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Annex G

Technical Specifications

October 2019

TECHNICAL SPECIICATIONS

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VOLUME III: Technical Specifications

SECTION: 1: GENERAL CONDITIONS

1.1 General

These specifications are to specify the quality of materials, level of workmanship, and methods to be followed and respected in executing and maintaining **Construction of Altayba Secondary Girls School- Jenin**which is owned by the Ministry of Education and Higher Education– Palestine.

1.2 Drawings

The contractor shall be provided with a list of drawings included in this bid on page G-002 of the drawings file. All expenses burned by the contractor, to execute the conditions included in this section, on the contractor own cost and his unit rates in the bills of quantity shall be deemed to include all costs and expenses.
In case the contractor asks for additional copies of the project drawings, he shall be provided with the copy at the cost of **Two Hundred Euro** payable to the Ministry of Education and Higher Education.

1.3 Bidding Documents

The bidding documents complete each other and to consider the case which gives the higher quality in executing as the Engineers decides. The contractor is to consider this when he prices the bill.
The contractor who participates in the bid must return all bidding documents, drawings and addenda including the pre-bid meeting, signed and stamped from his behalf. If the contractor didn't return any of these documents with his offer, the bidding committee has the right to reject his offer.

1.4 Shop Drawings

If during executing the work or before, the Engineer found that the contractor needs shop drawings to execute a certain task, the contractor must prepare these drawings and submit them to the Engineer for approval. The Engineer has the right to instruct the contractor at any time to submit shop drawings, which the Engineer considers necessary for executing a certain task. The contractor is to abide by this instruction and don't proceed with the task before the Engineer approves the shop drawings.
The shop drawings must be fully detailed with a suitable scale and unless otherwise specified be submitted in four copies.
The Engineer has within a reasonable time from receiving the shop drawings approve the drawings. If the Engineer returns the drawings with notes, the contractor shall adjust the drawings as instructed by the Engineer and resubmit to the Engineer for approval and he must point out the adjustment made to the first drawing according to the standard procedure.

1.5 As- Built Drawings

The contractor, at his own cost, shall check drawing number as necessary during execution of works. The contractor is required to obtain the Engineers approval on this adjustment. When the contractor hands over the works, he shall prepare a new set of drawings for the project as executed with all adjustments (if any) and submit to the Engineer for approval. When the Engineer approves the As-Built drawings the contractor shall submit one scaled calculation copy and one computer CD copy (prepared for AutoCAD) written on it the project name and the phrase "AS-BUILT DRAWINGS المخططات كما تم تنفيذها".

The final payment to the contractor shall be paid according to the works actually executed as recorded in the AS-BUILT drawings mentioned above.

1.6 Scaffolding

The contractor shall provide, erect and maintain the needed scaffoldings to execute the works of this project. Upon completion the contractor shall remove them. The contractor is to take all the necessary safety measures related to these scaffoldings and repair any damages caused by the scaffoldings to the permanent works during the execution period.

1.7 Protection of Works

The contractor, in the course of completing his obligation according to contract conditions, is to protect and maintain the existing borders of the area (steel angles). In case they are moved or removed, because of the contractor usage of his equipment or any other reason, the contractor is return these angles to its correct position as per the coordinate provided by the Engineer. The contractor is to cover and protect the works from the climatic conditions or misuse or negligence … etc, by providing proper barrier, covers according to the Engineer's approval. The contractor, at his own expenses, shall repair any damages to the works caused by his negligence, or not fulfilling his obligation, according to the Engineer's instruction and satisfaction.

1.8 Materials and Its Equivalent

All materials and goods must be according to technical specification. In no instance will environmentally harmful products, such as asbestos, dangerous wood varnishes, etc. be used.

The contractor is to submit the specification and description of the materials that he intends to supply with all necessary information to the Engineer to investigate before supplying. These information include, but not limited to, trade name, manufacturer address and the contractor is to submit samples if asked by the Engineer.

Wherever a trade name or catalogue number to any material or any item of work in the specification or bills of quantities or drawings, this is necessary to specify the level of specification required. The contractor can suggest alternatives for these materials provided it is with the same level of specification, and to obtain the Engineers approval.

When an alternative material, other than mentioned in the contract, is approved and it was not in the same level of specification, the Engineer has the right to refuse deduction to the unit rate of these materials. No increase to the contractor prices should be made if better materials were provided (compared to the required specification).

Wherever, in the bills of quantity or specification or drawings, a trade name is mentioned or materials known by its manufacturer company or distributing company or catalogue number, it is to be auto-

matically understood that the required is these materials or equivalent even if the phrase “or equivalent” is not mentioned.

1.9 Samples

The contractor shall execute the works according to the accepted samples and following conditions:-

a. The cost of all samples shall be borne by the contractor.
b. The contractor is to submit samples before a reasonable time of starting the work to give the Engineer time to inspect the samples and make the required tests.
c. The samples shall be submitted with a letter containing all the needed information to obtain the Engineers approval.
d. The samples shall be kept at the Engineers office in the site.

1.10 Materials’ Testing

The Engineer has the right to ask the contractor to accompany the required materials with a testing certificate from the source either from the manufacturer or a laboratory approved by the Engineer.

The Engineer has the right to test samples from any material supplied to the site, and whenever needed, either in the lab specified by the Engineer inside the country or outside. Any materials that don’t pass the test shall be rejected.

The contractor is to make for the Engineer and his assistants all necessary assistance and services to test the materials brought to site and taking samples and checking measurements and weighs and provides on his own expenses whatever need from labor, tools, materials …etc.

1.11 The Construction specified for the Use of the Supervision Staff

Supervision office, the cost of the offices for the Engineer’s use shall be included in the contractor’s prices in the bills of quantity as described in the tender documents section III Particular condition.

The contractor should complete constructing the Engineer and inspectors offices within 30 days of receiving the order to start works, and during this period, the contractor must provide temporary movable offices for the use of the Engineer and supervision staff. If the contractor didn’t provide the above or didn’t provide the required services, the Engineer has the right to deduct a penalty of Euro 50 /day for every day the contractor delays in providing the above. The Engineer shall also have the right to provide these services and needs on the contractor expenses. And all sums shall be deducted from the contractor payment and insurance whatever sum it reach.

The contractor shall during the execution of works provide all the required services for the above-mentioned offices including maintenance, cleaning, keeping and guarding the offices and its content at all times.

The contractor shall be responsible for all the costs of the needed services of the Engineer and inspectors offices and their maintenance including electricity, water, telephone, cleaning the sewage pit, providing drinking water and all needed papers, books, files,… for the works according to Engineer’s approval.

The required offices shall be erected in the place approved by the Engineer, and shall stay during the execution of the works and afterwards shall become the property of the school. The contractor must hand it over in a good condition without any construction or architectural defects.

1.12 Temporary Construction for the Contractor's Use

The contractor must, from the day of the order to start works, shall be exist in the site in a movable or temporary office for the use of his staff to receive the Engineer's instruction when needed. The office shall be in the size suitable for the contractor's needs and requirements and he must obtain the prior approval of the Engineer on this office.

The warehouses needed for the contractor use sufficient to store all construction materials needed for the project including equipment and tools. These warehouses must have all the conditions required to protect the materials from the environmental conditions.

The contractor shall be responsible to guard and maintain all the above-mentioned temporary constructions that are used by the contractor. He shall also be responsible to provide the required services for these constructions.

The contractor shall bear all the costs of constructing these temporary constructions.

1.13 Removing the Temporary Constructions

All temporary constructions for the contractor use shall be kept in all times in a good condition until all stages of works are completed and finally handed over. Afterwards, the contractor shall remove all these constructions and its residuals and cleaning its locations properly so that they leave no trace. If the contractor didn't fulfill this obligation, the Engineer has the right to execute these tasks on the contractor's account and deduct all the expenses from the contractor's payment and insurance with the owner, whatever sum it reach without any legal procedure.

1.14 Temporary and Permanent Services

The contractor shall, at his own expense, redirect public services if exist (like electricity, water, …) which he found during work and according to Engineer's directions and approval. If existing services is connected to or related to or related to the works, the contractor shall maintain and keep in place until handing over the works.

The contractor shall, on his own cost, repair any damages to the public services like telephone, electrical, sewage and water services for the concerned authorities or a third party.

If the concerned authority or the third party decided to repair the damages by itself, or asking any of its representatives to do so, the contractor shall born the cost of these repairs don by the concerned authority or the third party. The owner, according to the contract conditions, shall not be responsible for any claims for such actions.

1.15 Contradiction in the Contract Documents

The contract documents complete each other and in case of contradiction or ambiguity in the contract documents the contractor shall raise it to the Engineer's attention. The Engineer shall make the appropriate decision and inform the contractor. In case of contradiction or ambiguity, as mentioned above, the contractor price shall be as recorded in the bills of quantities. In case any material or work needed to execute the works is not mentioned in the bills of quantities, the contractor has to execute these materials or works and their cost shall be deemed to be automatically included in the contractor's price for the related item.

1.16 Site Meetings

During executing the works and on a periodical base, site meetings shall be held every 2 weeks or whenever needed for the purposes to coordinate the works and to be sure that it is properly exe-

cuted according to contract conditions and technical specification. Minutes of the meetings shall be prepared by the Engineer or his representative and distributed to all parties and it shall be followed.

The contractor shall present in the meeting detailed of the works intended to be executed in the next two weeks, which shall be discussed and proper instruction shall be given, and these instructions and approval issued in the meeting shall be followed by the contractor.

1.17 Daily Reports

The contractor shall submit to the Engineer (or his representative) a daily report containing the required information on the labor (No.s types & hours), equipment and materials arrived to the site and works executed in that day.

1.18 Photographs of Progress of Works

The contractor at his own expense shall submit once a month, or as the Engineers find suitable, suitable number of colored photographs in 3 copies (size 10x15 cm) for the executed works or works under progress as directed by the Engineer. The original Digital files and all copies shall be the ownership of the owner, and the photos can't be use without his approval.

1.19 Work Schedule

The contractor shall prepare (in 3 copies) and submit schedule of the work including all tasks of the subcontractors any works in the contract condition. The contractor shall keep a copy in his site office and submit 2 copies to the Engineer.

The contractor has to make monthly (or as the Engineers see necessary) adjustment to the schedule according to site conditions and progress of works. Two copies of the revised schedule shall be submitted to the Engineer**.**

1.20 Measurement of Works

The Engineering measurement (international measurements) shall be used for all works; all openings and intersection shall be deducted. Actual net distances shall be calculated but not exceeding the measurement reported in the drawings.
American Measurements and standards like inch, feet, ASTM etc will be used.

1.21 Codes And Standards

Where ever B.S. Standard is mentioned it should be read as follows:-
All building materials and equipment should be registered with an international recognized norm institution or correspond to an international recognized norm. The standards used shall be DIN, ISO, and B.S..Standard
or approved equivalent.

SECTION 2: EXCAVATION AND EARTHWORKS

2.1. Datum and Nature of Excavation

The Contractor shall be responsible for setting up and maintaining a site datum level. 'Zero' datum shall be given on the site by the Engineer, unless otherwise noted on the Drawings.
Information pertaining to the nature of the ground may be given to the contractor, when available, but without any guarantee of correctness or accuracy.

2.2. Bench Marks

The Trade Contractor shall establish permanent benchmarks determined by an approved land surveyor or professional civil engineer..Maintain all established bounds and benchmarks and replace as directed by the Construction Manager those, which are destroyed or disturbed due to the excavation operations, at no cost to the Owner.

Each Benchmark (B.M.) or centerline for the building and/or other constructions to be under this contract, shall be properly set out by the Contractor as shown on the Drawings and inspected and approved by the Engineer prior to commencing excavations.

2.3. Surface Leveling

All earth works on Site shall be completed before any fill is deposited. Excavations over areas of Site or filling with approved material shall be carried out where required to the levels shown on the Drawings or to such other levels as may be directed by the Engineer.

2.4. Size and Depth of Excavation

Excavation shall be cut to the size of the foundation shown on the Drawings and taken down to the foundation levels shown on the Drawings. If, without the Engineer's written instructions, the Contractor goes down below the foundation level specified, he shall fill up the part so excavated with concrete of the same type and grade as that required for the piles as defined in Concrete Works and the Bill of Quantities at his own expense.

2.5. Reduced Levels

All excavation for reduced levels shall be carried out to the lines and levels shown on the drawings or to such lines and levels as directed by the Design Professional.
If, from any cause whatsoever, excavation are carried out beyond their true line and level other than that directed by the Design Professional, the Trade Contractor shall, at his own cost, make good to the required lines and levels with mass concrete as directed by the Design Professional.
All excavations shall be performed so that the works are continually and effectively drained.

2.6. Shoring Excavations and Dewatering

The sides of excavations shall be supported as necessary to maintain a vertical face and/or to prevent caving-in of any nature, especially during subsequent operations. The Contractor shall be responsible for the design, supply, fixing, safety and removal of all planking, strutting and shoring required to the side of the excavation. The Contractor is responsible on the type and nature or soil to be excavated; also he is to use any equipment, including dewatering equipment, to carry out the work required by this Contract.

2.7. Types of Excavations

Excavations shall be classified according to the nature of the materials to be removed either as excavation in rock or as excavation in earth. Excavation in rock shall be classified as including all excavations in hard and consolidated materials which cannot be removed by normal excavation tools and equipment, and which require drilling or other special means for their removal. All excavation which is not in rock shall be defined as excavation in earth.

2.8. Required Bearing Capacity

The Contractor shall notify the Engineer and obtain instructions if the required bearing capacity:
(1).is obtained at a lesser depth than that shown on the drawings.
(2).is not obtained at the depth shown on the drawings.

Excavation bottoms are to be approved before new work is laid on them. The Contractor is to inform the Engineer when excavations are ready for inspection. If, after approval, surfaces become unsuitable due to flooding or other causes, the Contractor shall excavate further, backfill with approved filling material and compact to approval at no extra cost to the owner.

Should the soil condition, after the Engineer has been informed the excavations are ready for inspection, be such that the Engineer dems it necessary to carry out tests, the Contractor shall perform such tests to the satisfaction of the Engineer. Any expenses incurred in the performance of such tests are deemed to be included by the Contractor in his tender.

2.9. Filling

All filling materials shall be approved by the Engineer before being placed in position. Approved earth, sand, or any other suitable material free from rubbish shall be used to make up levels as shown on the Drawings. The material shall be placed in successive layers each having a finished thickness not exceeding 250 mm before compaction, watered and compacted to at least 98% compaction ratio of the maximum dry density of the Modified Proctor test (ASTM D-1557) prior to the placement of the succeeding layer.

Any exposed side or edge of fill shall be properly and evenly graded to a slope as directed or specified. When the required quantities of approved fill are not found on Site the Contractor shall, at his own expense, obtain them from locations approved by the Engineer.

Filling to make up levels under building shall be executed with approved suitable material from existing ground levels up to underside of ground floor slab, and shall be placed in successive layers each having a finished thickness not exceeding 250mm, compacted to at least 98%

compaction ratio of the maximum dry density of the Modified Proctor test (ASTM D-1557) prior to the placement of the succeeding layer.

The ground surrounding the building and pavements shall be filled with approved material, fine sand and coarse materials, free of foreign materials, debris, clay lumps, organic and vegetation.

a) Coarse materials
Such as sandy gravel, gravelly sand, etc., which is the material retained on sieve no. 4, and consists of crushed rock. It shall be clean, hard, tough and free from deleterious substance.

b) Fine Sand Materials
Shall consist of that portion of the total aggregate/fines passes no.4 sieve, such as sand, silty sand,…etc.
The fill materials shall consists of the combination of coarse and fine sand and conform to the following grading:

Sieve Size.....	1/ 2 "	...3/8"	.... # 4	.....# 10	# 30	....# 60		# 200	
%	90-100		.80-90	.. 58-72	 42-50	28-38	8-18		2-5
	70-100		.60-85	.. 50-75	 30-60	20-40	... 10-25	0-10	
Pass	100	.90-100	.. 65-85	 35-45	20-30	... 15-30	3-8		

The fine sand shall conform to the following grading:-

Sieve Size	# 4	# 30	# 60	# 200
%	100	80-100	30-50	4-8
	90-100	80-90	20-30	0-10
Pass	100	90-100	40-90	5-15

In addition, shall conform to the following physical requirements:
Minimum CBR 35 %..Coarse materials, Kurkar
25 %..Fine sand, Sand

2.10. Disposal of Surplus Material

All surplus excavated material not used in backfilling or leveling shall be loaded and transported elsewhere on the Site as required by the Engineer or, if not required on the Site, shall be loaded and carted away from the Site to a dump to be selected by the Contractor and approved by the Municipality at the Contractor's own expense.

All rubbish arising from the Works shall be cleared away and removed from the Site as it accumulates according to the Engineer's instructions and also on completion of the Works.

SECTION 3: CONCRETE WORK

3.1 General

All materials shall be subject to such tests as the Engineer may direct and provision for such tests shall be included in the price for such materials inserted in the Bill of Quantities or Schedule of Rates unless otherwise provided for. In case such tests required by the Engineer, an independent and officially authorized lab shall carry out such tests and sampling.

Properly representative samples of all materials to be used in the works shall be submitted by the Contractor for the Engineer's approval when required.

Where tests are required by the Engineer, the Contractor shall take samples and send to a firm experienced in analysis of the material. Reports shall be submitted to the Engineer. The Contractor shall bear all expenses consequent to the provision, taking and cartage, etc. of samples, in addition to the costs of performing the tests and reporting the results.

The Engineer reserves the right to reject any material which, in his opinion is objectionable in any respect, not withstanding its apparent compliance with the relevant Standards. Any such rejected material shall be removed from the site at the Contractor's expense at once.

3.2 Formwork for Concrete

The Contractor shall supply, design, erect, strike and remove the formwork and be entirely responsible for its stability and safety so that it will carry the fresh concrete and all incidental loadings and preserve it from damage and distortion during its placing, vibration, ramming, setting and curing. It shall be so constructed as to leave the finished concrete to the dimensions shown on the Drawings and of a material capable of providing the surface finish specified. In any event, the maximum permissible deflection under all loads shall not exceed l/480 of the free span according to ACI.

For any kind of concrete works ready mix concrete should be used.

Formwork shall be of timber and / or metal and shall include all temporary concrete moulds and their supports. Bolts to be used for fixing the formwork shall be approved by the Engineer before staring the work.

For concrete surfaces, which are to remain, exposed wrought formwork shall be used. Wrought formwork shall be of timber or steel framing lined with 12mm thick smooth-faced plywood or an equal lining approved by the Engineer, or of metal, suitable to obtain a fair face finish on the concrete. All external angles or fair faced in-site concrete shall have chamfers formed with 15x15mm (5/8"x5/8") wrought hardwood angle fillets planted in the angles of the formwork, unless larger chamfers are shown on the drawings.

Formwork ready to receive concrete shall be thoroughly clean and the internal faces properly painted with approved shutter oil or other preparation. Joints shall be tight to prevent leakage.

Wherever required and prior to placing of the reinforcement the internal surfaces of all formwork shall be treated with an approved mould oil.

All formwork shall be inspected and approved by the Engineer prior to concreting. This approval, however, does not relieve the Contractor of any of his responsibilities.

The striking of all formwork shall be carried out with the greatest of care to avoid damage to concrete.

The formwork to vertical surfaces such as walls, columns and sides of beams may be removed in accordance with the table below although care must be taken to avoid damage to the concrete, especially to arrisses and features.

Minimum periods in days for striking other formwork should be in accordance with the following table, or as directed by the Engineer

Ordinary Portland Cement Concrete

Slabs (props left under)	..3
Beam soffits (props left under)	..7
Props to slabs	..7
Props to beams	.16
Vertical surfaces as walls, columns and sides of beams.	..1

Formwork, shuttering, props, or any other means of temporary or semi-permanent support shall not be removed from the concrete until the concrete is sufficiently strong to carry safely the load (dead and temporary).

The Contractor shall inform the Engineer when he is ready to strike the formwork, or remove any form of temporary support, and shall obtain his written consent before proceeding.

The times given for the removal of props are based on the assumption that the total live plus dead weight to be supported at the time of removal is not more than one half of the total design load.

For horizontal members where the loading is to be a higher proportion of the total design load these times may need to be increased.

The Contractor shall be responsible for any damage to the concrete work caused by or arising from the removal and striking of the forms and supports Any advice, permission or approval by the Engineer relative to the removal and striking of forms and supports shall not relieve the Contractor from this responsibility.

Any work showing signs of damage through premature loading is to be entirely reconstructed at the Contractor's expense.

The Contractor shall confirm positions and details of all
(a) Permanent fixings
(b) Pipes and conduit
(c) Holes and chases
to ensure that alterations are not made without the knowledge and approval of the Engineer.

The Contractor shall fix inserts or box out as required to correct positions before placing concrete, and shall form all holes and chases..He shall not cut hardened concrete without approval.

Quality Assurance

Concrete formwork shall be constructed /erected by the Trade Contractor in accordance with ACI 347 and applicable construction safety regulations at the place of work

Reference Standards

ACI-347 Recommended Practice for Concrete Formwork.

Reinforcement for Concrete

Grade	Minimum Yield Strength
High Yield Steel	414.MPa
Mild Steel	278.MPa

a. Reinforcing Steel: High yield deformed weld able steel bars, BS 4449 and BS 4461.
b. Welded Steel Wire Fabric:.Deformed type, BS. 4493; in flat sheets.

QUALITY REQUIREMENTS

a. Steel reinforcement shall be hot rolled high strength high bond, Grade 414, complying with requirements of BS 4449, BS. 4461, and BS 8110, deformed bars.

b. Steel fabric mesh shall comply with BS 4483.

In case any other type of reinforcement is required, it shall comply with the requirements of the Particular Specification.

All reinforcement shall be free from rust and mill scale and any coating such as oil, clay, paint etc which might impair the bond with the concrete.

Manufacturer's test certificates for all classes of reinforcement shall be supplied when required..Specimens sufficient for three tensile tests and three cold-bending tests per ten tons of bars or fraction thereof and for each different size of bar shall be sampled under the supervision of the Engineer. Testing shall be in accordance with BS 4449 or other approved standard and batches shall be rejected if the average results for each batch are not in accordance with the specification. All tests should be made on the Contractor's expense.

All steel is to be totally free from dirt, paint, loose rust or scale when in position ready for concreting.

The Contractor shall cut and bend bars to BS 4466 and to schedule provided unless otherwise instructed by the Engineer.

Straight sections of bars must be kept out of winding. The internal radius of bends shall in no case be less than four times the diameter of the bar, except for stirrups, column binders, and wall shear bars which are to be bent to fit closely around the main bars..

Great care is to be taken to bend stirrups and columns binders separately and to the sizes shown.

All bars will be cut and bent cold using approved machines.

Lengthening of bars by welding, and rebinding of incorrectly bent bars will not be permitted, except where requested by the Engineer.

The Contractor shall provide on site facilities for hand bending to deal with minor adjustments.

Unless otherwise allowed for in the particular specification splices in reinforcing bars shall be formed by lapping. Such laps in bars in any member shall be staggered. Except as otherwise indicated on the drawings the minimum overlap of lapped splices shall be 50 bar diameters or 400mm whichever is greater.

The steel is to be fixed in position exactly as indicated; taking in to consideration the seismic requirements and the bars are to be securely wired together with 1.6 or 1.4mm soft iron wire or approved spring steel clips wherever necessary to prevent any displacement during concreting.

Spacers, chairs and the like, temporary or permanent, are to be used as required to ensure that the steel has the exact amount of cover indicated. No permanent spacers may show on a surface where a fair faced concrete finish or a brushed aggregate finish are required..Type of spacers shall be approved by the Engineer before starting the work.

Unless otherwise indicated, the minimum cover to the reinforcing bars is to be as listed below, or equal to the diameter of the bar, whichever is greater.

Position	Minimum cover - mm
Main bars in internal faces of columns and beams	25
Main bars in external faces of columns and beams	30
Main bars in floor slabs and soffits of roof slabs	20
Main bars in top of roof slabs	20
Outermost bars in internal faces of walls	20
Outermost bars in external faces of of walls	25
Bars in top of ground slabs...	20
Bars near faces in contact with soil	40

The placing of all reinforcement will be checked by the Engineer and in no case is concrete to be poured around any steel that has not been passed by him. The Contractor is to ensure that no steel is displaced from its position during the placement of concrete and until the concrete is set.

The insertion of bars into or removal of bars from concrete already placed will not be permitted. Reinforcement temporarily left projecting from the concrete at the joints shall not be bent without the prior approval of the Engineer.

Secondary reinforced concrete members for which no reinforcement details are given in the drawings or the Particular Specifications shall have a minimum ratio of reinforcement area to concrete area of 0.33 %.

3.3 Concreting

Cement

The cement used shall be Portland cement conforming in all respects to ASTM Standard Specification C150, type 1, or to BS 12, unless otherwise required, bags shall contain 50kg net + 1%.

If cements other than the above are required they shall be covered fully by the Particular Specification.

The Contractor shall at all times furnish the Manufacturer's statement of the above Standard Specifications together with the date of manufacture, certified by an independent agency in the country of origin approved by the Engineer.

The cement shall be delivered to the site by the Contractor in the original sealed and branded bags or containers of the manufacturer in batches not exceeding 100 tons and shall be stored in a proper manner off the ground to prevent deterioration. Each batch shall be stacked separately and used in the order of delivery..No cement shall be used which has been manufactured more than twelve months prior to its proposed use on site.

All cements whether stored in bulk, bags, or containers in warehouses or on site shall be sampled for testing according to ASTM C183 (Methods of Sampling Hydraulic Cements). Test samples over and above those specified shall be taken at any time if so requested by the Engineer. Testing of cement shall be in accordance with the methods required by ASTM C150 and C175 or BS 12 or any other accepted by the Engineer.

Aggregates

This specification covers fine and coarse aggregates other than lightweight aggregates for use in the production of concrete.

When lightweight aggregates are required they shall be defined in the Particular Specification.

The aggregates shall be crushed gravel or stone and shall comply with BS 882 for graded or single size aggregate and shall be obtained from any quarry in the mountains approved by the Engineer. For convenience part of Clause 5 of BS 882 (grading) including Tables 1, 2 and 3 are reproduced herein.

Coarse aggregate: the grading of coarse aggregate, when analyzed by the method given for sieve analysis in BS 812 shall be within the limits given in Table 1.

Fine aggregate: the grading of a fine aggregate, when analyzed by the method of sieve analysis described in BS 812, shall be within the limits of one of the grading zones given in Table 2, except that a total tolerance of up to 5 per cent may be applied to the percentages under-lined. This tolerance may be split up; for example, it could be 1 per cent on each of three sieves and 2 per cent on another, or 4 per cent on one sieve and 1 per cent on another.

The fine aggregate shall be described as fine aggregate of the grading zone into which it falls, e.g. BS 882, Grading Zone 1.

NOTE: It is intended that individual zones should not be specified in contract documents relating to concrete but that the concrete mixes should be modified to make the best use of the materials readily available.

If approved by the Engineer. Single-sized aggregate to BS 882 Table 1 may only be used for reinforced concrete when combined in two or more sizes to provide a well-graded mixture approved by the Engineer.

Sampling and testing of aggregates shall be as required by BS 882 and in accordance with BS 812 'Methods for Sampling and Testing of Mineral Aggregates, Sands and Fillers'. All sampling shall be done by or under the supervision of the Engineer.

The combined percentage of sulphates and chlorides by weight in coarse and fine aggregates shall not exceed 0.05 per cent (500ppm) of the combined weight of total aggregates.

Just before use the aggregate will be washed down with potable water to reduce the content of sulphates, chlorides and other extraneous material

Table 1: Coarse Aggregate

BS 410 Test Sieve	Percentage by weight passing BS sieves							
	Nominal size of Graded aggregate		Nominal size of Single-sized aggregate					
mm	400mm to 5mm	200mm to 5mm	14mm to 5mm	63mm	40mm	20mm	14mm	14mm
75.0	100	--	--	100	--	--	--	--
63.0	--	--	--	85-100	100	--	--	--
37.5	95-100	100	--	0-30	85-100	100	--	--
20.0	35-70	95-100	100	0-5	0-25	85-100	100	--
14.0	--	--	90-100	--	--	0	85-100	100

10.0	10-40	30-60	50-85	--	0-5	0-25	0-50	85-100
5.0	0-5	0-10	0-10	--	--	0-5	0-10	0-25
2.36	--	--	--	--	--	--	--	0-25

Table 2: Fine Aggregate

BS 410.Test Sieve	Percentage by weight passing BS sieves			
	Grading..... Zone 1	Grading..... Zone 2	Grading.....Zone 3	Grading.....Zone 4
mm				
10.00	100	100	100	100
5.00	90-100	90-100	90-100	95-100
2.36	60-95	75-100	85-100	95-100
1.18	30-70	55-90	75-100	90-100
microns				
600	15-34	35-59	60-79	80-100
300	5-20	8-30	12-40	15-50
150	0-10	0-10	0-10	0-15

Handling Aggregates

The choice and preparation of sites for stockpiling of aggregates, the number and sizes of stock-piles and the methods adopted to prevent segregation of component sizes shall be agreed with the Engineer.

Coarse aggregate shall be stockpiled in three separate gradings: 38-19mm, 19-10mm, and 10-5 mm. When aggregates of different gradings are stockpiled close together the stockpiles shall be separated by bulkheads.

