled and the screws countersunk so as to avoid scratching, gouging or locally distorting the frame.
 4. Frames are to be protected from alkaline materials by approved isolating tape.
 5. Timber sub-frames to be treated in accordance with BS 1282 and to meet specified requirements of BS 5707. Treatment certificates to be submitted to the Supervising Engineer.
 6. Timber sub-frames to be primed or sealed before the installation of the units.
 7. Joints between the frames of external units and the surrounding construction are to be sealed in accordance with BS 6213 BS 4254 and in such a way as to form a complete weatherproof seal between the frame and the surround. The sills of sliding doors are to be bedded in mastic. Rubber used in pre-formed gaskets for weather exclusion to the building shall be to BS 4255.
 8. After installation all opening units to be eased and adjusted to provide free operation and all moving parts are to be lubricated.
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3 PART 3 – GLASS AND GLAZING

3.1 GENERAL

Scope

1. This Part specifies various types of glass available.

References

2. The following standards are referred to in this Part:

BS 952 Glass for glazing
BS 2571 General purpose flexible PVC compounds for moulding and extrusion
BS 5051 Security Glazing
BS 5713 Hermetically sealed flat double glazing units
BS 5544 Anti-bandit glazing (glazing resistant to manual attack)
BS 5588 Fire precautions in the design and construction of buildings
BS 6206 Impact performance requirements for flat safety glass and safety plastics for use in buildings
BS 6262 Code of Practice for glazing for buildings
BS EN 572 Glass in Buildings - Basic soda lime silica glass products

3.2 GLASS TYPES AND REQUIREMENTS

General Requirements

1. Glass shall comply with the relevant provisions of BS 952.
2. Glazing for buildings shall comply with the relevant provisions of BS 6262.
3. Vacuum sealing requirements for double glazing units shall comply with the relevant provisions of BS 5713.

Transparent Glass

4. Transparent glass shall be clear float or polished plate glass not less than 4 mm nominal thickness. Sheet glass shall not be used in the Works.

Mirror Glass

5. Mirror glass is to be 6 mm float glass or polished plate glass, silvered on one side. The silvering shall be protected by a copper backing and protective paint coating. Mirror edges shall be ground and polished. Mirror edges shall be bevelled.

Patterned and Rough Cast (obscured) Glass

6. To be 6 mm nominal thickness unless otherwise to the approval of the Engineer.

Toughened Glass

7. Toughened glass shall be processed float or polished plate glass satisfying the impact requirements of BS 6206 Class B.

3.3 GLAZING MATERIALS

Glazing Compounds

8. Glazing compounds shall be non-setting oil based materials containing butyl rubber and shall be approved by the Engineer.

Distance Setting and Location Blocks

9. Distance pieces (for setting between) glass panes), setting and location blocks shall be plasticised PVC complying with BS 2571 (softness numbers 35 to 45), rigid nylon or sealed hardwood. Plasticised PVC shall not be used for heavy glass panes, or solar control (reflective and insulating) glasses or sealed double glazing units.

Glazing Gasket

10. Glazing gaskets shall be of neoprene or EPDM material as approved by the Engineer.

1. This Part deals with the specification of ironmongery items.
2. This part covers the requirements the use of metallic covering for buildings and structures.

3.4 REFERENCES

The following standard is referred to in this Part:

BS 3621 Specification for thief resistant locks
BS 5725 Emergency Exit Devices
BS 6459 Door closers
BS 6462 Casement stays
BS 7036 CP for powered doors
BS 7352 Specification for metal hinges
BS EN 60730 Electrically operated door locks

3.5 PRODUCTS

General

1. The Contractor is to provide and fix ironmongery as required by the Project Documentation complete, including all necessary screws, bolts, plugs and other fittings. The use of nails for fixing ironmongery will not be permitted. The Contractor to hand over all work in a finished state and to the satisfaction of the Engineer.
2. All ironmongery is to be of first quality and be obtained from an approved manufacturer. Butt hinges are to be aluminium alloy, stainless steel or brass as specified with double stainless steel washers to BS 7352.

3. The Contractor will be required to submit for approval samples of all items of ironmongery that he proposes to use. All doors are to be provided with an approved floor stop plugged and screwed to the floor or wall and all opening areas of aluminium work (louvered doors) are to be provided with appropriate stays (friction type to plant room or service area doors opening out) to BS 6462.
4. The size, materials, finishes, type and quality of ironmongery will be as described in the Project Documentation.

Finish

1. The finish of the various items of ironmongery is to be as described in the Project Specification or shown on the Drawings.
2. Ironmongery not obtainable from the same range and/or manufacturer as the general ironmongery for the Works is to match the general ironmongery as closely as possible.
3. Ironmongery to metal windows and doors is generally to match the general framing and is to be supplied and fixed with matching metal fixing screws and bolts and additional plates.

3.6 FITTING AND TESTING

General Requirements

1. All screws used for fixing ironmongery are to be of the correct type, material, finish, size and shape to the approval of the Architect and/or Engineer.
2. The hinges on which doors, windows, flyscreen doors, etc., are hung are to be carefully housed or let into the door, window, flyscreen doors, etc., and to the frames.
3. All fittings are to be removed before commencing any painting operations and are to be re fixed in place after all painting works are completed and approved..
4. All ironmongery is to be carefully wrapped and protected until the completion of the work and any items or parts which are damaged or defaced or found to be defective are to be replaced at the Contractor's expense before handing over.
5. On completion of all locks, catches and similar items of ironmongery they are to be properly cleaned, tested and oiled, and all keys are to be clearly labelled with metal tags approximately 50 x 20 mm and securely fixed to the keys and handed to the Architect and/or Engineer. Thief resistant locks are to BS 3621.
6. Door closers are to be fitted a maximum of two weeks before handover. Power door closers are to BS 7036 and other standard closers to BS 6459 as applicable.
7. All floor and door springs are to be fully charged with oil and their operation checked to the satisfaction of the Architect and/or Engineer.
8. Hinges are to be fitted in a standard position 250 mm from the top or bottom edge of the door to the centre of the hinge. Where a third hinge is fitted it is to be located centrally between the top and bottom hinges.

9. Locks are to be fitted so that the centre of the handle is at height of 1000 mm from the bottom of the door and to BS 3621 as applicable.

