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# Specification for Building Maintenance and Medium Building Construction Works

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General

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**100**

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**General**

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101 Office of the Director of Works

1. The Contractor shall provide, erect, maintain and remove on completion of the Works the offices and their contents, access roads and hard standing thereto described in the Contract for the use of the Director of Works. The offices shall be ready for use by the Director of Works within 2 weeks of the Date of Commencement of the Contract and shall be regularly and properly cleaned for so long as they are in use.
2. The offices shall be furnished by the Contractor with all required furniture and equipment as described in the Contract Documents to the approval of the Director of Works.
3. The Contractor shall provide and keep in good repair one (1) slump cone and two (2) 30m and 50m steel tapes for testing materials and workmanship.
4. The Contractor shall provide and maintain the offices with an A/C for cooling and heating.

102 Traffic Safety

1. The Contractor shall provide, erect and maintain such traffic signs, lamps, barriers, traffic control signals and such other measures as may be necessitated by the construction of the Works to the satisfaction of the Local Authority and the Director of works.
2. The Contractor shall not commence any work which affects public roads until all traffic safety measures necessitated by the work or required by the Local Authority are fully operational.
3. The Contractor shall keep clean and legible at all times all traffic signs, lamps, barriers and traffic control signals and he shall position, re-position, cover or remove them as necessitated by the progress of the Works.

103 Temporary Diversion of Traffic

1. The Contractor shall construct temporary diversion ways wherever the works will interfere with existing public or private roads and other ways over which there is a public or private right of way for any traffic.
2. The standard of construction and lighting shall be suitable in all respects for the class or classes of traffic using the existing way and the width of the diversion shall be not less than that of the existing way unless otherwise described in the Contract.
3. Diversion ways must be constructed in advance of any interference with the existing ways and shall be maintained to provide adequately for the traffic flows.
4. The provisions of this Clause shall not apply to any temporary access or accommodation works which the Contractor may construct for his sole use in the execution of the Works.
5. The Contractor shall not commence any work without coordination with the relevant Authorities and owners.

104 Privately and Publicly Owned Services

1. If any privately owned service for water, electricity, sewerage, etc. passing through the Site is affected by the Works then the Contractor shall locate it and provide a satisfactory alternative service before cutting the existing service.
2. The position and type of Public Authority main services utilities shall be verified by the Contractor who must satisfy himself as to the exact position and type of such existing utilities. The Contractor shall coordinate and take all measures required by any Public Authority for the support and full protection of the pipes, manholes, cables and other utilities during the progress of the works. The Contractor shall make allowance in his price for compliance with this clause.

105 Existing Ground Levels

1. The Contractor shall satisfy himself that the existing ground levels as indicated in the Contract are correct. Should the Contractor wish to dispute any levels he shall submit to the Director of Works a schedule of the position of the levels considered to be in error and a set of revised levels. The existing ground relevant to the disputed levels shall not be disturbed before the Director of Works' decision as to the correct levels is given.

106 Coins and Antiquities

1. Any coins or antiquities found on the site are to remain the property of the employer and are to be handed over to the Director of Works.
2. The Contractor is responsible for any coordination with the relevant Authorities.

107 Protection and Making Good

1. The Contractor shall protect all completed works from damage until the completion of the Works to the approval of the Director of works.
2. Should the Contractor allow any works to be damaged he shall at his expense make good or replace, as required by the Director of Works, to the approval of the Director of Works.

Demolition

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**200**

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**Demolition**

201 Scope

1. The area to be demolished is shown in the Contract Drawings. This includes site clearance, safety, pollution control; Country Regulations about location of dump area...etc. in accordance to the standard and Country Regulations.
2. Areas adjacent to demolition works shall be protected from damage resulting from the demolition.
3. Particulars of the proposed methods of carrying out demolition works, handling and sorting of recyclable materials and disposal of construction and demolition waste shall be submitted to the Director of Works for information at least 7 days before the demolition starts.
4. The Contractor shall comply with the requirements of preservation, protection and replanting of existing trees before commencing site clearance.

202 Giving Notices

1. The Contractor shall give all notices to wear, gas, and lighting and power Authorities and shall allow them facilities for removing or relocating any fixtures, fittings or services which may belong to them.

203 Nuisance

1. Demolition work is to be carried out in such a manner as to cause the minimum possible inconvenience to adjoining owners, users of existing facilities or the general public, and the Contractor will be held responsible for any claims arising from the disregard of this Clause in accordance to the country regulations. All rubbish and the works where necessary are to be sprinkled with water to prevent dust arising and screens and protection provided to the satisfaction of the Director of works.

204 Water and Electricity

1. The Contractor shall provide all necessary water and electricity for the works by whatever means are necessary, including temporary connections, supply installation and storage tanks, and clear away and remove the whole of the temporary installation upon completion.

205 Reinstating

1. The Contractor shall reinstate at his own cost and make good all damage occurring to remaining structures and/or adjoining property. All making out and making good is to be executed with materials and workmanship to match in every respect the surrounding work, and shall be properly bonded thereto. All to the satisfaction of the Director of Works.

206 Road and Footways

1. The Contractor is responsible for maintaining all public/internal roadways and footpaths and shall be responsible for and make good any damage thereto occurring as a result of the demolition work.

207 Plant

The Contractor shall provide all plant, scaffolding, gangways, planks, gantries, tarpaulins etc., for proper execution and protection of the works and adjoining buildings, roadways and footpaths.

208 Signboard

1. Where necessary the Contractor shall obtain all consents, pay all fees for and provide and erect vertical signboard to road frontages size 3m x 2mX 2mm thick painted steel to the approval of the Director of Works, on which will include the name of the Project, the Agency (UNRWA), the Donor of the Project and the name of the Contractor including the emblems of UNRWA and Donor as well the period of the project.

209. Diversion of Services

1. Before commencement of the demolition work, all electrical, water, telecommunication, heating, sprinklers, sanitation and other services which come within the area to be demolished shall be disconnected or redirected in such a manner as to provide the buildings which are to remain with said services totally unaffected by the demolition work. The Contractor shall be responsible for coordination with Services Provider Authorities in the country.

210 Pulling Down

1. Pull down the whole of the structure marked on the Contract Drawings to basement floor level and clear all cellular of debris, rubbish and other material. Include for pulling down of basement walls as shown on the Contract Drawings. Basement shall properly cleaned out and filled with hardcore in layers not exceeding 15cm compacted thickness in accordance with Clause 408.
2. Where there is no existing basement, break up ground floor slab and grub up foundations.
3. Provide all necessary shoring, safety measures, strutting etc., required to maintain adjoining buildings.

211 Overloading

1. Materials arising from the demolition must not be stacked or allowed to accumulate on existing structures in such a way as to endanger their stability. The Contractor will be solely responsible for damage arising from this cause.

212 Exposed Party Walls

1. Where existing party walls are exposed due to demolition work, the Contractor shall remove old plaster or wall covering (if any), rake out joints and leave ready to receive new plastering etc., elsewhere specified).

213 Enclosing Adjoining Buildings

1. Where floors of adjoining buildings are exposed to the outside air provide and erect in back from edge of floor temporary framed and close-boarded screens with access doors and fastenings covered on the outside with approval roofing felt. Adapt as necessary during the progress of the work and clear away when no longer required.

214 Materials arising out of the demolition

1. The Contractor shall be responsible to dismantle carefully all usable material as specify in the contract, such as steel and wooden doors, windows, electrical and sanitary fixtures, cupboards etc., which are to remain the property of the Agency and are to be cleared and stacked as directed on site or disposed of according to the instruction of the Director of Works.
2. The material arising from the demolition is to become the property of the Contractor unless otherwise stated in the Contract Documents and is to be removed from site to a tip provided by the Contractor. No excess materials shall be burnt on site without the written approval of the Director of Works.

215 Grub up Services

1. Grub up galleys, break up manholes etc., and fill in voids in accorded with Clause 408. Stop off all disused drains at point of entry and seal with concrete. Remove all water supply pipes at point of entry; plug and seal all dead ends.

216 Removal of Plant

- 1 The Contractor shall, upon completion of the demolition works, remove and clear away all temporary buildings, plant, rubbish and superfluous materials, and shall leave the site in a clean and tidy state to the satisfaction of the Director of Works.

217 Approval

1. Demolition work shall not be commenced before obtaining the written approval of the Director of Works.

Underpinning

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**300**

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**Underpinning**



301 Scope

1. Underpinning will only be carried out as shown in the Contract Documents and shall be executed under the direct supervision of the Director of Works.

302 Timbering and Shoring

1. Provide and fix all required timbering, needling, shoring etc., to ensure the safety of adjoining wall whilst underpinning. Remove and make good all disturbed work on completion.

303 Underpinning

1. Where foundations of new walls are below the level of foundations of walls of adjoining premises, excavate as necessary and underpin from the level of bottom of new foundations up to approx. 5cm below underside of foundations of old wall with concrete mix 300/20 for the full thickness of the foundation or as shown in the Contract Drawings.
2. Excavating and connecting shall be carried out in short, discontinuous lengths not exceeding 1.5m unless expressly directed by the Director of Works.
3. Plank and strut to sides of excavation as required or directed.
4. Provide and fix all necessary temporary shuttering to vertical faces of existing foundations and underpinning, and remove when no longer required.
5. Wedge and pin up on top of new underpinning to underside of existing foundations with cement and sand (1:3) mixed fairly dry and well rammed in.

304 Disposal of Surplus Material

1. Remove all surplus material to a tip off the site provided by the Contractor.

**400**

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**Excavation,  
Earthworks and  
Site Work**

401 Nature of Excavation

1. Information over the nature of the ground conditions made available by the Agency as the result of trial holes (bores) being made or soil test investigation report, does not in any way absolve the Contractor from his responsibilities nor is it guaranteed that similar conditions apply throughout the site.
2. The contractor shall be deemed to have visited the site, inspected trial holes (if any) and decided for himself the nature of the ground and sub-soil to be excavated.

402 Rock

1. Where rock is encountered in the course of excavation it should be removed with any required machineries / equipment, wedges and levers. Loose rock shall be removed and resulting cavities backfilled in accordance with Clause 407.

403 Sand or Ballast from the Excavation

1. Gravel or selected material, if approved by the Director of Works may be used for backfilling around foundations or making up levels according to the Contract Documents.
2. It is strictly forbidden to dig for gravel beyond the limits of the excavations as set out in the Contract Documents.

404 Clear Site

1. Clear site of all rubbish, grub up bushes, shrubs including trees with different heights and dimensions and plantings on site as indicated in the Contract Documents. Demolish, break up and remove buildings, structures and superficial obstructions on the site in the way of or otherwise affected by the Works.
2. Grub up all roots, break up and remove old foundations, drains or manholes, empty and cleanse all old wells and cesspools found during the excavations, seal up connections and dead ends, remove all contaminated earth, fill in voids in accordance with Clause 407.
3. Existing Trees and Roots
  - (a) Where shown in the Contract Documents trees shall be uprooted or cut down as near ground level as possible or as instructed by the Director of Works.
  - (b) All felled timber shall be removed from site and shall not be burned on site without the written approval of the Director of Works. Such approval does not absolve the Contractor from his responsibilities in respect of damage to property caused by burning felled timber.
  - (c) Holes left by the roots shall be filled in accordance with Clause 407.
4. Trees, bench marks and other objects which are to be retained on the Site shall be adequately protected from damage during the course of the works.
5. Clear the Site of all surplus excavated materials and other debris from the Works and leave clean and tidy on completion.

#### 405. Excavation

1. Excavate in any material whatsoever found to reduce levels and to form trenches, pier holes, column bases and the like to the sizes, depths and dimensions shown on the drawings or as directed by the Director of Works. The last 15cm of the excavation shall be performed using light equipment/ tools and manually to the approval of the Director of Works.
2. No excavated material shall be removed from the site unless the Director of Works declares that it is unsuitable for use in the works or surplus to the total requirements. Material that is unsuitable for use or surplus to total requirements shall be run to tips provided by the Contractor.
3. All soil that can support vegetation shall be removed from the site of new buildings, terraces, pathways etc., and shall be kept separate from general excavation materials.
4. Defective or soft spots at the bottom of excavations shall be excavated and filled with a lean concrete mix (1:8) to the satisfaction of the Director of Works.
5. The Contractor shall make good with granular fill to Clause 407 or a lean mix concrete (1:8) as directed by the Director of Works:
  - (a) Any excavation greater than the net volume required for the Works as described in the Contract.
  - (b) Any additional excavation or at below the bottom of foundations to remove materials which the Contractor allows to become unsuitable in the opinion of the Director of Works.
6. The sides of excavations shall be supported by whatever means the Contractor elects to adopt. The supports shall be sufficient to prevent “fall-ins”.
7. Level and trim the bottoms of all excavations including excavation in rock.
8. Bottoms of all trenches pier holes etc., are to be inspected and approved by the Director of Works before concrete or hardcore is laid.
9. The excavation area shall be fenced and protected to avoid accidents which may be resulting from any movements beside the excavation.

#### 406 Suitable Fill

1. Return fill and consolidate in selected excavated material( to be not included any red/mud soil) around foundations up to original ground level or to the levels shown, in layers not exceeding 15cm compacted thickness. The material shall be well watered before compaction unless otherwise directed. The Contractor shall be responsible to carry out the compaction laboratory tests, samples to be indicated and directed on site to the instruction of the Director of Works.

#### 407 Granular Fill

1. Make up to required levels for floor slabs and at the back of walls as shown in the Contract Drawings or where otherwise shown or directed with selected excavated granular material or hardcore, laid in layers, not exceeding 15cm compacted

thickness. The material shall be well watered before compaction unless otherwise directed. The Contractor shall be responsible to carry out the compaction laboratory tests, samples to be indicated and directed on site to the instruction of the Director of Works.

408     Hardcore

1.     The material for hardcore shall be chemically inert and possess a physical strength adequate for its purpose. Hardcore shall be well graded in size and shall all pass a 15mm BS sieve.
2.     Suitable materials are natural sand, crushed or uncrushed stone or quarry rubble, coarse well burnt clinker, crushed concrete or well burnt brick or a combination of any of these.
3.     Hardcore beds shall be finished with a layer of sand.

409     Disposal of Water

1.     Keep the Site and excavations free from all water by pumping, bailing or other means.
2.     The Contractor shall satisfy himself before tendering as to the water table, springs and wells on the Site or adjacent thereto and shall allow in his prices for the removal of all water on the Site during the course of the Works.
3.     The Contractor is responsible for any damage to adjoining properties caused, in keeping the excavations free from water. The Contractor must not without written authority use a method of keeping the excavations free from water which involves continuous pumping so as to withdraw water from the foundations of adjoining sites.

410     No filling in shall be executed until the concrete foundations, footings, walls etc., have been inspected and approved by the Director of Works.

Concrete Work

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**500**

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**Concrete Work**

501     General

1.     Execute and complete the concrete work shown on the drawings and/or described in the Contract Documents.
2.     The contractor shall ensure that each stage of the construction of the reinforced concrete work is supervised and finally inspected by competent and responsible members of his site staff. Proportions of materials for concrete shall be accurately measured in an approved manner and all equipment and measuring devices shall be properly maintained and regularly checked to the satisfaction of the Director of Works.

502     Cement

1.     Cement shall be ordinary Portland cement to comply with BS EN 197-1:2011 unless otherwise stated.
2.     Cement shall be obtained from an approved manufacturer (except when it is provided by the Agency) and shall be delivered to the Site in the sealed and branded bags or drums of the manufacturer.
3.     Cement shall be stored off the ground and under cover. Each consignment shall be kept separate and identified.
4.     Cement shall be used in the order of its delivery to the Site; cement from new deliveries shall not be used until all cement from earlier deliveries has been completely used.
5.     No cement shall be used which has been manufactured more than max six months prior to its proposed use on site for non-structural purposes only. For all structural jobs should always use fresh cement all to the approval of the Director of Works.

503     Aggregate

1.     In general aggregate should be a naturally occurring material complying with the requirements of BS EN 12620:2002+A1:2008.
2.     The Director of Works may approve on request the use of other aggregate including types or grading not covered by the BS provided that there is satisfactory data on the properties of concrete made with them.
3.     Aggregates shall be stored so that they are self-draining and are not contaminated by other material.

4. Coarse aggregate shall be batched separately from fine aggregate.
5. Samples of the aggregate shall be approved by the Director of Works before the commencement of the Works.
6. The Director of Works may, at his sole discretion, select samples of aggregate from each delivery of aggregate to the site for testing.
7. Coarse Aggregate
  - (a) Coarse aggregate shall be natural gravel or crushed hard stone, clean and free from dust, loam, clay and organic matter. Crushed stone shall not be of sandy, decayed, or disintegrated rock, or from sulphate, anhydrite or magnesia bearing rock.
  - (b) Coarse aggregate shall be graded as follows (% by weight)
    - (i) 20mm graded Aggregate for concrete
      - 100% passing of 37.5mm sieve
      - 95-100% passing a 20mm sieve,
      - 30-60% passing a 10mm sieve
      - 0-10 passing a 5mm sieve,
    - (ii) Aggregate for blocks
      - 100% passing a 20mm sieve,
      - 85% passing a 15mm sieve,
      - 30% passing a 10mm sieve,
      - 0% passing a 5mm sieve.
  - (c) Careful attention shall be given to the selection and grading of aggregate to ensure that the minimum compressive strengths are attained. A continuous graded aggregate is normally required.
8. Fine Aggregate (Sand)
  - (a) Fine aggregate shall be natural sand, clean, sharp, coarse grained, and shall mostly pass a 5mm sieve and be free from dust, loam, clay and organic matter.



- (b) The grading curve of the fine aggregate for concrete shall fall within one of the following zones

Percentage by weight passing

BS Sieve Size	Grading zone 1	Grading 2	Grading 3
10mm	100	100	100
5mm	90-100	90-100	90-100
2.36mm	60-95	75-100	85-100
1.18mm	30-70	55-90	75-100
600 micron	15-34	35-59	60-79
300 micron	5-20	8-30	12-40
150 micron	0-10	0-10	0-10

- (c) Fine aggregate for all work, other than concrete, shall pass a 2mm sieve and not less than 95% (by weight) shall be retained on a sieve of 900 mesh/cm<sup>2</sup>.

#### 504 Water

1. Water for use in the Works shall be clean, fresh, potable water free from chemical or organic taint.
2. Water is neutral in PH value, free from suspended solids and liquid contaminants non-miscible with water and that when tested according to the procedures given in BS EN 1008:2002; it had no significant effect on the setting time or strength of concrete.
3. Samples of water shall be approved by the Director of Works before the commencement of the Works.

#### 505 Admixtures

1. In general admixtures may not be used.
2. The Director of Works may approve on request use of an admixture if there is satisfactory data on the properties of concrete made with it. This suitability will generally require verification by trial mixes.
3. Both the amount of admixture and the method of use should be to the approval of the Director of Works, who should be provided with the following data:
  - i) Type and/or Proprietary brand
  - ii) Typical dosage and the detrimental effects of under dosage/over dosage, if any.

- iii) The chemical name of the main ingredient (s) in the admixture.
- iv) Whether or not the admixture contains chlorides and if so the chloride iron content expressed as a percentage by weight of the admixture.
- v) Whether or not the admixture leads to air entrainment when used at the recommended dosage.

#### 506 Steel Reinforcement

1. Hot rolled mild steel bars and hot rolled high yield steel bars shall comply with the requirements of BS 4449:2005+A2:2009 or approved equivalent.
2. Cold worked steel bars shall comply with the requirements of BS 4449:2005+A2:2009 or approved equivalent.
3. Steel fabric reinforcement shall comply with the requirements of BS 4483:2005 or approved equivalent and shall be delivered to the site in flat mats.
4. Steel reinforcement shall be stored in proper racks clear of the ground.
5. Steel reinforcement shall be free from oil, dirt, scale, loose rust and other deleterious matter before being placed in position.