Stockpiles are to be on concrete or other hard surface sufficiently sloped so that water is not re-tained in the base of the stockpiles.

All aggregates are to be handled from the stockpile in such a manner as to secure a typical grading of the material, care being taken to avoid crushing the aggregates and contamination with extrane-ous matter.

Aggregates need not be stockpiled when a crushing-screening plant is used in tandem with a batching plant properly equipped with several bins for different sized aggregates having the appro-priate weighing scales at such bin such that a mix of the desired gradation is obtained consistently and the whole operation is conducted to the satisfaction of the Engineer.

Water

Unless otherwise authorized in writing by the Engineer, only water from potable supply system may be used for mixing concrete and other products containing cement.

Similarly only potable water may be used for curing concrete and cement products during the first 24 hours after pouring. Later, fresh water, or other water containing not more than 4750 ppm dis-solved solids of which not more than 1000 ppm may be chlorides, may be used for curing.

No additives of any kind shall be used in the concrete without the express approval in writing of the Engineer.

Quality of Concrete

Concrete shall be a mixture of cement. Aggregates and water as covered respectively by 4.01 to 4.23 above.

Where air-entrainment is required, the method to be used shall be specified in the Particular Specification.

The mix proportions, workability and strengths of the various types of concrete shall conform to Table 4.

The terms contained in Table 4 are defined as follows: WATER/CEMENT RATIO: the term water/cement ratio means the ratio by weight of the water to the cement in the mix, expressed as a decimal fraction. The water is that which is free to combine with the cement in the mix.This includes free water in the aggregate but excludes water absorbed or to be absorbed by the aggregate. The aggregate for this purpose shall be taken in a saturated surface-dry condition.

The absorption of the aggregates shall be determined in accordance with Section 4 of BS 812 or any other method approved by the Engineer.

The strengths specified are for ordinary Portland cement to BS 12 or Type 1 Cement to ASTM C150; if other types of cement are specified, the required strength shall be defined in the Particular Specification

Table 3: Mix Proportions, Workability and Strength Grades of Concrete

Grade	Minimum Works cube Strength,.kg/cm2		Max. Agg, mm	Limits of agg. / Cement ration by weight		Use of concrete if not otherwise specified
	At 7 days	At 28 days		Max.	Min.	
(A) C-200	150	200	20	7:1	5:1	RC structures in general
	150	200	37	8:1	6:1	RC Foundations
(B) C-250	175	250	20	5.5:1	4:1	High load columns
	175	250	37	6.5:1	4.5:1	High load foundations
(C) C-300	200	300	20	5:1	3:1	High load columns
	200	300	37	5:1	3:1	High load foundations
(D) C-150	100	150	20	10:1	8:1	Plain concrete foundations
	100	150	37	10:1	8:1	Blinding layer under RC Found.
(E) C-100	75	100	20	14:0	12:1	Mass lean
	75	100	37	14:1	12:1	Concrete filling

Table 4: Mix Proportions, Workability and Strength Standard Mixes

Grade of Con-crete	Minimum works Cube Strength Kg/cm2		Weight of dry sand per 50 kg of cement	Weight of dry sand per 50 k of cement						Max. de-sign W/C ratio
				Workability						
				20mm max. size			37mm max. size			
	7 days	28 days		Low	Med.	High	Low	Med.	High	
			kg	kg	kg	kg	kg	kg	kg	
C-200	150	200	91	193	159	136	226	193	170	0.55
C-250	175	250	80	170	136	113	204	170	147	0.50
C-300	200	300	68	147	113	91	170	136	113	0.45

Table 5 : Mix Proportions, Workability and Strength Workability

Degree of Workability	20 mm Max. size aggregate		37 mm Max. size aggregate		Use for which Concrete is suitable
	Slump mm	Compacting Factor	Slump mm	Compacting Factor	
Low	13-25	0.82-0.88	13-50	0.82-0.88	Simple reinforced sections with vibration
Medium	25-50	0.88-0.94	50-101	0.88-0.94	Heavily reinforced sections with vibration
High	50-127	0.94-0.97	101-117	0.94-0.97	Sections with heavily congested reinforcement where vibration is difficult

In case cylinders are used for determination of concrete compressive strength in accordance with ASTM C 39, the corresponding cube strength shall be obtained by using a multiplication factor of 1.2.

AGGREGATE/CEMENT RATIO: the term aggregate/cement ratio means the ratio by weight of aggregate to cement in the mix. For this purpose the aggregate is taken in a saturated surface-dry condition as for the water/cement ratio above.

FINE/TOTAL AGGREGATE RATIO: the term fine/total aggregate ratio means the ratio by weight of the fine aggregate to the total aggregate in the mix expressed as a percentage. For this purpose the aggregate is also taken in a saturated surface-dry condition as for the water/cement ratio above.

VOLUME OF AIR ENTRAINED:.the air content expressed as a percentage by volume of concrete shall be determined by ASTM C231, 'Air Content of Freshly Mixed Concrete by the Pressure Method '..At least one test for each 120 cubic meters of concrete shall be made.

SLUMP: the slump of the freshly mixed concrete shall be determined in accordance with Part 2 of BS 1881 or ASTM C143. At least one morning and one afternoon test shall be made and whenever directed by the Engineer.

STRENGTH OF CONCRETE:.Preliminary Test Cubes shall be taken from the trial mixes designed to select the job mix and shall be made and tested in accordance with Parts 3 and 4 of BS 1881.

SAMPLING FOR COMPLIANCE TESTING: Works Test Cubes shall be those used for control during construction and shall be made and tested in accordance with BS 5328 PART 4:1990.

Recommended Minimum Rates Sampling

Average Rate o Sampling One Sample (6 cubes) per	Maximum quantity of concrete at risk under any one decision
10 m3 or.10 batches	40 m3
20 m3 or.20 batches	80 m3
50 m3 or.50 batches	200 m3

The Contractor when tendering having knowledge of the source and types of cement, aggregate, plant and method of placing he intends to use shall allow for the aggregate/cement ratio and water/cement ratio which he considers will achieve the strength requirements specified and will produce a workability which will enable the concrete to be properly compacted to its full depth and finished to the dimensions and within the tolerances shown on the Drawings and required by the Particular Specification. In any event the aggregate/cement ratio and the water/cement ratio shall not exceed the upper limits specified in Table 4 for each type of concrete. Furthermore, the quantity of cement per cubic meter of concrete shall in no case be less than the minimum specified in Table 4.

As soon as possible after signature of the Contract, the Contractor shall prepare such trial mixes as required to satisfy the Engineer that the specified concrete strengths will be obtained using the materials and mix proportions in accordance with the above clauses. The proportion of cement shall be increased if necessary to obtain the strengths required.

From each trial mix, six Preliminary Test Cubes shall be made and tested at 7 days and four at 28 days, the test at 7 days being intended to give and early indication of possible variation from the required strength. If the difference between the highest and lowest test results from any one trial mix is more than 15 per cent of the average of the strength test results, the test is to be discarded and a further trial mix made, unless all test results so obtained are above the required strength. Separate trial mixes are required for each type of concrete. The trial mix or mixes agreed by the Engineer shall be designated job mixes and used as a basis for actual concrete production.

Batching and Mixing Of Concrete

All concrete shall be batched by weight and mixed mechanically..

Concrete may either be batched and mixed on site or outside the site and transported thereto.

When mixed outside the site and transported to it, batching and mixing shall be in accordance with ASTM Specification C94, 'Standard Specification for Ready-Mixed Concrete'.

When mixed on site, batching and mixing shall be as follows:

BATCHING BY WEIGHT: The cement and each size of aggregate shall be measured by weight. The water may be measured by weight or volume. The weight-batching machines used shall be of a type approved by the Engineer and shall be kept in good condition while in use on the Works. Checks are to be made as required by the Engineer to determine that the weighing devices are registering correctly.

BATCHING AGGREGATE BY VOLUME:.When batching aggregates by volume is allowed as and when required, the cement shall be batched by weight and the water by weight or volume. Each size of aggregate shall be measured in metallic containers the depth of which is at least equal to their greatest width. The containers shall be of such shape that their volume can be easily checked by measurement.

MIXING CONCRETE: the location of the batching and mixing plant shall be agreed with the Engineer.
The amount of concrete mixed in any one batch is not to exceed the rated capacity of the mixer.The whole of the batch is to be removed before materials for a fresh batch enter the drum.
On cessation of work, including all stoppages exceeding 20 minutes, the mixers and all handling plant shall be washed with clean mixing water. If old concrete deposits remain in the mixer drum, they shall be rotated with clean aggregate and water prior to production of new concrete....

Concrete mixed as above is not to be modified by the addition of water or in any other manner to facilitate handling or for any other reason.

Work In Cold Or Hot Weather

Concrete is not to be mixed or placed at a shade air temperature below 2 deg.C on a rising thermometer or at a shade air temperature below 3 deg.C on a falling thermometer.

When the shade air temperature is 37 deg.C and rising, special precautions shall be taken during concreting operations, such as shading of the aggregates and plant, cooling of the mixing water or other methods approved by the Engineer, so that the temperatures of the concrete when placed shall not be in excess of 39 deg.C.

Fresh concrete placed at these temperatures shall be shaded from the direct rays of the sun to the satisfaction of the Engineer for a period of at least 24 hours.

Placing

Concrete shall be conveyed from the mixer to its final position in any suitable manner, provided there is no segregation, loss of ingredients or contamination.

It shall be placed in its final position before initial setting takes place and within 20 minutes of the addition of the water to the mixer without using any additives. Water is not aloud, only by the instructions of the Engineer In the manufacturer specifications of such additives must be handed over to the Engineer to be approved before using it.

The order of placing concrete shall be such as to prevent water from collecting at the ends, corners and along the faces of forms. It shall not be placed in large quantities at a given point and allowed to run or be worked over a long distance in the form.

Whenever possible concrete shall be placed and compacted in even layers with each batch adjoining the previous one.

The thickness of the layers shall be between 150 and 300mm for reinforced concrete and up to 450mm for plain (non -reinforced) concrete, the thickness depending on the width of forms, the amount of reinforcement and the need to place.each layer before the previous one stiffens.

Concrete shall not be allowed to drop freely for more than 2 meters. To convey the concrete as near as possible to its final position, drop chutes of rubber or metal shall be used for small sections and bottom dump buckets or other suitable vessels for large sections.

Concrete shall be carefully compacted when placed to ensure a dense and uniform mass free from air holes and cavities. Concrete type "A", "B"& "C" shall be compacted by vibration, whereas type 'D' and 'E' concrete may be vibrated or rammed, tamped and rodded. Vibration shall be performed by mechanical or electro -mechanical vibrators. The vibrators shall be of the plunger (poker) type for insertion in the concrete:.except that plate type vibrators (external) shall be used if requested by the Engineer.

The plunger (poker) type vibratos shall have a diameter compatible with the lowest spacing of reinforcement, a sufficiently high frequency and be properly handled by experienced personnel.

They hall be immersed at regular intervals close enough.to vibrate.all. of the concrete, but not too close to affect previously vibrated and partially set concrete.

Each immersion shall continue until shortly after air bubbles cease to appear on the surface of the concrete, but shall not last more than 30 seconds. The vibrators shall be withdrawn gradually and vertically to ensure that no air pockets are formed.

When external vibrators are used as directed by the Engineer, they shall be clamped to the forms whenever possible to avoid large impact during handling, and the forms shall be so constructed as to withstand the additional vibrations.

All vibrations, compaction and finishing operations shall be completed within 15 minutes from the time of placing the concrete in its final position. Until it has hardened sufficiently to carry weight without distortion, workers shall not be allowed to walk over freshly placed concrete.

Concreting of any one part or section of the work shall be carried out in one continuous operation, and no interruption of concreting work will be allowed without the approval of the Engineer. Where beams and slabs together form an integral part of the structure they shall be poured in one operation.

A record is to be kept by the Contractor on site of the time and date of placing the concrete in each portion of the works and the number and identification of the Works Test Cubes, corresponding to these portions. Such records are to be handed to the Engineer weekly during the progress of the work.

If placing of concrete by pumping is required it shall be specified in the Particular Specification.

Admixtures

No admixtures of any type shall be used in the preparation of concrete or concrete products unless so required by the Particular Specification or unless so directed by the Engineer. In case any such admixtures are used the rates and methods of application shall be strictly in accordance with the manufacturer's instructions which must be approved by the Engineer before using it.

Curing

Freshly placed concrete shall be protected from rain, dust storms, chemical attack and the harmful effects of heat, wind, flowing water, vibrations and shocks. This protection shall continue until the concrete is sufficiently set such that it is no longer damaged by these factors.

The Engineer shall determine when the protection is no longer required, but in any case this shall not be less than 24 hours after the time of placing.

Concrete shall be cured for at least seven days and as required by the Engineer. Curing shall be effected by the direct application of water to the surface of the concrete or by other approved curing methods or curing compounds applied in accordance with the manufacturers specifications. In case the application of such curing compounds is delayed for any reason, the concrete shall be kept moist until the application is made.

Timber formwork covering the concrete shall be moistened with water at frequent intervals to keep it from drying during the curing period. Metal formwork exposed to the sun must be shaded from its direct rays, painted white or otherwise protected during the curing period.

3.4. Formed Finishes

1. Basic Finish

General requirements:

(a) Produce an even finish with a sheet material.

(b) Arrange panels in a regular pattern

(c) Blowholes not more than about 10mm in diameter will be permitted but otherwise surface is to be free from voids honey combing and other large defects

(d) Variation in colour resulting from the use of an from discolaration due to contamination or grout leakage

The finish will be left as struck, making good or small defects will normally be permitted but only after inspection by the Engineer..All blowholes shall be filled with a matching mortar to an approved sample unless otherwise instructed by the Engineer. All faces shall be protected from damage, especially arrisses.

All faces shall be protected from rust marks and other surface disfigurements. Form tie holes shall be filled with a matching mortar to an approved sample accepted by the Engineer.

2. Fair Faced Finish:

Concrete surface which are described as fair face finished shall be finished free from honeycombing and excessive air holes, fines and projections arising from defective mixing, placing of formwork, and shall, if necessary, be filled with mortar and rubbed with fine carborudum stone all works to be approved of engineer..The finish shall be integral with the body of the concrete and shall not be obtained by means of an applied rendering.
The quality of the surface of concrete exposed to view shall be smooth and consistent throughout the project and the following methods shall be adopted to obtain the required fancy..The trade Contractor may submit alternative proposals for the approval of the Design Professional if he so desires.
Formwork for fair faced concrete shall be provide with regular joints to achieved the satisfaction on the job finished, be either of steel, fibrous glass reinforced plastic or exterior grade plywood not less than 16mm before placing,pouring the concrete.

All surplus oil on form surface and any oil on reinforcing steel shall be removed.

Approval by the Design Professional to Fair Faced Finishes.

1. Trade Contractor shall submit for approval of the Design Professional a sample panel not less than 60cm x 120cm to demonstrate the quality of the exposed concrete to be produced by forms, at his own expense.
2. The quality of the finished work shall be measured against the quality of the approved sample panel and the work of inferior quality shall be repaired or replaced as directed by the Design Professional without any additional cost.
3. The quality of the finished surfaces shall be of uniform color and consistency throughout the project..Should there by any inconsistency in color or texture in any of the finished surfaces the Design Professional may order the repair or the demolition of a portion of concrete work and its reconstruction at the Trade Contractor's own expense.
4. Construction Joints, in special cases of weather conditions and if approved by the Design Professional shall be studied in detail ahead of time and the joints shall be grooved in.a predetermined pattern approved by the Design Professional.

General Requirements :

a) Produce a smooth even finish with an impervious sheet metal.

b) Make panels as large as is practicable and arrange to approval.

c) Blowhole not more than about 5mm in diameter will be permitted but otherwise surface is to be free from voids, honey combing and other defects.

d) Variation in color resulting from the use of an impervious form lining will be permitted, but the surface is to be free from discoloration due to contamination or grout leakage.

e) Concrete cover spacers shall be used only if approved.

f) Sample on site has to be provided of 1by 2m.

The finish is to be left as struck. Making good will not normally be permitted. All form tie holes are to be filled with a matching mortar to an approved sample. Wire form ties shall not be used. With Approval and instruction.of the Engineer.

Quality Control Testing Etc.

Prior to commencing the work the contractor shall make available on site the following minimum.approved equipment.kept in good condition at all times :

- Six Cube moulds.
- Slump cones.
- Thermometer.
- Any other accessories as required by the Engineer.

All samples and testing shall be done in the presence of the Engineer or his authorised representative either on site or in an approved testing laboratory in the area.

The frequency of testing shall be as noted in the clauses of this section and whenever required by the Engineer.
The works Test Cubes shall be made as follows for types of concrete (A), (B), and (C).:

(a) At least three times weekly per mixing plant.
(b) At least once for three individual parts of the structure.
(c) At least once per 100 cubic meters of Concrete.or fraction thereof.

For types (D), and (E) concrete the rate shall be once per each 100 cubic meters or fraction thereof.

At least six cubes shall be made at one time. Two of the six cubes are to be tested at seven (7) days. The remaining four cubes are to be tested at 28 days, and their average strength must not fall below the minimum strength specified for each type of concrete and the lowest test result shall not be more than 20% below the average of the four cubes.

When the result of 7-day test is unsatisfactory, the Contractor may elect to remove and replace the defective concrete without waiting for the 28-day test. If the result of the 28-day test is unsatisfactory all concreting shall be stopped at the Contractors expense and shall not proceed further without the written permission of the Engineer.

The Contractor shall then, in accordance with the instructions of the Engineer, remove cores and test same or conduct in- insitu tests in accordance with CP 144 from or on suspect portions of the works, under the supervision of the Engineer.

Concrete judged by the Engineer to be defective shall be forthwith cut out, removed and replaced at the Contractors own expense.

In the event of strengths consistently higher than those specified being obtained, a reduction in the number of tests may be authorized by the Engineer.

Position of Reinforcement

The actual concrete cover to all steel at any point should not be smaller than the required nominal cover by more than 5mm.

The effective depth of fully or nearly fully stressed tensile.reinforcement should not be less than that given on the drawings by an amount exceeding 5 per cent.of the effective depth of the section being considered or 5mm whichever.is the greater.

Ready mixed concrete

Ready - mixed concrete as defined in BS 1926, batched off the site will be used with agreement of the Engineer and shall comply with all requirements of the Contract. The quality and strength of cements shall be determined by site tests. No test results supplied by Ready-Mix Supplier shall be accepted as proof of the quality and strength of the concrete.

The concrete shall be carried in purpose made agitators operating continuously, or in truck mixers. The concrete shall be compacted and in its final position within 1 hour of the introduction of cement to the aggregate or as agreed by the Engineer. The time of such introduction shall be recorded on the Delivery Note together with the weight of the constituents of each mix.

. When truck mixed concrete is used, water shall be added under supervision either at the site or at the central batching plant as agreed by the Engineer but in no circumstances shall water be added in transit.

. Unless otherwise agreed by the Engineer truck mixer units and their mixing and discharge performance shall comply with the requirements of BS 4251. Mixing shall continue for the number and at the rate of revolutions recommended in accordance with BS 4251 or, in the absence of the manufacturer's instructions, mixing shall continue for not less than 100 revolutions at a rate of not less than 7 revolutions per minute..

Prior to any ready mixed concrete being ordered, the Contractor shall submit to the Engineer details of the supplier and shall arrange for the Engineer to inspect the supplier's works if required.

Truck-mixer units shall be maintained and operated strictly in accordance with the manufacturer's recommendations.

SECTION 4: NATURAL STONE WORKS

4.1. GENERAL

The stone materials shall be class A according to the Jordanian.Technical specifications and shall be local manufactured and.to obtain the following Physical and mechanical properties: -

1. **Absorption**
The percentage of absorption shall not exceed 3 % according to ASTM – C97.

2. **Specific Gravity.**
Minimum specific Gravity of stone shall be 2.56 according to ASTM- C97.

3. **Modulus of Rupture**
Shall not be less than 6.9 N/mm2 according to ASTM-C99.

4. **Abrasion Resistance**
For all stone type shall not be less than 10% according to ASTM- C241.
Anchors: Two of each type to be incorporated in the work.
Submit samples of other materials specified herein upon request by the Engineer.

Samples:
Submit two sets of stone, full size units as selected by the engineer to the project site, in sufficient number to indicate the full range of color, texture and finish. One of each of the duplicate samples approved by the engineer will be retained by him at the project site, the other being returned to the stone supplier for his guidance. Color and type of the stone- dressing are as mentioned above.

1. The following physical data on proposed stone shall be submitted by the supplier:
2. Analysis of mineral composition
3. Analysis of chemical composition.
4. Thermal sufficient of expansion.
5. Absorption.
6. Specific Gravity.
7. Modulus of Rupture
8. Abrasion Resistance.
9. Samples of other materials specified here in shall be submitted upon request by the engineer.

References
National Standards referenced her in are included establishing` recognized quality only. Equivalent quality and testing standards will be acceptable subject to their timely submission, review and acceptance by the engineer.

4.2. MOCK UP

1. Furnish and install a typical stone wall, application required for the project at area designated by the Engineer. The panel shall be constructed for Engineer's approval showing 2.0m long x 1.5m high for wall installation. Wall installation shall include a corner condition indicating a jamb, sill, lintel and coping stones, etc., as shall be instructed by the Supervising Engineer.

2. All work shall include setting and jointing of all stone including final cleaning as specified here in for the actual work and as required for approval Construct as many mock-ups until approval by the Engineer has obtained.

3. The approved mock-up shall constitute the quality of work to be expected throughout the entire project, and shall remain in place for visual inspection until no longer needed as directed by the Engineer. The removal and disposition of the mock-ups shall be done by the Contractor at his expense without additional cost to the owner.

GUARANTEE / WARRANTY

Attention is directed to the provisions of the CONDITIONS OF THE CONTRACT regarding guarantees / warranties for the Work.

All warranties / guarantees to be issued by the Supplier, Manufacturers and sub-contractors shall be counter-signed by Main Contractor and both of them will be liable for repair / replace the items / works, etc., during the warrantee / guarantee period.

Standards : applicable provisions of the following standard publications shall apply throughout the work :

a. Palestinian General Specifications.
b. Jordanian Technical Specifications.
c. Bs 882 Aggregate for Mortar.
d. Bs 12 – Portland cement..

REFERENCES

National standards referenced herein are included to establish recognized quality only. Equivalent quality and testing standards will be acceptable subject to their timely submission, review and acceptance by the Engineer.

QUALIFICATIONS

A. **Supplier / Fabricator**: A firm having an adequate supply of the specified type of stone and an annual rated production capacity to deliver the stone to the project site on schedule within a time limit established by the Engineer, as required, to assure no delay in the progress and completion of the Work.

B. **Installer**: A qualified stone layer with a minimum of five years successful experience in the erection of stonework.

DESIGN CRITERIA

A. The method of erecting, installing and anchoring of all atone work shown on the Drawings is diagrammatic only, and is not to be used for the purpose of bidding or construction. It shall be the responsibility of the contractor to design and guarantee the mechanical fixation of the stone to the concrete structure, the permanent anchorage, and the watertight sealing of all stone work. The installation shall be designed to allow for expansion, contraction and differential deflection of supporting floors of the building structure. All fastenings into stone, such as plates, bolts, anchors, shelf angles, inserts, etc. are to be galvanized steel.

B. Design and calculations for stone anchor system shall be based on a minimum safety factor of five for aspects related to stone strength and anchor strength in masonry or concrete.

C. Allowable stresses in stainless steel anchor elements shall not exceed the following:
   1. Tension, bending 0.6 Fy
   2. Shear.... 0.4 Fy

D. Anchor stone elements to withstand a total temperature variation of 125 degrees F.

DELIVERY, STORAGE & HANDLING

1. Pac**king and Loading**: Finished stone shall be carefully packed and loaded for shipment using all reasonable and customary precautions against damage in transit no material which may cause staining or discoloration shall be used for blocking or packing.
2. **Site Storage**: Upon receipt at the building site or storage yard, the stone shall be stacked on timber or platforms at least 100mm above the ground, and extreme care shall be taken to prevent staining during storage. If storage is to be for a prolonged period, polyethylene or other suitable plastic film shall be placed between any wood and finished surfaces, and shall be used also as an overall protective covering.
3. **Defective Stone**: Any piece of stone showing flaws, cracks, or imperfections such as vents, sand and clay holes, shelly bars, shakes, mottle, seams or starts upon receipt at the storage yard, or at the building site, shall be discarded and removed from the work site, at the contractor's own expense.

ENVIRONMENTAL REQUIREMENTS

The following environmental requirements are applicable to stone set in mortar, and when caulking stone joints with sealant:

1. During freezing or near freezing weather provide equipment and cover to maintain a minimum of 4 degrees C and to protect stone work completed or in progress.
2. At end of working day, or during rainy weather, cover stone work exposed to weather with waterproof coverings, securely anchored.
3. Maintain materials and surrounding air to a minimum 10 degrees C prior to, during and 48 hours after completion of work.

4.3. PRODUCTS

STONE MATERIALS AND FABRICATION

General

1. Stone shall be of good quality, sound, free from cracks and defects, seams or starts which may impair its structural integrity, durability, appearance or function. Colour, texture and finish shall be within the range of samples approved by the Engineer.
2. All stone shall be obtained from quarries having adequate capacity and facility to meet the specified requirements. Cutting and finishing shall be performed by using approved equipment to process the material promptly on order and in strict accordance with the specifications. Evidence to this effect shall be provided by the contractor's.
3. Stone rejected for noncompliance with the submitted samples or the requirements of this specification shall be replaced with material acceptable to the Engineer. Replacement shall be prompt and at the Contractor's own expense. Inspection of stone by the Engineer shall not relieve the contractor of his responsibilities to perform all work in accordance with the Documents.

STONE SCHEDULE
Refer to the Drawings for locations, sizes and herein. All stone work shall be carried out and executed in accordance with the classifications of class " Special refer to clause 1.06, item A/1. Stone Type Application/ Thickness / Finish

Application: Exterior and Interior – Special Shapes include, but not limited to:
- Rebated and Splayed sills-Splayed copings with rounded edges – Splayed and mitered copings.
- Corner stones – Quoins
-.Splayed coping quoins
- Other, all as shown and / or noted in the drawings and in the Book of Details (Jordanian Code)

Thickness: As noted on the relevant details / drawings.

Finish: Mosamsam, Mattabeh and Tubza dressing, as noted on the drawings and details.

Stone Finish
The finish of stone shall be according to the drawings that show size, and thickness. All stone work shall be carried out and executed in accordance with the classification of class (A) according to the Jordanian Specifications.

Matabeh finish # 12 will be used for WHITE ASEERA stone and applied as follows:
- Thickness 50mm thick.
- Height of courses As shown in drawings.
- Finish Matabeh dressing without Zamleh.
- Backing 150mm reinforced concrete.

STONE FABRICATION – GENERAL:

1. Fabrication of stone shall be in strict accordance with approved shop drawings for fabrication, and with this specification.
2. To the maximum extent possible, fabrication and assembly of stone shall be executed in the shop. Work that is not shop assembled shall be shop fitted.
3 All work shall be of the highest quality, in accordance with the best trade practices, and performed by skilled workmen. All materials and workmanship shall conform to the highest industry standards.
4 Use no materials, equipment, or practices that may adversely affect the functioning, appearance, or durability of the stone work or work trades.

DIMENSIONS
1 Cut all stone work accurately to shape and dimensions shown on the final approved shop drawings. Exposed plans surfaces shall be true. Bed and joint surfaces shall be dressed straight and at right angles to the faces, unless otherwise shown. Exposed arise lines shall be sharp and true. Patching of stone will not be permitted.
2 Do all necessary cutting for anchors, support plates, shelf angles, and dowels, etc.

BEDS AND JOINTS
Stone beds and joints surfaces shall be cut square from the face for the entire thickness of stones. Stone shall be bedded and jointed including the various expansion joints dimensions as shown on the approved shop drawings.

BACKS OF PIECES
Backs of all pieces of stone receiving no concrete backing shall be sawn to approximately true planes with a maximum variation of 1.5mm in thickness from that indicated on the approved shop drawings.

EXTERIOR & INTERIOR SPECIAL SHAPES
All specially shaped pieces of stones shall be constant in profile throughout their length, in strict conformity with details shown on approved shop drawings.

INCIDENTAL CUTTING & DRILLING

1 Provide holes, grooves, sinkages and recesses, etc., as applicable, for anchors, plates, bolts, shelf anchor supports, inserts, etc., other cutting and drilling shall be provided only when specifically Shown on the approved shop drawings.

2 Holes for lifting will not be permitted on any stone element with a thickness of 51mm or less.

3 No cutting or drilling will be permitted on exposed surfaces

4.4. MORTAR MATERIALS AND ACCESSORIES

Cement

1 Cement for Setting Mortar: Non – Staining Portland Cement conforming to ASTM CI50, Type I except containing not more 0.03% water soluble alkali. Turkish cement will not be permitted.

2 Cement for Pointing Mortar: Non-staining white Portland Cement conforming to ASTM CI50.

Grey nonfattening cement may be used for pointing mortar if the colour of pointing mortar, as selected by the Supervising Engineer, does not require white Portland Cement.

Water
Water shall be potable, clean and fresh from public water system.

Sand
Well graded non-staining masonry sand conforming to ASTM C1 44. Use white Silica sand pointing mortar. No other Sand shall be permitted for mortar or grout unless otherwise tested and approved by the Engineer.