3.7 STANDARD IRONMONGERY FOR INTERNAL DOORS

General Requirements

1. Each door leaf is to be fitted with 1½ pairs of 100 x 75 mm satin anodised aluminium, stainless steel or brass, double stainless steel washered butts unless otherwise noted in the Particular Project documentation and drawings.
2. Where a supplier cannot offer the particular required ironmongery the Contractor is to produce samples of other supplier's items most nearly matching the general ironmongery and/or produce alternative ironmongery by the main supplier most closely conforming with the specification for the approval of the Engineer and to BS 7352.
3. All locks are to be provided with 2 keys on a key ring neatly labelled.
4. 'Master Key' locking systems are as stated in the Project Documentation.
5. All knob sets are to include for the appropriate mortise latch or lock with a 70 mm backset and with standard face-plates and roses unless otherwise noted.

END OF SECTION

4 PART 4 – IRONMONGERY

4.1 GENERAL

1. This Part deals with the specification of ironmongery items.
2. This part covers the requirements the use of metallic covering for buildings and structures.

4.2 REFERENCES

The following standard is referred to in this Part:

BS 3621 Specification for thief resistant locks
BS 5725 Emergency Exit Devices
BS 6459 Door closers
BS 6462 Casement stays
BS 7036 CP for powered doors
BS 7352 Specification for metal hinges
BS EN 60730 Electrically operated door locks

4.3 PRODUCTS

General

1. The Contractor is to provide and fix ironmongery as required by the Project Documentation complete, including all necessary screws, bolts, plugs and other fittings. The use of nails for fixing ironmongery will not be permitted. The Contractor to hand over all work in a finished state and to the satisfaction of the Engineer.
2. All ironmongery is to be of first quality and be obtained from an approved manufacturer. Butt hinges are to be aluminium alloy, stainless steel or brass as specified with double stainless steel washers to BS 7352.
3. The Contractor will be required to submit for approval samples of all items of ironmongery that he proposes to use. All doors are to be provided with an approved floor stop plugged and screwed to the floor or wall and all opening areas of aluminium work (louvered doors) are to be provided with appropriate stays (friction type to plant room or service area doors opening out) to BS 6462.
4. The size, materials, finishes, type and quality of ironmongery will be as described in the Project Documentation.

Finish

1. The finish of the various items of ironmongery is to be as described in the Project Specification or shown on the Drawings.
2. Ironmongery not obtainable from the same range and/or manufacturer as the general ironmongery for the Works is to match the general ironmongery as closely as possible.

3. Ironmongery to metal windows and doors is generally to match the general framing and is to be supplied and fixed with matching metal fixing screws and bolts and additional plates.

4.4 FITTING AND TESTING

General Requirements

1. All screws used for fixing ironmongery are to be of the correct type, material, finish, size and shape to the approval of the Architect and/or Engineer.
2. The hinges on which doors, windows, flyscreen doors, etc., are hung are to be carefully housed or let into the door, window, flyscreen doors, etc., and to the frames.
3. All fittings are to be removed before commencing any painting operations and are to be re fixed in place after all painting works are completed and approved..
4. All ironmongery is to be carefully wrapped and protected until the completion of the work and any items or parts which are damaged or defaced or found to be defective are to be replaced at the Contractor's expense before handing over.
5. On completion of all locks, catches and similar items of ironmongery they are to be properly cleaned, tested and oiled, and all keys are to be clearly labelled with metal tags approximately 50 x 20 mm and securely fixed to the keys and handed to the Architect and/or Engineer. Thief resistant locks are to BS 3621.
6. Door closers are to be fitted a maximum of two weeks before handover. Power door closers are to BS 7036 and other standard closers to BS 6459 as applicable.
7. All floor and door springs are to be fully charged with oil and their operation checked to the satisfaction of the Architect and/or Engineer.
8. Hinges are to be fitted in a standard position 250 mm from the top or bottom edge of the door to the centre of the hinge. Where a third hinge is fitted it is to be located centrally between the top and bottom hinges.
9. Locks are to be fitted so that the centre of the handle is at height of 1000 mm from the bottom of the door and to BS 3621 as applicable.

4.5 STANDARD IRONMONGERY FOR INTERNAL DOORS

General Requirements

1. Each door leaf is to be fitted with 1½ pairs of 100 x 75 mm satin anodised aluminium, stainless steel or brass, double stainless steel washered butts unless otherwise noted in the Particular Project documentation and drawings.
2. Where a supplier cannot offer the particular required ironmongery the Contractor is to produce samples of other supplier's items most nearly matching the general

ironmongery and/or produce alternative ironmongery by the main supplier most closely conforming with the specification for the approval of the Engineer and to BS 7352.

3. All locks are to be provided with 2 keys on a key ring neatly labelled.
4. 'Master Key' locking systems are as stated in the Project Documentation.
5. All knob sets are to include for the appropriate mortise latch or lock with a 70 mm backset and with standard face-plates and roses unless otherwise noted.

END OF SECTION

1 PART 1 - GENERAL

1.1 GENERAL

1. This Section specifies the general requirements for various methods and types of interior finishes within buildings for walls, floors, and ceilings.

1.2 REFERENCES

The following standard is referred to in this Part:

BS 12 Portland cement
BS 812 Testing aggregates
Bs 882 Aggregates from natural sources for concrete
BS 890 Building limes
BS 1014 Pigments for Portland cement and Portland and cement products
BS 1202 Nails
BS 1230 Gypsum plasterboard
BS 1494 Fixing accessories for building purposes
BS 1200 Building sands from natural sources
BS 3416 Bitumen based coating for cold application, suitable for use in contact with potable water
BS 4131 Terrazzo tiles
BS 5224 Masonry cement
BS 5262 Code of practice for external rendering
BS 5390 Code of practice for stone masonry
BS 5980 Adhesive for use with ceramic tiles and mosaics
Bs 5975 Code of practice for false work
BS 6431 Ceramic floor and wall tiles
BS 8000 Workmanship on building sites
BS 8203 Code of practice for installation of sheet and tile flooring
BS 8204 In-situ flooring

1.3 WORKMANSHIP & SCAFFOLDING

1. All work is to be performed by experienced and trained specialists or under supervision by specialists or trained personnel.
2. Scaffolding is to be erected to external facades and any other areas where it is required before any work is commenced, so that good access is obtained to the whole of the working area
3. Scaffolding is to be supported independently of the working area and is to provide platforms at about 2 metre intervals. A gap of at least 250mm should be left between the work face and the scaffolding to allow sufficient clearance for working.
4. Scaffolding to be designed and erected in accordance with BS 5975.