#### 507 Concrete

1. The concrete mix shall generally comply with the requirement of Table 1.

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Table 1 prescribed mixes for ordinary structural concrete

Weighs of damp aggregate based on one/50 kg bag of cement (kg)

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Cube Strength (kg/cm <sup>2</sup> )	Maximum Size of Aggregate (mm)	Medium	High
	Workability	Medium	High 75-125
	Slump (mm)	27-75	
100	Coarse Aggregate	240	210
	Sand	155	140
150	Coarse Aggregate	215	200
	Sand	135	100
200	Coarse Aggregate	190	155
	Sand	115	115
250	Coarse Aggregate	170	140

	Sand	90	90
300	Coarse Aggregate	155	130
	Sand	80	80

Notes to Table1.

- a) The weights of fine aggregate may be adjusted by  $\pm 14$  kg to obtain a more cohesive mix but the total weight of aggregate should be maintained.
- b) Batching using part bag mixes is not allowed.
- c) The Director of works may allow volume batching for grades 100/150/200 in which case the bulk density of the damp aggregates may be taken as 1450 kg/m<sup>3</sup>.
2. The Director of works may on request approve use of a concrete mix designed by the contractor provided that this design meets the requirements of Table 2. Evidence of the suitability of the proposed mix shall be submitted to the Director of Works to show that at the intended workability the proposed mix proportions and manufacturing method will produce concrete of the required quality. This will generally involve the production of trial mixes using materials typical of the proposed supply made under full scale production conditions. At least 3 separate batches of concrete shall be made for trial and these shall be tested for compliance with the requirements of Table 2 of the specification, at least 3 test cubes being made from each batch of concrete. Once a mix is approved no substantial change in the materials or proportions of materials being used shall be made without the approval of the class of concrete is denoted by the minimum 28 days cube strength (kg/cm<sup>2</sup>) Director of Works who may then require further trial mixes to be produced.
3. The class of concrete is denoted by the minimum 28 day cube strength (kg/cm<sup>2</sup>) and the maximum size of aggregate.

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Table 2 Design Mixes for Ordinary Structural Concrete

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Class kg/cm <sup>2</sup> /mm	Minimum cement content (kg/m <sup>3</sup> )	Minimum Compressive Strength Preliminary Test	At 28 days (kg/cm <sup>2</sup> ) Works Test
200/20	300	300	One cube minimum 180 and the average 220
250/20	300	350	One cube minimum 225 and the average 275
300/20	300	400	One cube minimum 270 and the average 330

Notes to table 2:

- a) Aggregate shall be weight batched.
  - b) Cement may either be weight batched or measured by whole bags.
  - c) Cement content shall not exceed 540 kg/m<sup>3</sup>.
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#### 508 Mixing

- 1. Cement shall be measured by weight or by the use of a whole number of 50 kg bags. Sand and aggregate generally shall be measured by weight but the Director of Works may approve volume batching of grade 100/150/200 in which case approved gauge boxes must be used.
- 2. The amount of water added to the dry mix shall be sufficient to give a mix that complies with the requirements of Table 1 or 2 but in no case shall the water/cement ratio exceed 0.60. The amount of water used shall be measured by weight or volume in a manner approved by the Director of Works.
- 3. The consistency of the mix shall be such that facility for easier placing does not affect the required compressive strength of the concrete. Slump cone, filled in four progressive layers, each well tamped. The cone shall be removed immediately after filling.
- 4. All mixing shall be carried out in a mechanical batch mixer of minimum capacity of 250 liters unless otherwise approved. Concrete shall be mixed for not less than two minutes after the addition of water and mixing shall continue until there is a uniform distribution of materials and the mass is uniform in color and consistency.

#### 509 Ready Mixed Concrete

- 1. Ready mixed concrete may, with the approval of the Director of Works, be used on the contract and it shall comply with all the requirements of the Specification.
- 2. The concrete shall be carried in purpose made agitators operating (Industrial Mixer) continuously or truck mixers.
- 3. The concrete shall be compacted and in its final position within 2 hours of the introduction of cement to the aggregates, the time of such introduction shall be recorded on the delivery note together with the weight of the constituents of each mix.

4. When truck mixed concrete is used the water shall be added under supervision either at the site or at a central batching plant as agreed by the Director of Works but under no circumstances shall water be added in transit.
5. Mixing shall continue for not less than 100 revolutions at a rate of not less than 7 revolutions per minute.
6. All structural elements shall be ready mix concrete.

#### 510 Placing of Reinforcement

1. Reinforcement shall be placed in according with the drawings. Nothing shall be allowed to interfere with the design requirements of the reinforcement. Reinforcement shall be secured to prevent displacement before or during the pouring of concrete. Braces, supports, distance pieces and spacers which are to be left in position shall be of an approved design, if concrete they shall be made with 10mm maximum size aggregate to produce the same strength as the adjacent concrete. The inside radius of stirrups shall be in full contact with the rods around which they fit
2. Rods shall be bound together with pliable, annealed soft iron wire no. 16 B.W.G (Birmingham Wire Gauge) (1.65mm) unless otherwise specified. The projecting ends of this wire shall be turned into the main body of the concrete and shall not encroach on the cover.
3. Reinforcement shall be cut and bent in accordance with BS 8666:2005 and BS EN ISO 3766: 2003. Cold-worked or hot-rolled high yield bars shall not be straightened or bent again once having been bent. Where it is necessary to bend reinforcement projecting from the concrete the internal radius of the bend shall not be less than twice the diameter of the bar.
4. During the placing of concrete a responsible steel fixer shall be in attendance to perform any adjustments or corrections to the reinforcement necessary to maintain it in the position shown in the Contract.
5. Reinforcement shall be inspected and approved by the Director of Woks before the concrete is poured. Such approval shall not relieve the Contractor of his responsibilities in connection with the Work.
6. The horizontal distance between individual reinforcement bars shall normally not, except at splices, be less than the diameter of the largest bar or 5mm more than the nominal maximum size of the coarse aggregate used whichever is greater. The vertical distance between parallel reinforcement shall normally not, except at splices, be less than the nominal maximum size of the coarse aggregate used. Bars may be arranged in pairs touching in which case the gap between pairs of bars shall be as specified above. The gaps between corresponding pairs in each row should be vertically in line.
7. The lengths of splices, dowels and anchors, shall be for mild steel plain bars 46D, high yield steel plain bars 53D, high yield steel deformed bars 41D(D: bar diameter).

8. The concrete cover to all reinforcement including links shall be:
  - a) In slabs – 2.5cm
  - b) In beams – 2.5cm
  - c) In columns – 3.0cm
  - d) In footings and all earth and water retaining structure – 5.0cm
9. Reinforcement in structures shall not be welded.

511 Formwork

1. The contractor shall supply formwork, shuttering, props, strutting, hanging bolts, staying, gangways, expansion boards, fillets, moldings and the like and shall ease and remove the same and do all that is necessary to execute and complete the concrete construction.
2. Formwork shall be adapted to the structure and the finish of the concrete and shall be made of metal or timber sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages. It shall be fixed to the correct shape and profile securely supported and braced to withstand vibration or the movement of plant, men or materials without deformation or displacement so that the final concrete structure shall be in the position and of the shape dimensions and surface finish described in the Contractor.
3. The maximum permissible deflection of the formwork under any load shall be 2mm or 1/600<sup>th</sup> of the unsupported span, whichever is the lesser.
4. Joints in formwork shall be close enough to prevent the loss of liquid from the concrete.
5. Formwork shall be so arranged as to permit easing and removal without jointed the concrete. Wedges, cramps and bolts shall be used wherever possible for securing the true position of the forms.
6. Sawn formwork, namely properly designed formwork of closely jointed swan boards, may be used for surfaces which are to be rendered or plastered.
7. Wrought formwork, namely properly designed formwork or closely jointed planed thicknesses boards, with joints aligned to produced continuous or horizontal lines shall be used for concrete surface which will remain exposed, the resulting surface shall be smooth and free from blemishes.
8. Formwork shall be cleaned out immediately before concrete is placed and necessary temporary openings shall be left to facilitate cleaning.
9. The internal faces of formwork shall be treated with mold oil, care being taken that the mold oil does not contaminate the reinforcement.
10. Formwork shall be inspected and approved by the Director of Works before concrete is poured which approval shall not relive the Contractor of his responsibility for the safety and efficiency of the formwork.

11. Striking Formwork

- (a) The Director of Works shall be informed in advance when the Contractor intends to strike any formwork.
- (b) The time at which the formwork is struck shall be the Contractor's responsibility. However, formwork supporting cast in situ concrete may be struck when either:
  - (i) The concrete has, in the opinion of the Director of Works, attained a compressive strength of 200 kg/cm<sup>2</sup> or twice the stress to which it will then be subject, provided such earlier striking will not result in unacceptable deflections due to creep etc.
  - (ii) The following minimum periods shall have elapsed between the completion of placing of concrete in the Works and the removal of the forms. These periods are based on the use of Ordinary Portland Cement and a constant surface temperature of the concrete of 16°C and shall be increased in colder weather or in the case of large spans all to the approval of the Director of Works.

Vertical formwork to columns, beams, walls	24 hours
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Soffit formwork to beams and slabs	12 days
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12. Care shall be taken that when formwork is reused its surface shall be thoroughly cleaned to the approval of the Director of Works.

512 Placing Concrete

- 1. Concrete shall not be placed in any part of the structure until the written approval of the Director of Works has been given.
- 2. Concrete shall be placed as soon as possible after mixing and in all cases within (30) minutes after mixing commences or within 30 minutes after discharge from the agitator for ready mix concrete.
- 3. Concrete shall be transported by an approved means which shall prevent contamination or segregation or loss of the ingredients.
- 4. Concrete which is lowered to a depth exceeding 120cm shall be conveyed in suitable vessels or by chute to a point as near as possible to the location of pouring. The vessels or chute shall be kept clean and well-watered.
- 5. All concrete shall be compacted to produce a dense homogeneous mass.

Unless otherwise agreed by the Director of Works it shall be compacted with the assistance of vibrators. Sufficient vibrators in serviceable condition shall be on site so that spare equipment is always available in the event of breakdowns.

6. Vibration shall not be away of the reinforcement. Where vibrators of the immersion type are used, contact with reinforcement and all inserts shall be avoided, so far as is practicable.
7. Concrete shall not be subjected to vibration between 4 and 24 hours after compaction. When in-situ concrete has been in place for 4 hours, or less as directed by the Director of Works no further concrete shall be placed against it for at least 24 hours and until the final Setting Time of Concrete.
8. Concreting of any one unit or section of the work shall be carried out in one continuous operation and no interruption of the work will generally be allowed. Where beams and slabs form an integral part of the structure they shall be poured in one operation. Concrete shall be deposited in horizontal layers to a compacted depth not exceeding 450mm where internal vibrators are used or 300mm in all other cases.
9. Temperature limits During Concreting
  - (a) Concreting shall be discontinued when the descending air temperature in shade reached 2°C and shall not be resumed until the ascending air temperature in the shade reached 1°C.
  - (b) When the air temperature in the shade is above 32°C special precautions shall observed during mixing and pouring concrete to the satisfaction of the Director of Works which should include:
    - (i) Shading of the aggregate piles
    - (ii) Adding the water to the aggregate before the cement
    - (iii) Concrete shall be protected from the sun and wind as soon as it is placed.
  - (c) Concrete when deposited shall have a temperature of not less than 5°C and not more than 32°C. Concreting shall not be permitted when the air temperature in the shade is above 45°C.



## 513 Finishes

### 1. Unformed Surface Finish

- (a) Generally the concrete shall be uniformly leveled to produce a plain surface and after the concrete has hardened sufficiently the surface shall be floated to produce a uniform surface free from screed marks.

### 2. Steel Troweled Finish

- (a) The concrete shall be uniformly levelled to produce a plain concrete surface.
  - (b) After the concrete has hardened sufficiently the concrete surface shall be floated sufficiently only to produce a uniform surface free from screed marks.
  - (c) When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, the concrete shall be steel trowel led under firm pressure to produce a dense smooth uniform surface free from trowel marks using required machinery for this job as Helicopter machine.
3. A slab finish which is to receive waterproofing shall be to an accuracy such that when tested with a 3m straight edge the maximum depression shall not exceed 10mm nor shall abrupt irregularities exceed 3mm.

## 514 Construction Joints

- 1. Construction joints shall only be formed where shown on the drawings or approved in writing by the Director of Works.
- 2. Construction joints shall be made at right angles to the axis of the member and formed against firm stop boards. Stop boards shall be so made as to form a grooved or indented profile to the concrete.
- 3. Where a construction joint contains a formed surface, that surface shall be roughened to expose the aggregate without damaging the aggregate and the arises of the joint. The roughened surface shall then be washed with clean water to remove loose particles.
- 4. Where sections of the work are carried out in lifts, the reinforcement projecting above the lift being cast shall be adequately supported so as to prevent movement of the bars during the casting and setting of the concrete.

5. Wherever possible laitance and all loose material shall be removed while the concrete is still green and no further roughening shall then be required. Where this is not possible, it shall be removed by mechanical means after the concrete has been in position for more than 24 hours. The roughened surface shall then be washed with clean water.

#### 515 Precast Concrete

1. The contractor shall provide molds and all other items in connection with the precast concrete work and shall cast, cure, hoist, cut and pin or build in, including bedding and pointing, and in cement and sand mortar (1:4) as shown on the drawings. Precast concrete shall comply with all the requirements of the Specification for concrete.
2. Manufacture of Precast Reinforced Members off the Site
  - (a) The Director of Works' approval to the method of manufacture shall be obtained before work is started. When the method has been approved, no changes shall be made without the consent of the Director of Works.
  - (b) The Contractor shall inform the Director of Works in advance of the date of commencement of manufacture and casting of each type of member.
  - (d) A copy of all 28 day cube test results relating to the work shall be sent to the Director of Works as soon as they become available.
  - (e) Where the Director of Works requires testes to be carried out, no members to which the tests relate shall be dispatched to the site until the tests have been satisfactorily completed.
  - (f) All members shall be indelibly marked to show the Member Mark as described in the contract, the production line on which they were manufactured the date on which the concrete was cast and, if they are of symmetrical section, the face which will be uppermost when the member is in its correct position.

#### 516 Curing Concrete

1. Immediately after compaction and for 7 days thereafter concrete shall be protected from the harmful effects of the weather including rain, rapid temperature changes and from drying out too quickly by being kept covered with sacking or sand, constantly kept moist by spraying with water or by covering with plastic sheeting or by using some other method which minimizes the loss of water from the concrete, such as hessian, chemical spray, liquid membrane forming curing compounds, polyethylene film/sheet ...etc.

2. The method of curing used shall be subject to the approval of the Director of Works.

#### 517 Testing Concrete

1. Prescribed Mixes to Table 1

- (a) The weights of cement and aggregate shall be as specified  $5\pm\%$ .
- (b) The workability of the concrete shall be within the following limits: slump-specified value  $\pm 25\text{mm}$  or  $\pm 1/3$  specified value whichever is the greater.

2. Design Mixes to Table 2

- (a) The contractor shall provide concrete cubes and shall have tests under-taken for compressive strength at least two cubes for every transit mixer, or when directed by the Director of Works. The cubes shall be taken at random from batches of concrete after leaving the mixer and under the supervision of the Director of Works.
  - (b) All cubes shall be made and tested in concordance with BS 1881-122:2011 and BS 1881-130: 2013.
  - (c) The specified strength requirements shall be assumed satisfied if at 28 days only one cube test result strength is 90% of the specified strength and the average of all cubes test results are 110% of the specified strength.
3. If the results of concrete testing failed after 28 days, the Director of Works shall decide removal and replacing of failure concrete member or accept the different types of further action to be taken such as redesign of the member, Strengthen the member, core test or loading test.

#### 518 Expansion Joints

1. Expansion joints shall be formed in the positions shown on the drawings.
2. Expansion joints shall be filled for the full width or depth of the joint with approved expansion joint filler.
3. The exposed edges of expansion joints shall be pointed to a depth of not less than 2cm with approved expansion joint pointing unless otherwise shown on the drawings.

4. The exposed edges to expansion joint covers described under section 10 hereafter, unless otherwise shown on the drawings.

519 Wall Ties

1. Where stone or block walls abut against concrete they shall be tied thereto by means of approved galvanized steel ties or strips of galvanized expanded metal.
2. Ties shall be fixed to the formwork in an approved manner prior to casting the concrete, care being taken to avoid contact with the reinforcement. When the formwork is struck the ties shall be straightened as necessary and built into the bed joints of the wall.
3. Where walls abut against a concrete column one vertical row of ties shall be used for each junction. The vertical spacing shall be every two courses (42cm).
4. Where walls are built as a facing to concrete, ties shall be staggered vertically and horizontally and be spaced at approximately 100cm horizontally and 42cm vertically.

Blockwork

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**600**

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**Blockwork**

601     General

1.     Execute and complete the block work in the positions and to the dimensions and sizes shown on the drawings and/or described in the Contract Documents.

602     Materials

1.     Blocks

- (a) Blocks shall be made in vibrated pressure machines and shall be in general manufactured from cement, aggregates and water. The minimum cement content shall be 200kg cement to 0.46m<sup>3</sup> fine aggregate and 0.82m<sup>3</sup> coarse aggregate. The specifications given for concrete materials under 500 shall apply equally for block work materials.
- (b) The Director of Works may approve on request the use of a different binder to cement, or the use of other aggregate types or grading, provided that there is satisfactory data on the properties of the blocks made from these.
- (c) Blocks shall be hard, sound, square and clean with well-defined arises. Where a special face finish is required this shall be as specifies in the Contract Drawings.
- (d) Blocks for walling shall be 40cm (3mm) long and 20cm (3mm) high unless otherwise shown on the drawings. The tolerance in thickness shall be (1mm).
- (e) Blocks for floor/roof slabs shall be of the shape and dimensions shown on the drawings. The tolerance in length or width shall be 5mm and the tolerance in thickness shall be 3mm.
- (f) The design of hollow blocks for walling shall be approved by the Director of works.
- (g) Blocks shall be cured for at least three days after manufactures, being kept wet by sprinkling with water.
- (h) Block Classification and Testing
  - (i) Blocks shall be denoted by the block type A, and the minimum average compressive strength.
  - (ii) Blocks shall be tested for density and compressive strength whenever required by the Director of Works. For each test 10 blocks shall be selected by the Director of Works. The blocks selected shall be immersed

in water for 24 hours before compressive testing and shall not absorb more than 15% of their own weight of water during this period.

(j) The blocks shall comply with the requirements of Table 3.

(i) Should a test not meet these requirements the batch of blocks from which the samples were taken shall not be used in the Works and shall be removed from the site.

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Table 3			
Block Type	Density	Minimum Average Compressive Strength kg/cm <sup>2</sup>	Compressive Strength lowest Individual Block kg/cm <sup>2</sup>
A	Not less than 1500kg/m <sup>3</sup>	50	40

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Note to Table 3

- (i) Block density is the block weight divided by the gross volume (including core space).
- (ii) Block compressive strength is the crushing load divided by the gross area (including core space).
- (iii) Type A is a concrete block made using natural dense aggregate for use above/below ground.

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(k) Cost of the tests shall be borne by the Contractor.

2. Lime

- (a) Lime shall be quicklime properly slaked with the minimum amount of water by experienced workmen and shall be left undisturbed for not less than 36 hours.
- (b) The slaked lime shall be screened before use to remove all lumps, stones and other impurities.

- (a) For concrete block Minimum Average Compressive Strength 50kg/cm<sup>2</sup>, minimum average strength the mortar used shall be as noted on the drawings and according to the tender documents. The mortar mix shall consist of cement and fine aggregate in the proportion 1: 4 by volume.