Lime
Approved brand of plastic hydrated, such as New England 4x, conforming to ASTM C207, Type "S"

Integral Waterproofing

Integral liquid waterproofed for concrete and mortar, manufactured by an approved manufacturer and conforming to ASTM C494.

Integral Color
Super permanent, manufactured by an approved manufacturer and conforming to BS 1014.

Mortar Plasticiser
As manufactured by an approved manufacturer and conforming to BS 4887.

4.5. STONE ANCHORAGE – MATERIALS

General

All stone anchorage in contact with stone shall be fabricated from approved galvanized steel.

Gravity anchors
Wherever possible and appropriate stone shall be supported by gravity anchors. The Type location and number of gravity anchors. shall be determined by calculations, recommended practices of the BST.

Lateral Anchors
The type, location and number of lateral anchors shall be determined by calculations, applicable codes, and recommended practices of the BSI.

Dovetail Anchor Slots
Fabricate from not less than 6 ga. Galvanized steel. Provide dovetail anchor slots with filler strips

Anchorage Tolerances
Stone anchors shall be sufficiently adjustable to overcome expected variations in the building frame and in the stone itself, and in both in combination.

4.6. EXECUTION

Conditions At Site

1. The Contractor shall, prior to proceeding with the stone installation, examine all surfaces and parts of the structure to receive stone work, and notify the supervising Engineer in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with installation until such conditions have been corrected and are acceptable to the Engineer.
2. Verify all measurements and dimensions coordinate the installation of inserts for this work and coordinate and schedule this work with the work of other trades. Give particular attention to the location and size of cutouts required to accommodate mechanical, electrical, and other work or adjoining construction, in accordance with the reviewed shop drawings for such trade.

Stone Installation

1. **Anchors, Brackets and Angles:** Securely fix in place all supporting anchors, inserts, brackets, angles and other items requiring building into concrete, provide location drawings in sufficient time so as not to delay job progress.
2. **Preparation for stone Installation:** Clean stone prior to setting, leaving edges and surface free from dirt and foreign mistrial. Do not use wire brushes or implements which mark or damage exposed surfaces, unless otherwise approved by the Engineer.

Mortar And Grout Proportioning – By Volume

1**. General**
Mortar and grout proportioning shall be prepared and tested by the contractor, and in addition the contractor shall allow for preparing and testing the motar and grout mixes included within this section to meet the Engineer's satisfaction and approval.

2. Setting Mortar for Stone

1. Portland Cement.-.1.part
2. Hydrated lime.-.0-0.25.part
3. Sand.-.3.Parts
4. Plasticiser
5. Integral water proofer

3. Pointing Mortar :
1. White Portland cement.-.1.part
2. Sand.-.1-1/2.parts
3. Add color additive.to acquire the color of mortar approved by the supervising Engineer.
4. Add water proofer

Add integral waterproofing admixture to setting and pointing mortar in the quantity and manner.recommended by the manufacturer.

Generally, only approved mortar plasticiser shall be used in all mortars, unless otherwise instructed by the Supervising Engineer.

4. Wall Grout
Fine grout shall be mixed in the following proportions by volume all in accordance with ASTM C476:
1. Portland Cement- 1 part
2. Hydrated Lime -.0.1.part
3. Sand.-.2.25-3.parts

Coarse grout, where required, shall be mixed in the following proportions by volume, all in accordance with ASTM.C479:

a- Portland Cement - 1.part
b- Hydrated Lime - 0.1.part
c- Fine Aggregate - 2.25.parts
d- Coarse Aggregate - 1-2 parts

Use sufficient water to produce a fluid, pourable consistency.

Mortar And Grout Mixing

1 Mortar and grout shall be machine mixed. Cement and hydrated lime may be batched by the bag..Sand preferably shall be batched by weight, but subject to the approval of the Supervising Engineer may on certain small operations be batched by volume in suitably calibrated containers, provided proper allowance is made for weight per cubic foot, contained moisture, bulking and consolidation, shovel measurement shall not be used.

2 Workability or consistency of mortar on the board shall be sufficiently wet to be worked under the trowel. Water for tempering shall be available on the scaffold at all times. Mortar and grout which has begun to "set" shall be discarded. Mortar and grout which has stiffened due to evaporation shall be retempered to restore its workablility. Retempering of mortar and grout at the mixer shall not be permitted.

4. Setting of Extertior and Interior wall Stone

1 All setting shall be done in accordance with the approved shop drawings. All work shall set in a rigid and substantial manner, straight and plumb, with all horizontal lines level and all vertical lines plumb, unless otherwise shown on the Drawings. Similar abutting profiles shall accurately intersect and be in true alignment. All joints shall be uniform and shall be of the size and detail shown on the approved Shop Drawings.

2 Except as otherwise indicated and as herein specified. All anchoring devices shall be accurately set and adjusted. Holes and slots for anchoring devices shall be filled completely with mortar. Each stone shall be anchored securely in place.

Joints noted to receive sealant shall be left void. If such joints cannot be sealed shortly after erection, they shall be taped or otherwise temporarily sealed in a manner as approved by the Engineer.

3 All exterior stone joints shall be 5mm wide unless otherwise indicated.

4 As setting stone joints, the work shall be fastened securely to take care of dead loads, wind loads and forces, and erection stresses. All units of stones shall have suitable temporary braces, shores, and stays to hold them in position until permanently secured. All bolts and nuts shall be drawn tight and the bolt threads shall be nicked to prevent the nuns from backing off.

5 All welding, where required, shall be done in accordance with the requirements of the Engineer, the current edition of the "*Standard Code for Arc and Gas Welding in Building Construction*" of the American Welding Society (AWS Code).

6 The definitions of all terms herein related to welds, welding, and oxygen cutting shall be interpreted in accordance with the "*Standard Definitions, Welding, and Cutting*", of the current edition of the **American Society**.

7 Cavities behind facing stones shall be filled with fine and /or course grout, as specifically shown on the approved shop drawings and as specified herein.

8 Stone elements indicated to be set with mortar joints shall be set with two cushions per stone in every horizontal joint. Stone shall be set in full horizontal mortar beds and joints raked out to a depth of 19 mm before mortar has set. The face surfaces shall not be smeared with the mortar forced out of joints or that used in pointing. No hammering, rolling or turning of stones will be allowed on the wall..Precautions shall be taken to prevent seepage of moisture, through or from the exposed surfaces.

9 Build in anchors and supports all as shown on the approved shop Drawings.

10 Allow stone units to set overnight and then completely fill joints with pointing mortar. Joints shall be toled flush..During the tooling of the joints, enlarge any voids or holes and completely fill with mortar. Surfaces of stone shall be cleaned using sponge and water to remove mortar spills from face of stone.

11 The setting of patched, chipped, cracked, broken, stained or defective stones shall not be permitted.

Protection

Stone shall at all times be protected from drippings, welding spatter and damage by other trades during construction. Where necessary or directed, substantial non-staining wooden or other approved covering shall be placed to protect the work. Heavy polyethylene film shall be used between stone and wood. Maintain all protection until remit final cleaning of stone work.

Cleaning

Clean soiled surfaces using non-acidic solution of type, which will not harm stone, mortar joint materials, or adjacent surfaces. A non-metallic tools shall be used in cleaning operations

Final Inspection

Finished surfaces shall show no objectionable visual distinction in jointing, bedding, plane, colour, texture, pattern, and finish. All stones which in the opinion of the Engineer do not provide the required uniformity shall be relocated, or removed and replaced with new stone units to the satisfaction of the Engineer and at the contractor's own expense.

All defective stones shall be replaced with new stones units, except that minor damages may be repaired when approved by the Engineer. Repairs, when approved, shall be completed to the satisfaction of the Engineer. When the repairs to stone are unsatisfactory to the Engineer, the stone shall be replaced with new stone. All repairs and all replacements of defective and unsatisfactorily repaired stone shall be performed at the Contractor's own expense.

SECTION 5: BLOCKWORK

5.1 Manufacture

Generally the blocks used shall be of local manufacture made with concrete in approved vibrated pressure machines. The fine aggregate to be used for blocks shall be clean and sharp approved sand. It shall be chemically and structurally stable and shall comply with the *Table of Gradings* given hereunder. The cement, coarse aggregate and water to be used for blocks shall comply with the requirements given for Concrete Works, and the methods of measuring and mixing the material shall be the same. The following Mixing Table shall be strictly adhered to in all cases. Water/cement ratio shall be strictly governed to produce a mix of nil - slump.

Mixing Table
Nominal Mix (all by volume)
1 part Cement, 2 parts Fine Aggregate and 5 parts Coarse Aggregate

Table of Grading

(a) Fine aggregate

BS 410 Sieve No	Approximate size: mm	Percentage(by weight) Passing BS sieve
--	10.00	100
--	5.00	90-100
7	2.36	75-100
14	1.18	55-90
25	0.60	35-59
52	0.30	8-30
100	0.15	0-10

b) Coarse aggregate 10mm single size aggregate.

The blocks shall be hard, sound, square and clean with sharp well defined arrises and shall, unless previously approved by the Engineer, be a work size of (400 x 200 x 200mm) with properly formed half blocks for bonding.

Hollow blocks, where required, shall be similar quality and overall size to solid blocks, and shall be of local manufacture made with concrete as described above in approved vibrated pressure machines. The design of the cavities and webs shall be submitted to the Engineer for approval before manufacture. The thickness of the membranes or solid portions of hollow blocks shall be not less than (30 mm) each and the combined thickness of the solid portion shall exceed one third of the total thickness in either horizontal direction (Light weight lime - blocks can be used according to drawings, bills of quantities and Engineer's approval).

Double wall with thermal insulation polystyrene board 3cm thick according to the drawing and details.

Arrises shall be sharp and true; blocks which have damaged arrises are not to be used in the works and shall be discarded at the expense of the Contractor.

Immediately after molding the blocks shall be placed on clean, level, non-absorbent pallets. Blocks shall not be removed from the pallets until inspected and approved by the Engineer. Blocks shall be cured by

being kept thoroughly wet by means of water sprinklers or other approved means for a period determined by the Engineer but in all cases for not less than three days. Blocks must not be left on earth or sand during the curing process. Blocks shall be stacked in honeycomb fashion. Solid stacking will not be permitted.

The average crushing strength of solid or hollow blocks shall be not less than 35 kg/cm of gross area (average of 12 blocks).

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5.2 Mortars

The sand to be used for mortar shall be clean and sharp. It shall be chemically and structurally stable and shall comply with the Table of Gradings below. The lime if used for mortar shall be hydrated lime complying with BS 890.

Where colored mortars are required these shall be obtained either by the use of coloured cement or by addition of pigments complying with BS 1014.

The cement and water to be used for mortar shall comply with the requirements given under Concrete Works Section, and the methods of measuring and mixing shall be the same. The following Mixing Table shall be strictly adhered to in all cases.

Mixing Table

Nominal Mix	Cement Kilos	Sand m3	Lime (Dry Hydrate) Kilos
1:4	360	1.00	as approved by the Engineer

Table of Grading

BS 410 Sieve No	Approximate size: mm	Sand Passing through Sieve: percentage
--	3	95-100
7	2.4	80-100
14	0.2	60-100
25	0.6	30-100
52	0.3	5-65
100	0.15	0-15
200	0.08	0-5

Note : the above figures represent the limits of percentages (by weight) passing sieves of the sizes mentioned.

The mortar generally shall be cement and sand (1:4) mix.

Where plasticiser is added to the mortar the following mixes shall be used:
(a) Building mortar - cement and sand (1:6) and
(b) Mortar for pointing - cement and sand (according to plasticizer manufacturer recommendation)

The plasticiser shall be used strictly in accordance with the manufacturer's instructions, and subject to the Engineer's approval.

All mortars shall be used before the initial set has begun. Mortar shall not be remixed after the initial set has taken place. The full description given under Plaster Work Section, shall apply also to the measuring, mixing etc. of mortar for blockwork.

5.3 Construction

All blockwork shall be set out and built to the dimensions shown on the Drawings.

Walls shall be carried up regularly without leaving any part more than one meter lower than another unless the permission of the Engineer is first obtained. Work which is left at different levels shall be racked back. In the case of cavity walls, both thicknesses shall not be carried up more than about 400 mm.

The courses of blockwork shall be properly leveled. The perpendicular joints shall be properly lined and quoins, jambs and other angles plumbed as the work proceeds.

All walls shall be thoroughly bonded in accordance with the best constructional practice and as directed by the Engineer. Broken blocks shall not be used except where required for bond (if approved by the Engineer).

All concrete blocks shall be soaked with water before being used and the tops of walls left off shall be wetted before work is resumed. The faces of walls shall be kept clean and free from mortar droppings and splashes

All blocks shall be properly spread with mortar before being laid and all joints shall be thoroughly flushed up solid through the full thickness of the wall at each course as the work proceeds.

For block walls the gauge shall be ten courses to 2100 mm.

Walls to be left unplastered shall have a fair face consisting of selected blocks pointed with a neat weathered or flush joint as the work proceeds using the same mortar mix as for jointing.

Walls to be plastered shall have the horizontal joints raked out to depth of 8 mm to form a key.

Blockwork shall be bonded to concrete columns and the like with 200 x 60 x 6 mm non ferrous metal ties cast in concrete and subsequently bent down, ragged and built into every 2 courses of blockwork. Gunning ties to concrete will not be permitted (other ways of bond must be approved by the Engineer).

SECTION 6: ROOFING

6.1. Corrugated Steel Roofs

All corrugated galvanized steel sheeting (whether fixed to wood or steel framing) shall be of 23 or 24 gauge fixed with a minimum of 50mm end laps and with a minimum of one corrugation side lap.

When instructed to have a one corrugation side lap, the sheets shall have a cover of not less than 20mm and all the lapped sides shall be turned.downwards. Where practicable the exposed lapped sides shall be arranged to face away from the prevailing wind. When instructed to have a one and a half corrugations side lap the sheets shall be.arranged alternatively with a cover of not less than 90mm, the first.sheet.being.fixed.with.the.lapped sides turned upwards away.from.the.bearer.and.the.cover.sheet with the lapped sides turned downwards.

Sheets shall be secured to purlins at centres not exceeding 300mm by galvanized self parking screws (minimum 75mm long) with galvanized.diamond shaped washers and lead sealing washers

All holes for bolts, self parking screws etc. shall be punched from the underside of the sheets and shall be on the crown of the corrugations.

Galvanized steel ridge capping shall be supplied and fixed to purlins as described above.

Hook bolts, self parking screws and washers shall generally comply with BS 1494.

6.2. Screeds

The provisions of Concrete Work section shall apply to the construction of solid reinforced concrete slab roofs and to hollow slab roofs. The actual finish will be specifically shown on the Drawings or in the Particular Specification.

Lightweight concrete screeds for obtaining falls or as an insulation layer shall be of approved type of foamed concrete. The materials shall be measured, applied and cured in accordance with the manufacturer's instructions and to the satisfaction of the Engineer.
In all cases the finished screed shall be of an approved proprietary type with a density of not less than 400kg/ m2 to receive the applied roofing. Mixing shall take place using approved mechanical mixers.

Concrete screeds for obtaining falls shall be (1:3:6) mix.

All screeds shall be laid in bays not exceeding 10 square metres and formed between stop boards of the correct height and cut on each side to indicate the slope required in the roofing. The screed shall then be trowelled with a wooden float to true and accurate falls or cross falls up to the stop boards. A 10mm side gap shall be left between each screed bay for the full depth of the screed. The screeds shall be allowed to cure thoroughly to attain maximum shrinkage. Any cracks which appear due to shrinkage shall be made good. The gaps between bays shall then be filled in with cold bitumen.

Where the roof screeds are to be reinforced with one layer of galvanized wire mesh, this shall be supported on top of the base on spacers to ensure that it is maintained at between 10mm and 15mm below the top of the finished screeds. It shall be at least 100mm wide, securely wired together.It shall be stopped 20mm from the edge of each bay.

6.3 Insulation

When asphalt sheets are used on the top of the screeds, they shall have the following properties:

- Asphalt sheets shall be supplied in rolls of 1-1.2 m width and 4mm thick.
- Top surface shall have a layer of medium size white aggregates (2-3mm)

Applying asphalt sheets shall be made according to the manufacturer instructions.

Top surface of screeds shall be cleaned and a suitable prime should be sprayed before using asphalt sheets.

An overlap of 15-20cm shall be made on sheets.

Hot asphalt shall be sprayed before erecting the sheets, which should be heated (bottom side).

Sheets shall have at least 15cm vertical edges, all around the roof (a special groove should be made in the roof parapet to erect the vertical side of the sheets)

During erecting asphalt sheets, contractor shall prevent air pockets entrained under the sheets, which will be full flame applied.

6.4. Tiling

Tiled finishing to roofs shall be manufactured and laid as described in Section of (tiling works)

Tilted tiled skirting shall include a triangular fillet of screed material and pointing at top with polysulphide mastic.

6.5. Expansion Joints

The expansion joints shall generally be of 10mm thick fibreboard impregnated with bitumen accurately cut, with butt joints and fixed vertical and straight.The top 10mm of the joint shall be filled with a grey polyurethane gun grade sealant which confirms with BS 4254.

Expansion joints shall continue into the tilted tile, skirtings and fillets.

6.6. Felt Roofing

Felt roofing, below tiling, shall be two-ply, tropical grade, fibre- based bituminous roofing felt weighing not less than 1.8kg /m2 and shall comply generally with BS 747 (Class 1 Type 16) and shall be executed by an approved specialist.

The felt shall be thoroughly bonded to the roof or screed and between layers. Care shall be taken to ensure that all surfaces upon which felt is to be laid are dry, smooth and clean.

The bonding shall be by means of bitumen (60 /70 penetration) applied hot as a continuous coating to an average thickness of not less than 1.5mm and not more than 2mm, so as to give a complete coat over the whole area at the rate of not less than 1.5kg /m2 and not more than 2.0kg /m2 for each bonding coat.

The felt shall be laid with 150mm side and end laps which shall be staggered.

The felt shall be carried up the walls etc., over fillets to from a skirting continuous with the roof covering. The skirting shall be bonded to the fillets and walls and shall be not less that 150mm in vertical height.

Application of materials shall conform in all respects with the British Standard CP 144: Part 1, 'Roof.Coverings, built-up bitumen felt', or any standards approved by the Engineer.

The felt shall be dressed and bonded into rainwater outlets and under flashings.

6.7. Bitumen Roofing

Where roof finishings are required to be of a bitumen and sand mix this shall be composed of a mix to the following proportion (by weight) :

* Bitumen 60 /70 penetration 13 %
* Filler (passing 200 sieve) 11 %
* Sand 76 %

Mixing shall be carried out in an approved machine until all materials are thoroughly mixed. The mixing temperature shall be between 163OC and 191OC and it shall be applied at a temperature sufficient to maintain the workability of the mix. The covering shall be laid in one coat to give a consolidated thickness of 20mm after rolling with a light hand roller. 150x150mm angle fillets shall be laid at edges of roofs against parapets etc., properly bonded to the roof covering and with top edges turned into joints of walls. The covering shall also be pressed into rainwater outlets and under flashings.

6.8. Asphalt

Asphalt roofing and tanking shall be executed by an approved specialist using mastic asphalt to BS 988.

The asphalt shall be applied in the thickness and number of coats described in the in BOQ, with each successive coat breaking joints at least 300mm (12") and with properly formed angles, double angle fillets and fair edges.

Joints of blockwork shall be raked out and all vertical surfaces hacked for key.

Horizontal work shall be laid on a layer of stout sheathing felt.

6.9. Completion

On completion all roofs etc are to be left sound, water- tight and in clean condition before handing over.

SECTION 7: PLASTER WORK.

7.1 General

The British Standards (BS) govern the work covered in this section.

7.2 Materials

Portland cement, fine aggregate and water shall be as previously specified in Concrete Work section.

The color pigments shall be of an approved manufacture, lime proof and non-fading.

The sand for plastering shall be clean fine sand and shall be chemically and structurally stable. The sand shall be sieved and graded in accordance with the Table of Grading given below.

Table Of Grading

BS 410 Sieve No.	Approximate Size. mm	Sand Passing Through Sieve Percentage:.	
		UNDERCOAT	FINISH COAT
7	2.4	95-100	100
14	1.2	80-95	95-100
25	0.6	30-55	30-85
52	0.3	5-50	5-50
100	0.15	0-10	0-10

Note: the above figures represent the limits of percentages (by weight) passing sieves of the sizes mentioned.

Imported lime shall be of the hydrate type complying with BS 890.

Bonding agents where required shall be of a type approved by the Engineer, and shall be used as recommended by the manufacturer

The Contractor shall ensure that supplies of materials are sufficient to give consistent and uniform colour to surface finishes which are not to be painted.

7.3. Mixing

The methods of measuring and mixing shall be as laid down under Concrete Work section, and the proportions shall be in accordance with the Mixing Table given below.

Mixing Table

Nominal mix	Ratio	Cement. Kg	Fine Aggregate or Sand m3	(l) (dry hydrate) kg
1:5 cement		289	1.00	-
1:4 cement		361	1.00	-
1:3 cement		476	1.00	-
1:2 cement		577	1.00	-
1:2 cement		721	1.00	-
1:1 cement		1442	1.00	-
1:5 cement with 20% (l)	1:5:1	289	1.00	124
1:4 (l) with 10% cement	1:10:2 1/2	145	1.00	161

.... * l = Imported Lime

With regard to the lime mortars gauged with cement, the addition just before use of.the cement to small quantities of the lime/sand mix shall preferably take place in a mechanical mixer and mixing shall continue for such time as will ensure uniform distribution of materials and uniform colour and consistency. It is important to note that quantity of water used shall be carefully controlled.

7.4. Plastering and Similar In-Situ Finishings And Backings

All plastering shall be executed in a neat workmanlike manner. All faces except circular work shall be true and flat and angles shall be straight and level or plumb.

Plastering shall be neatly made good up to metal or wooden frames and skirting and around pipes or fittings. Angles shall be rounded to 5mm radius.

Surfaces of undercoats shall be well scratched to provide a key for finishing coats. Screed marks or making good on undercoats shall not show through the finishing coats.

Surfaces described as trowelled smooth shall be finished with a steel trowel to a smooth flat surface free from trowel marks.

Surfaces described as floated shall be finished with a wooden or felt float to a flat surface free from trowel marks.

All tools, implements, vessels and surfaces shall at all times be kept scrupulously clean and strict precautions shall be taken to prevent the plaster or other materials from being contaminated by pieces of partially set material which would tend to retard or accelerate the setting time.

Coating work shall not be started until all:

a) Required openings, chases or other apertures have been cut
b) Pipes, fixtures, fixing pads and plugs have been fixed
c) Making good has been completed.

The Contractor shall protect all existing work and approaches, with boards, dust sheets etc. All droppings onto finished work shall be cleaned off immediately.

The Contractor shall ensure that all plant and tools are kept clean and free from previous mixes.

The Contractor shall make good defective or damaged coatings before starting decoration works.

7.5 Preparation for Plaster, etc.

All surfaces to be plastered shall be clean and free from dust, loose mortar and all traces of salts..Projections and concrete fins shall be hacked off. Traces of mould oil, paint, grease, dust and other incompatible materials shall be removed by scrubbing with water.containing detergent.

Where cement plaster is to be applied the surfaces shall first be wetted and dashed with a mixture of Portland cement and sand (1:2) mix to form a key..This should be kept wet with a fine water spray until set, and allowed to harden before applying undercoat for a minimum of 3 days.

All surfaces shall be thoroughly sprayed with water and all free water allowed to disappear before plaster is applied.

Bonding agents where required shall be applied in accordance with the manufacturer's instructions and must be approved by the Engineer.

Before plastering is commenced all junctions between differing materials shall be reinforced in accordance with clause 9.21.

7.6 Curing of Plaster, etc.

Each coat of plaster should be kept damp for the first three days. Care must be taken to prevent too rapid drying out during hot weather and in drying winds.

The Contractor shall therefore provide a protective covering of plastic or similar impervious sheeting which must be hung so that it is clear of the finished surface.

Any cracking, discoloration or other defects caused by inadequate protection shall be remedied at the Contractor's expense.

7.7 Uses of Plaster, etc.

The type, mix and thickness of plaster for each location shall be as stated in the Particular Specification or shown on the Drawings, and shall generally be selected from the Schedule of Plasters given in Table P1.

Table P1: Schedule Of Plasters

DESCRIPTION		Render and Spray Cement and Sand	Plain Face Cement and Sand	Gauged Plastering Lime and Sand with Cement
Total Thickness	Walls	13	15	13
	Ceilings	10	10	10
Undercoats Thickness (mm)	Mix Surface	1:4 Floated	1:4 Scratched	1:10:2.5 Scratched
	Walls	10	as required	as required
	Ceilings	7	as required	as required
Finishing Thickness (mm)	Mix Surface	1:1 Sprayed	1:4 trowelled or floated	1:10:2.5 trowelled or floated
	Walls	3	as required	as required
	Ceilings	3	as required	as required
Remarks		External use	External or internal use may be applied in one coat to ceiling only if finished thickness is 12mm and the required surface finish is obtained	Internal use may be applied in one coat if finished thickness is 12mm and the required surface finish is obtained.

7.8 Application of Plaster, etc.

After preparation of the surfaces the undercoat shall be applied to the required thickness between screeds laid, ruled and plumbed as necessary When nearly set the surface of the undercoat shall be scratched. The undercoat shall be allowed to set hard and shall be cured. Where plastering is applied in one coat or where roughcast is to be applied the scratching should be omitted.

The finishing coat shall be applied to the required thickness by means of a laying - on trowel and finished to give the required surface.

The surfaces shall be finished to a true plane to correct line and level, with all angles and corners to a right angle unless otherwise specified, and with walls and reveals plumb and square..The surfaces shall be finished to within 3 mm of a straight edge 1.80m long placed on face of plaster.

Undercoat shall be worked well into the interstices of metal work to obtain maximum key.

Each coat shall be applied firmly to achieve good adhesion, and ruled to an even surface.

Each coat shall be applied to each wall and ceiling surface in one continuous operation.

Each coat shall be applied at full thickness down to floor level or skirting lath.

All undercoats shall be cross-scratched to provide key for next coat.

Cement based undercoats shall be allowed to dry out thoroughly to ensure that drying shrinkage is substantially complete before applying subsequent coat.

50 mm each side of angle bead to be finished with neat Keene's cement before plaster finishing coat is applied. Where angle beads are not specified, angles shall be formed with pencil round arris.

. **Smooth Finish**
Finished with a steel laying trowel to an even surface.

Wood Float Or Plain Finish
Finished with a dry wooden float as soon as wet sheen has disappeared from surface to give overall even texture.

. **Rough Textured Finish**
Finished with a cork or carpet float to provide a rough but even open-textured surface.

. **Scraped finish**
Finished with laying trowel to uniform thickness and after coat has set but before it is too hard, aggregate exposed by scraping surface of skin to approved texture.

. **Rough Cast Finish**
Thrown on while wet with trowel or scooped to an even texture and left as cast.

. **Dry Dash Finish**
Top coat of rendering finished to uniform thickness; while coating is plastic, aggregate thrown on to cover surface and particles pressed lightly into mortar to ensure adhesion.

. **Sprayed Finish**
The sprayed finish shall be applied with an approved machine to give a finish of even texture and thickness. The sprayed finish shall be applied in three separate coats allowing time for drying between coats.

Application in one continuous operation to build up a thick layer will not be permitted. The total finished thickness of the four sprayed coats shall be not less than 3 mm. The sprayed finish shall not be applied until all repairs and making good to the undercoat are completed. Rainwater pipes, fittings and the like shall first be fitted, then removed during the spraying process and refitted and jointed afterwards. Any plaster which adheres to other pipes, doors, windows and the like shall be carefully removed before it has set..Curing shall take place after the application of the fourth coat.

7.9 Steel Mesh Lathing, Stops and Beads

Steel mesh lathing shall be galvanized type weighing 1.6kg/m.

Steel rods for distancing shall be hot rolled mild steel round bars to BS 4449, diameter to approval, galvanized to BS 729 or bitumen coated.

Steel clout nails shall be to BS 1202: Part 1, Table 3, galvanized to BS 729.

Galvanized steel angle bead with 50 mm galvanized expanded metal mesh on both sides of bead.

Mesh lathing shall be fixed with the long way of the mesh at right angles to supports.

In horizontal work it shall be fixed with all mesh strands sloping in the same direction.

In vertical work it shall be fixed with all mesh strands sloping inwards and downwards from face of coating.

Lathing shall be fixed from the center outwards so that it is taut.

Lathing shall not be lapped within 100mm of angles or curves.

Junctions of lathing shall be reinforced at corners with 75 x 75 mm angled plain mesh, fixed to rails with tying wire at not more than 100mm centers.

Ends of wire shall be bent away from face of coating.

Beads and stops shall be fixed plumb, square and true to line and level.

Metal angle beads shall be fixed to solid backgrounds with plaster dabs, and shall be fixed to timber supports with 28mm clout nail. Both types of fixing shall be on each side of angle at not more than 600mm centers.

At junctions between dissimilar solid backgrounds in the same plane and with the same coating, steel lathing shall be fixed with 38 mm clout nails or with staples. They shall be driven into drilled and plugged holes or into fixing bricks or plugs built in or cast in:

(a) At single junctions, lathing to be not less than 450mm wide, fixed each edge at 100 mm centers.
(b) At columns, lathing to extend not less than 150mm beyond each junction, fixed each edge and centrally at 100 mm center.