1.4 SAMPLE PANLES AND CONTROL PANELS

1. Sample panels minimum size 600 x 600mm are to be prepared for all textured coatings to be used in the Works
2. If the Supervising Engineer so requires, a control samples of a finishing materials shall be prepared in an agreed location within the Works (e.g. the floor tiling to a complete room). The area to be used as a control is to be completed and approved to the standard of workmanship and appearance obtained before the application of the material is proceeded with elsewhere in the Works

2 PART 2 – LATH & PLASTER

2.1 GENERAL

1. This Part specifies requirements for lath and plaster finishes for buildings and related structures.
2. Related Sections and Parts are as follows:

2.2 REFERENCES

The following standard is referred to in this Part:

BS 12 Portland cement
BS 405 Uncoated expanded metal carbon steel sheets for general purposes
BS 882 Aggregates from natural sources for concrete
BS 890 Building lines
BS 1191 Specification for gypsum building plaster
BS 1199 Building sands from natural sources
BS 1200 Building sands from natural sources
BS 1202 Nails
BS 1369 Steel lathing for internal plastering and external rendering
BS 1449 Steel plate, sheet and strip
BS 1494 Fixing accessories for building purposes
BS 3148 Water for making concrete
BS 4551 Method of testing mortars, screeds and plasters
BS 5262 Code of practice for external rendering
BS 5270 Bonding agents for use with gypsum plaster and cement
BS 5492 Code of Practice for internal plastering
BS 6452 Beads for internal plaster and dry lining
BS 8000 Workmanship on building sites

2.3 PORTLAND CEMENT PLASTER

Materials

1. Cement shall comply with the requirements of BS 12.
2. Aggregates shall generally comply with the requirements of BS 1199 except where modified by the grading limits stated elsewhere.

2.4 METAL LATH

2.4.1 Material

1. Expanded metal lath where required, is to be manufactured from tight coat galvanized sheet made in accordance with the requirements of BS EN 10142 and BS EN 10143 Grade Z2, coating type “C”. It shall have a minimum aperture of 6 mm measured the short way of the mesh.

2. It should weigh not less than 1.22 kg/m² where used as reinforcement over different backgrounds and not less than 1.90 kg/m² where used as a background for plastering or rendering.
3. Wire ties are to be galvanized with a minimum diameter of 1.20 mm.

2.4.2 Expanded Metal Lath at Junctions of Differing Backgrounds

1. Where a rendering or plaster is to be continuous across backgrounds of different types, a strip of metal lath with a minimum width of 300 mm and an isolating membrane of polythene sheet or building paper behind, is to be fixed across the junction. Where small widths of one material less than 300 mm wide are, the width is to be bridged completely and for a distance of 150 mm on both sides.
2. All cut edges of the metal lath and the fastenings are to receive a coating of bitumen solution.
3. Zinc coatings only partially surrounded by cement plaster or renderings are particularly liable to corrosion and care should be taken to ensure that the metal lath is completely embedded.

2.5 BEADS AND STOPS

Materials & Fixing

1. Beads and stops shall be used and are to be Stainless Steel complying with BS 1449 Part 2, profiled to suit the depth of plaster or render to be applied.
2. Beads, stops and the like are to be fixed plumb, square and true-to-line with 40 mm galvanized clout nails or plaster dabs at not more than 600 mm centres to each mesh wing.
3. Cut edges are to be treated with one coat bituminous solution.

2.6 WELDED-FABRIC MESH FOR REINFORCED RENDERING

2.6.1 Materials

1. Reinforcement required for rendering is to consist of galvanised welded-fabric mesh with 50 x 50mm squares having wires not less than 2.5mm diameter.

2.6.2 Preparation of Background to be rendered

1. Surfaces to be rendered are to be thoroughly cleaned of all mould oil, dust and loose particles.
2. If dubbing out is required it should be done well in advance of the undercoat, using a mix at least as strong as the undercoat but not stronger than the background. If the thickness needed is greater than 16 mm, it is to be built-up in two coats; no coat is to exceed 13 mm thick.
3. Concrete surfaces are to receive one of the following treatments before the application of the undercoat:
 - (a) Metal lathing.
 - (b) a spatter dash treatment of one part of cement and two parts of coarse sand, mixed with sufficient water to give a consistency of a thick slurry is to be dashed on to the dampened background with either a trowel or a scoop to give a thin coating with a roughcast uneven appearance. To prevent rapid loss of

moisture the spatter dash is to be dampened periodically and then be permitted to dry out slowly and harden before the application of the rendering.

4. Blockwork surfaces are to have the joints raked out during construction. Where the joints have not been raked out or where in the opinion of the Supervising Engineer concrete blocks with smooth surfaces will provide insufficient key, a spatter dash treatment is to be applied in accordance with Clause 3 above.
5. Junctions of differing backgrounds are to be treated in accordance with Clause 2.4.2.
6. A strip of metal lath minimum 200 mm wide should also be provided over all electrical conduits and service pipework running within chases, fixed in accordance with Clause 2.4.2.

2.6.3 Preparation Procedures and Selection of Materials

1. Unless specified elsewhere the mixes for rendering are to be selected from Table below and will vary in accordance with the types of background to which the render is to be applied. Backgrounds are subdivided as follows:
 - (a) moderately strong and porous materials - which include medium density concrete and concrete blocks providing some suction and mechanical key
 - (b) moderately weak and porous materials - which include medium density concrete and concrete blocks providing some suction and mechanical key
 - (d) metal lathing

Table 2.1
Rendering Mixes

Background Material	Undercoats Cement : Lime : Sand	Final Coat Cement : Lime : Sand
Dense, strong, smooth	1 : ½ : 4½	1 : 1 : 6
Moderately strong, porous	1 : 1 : 6	1 : 2 : 9
Moderately weak, porous	1 : 2 : 9	1 : 2 : 9
Metal lathing (first coat)	1 : ¼ : 3	1 : 1 : 6
Metal lathing	1 : ½ : 4½	1 : 1 : 6

2. The selection of the mixes is to take account of the following:
 - (a) strong mixes rich in cement have a relatively high drying shrinkage and are liable to cracking and crazing
 - (b) the high drying shrinkage of strong mixes applied to weak backgrounds may cause shearing at the surface of the background
 - (c) the mix for each successive coat must never be richer in cement than the mix used for the coat to which it is applied
 - (d) two coats having the same mix proportions can only be applied successively if the second coat is appreciated thinner than the first. A 10 to 12 mm first coat should only receive a 5 to 6 mm final coat of the same mix.
3. The mixes for rendering below ground level are to be made with sulphate resisting cement.