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The Minimum strength of the mortar shall be 10kg/cm<sup>2</sup> (using 75mm test cubes)

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- (b) For blocks made with a different binder to cement the mortar used shall be as noted on the drawings or as approved by the Director of Works.
- (c) Mixing shall be carried out using mechanical mixer on site or ready mix mortar and put on a close boarded platform or other impervious surface.
- (d) Mortar mixed on site shall be used within two hours of mixing. While the ready mix mortar shall be used according to the ready mix company instructions and the approval of the Director of Works.
- (e) Manual mixing is not allowed for any type of mortar or concrete.

604     Workmanship

1.     Blocks shall be soaked in water before laying. The tops of walls, where work has been left off shall be thoroughly wetted before work is recommended.
2.     Walls shall be bonded in accordance with best constructional practice or as shown on the drawings. Where required for bond, blocks shall be carefully cut to size.
3.     Walls shall be carried up regularly and no portions shall rise more than 1m above adjacent portions. At such changes in levels work shall be raked back.
4.     Courses shall be properly leveled. Perpendicular joints, quoins, jambs and angles shall be plumbed as the work proceeds.
5.     The gauge for walls shall be ten courses to 210cm unless otherwise shown on the drawings or approved.
6.     Blocks shall be spread with mortar before laying and joints shall be solid through the full thickness of the wall. Joints shall be flushed up, or raked out, as the work proceeds.



7. Walls which are to be left unplastered shall be faced with selected blocks, built with a fair face and pointed with a neat flush joint.
8. Walls which are to be plastered shall have the joints raked out to a depth of 15mm.
9. Take out joints for flashing and turn-in of asphalt where required as work proceeds.

605 Strengthened Quoins and Ends

1. The vertical row of air cells nearest the quoin, end or opening, shall be packed solid with concrete mix 100/20 as the work proceeds.
2. Secure door frames and the like in block work with stout, galvanized iron ties in accordance with Clauses 903 and 1003 secured to same and built into the block work as the work proceeds. Including 150mmx20mmx2.5mm galvanized steel wall ties or as specified in the contract documents.

606 Claustra Walling

1. Blocks for claustra walling shall be of a design approved by the Director of Works and shall be of self-finished concrete.
2. The foregoing clause 603 of this Specification shall, where appropriate, apply to claustra walling.

607 Sundries

1. Cut and fit, build in, wedge up, pin or otherwise secure in an approved manner the walls to columns, beams, slabs, steelwork and the like. Clause 519 specifies the method of tying to concrete.
2. Leave or form chases, rebates, openings, holes and the like for all trades and make good.
3. Cut and pin or build in lintels, cramps, plates and the like and make good all to the approval of the Director of Works.
4. Facing work shall be kept clean as the work proceeds.

Stonework

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**700**

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**Stonework**

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701 General

1. Execute and complete the stonework in the positions and to the dimensions and sizes shown on the drawings and/or described in the Contract Documents.

702 Materials

1. Stone

- (a) Samples of stone before and after dressing shall be submitted to the Director of Works for approval.
- (b) Stones shall be hard limestone of even color and texture free from holes and cracks.
- (c) The exposed surfaces of stones shall be dressed rock faced and all other surfaces shall be rough hammer dressed. Each face shall be true and square.
- (d) Unless otherwise shown on the drawings the length of a stone shall be not less than one and a half times its height.

2. Mortar

- (a) Mortar for building stonework shall consist of cement and fine aggregate, mixed in the proportions 1: 2 by volume. Mortar for pointing the stone joints shall consist of white cement and sand mixed in the proportions 1: 2 by volume including water proofing material.
- (b) The requirement Clause 603 of this Specification shall, except for mortar mixes, apply to mortar for stonework.

703 Workmanship

1. Stones shall be laid level, plumb, square and true. All arises shall be sharp, true to line and square.
2. Stones shall be soaked in water before laying. The tops of walls, where work has been left off, shall be thoroughly wetted before work is recommended.
3. Stones shall be laid with the natural or quarry bed horizontal.

4. Stones shall be laid in regular horizontal courses. The stones in each course shall be of equal height and shall be not less than 25cm and not more than 35cm high.
5. All vertical and horizontal joints in stonework shall be 5mm thick and shall be solid with mortar for the full thickness of the joints.
6. Face joints shall be raked out to a depth of 25mm as the work proceeds.
7. On completion of the stonework the joints shall be pointed. The pointing shall be not less than 20mm thick carried out in one coat. The pointing shall be finished with a curved edged tool leaving a clean sharp, regular joint or flush finished all according to the drawings and contract documents.
8. Stones which have been holed, broken or damaged in any way and broken stones which have been repaired shall not be used in the work.

704     Concrete Backing

1. Stonework shall be built with a concrete mix 300/20 backing. The stonework and concrete backing shall be of the thicknesses shown on the drawing. The concrete backing shall be carried out simultaneously, course by course, with the stonework. The projection of the fixing required under Clause 519 shall be completely embedded in the mortar of the face work.

705     Rubble Stonework

1. This type of work will be used for construction of dry stone boundary walls not exceeding 150cm in height, the average thickness will be as determined in the drawings or as directed by the Director of Works.
2. The stone used should be natural, hard and of various sized but not less than 200mm in any dimension.
3. Mortar not exceeding 10% of the volume of the wall could be used at the request of the Director of Works.
4. The face of the wall shall be laid level plumb
5. The top face shall be horizontal and capped as shown on the Contract Drawings.

706 Sundries

1. Cut and fit, build in, wedge up, pin or otherwise secure in an approved manner the stonework to beams, slabs, columns, steel work and like. Clause 519 specifies the method of tying to concrete.
2. Leave or form chases, rebates, openings, holes and the like for all trades and make good.
3. Cut and pin or build in lintels, cramps, plates and the like and make good all to the approval of the Director of works.

Carpentry

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**800**

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**Carpentry**

801 General

1. Execute all carpentry work shown on the drawings and/or described in the Contract Documents in a proper manner and in accordance with the Specification.
2. Carpentry work shall include all structural timber work, grounds, backings, temporary work and the like.
3. The Contractor is to perform all cutting away and making good in attendance upon all other trades.
4. The Carpenter is to clean out all shavings, cut ends and other timber waste from all parts of the building and remove same from site all to the satisfaction of the Director of Works.
5. All timber shall be hardwood unless otherwise specified.
6. Timber sizes shown on the drawings are finished sizes.

802 Materials

1. Timber for carpentry work shall be of a species and quality suitable for the purpose for which it is to be used. Structural timber shall be group I or II Structural hardwood in accordance BS EN 1995-1-1:2004+A2:2014.
2. Samples of every type of timber which the Contractor proposes to use in the Works shall be sent to the Director of Works for approval. Each sample shall be labelled and the label shall state the species of the timber and the purpose for which it is to be use.
3. Timber shall be sawn square, straight and true and shall be free from the following defects:
  - (a) Splits, ring shakes and soft pitch
  - (b) Checks exceeding 30cm long
  - (c) Checks Exceeding 1 1/2mm wide.
  - (d) Checks more than half the thickness of the timber in depth
  - (e) Knots exceeding 3cm mean diameter
  - (f) Knots exceeding half the width of the surface
  - (g) Decayed dead knots unless cut out and plugged
  - (h) Loose knots or knot holes unless cut out and plugged
  - (i) Pitch pockets
  - (j) Decay and insect attach

4. The timber which is not to receive a preservation treatment is to be seasoned to moisture content of 20% unless otherwise specified.
5. Where preservation treatment is specified in the Contract.
  - (a) The moisture content of the timber immediately prior to treatment shall not exceed 28 percent and the timber shall be free from surface moisture and dirt. Treatment is to take place after all cutting and shaping is complete, and care must be taken not to damage surfaces of treated timber. If surface damage or cutting after treatment is unavoidable a liberal coating of preservative is to be made to such areas.
  - (b) The preservative treatment shall be either.
    - (i) Creosote applied by vacuum/pressure to BS 144:1997, or
    - (ii) Copper/Chrome Arsenic salts applied by vacuum/pressure.

803. Workmanship

1. Timber shall be left “from the saw”, unless otherwise shown on the drawings, and shall be to the full dimensions shown on the drawings.
2. All framing shall be jointed as shown on the drawings or to the approval of the Director of Works.
3. Joints shall be designed and constructed so that they will transmit the loads and resist the stresses to which they will be subject.
4. Unless otherwise stated joints shall be secured with a sufficient number of nails of an approved type.
5. A butt joint shall be secured, wherever possible, with nails driven from the far side of the flanking member.
6. The joining surfaces of all connections exposed to the weather shall be thickly primed except where adhesives are used.
7. Surfaces shall be in contact over the whole area of the joint before fastenings are applied.
8. No nails, screws, or bolts shall be placed in an end split. If splitting is likely to occur, holes for nails are to be pre-bored at diameters not exceeding four fifths of the diameter of the nail. Clenched nails shall be bent at right angles to the grain. Lead holes shall be bored for screws.



9. Members of structural units shall be clamped and spiked together before drilling bolt holes. Holes for bolts shall be bored from both sides. A tolerance of 1mm will be allowed in positioning bolt holes.
10. Timber connectors, where specified, shall be two single-sided toothed plates for demountable joints and one double-sided toothed plate for permanent joint.
11. Timber shown on the drawings to be plugged shall be properly and securely fixed by means of splayed plugs or expansion bolts.
12. Timber shall not be built into walls or floors unless this is so shown on the drawings when it shall be coated with a wood preservative suitable for the position in which the member is to be incorporated.
13. Every post, stud, beam, binder, joist, rafter and purlin shall extend in one piece between its supports for fixings or shall be jointed in an approved manner to ensure the necessary structural stability.
14. All cantilevers shall be effectually counterbalanced by the other portion of the member or by suitable fixing or by dead loading.
15. The position of joints in wall plates shall be agreed with the Director of Works before the plates are fixed. In general, plates shall be in one continuous length between points of change direction. Joints at corners and in running lengths, where unavoidable, shall be halved.

No plates shall be built into walls of masonry blockwork or concrete. When the plates are supported over, or let into the sides of studs, they shall be fixed to every stud. Where they are laid over bearing walls of masonry blockwork or concrete, they shall be solidly bedded in cement mortar (1:3) to the required level.

16. The anchorage of roof frames, trusses and other structures that need to be secured against displacement, as shown on the Contract Drawings, shall be provided to the approval of the Director of Works by means of extra fittings at all points of support or direct loading.
17. Where joists of support are to be notched over supports, the depth of notches shall not exceed two fifths of the depth of the joists unless otherwise specified. The bearing surface of all notches shall be cut smooth and true in relation to the surface on which it bears.
18.
  - (a) Holes cut in joists or other timber members shall be centered on the neutral axis and shall be limited to one third of the depth of the member. No holes shall be cut without the approval of the Director of Works.
  - (b) Pipe and cable runs across joists shall be positioned away from the center of the span.

- (c) Nothing top, bottom or faces of timber members is not permitted.
- 19.
  - (a) Plates, joists, rafters, purlins and other members used for roof construction are to be of the sizes specified or as shown in the Contract Drawings and details. The spacing of rafters shall be the same as that used for joists unless otherwise stated.
  - (b) Overhangs shall be adequately cantilevered and anchored back to the main roof frame without weakening it in any way.
- 20.
  - (a) All joints in trusses or framework shall be of the most appropriate type, accurately formed and adequately secured with nails unless otherwise specified. The arrangement of the members and the construction of all joints shall be in accordance with the Contract Drawings and this Specification.
  - (b) Deflection shall not exceed that specified.

Joinery

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**900**

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**Joinery**

901 General

1. Execute and complete all joinery work shown on the drawings and/or described in the Contract Documents in a proper manner and in accordance with this Specification.
2. Joinery work shall include all timber finishing's, non-structural timber work and all other timber work not included in carpentry work including the supply and fixing of:-
  - (a) Metal straps lugs and dowels.
  - (b) Priming, preservatives, polishing or such wood finishes as are specified in the Contract Documents.
  - (c) All ironmongery specified or shown on the drawings and/or schedules including all screws, nails, plugs, nuts, bolts and other fittings required for the completion of the work.
3. All timber shall be hardwood unless otherwise specified complying with BS EN 942:2007.
4. Timber sizes shown on the drawings are finished sizes unless otherwise stated.
5. The joiner shall clean all joinery work and shall leave the whole of the work in good order and to the complete satisfaction of the Director of Works.

902 Materials

1. Timber for joinery work shall be of a species and quality suitable for the purpose for which it is to be used.
2. Samples of every type of timber which the Contractor proposes to use in the Works shall be sent to the Director of Works for approval. Each sample shall be labelled and the label shall state the species of timber and the purpose for which it is to be used.
3.
  - (a) Timber shall be properly seasoned and shall be sawn square, straight and true.
  - (b) The moisture content of the timber used for internal joinery shall not exceed 10% and that for external frames and doors shall not exceed 16%

when the timber is delivered to the site and the figures shall be maintained until the building is finished.

4. Timber shall be free from the following defects:
  - (a) Splits, ring shakes and pith wood.
  - (b) Sapwood
  - (c) Decay and insect attack
  - (d) Slope of grain exceeding 1 in 10 for softwoods and exceeding 1 in 5 for hardwoods.
  - (e) Checks other than hair checks
  - (f) Case hardening and honeycombing
  - (g) Boxed heart
  - (h) Knots exceeding 2cm mean diameter
  - (j) Knots exceeding half the width of the surface
  - (k) Knots clusters
  - (l) Decayed, dead or loose knots
  - (m) Knot holes
  - (n) Pitch pockets
  
5. Plywood
  - (a) Plywood shall be of best quality suitable for the purpose for which it is to be used.
    - (i) Grade 1 where varnished
    - (ii) Grade 2 where painted
    - (iii) Grade 3 where hidden
  - (b) Samples of plywood shall be sent to the Director of Works for his approval.
  - (c) Plywood shall be of a single thickness. The Contractor will not be allowed to make up thicknesses by bonding plywood together.
  
6. Block board
  - (a) Block board shall be built-up board with a core of softwood strips 2cm to 3cm wide glued edge to edge and faced with plywood or other facing as shown on the drawings.
  - (b) Samples of block board shall be sent to the Director of Works for his approval.

6. Laminated Plastic Sheeting

- (a) Laminated plastic sheeting shall be of 3mm minimum thickness and shall have a matt surface finish.
- (b) Laminated plastic sheeting shall be first quality available in the local market to the approval of the Director Of works.
- (c) Samples of laminated plastic facing shall be sent to the Director of Works for approval of quality, pattern and color.

8. Ironmongery and Hardware

- (a) Ironmongery and hardware shall be the best quality available. Samples of the ironmongery and hardware items shall be sent to the Director of Works and approval.
- (b) Ironmongery and hardware shall be complete with screws of a type, size material and finish to suit the item of ironmongery or hardware which they are fixing.

903. Workmanship

- 1. All timber shall be sawn, planed, drilled or otherwise machined or worked to the sizes and shapes shown on the drawings.
- 2. All timber that is to be exposed in the finished surfaces shall be finished smooth unless otherwise shown on the drawings.
- 3. Where a natural finish, finishing for staining, clear polishing or varnishing is shown on the drawings the timber in adjacent pieces shall be matched, uniform and symmetrical in color and grain.
- 4. The surface finish to timber shall be as shown on the drawings.
- 5. The arrangement, jointing and fixing of joinery work shall be such that shrinkage in any art or any direction, shall not impair the strength and appearance of the finished work and shall not cause damage to contiguous materials or structures.
- 6. The joinery shall be constructed exactly as shown on the drawings. Where joints are not specifically indicated they shall be the recognized forms of joints for each position to the approval of the Director of Works.
- 7. Loose joints shall be used where provision must be made for shrinkage .or other movements acting other than in the direction of the stresses of fixing or loading.

8. The joiner shall take all reasonable measures to check or prevent capillary penetration of water in the joints and open connections of external joinery works and in all other positions where joinery works may be exposed to water.
9. Mortices and holes for ironmongery shall be no larger than is necessary for the easy insertion and withdrawal of the ironmongery fitting.
10. Ironmongery shall be fitted and shall be taken off before any painting work is commenced and shall be refixed after all painting operations are complete.
11. Hinges shall be housed or let into doors, windows, frames and the like.

12. Coat Rails

- (a) Coat rails shall be of softwood of the sizes and profiles shown on the drawings.
- (b) Coat rails shall be screwed and countersunk. The screws shall be taken into approved expansion sleeves let into the blockwork or concrete walls.
- (c) Coat rails shall be complete with coat hooks fixed at 40cm centers.
- (d) Coat hooks shall be of 6mm x 2cm galvanized mild steel 16cm girth bent to shape or approved equivalent.

13. Display Board and Blackboard Frames and Panels

- (a) Display board and blackboard frames and chalk trays shall be of hardwood of the sizes and profiles shown on the drawings or equal approved.
- (b) Display board and blackboard frames shall be screwed and countersunk. The screws shall be taken into approved expansion sleeves let into blockwork or concrete walls.
- (c) Chalk trays shall be supported on galvanized mild steel or aluminum brackets as detailed on the drawings. Each bracket shall be fixed after plastering with two screws taken into approved expansion sleeves let into blockwork or concrete walls. Each bracket shall be twice countersunk, drilled and screwed to the chalk tray.
- (d) Display panels shall be approved 12mm thick standard, self-finished fiber insulation board. Display panels shall be fixed to the wall face by frames.

- (e) Or Display Board and Blackboard Frames and Panels could be readymade in according to the contract documents and the approval of the Director of Works.

14. External and Internal Doors

- (a) Doors shall be made to the sizes and details on the drawings.
- (b) Doors shall be fitted to give a uniform clearance of not more than 3mm all around and shall be hung to the frames or linings.

15. Frames, Architraves etc.

- (a) Frames, linings, architraves, beads, glazing beads, cover moldings and the like shall be of the sizes, dimensions and profiles shown on the drawings.
- (b) Frames and linings to doors other than cupboard doors shall be securely fixed to block or concrete walls by means of galvanized mild steel door cramps 3mm thick, 5cm wide and 20cm girth. The cramps shall be bent at right angles, one leg twice screwed to the frame or lining, and the other leg provided. Cramps shall be built in as the blockwork proceeds and not cut and pinned at a later stage including galvanized sub-frame for doors 2mm thick in according to the contract documents and the approval of the Director of Works.
- (c) Frames and linings to doors shall be drilled and bolted to concrete to the approval of the Director of Works.
- (d) Glazing beads shall be fixed with brass caps and screws at not more than 22.5cm centers.
- (e) Or readymade doors as specified in the contract documents and the approval of the Director of Works.

16. Cupboards shall be made to the sizes and details shown on the drawings.

17. Shelving

- (a) All shelving shall, unless otherwise specified, be of 2cm thick block board with hardwood edging glued and pinned to exposed edges. Block board for shelving shall, except where otherwise specified, be covered with plywood on both sides, Laminated Plastic Sheeting 3mm thick or varnish finish paint all in according to the drawings and contract documents.



- (b) All shelving shall, unless otherwise specified, be supported in an approved manner on all edges abutting a wall with fixings at not more than 20cm centers screwed to approved expansion sleeves let into blockwork or concrete walls.

18. Worktops

- (a) The worktops to the classroom cupboard units shall, unless otherwise specified, be of 28mm thick block board faced both sides with plywood, Laminated Plastic Sheeting 3mm thick or varnish finish paint all in according to the drawings and contract documents and with hardwood edging glued and pinned to exposed edges.

19. Drawer units shall be made to the sizes and details shown on the drawings.

20. Benches

- (a) The benches in the laboratory shall be of the sizes and dimensions shown on the drawings.
- (b) Benches shall be held in place by approved square-section hard neoprene plugs fixed by bolts to approved expansion sleeves let into the concrete floor. One neoprene plug shall be provided for each bench leg all in according to the contract documents.