Side edges of lathing shall be lapped not less than 25mm, and secure with tying wire at not more than 100mm centers.

Ends of lathing shall be lapped 40mm at supports and 50mm between supports, and secured with tying wire at not more than 100m centers.

Lathing fixed to metal supports shall be fixed with hair-pin shaped tying wire ties at not more than 100mm centers, passed over the support with both ends through mesh, twisted tight, ends cut off and bent flat.

Concrete, blockwork or masonry backgrounds shall be drilled and plugged at not more than 100x400mm centers and the lathing shall be fixed with 38mm clout nails or wire staples driven at an angle to tauten the mesh.

SECTION 8:
WALL AND FLOOR TILING WORKS

8.1 General

8.1.1 Section includes:

a. Ceramic and Terrazzo tile floor finish using the mortar bed application method. Approved Gravel bed under mortar for terrazzo tile, and for cement tiles.

b. Local marble tile stair treads using the mortar bed application method.

c. Interlock floor tile using the sand bed application.

d. Cements tiles.

8.1.2.References:

ANSI
TCA
ASTM
BS.

8.2 Materials:

Portland cement, fine aggregate and water shall be as previously specified in Concrete Work section.

The marble chipping shall be of an approved quality in irregular pieces varying from 2 mm to 10 mm in size depending on the effect required. The pieces should preferably be roughly cubical in shape where flaky shaped pieces shall not be used.

The granite chipping shall be of an approved quality graded from 12 mm down with not more than 5 percent fine material passing a No.100 sieve.

Marble and granite aggregates shall comply generally with the Table of Grading. In connection with marble aggregates the percentages are approximate only. The actual grading should be selected to produce the surface effects required.

Table Of Grading

BS 410 Sieve No.	Approximate Size. mm	Percentage of Aggregate Passing Through Sieve	
		GRANITE	MARBLE
-	13	100	-
-	10	95-100	95-100
-	5	30-60	25-60
7	2.4	20-50	5-30
14	1.2	15-40	0-10
25	0.6	10-30	-
59	0.3	5-15	-
100	0.15	0-5	-

NOTE: the above figures represent the limits of percentages (by weight) passing sieves of the sizes mentioned.

8.3 Cement and Sand Tiles

Cement and sand tiles shall be formed with a (1:2) mix of white or colored cement, or in white cement with a colour pigment added, and sand applied as a facing not less than 7.5mm thick to a Portland cement and sand (1:5) mix backing.

The tiles shall be cast in heavy moulds under pressure to the proportions and sizes shown in the following table.

Cement and Sand Tile Dimensions

Size. mm	Size tolerances. mm	Minimum total thickness mm
200x200	0.5	20
250x250	0.5	25
300x300	1.0	25
400x400 Interlock tile (size.vary)	1.0 1.0	30 60

Coloured cement and sand skirting to match tiles, 100mm or 200mm with chamfered top edges shall be produced in the same way as the tiles using the same mixes.

All cement and sand tiles shall be cured by totally immersing them, after the initial set has taken place, in a tank of clean water for at least 24 hours.

Cement and sand tiles shall be laid and bedded direct onto a concrete sub-floor on a cement and sand (1:4) mix screed. This screed shall be 25mm thick in the case of 25mm tiles and 30mm thick in the case of 20mm tiles. The total thickness of cement and sand screed and tiles shall not exceed 50mm..All tiles shall be laid with square joints.

All tiling shall be grouted up on completion, care being taken to fill all joints completely. The grout shall consist of neat cement of a colour to match the tiling..Any surplus grout shall be cleaned off the face of the tiling and surrounding surfaces immediately and all tiling shall be carefully cleaned off.

8.4. Terrazzo Tiles

Terrazzo tiles shall be formed with a (1:2 1/2) mix of white or coloured cement or white cement with a colour pigment added and granular marble chippings applied as a facing not less than 5 mm thick to a Portland cement and sand (1:5)) mix backing.

The tiles shall be cast in heavy metal moulds under pressure to the proportions and sizes shown in the following table.

Terrazzo Tile Dimensions

Size mm	Size tolerances mm	Minimum total thickness mm
200x200	0.5	20
250x250	0.5	25
300x300	1.0	25
400x400	1.0	30

Tiles shall be cured as for cement and sand tiles and then ground, filled and polished before distribution to site.

Grinding shall be done wet by means of a No. 80 carborundum stone. Filling shall be carried out with a neat cement grout of the same colour as the facing mix and this shall be worked into the surface with a wooden shaper to fill all voids and air holes.

Surplus grout shall be removed with a dry cloth. After a minimum period of 24 hours polishing shall be carried out wet by means of a No. 140 carborundum stone.

Terrazzo skirting 100mm high with chamfered top edges shall be produced in the same way as for tiles using the same mixes.

Terrazzo tiles shall be laid and bedded direct onto a proved gravel layer with a cement and sand (1:4) mix mortar. This mortar shall be 25mm thick in the case of 25mm tiles and 30mm thick in the case of 20mm tiles. The total thickness of the cement and sand screed and tiles shall not exceed 50 mm.

All tiling shall be grouted up on completion; care being taken to fill all joints completely. The grout shall consist of neat cement of a colour to match the tiling. Any surplus grout shall be cleaned off the face of the tiling and surrounding surfaces immediately and all tiling shall be carefully cleaned off.

All terrazzo surfaces shall be polished on completion. Large areas such as floors shall be wet polished by means of approved machines using No. 140 carborundum wheel..Any surface too small for convenient machine polishing may be polished by hand using a No.140 carborundum stone and water.Care must be taken during any polishing operation not to damage any of angles or arrises.

Terrazzo covering to items such as sills, treads and risers to steps, skirtings, etc., shall generally be applied in accordance with the foregoing specification except that the thickness of the facing shall be at least 10 mm (marble can be used if approved by the Engineer).

8.5. Marble Paving

Marble pavings shall generally be 30 mm thick and the size, type and pattern shall be as stated in the Particular Specification and/or shown on the Drawings. The marble slabs shall be fixed solid on a bed of cement and sand (1:4) mix 30 mm thick with tight joints grouted in lime putty. A protective slurry of lime putty at least 3 mm thick shall be applied to the marble pavings and subsequently cleaned off.

Treads shall be 30mm thick fixed solid on a bed of cement and sand (1:4) mix 30mm thick. Risers to stairs shall be 20mm thick fixed solid on a backing of cement and sand (1:4) mix 30 mm thick. Window sills shall be 40mm thick bedded hollow on plaster slabs. Skirtings shall be 10mm thick, in lengths of about 1.5 meters, fixed solid on a backing of cement and to coincide with joints in adjacent pavings. Rounded arrises, nosing and moldings shall be adequately protected by means of timber casings. Treads, risers, skirtings and window sills shall be grouted and protected in a manner similar to pavings.

The exposed faces and edges of all marble shall be polished smooth and be free from scratches or other defects..Concealed faces of marble shall be treated with shellac or bituminous paint.

8.6. Marble Lining

Marble lining to walls, columns and the like shall generally be 20 mm thick and the size, type and pattern shall be as stated in the Particular Specifications and/or as shown on the drawings.

The marble slabs shall be cut square and true and shall be uniform in shape and thickness. Patterns and mouldings shall be accurately formed in accordance with the Drawings.

Exposed edges and mouldings shall be protected by means of timber casing or lime putty coating. The exposed edges and faces of all marble shall be polished smooth and shall be free from scratches or other defects.

8.7. Interlock tile – colored cement tile:

1. Interlock cement tile 6cm thick, first grad from certified factory.
2. Colour and shape to be approved from consultant.
3. Samples for lab testing.
4. Apply clean sand with minimum.thickness 5cm
5. Lay tile according to the specification and drawings.
6. Paving on compacted base cours layer not less than 20cm thick

8.8. Ceramic, Glazed and Quarry Tiling

Clay floor quarries and fittings shall be in accordance with BS 1286 type A and the thickness and size shall be as stated in the Particular Specification or on the Drawings.

Ceramic floor tiles and fittings shall be in accordance with BS 1286 type B, vitrified or fully vitrified and the thickness and size shall be as stated in the Particular Specification or on the Drawings.

Glazed ceramic floor tiling shall be of the type, thickness and size as stated in the Particular Specification or on the Drawings.

The tiles shall be true to shape, flat and free from flaws, cracks and crazing and keyed on the reverse side and shall be of a manufacture approved by the Engineer.

Bedding mortar shall be cement and sand all in accordance with the materials stated in Concrete Work and Blockwork sections.

Any admixtures to the mortar must be approved before use.

Grout pointing shall be white or coloured cement.

Cement and sand mortar bed of not more than 20 mm or thickness of the tile shall be laid.

Tiles shall be firmly tamped into mortar to form a level surface.

The Contractor shall ensure that when fixing tiles with thin bed adhesive, the base to receive tiles is clean level and dry, with no loose and friable areas and surface dusting.

Cement-based adhesive shall be prepared and used in accordance with the manufacturer's recommendations to form a bed not more than 3 mm thick.

Tiles shall be laid dry and tamped well down into the adhesive to ensure a proper bond with base and a level surface.

When bedding tiles on thick bed, semi-dry cement and sand (1:4) mortar bed shall be spread not less than 25 mm thick.

Before the compacted bed has set a cement and sand slurry (1:1) about 3mm thick shall be spread over the surface.

The tiles shall be laid dry and tamped into the slurry to form a level surface.

Joints shall be even and not more than 3mm wide, in both directions.

Joints shall be continuous both horizontally and vertically.

The tiles shall be grouted up with grey or coloured cement mortar (1:1) worked well into joints when bed is sufficiently firm to prevent disturbances of the tiles; surplus grout shall be cleaned off from faces of tiles.

Movement joints shall be provided not less than 6 mm wide where shown on the Drawings or as directed by the Engineer.

Movement joints shall be carried through the depth of tile and bedding and partially filled with filling strip and finished flush with sealant to manufacturer's recommendations.jonts have to be made made out of silicone.

Where tiling abuts against wood or metal frames or other tiling at angles and around pipes etc., it shall be carefully cut and fitted to form a close neat joint..Open irregular.joints filled with cement and sand or plaster will not be permitted.

Tiles shall be cleaned off and polished at completion.

Water shall not be allowed on new tiling until bedding and grouting have completely set.

No traffic shall be allowed on the floor until 4 days after completion and then only light traffic for a further 10 days.

8.9. Glazed Ceramic Wall Tiling

Glazed ceramic wall tiles shall be in accordance with BS 1281 with or without cushioned edges and spacer lugs and shall be grey or coloured as stated in the Particular Specification.

Glazed ceramic tile fittings shall be rounded edge or angle bead type to match plain tiles.

The tiles shall be true to shape, flat and free form flaws, cracks and crazing and keyed on the reverse side and shall be of a manufacture approved by the Engineer.

Bedding mortar shall be cement and sand (1:3) all in accordance with the materials stated in Concrete Work and Blockwork sections

Any admixtures to the mortar must be approved before use.

Mastic adhesives shall be of an approved manufacture and shall comply with the performance requirements of CP 212: Part 1, if approved by the Engineer.

Grout pointing shall be neat grey or coloured cement.

The Contractor shall ensure that the cement render backing is at least 14 days old, firmly bonded to its background, free from dust, with surfaces plumb and true to 3mm in any 1800 mm.

8.10. Fixing Tiles with Cement and Sand Mortar

The tiles shall be immersed in water for 6 hours or until saturated then stacked tightly together to drain with end tiles turned glaze outwards. Tiles shall be fixed as soon as surface water has drained.

The render coat shall be wetted sufficiently to prevent it absorbing water from the bedding coat.

Mortar bedding shall be applied to render background to an even thickness of approximately 10mm.

Each tile shall be buttered evenly with mortar and tapped firmly into position so that the bed is solid throughout.

Thickness of finished bed shall be not less than 6mm nor more than 12 mm.

Any necessary adjustment to tiles shall be made within ten minutes of fixing and tiles cleaned off after not less than two hours.

8.11. Fixing Tiles with Adhesive

The tiles shall be fixed in accordance with the recommendations of the adhesive manufacturer.

Adhesive shall be applied not more than 1sq.m at a time to avoid premature drying out.

Adhesive shall be applied as a continuous screed to a thickness of approximately 3mm on the surface to be tiled.

Dry tiles shall be pressed on to the adhesive and tapped firmly into position to ensure solid bedding without voids.

Any necessary adjustment to tiles shall be made immediately after bedding.

Tiles shall be cleaned off as soon as bedding is complete.

Joints shall be even and not more than 2mm wide using spacer lug tiles or spacer pegs.

Joints shall be continuous both horizontally and vertically.

Tiles shall be fixed to a finished surface that is plumb and true to 2 mm in any 2m.

Joints shall be grouted up not less than 24 hours after fixing tiles to porous surfaces and not less than 3 days after fixing to impervious surfaces.

Tiles shall be grouted by pressing mix firmly into joints, working in areas of not more than 1sq.m.

Surplus grout shall be cleaned off as the work proceeds.

Where tiling abuts against wood or metal frames or other tiling at angles and around pipes etc., it shall be carefully cut and fitted to form a close neat joint.. Open irregular joints filled with cement and sand or plaster will not be permitted.

Tiles shall be cleaned off and polished on completion.

External tiling shall be protected from inclement weather until grouting is completely set.

No water is to be allowed on new tiling until bedding and grouting have completely set.

8.12. Protection

All floor, wall and ceiling finishes shall be protected from damage during subsequent work, and shall be thoroughly cleaned before handing over the works.

SECTION 9: CARPENTRY AND JOINERY

9.1 Timber

All softwood for carpentry and joinery work shall be well seasoned sound,.bright, free form shakes, large loose or dead knots, waney edges, warp, incipient decay, stained sapwood or other defects and shall be to the approval of the Engineer.

Only brass, galvanized or stainless screws will be allowed to use

Timber for carpentry work shall be carefully sawn square and shall hold the full dimensions shown on the Drawings.

The hardwood for joinery work shall be to the approval of the Engineer, well seasoned, close grained and free form all defects. Hardwood for polishing or clear treatment shall be selected and kept clean.

Leafs,.Shelves, drawers, sashes and partitions 17 mm thick of sandwich plywood covered on both sides and seen edged with (0.5 mm and 0.8 mm) thick Formica sheets internally and externally. All works shall be as per drawings and specifications.

Preservative treatment shall be approved by the Engineer. an environmentally friendly preservatives.

The Contractor shall allow for all necessary cutting of timber to size and shape, for preparation of surfaces, for all fixings, for properly jointing and putting together including farming, gluing, doweling screwing and mortising, for all cutting and waste, notching, sinking, scribing, mitres, ends, short lengths and any other sundry items of like nature and for priming all concealed surfaces of joinery. Aluminium primer shall be applied to concealed surfaces of all joinery timber.

All sizes and dimensions shown on the Drawings are finished sizes unless otherwise stated.

Timber for joinery work shall be finished work to the exact sizes shown on the Drawings with pencil rounded exposed arrises and no joinery shall be built in until inspected and approved by the Engineer.

All timber shall be properly seasoned and shall be planed square, straight and true and shall be free from the. following defects:

- Sapwood slits, ring shakes and soft pith.
- Checks exceeding 1,5 mm wide.
- Checks exceeding 1.5 mm wide.
- Checks more than half the thickness of the timber in depth.
- Knots exceeding 20mm mean diameter.
- Knots exceeding half the width of the surface.
- Decayed or dead knots unless cut out and plugged.
- Loose knots or knot unless cut out and plugged.
- Pith pockets.
- Decay and insect attach including pinworm holes.

The whole of hardwood joinery shall be flush with timber surface,.and left clean and ready to receive any oiled or other finish

Where screw fixings would show on the surface of hardwood, the heads shall be countersunk 6mm below timber surface and grain matched fillets not less than 6mm thick and traped and cut from matching timber shall be glued in and finished off flush with the face. This will apply equally to hardwood which is to be painted.

9.2 Moisture Content of Timber

The softwood generally shall have a maximum moisture content of 12%.

The hardwood shall have a maximum moisture content of 10% and shall have been kiln dried.

The whole of the timber for joinery work shall be properly stacked and protected from rain and ground moisture.

9.3 Plywood

The minimum thickness shall be 5mm.

Plywood face veneers shall be approved by the Engineer.

Plywood adhesives shall be approved by the Engineer.

The Contractor shall not be permitted to make up the required thickness by gluing together sheets of thinner plywood.

9.4 Timber Face Veneers

All timber face veneers that are exposed shall be selected to the approval of the Engineer and shall be hard, durable and capable of being finished easily to a smooth surface.

They shall be free from knots, worm and beetle holes, splits, glue stains, filling or inlaying of any kind, or defects.

9.5 Fixing and Jointing

Joinery work shall be carefully put together and properly jointed in accordance with best practice, all joints shall be glued and screwed or doweled. Any screws appearing on facework shall have the heads let in and pellated unless otherwise described. Softwood fixings shall be stout steel screws.

Where joinery is required to be put together and fixed with brass cups and screws, the cups for fixing hardwood joinery shall be cast brass cups with milled edges and shall be neatly let in to finish flush with the face of the work.

Nail lengths shall not be more than total thickness of sections to be joined less 5mm, but otherwise not less than twice the thickness of the section through which nails are driven.

Screw lengths shall be not more than total thickness of sections to be joined less 5mm, but otherwise not less than 1 times the thickness of the section through which screws are driven.

Proprietary plugs shall be approved by the Engineer.

Steel nails shall comply with BS 1202: Part 1.

Wood screws shall be brass complying with Bs 1210 with slotted countersunk heads.

Screw cups shall be brass complying with BS 1494: Part 2.

Synthetic resin gap-filling adhesives shall comply with BS 1204: Part 1, type WBP.

Synthetic resin close-contact adhesives shall comply with BS 1204: Part 2, type WBP.

9.6 Spacings And Additional Supports

Where no dimensions are specified or shown on Drawings, space battens, fillets, grounds studs etc., shall be used in accordance with the recommendations of the manufacture of the sheets and/or sections being fixed.

Where not shown on Drawings, additional supports shall be positioned and fixed for appliances, fixtures, edges of sheets etc., in accordance with the manufacturer's recommendations.

9.7 Doors

Door leaves with a polished finish are to be veneered as approved..Hardwood veneered plywood factory finished and supplied with protective wrappings, and with all necessary preparation for ironmongery carried out.

All edges are to be lipped with hardwood and all beads and lippings are to match face veneers.

All doors whether light cored, solid cored and/or fire resisting shall conform to BS 459 and 476 and 4787 as appropriate with adequate blocking out for ironmongery etc.

Door frames shall be as shown on the Drawings all in wrought hardwood treated to match doors in accordance with door manufacturer's recommendations and should be manufactured and finished by the door manufacturer where possible.

Hardwood polished thresholds are to be provided to individual flat entrance doors. All other doors within flats should allow sufficient clearance for fitted carpets. The Contractor should ascertain requirements for clearance in all other positions from the Engineer.

9.8 Windows

Windows and fanlight sashes shall be framed to the size shown on the Drawings. Sashes hung folding shall have meeting beads screwed on. Glazing bars if required shall be of twice rebated section.

Aluminium windows (Best quality) will be used. Colour and type of section must be approved by the Engineer.

9.9 Flyscreens

Flyscreens to doors shall be framed and braced with rails styles and braces and filled in with aluminium mesh, 18x16 meshes per inch.

9.10 Frames

Frames to doors, windows and flyscreens shall be provided and built in to the sizes shown on the Drawings or as directed by the Engineer.

Frames shall be securely tied to walls by means of steel or similar metal cramps, galvanised or dipped in bitumen and provided as follows:

(a). Door frames: three cramps to each side.
(b). Window frames: two or more cramps to each side according to size.
(c). Any other way approved by the Engineer (e.g. foam bond)

Doors, windows, etc. shall be carefully and accurately fitted to the frames to give a uniform clearance of not more than 3mm all round.

9.11 Architraves, Door Stops etc.

Architraves, door stops etc. shall be as shown on the Drawings and all properly mitred at intersections as approved by the Engineer.

Glazing beads where required shall be wrought splayed and rounded and shall be neatly mitred and fixed with small brads or lost-head nails.

9.12 Fittings

In connection with fittings such as wardrobes, cupboards, counters etc., the doors, frames, drawers, rails and framing etc. shall be properly and accurately framed together.

Before starting repetitive fabrication of any component, prototypes shall be prepared and approved.

Unless components are specified to be built in, these shall not be made until all site dimensions have been checked.

Matching clearance holes shall be provided for all sizes of screw and matching pilot holes for screws of 6 gauges or more for screwing softwood.

Clearance and pilot holes to match screw sizes shall be provided for screwing hardwood.

Pilot holes shall be provided slightly less than half the diameter of the screw for screwing particle board.

All nail heads which will be visible in completed work shall be punched below timber surface.

9.13 Finish

All joinery which is to be polished, varnished or painted shall be finished smooth and clean by rubbing down with fine sandpaper.

9.14 Protection

All joinery shall be protected from damage during the course of the Works and on completion shall be to the Engineer's entire satisfaction. Before handing over the Contractor shall ensure that all doors, drawers, etc, work easily and shall make all necessary adjustments including those needed during the maintenance period.

SECTION 10: IRONMONGERY

10.1 Description

The Contractor shall provide and fix the ironmongery required by the Particular Specifications or shown on the Drawings complete, including all necessary screws, bolts, plugs and other fixings. The use of nails for fixing ironmongery shall not be permitted. The Contractor shall hand over all in a finished state and to the satisfaction of the Engineer.
Any fitting have to be heavy duty.

All ironmongery shall be of first quality and shall be obtained from an approved manufacturer. Butt hinges are to be aluminum alloy with silver anodised finish with double stainless steel washers, or as approved by the Engineer.

The Contractor shall be required to submit for approval samples of all items of ironmongery he proposes to use.

All doors shall be provided with an approved door stop plugged and screwed to the top wall mounted all opening areas of aluminum work shall be provided with appropriate friction stays. The size, materials, finishes, type and quality of ironmongery shall be as described and.shown on the Drawings.

Quality Assurances

Field Measurements: take field measurements prior to Preparation of shop drawings and fabrication, where Possible. Do not delay job progress; allow for timing and fitting where taking field measurements before fabrication might delay work.

Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassemble and coordinated installation.

10.2.References

Applicable Publications: The following publications of the issues listed below, but referred to thereafter by basic designation only form a part of this Section.

1. Federal Specifications. Naval Publications and Forms Center. 5801 Tabor Avenue, Philadelphia. Pennsylvania 19120. USA, FF-W-92B Washers, Flat (Plain).and RR-G-66'1 E Grating, Metal, Bar Type (Floor, Except for Naval Vessels).
2. American National Standards Institute (ANSI). 1430 Broadway. New York. New York 10018. USA.A 14.3-1984 Fixed Ladders, Safety Requirements.
3. American Society for Testing and Materials Standards 1916 Race street Philadelphia, Pennsylvania 19103. U.S.A
   A 27 -83 Specifications for Steel Castings, Carbon, for General Application.
   A 53-82 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc- Coated Welded and Seamless
   A 123-78 Specification of Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
   A 153-82 Specification of Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   A 307 -83a Specification for Carbon Steel Externally Threaded Standard Fasteners.

A569-72(79)...Specification of Steel, Carbon (0.15 Maximum, Percent), Hot Rolle Sheet and Strip, Commercial Quality.
F593-82 Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

4. American Welding AWS.2501 N.W. 7thStreet. Miami..Florida 33125. USA, D1.1-85.Structural Welding Code -Steel.
5. Military Specifications. Naval publications and forms center 5801 Tabor Avenue Philadelphia. Pennsylvania 19120 USA. MIL-P-21035A Paint, High Zinc Content, Galvanizing Repair (Metric).
6. National Association of Architectural Metal Manufacturers. (NAAMM) 221 N. La Salle, Chicago. Illinois 60601, U.S.A Metal Bar Grating Manual -October 1979
7. Steel Structures Painting Council. (SSPC), 440Fifth Avenue. Pittsburgh, Pennsylvania 15213, USA
   PA1 Shop, Field & Maintenance Painting, November 1.1982.
   Paint 20 Zinc-Rich Primers (Type1-inorganic and Type 11- organic), November 1, 1982.
   SP3 Power Tool Cleaning, November 1, 1982.

Submittals

Submit items in accordance with the contract provision Product Data: Submit Manufacturer's specifications, anchor Details and installation instructions for products used in Miscellaneous metal fabrications, including paint products.

Shop Drawings: Submit shop drawings for fabrication and Erection of miscellaneous metal fabrications. Include plan, Elevations and details of sections and connections Show anchorage and accessory items. Provide templates for anchor and bolt installation in critical area. Where materials or fabrications are indicated to comply with certain requirement for design loading, include structural computations, material properties and other information needed for structural analysis.

10.3 Finish

The finish of the various items of ironmongery shall be as described as shown on the Drawings or as required and directed by the Engineer.

10.4 Fitting and Testing

All screws used for fixing ironmongery shall be of a suitable type, material, finish, size and shape to the satisfaction of the Engineer.

The hinges on which doors, windows, flyscreen doors etc., are hung shall be carefully housed or let into the door, window, flyscreen door etc., and to the frames.

All fittings shall be removed before commencing any painting operations and shall be refixed in place after all painting works are completed and approved by the Engineer.

All ironmongery shall be carefully wrapped and protected until completion of the work and any items or parts which are damaged or defaced or found to be defective shall be replaced at the Contractor's expense before handing over.

On completion of all locks, catches and similar items of ironmongery they shall be clearly labeled, with metal tags approximately 50x20mm and securely fixed to the keys and handed to the Engineer.

Door closers shall be fitted a maximum of two weeks before handover.

All floor and door springs are to be fully charged with oil and their operation checked to the satisfaction of the Engineer

10.5 Standard Ironmongery for Internal Doors

Ironmongery is to be hard satin anodised aluminum alloy of best quality with matching screws fully matching and integrated. Where a supplier cannot offer the particular required ironmongery the Contractor shall produce samples. All locks are to be provided with 2 keys on a key ring neatly labelled to indicate clearly the corresponding lock.

Any requirements for ' Master key ' locking systems will be stated in the contract provision and Drawings.

All knob sets shall include the appropriate mortice latch or lock with a 70 mm backset and with standard faceplates and roses unless otherwise noted.

SECTION 11: METAL WORKS

11.1 Cleanliness

All materials shall be free form scale, damage or defects. All welding, brazing or hot forging shall be carried out by approved processes.

includes fixing complete to the structure heavy duty dowels and three points to be fixed from each side, architrave, door stopper, ironmongery, cylindrical locks handles (Wally or equal), 6 mm Glazing, gaskets, automatic closing piston, accessories, Hammer Finish painting in three coats in addition to two primer coats as per detailed drawings and Engineer's instructions.

Metalwork shall be approved by the Engineer before starting painting works.

HOLLOW METAL DOORS [AND PANELS]

Hollow metal doorframes shall be purpose made to the profiles and sizes shown on the drawings and obtained from an approved manufacturer. The doors shall be delivered to site complete with a factory applied anti-corrosive plastic coating, ties cast on to backs of frames for building in and rubber silencers on the locking stile.

The frames shall be stored in a clean, dry place, off the ground and protected from the weather.

The frames shall be free of all dents, bumps, splits, and cracks and any defective frames shall be made good or replaced at the Contractor's own expense.

Hollow metal doorframes shall be fixed and shown on the drawings all in accordance with the manufacturer's printed instructions and flushed up solid with plain concrete or cement mortar.

The rates for hollow metal door frames are to include for the supply and assembly of the complete unit including all necessary hole for fixing in walls in accordance with the manufacturer's printed instructions and plain concrete or mortar filling as shown on the drawings.

Galvanize metal work as specified and describe. and as manufactured.

11.2 Aluminum Windows And Doors

Extruded aluminium sections should be used as approved by the Engineer.

All visible surfaces of the sections shall be brilliantly polished prior to anodising. The color of anodising shall be as described in the Drawings and /or 8. Samples of colour shall be submitted for the Engineer's approval before work commences.

The sections shall be anodised to a minimum thickness of 25 microns. The supplier must submit necessary evidence to the satisfaction of the Engineer that the thickness of anodisation is not less than 25 microns. In case of doubt the Engineer reserves the right to send sample pieces to independent testing laboratories, at the supplier's expense. If the testing laboratory report states that the thickness or quality of the anodisation is deficient, the Employer may ask the supplier to treat the order as cancelled and the supplier in such a case shall indemnify the Employer of any / all losses incurred by the supplier.

All farms shall be made to fit the actual openings with a 5mm clearance all round. Discrepancies in overall width or height exceeding 5mm will not be allowed and the frames will be rejected in such cases. All

small discrepancies shall have the gaps suitably backed and then filled with gun- applied mastic / sealant UV resistance as approved by the Engineer.

At all opening windows and doors and where there are louvered screens and approval of the Engineer, constructed following the principles and specifications as described elsewhere in this Specification.

Insect screens shall be in aluminum mesh, 18x16 meshes per inch..The gap between the insect screen and the shutter shall be covered with an adaptor PVC section.

For reference to window types see general arrangement drawings and elevations.

Tolerances are to be approved by the Engineer before manufacture.

All ironmongery which is to have the same finish as the frames it is to be installed on shall be approved by the Engineer.

The Contractor shall provide shop drawings for aluminium windows and doors which shall be submitted in quadruplicate to the Engineer for approval.