4. Cement, lime and sand for each batch are to be accurately measured by volume using properly constructed gauge boxes or, wherever possible, whole bags of cement or hydrated lime. Lime shall comply with the relevant provisions of BS 890.
5. Mixing should preferably be by machine. Where, however, small quantities are required, mixing may be carried out on a board or platform which should be cleaned after each batch has been removed.
6. The hydrated lime is first to be thoroughly mixed with the sand. Cement shall then added and mixing continued until the material is uniform in appearance. Water should then be added while continuing mixing until the materials are workable and of a uniform colour and consistency.
7. To improve workability of the mix, the hydrated lime, sand and water may first be mixed in the required proportions and then allowed to stand undisturbed for at least 16 hours before mixing with the cement. If allowed to stand for a longer period it must be protected from drying out.
8. Propriety plasticisers may not be used as a substitute for lime without the approval of the Supervising Engineer. Amongst other considerations, the Supervising Engineer will not give approval unless:
 - (a) the manufacturer, brand and chemical composition of the admixture is disclosed
 - (b) the Supervising Engineer is satisfied that correctly calibrated equipment is available to control the amounts used.
9. The whole of each batch is to be used within an hour of being mixed.

2.6.4 Application of the Various Render Coats

1. The work is not to be started until the background has been properly prepared in accordance with Clause 2.3.2 of this Part.
2. The render shall generally be applied in two coats except where the background is metal lathing where three coats shall be applied.
3. Before applying any coat the background or preceding coat is to be brushed down to remove any loose particles and is to be dampened sufficiently to ensure uniform absorption.
4. The undercoat is to be applied either by laying on with, or throwing from, a trowel or float. It should be as uniformly thick as possible, and not less than 8 mm or more than 13 mm thick in any part.
5. The undercoat is to be left rough and open from the edge of the trowel, and after it has been left long enough to set firm, it should be combed with evenly spaced wavy horizontally lines. The lines are to be approximately 20 mm apart and 5 mm deep (less in the case of a first coat on metal lathing).
6. The first undercoat applied to metal lathing is to be well worked into the lath to ensure that the material is completely embedded.
7. The finishing coat should not to be less than 5 mm or more than 10 mm thick and is to be laid on with a trowel and finished with a wood float, care being taken not to over-work the surface.
8. All coats are to be applied with firm pressure to exclude air and to ensure a good bond.
9. All coats are to be prevented from drying out too quickly. All external rendering is to be protected by properly constructed hessian or similar screens.
10. Each coat is to be kept damp by means of a fog spray of water for a minimum of three days to allow the render to cure and then be allowed to dry out for at least a further three days before a subsequent coat is applied or, in the case of the finish coat, before the protective screens are removed.

11. The surface of the finish coat is to be smooth, true and free from waviness, irregularities or blemishes with straight, level or plumb angles. External angles are to be pencil rounded.
12. Care is to be taken when rendering up to plaster beads or stops to avoid excessive polishing at the arris and damage to the galvanizing, or stainless steel.

3 PART 3 – FLOOR SCREEDS

3.1 GENERAL

1. This Part specifies the requirements for the installation of floor screeds and treatment.

3.2 REFERENCES

The following standard is referred to in this Part:

BS 8000 Workmanship on building sites

3.3 PREPARATION & PROCEDURES

1. The surface of the concrete base must be clean, firm and rough to ensure a good bond. This is to be achieved by hacking thoroughly to remove all laitence and to expose the aggregate over the whole area, followed by sweeping clean and hosing down to remove all dust.
2. The base is to be soaked with water for at least 12 hours and any surplus water removed before laying commences.
3. Screeds to receive thin flexible finishes (i.e. of vinyl and rubber sheet or tile) are to consist of 1 part of cement of 3 parts of sand by weight to BS 8000, Part 9.
4. Screeds to receive strong rigid coverings (e.g. quarry and ceramic tile) are to consist of 1 part of cement to 4 parts of sand by weight to BS 8000, Part 9.

3.4 INSTALLATION

1. To obtain the required thickness of screed, leveling battens are to be used, carefully fixed to line and level and fully bedded. There is to be a minimum thickness of screed of 20mm over the top of any conduit or duct.
2. The screed is to be laid in alternate bays with plain butt joints. The length of a bay is not to exceed 1.5 times the width. The maximum plan area of a bay shall not exceed 15 m². Movement and construction joints in the base are to be carried through the screed.
3. Immediately prior to laying the screed a thick brush coat of wet cement grout is to be applied to the damp surface of the base concrete and be well scrubbed in. The brush coat must not be applied more than 10 minutes before it is covered with screed.
4. The mix is only to contain sufficient water that will allow full compaction and shall be evenly spread to a thickness approximately 10mm greater than that required. The screed should then be thoroughly compacted by tamping and drawing off to the required level with a screed board.

5. If a smooth surface is required, the final working up is to be done with a wood float, steel trowel, power float or other finish as required. Care is to be taken to avoid excessive trowelling which may cause crazing.
6. Screeds to receive thin flexible finishes or screeds which are finished as paving are to be laid to a tolerance such that localized variations do not exceed ± 2 mm under a 3 metre straightedge and ± 10 mm over large areas, measured from datum.
7. As soon as each bay is completed and has hardened sufficiently to prevent damage to its surface, it is to be covered with polythene or similar sheets which are to be adequately lapped and held down. The screed should not be allowed to dry out for a minimum period of 7 days and no traffic shall be permitted on the surface during this time.

4 PART 4 – DRY LINNINGS

4.1 GENERAL

1. This Part specifies the requirements for use of dry wallboard or plaster board.

4.2 REFERENCES

The following standard is referred to in this Part:

BS 1230 Gypsum Plasterboard
BS 8000 Workmanship on building sites

4.3 MATERIALS & STORAGE

1. Gypsum wallboard is to consist of either 9.5 or 12.7 mm thick gypsum plasterboard complying with BS 1230, having one face finished for direct decoration.
2. The edge profiles of wallboard to be:
 - tapered - for smooth seamless jointing
 - bevelled - for V-jointing
 - square - for stippled textured coatings, corner strip jointing or plaster.
3. Accessories for installing wallboard are to be approved proprietary materials recommended by the manufacturer of the board and are to comply with the requirements of BS 8000, Part 8.
4. Wallboards are to be stored flat in dry conditions and should always be carried on edge.