21. Windows

- (a) Windows shall be made to the sizes and details shown on the drawings.
- (b) Window frames shall be securely fixed in window openings by galvanized mild steel cramps cut and pinned or built in to the surrounding surfaces and fixed by screws to the window frame. The space between the window frame and the surround shall be grouted solid with cement and sand mortar (1:3).

904. Sundries

- 1. On completion of the Works all locks, latches, bolts, catches, hinges and the like shall be cleaned, oiled and tested to the satisfaction of the Director of Works.
- 2. All keys shall be clearly labelled with plastic tags (5cm x 2cm) securely fixed to the keys, which shall be handed to the Director of Works.
- 3. Three keys will be required for all locks unless otherwise specified such as master keys.

Metalwork

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**1000**

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**Metalwork**

#### 1001 General

1. Execute and complete all metalwork shown on the drawings and/or described in the Contract Documents in a proper manner and in accordance with the Specification.

#### 1002 Materials

1. Mild Steel
  - (a) Mild steel shall be best quality mild steel free from manufacturing defects and shall comply with BS ENG 10025-1:2004, BS ENG 10025-3:2004 and BS ENG 10025-4:2004. BS EN 10029: 2010, BS EN 10210: 2006 and BS 7668: 2004.
2. Ironmongery and Hardware
  - (a) Ironmongery and hardware shall be the best quality available. Samples of the ironmongery and hardware items shall be sent to the Director of Works for approval.
  - (b) Ironmongery and hardware shall be complete with screws of a type, size, material and finish to suit the item of ironmongery or hardware which they are fixing.

#### 1003 Workmanship

1. Metalwork shall be fixed complete with all plates, cleats, bolts, anchors, lugs, hardware and ironmongery.
2. Windows shall be manufacture from rolled mild steel sections welded together. Built-up welded sections shall not be used.
3. Finished surfaces of fabricated items shall be ground to a flat, even surface without pitting, holes or other blemishes.
4. Items of steelwork which are to be galvanized shall be galvanized after fabrication by an approved method in accordance with BS729 Part 1.
5. Items of steelwork which are not to be galvanized shall be cleaned of all dust, scale, other impurities and painted as specified under Series 1900 Painting and Decorating in this Specification.

6. The Contractor shall take precaution to minimize exposure of steel awaiting fabrication to chemical pollution.
7. Fabricated steelwork which is stored awaiting erection on site shall be kept clear of the ground and shall be stacked so as to prevent water or dirt accumulating on or against any of the surfaces.
8. Windows
  - (a) Metal windows shall be of the dimensions, sizes and profiles shown on the drawings
  - (b) Windows shall be manufactured from rolled mild steel sections welded together. Built-up welded sections shall not be used.
  - (c) Windows shall be securely fixed in window openings either by lugs welded to the window frames and cut and pinned or built into the surrounding surfaces or by screwing the window frames with rust-proof screws to approved expansion sleeves let into the surrounding surfaces. Lugs or screws shall be of the number and in the positions shown on the drawings. The space between the window frame and surrounding surface shall be grouted solid with cement and sand mortar (1:6).
  - (d) Glazing beads shall be of mild steel of the sizes and profiles shown on the drawings and shall be fixed to the window with dome headed, rust, proof, self-tapping screws at not more than 22,5cm centres.
9. Doors
  - (a) Doors and frames shall be of mild steel sheets, sections and profiles welded together to the dimensions and sizes shown on the drawings.
  - (b) Frames shall be securely fixed to block walls by means of mild steel cramps 3mm thick, 5cm wide and 20cm girth. The cramps shall be bent into a right angle, one leg welded to the frame and the other leg built into the joint of blockwork. Four cramps per jamb shall be provided. Cramps shall be built in as the blockwork proceeds and not cut and pinned at a later stage.
  - (c) Frames shall be drilled and bolted to concrete to the approval of the Director of Works.

10. Gates

- (a) Gates shall be of mild steel sections and profiles welded together to the dimensions and sizes shown on the drawings.
- (b) Gates shall be securely hung on brackets as detailed on drawings, built into the supports as work proceeds.

11. Guard Bars and Screens to Windows

- (a) Guard bars and the framework of the screens to windows shall be of mild steel sections and profiles welded together to the dimensions and sizes shown on the drawings.
- (b) Guard bars and screens shall be securely fixed to the surrounding surfaces by lugs welded to the frame in the positions shown on the drawings and cut and pinned or built-in, unless otherwise specified.
- (c) Guard bars shall be provided to all external windows of laboratories and multipurpose rooms or where shown on the drawings.
- (d) Screens shall be provided to all external windows on the ground floor unless otherwise detailed on the drawings.

12. (a) Balustrades shall be constructed and erected to the details and the dimensions shown on the drawings and shall be of mild steel sections welded together, unless otherwise specified.
- (b) Vertical supports shall be at maximum 1.5m centers and shall be fixed in an approved manner to the supporting structure.

13. Curtains

- (a) Curtain tracks shall be of an approved single-track type with top fixing complete with nylon gliders at 10cm centers and end stops.
- (b) Curtain tracks shall be fixed in the positions shown on the drawings with wood screws to timber pelmets.

14. Expansion Joint Covers

- (a) Approved expansion joint covers of the materials and dimensions shown on the drawings shall be provided to expansion joints in floors of corridors

and verandahs with fixings as detailed on the drawings or approved by the Director of Works.

15. (a) Step rungs, edging to steps, foot scrapers and edging to expansion joints shall be of mild steel to the profiles, dimensions and sizes shown on the drawings.
- (b) They shall be securely fixed to the surrounding surfaces by lugs, welded-on in the positions shown and cut and pinned or built-in.

#### 1004 Sundries

1. On completion of the works all locks, latches, bolts, catches, hinges and the like shall be cleaned, oiled and tested to the satisfaction of the Director of Works.
2. All keys shall be clearly labelled with plastic tags (5cm x 2cm) securely fixed to the keys, which shall be handed to the Director of Works.
3. Three keys will be required for all locks unless otherwise specified such as master keys.

Plastering

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**1100**

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**Plastering**

#### 1101 General

1. Execute and complete all the plasterwork, in the mixes specified, to the surfaces shown on the drawings.
2. Internal plastering shall be carried out in accordance with BS EN 13914-2:2005.
3. External rendering shall be carried out in accordance with BS EN 13914-1:2005.

#### 1102. Materials

1. (a) Cement and water shall be as specified under Series 500 Concrete Work of this specification.  
(b) Fine aggregate shall be natural sand to the approval of the Director of Works.
2. Lime
  - (a) Lime shall be quicklime properly slaked with the minimum amount of water by experienced workmen and shall be left undisturbed for not less than 36 hours.
  - (b) The slaked lime shall be screened before use to remove all lumps, stones and other impurities.
1. Metal lathing( such as expanded metal 200mm wide to all chases of electro- mechanical works and to the junctions of blockwork and concrete, stop beads, angle beads, movement beads,...etc.), where used, shall have a minimum weight of 1.2 kg/m<sup>2</sup> and shall comply with BS EN 13658-1:2005 and BS EN 13658-2:2005.
4. All branded materials shall be delivered to the site in original packings bearing the trade names of the material concerned.

#### 1103. Workmanship

1. General
  - (a) All plastering work shall be even and true, and shall provide a smooth, hygienic crack-free surface suited to the application of the specified decorative finish.
  - (b) Materials used for plastering work shall be proportioned by volume with approved gauge boxes. Mixing shall be carried out in a mechanical batch



mixer unless otherwise approved and shall be continued for at least two minutes after the water has been added.

- (c) Plastering mixes containing self-setting materials shall be used with-in the recommended working time for the mix concerned.
- (d) Mixes containing cement shall be used up within two hours of initial contact with water. All materials remaining after this time shall be discarded.
- (e) Materials which have started to set should not retemper.
- (f) When mixing sand, lime and cement, the lime and sand shall be mixed first and the cement added thereto.
- (g) The amount of water in the mix shall not exceed that which is necessary to give a good, workable mix.
- (h) Surfaces to be plastered/rendered shall be cleaned of dust, loose mortar and traces of salt. They shall then be dashed with a wet cement and fine aggregate mix (1: 2) to form a key, which should then be allowed to harden before plastering proper begins the other two coats.
- (i) Immediately prior to the application of plaster or rendering, surfaces shall be thoroughly wetted and excess water allowed running off.
- (k) Plaster thickness shall be as specified in the Contract Documents for individual surfaces.
- (l) Undercoats to be plastered or rendered shall be well scratched or scored to form a key. Undercoats shall be allowed to set hard before the application of subsequent coats.
- (m) All angles, arises, corners and internal angles on plaster and rendering shall be straight and level or plumb and shall be rounded to a 5mm radius. This shall be deemed to include for furnishing and installing of reinforcing expanded metal 200mm wide to all chases of electro-mechanical works and to the junctions of blockwork and concrete. It shall also include for all stop beads, angle beads, movement beads...etc. all as indicated on the contract drawings and the contract documents.
- (n) Plaster, rendering and paving shall be made good up to frames and skirtings and around fittings and pipes.
- (p) Undercoats and finishing coats to plaster and render shall be protected from the weather until they have set and shall not be allowed to “dry out”

or “seat out” to the detriment of the surface. They shall be cured by being covered with plastic sheets or sacking which is kept stantly damp for at least seven days after being applied.

2. Internal Plaster

- (a) Internal plaster shall be applied in two coats. The overall thickness of two coat work internally shall not exceed 15mm.
- (b) Internal plaster first coat (rough coat) shall consist of cement and fine aggregate mixed in the proportions:
  - 1 part cement
  - 4 parts fine aggregate
- (c) Internal plaster second coat (final or smooth coat) shall consists of cement, lime and sand mixed in the proportions:
  - 1 part cement
  - 1 part lime
  - 1 part sand

3. External Render

(a) General

- (i) External render shall be applied in two coats of overall thickness not exceeding 20mm. Including waterproof material as specified in the contract documents and to the approval of the Director of Works
- (ii) External render first coat (rough coat) shall consist of cement, lime and sand mixed in the following proportions:-
  - 1 part cement
  - 1 part lime
  - 5 parts sand
- iii) External render second coat (final or smooth coat) shall consist of Cement, lime and sand mixed in the following proportions:-
  - 2 part cement
  - 1 part lime
  - 4 part sand

(b) Tyrolean Finish

(i) External render shall be applied in one coat of overall thickness not exceeding 15mm wood floated to receive tyrolean finish.

(ii) External render shall consist of cement, lime and sand mixed in the proportions:

- 1 part cement
- 1 part lime
- 5 parts sand

(iii) Machine applied wet dash (Tyrolean) finish shall be applied after hardening of the rendered surface. The mix shall consist of cement and fine aggregate (1: 2) including waterproof material. The color of the finish shall be as shown on the Contract Drawings or as directed by the Director of Works.

4. Cement and Sand Skirtings

(a) Cement and sand skirting's shall be provided to all vertical concrete and blockwork surfaces at which finished floor slabs abut, except for the outer kerbs to verandahs. All as specified in the contract documents.

(b) Cement and sand skirting's shall consist of cement and sand mixed in the proportions:  
1 part cement to 3parts sand.

(c) Skirtings shall be 100mm high and shall be 10mm thicker than the plaster or rendered surface.

(d) Raking skirtings shall be 100mm higher than the lien of the staircase measured at right angles to the nosing.

(e) Skirtings shall be finished with a bulldozed top edge and shall be treated with an approved hardener and dust proofer.

1104. Sundries

(a) Clean all floors, skirtings and unpainted wall finishing and leave to the satisfaction of the Director of Works on completion.

Tiling (Including Terrazzo work and Marble work)

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**1200**

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**Tiling**

#### 1201. General

1. Execute and complete all the tiling, terrazzo, porcelain, ceramic, glazed and marble work shown on the drawings and/or described in the Contract Documents all in the manner specified and to the satisfaction of the Director of Works.
2. Wall tiling shall be executed in accordance with BS5385 -1:2009, BS5385 -2:2015 and BS5385 -3:2014(Code of Practice for wall and floor tiling).
3. Samples showing qualities and colors of tiles, terrazzo, porcelain, ceramic, glazed and marble proposed are to be submitted to the Director of Works for testing and approval prior to commencement of the Works.

#### 1202. Materials

##### 1. Glazed Wall Tiles

- (a) Glazed wall tiles shall be 200mm x 300mm or 250mm x 300mm with 7mm thick, unless otherwise specified in the Contract Documents, approved best quality white glazed ceramic wall tiles not less than 7mm thick in accordance with the requirements of BS EN 14411:2012.
- (b) Angles, edges and junctions with horizontal surfaces shall be made with rounded or purpose made tiles in according to the drawings and contract documents.

##### 2. Precast Terrazzo Tiles

- (a) Precast terrazzo tiles shall be approved best quality, manufactured locally in accordance with the requirements of BS EN 13748-1:2004 or BS EN 13748-2:2004.
- (b) Terrazzo finish to tiles shall be not less than 8mm thick and shall be cast integrally with a fine concrete backing.
- (c) Terrazzo floor tiles shall be 300mm X 300mm x 27mm thick unless otherwise specified in the Contract Documents.
- (d) Terrazzo tiles skirting's shall be 300mm X 70mm X 10mm thick unless otherwise specified in the Contract Documents.

3. Marble where required for bench tops or the like shall be 30mm thick approved local material free from cracks, chipping or other blemishes. Or could be granite type or other type as specified in the contract documents.
4. Resilient floor coverings
  - (a) Resilient floor coverings shall be of the best quality available and shall be manufactured in accordance with BS EN ISO 10581:2013.
  - (b) Resilient floor coverings shall be of size and type as specified in the contract documents and shall be stuck to steel troweled concrete floor surfaces by means of an approved bituminous or other type adhesive.
  - (c) Resilient floor coverings include many different manufactured types/ products including linoleum, sheet vinyl, vinyl composition tile (VCT), cork (sheet or tile) and rubber.
5. Glazed clay floor tiles (Ceramic tiles) shall be of through-body color of the sizes and thickness' specified and shall conform to the requirements of BS EN 14411:2012.
6. Slip resistant flooring-anti-slip flooring
  - (a) Slip resistant flooring shall be of the best quality available and shall be manufactured and tested in according with BS 7976-1:2002+A1:2013, BS 7976-2:2002+A1:2013 and BS 7976-3:2002+A1:2013.
  - (b) Slip resistant flooring shall be of size and type as specified in the contract documents.
  - (c) Slip resistant flooring include many different manufactured types/ products including non slip rough Porcelain tile, ceramic floor tile, terrazzo, mosaic, granite, unglazed tradition tiles, quarry tile, natural stone, matt finish profiled and other stone or mineral surfaces..etc.
7. Sand, cement, fine aggregate and water shall be as specified under Series 500 Concrete work of this Specification.

## 1203 Workmanship

### 1. Glazed Wall Tiling – Internal

- (a) Lay glazed tiles on a cement and fine aggregate backing to a true, vertical face with closed, tight, continuous joints. Joints shall be grouted and pointed in neat white cement; surplus grout shall be cleaned off as the work proceeds. Tiles shall be immersed in water until saturated and all surplus water drained off before bedding.
- (b) Backing for tiles shall consist of cement and fine aggregate mixed in the proportions:
  - 1 part cement
  - 3 parts fine aggregate
  -
- (c) The Contractor shall apply the mortar to the back of the tiles and then press them onto the backing. The finished bed shall not exceed 12mm thickness. All as specified in the contract documents and to the instruction of the Director of Works.
- (d) Tiles shall be fixed in a regular pattern. In areas, the dimensions of which are not a multiple of the size of the tiles, they shall be carefully cut and fixed so that a margin of equal width is formed on opposite sides of the area.

### 2. Glazed Clay Floor Tiles (Ceramic tiles) and Precast Terrazzo Work

- (a) Floor tiles, treads and sills shall be laid to level or prescribed falls onto 20mm mortar beds consisting of 1 part cement and 3 parts fine aggregate. Base concrete should be clean and well wetted before placing the bedding. Before bedding, the back of the tiles shall be coated with neat cement slurry; the bedding shall support them over their whole area. Tiles shall be laid with straight, continuous joints and shall be grouted and pointed after laying, with mortar of the same mix. Terrazzo floor tiling shall be machine polished to a level, true and even surface after the pointing is completed.
- (b) Tile skirtings shall be bedded, jointed and pointed with mortar as for the floor tiles, but the bedding shall not exceed 10mm thickness. Skirting joints shall line up with the joints in the floor tiles and shall be grouted and pointed after laying. Terrazzo tile skirtings shall be hand polished to produce a true and even surface after the pointing is completed. Tile skirting's shall be provided to all vertical concrete and blockwork surfaces against which the floor tiling abuts.

- (c) Precast terrazzo door sills shall be cast to the profiles and dimensions shown on the drawings. The terrazzo finish shall be continued on all exposed surfaces. All exposed arises shall be continued on all exposed surfaces. All exposed arises shall be slightly rounded. Each sill shall be provided with two 10mm diameter copper drain tubes cast into the sill as shown on the drawings. Precast terrazzo door thresholds shall be provided to all external doors of rooms that have terrazzo floor finish unless otherwise noted on the Contract Documents. Alternatively, Polished cut stone can be used all as specified in the contract documents.
- (d)
  - (i) Terrazzo stair slabs are to be precast terrazzo slabs 50mm thick including not less than 10mm thick terrazzo finish cast integrally with the concrete backing. Alternatively, Polished cut stone or granite can be used all as specified in the contract document.
  - (ii) Pre-formed skirting pieces for stairs shall be not less than 15mm thick and shall be provided at each side of stairs.
  - (iii) Where terrazzo handrails for staircase balustrades are specified they shall be not less than 20mm thick and shall be cast in sections providing neat joints.
- (e) Precast terrazzo worktops shall be 40mm thick and shall be cast with openings for sinks and the like. The terrazzo finish shall be continued on all exposed surfaces and around the edges of openings. All exposed arises shall be slightly rounded. The worktops shall be bedded in cement and sand mortar (1:3) on bearer walls. Alternatively, Polished cut stone, marble and granite can be used all as specified in the contract document.

3. Resilient floor coverings

- (a) Resilient floor coverings shall be laid by approved specialist contractors, to provide a continuous, uninterrupted floor finish.
- (b) On completion of the work the entire surface is to be cleaned to the satisfaction of the Director of Works.
- (c) Surfaces to receive resilient floor coverings shall be cleaned of dust and loose mortar. Laying of resilient floor coverings will not be permitted on concrete surfaces which are not thoroughly dried out and free of moisture.

4. Marble Bench Tops



- (a) Marble or granite bench tops, where required, shall be 30mm thick and shall be bedded in cement/sand mortar (1:3) on block wall supports.
- (b) Slabs are to be cut true to shape and shall have openings for sinks and the like where shown in the Contract Documents. All exposed arises shall be rounded and the whole surface must be cleaned and polished before handing over to the Agency.

1204 Sundries

- 1. All finishes shall be cleaned with soap solution free from any acid or alkali before handing over to the Director of Works.

Paving

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**1300**

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**Paving**

### 1301. General

1. Execute all paving work shown on the drawings and/or described in the Contract Documents in accordance with this Specification and to the approval of the Director of Works.
2. Paving work shall include:
  - (a) The laying of unsuspended reinforced concrete ground floor slabs, including hardcore or base course.
  - (b) The finish of such unsuspended ground floor slabs or of suspended reinforced concrete slabs with fine concrete paving screeds where these are specified in the Contract Documents.
  - (c) The laying of precast concrete paving flags.
  - (d) Treating all concrete floors with hardener etc.