Approval by the Engineer of the shop drawings shall not relieve the Contractor of his responsibilities under the Contract.

All assembly screws shall be in 18-8 stainless steel.

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.

Sliding Windows And Doors

Weatherstripping - high density acrilan or wool weather - pile shall be used. There shall be double brushes at every contact between shutter and frame sections for complete insulation.These shall be present consistently throughout the unit between the inside and the outside and no portions without it are permitted.

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 and a vertical adjustment of 7mm shall be possible.

All sections for sliding windows and doors shall be of tubular shape and the cross sectional dimensions of same shall be not less than 60x 40 mm.

The outer frame must be suitable for accommodating sliding flyscreens as required or as directed by the Engineer.

The handle-latch set shall have all visible surfaces of anodised aluminum or similar non-rusting material to approval. The handle shall have a proper grip. A small projecting flange or a recess in the shutter sections shall not be accepted to serve as a handle. The latching mechanism shall not be surface mounted but shall be concealed within the sections.

Side Hung Windows, Doors and Ventilators

All windows and doors shall be weatherstripped 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 weatherstipping sections shall be provided for complete weather protection.

The bottom sections of hinged doors shall be capable of being adjusted vertically if necessary. The gap between the bottom section and the floor shall be covered with a pair of special flay-type PVC sections.

The shutter sections for windows and doors shall be of tubular type and shall be of overall size 57x45mm for windows and overall size 81x45mm for doors (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.

Hinges shall be in anodised aluminum with stainless steel pins and nylon washers. Handles shall be in anodised aluminum and mounted with self - lubricating nylon washers.

A mortice cylinder rim automatic deadlock of high quality with double pin tumbler shall be used.

Windows shall have anodised aluminium handles and a latching mechanism securing the shutter to the frame both at the top and bottom.

The glazing vinyl shall be in heat resisting PVC and of channel type to the approval of the Engineer.

11.3 Flyscreens

Flyscreens shall be fitted to all opening leaves of windows, consisting of a separate metal sub-farme filled in with flywire as previously described. The flyscreens shall be adequately secured with suitable clips, set screws or turn buckles and shall be removable for maintenance purposes. sections to the metal casement doors and shall be fitted with removable panels of flywire, in a manner similar to that described for window flyscreens. Flyscreen doors shall be mounted where indicated on the Drawings or as directed by the Engineer. with better system for fixing and moving fly screens..

11.4 Sealing Joints

The Contractor shall ensure that joints are dry and shall remove all loose material, dust and grease.

Joints shall be prepared in accordance with sealant manufacturer's recommendations using recommended solvents and primers where necessary as approved by the Engineer.

Backing strips shall be inserted in all joints to be pointed with sealant.

When using backing strips, the Contractor shall not leave gaps and shall not reduce depth of joint for sealant to less than the minimum recommended by the manufacturer.

Cavities shall be filled with sealant /mastic joint has to be uv- resistance in accordance with the manufacturer's recommendations.

Joints between frames and walls have to be closed with pre –compressed polyuthean foam sealant Sealant shall be tooled to form a smooth flat bed.

Excess sealant shall be removed from adjoining surfaces using cleaning materials recommended by the sealant manufacturer, and shall be left clean.

11.5 Expansion Joint Trims, etc.

The Contractor is to provide at all expansion joints in floors, roofs, ceilings, walls and columns extruded aluminum expansion joint cover systems as appropriate and as shown on the Drawings and fixed in accordance with their printed instructions including all necessary components and fixings.

11.6 Steel Pipe Railings and Handrails.

A. Fabricate Steel pipe railings and handrail to design, dimensions, and details indicated. Furnish railings and handrail members formed of the sized indicated conforming to ASTM A53, standard weight, galvanized.

B. Fabrication jointing of post, rail, and corners shall be by one of the following methods-

1) Flush-type rail fittings of commercial standard welded..and ground smooth with railing splice locks secured with 10 mm hexagonal-recessed-head set screws.
2) Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight-fitting interior sleeve not less that 152 mm (6 inches) long.
3) Railings may be bent at corners in lieu of jointing, provide bends are made in suitable jigs and that the pipe is not crushed.
4) Furnish wall returns at ends of wall-mounted handrails.
5) Close exposed ends of pipe by welding 5mm (3/16-inch) thick steel plate in place or by use of prefabricated fittings.
6) Furnish removable railing where indicated.
7) Handrails shall be capable of withstanding a concentrated load of 91 Kg. (200 pounds) applied at any point in any direction.
8) Pipe 50mm dia. meter steel pipe welded joints.
9) Posts 25mm diameter steel pipe; welded joints.
10) Fitting Flanges fixed by screws.
11) Mounting Adjustable flanges, with screws casting in concrete.
12) Exposed Fasteners flush countersunk screws or bolts; consistent with design of railing.
13) Splice Connectors Steel welding collars.
14) Galvanized or stainless screws to be used

Floor joint covers shall be.5cm deep. Butt joints within continuing runs shall be a maximum of 6.00m apart and will be sealed during installation.

Wall and ceiling joint covers shall be standard grey.

Transition pieced at changes of direction and at joints between horizontal and vertical joint covers shall be factory fabricated.

11.7.FIRE RATED DOORS

11.7.1. GENERAL

One hour Fire rated doors, resistance to fire

SUBMITTALS
Product Data: Submit manufacturer's product data.
Shop Drawings: submit shop drawings indicating locations, handling, sizes, elevations, materials and frames.
Certifications: Submit manufacturer's certification stating that doors meet or. exceed specified requirements (1hour fire rating)

Quality Assurance
Certification of fire rated doors:

Delivery, Storage an Delivery
Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and materials.

Storage ;
1. Store materials in a dry, ventilated area in doors, protected from damage and in accordance with manufacturer's instructions.
2. Store doors in a clean, dry, well-ventilated building, in an area protected from damage and sunlight.
3. Store on flat, level surface.
4. Do not store directly on concrete
5. over doors to keep clean and avoid discoloration.use a covering, which allows air circulation and, does not. permit light to penetrate.
6. Do not subject doors to sudden changes in temperature or humidity.
7. Relative Humidity: between 30 and 60 percent.

Handling
1. Protect doors during handling and installation to prevent damage
2. Do not drag doors across one another or other surfaces.
3. Handle doors with clean gloves to avoid smudging or staining.

11.7.2. PRODUCTS

2.1. Fire Rated Doors:-
- Galvanized anti corrosion steel panels strengthened by welded horizontal and vertical stiffeners.
- Firelock.
- One fixed bolt on hinge side.
- Three hinges.
- Lower steel insert PVC covered color approved by the engineer.
- Compressed fire resistance rock wool filling.
- Intumescent strip on door rabbet.
- Rubber sealing surrounding door.

2.2 Door finish:-
PVC coating in any color approved by the engineer.

2.3 Hardware:-
Narrow security steel plates and handles in any color approved by the engineer.
Upper hydraulic door closer.
Optional panic lock /fire exit device.

11.7.3. EXECUTION

3.1. Examination
A. Inspect and verify frames are solidly anchored, allowing no deflection when door are installed.
B. Do not install doors in frame openings that are not plumb and level or are out of tolerance.
C. Notify the architect of conditions that would adversely affect the installation or subsequent utilization of the.doors. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2. Preparation
A. Acclimate doors to project conditions for 24 hours minimum before installation.
B. Do not remove labels from fire-rated doors.
C. Field finishing: Field finishes doors in accordance with door manufacturer's instructions.

3.3. Installation

A. Install doors at locations indicated on the drawings and in accordance with manufacturer's instructions.

Hinges:

B. Exterior Doors: Install 3 hinges on doors 7 feet tall or less, and 4 hinges on doors over 7 feet in height.
C. Interior Doors: Install 3 hinges on doors 7 feet 6 inches tall or less, and 4 hinges on doors over7 feet 6 inches in height.
D. Install doorframe s as specified in wood doorframes.

3.4 Adjusting

Adjust and align doors for smooth operation without binding.

SECTION 12: PAINTING AND DECORATING

12.1 General

Every possible precaution shall be taken to keep down dust before and during painting processes. No paint shall be applied to surfaces structurally or superficially damp and all surfaces must be ascertained to be free from condensation, efflorescence etc. before the application of each coat.

Primed or undercoated woodwork and metalwork should not be left in an exposed or unsuitable situation for an undue period before completing the painting process. No exterior or exposed painting shall be carried out under adverse weather conditions, such as rain, extreme humidity, dust storms etc. Any external paints have to be UV –Resistance.

Metal fittings such as ironmongery etc. not required to be painted shall first be fitted and then removed before the preparatory processes are commenced. When all painting is completed the fittings shall be cleaned and refixed in position.

The contractor will be required to repaint at his own expense any work on which the paint is found to be incorrectly applied. The contractor shall be responsible for protecting from damage the paint work and all other work during and after painting operations including the provision of all necessary dust sheets, covers etc.

Brushes, pails, bottles etc., used in carrying out the work shall be clean and free from foreign matter. They shall be thoroughly cleaned before being used for different types or classes of material.

The number of coats stated in this specification is the minimum, and the Contractor must apply sufficient coats to achieve a proper even finish to the approval of the Engineer.

12.2 Materials

The decorating materials shall be obtained from approved manufacturers and shall be supplied in the manufacturers' sealed and branded containers.

All materials must be thoroughly stirred before use, unless not recommended by the manufacturer.

All paints shall be environmentally friendly and for the use in internal rooms.

Details of mixing and application shall be in accordance with the specifications of the manufacturers concerned and to the approval of the Engineer.

The mixing of paints etc. of different brands before or during application will not be permitted. No dilution of painting materials shall be allowed except strictly as detailed by the manufacturers and as approved by the Engineer.

Mordant solution shall be of approved manufacture.

Rust inhibitors shall be of approved manufacture.

Stopping for woodwork to receive clear finish shall be tinted to match surrounding woodwork, to the approval of the Engineer.

Stopping for internal woodwork, plywood, hardboard, and fiberboard, shall be linseed oil putty, tinted to match the colour of the undercoat.

Stopping for external woodwork shall be white lead paste and gold size well mixed.

Thinners shall be approved turpentine or white spirit.

Priming paints shall be:

a) For woodwork : Leadless grey priming paint in accordance with the recommendations of the decorative coating manufacturer.
(b) For steelwork: red oxide priming paint.
(c) For galvanized, zinc or aluminum alloy surfaces: grey zinc chromate priming paint.
(d) For plaster, concrete and brickwork, ceiling boards etc.: alkali resisting priming paint in accordance with the recommendations of the decorative coating manufacturer.

Knotting shall be in accordance with BS 1336.

Undercoating shall be:

(a) Zinc oxide based undercoating paint;
(b) White lead based undercoating paint. Colours shall approximate to the finishing paint.
(c) Synthetic alkyd based undercoating in accordance with the recommendations of the decorative coating manufacturer.

Finishing paints shall be:

(a) Zinc oxide based oil paint :
(b) White lead based oil gloss finishing paint.
(c) Synthetic alkyd based finishing paint as approved by the Engineer.

Petrifying liquid shall be used undiluted as supplied by the manufacturer. A small quantity of water paint of the finishing colour may be mixed with the petrifying liquid.

Water paint shall be an approved brand of washable oil-bound water paint. Thinning shall be done with petrifying liquid or fresh water only.

Emulsion paint shall be of the Polyviny1 Acetate (PVA)type obtained from an approved manufacturer. The precise specification shall comply with the manufacturer's normal practice. In all cases thinning shall be done with thinners supplied by the manufacturer or fresh water only.

Stain for woodwork shall be an approved brand of oil stain.

Polyurethane lacquer for woodwork shall be in accordance with the recommendation of the manufacturer.

Preparation Process

12.3 Internal Plaster, Fair Faced Concrete and Blockwork

Surfaces shall be allowed to dry out completely and cracks shall be cut out and made good with suitable hard plaster or cement and sand mix as appropriate, such repaired portions shall be allowed to dry out. No painting shall be carried out on plastering less than five weeks old.

Efflorescence shall be completely removed by rubbing down with dry coarse cloths followed by wiping down with damp cloths and allowed to dry. All surfaces shall be rubbed down with fine glass paper and brushed free of dust before applying any form of decoration.

Surfaces which are to receive water paint shall be treated with one coat of petrifying liquid applied by brush.and allowed to dry for at least 24 hours before the application of water paint. A period of 24 hours or longer if necessary, shall be allowed between subsequent coats.

Fair faced concrete and/or cement and sand plastered surfaces which are to receive oil paint shall be given one thin coat of oil putty and allowed to dry for at least two days.

The surfaces shall then be rubbed down with fine glass paper and given a second thin coat of oil putty and when completely set The surfaces shall then be rubbed down with fine glass paper and given a second thin coat of oil putty and when completely set

All surfaces which are to receive oil paint shall be treated with one coat of alkali resisting priming paint applied by brush and allowed to completely harden.

12.4 Fiber Acoustic Boards etc.

Execution only by instructions and approval of the engineer in accordance with the recommendations of the.manufacturer

SOFT BOARDS: where used externally or under humid conditions will receive one coat of priming paint and one coat of undercoat on back face and edges.

SOFT BOARDS: where used internally will receive one coat of priming paint and one coat of emulsion paint on back, face and edges.

HARD BOARD: composite panels will be treated in the same way as soft boards under humid conditions.

ACOUSTIC BOARDS: will be treated on the face in the same way as plaster, but the paint may be applied by spray; the backs and edges should not be treated.

12.5 Steelwork Including Windows, Louvers etc. Internally and Externally

Execution only by instructions and approval of the engineer in accordance with the recommendations of the..manufacturer

If delivered galvanized, the surfaces shall be cleaned to remove grease and dirt before priming. Where rusting has occurred through damage to the galvanizing, such rust shall be removed by wire brushing back to clean metal and the galvanizing made good with a rust inhibiting agent.

The surface shall then be treated with one coat of mordant solution and one coat of zinc chromate priming paint.

If delivered primed, the surfaces shall be examined to ascertain that the priming paint is hard, firmly adhering and in good condition. If not satisfactory, the priming paint shall be removed and the surfaces cleaned to remove rust, and reprimed. If the condition of the priming paint is satisfactory, the surfaces shall be cleaned to remove grease and dirt, minor damage to the priming paint being made good with red oxide priming paint after removal of rust.

If delivered unprimed and not galvanized, the surfaces shall be cleaned to remove grease and dirt, and wire brushed and scraped to remove all rust and scale before applying a red oxide priming paint.

Priming paint shall be brushed well into the surface and shall be allowed to dry and harden thoroughly before the application of subsequent coats.

Items of steelwork such as frames to roller shutters, covers to expansion joints etc., which are to be built into walls, shall first be primed.

12.6 Exposed Service Pipes

Copper and brass pipework shall have the surfaces slightly abraded with glass paper and white spirit or similar solvent and wiped clean. No priming paint will be necessary, the surfaces being finished in two coats of gloss paint.

Steel pipes will be treated as for steelwork with the exception that galvanized pipes are to be treated with a zinc-chromate priming paint.

Coated soil pipes shall be wiped clean and treated with two coats of knotting followed by priming paint as described below.

12.7 Woodwork Required to be Painted

Surfaces shall be cleaned to remove grease and dirt..The surface of teak shall be cleaned with white spirit to remove free oil. Tropical timber should be avoided The preparation process shall then be :

(a) **KNOT:** all knots shall be treated with shellac knotting
(b)**PRIME:** one coat of primer shall be thoroughly applied by brush to all surfaces and when dry a further coat to be applied to end-grain surfaces.
(c) **STOP :** when priming paint is hard, all cracks, holes, open joints etc. shall be made good with hard stopping and all open grain surfaces filled smooth with linseed oil putty or an approved filler and rubbed down with fine glass paper.

No joinery shall be primed until it has been approved by the Engineer Priming shall be carried out on the site and not in the factory.

Items of carpentry work which are to be built into walls etc. shall be first treated by twice coating with creosote or other approved preservative. And shall be environmentally friendly and for the use in internal rooms.

12.8 Woodwork required to be not stained

Surfaces shall be cleaned to remove grease and dirt..The wood shall then be stopped, filled and rubbed down..In the case of teak free oil shall be removed by cleaning with white spirit.

Finishing Processes

12.9 Internal Plaster

Where emulsion paint is specified three coats shall be applied by brush or sprayed in addition to any priming paint.

Where water paint is specified two coats shall be applied by brush or sprayed, in addition to the Petrifying liquid. The water paint shall be thinned to the consistency of thick cream.

Where oil paint is specified this shall be two or three coat work as detailed in the particular Specification, applied by roller or brush, but not by spray, to produce hard gloss, oil gloss, eggshell or flat finish as required.

The finishing coat of paint to walls and ceilings shall be applied after the completion and testing of the electrical installation. Any paint splashes on electrical fittings shall be carefully cleaned off.

12.10 Fibre Boards etc.

Both acoustic and plain soft or hard boards will be treated as for plaster, but the paint has to be applied by spray.

Water paint or emulsion paint shall be applied by brush to the specification of the manufacturers..Where a board is likely to be exposed to extreme humidity, i.e kitchen and external corridors and covered ways, an oil paint shall be used on the face after fixing.

12.11 Unplastered Blockwork or Concrete

As for internal plastered surfaces.

Externally a cement type paint may be used, and shall be applied keeping a constantly wet edge, in strict accordance with the manufacturer's instructions.

12.12 Steelwork and Exposed Service Pipes

Internally, apply one coat of hammer finished paint over two undercoats.

Non-ferrous pipes shall be finished in two coats of gloss paint.

Externally, apply two coats gloss paint over one undercoat.

12.13 Woodwork Required to be Painted.

Paints has to be avoided high maintenance and to apply the paint according to manufacturer recommendation.

12.14 Woodwork Required to be Stained and Polyurethaned

The woodwork, internally and externally, shall be stained as directed on site, rubbed down, brushed off, and treated with two coats of polyurethane.

12.15 Protection of Factory Finished Work

The contractor is to allow for protecting all factory finished doors, frames windows, suspended ceilings and the like at all times to ensure that factory finishes are not damaged and must make good or replace a defective component at his own expense.

SECTION 13: GLAZING

13.1 Sheet Glass

Sheet glass shall be flat-drawn clear sheet glass, of the substances shown below.

Nominal Substance or thickness	Limits of thickness		Approximate Weight	Normal.Maximum Size
	mm	inch	lb/ft2	inch
20oz	2.75-3.05	0.108-0.120	1 1/2	80x48
26oz	3.1-3.50	0.1 22-0.138	1 3/4	80x48
32oz	3.8-4.20	0.150-0.165	2	80x48
3/16 in	4.65-5.25	0.183-0.207	2 1/2	50 ft2 max width 84 in
7/32 in	5.3-5.80	0.209-0.228	3	50 ft2 max width 84 in
1/4 in	6.25-6.75	0.246-0.266	3 1/2	75 ft2.max width 84 in

13.2 Plate Glass

Plate glass shall be cast, rolled or drawn glass ground and polished on both.surfaces, of the thickness shown below.

Limits for Clear Plate Glass

Nominal Substance or thickness	Limits of thickness		Approximate Weight	Normal.Maximum Size
	mm	inch	lb/ft2	inch
3/16	3.97-5.56	0.156-0.219	2 1/2	100x72
1/4	5.56-7.94	0.219-0.312	3 1/4	175x98
3/8	9.13-10.72	0.359-0.422	5	280x130
1/2	11.91-13.49	0.469-0.531	6 1/2	156x96

13.3 Obscured Glass

Obscured glass shall be figured rolled glass, and of the thicknesses shown below.

Nominal Substance or thickness	Limits of thickness		Approximate Weight	Normal.Maximum Size
	mm	inch	lb/ft2	inch
1/8	2.94-4.4	0.116-0.173.	1 1/2	100x48
3/16	4.5 -6.1	0.177-0.240	2 1/2	100x48
1/4	6.0 -7.0	0.237-0.276	3 1/2	100x48

13.4 Wired Glass

Wired glass shall be polished Georgian wired having both surfaces ground and polished and with square mesh inserted during rolling. of the thicknesses shown below.

Limits for Wired Glass

Nominal thick-ness	Limits of thickness		Approximate Weight	Normal.Maximum Size
	mm	inch	lb/ft2	inch
1/4	5.5-7.2	0.216-0.283	3 ½	130x72

13.5 Heat - Absorbing Glass

Heat - absorbing glass shall be floated glass substantially opaque to infra-red radiations of the thickness-es shown below.

Limits for Heat Absorbing Plate Glass

Nominal thickness :. 6mm
Light transmittance :. 0.49
Reflectance :.. 0.10
Absorptance :.. 0.34
Shading coefficient :.. 0.76
Normal maximum size:. 4500 x 2500mm

13.6 Armourplate Glass

Armourplate glass shall be toughened safety glass made of heat treated polished plate of the thickness shown below.

Limits For Armourplate Glass

Nominal thick-ness	Limits of thickness		Approximate Weight	Normal.Maximum Size
	mm	inch	lb/ft2	inch
1/4	5.56-7.94	0.219-.312	3 ½	2600x1520
3/8	9.13-10.72	0.359-0.422	5	3950x1520
1/2	11.91-13.49	0.469-0.531	6 ½	3950x1520

13.7 Mirror Glass

Mirror glass shall be silvering Quality polished plate glass silvered on one side, copper-backed, varnished and painted of the thickness given in clause 2.02. Edges of mirrors shall be beveled.

13.8 Putty

Putty for glazing to metal shall be tropical grade metallic glazing quality and shall be approved.

13.9 Glazing Beads

Wooden glazing beads shall be of teak, splayed and rounded to the sizes shown in the Drawings and neatly metered and braded .No tropical timber shall be used.

Metal beads shall be supplied with metal windows and doors and these shall be sprung or screwed on according to design.

13.10 Glazing to Wood without Beads

The rebates shall be previously treated with one coat of priming paint and the bedding putty inserted. The glass shall be embedded in the putty and secured by sprigs.The front putty shall be inserted to form a triangular miter filling from the edge of the rebate to 2mm from the sight line. The bedding putty shall be trimmed off level with the sight line to form neat back putty.
When the putty has hardened sufficiently the painting shall be carried out and care shall be taken to seal the joint between putty and glass by painting up to the sight line.

13.11 Glazing to Wood with Beads

The rebates shall be previously treated with one coat of priming paint and the bedding putty inserted. The glass shall be embedded in the putty and secured by the beads.
The bedding putty shall be trimmed off level with the sight line to from neat back putty and the painting shall be carried out.

13.12 Glazing to Metal Without Beads

The rebate shall be previously treated either by rust proofing or priming as described elsewhere and the bedding putty inserted. The glass shall be embedded in the putty and secured by pegs or.clips inserted in holes in the rebates.

The front putty shall be inserted to from a triangular mitred filling from the edge of the rebate to 2mm back from the sight line. The bedding putty shall be trimmed off level with the sight line to from a neat back putty. When the putty has hardened sufficiently the painting shall be carried out and care shall be taken to seal the joint between putty and glass by painting up to the sight line.

13.13 Glazing To Metal With Beads

The rebates shall be previously treated by rust proofing or priming as described elsewhere and the bedding putty inserted.The glass shall be embedded in the putty and secured by the Beads. The bedding putty shall be trimmed off level with the sight line to from neat back putty and painting shall be carried out.

13.14 Glazing without Putty

Where specified, wash leather, ribbon velvet, flannel, felt, of putty for internal glazing in conjunction with beads. The material should be fitted so that it covers all parts of the glass which will be covered by the rebate and bead.

13.15 Mirrors

Mirrors shall be fixed to walls with compressive spacers, fibre washers and chromium plated dome - headed screws, screwed into prepared plugs let into walls and set flush with surrounding wall finish.

Mirrors used as wardrobe doors or as wall linings are to be bedded with an approved mastic on a painted block - board backing not less than 12mm (1/2") thick to walls and 18mm (3/4") thick to doors. Glass sizes will be whole size to doors and minimum 900mm (3'0") wide to wall linings unless otherwise detailed, and backings continuous where possible.

Joints in backings must coincide with joints in mirrors.

13.16 Cleaning, etc

The Contractor shall replace all scratched, cracked or borken glass and clean all glazing on both sides and all mirrors before handing over.

13.17 Tempered Glass

1. ***DEFINITIONS***
   Heat-treated glasses are classified as either fully tempered or heat strengthened. According to Federal Specification DD-G-1403B, fully tempered glass must have a surface compression of 10,000 psi or more or an edge compression of 9,700 psi or more. Heat-strength glass must have a surface compression between 3,500 and 10,000 psi, or an edge compression between 5,500 and 9,700 psi. The fracture characteristics of heat- strengthened glass vary widely from very much like annealed glass near the 3,500 psi level to similar to fully tempered glass at the 10,000 psi level.

2. ***HEAT TREATMENT PRINCIPLE***
   Glass can fracture when its surfaces or edges are placed into tension. Under these conditions inherent surface or edge fissures may propagate into visible cracks.
   The basic principle employed in the heat treating process is to create an initial condition of surface and edge compression. This condition is achieved by first heating the glass, then cooling the surfaces rapidly. This leaves the center glass thickness relatively hot compared to the surfaces. As the center thickness then cools, it forces the surfaces and edges into compression. Wind pressure, missile impact, thermal stresses or other applied loads must first overcome this compression before there is any possibility of fracture.

3. ***STRENGTH***
   Under wind pressure, tempered glass is approximately four times as strong as annealed glass. It resists breakage by small missiles traveling approximately twice as fast as missiles which break annealed glass. Tempered glass is also able to resist temperature differences (200 ° F - 300 ° F) which would cause annealed glass to crack.

	Annealed	Tempered

	Glass	Glass
Typical Breaking Stress (large light 60 sec. load)	6,000 psi	24,000 psi
Typical Impact Velocity Causing Fracture (1/4" light 5 gm missile, impact normal to surface	30 ft/sec	60 ft/sec

4. SAFETY

Fully tempered glass is used in many applications because of its safety characteristics. Safety comes from strength and from a unique fracture pattern. Strength, which effectively resists wind pressure and impact, provides safety in many applications. When fully tempered glass breaks the glass fractures into small, relatively harmless fragments. This phenomenon called "dicing," markedly reduces the likelihood of injury to people as there are no jagged edges or sharp shards.

Fully tempered glass is a safety glazing material when manufactured to meet the requirements of the ANSI Z97.1 Standard and Federal Standard CPSC 16 CFR 1201. Federal Standard CPSC 16 CFR 1201, as well as state and local codes, require safety glazing material where the glazing might reasonably be exposed to human impact. This includes doors, tub and shower enclosures, side lights, and certain windows. Applicable building codes should be checked for specific information and requirements.

5. USES FOR TEMPERED GLASS

Fully tempered glass is used traditionally in place of other glass products in applications requiring increased strength and reduced likelihood of injury in the event of breakage. The building industry, motor vehicle industry and certain manufacturing industries find tempered glass is effective and economical in a wide range of applications. Fully tempered glass can satisfy federal, state and local building code requirements for safety glazing in such applications as doors, side lights, shower and tub enclosure, and interior partitions. It is also used in storm doors, patio-door assemblies, and escalator and stairway balustrades. As a glazing product it is used in windows and in spandrel areas (for wind pressure, small missile impact and thermal stress resistance). Special building applications include sloped glazing, racquetball courts, skylights (see below), and solar panels.

Any conditions or requirements imposed in the applicable safety glazing laws and building codes limiting such special uses should be determined prior to glazing.

The domestic motor vehicle industry employs tempered glass as side and rear windows in automobiles, trucks, and multi-purpose vehicles. Manufacturing industries use tempered glass in refrigerators, furniture, ovens, shelving, and fireplace screens.

Tempered glass should not be used where building codes require wired glass for fire-spread resistance. Tempered glass should not be used, alone, where the objective is to provide security against forced entry or bullet passage. Combinations of annealed and tempered glass can be effective barriers against forced entry and bullet impact, if properly designed and constructed. When using tempered glass in fireplace screens, provisions must be made for expansion and edge insulation

6. TEMPERED GLASS IN SLOPED GLAZING AND SKYLIGHTS

Because of its high resistance to thermal stresses and small missile impact, tempered glass is used in skylights and sloped glazing. On rare occasions when tempered glass in these applications fails, it may fail completely from the opening, individual fragments from tempered glass are relatively small and harmless. A number of these fragments may be loosely joined and fall in this manner. Such pieces do not have the sharp edges normally associated with broken glass but may have significant weight. Some building codes may require the use of screens under skylights. The use of screens may also be dictated by considering the risk of breakage and the resulting consequences.

7. HANDLING AND INSTALLATION

Tempered glass should receive the same care as annealed glass. Unfortunately, familiarity with the greatly improved strength of tempered glass may mislead people to exert less care in handling it.

Careless handling and improper installation sometimes produce edge damage. Delayed breakage can ensue when edge-damaged tempered glass is subjected to a moderate thermal of mechanical stress. Full penetration of the compression layer will likely produce instantaneous total fragmentation of tempered glass. Hence, tempered glass cannot be cut or modified following heat treatment.

8. IMPERFECTIONS

Inclusions in glass originate from impurities in th batch or cullet, or are combined from furnace refactories. Common forms of inclusions include aluminous stones, iron stones, and silicon. Nickel sulfide stones are uncommon, microscopic defects in glass, and may cause breakage. Delayed breakage may occur when a nickel sulfide stone is present near the center of the glass thickness.