4.4 INSTALLATION

1. The background is to provide supports at the maximum centres of:
 - 9.7mm boards – 400mm
 - 12.7mm boards – 600mm
2. Additional framing members are to be provided as necessary to ensure that all board edges are supported.
3. The boards are to be fixed to backgrounds with the paper covered edges vertical and to ceilings with the paper covered edges at right angles to the main supporting members/joists.
4. The boards are to be fixed to the backgrounds not nearer than 15 mm from the edges using 40 x 2 mm galvanized clout nails for wallboard.

5. The nails should be driven home straight and firmly so that the heads are slightly below the surface of the board. Care shall be taken not to fracture the board. Care shall also be taken to ensure that the insulation is not compressed unduly.

4.5 JOINTING OF BOARDS

6. The joints of square edge boards which are to receive a stippled textured coating are to be finished with a paper faced cotton joint tape fixed with a suitable adhesive.
7. The joints of bevelled edge boards are to have the “V” joint completely filled with joint filler and the surplus removed.
8. The joints of tapered edge boards should either be finished by the manual methods described in the following paragraphs, or except for joints at external angles, by approved mechanical methods recommended by the manufacturer of the board.
9. Before jointing commences the boards are to be checked to ensure that all are securely fixed and protruding screws or nails are driven home. Cut edges are to be lightly sanded to remove burrs and treated with a brush coat of PVC sealer.
10. Joints in straight runs of tapered edge boards are to be finished as follows:
 - a) a continuous, thin band of joint filler is to be applied to the trough of the tapered edge joints using an applicator and making sure areas are not left uncovered. A 45 mm wide joint tape is to then be pressed into the band of filler using a taping knife. The tape is to be firmly bedded and free from air bubbles, with sufficient filler under the tape to ensure good adhesion
 - b) immediately after the tape has been fixed a new layer of filler is to be applied over it. This should be brought flush with the surface of the board. Before the filler begins to stiffen, a jointing sponge should be moistened and surplus material wiped from the edges of the joint, taking care not to disturb the main joint filling
 - c) once the filler has set, any slight depressions in the surface are to be filled with another coat of the filler and any projections cut back with the taping knife.
 - d) when the filler has set a thick layer of joint finish is to be applied to a broad band 200 to 250 mm wide over the joint using the applicator. The edges of this band shall be immediately feathered out with a slightly damp jointing sponge. When this band of jointing finish has dried, another application is to be made and feathered out as before. The first coat of finish must dry before the final finish coat is applied.
11. Joints at internal angles of tapered edge boards are to be finished as follows:
 - a) The jointing tape is to be folded and pressed firmly into the angle using a brush or applicator to make sure any air bubbles are removed and the tape is firmly bedded. A thin layer of joint finish 150 mm wide centred on the joint is to be applied immediately and the edges feathered out with the jointing sponge.
 - b) surplus material is to be removed from the extreme edges as described in subparagraph 10(b) above.
 - c) when this coat has dried, another coat of joint finish 200-250 mm wide is to be applied and the edges feathered out with the jointing sponge.

12. Joints at external angles of tapered edge boards are to be finished as follows:
 - a) the edges of the board to be treated as recommended by the dry lining manufacturer with the insulation cut back and using a bound and tapered edge so as to mask the cut edge of the dry lining.
 - b) the angles should be reinforced with a 54 mm wide corner tape consisting of strong paper tape with bonded parallel steel reinforcement strips. The tape is to be cut to the required length and creased firmly at the angles to allow the steel strips to lie close to the board surfaces. A 50 mm wide band of joint filler is to be applied to each side of the angle and the tape be pressed firmly into the corner with a taping knife, making sure that the arris of the folded tape is straight.
 - c) immediately after bedding the tape, a 125 mm band of joint filler shall be applied to both sides of the angle with an applicator and the edges feathered out with the jointing sponge.
 - d) after the filler coat has set, a thin layer of joint finish is to be applied and the edges again feathered out with the jointing sponge.
 - e) when the first filler coat is dry, the process is to be repeated with a further application of joint finish.
13. Nail and screw indentations are to be filled with joint filler and finished flush. When the filler has set a thin layer of joint finish is to be applied and the edges feathered out with the jointing sponge.
14. When all jointing and filling has been completed and the last application of joint finish has dried, a slurry coat of joint finish shall be applied over the entire surface of the boards to give an even sponged texture.

5 PART 5 – CEILINGS

5.1 GENERAL

1. This Part specifies the requirements for suspended ceiling systems of lay-in type and fixed type construction.

5.2 REFERENCES

The following standard is referred to in this Part:

BS 476 Fire tests and building materials and structures
BS 1191 Gypsum building plasters
BS 1230 Gypsum plasterboard
BS 5492 Code of practice for internal plastering
BS 8000 Workmanship on building sites
BS 8212 Code of practice for dry lining and partitioning using gypsum plasterboard
BS 8290 Suspended ceilings

5.3 GENERAL REQUIREMENT

1. The suspended ceilings shall not be installed until:
 - (a) the building is weathertight
 - (b) the wet trades have finished their work
 - (c) all work above the ceilings such as ductwork, pipework and electrical work has been installed, tested, inspected and approved
 - (d) the positions of light fittings, diffusers and the like have been checked
 - (e) the position of access panels have been confirmed with the supervising Engineer.
2. The ceiling shall be installed to within 3 mm of required level. When measured against a straight edge over a distance of 3 m, the gap between the straight edge and the ceiling shall not exceed 3 mm.
3. The manufacturer's recommendations for the use and installation of products covered in this Part shall be strictly adhered to unless otherwise agreed with the Supervising Engineer.
4. Existing conditions shall be inspected before commencing installation of suspended ceilings to ensure the following:
 - (a) that services all have been installed
 - (b) that fastenings and supports installed by others are in place
 - (c) that installation of others will not touch the back of ceiling system.

The Contractor shall verify to the Supervising Engineer in writing that such inspections have been performed and that work is ready to commence.

5.4 SUBMITTALS

1. The Contractor is to submit shop drawings showing general layout, support framing, and installation details including lay-in, hanger and support details.

2. Samples of support framing, lay-in, lay-in hangers and hanger insert are to be submitted for approval.
3. Suspended ceilings shall comply with the relevant provisions of BS 8212 and BS 8290.

5.5 LAY IN TYPE SUSPENDED CEILINGS

5.5.1 General

1. The lay-in material shall be tile or plank as detailed in the drawings.
2. The lay-in material shall have a fire performance when tested in accordance with BS 476 which satisfies the requirements of:
 - (a) class 0 - BS 476, Part 6.
 - (b) class 1 - BS 476, Part 7.
3. The Contractor shall produce certificates that certify that the requirements of Clause 14.2.1-2 are met.
4. The suspension system and shall be constructed from hot dipped galvanized steel sections and galvanized wire or similar non-corrodable materials and fixings.