### 1302 Materials

1. Hardcore shall be as specified under Series 400 Excavation, Earthworks and Site Work of this Specification.
2. Sand, coarse aggregate, cement and water shall be specified under Series 500 Concrete Work of this Specification.
3. Precast concrete flags shall comply with the requirements of BS EN 1339:2003 and, unless otherwise indicated, shall be 500mm x 500mm x60mm overall size.
2. Steel reinforcement shall be as specified under Series 506.

### 1303 Workmanship

1. Materials shall be proportional by volume with approved gauge boxes. Mixing shall be carried out in a mechanical batch mixer unless otherwise approved. Mixing shall continue for at least 2 minutes after the water has been added.
2. Concrete mix 300/20 shall be used for unsuspended ground slabs unless otherwise stated and shall be as specified under Series 500 Concrete Work of this Specification.

3 Concrete Slabs

- (a) Concrete ground slabs shall be laid on polythene sheet (0.3mm thick) over 15cm compacted thickness granular fill in accordance with Clause 407. Slabs shall be laid in bays not greater than 5m x 5m square cast alternately within frames of planned shuttering unless otherwise stated. Slabs shall be cured for not less than 7 days in accordance with Series 500 Concrete Work of this Specification.
- (b) Unless otherwise specified or directed the surface of unsuspended concrete slabs shall be given a steel trowel finish in accordance with Series 500 Concrete Work of this Specification.
- (c) Where terrazzo floor covering or screed is specified, the surface of slab shall be finished in accordance with Clause 513.1.

- 4. (a) Provide and lay precast concrete flags to the areas shown in the drawing or where directed by the Director of Works on and including a bed of cement and fine aggregate mortar in the proportion 1:3 by volume
- (b) Grout-up with cement/sand mortar tinted as appropriate to match color of slabs and brush well in.

5. Cement Screed

- (a) Lay a screed in sand and cement consisting of 1 part cement and 3 parts sand to concrete surface as shown on the Contract Drawings.
- (b) Screed to freshly lay concrete  
Lay a 20mm minimum thickness screed in bays not exceeding 30m<sup>2</sup>. This screed shall be laid within 3 hours of casting the slab or else screening shall be considered the screening of mature concrete.
- (c) Screening to mature concrete:
  - (i) The surface of the slab shall be thoroughly roughened to expose the coarse aggregate cleaned and watered and then treated with cement slurry immediately prior to screeding.
  - (ii) Lay a 40mm minimum screed in bays not exceeding 15m<sup>2</sup>.
- (d) Screeds shall be finished with a steel trowel to produce a smooth firm even surface free from trowel marks.

- (e) All paving shall be truly horizontal and the joints between the bays shall be in straight lines cut accurately and neatly at right angles filled with a felt paper of approved pattern and thickness to the full depth of the concrete.
- (f) Screeds are to be cured for not less than 7 days after casting in accordance with Series 500 Concrete Works.
- (g) No moisture-sensitive floor finish shall be laid unless an approved moisture test shows that the screed is sufficiently dry to receive it.

#### 1304 Sundries

- 1.
  - (a) All concrete floors finish shall be treated with a liquid hardener and dust Proofer unless otherwise stated.
  - (b) The hardener and dust proofer shall be as specified in the contract documents.
  - (c) The hardener and dust proofer shall be applied strictly to the manufactures instructions.
- 2 Clean all surfaces to the approval of the Director of Works before handing over to the Agency.

### **INTERLOCK BLOCK PAVERS**

#### 1305 GENERAL

The work shall consist of the construction of Interlock Block Pavers in accordance with Specifications, Drawings and the Director of Works.

Precast Interlock Block Pavers shall be formed by homogeneous elements 6 cm (6mm top surface layer + 54mm lower base layer) thickness to be used in sidewalk and 8 cm (6mm top surface layer + 74mm lower base layer) thickness to be used in drive way.

The maximum dimension deviations from the stated work sizes for Interlock Block Pavers as follows:

- Length  $\pm$  2mm.
- Width  $\pm$  2mm.
- Thickness of top surface layer  $\pm$  1 mm.
- Thickness of lower base layer  $\pm$  2 mm.

The finished product shall be of solid appearance with clean face, be free of segregation, honeycombing and no evidence of internal rendering.

### 1306 MATERIAL

Materials shall be conforming to the requirements of BS EN1338:2003 and BS 7533-3:2005+A1:2009 unless otherwise specified. The aggregate used shall be of two different types of natural crushed aggregates conforming to the appropriate British Standard.

The interlock block pavers shall consist of two layers. The first is the surface layer which shall be formed as an integral part of block and will be of black basalt aggregates with thickness of  $(6\text{mm} \pm 1\text{mm})$ . If the sample fails to meet this thickness  $(6\text{mm} \pm 1\text{mm})$ , interlock pavers shall be rejected. The lower layer will be of common type aggregates used for concrete works with suitable size. Retarding, colour and any admixtures shall not have adverse effect on properties of Interlock Block Pavers.

Interlock Block Pavers shall be made using one or more of binders conforming to the appropriate British Standards. The Contractor shall submit samples of various types of Interlock Block Paver for approval of colour and shape by the Director of Works prior to commencing the Work.

### 1307 Workmanship and Construction

Interlock Block Pavers shall be set on to locations and grades shown on the Drawings and shall be laid directly on a granular material. Granular material shall be placed on the top of a crushed aggregate base course layer to adjust the final level of the Interlock Block Pavers and to fill the joints between the Blocks.

All Interlock Block Pavers shall be thoroughly cleaned of all extraneous material prior to approval. All Interlock Block Pavers shall be laid within a tolerance of plus or minus three (3) millimetres, at each end of an element, to the lines and grades given on the Drawings. All spaces between Interlock Block Pavers shall be filled with clean sand.

All Interlock Block Pavers shall be compacted by a compactor plate to the satisfaction of the Director of Works. No interlock block pavers are to be paved during heavy rains.

### 1308 Testing and Acceptance

#### a) Compressive Strength Test

Test shall be carried out on Interlock Block Pavers to ascertain the strength.

Before laying Interlock Block Pavers, 16 samples shall be collected; each 2 sample shall represent 5000 blocks. All samples shall be stored for  $(24 \pm 4)$  h in water maintained at temperature of  $(20 \pm 5)$  C°. The average compressive strength of 16 samples shall be not less than  $490 \text{ kg/cm}^2$  and crushing strength of any individual block shall not be less than  $400 \text{ kg/cm}^2$ . If the sample fails to meet strength limit, the interlock pavers shall be rejected.

b) Abrasion Test

Test shall be carried out to ascertain surface requirement in according to BS EN 1338:2003 using Bohme abrasion machine according to DIN 52108 with natural abrasion material or artificial Corundum.

The average Abrasion of 16 samples shall not exceed 5 mm and not exceed 6mm for each individual sample after 440 revolution of abrasion machine. If the sample fails to meet the abrasion limit, the interlock pavers shall be rejected.

Drainage

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**1400**

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**Sewerage**



#### 1401. General

1. All Sewerage work shall conform to the regulation by-laws or other statutory controls of the area in which carried out.
2. All existing pipes, ducts, cables, manholes, gullies, storm water inlets and other services exposed in the execution of the Sewerage work shall be effectively supported, protected, and, where necessary, made good to the satisfaction of the Director of Works/Local Authority.
3. For connection to existing sewer give notice to the local authority. Take up paving and roadway, open in existing manholes, divert existing flow to facilitate connection works, excavate trenches, connect new system with existing, backfill and make good to the satisfaction of the Director of Works/Local Authority.
4.
  - (a) Sewerage pipes will be generally specified in Unplasticised P.V.C. (U.P.V.C.) where this is not available, acceptable alternative materials are concrete pipes.
  - (b) Flexible joints shall mean joints made with deformable rings or gaskets held between pipe spigots and sockets, sleeves or collars.
  - (c) Flexible joints shall be obtained from the pipe supplier and shall be used according to the manufacturer's instructions.
5. Samples of the proposed materials shall be a proved by and deposited with the Director of Works.
6. The excavations shall be kept free from water by pumping, bailing or other approved means.
7. The Contractor shall use shuttering, tight sheeting, skeleton sheeting, stay bracing, trench jacks or a trench shield or box to support the trench during pipes laying.
8. The use of explosives is strictly forbidden without the approval of the Director of Works. See also Series 400 Excavation, Earthworks and Site Work of this Specification.

#### 1402 Materials/Joints

1. Pipe bends and junctions are to be in U.P.V.C. complying with BS EN 13598-1:2010. These shall be supplied with flexible joints.
2. Concrete drain pipes shall, unless otherwise described, be cylindrical pipes with spigot and socket ends, all complying with the requirements of BS 5911-1:2002+A2: 2010 and BS 5911-3: 2010+A1: 2014 standard class. These pipes

shall be supplied with flexible joints. If the precast reinforced concrete pipes were requested to be internally lined with polyethylene, a High-Density Polyethylene (HDPE) sheet shall be used with at least 3mm thick with projecting studs back that key into internal pipe surface. Sheets of HDPE shall be butt-welded to form a barrel shape to be monolithically cast with concrete. All polyethylene lining sheets shall be sealed at both ends with butt-welding before installation

If it is required to use a piece of a pipe, mechanical sawing machine should be used such that the piece has the same requirements of a whole pipe. No hammering or chiselling is allowed.

3. Yard gullies shall be cast iron 300mm diameter inside, a minimum depth of 600mm, an outlet of 150mm diameter complete with galvanized perforated bucket, and heavy duty cast iron grating and be jointed to drains all set in bed of concrete mix 200/20. Or as specified in the contract documents and the approval of the Director of Works.
4. Cement, sand and steel reinforcement shall be as described under Series 500 Concrete Work of this Specification.
5. Blockwork shall be as described under Series 600 blockwork of this Specification.

1403 Workmanship

1. (a) Excavations for Sewerage trenches, manholes and the like shall be to straight lines and to the correct depths and gradients required for pipes and beds as specified on the Contract Drawings and sufficient width to ensure adequate working space.  
(b) Sides and bottoms of trenches shall be trimmed and squared.  
(c) Trenches shall be supported, in the manner selected by the Contractor, to ensure safety and the speedy execution of the work.  
(d) In the event of excavations being made deeper than specified, they shall be made up to the correct level with lean mix concrete (1:8) at the Contractor's expense.  
(e) Turf and top soil shall be set to one side for re-use at the discretion of the Director of Works.
2. Grade bottom of trench and fill 150mm below invert level for the full width with sand.
3. Lay pipes on prepared solid bedding in straight lengths with joints facing the direction of flow to true gradient and laid so that each pipe is in contact with the

bed for the whole length of its barrel. The bed shall be cut away at each socket to give a clearance of at least 50mm so that the socket does not bear on the bed.

4. No drain shall be covered up before it has been tested and approved by the Director of Works. After all tests have been carried out, fill in with sand up to 150mm above the top of the pipe for the full width of the pipe for flexible pipes (plastic). For rigid pipes (concrete) the sand filling shall extend to 300mm above the top of the pipe.
5. Fill in to ground level in layers not exceeding 150mm compacted thickness with base course or imported granular fill in according to the contract documents and approval of the Director of Works.
6.
  - (a) Solid and waste drains under buildings shall be carried out in UPVC pipe bedded in 200/20 concrete to a depth of 150mm under the drain invert.
  - (d) After testing fill in and tamp round pipe to the full width of the trench with 200/20 concrete to a level 150mm over the upper level of the pipework.
  - (c) Fill in remainder as described in Clause 1403.5.
7.
  - (a) Connect sanitary fittings and gullies to manholes or vent stacks with soil and waste pipes of the sizes and in the materials specified.
  - (b) Solid and waste pipe shall be of the same diameter as the outlet to the sanitary fittings or gullies.
8. Dispose of surplus excavated material from the site and reinstate surfacing of pavings and roadway to the approval of the Director of Works.
9. Provide all necessary planking, strutting, watching, lighting, temporary barriers etc. as shall be deemed necessary by the Local Authority.
10. Vent the head of the drain where indicated on the drawings with 75mm diameter vent pipe all as described above and in according to the contract documents .
11. Supply and fix all junctions, bends, reducing pieces, rodding eyes and sleeves as are shown on the drawings or are considered necessary by the Director of Works for the execution of the Work.
12. Pipe Sleeves
  - (a) Wherever pipes pass through blockwork or concrete they shall be provided with sleeves of the same material as the pipe.

- (b) The internal diameter of the sleeve shall be at least 1cm more than the external diameter of the pipe and the length of the sleeve shall be the same as the thickness of the blockwork or concrete plus surface finishes through which the pipe passes.
- (c) The space between the pipe and the sleeve shall be packed with rock wool or an approved non-hardening compound.

#### 1404. Connection to Sewer

1. Provide and fix saddle piece and lay drain in the diameters and materials specified to the falls indicated on the drawings all on a granular bed as previously described in Clause 1401.3 above.

#### 1405 Manholes

1. Excavate, return, fill and ram; dispose of surplus material; prepare bottoms and support sides for construction of manholes all as described in Clause 1403 of this Specification.
2. From the base slab to manhole with concrete mix reinforced concrete 250/20 200mm thick, the slab to finish flush with the external face of the manhole wall.
3. Build the walls of the chamber in reinforce concrete 250/20 200mm thick and 200mm thick reinforced concrete 250/20 manhole cover slab and in according to the contract documents.

Provide and lay in the bottoms of manholes, unless otherwise specified, half-round U.P.V.C. main invert channels of the same diameter as the drains with all necessary curves and tapers.

4. Provide and lay half-round U.P.V.C. branch channel bend curved in the direction of flow and set to discharge over main channel.
5. Bench up the channels with concrete mix 200/20 rising vertically from the edge of the channel to a height not less than the soffit of the out-going drain and sloping upwards to meet the side of the chamber at a gradient of approx. 1 in 6. Float the benching to a smooth, hard surface with a coat of cement mortar 1:1. All cement used for benching shall be Sulphate Resisting Type.
6. Build in the ends of drain pipes.
7. Manhole covers and frames shall be either:

- (a) Heavy Duty Cast iron or cast steel in accordance with BS EN 124-1: 2015 and BS and EN 124-2: 2015. The frames shall be set in 1:3 cement, sand mortar, or
  - (b) Precast reinforced concrete mix 250/20 all in accordance with Series 500 Concrete Work of this Specification, as shown on the Contract Drawings.
8. Manhole sizes shall be in accordance with contract drawings and contract documents.
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9. Manholes shall be watertight on completion. Alternatively, readymade circular manhole can be used all as specified in the contract documents.

1406. Drawing(s)

- 1. (a) Where shop drawings are required, this will be stated in the invitation to tender.
- (b) Shop drawings shall be submitted when required to the Director of Works before the commencement of the Sewerage work.
- (c) On completion of the Works the Contractor shall provide the Director of Works with “as-built” drawings showing the exact location and sizes of all pipes, branches, manholes and the like to the approval of the Director of Works.

1407. Testing

- 1. The Contractor shall carry out all tests necessary to ensure the satisfactory functioning of the Sewerage system. Any section not passing any of the test shall have the defects made good and shall be retested.
- 2. All foul sewers, drains and surface water drains shall be tested as directed by the Director of Works, in sections, e.g. between manholes, before the pipes are covered, by means of either the air test described below or by the water test described below. Before testing, the ends of the pipeline to be tested, including those of short branches, shall be plugged and sealed to the satisfaction of the Director of Works. Any section not passing any of the tests shall have the defects made good and shall be retested, using either of the alternative tests given below as directed by the Director of Works.
- 3. For the air test, air shall be pumped in by suitable means until a pressure of 100mm head of water is indicated in a U-tube connected to the system. The air pressure shall not fall to less than 75mm head of water during a period of 5 minutes without further pumping, after an initial period to allow stabilization.

Drains with traps shall be tested to 50mm head of water and the permissible loss shall then be no more than 13mm head of water in 5 minutes after the initial stabilizing period.

4. For the water test, the pipes shall be filled with water under a head of not less than 1.2m above the crown of the pipe at the high end and not more than 2.4m above the pipe at the low end. Steeply graded pipelines shall be tested in sections so that the above maximum shall not be exceeded. Unless otherwise agreed by the Director of Works, the test shall commence one hour after filling the test section at which time the level to water at the vertical feed pipe shall be made up to produce the required 1.2m minimum test head. The loss of water over a 30 minute period shall be measured by adding water at regular 10 minute intervals to maintain the original water level and recording the amounts so added. The drain will have passed the test if the volume of water added does not exceed 0.12 liters per hour per 100 linear meters of drain per mm of nominal internal diameter.
5. All drains and service ducts less than 350mm diameter shall be checked by drawing through each completed length of pipe a smooth ball 12mm less than the pipe diameter unless an alternative method of checking is agreed by the Director of Works.
6. On completion of the works, or earlier if the Director of Works agrees, all manholes and drains shall be flushed from end to end with water and left clean and free from obstructions.
7. Manholes shall be tested for water tightness on completion by filling them with water and observing any subsidence in water level.

#### 1408 Sundries

1. The Contractor shall take all precautions to prevent the entry into the drains or sewers of builders' debris, cement slurry and plaster washings.

#### 1409. Certificates

1. Copies of all certificates of acceptance of drains or drain connections issued by the Local Authority shall be given to the Director of Works prior to the handing over of the Works.

Asphalting

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**1500**

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**Asphalting**

1501. General

1. Lay asphalt as hereinafter described on prepared surfaces indicated on the drawings, to the prescribed falls.

1502. Materials

1. Asphalt for paving or playground asphalt base course (dense bitumen macadam course) and wearing course shall be in one coat work of Fine Hot Asphalt with the aggregate, laid to produce a smooth surface all in accordance with BS EN 13108-1:2006, BS EN 13108-7:2006 and BS EN 12591: 2009.
2. Asphalt for roofing purposes shall be bitumen polymer membrane with chipping in accordance with ASTM D6222 and ASTM D6223.
3. Underlay for Mastic Asphalt laid on concrete roofs shall be sheathing felt complying with BSEN 13707:2013 Bitumen based.
4. Precast concrete edgings shall comply with BS EN 1340:2003.
5. Sand, cement and water shall be as described in Series 500 Concrete Work.

1503. Workmanship

1. Paving and playground areas
  - (a) Excavate for, provide and lay on edge 300mm high x 150mm wide precast concrete edging(curbstone) , top to be level with finished level of playing area/paved area, on 150mm bed concrete class 200/20 hunched up at outside edge to within 75mm of top. Bed joint and point in cement, sand mortar 1:3 backfill and make good surrounding levels.
  - (b) Provide and lay 150mm compacted hardcore, crushed aggregate or base coarse as specified in the Contract Documents, using the required rollers to the approval of the Director of Works, Degree of compaction shall not be less than 96% of the maximum density
  - (c) Provide and lay asphalt paving in one coat work (layer) of 70mm compacted overall thickness, using hot asphalt mix 3/8" maximum aggregate and asphalt bitumen (80/100) heated to the temperature specified by the manufacturer, asphalt at rate of 55kg/ton. Include of one prime coat of liquid (MCO) at the rate of 2 kg/m2, ramming, leveling and compacting the hot asphalt mix using the required rollers to the approval



of the Director of Works with a minimum compaction of 98% of the control strip density, laid to falls and cross-falls. All in accordance to the detail drawings, the contract documents and to the Director of Works approval..

2. Roofing

- (a) Provide and lay one layer bitumen polymer membrane with chipping (Mineral slate granules layer) 5mm thick Minimum and 5 kg/m<sup>2</sup> minimum weight per square metre, including priming "GS/474" 500(gr/m<sup>2</sup>), dressing into rainwater outlets to form waterproof seal as specified in the contract documents and the approval of the Director of Works.
- (b) Rake out joints in vertical walls to receive joint filler components. From chase, 25mm x 25mm with splayed bottom edge, to receive the top edge of the upstand.
- (c) At all junctions of roof coverings with parapet walls stacks etc., provide one layer bitumen polymer membrane with chipping skirting as specified in the contract documents and the approval of the Director of Works.
- (d) Execute all required angles, fair ends etc., and from a proper fillet at all internal angles.
- (e) Finish at open edges of flat roofs with a mastic asphalt apron taken 150mm down the fascia or as specified in the contract documents and the approval of the Director of Works.
- (f) Properly dresses all pipes and outlets on the roof with a special rubber sealant including caps. All shall be in according to the detail drawings, the contract documents and to the Director of Works approval.