The tempering process rarely introduces imperfections into glass. The basic glass may contain bubbles, vents, chips, and inclusions which, if accepted or not revealed by inspection before tempering can cause breakage in the initial heating or final quench operations. If inclusions are not eliminated by self destruction during the tempering process, in rare cases they may lead to failure at a later time.

9. VISUAL APPEARANCE

Tempered glass possesses the basic optical qualities of annealed glass. The induced stress condition sometimes produces a slight bow in tempered glass lights. Tempered glass that has been manufactured in a vertical tempering oven contains small surface depressions resembling dimples along one edge. These marks are caused by the pointed metal tongs which support the glass during its passage through the oven. Glass which is passed horizontally through an oven may contain a very slight surface wave caused by contact with the rollers. The waviness can sometimes be detected when viewing reflected images from a large distance. Finally, the air quench nozzles discharge air in a fixed, reciprocating or rotating motion. The area of air quench can be seen through polarized glass as arrays of irridescent spots or lines. Under some lighting conditions these patterns can be seen in ordinary light.

SECTION 14: DRAINAGE

14.1 Scope

This Specification deals with the installation of the materials, fittings and equipment, the design and performance, the workmanship and the testing and commissioning of the below ground drainage.

This Specification is in addition to and will be read in conjunction with the Contract Drawings and relevant parts of the Contract Documents.

14.2 General

Works shall be constructed in accordance with BS CP 301: 1971 Building Drainage. The Contractor shall notify the Engineer of discrepancies between BS CP 301 and the working drawings and specifications.

Pipes and fittings shall be jointed and laid in accordance with the manufacturer's recommendations. The Contractor shall notify the Engineer of discrepancies between the manufacturer's recommendations and the design.

Unless otherwise stated, the provisions of the latest revised additions of relevant British Standards and Codes of Practice shall be held to be incorporated in the specification of materials and workmanship.

Drains shall be accurately laid, true to line and grade from point to point. Manholes shall be provided at changes of direction or gradient and at points of connection. Drain runs between manholes should be absolutely straight. Lines and falls shall be accurately set as shown on Drawings or as directed on Site.

Pipe work materials shall be as stated in the Particular Conditions or on the Drawings.

The Contractor shall perform all necessary excavation for drains, manholes, septic tanks, soak ways etc., uphold sides, level or.grade bottoms, return fill and ram and remove surplus spoil as directed.

The system shall be maintained in accordance with Clause 6 of CP 301.

14.3 Pipework

Excavation of any section of the work shall not start until a complete set of the pipes and components for that section is available.

The trench shall be as narrow as practicable but not less than the pipe diameter plus 300 mm from each side to permit adequate compaction of side fill. Adequate working space shall be left for pipe jointers and joint holes shall be formed where necessary.

The trench sides shall be kept vertical unless the approved use of a batter is unavoidable. In the latter case the sides of the trench shall be kept vertical up to 300mm above the top of the pipe. If over width excavation occurs at or below this level the trench shall be reformed using concrete to 300mm above the level of the top of the pipe or the Engineer's approval shall be obtained for the proposed bedding for the wider trench condition.

Bedding material shall be
(a) Local korkar.
(b) Sand to BS 882 Zones 1 - 4.

Pipes and fittings shall be inspected before fixing, and defective items shall be rejected.

Pipes shall be laid with the socket ends against the flow and shall rest on a solid and even bearing for the full length of the barrel.

Trenches shall be back-filled only after drains have been tested to the satisfaction of the Engineer.

Flexible pipes including pitch fibre pipes, UVC pipes, steel pipes and tubes and ductile iron pipes shall be laid on a granular or sand bed. The trench shall be excavated below the invert level of the pipe to depth that will allow a minimum thickness of 200mm of Sand as bedding material which shall extend to the full width of the trench.

In rocky ground a minimum of 200mm of granular or sand bed shall be used.

The bedding material shall be well tamped down on the trench bottom which shall be free from hard or soft spots.

The finished bottom shall be true to line and gradient.

Rigid pipes including vitrified clayware, cement pipes, grey iron pipes and concrete pipes shall either be laid on a granular or sand bed or on a concrete base in the trench bottom. The type of base provided shall depend on the nature of the trench formation and the presence of ground water.

Where the nature of the ground is such as to allow the trench formation to be trimmed to provide a uniform and solid bearing, pipes shall be laid upon the formation. Socket and joint holes shall be as short as practicable and shall be scraped or cut into the formation.

Where because of the nature of the ground or the presence of ground water pipes cannot be laid directly on the trench formation, the trench shall be excavated below the invert level of the pipe to a depth to allow a minimum thickness of 200mm of granular bedding material which shall extend the full width of the trench. The bedding material, trench, etc., shall be as for flexible pipes.

. Where pipes are to be laid with a concrete bed, bed and haunch or surrounds, the trench bottom shall be prepared as for the laying of pipes on a granular bed but with a layer of concrete at least 50mm thick. The pipes shall be supported clear of the trench bottom by blocks or cradles placed under the pipe and immediately behind each socket for short small pipes with a second block near the spigot end for long or large pipes.
The support should yield under load sufficiently to permit the barrel of the pipe to rest uniformly on its bed after the normal setting shrinkage of the concrete has occurred. The clearance under the barrel before placing the concrete should be not less than 100mm. The concrete bed or haunch should extend to 150mm on each side of the pipe.

. Concrete shall not be laid until the drain has been approved by the Engineer.

Where rigid pipes with flexible joints are employed with a concrete bed, haunch or surround a simple constructional flexible joint shall be provided in the concrete and at the face of a pipe joint at intervals of not more than 5 metres to reduce the natural rigidity of the concrete.

The first 300mm of filling above the top of pipes and the filling around the pipes shall be placed by hand over the pipe and compacted by hand in finished layers of 150mm to a maximum of 300mm and shall be selected material, carefully rammed around the pipes.The material shall be distributed equally to both sides of the pipe to buttress it to the sides of the trench. Subsequent filling shall be placed, rammed and watered if necessary in 300mm thick layers. Drains shall be kept free from earth , sand, surplus mortar and other obstructions during laying. Adequate cover shall be provided before using power compactors or heavy rollers.

Vitrified clay pipes and concrete pipes with more than 4.25 m of earth cover shall be laid on a 150mm thick bench of concrete and be haunched with concrete 150mm thick to at least the horizontal diameter of the pipe and above that level splayed tangentially to the extrados.

Where vitrified clay pipes and concrete pipes with more than 6 m of earth cover are used or where the pipes are laid in a heading or the cover is less than 1.2m if the pipes are laid in roads or 0.90 m elsewhere, the pipe shall be completely surrounded with concrete to a thickness of not less than 150mm.

The width of concrete beds shall be 150mm greater than the external diameter of the pipe on both sides.

Where drains run beneath buildings they shall be constructed of UPVC-SN8 pipe and shall be encased in concrete on bottom, top and both sides to a thickness of 150mm greater than the external diameter of the pipe and adequate flexibility in the pipeline shall be allowed.

The Engineer shall be consulted if pipes are to be laid with less than 600mm of cover or within 150mm of the underside of a concrete slab.

The head of every drainage system shall be ventilated and such ventilating pipes shall, where possible, be fixed against the outside face of an external wall unless otherwise shown on the Drawings and carried up to a height of 900mm above that part of the structure immediately adjacent to it. The ventilating pipe shall be fitted with a galvanized or copper wire balloon at the top.

Except where branches or other fittings occur, the top length of each ventilating stack shall consist of a complete length of pipe which shall be anchored 1.20 m from the top by means of wrought steel strap fixed as described elsewhere and painted to match the pipe. Any short length required to make up the length of the stack shall be fitted immediately below the top length.

14.4. UPVC Pipes and Fittings

UPVC-SN8 pipes and fittings shall comply with BS 4660.

All pipes and fittings on all soil, waste and vent pipes shall be in Unplasticised Polyvinyle Chloride, with solvent weld cement joints, to pipes and fittings.

All branch waste and vent pipes from basenes and sinks to stacks, floor gullies, collection boxes and manholes shall be in modified UPVC-SN4 with seal ring joints suitable to receive high temperature water discharge.

Fittings and coupling for use with UPVC pipes shall be jointed with solvent cement in accordance with manufacturer recommendations.

Fittings and coupling for use with UPVC pipes on movement joints shall be jointed with an incorporate synthetic rubber rings in accordance with the manufacturer recommendations.

Slip on cover plates shall be provided as a finish to pipe work, up to and including 50mm diameter, emerging from a wall in occupied areas other than service voids. Samples shall be first submitted to the Engineer for approval.

On pipe work up to and including 50 mm diameter union type fittings shall be provided to make up to outlets of basin, bath and sink wastes.

Access plates shall be fitted at the roof of each vertical stack at changes, to enable the complete disposal system to be internally cleaned and ridded.

Soil, waste and vent stacks above their highest branches shall be continued up words, at their full diameter, above roof level.

14.5 Safety

The Contractor shall provide, maintain and uphold safety measures adequate for the particular hazards of drainage works for all his employees. All safety measures taken by the Contractor should be approved by the Engineer.
Such approval will not affect the full responsibility of the contractor toward the safety of all his employees, the supervision staff and any other third party existing on site.

The Contractor shall ensure that all timbering, shuttering, staging, strutting, ladders etc., used in drain trenches and pits are adequate for the duty involved.

14.6 Manholes

Manhole dimensions shall be as shown on Drawings.

Manholes shall be constructed from approved precast concrete rings.

Manholes, chambers, Septic tanks, disintegration and settling tanks and percolating pits shall be constructed in the positions and to the dimensions shown on the Drawings or as directed by the Engineer. The method of execution of all work in connection with these shall be as elsewhere described in the appropriate trades.

Manhole base slabs shall be according to drawings, and.at least 150mm thick grade (A) concrete or as directed and approved by the Engineer.

Manhole cover slabs shall be a minimum of 150mm thick suitably reinforced grade (A) concrete, where also approved precast covers can be used.

Precast concrete manholes shall comply with BS 556.

Manhole sections shall be jointed using a cement and sand mortar, 1 : 2, proprietary bituminous or resin fillers. Where flexible fillers are used their shape, thickness and location in the joint shall be in accordance with the manufacturer's recommendations. The remainder of the joint shall be filled with a cement and sand mortar 1 : 2, to prevent settlement of the sections with possible point contact and subsequent spalling of the concrete joint.

Precast concrete manholes used below water table level shall be surrounded with a minimum thickness of 150mm concrete which shall be not less than a 1:2:4 mix.

Sulphate resisting cements shall be used in concrete and mortar, or accepted epoxy paint should be made for all concrete and mortars facing the waste water.

Cast iron manhole covers and frames shall comply with BS 497 except that the bituminous based protective coating shall not flow or chip when exposed to temperatures in the range of 0OC to 76.7OC.

Manholes exceeding 1.00 metre deep internally shall have a minimum internal diameter of 80 cms.

Where required the channels in manhole bottoms shall be constructed of glazed earthenware channels jointed in a similar manner to the pipes. Alternatively when so described the channels shall be formed in fine concrete finished smooth. The channels shall be semi circular in section and the concrete shall then be carried up vertically for a distance of 80mm at each side and sloped back at a minimum fall of 1: 10.

The benching shall be of fine concrete and shall be rendered over in cement and sand (1: 3) mix. Pipes entering manholes shall not project beyond the face of the internal rendering. The invert of the pipes and the channels shall be continuous. All benching surfaces should be painted by approved epoxy paint.

Covers and frames shall comply with the following:
GRADE A: Heavy duty covers suitable for heavy fast moving wheeled traffic (25 tons)
GRADE B: Medium duty covers suitable where heavy commercial vehicles would be exceptional (8 tons).
GRADE C: Light duty covers suitable for pedestrian traffic only (5 tons).

Manhole covers situated inside buildings or on verandahs shall be as follows:
(a) Double seal type cover and frame or
(b) Frame with ground - fit air tight cover manufactured for use inside buildings.

Manhole frames shall be bedded and pointed with cement and sand mortar and the rebates sealed with manhole grease.

Step irons shall be located and comply with BS CP 301, Clause 3.12.5.1.

Channels and benching shall comply with BS CP 301.

Where cast iron inspection chambers are shown on the Drawings these are to comply with BS 1130 using caulked joints and gasket sealed covers set in concrete block manholes benched to top of cover level. The manhole cover required can be single seal in lieu of double seal.

14.7 Septic Tanks

Septic tanks shall be sized and constructed of reinforced concrete for all sides with a block layer around the tank and according to drawings and specification mentioned in the.POQ as shown and constructed as stated in BS CP 302 unless otherwise stated.

External Walls of septic tanks shall be at least 300mm thick.

Where indicted on the drawings the Contractor shall provide an intercepting trap with cleaning arm and lever-locking stopper to be set in cement mortar in the intercepting manhole adjacent to the septic tank or inside the site boundary in the case of main drainage. The normal drop from inlet to outlet of trap shall be preserved. A fresh air inlet shall be taken to the intercepting manhole with 100mm cast iron drain pipes with an easy bend to a point just below ground level.

Septic tanks shall meet the requirements of the local Authority.

14.8 Soakaways

Soakaways shall be constructed in one of the following ways :
(a) Precast concrete rings to BS 556.
(b) 200mm (min) cast in situ concrete.

Cover and base slabs shall be at least 150mm thick Grade (A) reinforced concrete, or precast covers according to Specification and as directed and approved.by the Engineer.
Removable covers shall be as described for manhole covers.

Soakaways shall be of the sizes and in the positions shown on the Drawings or as directed on site by the Engineer.

Soakaways constructed in cast in site concrete shall have walls of at least 200mm thicknesses.

Soakaways shall meet the requirements of the Local Authority.

14.9 Connections To Existing Manholes And Drains

When work is being undertaken on existing drains and manholes including the construction of new manholes, building in pipes, cutting through manhole walls, cutting out and reforming benching, completing pipe entries and making good the Contractor shall keep existing drains open to flow and reasonably free form debris at all times during the progress of works.

On completion all work shall be in a watertight condition.

14.10 Cleaning, Protection and Testing Of Drains

The Contractor shall remove all silt and foreign matter from drains and manholes and leave the whole in a clean and workable condition.
In the event of delay between the laying of a drain and the placing of the first 300mm of back filling over the top of the pipe, precautions shall be taken to protect the pipes from damage arising from differential exposure to sun or wind.

Lengths of drain, manholes and inspection chambers shall be capable of withstanding the test. The test shall be applied after laying and before back filling or placing concrete surround and bedding concrete.

Leakage of the section under test, including sweating, which causes a drop in the test water level shall be noted and the defective part of the work shall be rectified on the Contractor's own expenses.

The test shall be repeated after back filling and any faults in the bedding or support of the pipe, inadequacies in design or accidental damage during, or subsequent to, back filling, shall be noted and the defective part of the work shall be rectified on the Contractor's own expenses.

Whenever possible testing shall be carried out from manhole to manhole.

Testing shall not be started until at least 48 hours after completion of the last joint.

Tests before back filling:

(a) The section shall be filled with water and after about one hour test readings shall be taken.
(b) A test pressure of 1. 2m head of water shall be applied at the high end of the section (but not let than 2.4m at the low end). Steeply graded mains shall be tested in sections.
(c) The loss of water over a period of 30 minutes shall be measured by adding water from a measuring vessel at regular intervals of 10 minutes and noting the quantity required to maintain the original water level in the standpipe.
(d) The average quantity of water added shall not exceed 0.06 litres pre hour per 100 linear meters per millimeter of nominal bore of the drain.
(e) For sections of drain where the highest point is more than 1.2m below the water table the following infiltration test shall be undertaken.
(f) Inlets to the system shall be closed. Visual inspection at manholes or inspection chambers will reveal any flow the cause of which shall be investigated and the faults rectified.
(g) Tests for line, level and freedom from obstruction shall be applied by means of a mirror at one end of the drain and a lamp at the other.
(h) Final test: The water test shall be repeated in accordance with the requirements of the Local Authority or the Engineer.
(i)Tested have to be don only in company with the engineer

SECTION 15: ASPHALT WORKS

15.1 GENERAL

The Contractor shall construct the area to be paved in accordance with the applicable specifications stipulated herein after, in conformity with the alignment, dimensions, and typical sections shown on the Drawings, or as directed by the Engineer.

15.2 TYPE OF WORK

For the purpose of these specifications, the following type of asphalt works is designated:
- Preparing and leveling of existing base - course.
- Compacting of existing base - course.
- Prime coat.
- Single asphalt surface layer.

15.3 BASE - COURSE

General
The Contractor shall provide only an aggregate material for the base-course consisting of hard, durable, crushed limestone or crushed wadi gravel, provided that the crushed aggregates retained on sieve No. 4 shall have 80% by weight of at least two fractured faces, which have to be crushed by approved crushing plant and shall be free from any organic matter or any other deleterious substances and also free from clay balls.
Base - course aggregate shall conform to the following gradation:

Sieve Size	Percent Passing
(38.10 mm)	100
(25.40 mm)	75-100
(19.10 mm)	 60-90
(12.70 mm)	45-80
(09.52 mm)	40-70
(04.76 mm)	35-65
(02.00 mm)	20-40
(00.42 mm)	8-20
(00.075 mm) .	5-10

The fraction passing No. 200 sieve shall not be greater than 70% of the fraction passing No. 40 sieve.

Base - course aggregates shall confirm to the requirements of the following standard tests:

Los Angeles Abrasion	(AASHTO -T- 96) 35 max.
Liquid Limit	(AASHTO -T- 89) 25 max.
Plasticity Index	(AASHTO -T- 90) 2 min. 6 max.

Flaky & Elongated Particles (B.S.812) 15% max. each.

The base-course shall be compacted to not less than 100% of the density obtained at optimum moisture content as determined by ASTM-DT 99C.

The following test shall also be performed:

a) Gradation tests shall be performed on samples of base - course taken after mixing with water and spreading before compaction and shall have a maximum % passing sieve No. 200 of 10%.
b) Gradation tests shall be performed on samples of base - course taken after compaction and the maximum material passing sieve No. 200 shall not exceed 10%.

The thickness of the compacted layer shall be measured and recorded when performing filed density tests and sieve tests on samples taken from compacted layers in place.

Construction

Aggregate for base-course shall be delivered to the area to be paved as a uniform mixture and shall spread in layers.

Segregation shall be avoided and the base-course shall be free from pockets of coarse or fine materials. The base-course shall be spread by a grader or any other mechanical method, approved by the Engineer, watered, shaped and compacted to the required grade and cross section.

The finished surface of the base-course shall not vary at any point by more than 1 cm.below the grade established by the Engineer, and the total thickness of the base-course shall not vary by more $\pm$0.50 cm. In addition to level checking, longitudinally the surface shall be checked with a straight edge (4m long), where irregularities in this direction shall not vary by more than 1cm.

A minimum of (4) levels of the base at the total longitudinal side shall be taken and if (2) or more of these levels exceed the tolerance given the Contractor shall re-grade the entire length of the area. If one of these levels exceeds the tolerance then the Contractor shall make good this point.

The aggregate base shall be compacted to not less than 100% of the maximum density determined in accordance with the latest modified AASHTO T-191,T-205 or T-205 and T-239.

The base-course shall be maintained in a condition satisfactory to receive surfacing material. Aggregate base-course which does not conform to the above requirements, shall be reshaped or reworked, watered and thoroughly re-compacted to conform to the specified requirements at the Contractors own expense.

15.4 PRIMECOAT

General

Liquid asphalt for prime coat shall be medium curing grade MC70, in conformance with AASHTO standard M82, or emulsion type SS1, SS2 or equivalent according to the manufacturer instructions and lab tests results.

The surface to be treated shall be smooth, compact and tight. It shall be true to grade, and cross-section where dust shall be removed by brooming.

Equipment

The equipment used by the Contractor shall include a power broom or a power blower or both; a self -propelled, pneumatic roller, or steel-wheeled tandem (5 to tons) or both; mechanical or self-propelled aggregate spreading equipment that can be adjusted to spread accurately the specified amounts per square meter, a pressure distributor and equipment for heating the asphalt material. Pneumatic - tired rollers shall have a total compacting width of not less than 120 cm and shall have minimum contact pressures of 2.8 kg/cm2 or as specified by the Engineer. Other equipment are to be used in addition to, or in lieu of the specified equipment when approved by the Engineer.

The pressure distributor shall be designed and operated to distribute the asphalt material in a uniform spay with atomisation, in the amount and between the limits of temperature specified. It shall be equipped with a tachometer having a dial registering feet or meters of travel per minute. The dial shall be visible to the truck driver so he can maintain the constant speed required for application at the specified rate. The pump shall be equipped with a bitumetre having a dial registering litres, or gallons per minute passing through the nozzles. The dial shall be readily visible to the operator.

Means for indicating accurately the temperature of the asphalt material at all times shall be provided. The thermometer reservoir shall not be in contact with a heating tube.
The spray bar shall be adjustable to a reasonable width. A hose and spray nozzle attachment shall be provided for applying asphalt material to paths and areas inaccessible to the spray bar.

The distributor shall be provided with heating attachments and the asphalt material shall be circulated during the entire heating process.

Application of Primecoat

The Engineer will select the rate of application for the asphalt primer to be used. The Contractor shall keep a record of the application rates selected. Tentatively an application rate of 1.0-1.5 Kg/m2 of MC 70 shall be used.

Application of the asphalt prime shall be made uniformly at this rate with the pressure distributor. The asphalt prime shall be applied at the temperature specified by the Engineer. When heating is required, precautions shall be taken to avoid fire hazard.

Application shall be made when the surface is dry or slightly damp and, unless otherwise permitted by the Engineer, when the air temperature in the shade is not less than 10C. After application of the asphalt prime, at least forty - eight (48) hours shall elapse before further applications are made.

Before beginning application, building paper shall be spread over the surface, from the joint back, for a sufficient distance for the spray bar to begin spraying and be operating at full force when the surface to be treated is reached. After the asphalt is applied the building paper shall be removed and destroyed.

The spray bar shall be shut off instantaneously at each construction joint to assure a straight line and the full application of asphalt prime up to the joint. If necessary to prevent dripping, a drip pan shall be inserted under the nozzle when application is stopped. A hand spray shall be used to apply primer material necessary to touch up all spots unavoidably missed by the distributor.

Following the application, the primed surface shall be allowed to dry for a period of not less than 48 hours without being disturbed or for such an additional period of time as may be necessary to permit the drying out of the prime until it will not be picked up.

The surface shall then be maintained by the Contractor until the surfacing has been placed and no traffic (other than that necessary for the Contractor) shall be allowed on the primed surface before placing of the surface treatment.

Method of Measurement

The quantities to be paid for shall be the total quantity in sq.m. of the primed surface area, actually applied, and shall be based on the approved records of the application rates as selected by the Engineer.

Method of Payment

Payment shall be based on the Contract unit rate for *"Prime Coat*" per sq.m.

15.5 HOT MIX ASPHALT SURFACING

Scope
Furnishing and mixing non plastic aggregate crushed limestone and asphalt binder at a central mixing plant, spreading and single layer surface course.

Construction shall be in accordance with these specifications and in conformity with lines, grades and thickness as shown on drawings or established by the Engineer.

Composition of Mixes of Mixes
The paving mix shall be Composed of specified aggregates and asphalt cement within the limits of the following table:

Standard Sieve Size	Percent Passing.Surface Course
(25.40 mm)	 100
(19.10 mm)	 90-100
(90.52 mm)	 56-80
(04.76 mm)	35-65
(02.00 mm)	23-49
(00.42 mm) .	 5-19
(00.075 mm)	..... 2- 8

Asphalt to be added by weight of total weight according to design.

The aggregate shall have a percentage of wear of not more than 35% in 500 revolutions as determined by AASHTO T96. The sand equivalent shall be 50 minimum according to AASHTO T-176. Aggregate shall in all respects comply with the relevant standards. Aggregate limestone to be used be fresh mechanically crushed coarse aggregate. Materials on sieve No.4 shall have 90% by weight of at least two fractured faces.

Filler Material
When the combined grading of the coarse and fine aggregate is deficient in material passing No. 200 sieve, a filler conforming to the requirements specified hereafter shall be added.

Mineral filler shall comply in all respects with AASHTO Standard Specification M17.

The amount of commercial filler to be added shall be only that amount necessary to make the combined grading of the material comply with the grading requirements for the complete mixture.

In no case shall the amount of commercial filler added exceed three percent (3%), sample obtained form hot bins, by weight of the combined aggregate, The material passing No. 200 sieve may consist of fine particles of the aggregates or mineral filler, or both.It shall free from organic matter and clay particles.

Job Mix Formula
The Contractor shall submit for the Engineer's approval a job mix formula within the limits of these specifications.

The maximum permissible variation from the job mix formula within the specification limits, shall be as follows:

Standard Sieve Size	Permissible Variation Percent by Weight of Total Mix
3/8 inch and larger	± 5.00
No. 4 to No. 80	± 4.00
No. 200	± 1.00
Asphalt	± 0.30

Mix Test Criteria
Test requirements and criteria for the paving mixes prepared these specifications shall be as follows:

Surfacing

No. of compactive blows each end specimen	75
Minimum Stability (Kg)	900
Flow (1/100")	2-4
Percent air.voids	3-5
V.M.A. using bulk S/Gr. (Tolerance - 1%)	min.14%
V.F.B.	60-75 %
Loss of stability (soaking 24 hours compared with 30 min. at 60OC for all specimens in water bath).	max.25
Plasticity Index for material passing sieve No.40(from hot bins)	non plastic uncoated
Stripping Test(ASTM D1664)	aggregate

Laboratory test specimens of paving mixes, combined in the proportions of the job mix formula, shall be prepared and tested in accordance with the procedures of the Marshall method of mix design as detailed in the 'Asphalt Institute Manual - MS2' and ASTM method of Test D 1559.

General Equipment Requirements
All equipment furnished by the Contractor shall meet the requirements of this section and shall be maintained in its best mechanical condition. Equipment shall be serviced and lubricated away form the paving site; units drip fuel, oil, or grease shall be removed from the site until such leakage is corrected.

Elements for All Plants: **Uniformity**
The plants shall be designed, co-ordinated and operated to produce a uniform mix within the specified job mix tolerances.

Job Mix Formula
The Engineer will make frequent gradation analyses of the hot aggregates and of the completed mix to be certain that the materials being used and produced are within the tolerances of the job mix formula and the specifications of the mix number being used.

If the mix is found to be outside the job mix formula tolerances or outside of the specification limits, correction shall be made in quantities measured from the hot bins and adjustments made the cold bin feeders and the Contractor shall submit a new mix design.

Sampling and Testing
Stockpiles and bins will be sampled for gradation analyses and examined for dust coating and for other purposes, in compliance with stated requirements. Gradation analyses of each hot bin will be performed and a combined analysis conducted at least twice a day once in the forenoon, and once in the afternoon. If materials do not run uniform, more frequent tests will be made.

When requested by the Engineer, the Contractor shall provide representative samples by taking aggregate from each bin through the mixing chamber (without asphalt) into a truck or other receptacle.

At least one sample shall be taken from each truck of the hot mix being delivered to the site. Samples will be used to determine compliance with general and special requirements set forth in these specifications.

Construction Method

Weather Limitations
When the moisture of the aggregate in the stockpile or from the dryer in the plant interferes with the quality of mix production, or with normal plant operations, or when pools of water are observed on the base, then mixing and placing of hot-mix asphalt will not be permitted.

The temperature of the surface on which the hot-mix asphalt is placed shall not be less than 5oC When the surface temperature on which the material is to be placed falls below 10oC, precautions shall be taken to compact the mix before it cools too much, to obtain the required density.

All truck loads shall be delivered continuously and immediately spread and compacted. In cold weather and for shall be delivered at a temperature within 8oC of that temperature specified by the Engineers Representative.

Preparation of Area
The area to be paved shall be true to line and grade, and have a dry and properly prepared surface prior to the start of paving operations. It shall be free from all loose screenings, and other loose or foreign material.

The surface shall be primed as specified. The surface of structures in actual contact with asphalt mixes shall be painted with a thin, complete coating of asphalt material to provide a closely bonded water - tight joint.

Proportioning and Mixing
To aid in determining the proper temperature of the completed batch, current viscosity data shall be available at the plant at all times.

With information relative to the viscosity of the particular asphalt being used, the temperature of the completed mix at the plant and at the paver shall be designated by the Engineer's Representative after discussing with the Contractor the hauling and placing conditions.

The asphalt shall be heated so that it can be distributed uniformly throughout the batch. For mixing applications, the specified temperature will generally be such that the asphalt viscosity is within the range of 150-300 centistokes (75-150 seconds, Saybold Fuyol). The material shall be sufficiently fluid to produce a complete coating on every particle of aggregate within the specified mixing time. The temperature of the aggregates and asphalt immediately prior to mixing shall be approximately that of the completed batch.

When the mix is produced in a batch type plant the aggregate shall be weighed accurately in the designated proportions to provide the specified batch weight. The temperature of the aggregate at the time of introduction into the mixer shall be as directed by the Engineer's Representative with a tolerance of + 8OC.
In no case, however, shall temperature of the mixture exceed 165OC.

Transportation of Mix
The mix shall be transported to the job site in vehicles and painted, or sprayed, with a limewater, soap or detergent solution, at least once a day or as often as required.

After this operation the truck bed shall elevated and thoroughly drained ; no excess solution shall be permitted. The dispatching of the vehicles shall be so scheduled that all material.

Delivery of material to the paver shall be at a uniform rate and in an amount well within the capacity of the paving and compacting equipment.