5.5.2 Installation

1. The tiles shall be set out so that:
 - (a) the soffits are level, free from undulations and lipping, with all lines and joints straight and parallel to walls unless shown otherwise in the Drawings.
 - (b) they are symmetrical about the centre lines of the roof, or space, beginning with a tile or joint line as required to avoid narrow tiles at the perimeter edges.
2. At junctions between the ceiling and walls, and between the ceiling and columns, the ceiling shall be finished with perimeter edge trim. The trim shall be fixed at maximum 450 mm centres.
3. Additional hanging supports shall be provided between the floor or roof structure above and the suspended ceiling at all access panels, light fittings, diffusers, etc. The lay-in material shall be accurately cut to accommodate all such fittings. Under no circumstance shall any fitting be supported by the lay-in material.
4. Care shall be taken to ensure that the tiles, planks and strip membrane are kept clean if subsequently removed for access to services, for inspection or for remedial work.

5.6 FIXED TYPE SUSPENDED CEILINGS

5.6.1 General Requirements

1. Gypsum board will be used for fixed type suspended ceilings in all internal areas unless otherwise indicated in the Drawings.
2. Installation of gypsum board for suspended ceilings and associated plaster or rendering work shall comply with the relevant provisions of BS 1191 and BS 5492.

5.6.2 Materials

1. Gypsum wall board shall be either 9.5 or 12.7 mm thick gypsum plasterboard complying with BS 1230, having one face finished for direct decoration.
2. The edge profiles of wall board shall be:

- (a) “tapered” for smooth seamless jointing.
 - (b) “bevelled” for V-jointing.
 - (c) “square” for stippled textured coatings, corner strip jointing or plaster.
3. Accessories for installing wallboard shall be approved proprietary materials recommended by the manufacturer of the wallboard or ceiling system, inclusive of the following:
- (a) soffit assemblies, where indicated on drawings shall consist of galvanized steel channel runners and studs faced with gypsum panels, screw attached unless specified otherwise and approved by the Supervising Engineer
 - (b) hangers, hanger attachments, support carrier members with connectors, and trim members related to ceiling as is required for complete
 - (c) fabricated miscellaneous clips, splices, connectors, screws, and other standard metal accessories of strength and design compatible with the suspension methods and system.

5.6.3 Installation

- 4. The Contractor shall ensure that adequate preparation is made for attachment of hangers and fasteners and provide for support and incorporation of flush-mounted and recessed fittings and service components.
- 5. The ceiling system shall be installed in accordance with manufacturer’s recommendations and to BS 8290 Part 3.

6 PART 6 – TILING

6.1 GENERAL

1. This Part specifies the requirements for use of ceramic tile products and the installation of such for wall and floor surfaces.

6.2 REFERENCES

The following standard is referred to in this Part:

BS 1286 Clay tiles and flooring
BS 5980 Adhesives for use with ceramic tiles and mosaics
BS 6431 Ceramic floor and wall tiles
BS 8000 Workmanship on building sites

6.3 TILE ADHESIVE

Adhesives used for fixing ceramic tiles to comply with BS 5980, Class A.

6.4 CERAMIC TILES

6.4.1 General

This specification includes ceramic wall tiles used in standard applications for floor and wall surfaces. Tile products and application for walls and floors shall comply with BS 8000, Part 11.

6.4.2 Glazed Ceramic Wall Tiles

1. Glazed ceramic wall tiles for internal use shall comply with BS 6431 and for external use must be recommended for the purpose by the manufacturer.
2. Grout for wall tiling to be an approved proprietary grout.

6.4.3 Fixing internal Ceramic Wall tiles

1. Ceramic wall tiles shall be fixed by bedding in an approved adhesive on cement rendering. The rendering shall be applied in accordance with relevant clauses of this specification unless where modified by the requirements of this Part.
2. All backgrounds are to receive the spatter dash treatment described in elsewhere of this specification before the surfaces are rendered.
3. The rendering is to be in one coat, except where applied to metal lathing when two coats are to be used, and be left with a wood float finish. It is to be as uniformly thick as possible and not less than 8 mm or more than 13 mm thick in any part.
4. Mesh reinforcement is to be incorporated in the rendering in accordance with relevant clauses of this specification where:
 - (a) the structure is out of line and the thickness of render required exceeds 13 mm
 - (b) the rendering is to be applied over differing structural materials

- (c) the surface of the structural wall will be subject to excessive movement.
- 5. Where the tiling is to be bedded in a thin-bed adhesive, the trueness of the rendering is to be such that when tested with a 3 m straightedge, no gap exceeds 3 mm. Where the gap exceeds 3 mm but is less than 6 mm, or if the walls are out of plumb by not more than 6mm, the Supervising Engineer may permit a thick-bed adhesive to be used or may direct that the defective areas are cut back and made good. Deviations from true or plumb in the surface of the rendering exceeding 6 mm are to be made good.
- 6. Thin-bed adhesive should not be used for fixing tiles with backs incorporating deep keys or frogs; for these thick-bed adhesives must be used.
- 7. The tiles are to be set out before the work commences so that:
 - (a) cut tiles are kept to a minimum and where they do occur, are as large as possible
 - (b) joints are horizontal and vertical, with horizontal joints aligning in walls that are adjacent.
- 8. The tiles shall be neatly and accurately cut to a close fit where necessary at abutments and around outlets, pipes and the like.
- 9. Movement joints not less than 6 mm wide are to be provided:
 - (a) at all internal vertical corners
 - (b) at all angles with structural walls and ceilings
 - (c) to give bays not greater than 3000 x 4500 mm
 - (d) over all structural movement joints.
- 10. The joints are to be carried through the rendering to the structural wall and shall be partially filled with an approved joint filler and finished flush with an approved sealant recommended by the manufacturer for the situation in which it will be used.
- 11. Glazed edge tiles to be used where edges are exposed.
- 12. The adhesive is to be prepared and applied with a trowel to dry rendering in the manner recommended by the manufacturer. The tiles are to be pressed firmly into the adhesive with a twisting/sliding action, tapped firmly into position and cleaned as soon as the bedding is complete.
- 13. It is essential that the tiles are fixed in position before the surface of the adhesive dries and the work is to be carried out in small areas of not more than 1m² at a time.
- 14. The finished surface of the tiles should be plumb and true such that when checked with a 3 m straightedge no gap exceeds 3 mm.
- 15. The joints are to be even, approximately 2 mm wide and where tiles without spacer lugs are used, spacer pegs of suitable and even thickness to be inserted between the tiles as the work proceeds.
- 16. The joints are to be grouted after the adhesive has set and not less than 48 hours after fixing. The grout should be well worked into the joints so that they are completely filled, and finished flush. Surplus grout is to be cleaned off as the work proceeds using a damp cloth and the joints tooled smooth.