1504 Sundries

- 1. Storage of materials on finished asphalt work is strictly forbidden.

Roofing

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**1600**

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**Roofing**

#### 1601. General

1. Cover the whole of the roofs indicated on the drawings with the tiles/sheeting hereinafter described to the prescribed pitches all according to specification and to the satisfaction of the Director of Works.

#### 1602. Materials

1. Roof tiles
  - (a) Where roof tiles are specified they shall be concrete tiles from the best quality in the local market conforming to BS EN 1304:2013, BS EN 490:2011 and BS EN 491:2011.
  - (b) Ridge pieces or other special tiles for eaves verges or the like shall be of the same material and quality as above and shall be from the same supplier or as specified in the contract documents.
2. Timber for battens shall be sawn softwood pressure impregnated with creosote in accordance with BS 144:1997 unless otherwise specified or directed.
3. Nails for tiling or securing battens shall be of copper, aluminum alloy, zinc or galvanized wire to BS 5534:2014+A1:2015. Nails subject to corrosion will not be permitted.
4. Sarking felt where specified shall be aluminum foil-faced reinforced copolymer felt complying with the requirements of BS EN13707: 2013 laid parallel to the ridge with 150mm side laps
5. Mortar for bedding plain tiling shall be cement: fine aggregate mix 1: 3 mix of proportions by volume and pointing plain tiling shall be cement: sand 1: 2 mix of proportions by volume.
6. Profiled galvanized steel sheeting shall comply with the requirements of BS 3083:1988.
7. Fixing for profiled sheeting shall be in accordance with BS EN ISO 1479: 2011.

## 1603 Workmanship

### 1. Tiling

- (a) Supply and fix roofing tiles to the roof surfaces indicated on the drawings. Each tile in every 3<sup>rd</sup> course and the 2 end tiles in every course adjacent to verges, valleys, abutments and hips shall be twice nailed to softwood battens 50mm x 25mm overall. The dimensions from center to center of battens shall be  $\frac{\text{length of tile} - \text{lap}}{2}$ . The lap shall be not less than 70mm assuming a pitch of not less than 400 and shall not exceed one-third of the length of the tiles.
- (b) Eaves shall have a proper under tile course size 165mm x 165mm minimum overall each tile twice nailed to battens. Both eaves courses are to overhang by 50mm unless otherwise specified.
- (c) Verge tiling shall be tilted to prevent dripping. Form under cloak with plain tiles bedded in mortar onto gable wall. Verge tiles to be similarly bedded on under cloak and the whole pointed in cement, lime and sand mortar cut back 6mm. Bedding shall be carried out in "tile-and-a-half" tiles and no cut tiles will be allowed.
- (d) The top course of tiles at ridges shall maintain the gauge without cutting. Ridge-tiles shall be carefully bedded on to the top course and fully bedded at joints and pointed in mortar as described above with a neat, flush joint. Open ends at gables to be filled with pieces of cut tile bedded and pointed in mortar as above.
- (e) At abutments carry out all necessary cutting and fitting and fix only soakers supplied by others. No tiles shall be cut so that it is reduced in width at any part to less than its full length. "Tile-and-half" tiles shall be used where possible at abutments to retain bonding.

### 2. Sheeting

- (a) Supply and fix corrugated roofing sheets to purlins, all to the pitches shown in the drawings.
- (b) Laps shall be in accordance with the suppliers' recommendations.
- (c) Holes for hook bolts at other fixings shall be pre-drilled at the highest point of the corrugations/profiles, at every third corrugation/profile unless otherwise recommended by the manufacturer.

- (d) Seam fixings for side laps are required at 400mm centers on galvanized steel sheeting.
- (e) All fixings which penetrate the sheeting shall be made watertight by means of washers, all to the manufacturer's recommendation.
- (f) Supply and fix ridge-piece, end-closers, eaves-closers and all accessories necessary for the execution of the Work.

1604 Sundries

1. Storage of materials on the finished roofing is strictly forbidden.

Plumbing

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**1700**

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**Plumbing**

1701 General

1. Execute all plumbing work shown on the drawings and/or described in the Contract Documents all in accordance with this Specification and to the satisfaction of the Director of Works.
2. The plumbing work shall include all internal sewerage pipes and fittings, rainwater disposal, water supply distribution system and sanitary appliance with all necessary plumbing fittings.
3. Soil and waste disposal shall be effectual by means of a “one pipe” system unless otherwise specified. Traps shall have a water seal of 50mm for W.C.’s and piping above 50mm diameter and 75mm for pipes below 50mm diameter. All branches shall be ventilated into a ventilating stack.

1702. Materials

1.
  - (a) Rainwater pipes and gutters shall, unless otherwise stated, be in U.P.V.C., complying with BS EN 12200-1:2000, BS EN 607:2004 and BS EN 1462:2004. Downpipes shall have push-fit joints and all branches, offsets, heads, shoes, etc. shall be in the same material and by the same manufacturer.
  - (b) Balcony and roof outlets shall be of approved type, fitted with circular heavy duty gratings. The diameter of the gratings shall be twice the diameter of the pipe. Each grating shall be secured to the outlet with two countersunk non-corrosive screws.
2.
  - (a) Soil waste and vent pipes including fittings and accessories shall generally be in U.P.V.C. in accordance with BS 4514:2001 and BS EN 1329-1:2014.
  - (b) Acceptable alternative material for (a) above are:  
Galvanized Steel to BS EN 10255:2004 and BS EN 10241:2000
3.
  - (a) Water supply/distribution pipes shall generally be in seamless steel tubing galvanized internally and externally with screwed and socketed joints, all in accordance with BS EN 10241:2000 and BS EN 10255:2004..  
Acceptable alternative materials are: Copper to BS EN 12449:2012, BS EN 1254-1:1998 and BS EN 1254- 2:1998. Un-plasticized polyvinyl chloride (U.P.V.C.) to BS EN ISO 1452-1:2009, BS EN ISO1452-2:2009, BS EN ISO 1452-3:2010 and BS EN ISO 1452-4:2009, polythene to BS EN 12201-1:2011, BS EN 12201-2:2011+A1:2013 and BS EN 12201-

5:2011 may be used for cold water services.

- (b) Galvanized steel pipes and galvanized malleable iron fittings shall be put together with screwed joints. All threading shall be executed with sharp dies. Pipe ends shall be reamed out to a slightly larger diameter before assembly. Joints shall be put together with and approved jointing compound; oakum, string or other fiber shall not be used in joints. All joints, junctions, bends in the water supply and distribution pipework shall be made up welded assemblies shall not be allowed.
  - (c) Galvanized steel pipes and fittings shall be fixed at least 20mm clear of the face of walls and soffits by means of approved, two-piece holder bats at not more than 1500mm centers. Saddle-type pipe clips shall not be used.
4. Water storage tanks shall be of glass fiber reinforced polythene or polypropylene of approved manufacture, in accordance with BS 4213:2004 and BS EN 13280:2001 . Water storage tanks shall be of 1.00m<sup>3</sup>, 1.5m<sup>3</sup> or 2 m<sup>3</sup> capacity and shall be supplied complete with polythene ball valves, overflows, covers, under tray, all inlets and outlets connections, and distribution pipe including all required fittings and accessories to put water storage tanks in service.

Alternative materials acceptable for water storage tanks are:  
Galvanized Mild Steel to BS 417-2:1987.

- 5.
- (a) Sanitary appliances shall be in glazed white fireclay or as specified in the contract documents or other equal approved by the Director of Works.
  - (b) High level W.C. suite shall be pedestal type wash down pan as specified in the contract documents or other equal approved by the Director of Works. and shall include plastic flushing cistern with brackets, flushing mechanism, and ball valve and pull chain. W.C.suite shall be delivered complete with plastic seat and cover by same specified type.
  - (c) Squat type W.C. pans shall be as specified in the contract documents or other equal approved by the Director of Works. complete with plastic flushing cistern, wall brackets, flushing mechanism, ball valve and pull chain by same specified typ.
  - (d) Lavatory Basins shall be white glazed fireclay size not less than 555mm X 410mm overall, complete with waste fitting, siphon, trap, plug and chain, chromium plated gear water mixer, 1/2" pillar tap, all associated water



supply pipework, waste to slab level, and including brackets screwed to concrete or blockwork, sealing joint to worktop or wall with mastic sealant. All in according to the contract documents and the Director of Works instructions.

- (e) White glazed fireclay sinks shall be not less than 610mm x 405mm x 255mm as specified in the contract documents or other equal approved by the Director Of Works, complete with waste fitting, siphon, trap, plug and chain, chromium plated gear water mixer, 1/2" pillar tap, all associated water supply pipework, waste to slab level, on and including brackets screwed to concrete or blockwork, sealing joint to worktop or wall with mastic sealant.
- (f) Polypropylene sinks shall be not less than 540mm x 380mm x 210mm, and shall include brackets, waste fitting, trap and standing waste overflow by the same manufacturer. or as specified in the contract document or other equal approved by the Director of Works.
- (g) Wall hung urinal bowls shall be in white glazed fireclay as specified in the contract documents or other equal approved by the Director of Works, complete with grating, waste fitting, trap and automatic flushing valve, all by same specified type .
- (h) Automatic flushing tanks shall include flush pipe and automatic syphon set to discharge every 10 minutes or as specified in the contract documents.
- (j)
  - (i) Urinal traps and trapped gullies shall be approved U.P.V.C. with back or side inlets as required and 100mm diameter outlet. Where necessary, the gullies shall be provided with approved raising-piece complete with chromium plated brass grating fixed securely with 2 countersunk screws,
  - (ii) Gullies and raising-pieces shall be bedded on 100/20 concrete 150mm thick.
- (k) Bib taps in latrine areas and at water points shall be brass with easy-clean shields or as specified in the contract documents.
- (l) Stop valves shall be solid brass with wheel head or as specified in the contract documents .
- (m) Mirrors, where specified, shall be approved high quality size 60cm x 60cm chamfered all edges, fixed with 4 number chromium plated dome headed screws and rubber washers to concrete or blockwork .

1703 Workmanship

1. Rainwater pipes and gutters

- (a) Supply and fix U.P.V.C. rainwater downpipes shown on the Contract Drawings to concrete columns/blockwork by means of pipe brackets (screwed-to-wall) at not greater than 2.00m centers with rustproof screws with additional brackets at her, connectors, branches and head.
- (b) Supply and fix heads, branches connectors and shoes as shown in the Contract Documents.
- (c) Connect all roof and balcony outlets to main downpipe.
- (d) Supply and fix U.P.V.C. eaves gutters in the positions shown on the drawings. Gutters to be complete with all necessary angles, stop ends, stop end outlets and running outlets al as shown on the drawings or as directed by the Director of Works. Gutters to be secured by means of support brackets secured to facial/rafter spaced at not more than 1.00m centers. Additional brackets shall be fixed on each side of running outlets, stop ends and outlets, and at angles. Only rust-proof screws shall be used for fixing gutters.

2. Soil pipes

- (a) Supply and fix all internal soil waste and ventilating pipe work as shown on the drawings and connect to manhole, all in U.P.V.C. pipe unless otherwise specified or approved.
- (b) Supply and fix all bends, junctions, reducing pieces, inspection eyes, sleeves etc. as are shown on the drawings or as instructed by the Director of Works.
- (c) Vertical stacks to be firmly secured to blockwork/concrete by means of pipe brackets at not more than 2.00m centers.
- (d) The soil pipe above the highest branch is to be continued upwards to such a height and in such a position as to afford a safe outlet for foul air and shall be covered with wire dome at the outlet.

- (e) Traps on branch soil and waste pipes to be ventilated at a point not less than 75mm or not more than 30mm from the highest point and on the nearest side to the soil and waste pipe. The vent pipe may be in U.P.V.C. unless otherwise specified or approved with all needed joints, of diameter not less than 32mm for single lavatory or sink waste and not less than 50mm for W.C. and urinal traps. The size of vent pipe serving a number of fittings shall be 50mm. Connect the branch vent pipes to the main ventilation stacks(s) as shown on the drawings or approved by the Director of Works, finish as for soil pipe.
- (f) Connect sanitary appliances to main soil pipe; all appliances/fittings to be trapped, with the exception of waste outlets, discharging into gullies “over air”. Waste pipes shall be of the same diameter as the outlet from appliance/fitting.

### 3. Supply pipework

- (a) Excavate for supply pipe not less than 45cm below the surface, back-fill over supply pipe after testing in accordance with Clause 1403, 4 and 5 using 150mm granular fill above the pipe.
- (b) Take possession of and install at site boundary, water meter supplied by water authorities in meter chamber constructed to the sizes specified and in the manner described for manholes in Series 1400 Drain layer. Provide and install stop valves at point of entry to the site before the Company meter.
- (c) Lay main supply pipe on 150mm bed of sand in the material and of the size shown on the drawings from main company supply to point of entry to the building/to rising mains to storage tank, provide stop valve to rising main to tank.
- (d) Provide and fix rising main to storage tanks and connect thereto. Provide and install stop valve adjacent to the connection to the tanks.
- (e) From the rising main, run services as specified to drinking water points and cold water storage tanks shown on the drawings and connect to outlets with union fittings. Provide stop valves on each branch immediately adjacent to the mains supply connection and adjacent to the water points and cold water storage tanks.
- (f) Provide and fix on approved bearers, water storage tank as previously specified in the position shown on the drawings complete with ball valve, cover, overflow (larger than supply pipe) to be carried through/over wall and to discharge in the open. Bearers shall run the full width of the tank.

- (g) Stop valves below ground level shall be placed in approved underground valve boxes with lockable covers.

#### 4. Distribution

- (a) Provide and fix distribution pipework from storage tanks to sanitary fittings and draw-off points including installing all necessary bends, tees and other fittings, and the connection to tanks and fittings. Pipework shall follow the line of walls vertically and horizontally and shall be graded as necessary for draining and venting. Provide draw-off valves at low points. Pipework carried through floors, walls, beams or other structural elements shall be sleeved.
- (b) Provide a stop valve on each distribution pipe outlet from the cold water storage tanks.
- (c) Provide a stop valve on distribution pipes adjacent to each sanitary fitting or bib valve or to each range of sanitary fittings or bib valves as indicated on the drawings.
- (d) All internal pipework shall be surface-mounted unless otherwise specified or directed.

#### 5. Fittings

- (a) Provide and install sinks, lavatory basins, gullies and all other sanitary fittings in the positions shown on the drawings.
- (b) Provide and fix bib or pillar taps to sinks, lavatory basins and drinking points as indicated on the drawings.

#### 6. Testing

- (a) The Contractor shall be responsible for testing to insure the efficient functioning of the water supply and distribution system, internal sewerage, and rainwater disposal system to the approval of the Director of Works.
- (b) Water supply and distribution pipework shall be watertight under the full operating head, any joints/connections which leak shall be remade to the approval of the Director of Works.

#### 7. Shop Drawings

- (a) Before the commencement of any plumbing and sewerage work the Contractor shall submit one soft copy and two hard copies of drawings,

detailing his proposals for the layout of the plumbing and sewerage installations, to the Director of Works for approval.

- (b) The drawings shall show the proposed location and diameter of every pipe run and the proposed location of all valves, manholes and the like.
- (c) On completion of the Works the Contractor shall provide the Director of Works with a set of “as-built” drawings one soft copy and two hard copies detailing the exact location and size of all pipes, branches, tees, valves, manholes and the like.

8. Samples of all materials, appliances and fittings shall be approved by and deposited with the Director of Works. Such samples will be returned to the Contractor for installing in the Works.

Glazing

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**1800**

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**Glazing**

## 1801 General

1. Prepare beds and surfaces for glazing and install glass of the type, thickness and quality specified in fixed and opening lights as shown on the drawings all in accordance with this Specification and to the satisfaction of the Director of Works.

## 1802 Materials

1. All glass shall be in accordance with BS 952-1:1995 and BS 952-2: 1980 and shall be free from all blemishes. Glass shall be delivered in proper containers with maker's name, guarantee, type of glass and thickness or weight of glass attached to the outside of the containers.
2. Sheet glass shall be 6mm thick ordinary quality glazing, unless stated otherwise.
3. Obscured glass shall be plain rough cast glass with one side textured, 6mm thick.
4. Wired glass shall be rough cast wired glass 6mm thick, polished Georgian wired having both surfaces ground and polished and with square mesh inserted during rolling.
5. Transparent silicone for glazing to timber frames of approved manufacture.
6. Transparent silicone for glazing to steel frames of approved manufacture.
7. Other type of safety glass could be used such as:
  - (a) Tempered glass is used to create entrance doors and other components in commercial buildings. It's also used in vehicles as door, vent and back glass. During the manufacturing process, tempered glass is heated to over 1,100 degrees. It's then shot with cold air, which forces the glass to cool very rapidly. That process causes the outer surface to become much harder than the inner material. As a result, tempered glass shatters into tiny fragments with rounded edges when it's broken.
  - (b) Laminated glass is used primarily for vehicle windshields. Two sheets of glass are bonded together by a plastic inner layer known as poly vinyl butyral (PVB). The inner layer softens the blow when anything hits the windshield and prevents the glass from separating. That, in turn, reduces the chances that you and your passengers will be seriously cut in the event of an accident.

1803 Workmanship

1. Clean timber rebates, prime and paint with one undercoat prior to applying silicone to frames.
2.
  - (a) Out glass to sizes (leaving suitable clearance) set in silicone bed in frames, sprigging for timber frames and wedging for metal frames and neatly silicone. Silicone shall not appear over sight liens.
  - (b) Alternatively set glass in silicone beds/wash leather and secure with glazing beads (by others) of the sizes and profiles shown on the drawings metal beads (by others) of the sizes and profiles shown on the drawings. Metal beads shall be secured with dome headed rustproof self-tapping screws at not more than 22.5cm centers. Timber beads shall be secured with brass caps and screws at not more than 22.5cm centers.
  - (c)
    - (i) Glaze all external windows except the W.C. or where otherwise specified with sheet glass as specified above.
    - (ii) Glaze internal clearstory lights, W.C. windows, fixed light panels and where otherwise specified in the Contract Documents with obscured glass.

1804 Sundries

1. Clean the glass inside and outside on completion and replace all cracked and broken glass.
2. Samples of alternative glazing materials shall be submitted to and require the written approval of the Director of Works.



**1900**

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# **Painting and Decorating**

1901 General

1. All metal fittings and fastenings are to be removed before the preparatory finishing processes are commenced, cleaned and refixed in position on completion.
2. All mild steel fittings, fastenings, screens, grills etc. shall be painted in accordance with Clause 1903.2.
3. Floors, fixtures and surfaces not to be painted shall be adequately protected.
4.
  - (a) A painting schedule will be provided prior to the execution of the work, specifying color and surfaces to be coated. Successive coats of paints shall be different shades to facilitate identification.
  - (b) Provision must be made for the execution of patterns or trial areas on the site if requested by the Director of Works.
5.
  - (a) All materials shall be applied strictly in accordance with the manufacturer's instructions. Any addition of thinner must be made under the supervision of the Director of Works and only as allowed by the manufacturer's instructions.
  - (b) All paints shall be brought to the site in the manufacturer's sealed containers; each container shall be labelled by the manufacturer with labels stating:
    - (i) The manufacturer's name, date of manufacture
    - (ii) The type of paints
    - (iii) The color
    - (iv) Instructions for thinning and mixing.
    - (v) Instructions for applying and warnings.
  - (c) Paints shall be stored in sealed containers and shall not be subject to extremes of temperature.
  - (d) Paints shall be used within their stated 'shelf life' or within 18 months of manufacture whichever period is lesser.
6. Paints shall not be applied in a relative humidity of 80% or over or externally in wet weather or damp conditions.