Spreading and Finishing
Spreading and finishing shall be conducted in the following manner :

Mechanical Paver
The binder and surface courses shall be spread and struck-off with a mechanical paving machine connected with an automatic sensor. The paving machine connected with an automatic sensor. The paving machine shall be operated so that material dose not accumulate and remain along the sides of the receiving hopper.

Equipment which leaves tracks or indented areas which cannot be corrected in normal operation, or which produces flushing or other permanent blemishes or fails to produce a satisfactory surface shall not be used .

Lines for the paver to follow will be established by the Engineer's Representative parallel to the centreline of the proposed roadway. The paver shall be positioned and operated to follow closely the established lines.

In backing trucks against the paver, care shall be taken not to jar it out of its proper alignment.

As soon as the first load of material has been spread, the texture of the unrolled surface shall be checked to determine its uniformity.

Segregation of materials shall not be permitted If suspended until the cause is determined and corrected.
Transverse joints in succeeding courses shall be offset at least 60 cm.

Any irregularities in alignment left by the paver shall be corrected by trimming directly behind the machine. Immediately after trimming, the edges of the course shall be thoroughly compacted by tamping. Distortion of the pavement during this operation shall be avoided.

Edges against which additional pavement is to be placed shall be straight and immediately vertical. A lute or covered rake shall be used immediately behind the paver when required to obtain a true line and vertical edge. Any irregularities in the surface of the pavement course shall be corrected directly behind the paver. Excess material forming high spots shall be removed by a shovel or lute. Indented areas shall be filled with hot mix and smoothed with the back of a shovel being pulled over the surface.
Fanning of material over such areas shall not be permitted..

Hand Spreading
In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand, if so authorised by the Engineer's Representative. Wood or steel form, approved by the Engineer's Representative, rigidly supported to assure correct grade and cross-section, may be used. In such instances, measuring blocks and intermediate strips shall be used to aid in obtaining the required cross-section. Placing by hand shall be performed carefully, the material shall be distributed uniformly to avoid segregation of the coarse and fine aggregate

Broadcasting of material shall not be permitted. During the spreading operation, all materials shall be thoroughly loosened and uniformly distributed by lutes or covered rakes. Material that has formed into lumps and dose not break down readily shall be rejected.

Following placing and before rolling, the surface shall be checked with templates and straight edges and all irregularities shall be corrected.

Heating equipment used for keeping hand tools free from asphalt shall be provided. Caution shall be exercised to prevent high heating temperatures which may burn the material. The temperature of the tools when used shall not be greater than the temperature of the mix being placed. Heat only shall be employed to clean hand tools; petroleum oils or solvents shall not be permitted.

Compaction General

General
Except for small jobs, such as driveways, at least two rollers shall be required at all times. As many additional rollers shall be used as necessary to provide specified pavement density.

During rolling, the roller wheels shall be kept moist with only sufficient water to avoid picking up the material.

After the edges have been compacted rolling shall start longitudinally at the sides and gradually progressing toward the centre of the pavement.

The rollers shall move at a slow but uniform speed with the drive roll or wheel nearest the paver. The speed shall not exceed 5 kph for steel-wheeled rollers or 8 kph for pneumatic - tired rollers.

The line of rolling shall not be changed suddenly. If rolling causes displacement of the material, the affected areas shall be loosened at once with lutes or shovels and restored to the original grade of the loose material before being re-rolled.

Heavy equipment or rollers should not be permitted to stand on the finished surface before it has been compacted and has thoroughly cooled.

Rolling shall be in the following order:
a) Transverse joints.
b) Outside edge
c) Initial or breakdown rolling, beginning on the low-side and progressing toward the high side
d) Second rolling, same procedure as (c)
e) Finish rolling.

The compaction temperature (laboratory) shall be (viscosity) of bitumen is 280+30 centistoke, as follows:
148+3oC for 60/70 penetration.

Transverse Joints
Transverse joints shall be held to a minimum and thoroughly compacted to provide a smooth riding surface.

Joints shall be straight edges and string - lined to assure smoothness and true alignment. If a joint is formed with a bulkhead, such as a board, to provide a straight line and vertical face, it.shall be checked with a straight edges before fresh material is placed against it to complete the joint. If a bulkhead is not used to form the joint and the roller is permitted to roll over the end of the new material, the line shall be located back of the rounded edge a sufficient distance to provide a true surface and cross-section. If the joint has been distorted by traffic or by other causes, it shall be trimmed to line.

In either case, the joint face shall face shall be painted with a thin coating of asphalt before fresh material is placed against it.

To obtain through compaction of these joints, material placed against the joint shall be tightly crowded against the vertical face of the joint.

To accomplish this, the paving machine shall be positioned so that the material shall overlap the edge of the joint by 3 to 5 cm. The depth of the overlapped material shall be kept uniform.

The coarse aggregate in the overlapped material that was dislodged through raking or luting shall be removed form the pavement surface and discarded.

A tandem roller shall be placed on the previously compacted material transversely so that no more 15 cm of the rear rolling wheel rides on the edge of the joint.

The roller shall be operated to pinch and press the mix place at the transverse joint. The roller shall continue to roll along this line, shifting its position gradually across the joint, in 15 to 20 cm P17 increments, until the joint has been rolled with the entire width of the roller wheel. Rolling joint is obtained

Edges
Care shall be exercised in consolidating the course along the entire length of the edges. Before it is compacted, the material along the unsupported edges shall be slightly elevated with a tamping tool or lute.

This will permit the full weight of the roller wheel to bear on the material to the extreme edges of the mat. In rolling pavement edges, roller wheels shall extend 5 cm to 10 cm beyond the pavement edge.

Breakdown Rolling
Breakdown rolling shall commence at a temperature of not less than 120OC and immediately follow the rolling of the longitudinal joint and edge. Rollers shall be operated as close to the pavement as necessary to obtain adequate density without undue displacement. The breakdown roller shall be operated with the drive roll or wheel nearest the finishing machine. Exceptions may be made by the Engineer's Representative when working on steep slopes.

When both three-wheeled rollers and tandem rollers are used, the three-wheeled rollers shall work directly behind the paver following by the tandem rollers. Only experienced roller operators shall be used for used this work.

Second Rolling
Pneumatic-tired rollers shall be used for the second rolling. The second rolling shall follow the breakdown rolling as closely as possible and while the paving mix is still of at a temperature that will result in maximum density from this operation.

Pneumatic-tired rollers shall be continuous (at least three complete coverages) after the initial rolling until all of the mix placed rollers on the hot paving mix which causes undue displacement will not be permitted.

Finish Rolling
The finish rolling shall be accomplished with two-axle tandems or three-axle tandems while the material is still warm enough for the removal of the rollers marks. If necessary to obtain the required surface finish, the Engineer's Representative shall specify the use of pneumatic - tired rollers. All rolling operations shall be conducted in close sequence.

In places inaccessible for the operation of standard rollers as specified, compaction shall be performed by trench rollers or others. The trench roller shall be operated at the direction of the Engineer's Representative until the course is thoroughly compacted. Hand tamping, manual or mechanical, may be used in such areas if it proved to the Engineer's Representative that such operations will give the desired density.

Shoulder
The shoulder material shall not be placed against the edges of the pavement until the rolling of the surface course has been completed.

Adequate precaution shall be taken to prevent distortion of the pavement edge from specified line and grade.

When the rolling of the surface course has been completed and the edges have been thoroughly compacted, shoulder material shall be immediately placed against the edges and rolled.

Density and Surface Requirements

The completed pavement shall have a relative compaction equal to or greater than 98% (from daily Marshall) of a laboratory specimen prepared as specified in Section A, "Test Methods and Definitions", and made form plant mix conforming to the result of density from samples taken on site.

The final surface shall be of uniform texture and shall conform to line and grade shown on the plans. Before final acceptance of the project, or during the progress of the work, the thickness of all courses will be determined by the Engineer's Representative.
All unsatisfactory work shall be repaired, replaced or corrected.

Both density and thickness shall be carefully controlled during construction and shall be in full compliance with the plans and specifications. During compaction, preliminary tests as an aid for controlling the thickness, shall be made by inserting a flat blade, correctly graduated, through the material to the top of the previously placed base, or by other means approved by the Engineer's Representative

In checking compacted depth, the cutting of the test holes, refilling with acceptable materials, and proper compaction shall be done by the Contractor under the supervision of the Engineer's Representative.

For the purpose of testing the surface on all courses, a 3- meter long aluminum straight edge at the longitudinal direction shall be used.

Any irregularities which vary more than 0.5 cm in 3 meters shall be corrected. Irregularities which vary may develop before the completion of rolling shall be remedied as may be required.
Should any irregularities or defects remain after the final compaction, the surface course shall be removed promptly and sufficient new material laid to form a true and even surface. All minor surface projections, joints, and minor honeycombed surfaces shall be ironed smooth to grade as may directed by the Engineer's Representative.

Basis of Payment

Payment shall be based on the Contract unit rate for "Asphalt mix surface thickness 0.06m" per square meter, complete in place including bituminous material. No payment shall be made for extra width or for extra thickness.
The required compacted thickness is the minimum acceptable and tolerance shall be on the plus side.

Payment may also be based on the unit linear meter of road excavation according to B.O.Q. where thickness of asphalt mix shall remain as 0.06m, and the Contractor shall follow all above mentioned specifications.

SECTION 16: PLUMBING & SANITARY INSTALLATIONS

General

16.1 Layout

The Layout of the fitting and pipe work is approximate and diagrammatic only. The Contractor shall be responsible for laying out the fittings and equipment together with the service pipe work to satisfaction of the Engineer.

16.2 Pipe work and Fittings for Services

16.2.1. Piping

Each part of the piping systems shall be complete in all details and provided with all control valves and accessories necessary for satisfactory operation.

The drawings indicate generally the sizes of all main piping, and while the sizes are not to be decreased the Engineer reserves the right to change the runs and sizing of piping to accommodate conditions arising during construction.

All pipe work, valves, fittings etc. are to be as detailed for various services in the Schedules.

All piping shall be grouped wherever practical and shall be erected to present a neat appearance. Pipes shall be parallel to each other and parallel or at right angles to structural members of the building and shall give maximum possible headroom.

Pipe work shall generally be set around all columns and shall follow the contour of the building. Piping shall not pass in front of doorways or windows, nor be installed passing through ductwork or directly under electric light outlets.

Unless otherwise shown on the drawings or instructed on the site, all pipes shall have a minimum clearance of 75mm from floors and ceilings and 25mm from the finished face of walls or other surfaces.

All pipe drops shall be truly vertical, drain piping shall pitch down in direction of flow, and all pipework shall be installed with a continuous gradient to allow natural circulation, air venting and drainage. Levels are to be approved by the Engineer.

Run outs shall be graded in such a manner as to prevent air traps being formed within them when the mains expand or contract.

Pipes erected in plant rooms, vertical shafts or false ceiling spaces shall be arranged to provide maximum access, and generally all pipe work installed in voids, shafts or false ceilings and in other places where subsequent access is likely to be difficult and where ease of dismantling is not required, shall have welded joints.

Sufficient space is to be allowed for accessibility for servicing..No joints shall be formed in the thickness of walls, floors or ceilings.

Where pipes are to pass through reinforced concrete this must be ascertained before the concrete is cast and approval must be obtained for size of hole to be formed.

The Contractor is responsible for ascertaining the thickness of plaster and other wall finishes, skirting heights, sill lengths and floor finishes and routing pipe work to suit.

Where pipework is to be insulated, it shall be fitted in such a manner as to allow each pipe to be insulated the full circumference and also to allow the prescribed clearance, after insulation,.between the insulation and walls, floors, ceilings, other pipes or the insulation on other pipes, to any other surfaces.
Where pipes pass through or near walls, partitions or in chases, sufficient space must be left for the complete insulation treatment to be continued without interruption.

The Contractor shall be deemed to have included in his tender for work in setting pipes around all work and apparatus connected with other trades such as piers, wastes, drains, girders etc.

. All reductions in sizes of horizontal piping shall be installed with eccentric fittings to maintain a level bottom.

Overflow and other warning pipes shall be fitted so that they discharge in obvious positions..Lightweight hinged weather flaps shall be provided which will close against wind pressure and open when discharging.

Pipe connections to equipment and valves shall be flanged for sizes 65 mm and above and with unions for other sizes, and shall be arranged for easy dismantling and removal.

All branches from mains shall be taken from the top of the main wherever practicable and shall be made in such a manner as to allow for expansion and contraction in both main and branch.

All sets, double sets and springs shall be formed on long lengths of tube with as large a radius as possible and shall be free from distortion.

The Contractor shall supply and install malleable iron unions for all pipes, up to and including 50 mm nominal bore to form removable joints at intervals of approximately 18 m and wherever difficulty in dismantling might occur.

All pipework shall be free of corrosion and without any signs of scaling pitting or excessive weathering, to the satisfaction of the Engineer.

Pipes stored on site shall be kept clean and off the ground and were possible stored under cover..Pipes corroded beyond normal "stock rust" conditions shall not be used.

The Contractor shall ensure that all tubes are free from internal obstructions. All burred and cut ends of pipes shall be well reamed and filed to ensure that the full bore of the pipes is maintained. The Contractor shall take special care to prevent dirt or rubbish entering the open ends of all pipework during storage and erection. Screwed iron caps or plugs or plastic caps shall be used for this purpose.

Wood, rag, paper or other inadequate material will not be permitted. A valve fitted at an open pipe end shall not be considered adequate protection. Should any stoppage in the circulation occur after the various systems have been put into operation owing to non-compliance with these requirements the Contractor shall attend and rectify the matter at his own expense. Further information regarding flushing out of pipework system is given elsewhere in the Specification.

The Contractor will ensure that at no part of any one system does he include, either in contact or at a distance, dissimilar metals which will promote chemical or electro - chemical action, causing a weakening or failure of the service. This applies not only to the internal surfaces but also the external surfaces of all pipes, fittings, valves, plant, vessels, pumps and any other item of equipment in the installation.

Where pipes are held in vices, as when screwing, care shall be taken to ensure that the pipe surface is not damaged. Any pipework so damaged shall not be fitted.

The average depth of the inverts of mains below ground level shall be 60 cms minimum. The Contractor shall mark out and accept the entire responsibility for the correct positioning of the trenches required, both as regards line and level, and shall collaborate to the best of his ability with the Main Contractor in order to ensure adherence to the programme, and to avoid lengths of trench being opened up unnecessarily soon or remaining open unnecessarily long after the pipes have been satisfactorily tested. Depths of mains and branches must be approved by the Engineer.

Where piping is buried underground it shall be wrapped with PE (High density polyethylene protection insulation)of thickness 1.5mm.factory applied. All wrapping shall be approved by the Engineer before the trench is filled in.
Any pipework which, in the opinion of the Engineer, does not conform as to material and workmanship with this specification shall be removed and refixed at the expense of the Contractor.

6.2.2 Joints

Reduction in pipe diameters shall be made by using one fitting only, be it reducing elbow, tee or coupling.

Where standard fittings are not available in the configuration required reductions to the run and branch connections shall be made with reducing sockets. Bushes will not be permitted.

Branch connections to mains may be employed where the sizes of the branch is two or more smaller than the size of the main. Generally sweep branches shall be made except for tees on headers, or where a sweep fitting would cause air to be trapped.

Upon completion welded joints shall be thoroughly cleaned with a stiff wire brush.and screwed joints shall have jointing compound removed.

16.2.3 Plastic Piping

Plastic pipes shall be used only if approved by the Engineer (in all cases UPVC SN4&SN8 pipes must be used).

Cleaning fluids and solvent cements shall be suitable for use in the local ambient air conditions and operatives shall be fully trained in their use by attendance at an installation course organized by the manufacturers of the particular piping system.

16.2.4 Valves and Cocks

All valves and cocks for the services in which they are installed shall comply with the requirements of the appropriate Water Authority, and the Contractor shall include for any testing and stamping which the Authorities may require.

. Valves are to be provided as indicated and at all places necessary for the proper working, regulation, control and maintenance of the installation.

. Valves shall be either screwed or flanged in accordance with the Specification for the pipe work into which they are installed and as directed by the Engineer.

. Where flanged valves are specified, flanges are to correspond to appropriate BS specified in respect of the piping.

. Gate valves shall be used for shut-off purposes and globe valves shall be used for balancing purposes..All valves shall be designed for packing under pressure when fully open..Gate valves shall comply with BS 5154 or 5150. All valves must be approved by the Engineer.

. Taps and stop cocks shall comply with BS 1010 and shall be marked with the manufacturer's name or trade mark and the nominal size. All taps and stops cocks must be approved by the Engineer.

Valves shall be marked with the manufacturer's name or trade mark, the.nominal size and the class number and must be approved by.the Engineer.

. Mixing valves shall comply with BS 1415 and shall be marked with the manufacturer's name and trade mark and the nominal size, and must be approved by the Engineer.

16.3 Pipe installation

16.3.1 All piping shall be properly supported or suspended on stands, clamps, hangers, etc. of approved design. Supports shall be designed to permit free expansion and contractions while minimizing vibration. Pipes shall be anchored as directed by means of steel clamps securely fastened to the pipe and rigidly attached to the building structure.

Screw threads shall be cut clean and true and joints made tight without caulking. No bushing shall be used. Reducing fittings shall be used to change pipe size, and reductions to be made with eccentric reducers, short radius fittings shall not be used.

The drawings indicated generally the size and location of piping as designed for space conditions; ceilings heights and may not be changed until coordinated other contractors. If it is seemed necessary to modify the piping system the contractor shall size the pipes on the basic of 3-6 fps. Velocity and re-check pump heads which are presently indicative and for purposes of an estimate.

Pipe work shall conform fully of the following requirements.
Piping shall be properly graded to secure easy circulation and prevent noise and water hammer. As much pitch as space conditions allow must be given. Capped dirt pockets to be installed at all risers heel, low points, and other places where dirt may accumulate must be provided. Allowance must be

made for proper provision for expansion and contractions in all portions of pipe work to prevent undue strain in piping or machines. Expansion joints to be installed as directed by the engineer.

All fittings such as elbow, tees, bushes etc…shall be of best quality foreign made or local class "A" according local standard with smooth interior surfaces. Approved screw unions with bronze or steel bodies and ground brass taper or spherical joints shall be installed at traps instruments, etc… and where else directed to permit easy connection and disconnection.

Final connection to equipment and Fixtures shall be made in manner that will permit the complete removal of any fixtures or any piece of equipment without cutting of pipe line.

Each piece of pipe and each fitting shall be carefully inspected on the inside to see that there is no defective workmanship on the pipe or obstructions in the pipes or fitting. Joints in all screwed piping shall be made with red lead and boiled linseed oil completely covered the male threads.

Straight Elbows, bushing, long screws, or bull head tees shall not be installed, and all officets shall be made with fittings. Pipes shall not be bent at any time.

Pipe work shall be installed in manner to allow for ease of air escape and system draining it shall be endeavored to obtain this naturally by gravity. However, where conditions do not permit it an automatic air vent shall be installed at all air pocket locations and drain gate valve shall be supplied and installed at all low points and risers legs.

Materials for piping

Service	....	Material Type	
Domestic hot and cold water		Steel	Galvanized Schedule 40
Domestic water under ground		pex-pipe.....	Cross linked polyethylene
Vent, feed, expansion		Steel	Galvanized Schedule 40
Internal Drain	..	UPVC(SN4)	Polyvinyl chloride resin
Sewage.....		UPVC (SN8)	
Gas pipe		copper	Type K

All piping black steel up to 11/4" shall be screwed and socketed with threaded fittings. All piping including 11/2" and above shall be welded or screwed and socketed. All steel welding elbow shall be of the long radius type except where space conditions do not allow.
Joints shall be but welded single V type, elbow and fittings formed of welded cut pipe section will not be acceptable..No piping shall be hung from other piping and all hangers shall be of heavy construction suitable for the size of pipe being supported.All piping in the machine room shall provided with rubber in shear vibration eliminating

1. Screwed Joints

Screwed joints on steel piping shall be clean threaded, pulled up tightly and made with approved jointing compound and long strand hemp. After joints have been formed, all surplus hemp should be cut away and the joints wiped clean. Alternatively, P.T.F.E. Taps may be
Hemps should be cut away and the joints wiped clean Alternatively, P.T.F.E. Tap may be used. Where galvanized piping is used, care shall be taken to ensure that threads are carefully cut, so that the number of exposed threads is minimized.

2. Flanged Joints

All flanged joints shall be flush and truly aligned and made with approved corrugated rings, compressed asbestos or composition joints. Flanges for connection to welded pipes shall be “slip on” or welding neck standard steel type made as indicated in the schedules. Flanges or unions shall be

provided on straight runs at not greater than 12 meter intervals. Wherever possible, at piping connections to equipment, valves or other units requiring maintenance, servicing, or possible removal, the connecting joint shall be made by means of unions or flanges. Pressure rating or flanges shall match the pressure of the flanges on the equipment to which the pipe connected.

3. Unions

Unions are required on pipe 50 mm and under. Unions shall be ground taper joint type good for 8.37 Kg/sq. cm working pressure. Unions shall have bronze conical seats ground in. Flat unions shall not be used.

Temperature midway between the high and low limits of normal service. Bellows expansion joints shall be provided with guides to ensure that all movement is taken up in the designed manner. The manufacturer's recommendations shall be closely followed. Guides shall be secured rigidly and shall provide free movement for expansion without undue tolerance. Means for lubrication shall be provided where necessary.

4. Pipe Supports and Anchors

All supports for steel piping shall be ferrous. Supports for copper pipes shall be non-ferrous and chromium plated where chromium plated pipe is specified. Brackets or supports shall be set out so that they not obstruct the access to valves, flanges or other fittings requiring maintenance.

Supports **for Steel Pipe-Works:**

Piping at all equipment and control valves shall be supported to prevent strains or distortions in the connected equipment valves and control valves. Piping shall be supported to allow for removal of equipment valves and accessories with a minimum of dismantling and without requiring additional supports after these items are removed. All channels, angles, plates, clamps, etc, necessary for the fastening of hangers shall be furnished and fitted by the contractor.

All hangers shall be properly sized for the pipe to be supported. Over-sized hangers shall not be permitted. Details of hangers and supports to be used by the contractor shall be submitted to the Engineer for approval before fitting. All hangers shall be provided with lock nuts and have provision for vertical adjustment pipes. Parallel groups of pipes shall be supported by trapeze type hangers of steel construction. Individual horizontal piping shall be supported by hangers consisting of malleable split rings with malleable iron sockets steel clevis type hangers, or roller hangers where specified or directed. Pipe standards with base flanges and adjustable type yokes shall be used for pipes supported from the floor. Vertical piping shall have wrought iron or steel clamps securely bolted on the piping with the end extensions bearing on the structure of the building.

Piping shall be anchored where required to localize expansion or to prevent strain on piping and branches. Anchors shall be entirely separate from hangers and shall be heavy forged or welded construction of approved design. Hangers for cold piping shall have hard wood inserts or high density insulation capable of withstanding the compression and allowing the hanger to support the pipe without any metal contact. No piping shall be hung from other piping and all hangers shall be of heavy construction suitable for the size of pipe being supported. All piping in the machine room shall be provided with rubber in shear vibration eliminating. hanger

5. Pipe Sleeves

All pipe openings through walls, partitions and slabs are to have sleeves having an interval diameter at least 1' larger than the outside diameter of the pipe or of the insulation passing through the sleeve. Pipes passing through external block work or concrete shall be provided with sleeves of galvanized standard weight steel pipe flush with walls and ceilings and extending one inch above finished floors. Pipes passing through internal partitions shall be provided with sleeves of gauge 22 galvanized sheet steel made flush with finished wall surfaces.

6. Flashing Sleeves

Flashing sleeves are to be provided where pipes pass through waterproof membranes. Flashing sleeves details are to be submitted to the Engineer for approval but generally they shall be provided with an integral flange set into the membrane. The associated pipe shall also have a flange and shield which shall extend beyond the insert and be sealed with approved mastic.

7. Pipe Insulation Protection Saddles

Insulation shields shall be used to protect the insulation on all pipes. Insulation protection saddles shall be welded to insulated hot pipes at roller supports. Wherever fiber-glass pipe insulation is installed, alternative high density insulation of equal thickness shall be installed in lieu thereof. Where hangers and insulation shields are installed the insulation shields shall bear only an insulation material which is of such density that it will not compress, crush or deform. Saddles shall consist of gauge 10 galvanized steel plates. The plate shall be curved to fit the contour of the insulation and shall cover the lower 180 deg. of the surface. Saddles shall be secure to the insulation by means of steel bands.

8. Strainers

Approved “self-cleaning” strainers shall be fitted in the section line of each pump and at the inlet connections to each feeder and make-up connections, and each automatic control valve of all apparatus of an automatic character, whose proper functioning would be interfered with by dirt on the seat or by scoring of the seat. All strainers shall be suitable for pressures as stipulated for the system concerned and are to be inspected and pressure tested at the works. All strainers shall be cast iron or bronze bodied of ample strength for the pressure to which they shall be subjected with suitable flanges or tapping to connect with the piping they serve. Strainers basket screens shall be stainless steel and shall be of ample strength to prevent collapsing the basket under shock loading.
Each water strainer shall be provided with an approved valve dirt blow-out connection suitably piped to the nearest floor drain.

9. Automatic Air Vents

Wherever possible, all water pipe work system is to have open venting. At all high points in the system where this is not possible an automatic air vent shall be fitted and connected to the nearest drain. Air vents shall be of the float type. Sizes and working pressures shall be as indicated on the schedule, and/or in the bill of quantities. They shall be fitted with a suitable sized gate type lock shield valve.

10. Valves

Shut-of valves and balancing valves.
Gate valves shall be used for shut-off purposes and globe valves shall be used for balancing purposes. All valves shall be designed for packing under pressure when fully open. Shut-off valves shall be installed in both sides of all equipment.
Regulating valves shall be installed where indicated on the drawings and shall be of the *Hattersley* type P1373EC pattern or equal for screwed fitting or type 4733DR pattern or equal for flanged fitting.

11. Pipe work Underground Protection

Where pipe work is to be run underground it shall be wrapped with layer of PE (Poly Ethylene)applied by extrusion method 1.5 mm thickness wrapping from outside.and fitting should be protected also ..

12. Union and Flanges

Shall be provided on both sides of each piece of equipment. Also when required to facilitate removal of valve for repair. Union shall be provided for all piping 2" and smaller. Flanges shall be provided for all piping 2.5" and larger.

13. Cleaning of pipe

During constructions, the contractor shall properly cap all lines so as to prevent the entrance of sand, dirt, etc... All pipe, fittings, valve etc. shall be cleaned of grease, dirt, scale, and foreign material before installation.

Before turning the project over to the owner prior to start-up of any mechanical equipment, all piping system shall be thoroughly cleaned following the hereinafter specified instructions.

Piping shall be cleaned by operating system at normal operating pressure approximately 48 hours. At the end of the 48 hours period, contractor shall clean all strainers by removing baskets and flushing with clean water; Blowing down thru strainer blow down valve will not be acceptable.

14. Testing

The piping system shall be tested by accepted method and under 150 psi hydrostatic pressure. Test shall be maintained under inspection by consulting engineer for period of not less than 24 hours.

If leaks develop test shall be repeated after leaks are corrected. No part of piping system shall be covered or concealed until it has been tested inspected and approved by engineer.

16.4 Insulation

All insulating materials required for general plumbing and equipment shall be furnished and installed according to this section of the specifications.

. Insulation shall be installed in a smooth, clean, workmanlike manner and joints shall be tight and finished smooth.

All surfaces to be insulated shall be dry and free from loose scale, dirt, oil or water when insulation is applied.

Insulation shall be applied in such a manner that there will be no air circulation within the insulation or between the insulation and the surface to which it is applied.

Surface imperfections in the insulation such as clipped edges, small joints or cracks and small voids, or holes not over 25 sq.mm shall be filled with like insulating material or with insulating cement if approved by the Engineer.

Insulation for all services shall be continued through sleeves. The insulation on exposed risers shall extend through the floor.

16.5. Domestic Water Services

Generally water shall be supplied from the City Main and will connect either to the roof storage tanks or to the low level suction tanks. From the suction tanks water shall be pumped up to the tanks at roof level. Connection can also be made directly to the water network in the building if it is available continuously.

The city water supply to building by ϕ1" inch size galvanized steel seam less sch. 40pipe wrapped from outside with layer of PE high density polyethylene insulated protection factory cover of thickness 1.5mm.
Laid underground with all necessary fitting and work from main city water supply pipe price .completed with ϕ 1" inch water meter, shut of valve, check valve and strainer work include Fees for city municipality, sheet metal cabinet, excavation, back filling.

The price of tank completed with mechanical floater, connection for booster pump supply, drain valve and angle steel painted base of height 20 cm.

. Where the rising main is installed in an open-to-sky void, it shall be in cast iron to BS 1211 with flanged joints or as directed by the Engineer.

. All hot and cold water services shall be in galvanized steel sch.40,.

. The use of flexible connectors between services and sanitary fittings will NOT be permitted.

16.6. Filter and Water Tanks

. All cold water storage tanks shall comply with the relevant British and local standards, and must be approved by the Engineer.

Drinking water tank of row material linear low density polyethylene (food grade a drinking water) of white color and of capacity as indicated in P.O.Q the tank of cylindrical shape equipped with round screwed seated cover and supply with connection for city water supply,building network supply,pump water supply and rain pipe.
The price of tank completed with mechanical floater, connection for booster pump supply, drain valve and angle steel painted base of height 20 cm.