6.4.4 Fixing External Ceramic Tiles

- 1. The ceramic wall tiles are to be fixed by bedding in an approved adhesive. The adhesive must be suitable for external application and the Contractor is to obtain confirmation from the manufacturer that it is suitable for the type of tile to be fixed and in the local climatic conditions and provide the Supervising Engineer with copies of the correspondence.

2. The tiling is to be carried out generally in accordance with Clause 6.4.3 of this Part describing internal work except that the rendered backing is to be reinforced with galvanized welded fabric reinforcing mesh and except where modified by this Clause.
3. Stainless steel reinforcing mesh to be used where required or as directed by the Supervising Engineer.
4. The mesh is to be fixed, with the horizontal wires outwards by means of 25 mm stainless steel anchors or by drilling holes in which plastic anchors are inserted to receive 38 mm stainless steel, slotted head, countersunk wood screws. It is essential that the fixings extend into the structural wall by a minimum of 25 mm after passing through any dubbing etc.
5. The fixings are to be set at maximum 450 mm centers in both directions and staggered, located so that the horizontal wires of the mesh rest on the screws. The vertical wires of the mesh shall be spaced 3 mm from the structure by stainless steel washers placed as the screws are inserted.
6. The mesh should be secured to the screws by stainless steel binding wire of softened quality and 1.22 mm in diameter, twisted tightly and with its ends turned inwards.
7. The mesh is to be cut off at all movement joints leaving 40 mm free space on either side.
8. All cut edges of the mesh are to receive a coating of bitumen solution.
9. A slurry coat of neat cement is to be brushed on the background and the mesh. Whilst the slurry coat is still wet, the rendering is to be applied, working around and through the wires and ensuring that it is fully bonded to the background and that the wire is covered by a thickness of 7 mm.
10. Joints in tiled areas are not to be less than the width of the joints in the tiling and be provided in positions to be agreed with the Supervising Engineer, generally:
 - (a) over all structural movement joints.
 - (b) to give bays not greater than 3000 by 4500 mm.
 - (c) at all internal and external vertical corners.
 - (d) at each storey height level coinciding with the bottom of the floor slab.

6.4.5 Floor tiles

Ceramic floor tiles and clay floor quarry tiles shall comply with BS 6431.

6.4.6 Laying Ceramic Floor Tiles by the Direct Mortar Bedding Method

1. The areas of concrete substrata to be tiled should be brushed clean and dampened until absorption ceases and the finished floor level is to be established by means of dots and rules.
2. The mortar for bedding the tiles is to consider of 1 part of cement to 4 parts of sand by volume, mixed in a mechanical mixer to a stiff plastic consistency so that when tamped and fully compacted into place free water does not bleed to the surface.
3. The bedding mortar is to be laid on the concrete substrata 15 to 25 mm thick, except where tiles 10 mm thickness or less are used in which case the bedding is not to exceed 15 mm, and shall be levelled and tamped with a straightedge board.
4. The tiles are to be soaked in clean water for 15 to 30 minutes before fixing and allowed to drain for 10 minutes to remove all surplus water. Fully vitrified tiles do not require soaking.

5. The bedding mortar is to be lightly dusted with dry cement sprinkled from a flour sieve and lightly trowelled level until the surface becomes damp. The tiles are then to be laid on the bedding and beaten firmly into position with a wooden beater to ensure a true surface and that contact between the tiles and bedding is complete.
6. The tiles must be correctly positioned at the time they are placed and laid with joints of about 3 mm.
7. Grouting of the joints to be carried out within a period of 4 hours of the completion of the laying of the tiles so that the grout will attach itself firmly to the bedding. Care is to be taken to avoid disturbing the tiles and walking boards are to be used during the grouting operation.
8. The grouting mix is to either consist of 1 part cement to 1 part fine, dry sand by volume, or an approved proprietary grout may be used.
9. The tiles are to be neatly and accurately cut to a close fit where necessary at abutments and around outlets, pipes and the like.
10. Tiles are to be laid level or to 1% falls in “wet” areas, as may be required. Localised variations in level for a nominally flat floor are to be a maximum of ± 3 mm under a 3 m straightedge. Particular care is to be taken in “wet” areas to prevent low spots and the pooling of water.
11. Skirtings of the same tile size as the floor are to be fixed in such a manner that their vertical joints coincide with the horizontal joints of the floor tiles.

7. PART 7 – PAINTING & DECORATIVES

7.1. GENERAL

This part specifies requirements for preparation, painting or finishing of exterior and interior surfaces exposed to view.

7.2. REFERENCES

The following standards are referred to in this Part:

BS 245 Mineral solvent (white spirit and related hydrocarbon solvents) for paints and other purposes
BS 1336 Knotting
BS 4652 Metallic zinc-rich priming paint (organic media)
BS 4756 Ready-mixed aluminum priming paints for woodwork
BS 5082 Water-borne priming paints for woodwork
BS 5358 Solvent-borne priming paints for woodwork

7.3. SUBMITTALS

1. Sample panels are to be prepared for each type and colour of coating material to be used in the Works and shall be submitted to the Engineer for approval. As a minimum, the following sample panels shall be submitted:
2. Paint Colors: 300 x 300 mm samples labeled to indicate finish, formula, colour name and/or, number, sheen and gloss units of approved colors for:
 - (a) each specified colour in each specified finish coat material.
 - (b) each standard wood finish on specified wood species.
3. Other Materials: 500 x 500 mm (minimum) samples of each paper/fabric material minimum size showing at least the pattern repeat where applicable.

7.4. SURFACE PREPARATION - GENERAL

General Preparations

1. Before painting commences all surfaces in the work area are to be washed and scrubbed clean of debris and every possible precaution taken to keep down dust. No paint is to be applied to surfaces structurally or superficially damp and all surfaces must be ascertained to be free from condensation, efflorescence, etc., before the application of each coat.
2. All items not required to be painted (e.g., ironmongery) are first to be fitted and then removed before any painting preparation commences. The fittings shall be refixed in position when all painting is completed.