7. Surfaces for painting must be dry and free from dust, dirt, efflorescence or condensation.
8. Execute and complete all the painting and decorating work shown on the drawings/schedules all in accordance with this Specification and to the satisfaction of the Director of Works.

## 1902 Materials

1. Knotting shall be a solution of approved shellac or other resins in alcohol.
2. Stoppers shall be emulsion polymer based of approved manufacture.
3. Galvanizing shall be in accordance with BS EN ISO 1461:2009.
4.
  - (a) Wood primer shall be a low-lead content primer to BS 7956:2000 of approved manufacture.
  - (e) Metal primer, for application to steel surfaces, shall be a zinc chromate red oxide based primer of approved manufacture.
  - (f) Primer for application to galvanized surfaces shall be a calcium plumb ate metal primer of approved manufacture to BS 3698:1964-01-15.
  - (g) Plaster and concrete primers shall be an alkali resistant primer of approved manufacture.
5. Oil paint shall be alkyd-based paints in gloss matt or eggshell as specified, all of approved manufacture. Undercoats shall be from the same manufacture and shall be compatible with the finishing paint.
6. Emulsion paint shall be synthetic polymer dispersions in water of approved manufacture.
7. Lime wash shall be composed of slaked lime and alum with coloring pigments added as required all of best quality and to the satisfaction of the Director of Works.
8. Vanish shall be best quality synthetic resin based varnish of approved manufacture.
9. Bituminous paint shall be from natural asphalt dissolved in white sprit. It shall be of approved manufacture. Tar paint shall be hot applied tar complying with.

## 1903 Workmanship

### 1. General

- (a) Primed or undercoated timber or metal shall not be left in an exposed or unsuitable situation for an undue period before completing the painting.
- (b) Brushes, pails, kettles and the like used in carrying out the work shall be kept clean and free from foreign matter. They shall be cleaned before being used for different types or classes of materials.
- (c) Priming and undercoats shall be lightly rubbed down with fine sand-paper before subsequent coats are applied.

### 2. Paint on Metalwork

- (a) All steel surfaces to be painted shall be cleaned from rust, scale, loose paint, oil, dirt and all deleterious matter before priming. The cleaning shall be carried out to the approval of the Director of Works using power driven tools followed by steel wire brushing and dusting, wherever possible.
- (b) Prepared steel surfaces shall be primed with an approved primer. Priming of steelwork shall take place as soon as possible after preparation of surface. Provide a second coat of primer if undercoating cannot be carried out immediately afterwards.
- (c) Galvanized surfaces shall be treated with mordant washes prior to priming with approved primer.
- (d) Apply one undercoat oil paint, as specified, to the primed steelwork. Putty shall be painted at the same time wherever possible. All edges, angles, projections to have a stripe undercoat applied as soon as the first coat is dry.
- (e) Apply two finishing coats of oil paint as specified to the under coated steelwork.
- (f) The minimum dry film thickness of the paint coating shall be 200 microns.

### 3. Paint on Woodwork

- (a) All cracks, defects and holes in the woodwork shall be scraped out, primed, made good with hard stopping, leveled and rubbed down to an even surface.
- (b) Larger knots in woodwork shall be removed and replaced with sound wood and/or made good with approved filler. Small knots shall be treated with two coats knotting as specified above.
- (c) All woodwork shall receive one coat of approved primer prior to incorporation in the works.
- (d) All exposed woodwork shall be painted with 1 undercoat and 2 finishing coats oil paint, as specified.

4. Paint on Plasterwork or Concrete Surfaces

- (a) Prepare surfaces to be painted; large cracks shall be cut out with undercut edges and made good with cement mortar or equal and approved. Small cracks shall be made good with hard stopping and rubbed down level with the main face. Concrete surfaces to be painted shall be prepared with approved filler and rubbed down to a smooth, even surface.
- (b) Prime plaster surface with approved primer.
- (c) Apply two coats lime wash, as specified, to ceilings internally unless otherwise stated on the Contract Drawings.
- (d) Apply two coats emulsion paint, as specified, to walls and soffits internally, where indicated on the Contract Drawings.
- (e) Apply one undercoat and two finishing coats of oil paint, as specified, to plastered wall surfaces including surface preparation and putty as indicated in the Contract Drawings.

5. Painting with Tar or Bitumen

- (a) Apply two coats tar or bituminous paint to plastered/concrete surfaces below ground/fill level as indicated on the drawings. Or One layer membrane without chipping (Mineral slate granules layer) 5mm thick, including priming "GS/474" 500 (gr/m<sup>2</sup>) all in according to the contract documents.

- (b) Prior to the application of the tar or bituminous paint the surfaces to which it is to be applied shall be clean and dry. The first coat shall be allowed to dry before the second coat is applied.

1904 Sundries

1. Samples of all materials used for painting and decorating work shall be approved by and deposited with the Director of Works.
2. On completion of the works all painted surfaces shall be kept clean and free from dirt and dust.

**2000**

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**Electrical  
Installation**

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## 2001 General

1. The work shall be carried out to the satisfaction of and in accordance with the rules, regulations and requirements of the supply authority.
2. Execute and complete the electrical installation shown on the drawings and/or described in the Contract Documents.
3. Shop Drawings
  - (a) Before the commencement of the Works the Contractor shall submit one soft copy and two hard copies of drawings, detailing his proposals for the electrical installation, to the Director of Works.
  - (b) The drawings shall show the proposed location and sizes of all conduit runs, junction boxes, outlet boxes, connections, switches, sockets, cables, electrical boards, fittings, accessories and the like together with wiring diagrams.

## 2002 Materials

1. Cables and Cabling
  - (a) Power cabling from the source of supply to the distribution board and from the main distribution board to secondary distribution boards shall be of the underground type; such cables shall be of an approved four core P.V.C. (Polyvinyl Chloride) insulated and sheathed steel wire armored and PVC sheathed, and shall be in accordance with IEC 60502-1:2004+A1:2009 CSV Consolidated version standards-rated for not less than 1000 volts to ensure that voltage drop from the main to the distribution board does not exceed a 0.55 of the full rated load. The conductors shall be high-conductivity standard annealed copper or aluminum. These cables shall be used to connect between the source of supply and the various buildings and between one building and another. Routes as shown on the layout drawings shall be used.
  - (b) Where cables cross roads subject to heavy traffic, they shall be run in steel pipe. Where cables cross in, or under, concrete slabs, they shall be pulled in a 100mm diameter rigid PVC pipe embedded in concrete.
  - (c) Cables shall be laid in general at a depth of not less than 50cm below the ground surface on 150mm of clean dry sand. After laying the cable, 10mm of clean sand shall be poured over the cable as cover. Concrete tiles shall then be laid over the sand cover including warning strip before backfilling the trench.



- (d) Where two or more cables are laid in the same trench, a minimum of 150mm shall be left between them and they shall be laid in the same horizontal plane. Where crossing is necessary cables shall be clear of each other by at least 150mm.

## 2. Grounding

- (a) A grounding bus shall be established at the source of supply in according to the local electrical authority's requirements and regulations and the armor of each cable shall be grounded at both ends. Additional grounding rods shall be used as instructed by the Director of Works. Grounding rods shall be consists of three driven copper rods, 250cm long and 12mm diameter, the distance between each rod and the other have to be at least 7 meters with a checking man hall at least 60cm depth, and the ground resistance shall not exceed 5 Ohms.
- (b) Unless otherwise specified, all grounding wires shall be stranded cooper bare conductors without joints between the terminals. They shall be adequately protected from mechanical injury and shall be well secured at both ends with proper and approved ground clamps.
- (c) Facility shall be provided for the adequate earthling of each fitting.
- (d) All non-live metal parts shall be grounded. All equipment and system grounding shall be accomplished with separate conductors to the grounds bus.
- (e) The grounding connections of the distribution boards shall be carried out with AWG no.2 (American Wire Gauge) (35mm<sup>2</sup>) wires. Special care shall be taken to ensure ground continuity through the conduit system.
- (f) All grounded three-pin outlets shall have the ground terminal connected to the metal straps which are in contract with the box.

3. Conduit and Fittings

- (a) All cables and wires shall be carried in approved continuous, rigid PVC conduit conforming to BS 4607-1:1984+A2:2010 and BS 4607-5: 1982+A3: 2010, medium impact, unless otherwise stated. The installation shall be a screwed or adhesive fixed assembly embedded in the concrete slabs, beams or columns or run in chases out into the wall surfaces and covered with plaster unless surface fixing is specified. Adequate provision shall be made for expansion. Proper earthing continuity shall be provided in the drawn-through cabling. The inside surface of the erected conduit and fixings shall be hard, smooth and free from burrs.
- (b) All wires and cables passing under floor tiles shall be carried in galvanized continuous steel conduit to with fitting to BS 4607-1:1984+A2:2010 and BS 4607-5: 1982+ A3: 2010, and painted with black bituminous paint after erection, or rigid PVC conduit.
- (c) No conduit smaller than 16mm outside diameter shall be used. The conduit shall be of such diameter that the total cross-sectional area of the cables and wires inside does not exceed 50% of that of the conduit.
- (d) Approved junction or outlet boxes shall be used at all branching's of conduit r\or outlets. A maximum run of 10m with 2 no. 90 degrees bends shall not be exceeded between one box and another on a single run of conduit.
- (e) Junction boxes for concealed conduit runs shall be with knockouts. Reducing washers shall be used at boxes which do not have the required size of knockouts. Boxes shall have knockouts of conduit fitted to them. All boxes shall be supplied complete with covers, locknuts, bushings and the like.
- (f) Bends in conduits shall be made such that the inside radius of the bend is not less than two and a half times the outside diameter of the conduit. Bent angles shall not exceed 90 degrees.
- (g) Conduit work in floor slabs, or underground, shall be rendered water-tight by adhesive jointing with a waterproof adhesive approved by the Director of Works or by wrapping with a coating approved by the Director of Works.
- (h) Conduits passing through floor slabs, walls or partitions shall be protected by sleeves.

- (j) Conduits emerging from slabs for surface runs shall have all points of connection (i.e. bends) properly aligned so that the surface runs fit exactly in place.
- (k) Where conduit terminates in a box, a smoothly rounded bushing with a separate locknut, to the approval of the Director of Works, shall be used to provide protection against wire abrasion.
- (l) Surface mounted conduits to external or internal surfaces, where specified, shall be fixed by galvanized pressed steel or approved PVC straps at not more than 1.5m spacing for sizes up to 25mm diameter and not more.
- (m) All conduit ends left open during the course of the Works shall be plugged to avoid filling with plaster, and the like.

#### 4. Wire

- (a) PVC insulated PVC sheathed copper conductors to BS 6004:2012 shall be exclusively used for wiring inside conduits and an earth wire shall be approved by the Director of Works. Wires shall be standard 600 volt grade for both light and power circuits.
- (b) Pulling of wires inside conduit may be carried out before the finishing works have been completed, unless otherwise instructed by the Director of Works. However, connections to all devices and installation of fixtures shall be carried out after the finishing works have been completed.
- (c) No lubricant, other than soapstone, shall be used to facilitate pulling of wires.
- (d) All taps and joints in conductors shall only be made in outlets, junction boxes, and fuse boards, no joints shall be made in joint boxes. Connectors and clamps shall be of approved design shrouded with plastic insulation. At each fixture a loop or end of wire not less than 20cm long shall be left for connection to devices or fixtures. Soldered connections shall be used where conductors are under a strain. Non-acid base flux shall be used for soldering.
- (e) Insulation at joints connections shall be equal to the relative conductor insulation and shall be made with PVC insulating tape.
- (f) Wiring inside distribution boards shall be neat and well-arranged using appropriate lugs for termination and connection of conductors.
- (g) Switches shall be wired in the phase lines only. The neutral conductors shall not be broken. All outlets shall be wired in the same manner with the

phase always connected to the name pole (right pole when viewed from the rear or the top pole).

- (h) In three phase circuits, phase identification shall be applied by adopting red, yellow and blue for the three phases. The same color shall be used consistently for the same phase. No phase shall be allowed to terminate within 2.5m of any different phase. Neutral conductors shall have white insulation, grounding conductors, when required for grounding fixtures, shall have green insulation, or shall be bare copper wire.

5. Switches

- (a) Switches shall be of an approved silent tumbler type.
- (b) Outlet boxes for switches shall be fixed 1400mm above finished floor level, unless otherwise directed and 120mm horizontally from the outside edge of the nearest door architrave.
- (c) Outlet box shall be of standard grade two-piece, molded housing, totally enclosed, top-wired type, 220 volt, single pole, with bar-type plaster ears and mounting screws.

6. Socket Outlets

- (a) Boxes for socket outlets shall be installed 600mm above finished floor level unless otherwise directed.
- (b) Socket outlets to BS 546:1950 shall be approved 5 Amp. Or 15 Amp. Outlets, to take two-pin plugs and shall be complete with plug.
- (c) Outlets shall be suitable for 220 volts single phase and shall have molded casing, plaster ears and mounting screws.

7. Plates

- (a) Plates for switches and socket outlets shall be approved heavy-duty white plastic, fitting flush against the plaster, attached to the outlet box by two screws.

8. Tungsten Fittings

- (a) All ceiling lighting points for interior tungsten filament lamps are to be supplied to approved design and complete with ceiling rose, twin-twisted 1.00mm<sup>2</sup> heat resisting PVC covered flex, lamp holder and pearl coiled-

coil gas-filled filament lamp (blub) of wattage shown on drawings, and if indicated in the Bill of Quantities, also with the light fitting there stipulated (ceiling or wall type).

9. Fluorescent Lighting Fittings

- (a) All ceiling lighting points for fluorescent tubes with reflector are to be supplied to approved design complete with ceiling rose, twin-twisted 1.00mm<sup>2</sup> heat resisting PVC covered flex, suspension hooks and rod or chains of enough length and double tube fluorescent light fittings of the best quality in the market or in according to the specified type in the tender documents or equal approved by the Director Of Works complete with starter, tube holder, transformers, and two 36 watt daylight type fluorescent tubes all fitted in white enameled, steel, open-ended trough reflector (local made).

10. Distribution Boards

- (a) Distribution Boards shall be to BS EN 61439-2:2011 and BS EN 61439-3:2012 and shall be of the dust resistant 3 –phase 4-wire (solid neutral) 380/220 volt type with a main circuit breaker controlling a 3-phase distribution chamber with fuses for separate circuits mounted in a box of galvanized steel 2mm thick with a single door and wiring gutters and knockouts on all four sides. Alternatively, Miniature Circuit Breakers to BS EN 61439-3:2012 may be provided in place of fuses. The box shall be finished in medium light grey enamel over a rust inhibitor and the door shall have semi-concealed heavy duty galvanized hinges, combination catch and lock, and circuit directory card and card holder on the back. Distribution boards shall be wall-mounted with 12mm bolts.
- (b) 25% spare ways shall be allowed.
- (c) Circuit breakers shall be of the bolted-in type with interrupting rating of 7500 Amps. RMS a.c. and shall be of either three pole or single pole 380/220 volt as appropriate. They shall be of the quick made, quick break, trip free, trip indicating with thermal magnetic tripping mechanism (enabling non-automatic tripping) of the dust light and watertight type.

## 2003 Workmanship

1. The system of distribution shall be of the radial type, for both light and power circuits.
2.
  - (a) Connect the electrical installation to the electricity supply company's main supply and make all arrangements therefore and pay all charges in connection therewith.
  - (b) Provide all circuit breakers, meters and the like, required by the electricity supply company.
3. Lighting Wiring
  - (a) From distribution board run 1.5mm<sup>2</sup> twin-with-earth sheeted-wiring cables to the lighting points shown on the drawings terminate at each point with fitting as shown on the drawings. All earth wires shall have green sleeveings. No more than 12 lighting points shall be connected to 1 fuse way or Miniature Circuit Breakers (MCB). All in according to the drawings and the contract documents.
4. Socket Wiring
  - (a) From the distribution board run 2.5mm<sup>2</sup> twin-with-earth sheeted-wire cables to the socket outlets shown on the drawings. 15Amp sockets shall be connected to individual fuses or MCBs. 5 Amp sockets shall be connected in group of not more than 3 to individual fuses or MCBs. All in according to the drawings and the contract documents.
5. All motors over 1/8 HP shall be connected to individual fuse ways or MCBs. All motors other than fan motors less than 1/16 HP shall be provided with contactor starters fitted with overload tips and 'no-volt' release. All motors and other fixed appliances shall be provided with efficient means of isolation mounted immediately adjacent to the appliance. Final connection to motors and other appliances shall be made by means of PVC insulated cables enclosed in PVC covered flexible metal conduit of approved manufacture. A separate earth-wire shall in all cases be run through this conduit and exposed at either end. All in according to the drawings and the contract documents.

6. Testing

- (a) The complete system shall be thoroughly tested before operation. Tests shall be carried out by the Contractor, under the supervision of the Director of Works, or a person nominated by him. Any modifications or repairs necessary on the completion of the tests shall be made good at the Contractor's expense. The contractor shall provide all testing equipment and materials.
- (b) Tests at site shall include:
  - (i) Continuity test of the whole system, including the grounding system, shall be carried out by means of a bell and battery supply;
  - (ii) Megger tests shall be carried out on conductor installations and between insulated conductors and ground, using a 500 volt megger. Readings shall not be less than the value specified in the National Electric Code;
  - (iii) Operating tests shall be carried out on all circuits and equipment to the satisfaction of the Director of Works and the local electricity authority.

7. Labeling

- (a) All sockets, switches, cables, circuits, junction boxes, low voltage outlets shall be labeled using special labeling system to the approval of the Director of Works.

2004. Sundries

- 1. The Contractor shall leave the electrical installations in proper working order on completion of the works.
- 2. If indicated in the Bill of Quantities that wiring and outlets are required for a telephone system, such wiring and fitments will be according to instructions, and will be embedded in the walls with in-lets and outlets as shown on the drawings. Handsets and exchange will be provided by the Telephone Office or by the Agency, and the Authority in charge will also make connections to the exchange. Materials and labor should be approved standards.

**2100**

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## **Gas Installation**



## 2101 General

1. The work shall be carried out to the satisfaction of the Director of Works and in accordance with the rules, regulations and requirements of the supply authority.
2. Execute and complete the gas installation shown on the drawings and/or described in the Contract Documents.
3. Pipework shall be laid in UPVC pipe/sleeve underground and in galvanized pipe externally and to be painted in accordance with Series 1900 Painting and Decorating, unless otherwise specified.

## 2102 Materials

1. Pipework shall generally be copper to BS EN 12449:2012.
2. Gas outlets/ collectors
  - (a) Gas outlets shall be solid brass, chromium plated, and duplex gas outlets as specified in the contract documents or equal approved.
  - (b) Each gas outlet shall be provided with a 12mm diameter threaded, chromium plated pipe with two chromium plated back nuts and two hard neoprene washers; one end of the pipe shall be fitted with a 10mm diameter brass hose connector.
  - (c) Outlets, elbows, pipes and hose connectors shall be jointed with an approved jointing compound suitable for use with gas installations specified. Joints shall not be made with red lead.
  - (d) The gas outlets/collectors shall be put within a steel/galvanized distribution box size 60cm wide x 75cm height and 15cm deep recessed inside wall, including handles, key and painting all in according to the contract documents.
  - (e) Gas Regulator of the best quality in the local market shall be installed at the gas store, including the required distributor outlets, regulator, pressure reducer, gauges, and required connections all in according to the contract documents and the instruction of the Director of works.