3. Brushes, pails, kettles, etc., used in carrying out the work are to be clean and free from foreign matter. They are to be thoroughly cleaned before being used for different types or classes of material.
4. All materials to be used for surface preparations are to be used strictly in accordance with the manufacturer's instructions.
5. Paint removers, abrasive papers and blocks, cleaning agents, etching solutions, stopping, knotting, fillers and other commodities are to be of the types recommended by the manufacturer of the coating to be applied.
6. White spirit shall comply with BS 245. Knotting shall comply with BS 1336.
7. Stopping and filler for woodwork shall be an approved proprietary lead free, oil-based type recommended for internal or external work as appropriate. Stopping for woodwork to receive a clear finish shall be tinted to match with the surrounding woodwork. Filler for plaster and rendering to be an approved proprietary type.

7.5. PREPARATION OF PLASTERED AND RENDERED SURFACES

1. The surface is first to be scraped to remove mortar splashes, etc., and then made good, cutting out all defective work and repairing with plaster or render of the same type as previously used.
2. The surface is then to be rubbed down with fine glass paper to remove loose particles and to smooth irregularities before the application of the filler coat, which is to be spread evenly with a scraper over all surfaces and allowed to dry.
3. The first application of filler coat will be rubbed down and a second application of filler coat made as before.
4. The surface is then to be sanded using progressively finer grades of paper until perfectly smooth and approved by the Supervising Engineer.
5. All rendered surfaces are to receive one full coat of alkali resistant primer before the application of oil based paints.

7.6. PREPARATION OF WOOD SURFACES

1. All large, loose or resinous knots are to be cut out and the holes plugged with sound wood. Nails are to be punched well below surfaces.
2. All surfaces are to be rubbed down with fine glass paper in the direction of the grain to give a smooth, even finish with arises rounded or eased.
3. After dusting off all oily woods they are to be washed with white spirit.

4. Two thin coats of knotting should be applied to all knots and any other resinous parts of softwood.
5. A full coat of primer is to be vigorously brushed in, particular care being taken to fill end grain. Backs of members are to receive two coats of primer.
6. After priming all nails, screw holes and similar depressions are to be filled with stopping, pressed well in and finished off flush with the surface. Screw heads are to be countersunk sufficiently to hold the stopping.
7. After priming and stopping is completed, pore and grain irregularities are to be treated with a coat of brush or knife applied filler, and the surface rubbed down smooth and even.

7.7. PREPARATION OF METAL SURFACES

1. Iron and steel surfaces are to be wire brushed to remove rust, loose scale, welding slag and spatter, and cleaned with white spirit to remove oil, grease and dirt.
2. Iron and steel surfaces are to receive two coats of primer.
3. On pre-primed surfaces care is to be taken to ensure that defective primer, rust and loose scales are removed back to bare metal and patch primed.
4. Blast cleaned surfaces shall be primed within 1 hour of blasting. All other surfaces shall be primed no later than 3 hours after preparation.

7.8. APPLICATIONS - GENERAL

1. Coatings are to be applied in accordance with the manufacturer's instruction to clean, dry surfaces, in dust free and dry atmospheric conditions and after any previous coats have hardened.
2. All brands of primers, paints and coatings are to be approved and shall comply with the relevant British Standards.
3. Paints of different brands are not to be mixed or used in the same coating system.
4. No dilution of painting materials is to be allowed except strictly as detailed by the manufacturers and as approved by the Engineer
5. No primed or undercoated woodwork and metalwork is to be left in an exposed or unsuitable location for any undue period before completion of the painting process. No exterior or exposed painting is to be carried out under adverse weather conditions, such as rain, extreme humidity, dust storms, etc.

7.9. PRIMERS AND UNDERCOATINGS

1. Primers for plaster and rendering are to be alkali resistant. Primers for other surfaces shall comply with Table 7.1.

Table 7.1
Suitable Primers for Background

SURFACE	PRIMER
Non resinous wood (for alkyd gloss finishes)	Low lead oil based primer to BS 5358 or Aluminum wood primer to BS 4756 or Solvent borne acrylic primer
Resinous woods (for alkyd gloss finishes)	Aluminum wood primer to BS 4756 or long oil alkyd based oxidative drying primer
Iron and steel	Red lead primer to BS 2523, Type “B” or zinc phosphate pigmented urethane alkyd modified primer
Galvanised steel	Calcium plumbate primer to BS 3698, Type “A” or Zinc chromate primer Two component polyamide cured epoxy or modified vinyl based physically drying primer.
Exterior Rendered surfaces	Stabilizing primer
Exposed concrete floors	Surface hardener

2. Undercoats on wood surfaces (exterior and interior exposed wood surfaces) requiring translucent finishes are to be of the appropriate type as recommended by the manufacturer of the translucent finish.

7.10. PAINTS & FINISH COATINGS

1. The number of coats shall be as specified by the paint manufacturer, or at minimum, as specified on Table 7.2 below.
2. Care shall be taken to ensure that finish coats applied over calcium plumbate primer are compatible with the primer.
3. Finish coats will be applied as an even film over all exposed surfaces, avoiding brush marks, sags, runs and other defects. Where two gloss finish coats are specified the second coat shall be applied within 48 hours of the first.
4. The application of paint systems for iron and steel should result in a minimum total film thickness of 125 microns internally or externally notwithstanding the number of coats specified.

Table 7.2
Minimum Number of Coats for Drying-Oil/Resin Based Paint Systems

SURFACE	LOCATIONS	PAINT SYSTEMS
Wood-oil paint finish	Internal	1 coat primer 1 coat undercoat 1 coat alkyd gloss finish or 1 coat primer 2 coats alkyd mid-sheen finish
	External	1 coat primer 2 coats undercoat 1 coat alkyd gloss finish (lead free)
Wood-natural finish	Internal	2 coats translucent finish
	External	2 coats translucent finish
Iron and steel including	Internal	1 coat primer 1 coat undercoat 1 coat alkyd gloss finish (lead free)
Galvanised steel	External	2 coats primer 2 coats undercoat 1 coat alkyd gloss finish (lead free)
Cement rendering	Internal	1 coat alkali resistant primer 1 coat undercoat 1 coat alkyd gloss finish (lead free)
Plaster (ceiling and walls)	Internal	2 coats Vinyl silk emulsion
Concrete floors	Internal	1 coat anti dust paint

END OF SECTION