1.
  - (a) Drill holes through tops to benches for pipes. Outlets shall be secured to bench tops by means of washers and back nuts on each side of the bench top.
  - (b) Copper pipes may generally be soldered but shall be brazed when near and appliance or subject to heating.
  - (c) Sharp bends and angles producing loss in pressure should be reduced to a minimum.
  - (d) Each run of pipe should be provided with a means of disconnection for easy cleaning or replacement.
  - (e) Pipes should be easily accessible without damaging the structure.
  - (f) Pipes should be properly supported with an incombustible material.
  - (g) As for a service pipe, where an installation pipe passes through a floor or wall, a sleeve should be provided, the space between sleeve and pipe being afterwards filled in.
  - (h) Where pipes are run on the surface of the structure, the support should be such that the pipe is held clear of the surface.
  - (j) Where vertical runs occur, means should be provided for removing obstructions by fitting a screwed plug at the bottom of the vertical run.
  - (k) Where non-ferrous pipes are used under floors, care should be taken to ensure that they will not be damaged by puncturing.
  - (l) Gas pipes should not touch other service pipes and should be laid as far as possible from electric cables.
  - (m) Pipes should not be laid near any source of heat.
  - (n) Where pipes are laid to points for future use only, the ends should be securely capped or plugged and be left under the floor surface preferably with access through a screwed-down trap.
  - (p) Joints in pipes should be of an approved type and jointing compounds, when used, should be non-corrosive and allow easy disconnection.

2104 Testing

1.
  - (a) Before connection to any meter and before the exposed pipes are painted, the system shall be checked by or under the supervision of the Supply Authority.
  - (b) Taps shall be specially designed for the type of installation specified (bottled or mains) and shall be tested to 5 lb/ Inch<sup>2</sup> pressure.
  - (c) Joints shall be tested to 3 lb/ Inch<sup>2</sup> pressure after completion and before painting.

Aluminum work

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**2200**

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**Aluminum work**

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## 2201 General

1. Execute and complete all aluminum work shown on the drawings and/or described in the Contract Documents according to the specified sizes, profiles, types and dimensional requirements in a proper manner and in accordance with the Specification, contract documents and the approval of the Director of Works.
2. The aluminum works shall include all required ironmongery and hardware of the best quality available including all accessories and fittings such as wheels, rails, hinges, handles, locks, brushes, rubbers, supporting arms, door jacks, silicone sealant, stainless steel, screws and angles...etc. in accordance to the contract documents and the approval of the Director of Works.
3. The contractor shall submit shop drawings to the Director of Works prior to the commencement of works as well sample of manufacturing for approval. Approval by the Director of Works of the shop drawings or samples shall not relieve the Contractor of his responsibilities under the Contract.

## 2202 Materials

1. Extruded aluminium sections should be used as approved by the Director of Works. Shape shall be as shown on the drawings and as required fulfilling performance requirements, but not less than 3 mm thick.
2. This specification covers extruded bars, rods, wires, profiles, and tubes made from aluminium and aluminium alloys and shall comply with ASTM B221-14. All the products should be produced by hot extrusion or similar methods. The chemical composition of each material is determined in accordance with the specified suitable chemical and spectra chemical test methods. Samples for chemical analysis should be taken when the ingots are poured or from the finished or semi-finished products by drilling, sawing, milling, turning, or clipping. Tensile properties, elongation, and yield strengths of each product should conform to the requirements listed herein. Elongation requirements are not applicable for materials with sizes smaller than the specified limits.
3. All visible surfaces of the sections shall be brilliantly polished prior to anodising. The colour of anodising shall be as described in the Drawings and the contract documents.
4. The sections shall be anodised to a minimum thickness of 25 microns and shall comply with ASTM B137 - 95(2004) And ASTM B680 - 80(2014). The supplier must submit necessary evidence to the satisfaction of the Director of Works that the thickness of anodization is not less than 25 microns. In case of doubt the Director of Works reserves the right to send sample pieces to independent testing laboratories.

5. All required ironmongery and hardware shall be complete according to the contract documents and to the satisfaction of the Director of Works.

#### 2203. Workmanship

1. The contractor shall verify all the dimensions of openings by field measurements so that all required aluminum works types as specified in the drawings and the contract documents including windows, doors, gates and fly screen...etc. will be accurately designed, fabricated and fitted to the structure. All frames shall be made to fit the actual openings with a maximum variation of erection tolerances 3mm clearance all round. Discrepancies in overall width or height exceeding 3mm will not be allowed and the frames will be rejected in such cases.
2. The manufacturing and erection of all aluminium works shall be in accordance with the manufacturer's written instructions and recommendations.
3. All windows, doors and gates shall be weather stripped with heat resistant PVC sections. The weather fighting action shall be achieved by a positive compressive action against the PVC section and shall not depend on an external contact with the PVC section. At every contact between two profiles two weathers tipping sections shall be provided for complete weather protection.
4. Hinges shall be in anodised aluminium with stainless steel pins and nylon washers. A mortice cylinder rim automatic deadlock of high quality with double pin tumbler shall be used when required.
5. The handle-latch set shall have all visible surfaces of anodised aluminium or similar non-rusting material to the approval of the Director of Works. The handle shall have a proper grip. The latching mechanism shall not be surface mounted but shall be concealed within the sections.
6. Glazing sections shall be in special heat-resisting PVC and of channel type. Separate glazing sections on each side of the glass will not be permitted. The thickness of the glass shall be as specified in the drawings and the contract documents but not less than 4mm thick. In case of the double sheets glass the minimum thickness shall be 6mm out, 4mm void and 4mm in.
7. If aluminium shutter or louvre specified in the drawings and the contract documents the contractor shall follow the details accordingly to the approval of the Director of Works. The shutter sections for windows and doors shall be of tubular type and shall be including flanges. The shutters of the windows and doors shall be assembled with concealed corners of high rigidity. Hinges shall be concealed within the sections. The rollers for sliding shutters for windows and doors shall be of an adjustable type. The adjusting screws shall be accessible in the assembled state of the shutters.

2204. Sundries

1. On completion of the works all frames, sections, latches, hinges, locks, angles, brushes, rubber, screws, glass and the like shall be cleaned, to be free from dirt, tested and functioning properly to the satisfaction of the Director of Works.
2. All keys shall be clearly labelled with plastic tags (5cm x 2cm) securely fixed to the keys, which shall be handed to the Director of Works.

## Appendix

# APPENDIX

The following is a list of British Standards to which reference is made in this Specification

1. British Standards or Others	(Published by British Standards Institution or Others)
BS EN 197-1:2011	Cement. Composition, specifications and conformity criteria for common cements.
BS EN 12620: 2002+A1: 2008 BS EN 1008:2002	<u>BS EN 12620: 2002+A1: 2008</u> -Aggregates for concrete.  <u>BS EN 1008:2002</u> -Mixing water for concrete. Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete
BS 4449: 2005+A2: 2009	Steel for the reinforcement of concrete. Weldable reinforcing steel. Bar, coil and decoiled product. Specification.
BS 4483: 2005	Steel fabric for the reinforcement of concrete. Specification.
BS 8666: 2005 BS EN ISO 3766: 2003	<u>BS 8666: 2005</u> - Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete. Specification.  <u>BS EN ISO 3766: 2003</u> - Construction Drawings. Simplified representation of concrete reinforcement...
BS 1881-122:2011 BS 1881-130: 2013	<u>BS 1881-122:2011</u> - Testing concrete. Method for determination of water absorption.  <u>BS 1881-130: 2013</u> - Testing concrete. Method for temperature-matched curing of concrete specimens.
BS EN 1995-1-1:2004+A2:2014	<u>BS EN 1995-1-1:2004+A2:2014</u> - Design of timber structures. General. Common rules and rules for



BS 144:1997	buildings.  <u>BS 144:1997</u> - Specification for coal tar creosote for wood preservation.
BS EN 942:2007	Timber in joinery. General requirements.
BS EN 10029:2010 BS EN 10210-1:2006 BS 7668:2004 BS EN 10025-1:2004 BS EN 10025-3:2004 BS EN 10025-4:2004	<u>BS EN 10029:2010</u> - Hot-rolled steel plates 3 mm thick or above. Tolerances on dimensions and shape.  <u>BS EN 10210-1:2006</u> - Hot finished structural hollow sections of non-alloy and fine grain steels. Technical delivery requirements.  <u>BS 7668:2004</u> - Weldable structural steels. Hot finished structural hollow sections in weather resistant steels. Specification.  <u>BS EN 10025-1:2004</u> - Hot rolled products of structural steels. General technical delivery conditions.  <u>BS EN 10025-3:2004</u> - Hot rolled products of structural steels. Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels.  <u>BS EN 10025-4:2004</u> - Hot rolled products of structural steels. Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels.
BS EN 13914-2:2005	Design, preparation and application of external rendering and internal plastering. Design considerations and essential principles for internal plastering.
BS EN 13914-1: 2005	Design, preparation and application of external rendering and internal plastering. External rendering.
BS EN 13658-1:2005 BS EN 13658-2: 2005	<u>BS EN 13658-1:2005</u> - Metal lath and beads. Definitions, requirements and test methods. Internal plastering.  <u>BS EN 13658-2: 2005</u> - Metal lath and beads. Definitions, requirements and test methods. External rendering.
BS 5385-1:2009	<u>BS 5385-1:2009</u> - Wall and floor tiling. Design and installation of ceramic, natural stone and mosaic wall

BS 5385-3:2014 BS 5385-2:2015	tiling in normal internal conditions. Code of practice.  <u>BS 5385-3:2014</u> - Wall and floor tiling. Design and installation of internal and external ceramic and mosaic floor tiling in normal conditions. Code of practice.  <u>BS 5385-2:2015</u> - Wall and floor tiling. Design and installation of external ceramic, natural stone and mosaic wall tiling in normal conditions. Code of practice
BS EN 14411:2012	Ceramic tiles. Definitions, classification, characteristics, evaluation of conformity and marking.
BS EN 13748-1:2004 BS EN 13748-2:2004	<u>BS EN 13748-1:2004</u> - Terrazzo tiles. Terrazzo tiles for internal use.  <u>BS EN 13748-2:2004</u> - Terrazzo tiles. Terrazzo tiles for external use.
BS EN ISO 10581:2013 BS 7976-1:2002+A1:2013 BS 7976-2:2002+A1:2013 BS 7976-3:2002+A1:2013	<u>BS EN ISO 10581:2013</u> - Resilient floor coverings. Homogeneous poly (vinyl chloride) floor covering. Specifications.  <u>BS 7976-1:2002+A1:2013</u> - Pendulum testers. Specification.  <u>BS 7976-2:2002+A1:2013</u> - Pendulum testers. Method of operation.  <u>BS 7976-3:2002+A1:2013</u> - Pendulum testers. Method of calibration.
BS EN 1339:2003 BS EN 1338:2003 BS 7533-3:2005+A1:2009	<u>BS EN 1339:2003</u> -Concrete paving flags. Requirements and test methods.  <u>BS EN 1338:2003</u> - Concrete paving blocks. Requirements and test methods.  <u>BS 7533-3:2005+A1:2009</u> - Pavements constructed with clay, natural stone or concrete pavers. Code of practice for laying precast concrete paving blocks and clay pavers for flexible pavements.
BS EN 13598-1:2010	Plastics piping systems for non-pressure underground drainage and sewerage. Unplasticized poly (vinyl

	chloride) (PVC-U), polypropylene (PP) and polyethylene (PE). Specifications for ancillary fittings including shallow inspection chambers.
BS 5911-1:2002+A2:2010 BS 5911-3:2010+A1:2014	<p><u>BS 5911-1:2002+A2:2010</u>- Concrete pipes and ancillary concrete products. Specification for unreinforced and reinforced concrete pipes (including jacking pipes) and fittings with flexible joints (complementary to BS EN 1916:2002).</p> <p><u>BS 5911-3:2010+A1:2014</u>- Concrete pipes and ancillary concrete products. Specification for unreinforced and reinforced concrete manholes and soak ways (complementary to BS EN 1917:2002).</p>
BS EN 124-1: 2015 BS EN 124-2: 2015	<p><u>BS EN 124-1: 2015</u>- Gully tops and manhole tops for vehicular and pedestrian areas. Definitions, classification, general principles of design, performance requirements and test methods.</p> <p><u>BS EN 124-2: 2015</u>-Gully tops and manhole tops for vehicular and pedestrian areas. Gully tops and manhole tops made of cast iron.</p>
BS EN 13108-1:2006 BS EN 13108-7:2006 BS EN 12591: 2009	<p><u>BS EN 13108-1:2006</u>- Bituminous mixtures. Material specifications. Asphalt Concrete.</p> <p><u>BS EN 13108-7:2006</u>- Bituminous mixtures. Material specifications. Porous Asphalt.</p> <p><u>BS EN 12591: 2009</u>- Bitumen and bituminous binders. Specifications for paving grade bitumen.</p>
ASTM D6222- 11 ASTM D6223- 02(2009)e1	<p><u>ASTM D6222-11</u>-Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Polyester Reinforcements.</p> <p><u>ASTM D6223- 02(2009) e1</u>- Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibber Reinforcements.</p>
BS EN 13707:2013	Flexible sheets for waterproofing. Reinforced bitumen sheets for roof waterproofing. Definitions and characteristics.

BS EN 1340:2003	Concrete kerb units. Requirements and test methods.
BS EN 1304:2013 BS EN 490: 2011 BS EN 491: 2011	<p><u>BS EN 1304:2013</u>- Clay roofing tiles and fittings. Product definitions and specifications.</p> <p><u>BS EN 490: 2011</u>- Concrete roofing tiles and fittings for roof covering and wall cladding. Product specifications.</p> <p><u>BS EN 491: 2011</u>- Concrete roofing tiles and fittings for roof covering and wall cladding. Test methods.</p>
BS 5534:2014+A1:2015	Slating and tiling for pitched roofs and vertical cladding. Code of practice
BS 3083:1988	Specification for hot-dip zinc coated and hot-dip aluminum/zinc coated corrugated steel sheets for general purposes.
BS EN ISO 1479:2011	Hexagon head tapping screws.
BS EN 12200-1:2000 BS EN 607:2004 BS EN 1462:2004	<p><u>BS EN 12200-1:2000</u>- Plastics rainwater piping systems for above ground external use. Unplasticized poly (vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system.</p> <p><u>BS EN 607:2004</u>- Eaves gutters and fittings made of PVC-U. Definitions, requirements and testing.</p> <p><u>BS EN 1462:2004</u>- Brackets for eaves gutters. Requirements and testing.</p>
BS 4514:2001 BS EN 1329-1:2014	<p><u>BS 4514:2001</u>- Unplasticized PVC soil and ventilating pipes of 82.4 mm minimum mean outside diameter, and fittings and accessories of 82.4 mm and of other sizes. Specification.</p> <p><u>BS EN 1329-1:2014</u>- Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Unplasticized poly (vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system.</p>
BS EN 10255:2004	<u>BS EN 10255:2004</u> - Non-alloy steel tubes suitable for welding and threading. Technical delivery conditions.

BS EN 10241:2000	<u>BS EN 10241:2000</u> - Steel threaded pipe fittings.
BS EN 12449:2012 BS EN 1254-1:1998 BS EN 1254-2:1998	<p><u>BS EN 12449:2012</u>- Copper and copper alloys. Seamless, round tubes for general purposes.</p> <p><u>BS EN 1254-1:1998</u>- Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes.</p> <p><u>BS EN 1254-2:1998</u>- Copper and copper alloys. Plumbing fittings. Fittings with compression end for use with copper tubes.</p>
BS EN ISO 1452-1:2009 BS EN ISO 1452-2:2009 BS EN ISO 1452-3:2010 BS EN ISO 1452-4:2009	<p><u>BS EN ISO 1452-1:2009</u>- Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly (vinyl chloride) (PVC U). General.</p> <p><u>BS EN ISO 1452-2:2009</u>- Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly (vinyl chloride) (PVC U). Pipes.</p> <p><u>BS EN ISO 1452-3:2010</u>- Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly (vinyl chloride) (PVC-U). Fittings.</p> <p><u>BS EN ISO 1452-4:2009</u>- Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly (vinyl chloride) (PVC U). Valves.</p>
BS EN 12201-1:2011 BS EN 12201-2:2011+A1:2013 BS EN 12201-5:2011	<p><u>BS EN 12201-1:2011</u>- Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). General.</p> <p><u>BS EN 12201-2:2011+A1:2013</u>- Plastics piping systems for water supply and for drainage and sewerage under pressure. Polyethylene (PE). Pipes.</p> <p><u>BS EN 12201-5:2011</u>- Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). Fitness for purpose of the system.</p>

BS 4213:2004 BS EN 13280:2001	<u>BS 4213:2004</u> - Cisterns for domestic use. Cold water storage and combined feed and expansion (thermoplastic) cisterns up to 500 l. Specification.  <u>BS EN 13280:2001</u> - Specification for glass fiber reinforced cisterns of one-piece and sectional construction, for the storage, above ground, of cold water.
BS 417-2:1987	Specification for galvanized low carbon steel cisterns, cistern lids, tanks and cylinders. Metric units.
BS 952-1:1995 BS 952-2: 1980	<u>BS 952-1:1995</u> - Glass for glazing. Classification.  <u>BS 952-2: 1980</u> - Glass for glazing. Terminology for work on glass.
BS EN ISO 1461:2009	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.
BS 7956:2000	Specification for primers for woodwork.
BS 3698:1964-01-15	Specification for calcium plumbate priming paints.
IEC60502-1:2004+A1:2009 CSV Consolidated version	Power cables with extruded insulation and their accessories for rated voltages from 1 kV ( $U_m = 1,2$ kV) up to 30 kV ( $U_m = 36$ kV) - Part 1: Cables for rated voltages of 1 kV ( $U_m = 1,2$ kV) and 3 kV ( $U_m = 3,6$ kV).
BS 4607-1:1984+A2:2010 BS 4607-5:1982+A3:2010	<u>BS 4607-1:1984+A2:2010</u> - Non-metallic conduits and fittings for electrical installations. Specification for fittings and components of insulating material.  <u>BS 4607-5: 1982+A3: 2010</u> - Non-metallic conduit fittings for electrical installations. Specification for rigid conduits, fittings and boxes of insulating material.
BS 6004:2012	Electric cables. PVC insulated and PVC sheathed cables for voltages up to and including 300/500 V, for electric power and lighting.
BS 546:1950	Specification. Two-pole and earthing-pin plugs, socket-outlets and socket-outlet adaptors.

BS EN 61439-2:2011 BS EN 61439-3:2012	<p><u>BS EN 61439-2:2011</u>- Low-voltage switchgear and control gear assemblies. Power switchgear and control gear assemblies.</p> <p><u>BS EN 61439-3:2012</u>- Low-voltage switchgear and control gear assemblies. Distribution boards intended to be operated by ordinary persons (DBO).</p>
BS EN 12449:2012 BS EN 1254-1:1998 BS EN 1254-2:1998	<p><u>BS EN 12449:2012</u>- Copper and copper alloys. Seamless, round tubes for general purposes.</p> <p><u>BS EN 1254-1:1998</u>- Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes.</p> <p><u>BS EN 1254-2:1998</u>- Copper and copper alloys. Plumbing fittings. Fittings with compression end for use with copper tubes.</p>
ASTM B221 - 14	Standard Specification for Aluminium and Aluminium-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
ASTM B137 - 95(2004) ASTM B680 - 80(2014)	<p><u>ASTM B137 - 95(2004)</u> - Standard Test Method for Measurement of Coating Mass Per Unit Area on Anodic ally Coated Aluminium.</p> <p><u>ASTM B680 - 80(2014)</u> - Standard Test Method for Seal Quality of Anodic Coatings on Aluminium by Acid Dissolution.</p>