Tanks shall be fitted with a suitably sized ball valve and overflow

Before all pumps and control equipment and on the outlet from all tanks, a strainer shall be fitted.
The sizes of the tanks shall be as shown on the Drawings and noted on the schedules in the Particular Specification and the Contractor must allow in his rates for assembling, waterproofing, and providing holes, overflows and valves as required.
Alternatively the Contractor may provide fiberglass tanks subject to their suitability for the particular project and the approval of the Engineer.

All tanks must be provided with strong covers and adequate access points for maintenance and cleaning.

16.7. Tests at Site

Pressure tests shall be applied to piping only before connection of equipment and appliances. In no case shall piping, equipment or appliances be subject to pressures exceeding their rating.
Tests shall be completed and approved before any insulation is applied or pipes, valves and fittings have been concealed. Tests shall be performed in the presence of and to the satisfaction of the Engineer. Any leaks or defects uncovered by the tests shall be repaired and the system re-tested at no additional cost to the Employer.

When the installation has been completed to the satisfaction of the Engineer, it shall be tested in the following manner:
(a) The entire system shall be slowly filled with water, allowing any trapped air to escape
(b) When all outlets are closed the system shall be checked for water tightness.
(c) Each outlet must be checked for rate of flow and correct operation.

16.8. Cleaning

The Contractor shall carefully clean out all cold water and hot water tanks, service pipes, sanitary fittings throughout, traps and wastes. The Contractor shall also overhaul and make good all flushing valves, check regulating valves, check taps including rewashering as necessary and leave all works in perfectly clean and working condition to the satisfaction of the Engineer.

16.9. Sanitation and Rain Water Drainage

The soil and waste system shall be installed in accordance with this Specification and bill of quantities and must be approved by the Engineer.

Soil, waste and ventilation pipe work and fittings fixed in open-to-sky areas shall be in cast iron or UPVC as shown on the Drawings or directed and approved by the Engineer.

Soil, waste and ventilation pipe work and fittings fixed in internal ducts shall be in unplasticised P.V.C. and according to manufacturer's specification and as approved by the Engineer.

Expansion joints and brackets shall be fixed in accordance with the manufacturer's recommendations where required

Rain water pipes and fittings shall be as shown on the Drawings, Bill Of Quantities and as directed by the Engineer.

16.10 Testing

Tests shall be carried out at the Engineer's request during installation in accordance with manufacturer's specifications and to the approval of the Engineer.

a) General

The contractor shall submit to the engineer prior to the date of commencement of the tests his proposed test procedure. The procedure method and points of measurement and the method of calculation shall be approved by the engineer before any test is carried out.

The contractor shall supply skilled staff and all necessary instruments and carry out any test of any kind on a piece of equipment, apparatus part of a system or on a complete system if the engineer.requests such a test for determining specified or guaranteed data, as given in the specifications.

Any damage resulting from the tests shall be repaired and/or damaged material replaced, all to the satisfaction of the engineer at the expense of contractor.

In the event of any repair or any adjustment having to be made other than normal running adjustment, the tests shall be void and shall be repeated after the adjustment or repairs have been completed.

The tests shall not be made void due to circumstances beyond the contractor’s control

All testing, balancing and final adjustment shall be in accordance with the provision of the appliance B.S code of practice.

b) Water Supply Systems

All water supply piping shall be tested under hydrostatic pressure of not less than 1.5 times (8Bar) working pressure p.s.i., maintained for twelve hours. This test shall be applied to separate lengths of pipe work before final connection of equipment and appliances but after all piping is completed. Systems shall also be flushed. Test shall be completed and approved before pipes, valves and fittings have been concealed. These systems shall be subject to a water test prior to being covered and also tested for water tightness before backfilling. On any section of the pipe under test, the head of water applied shall not be less than 3.00 meters and not greater than 6.00 meters. Tests shall be maintained for 20 minutes, and any defects shall be rectified and the test reapplied to the complete satisfaction of the engineer.

c) Drainage, Soil, Waste and Ventilation System

These systems shall be subjected to a water test prior to being covered and also tested for water tightness before backfilling. On any section of the pipe under test, the head of water applied shall not be less than 3.00 meters and not greater than 6.00 meters. Tests shall be maintained for 20 minutes, and any defects shall be rectified and the test re-applied to the complete satisfaction of the engineer.

d) <u>Final Testing</u>

In addition to the above, final tests shall be carried out as directed by the engineer, just before final completion of the works and during the maintenance period.

16.11. Sanitary Fittings

16.11.1 General

Supply and install all sanitary fixtures shown on the drawings and as specified in these specifications.

Vitreous china fixtures shall be of the first quality with smooth glazed surfaces, free from wrap, cracks, checks, discoloration or other imperfections.

Fixtures shall be set in a neat, finished and uniform manner making the connection to all fixtures at right angles to the wall, unless otherwise directed by the engineer. Fixtures are not to be set until so directed by the Engineer.

Ample application of petroleum jelly shall be applied to all surfaces of exposed chromium plated piping, valves and fittings and stainless steel fixtures immediately after installation.

All fixtures shall be set, true, level, and finished in an approved and uniform manner..

Concealed brackets, hangers and plates shall have a shop coat of paint.

All necessary supports for fixtures shall be installed before plaster work.

All exposed piping and trim shall be chrome plated and fully protected during installation. Strap or padded wrenches shall be used on chrome pipe fittings and valves.

All exposed metal parts in toilets rooms and bathrooms shall be chromium plated and fully protected during installation.

All valves in bathrooms, toilets and kitchens shall be chrome plated recessed type.

In the selection of the sanitary fixtures and their accessories, model numbers of manufacturer's catalogues are given. A model numbers is given to describe the type and the shape of the item requested and does not in any way limit the supply to the model listed. Any item of different make judged by the engineer to be similar in quality and manufacture will be approved. Catalogues will be available at the engineer's office for reference.

The location and disposition of all items shall be indicated on the relevant **drawing**

All sanitary fittings shall be of an approved quality obtained from an approved manufacturer. Sanitary fittings and their connections, services, wastes, overflows etc. shall be located as shown on the Drawings and shall be designed and installed to the satisfaction of the Engineer.

Details of the fittings are as shown in the Particular Specification and Drawings or as directed by the Engineer.

All sanitary fittings noted in the Particular Specification shall be properly assembled and the Contractor shall include for all waste fittings, traps, taps, plugs, chains, seats, handles, levers, fixings and brackets required to suit the installation.

All traps shall be of the correct size with a 3" deep seal and compression outlet connection.

When fixing washbasins (ceramic – with metal down pipes!), silicon or flexible putty is to be used. All washbasins are to be solidly affixed to the walls (using dowels, as appropriate).

16.11.2 Pipes and Fittings

Potable water main between city mains and water collector in floor water cabinet shall be galvanized steel sch. 40, heavy weight. Fittings shall be of seamless pipe with same characteristics as pipe.

Domestic cold and hot water pipes shall be sch. 40. All pipe fittings (elbow, tees, crosses, unions, reducers, etc...) shall be galvanized forged steel of the same quality and weight as the pipes. Pipes and fittings shall be suitable for threaded connections.

All drainage pipes 11/4" in diameter and larger shall be UPVC –SN4 (Polyvinyl chloride) of approved quality UAP-Plast.

All rain water pipes shall be UPVC-SN4 pipe. All fittings and accessories shall be of the same quality, and material of the pipe. All joints shall be rubber sealed stainless steel and plastic. Pipes and fittings shall be in accordance with latest PALESTINE standards.

16.11.3 Local Regulations

All works shall be carried out to comply with the current local public health regulations, the latest BS 5572/BS 8301 and current local by-laws and shall be to the entire satisfaction of the Engineer.

16.12. Builders Work

Normally pipes will be fixed on the surface of walls and the Contractor shall perform all cutting and pinning for holder bats or plugging and screwing for pipe clips.
Where pipes are required to be concealed in the walls etc., the contractor shall perform all cutting and subsequent making good. Pipes passing through walls and floors shall be sleeved with metal.

The expression 'Builders Work' shall mean work to be carried out by the Main Contractor under the direction of the Engineer in connection with the plumbing installation.

The Contractor shall prepare accurate drawings giving details of all holes, fixings, bases, and other builders work requirements and shall be responsible for their accuracy. The cost of any unnecessary work due to failure to comply with this condition will be charged to the Contractor and deducted from his account when making payment. The cost of preparing builders work drawings shall be included in the tender price.

If, in order to progress the contract, the Engineer has prepared certain details in connection with the builders work, the Contractor, when appointed, must immediately check these details against the architectural and structural drawings and if any additional work or alterations are required the Engineer must be advised immediately.

The following is a summary of the work to be carried out by the Main Contractor:

(a) Cutting and forming of holes for pipes or pipe fixings through walls, floors, ceilings, partitions, roofs etc., and making good after the work is sufficiently advanced.
(b) Building of concrete and/or brick ducts in floors, walls…etc.
(c) Formation of concrete bases, plinths etc. for plant and equipment.
(d) Building of manholes pits etc.
(e) Excavation, forming of trenches for services etc., and the filling in of same after the pipes are laid.
(f) Cutting or forming of chases, recesses etc. in floors, walls…etc. for pipes and fittings, and making good.
(g) Excavation for and laying of pipes and ducts.
(h) The building in of brackets and supporting bars or other form of pipes after fixing unless specified to the contrary.
(j) Painting of all pipes after fixing unless otherwise specified
(k) Providing and building in of sleeves through slabs and walls

In general all holes through walls, floors and beams for pipes and ducts will be left out by the Main Contractor during the process of building.

Where pipes or fittings are fixed to concrete or woodwork by means of saddles or clips the Contractor shall himself execute the work necessary and shall include the cost of such work in the price given in the Form of Tender.

16.13. Solar Water Heater

The contractor shall supply and install solar hot water heater of capacity as indicated in drawings vertical type. The heater install on roof as indicated in the drawings.

Completed with following item:

A. **3** Solar panel of size 190*90 cm consist of 11 galvanized pipes row black painted 0.5 inch diameter, insulated by 5 cm polyethylene layer and covered with 3 mm normal glass.
B. Hot water storage tank of capacity 200 Liter and thickness of sheet metal 3mm. Painted inside by epoxy paint treated by oven. Insulated by 5 cm polyethylene.and covered by white paint galvanized sheet metal.
C. Electrical heater coil capacity 3000W with thermostat.
D. Plastic Water tank of capacity 1500 liter.
E. Steel structure base for solar panel, hot water storage tank. cold water tank of height 2 meter

Each heater shall be completed with all fitting such as valves, union, safety valve, non-return valve and all piping necessary for connection to city water, cold water and hot water electrical cable connected to heater coil with adjustable thermostat and electrical switch with indicated lamp

16.14. Water Booster Pump

The contractor shall supply and install a BOOSTER centrifugal pumps as indicated on drawings and of capacities and ratings as indicated on drawings and bills of quantities.
All pumps shall be centrifugal type single stage directly coupled to a squirrel cage, totally enclosed fan cooled induction motor by a flexible coupling.

Both pumps and motor shall be mounted on a common steel base frame which shall be securely fixed to a concrete base frame, suitable isolation pads must be provided for each pump. The pump shall have cast iron casing stainless steel shaft for cold water and good quality bronze impellers..pump shall be fitted with pressure gauges on its.discharge. The gauges shall be equipped with approved type cocks in order to take reading when required.

Each pump shall be fitted with a check valve on the discharge and an approved type strainer in the suction. Furthermore, each pump shall include with it two shut-off valves, two gate valve in suction and discharge. Pump speed shall not exceed 1450 R.P.M.

Each pump shall be driven by a constant speed motor and be provided with a suitable starter as specified under motor and starter clauses in the electrical specifications in this tender book. Each pump shall be guaranteed not less than the quantity of water against the circulating head given in the schedule when operating continuously without over-heating the motor or bearings.

16.15. Grey water

The rain water is the source of.gray water in school collected from school roof only, The rain water stored in underground tank of capacity 125 m^3 (5X5X5)m, The rain water supply to tank from roof using rain manhole and rain water UPVC pipe of size 6", The gray water used for flushing toilet and irrigation purpose.
The system include booster pump, to discharge water from underground water tank to special roof tank.

16.16. Fans

16.16.1 General

Exhaust and return air fans shall be of approved quality and quite noise, supplied and installed by the contractor as shown on the drawings. The capacity, type and rating of the fans shall be as specified in the schedules. The fans motors and starters shall be in accordance with the specifications and electrical equipment.

16.16.2 Extractor Fans

The contractor shall supply and install as shown on the drawings a range of vent axia extractors or equivalent of ratings as indicated on the drawings.
Fan shall be either centrifugal or propeller type direct drive suitable for window or wall mounting. Fans shall be designed to ensure lowest noise level and each shall be supplied with its starter or switch and weatherproof hood. Fans shall be constructed from non corrodible materials. Fans shall be furnished with self acting louvers mounted on the face of fan.
The propeller will be strong and rigid giving large volinetric capacities and high efficiency, with non overloading characteristics and very quite operation.

The motor to be squirrel cage induced type suitable for continuous operation.
For wall mounted fan the motor to be attached to the fan ring by three arms of pressed steel.
Rubber inserts to prevent transmission of motor noise.

16.17. Split Unit Heat pump Air Condition Unit

Split type air-conditioning unit, reversible cycle (heat pump), high wall mounted type indoor unit, air discharge directions, with adjustable air emitting the wall unit (indoor unit) depth not to exceed 35 cm. remote controller:
All operation of the remote control unit to be push button system. Each switch has a lamp which is illuminated when switch is pushed. The controller to include
(1) Three speed fan selector
(2) Pre-heater/defrost lamp
(3) Indication lamp for each switch
(4) Operation On/Off switch
(5) Thermostat control heat-cool

The Outdoor unit includes the condenser, condenser fan and the rotary type compressor, and all relays and safety switch as following:
- Reversing valve
- Defrost thermostat
- Relay
- Transformer
- Thermostat
- Bimetal thermostat for condenser fan
- Over current relay for compressor contactor
- Magnetic contactor for compressor
- High pressure switch
- Crankcase heater
- Capacitors for fan
- Safety fuses
- Terminal board for main circuit
- Terminal board for control circuit

The Indoor unit:-
- Internal thermostat for fan motor
- Fan motor
- Capacitor for motor fan
- Drain up motor
- Earth terminal
- Float switch for line cut
- Transformer
- Terminal board for control circuit
- Terminal board for main circuit
- Relay for IC control
- Varistor

SECTION 17: ELECTRICAL INSTALLATIONS

17.1. General

The Contractor shall supply all labour, materials and equipment necessary for the installation of medium voltage switchboards, sub-main cables and distribution units, lighting and power, together with all other apparatus shown on the Drawings and as detailed in the Particular Specification, with the exception of those items stated specifically as being supplied by others.

All works shall be carried out in a manner satisfactory to the Engineer and all unspecified materials shall be of approved manufacture. The complete installation is to be to the entire satisfaction of the Engineer.

The whole of the electrical installation and all works appertaining thereto shall be carried out in strict accordance with the Regulations for the Electrical Equipment of Buildings current edition (including all amendments and supplements made and issued thereto) as issued by the Institution of Electrical Engineers, British or VDE Standards, and also to the national and local requirements.

The Contractor shall further make good, repair, replace all defective work and clear away on completion and leave all installations in perfect working order and to the satisfaction of the Engineer.

Building works shall include the preparation of trenches and provision and laying in such trenches of asbestos cement or salt-glazed stoneware pipes, having easy bends to form ducts for entry of main cables. The numbers, sizes and locations of such pipes shall be as required by the Particular Specification.

Manufacturer's Recommendations means the recommendations or instructions printed or in writing and current at the date of tender.

The phrase "or other approved" means that commodities of different manufacture may be substituted if prior approval has been obtained.

The Contractor shall be deemed to have included in his price for anything necessary to supply the installation described in the Specification, or as shown on the Drawings.If no figure is put against the item shown in the summary it shall be deemed to have been included elsewhere.

The Contractor shall handle, store and fix each commodity in accordance with the manufacturer's recommendations. He shall inform the Engineer if these conflicts with any other specified requirement and submit copies of manufacturers' recommendations to the Engineer when requested to do so.

When choice of manufacturer is allowed for any particular commodity the Contractor shall obtain the whole quantity required to complete the work from one manufacturer or obtain approval of any change in source of supply. He shall produce written evidence of sources of supply when requested to do so by the Engineer.

All the materials purchased for the work must operate satisfactorily at an ambient temperature of 50ϟC.

All electrical switches, conduits, plugs are to be properly (vertically) aligned, no wall openings are to be left uncovered.

Progress reports shall be made by the Contractor, to be inspected and approved by the Engineer. Changes in plans or additional works shall be executed by written approval of the Engineer.

17.2. Specialist Subcontractors

The Electrical Works shall be executed by an approved Specialist Subcontractor. The Main Contractor shall attend on same and provide all the usual services required for such attendance.

17.3. Builders Work:

The following is a summary of the work to be carried out by the Main Contractor:

All supplied materials should be local made if available – Class A and free from defects and having supervisor certificate from Palestinian Standard Institution (PSI). Price to include submittal and obtaining approval of shop drawings, detailed and as-built drawings for all works as well as coordinating the same with the other services, activities and furniture complete ready for work in place and operable manner. Price to include also submittal of catalogues and manufacturer's instructions. Fixtures and appliances shall be measured in number. Supply and feeder cables, cable conduits and cable trays shall not be measured but included in DBs prices. Manholes handholds and the like shall be measured in number. All systems and devices shall be in lump sum including installations, testing and commissioning. Rates of fixtures and appliances shall include installations, wiring, switches, conduit works, carrying up all required tests and handling over to local Electric Authority. All systems equipment should be class A and approved by (PSI).

(a) The cutting and forming of holes for conduits or pipes or conduit or pipe fixings through walls, floors, ceilings, partitions, roofs etc. and making good after the work is sufficiently advanced.
The building of concrete and/or brick ducts in floors, walls etc..
The building of manholes, pits etc..
(b) The excavation, forming of trenches for services etc. and the filling in of same after the cables are laid.
(c) Excavation forming for underground services of ducts and courses.
(d) The cutting or forming of chases, recesses etc. in floors, walls etc. for conduits and fittings, and making good.
(e) Excavation for and laying of cable carrying pipes.
(f) The building in of brackets and supporting bars or other from of conduit or pipe suspensions.
(g) The painting of all pipes, tubes and conduits etc. after fixing unless specified to the contrary.
(h) The providing and building of sleeves through slabs and walls

17.4 Testing

The Contractor shall provide all necessary testing equipment as required by the Engineer to carry out tests as set out in the Regulations and as required by the relevant Electricity Authority.

The Subcontractor shall also be responsible for the payment of fees to specialists and manufacturers, for testing and commissioning required to bring all such plant and equipment into fully efficient operation as part of the installation.

The Subcontractor shall thoroughly test each section of the Contract Works all generally in accordance with I.E.E. and Electricity Authorities regulations, and except where otherwise specified the tests shall include the following.

Insulation resistance tests to earth and between phases on all circuits and power consuming equipment by means of a 500-Volt insulation tester. During the test all lighting switches, except those controlling fluorescent fittings, shall be turned off and all lamps installed but no inductive apparatus shall be connected.

All insulation tests shall be made between phases, between each phase and earth, and between earth and neutral with the controlling switch neutral link removed.

Insulation tests shall be repeated between phases and between each phase and neutral with all switches off and all lamps removed.

Insulation resistances below 5 megaohms will not be accepted.

Earth continuity tests shall be made on each main, submain, circuit and sub circuit.

Polarity of switches and continuity of ring main circuits shall be tested.

Insulation resistance tests of all connected appliances shall be made

Tests of the effectiveness of earthling including resistance of main earth shall be made.

Any other tests the Engineer may reasonably instruct the Subcontractor to make. Such will include readings of potential drop and current balance between phases at full load conditions at various points in the installation.

The Subcontractor is to provide all necessary labour, materials, test media and instruments required and all instruments must carry a recent calibration certificate from an approved body.

All tests are to be witnessed by the Engineer, and triplicate test record certificates, signed by all test witnesses, are to be provided to the Engineer as the work proceeds, upon request, or in any event before the commencement of the Maintenance Period.

At least 7 days written notice is to be given of intention to perform any test.

In addition to installation testing the Subcontractor is to carry out operation testing of all sections and is to clean, set, calibrate and fully commission, demonstrate and hand over the entire contract works in a thoroughly complete and operational state to the satisfaction of the Engineer.

17.5 Main- Switchgear and Sub- main Distribution Equipment

All main switchgear and sub-main distribution equipment to be provided and installed within the Contract shall comply with the relevant British Standards.

Main switchboards shall be 600 volt rating, of sheet steel construction of 2mm minimum thickness, finished in a suitable anti-rust cubicle type front access panels, epoxy-electrostatic painted (colour to be approved by the Engineer), complete with all necessary incoming main isolators, low bars, outgoing fuse switches, distribution units, interconnection accessories, cable glands and entries. The main switchboard shall also be provided with a metering panel and all necessary interconnections as may be required by the Electricity Authority. Three ammeters and a voltmeter complete with an integral phase shift switch shall be provided and connected via the main incoming cable connections. The main switchboard shall also be provided with all necessary labels for each item of switchgear stating the area service duty or equipment controlled there from both in Arabic and English.

All access panels; hinged doors etc. should be provided with rubber or similar gaskets to protect the interiors against ingress of dust.

An 'as installed' diagram of the electrical distribution shall be provided within a glazed frame and fitted adjacent to the main switchboard.
Switch fuses, isolating switches, fuse boards, miniature circuit breaker boards and main distribution panels are to be of the particular types, capacities and manufacture later specified in the Particular Specifications or as indicated on the Drawings and unless otherwise specified are to be generally in accordance with the following.

Switch fuses are to be of the 600 Volt "on-load" pattern with the switch blades mounted on to a solid insulating bar arranged for quick make and break action.

Fuses are to be H.R.C. type mounted independently of the switch mechanism.

Switch operating handles are to be of the 'free handle type' interlocked so that the access door may not be opened unless the switch is 'Off ' but with a means to circumvent this feature. The switch 'On ' or 'Off ' positions are to be clearly marked.

Miniature /mould case type circuit breakers shall have automatic tripping by means of a calibrated bi-metal mechanism for over-current protection and an electro-magnetic tripping device for short circuit protection. All three-phase circuit breakers shall have over-current and short circuit protection devices in each phase.
These devices shall be interlocked with each oh the other phases, such that the operation of a trip in any one phase will automatically cause all three phases to be isolated from the supply.

The Fuse /M.C.B. Boards shall be adequately and securely fixed to the surface of the building walls in the positions shown on the various Drawings by means of raw bolts or other metallic fixing devices as approved by the Engineer..All fixing bolts that can be accommodated in the fixing holes shall be used.

The positions of the Fuse M.C.B. Board as shown on the Contract Drawings shall be agreed with the Engineer before erection of any Fuse /M.C.B. Board.

The busbars of all Fuse /M.C.B. Boards shall be connected to the phases of the supply so that the standard arrangement of red, yellow, blue and neutral working from top to bottom of the Fuse /M.C.B. Boards is adhered to throughout the installation to ensure uniformity in phase colouring.

The top busbar of the Fuseboard is to be tested to make sure it is fed from the red phase right the way back through the system to the source of supply.

The Fuse /M.C.B. Boards shall be supplied with charts mounted inside their doors and /or across the phase barriers. These charts shall be completed by the Subcontractor to give a clear and permanent indication of :

(a) The circuit reference of each fuseway /M.C.B.
(b) The correct H.R.C. fuse /M.C.B. for each fuseway.
(c) The title of the plant protected by each H.R.C. fuse /M.C.B.

Sweating sockets or facilities for crimped terminals are to be provided for incoming phase and neutral cables.

All live metal parts are to be enclosed by insulating material including when the fuse carriers are withdrawn, and the carriers are to be arranged to protect persons handling them from electric shock or burns.

17.6 Earthing

Earth leads and earth tapes shall be of high conductivity bare copper in internal dry conditions and where they are run underground or in damp locations they shall be tinned.
As far as possible they shall be continuous without joints, but where joints are unavoidable, they shall be bolted and soldered. All such joints shall be coated with anti-corrosive paint and wrapped with self -adhesive PVC tape.

Where earth leads and earth tapes are required to be buried, they shall be at a depth of not less than 500mm (1'8"). Where they are fixed to building surfaces they shall be fixed at intervals not exceeding 1.0 m (3'4") with copper or brass saddles of the spacing type. The saddles shall be tinned where necessary to correspond to the lead or tape being fixed.

An earth test link is to be provided adjacent to all switchboards. The link shall be a 13mm x 3mm copper strip secured across a 50mm (2") break in the earth lead or tape by high tensile steel bolts and nuts.

All earthing cables shall be installed in accordance with the relevant requirements called for in the Cables section of this specification.

All bonding leads in the form of cable having a standard conductor shall be terminated in 'sweated' sockets and shall be rigidly bolted to earthing terminals.

All earthing cables shall be insulated with a green PVC sheath. Where connection on the earth lead to the main earth is made with a standard cable, the earth lead shall be double insulated with PVC sheaths, the outer sheath being coloured green.
Where a lightning protection scheme is installed the earth lead may be bonded to the lightning conductor earth.

The Main Contractor will execute any trenching and backfilling and erect and cement into position all electrode manholes to details provided by the Subcontractor.

Connections by means of copper earth tape shall be made between the main earth bars to the frame terminals of all items such as switchboards etc.

The main ground connection shall be to a grid of electrodes of galvanized water pipes buried in the ground, and shall provide a minimum ground resistance of 2 ohms.
The connections from the main ground to the switchboard shall be of 50 sq.mm copper cable.

17.7 Cables

All cables shall be manufactured to comply with the relevant British Standards and are to be obtained from one of the approved manufacturers. All cables shall be XLPE, except that underground cables shall be NY.

Data and Ethernet cables should be :
(Superior cables four pairs 24AWG.HFFR.IEC 61156-5.CAT6. 450MHz)
Loud speakers cable should be single pair with solid copper conductor 1.25mm diameter in flat configuration with poly ethylene insulation and PVC jacket. Conductors to have a maximum DC loop resistance at 20F of. 28 OHM/KM and a nominal capacity of 91 PF/M.

Microphone cable should be single pair screened with standard copper conductor. 31/0.2mm with PVC insulation lapped copper screen and PVC jacket. Conductors to have a maximum DC loop resistance of 45.7 OHM/KM and a nominal capacity of 430PF/M.

The minimum size of conductor used for lighting sub circuits shall be 1.5 sq.mm and for local ring main circuits 2.5 sq.mm.

All cables shall be supplied to site on suitable drums with labels clearly indicating the origin and specification of cable.

Where cables are installed underground the Subcontractor shall mark out trenches for excavation by the Main Contractor, according to the Drawings and as directed by the Engineer.
The Subcontractor shall install the cables on a smooth bed of sifted sand 10 cm thick (minimum), and then cover the cables with another layer of sand up to 10cm above the top of the cable, and provide and install interlocking concrete cable covers engraved 'Electricity' in both English and Arabic along the complete underground length of the cables.

The cable clamps are to be fixed to the building structure by means of loose bolt type rawlbolts and by steel nuts and bolts to any other structure.

All cables run within the site buildings are to have the serving removed and the single wire armoured cleaned bright and left bare throughout the entire length of the cable, or alternatively the cable is to be taped with 50mm (2") wide PVC tape half lapped. This is to minimize the fire risk of the compound serving on the cable.

All cables shall be coloured in accordance with the following:

Red phase	-	Red
Yellow phase	-	Yellow
Blue phase	-	Blue
Neutral	-	Black

17.8. Lighting Fittings:

Lamps and Tubes: (All lamps and tubes of the lighting have to be low energy system)

The Subcontractor shall supply all lighting fittings unless otherwise specified in the Schedule of Lighting Fittings. The Subcontractor shall provide all the lamps for lighting fittings, which he supplies as part of the Contract.

The Subcontractor shall allow for the installation of all the lighting fittings in the locations as shown on the Drawings. Where lighting fittings are recessed in ceiling panels he shall obtain from the Engineer detailed drawings of the ceiling layout prior to commencement of fixing.
Lighting fittings shall generally be fixed direct or suspended from the structural ceiling to heights as stated in the Particular Specification. In the case of wall mounted lighting fittings not above doorways or structural openings the mounting heights shall be as indicated on the Contract Drawings. In instances where they are mounted over doorways or structural openings they shall not be fixed more than 300mm (10") higher than the lintel of the doorway.

Where fluorescent lighting fittings are required to be suspended this shall be done by means of a 1" link galvanized heavy jack chain of the welded link type, the chain being attached to standard conduit box hook plates fixed to conduit boxes.
The conduit boxes from which any fluorescent lighting fitting is supported or suspended shall be securely fixed to the building structure by means of at least one 1/4" whitworth bolt, complete with flat washers, spring washer and full size nut or the equivalent diameter roundhead wood screw and /or toggle bolts of Rawlplug manufacture or other fixings as approved by the Engineer.

The supply to each lighting fitting shall be by means of 32/0.2mm 3-core circular, heat resistant butyle sheathed flexible 250 volt grade cable, to be connected to the circuit wiring by means of multiway P.V.C. connector blocks having brass mechanical screw clamp connections. Screwit type connectors will not be permitted. Taped and soldered joints will not be permitted.

The third core, earth conductor of the flexible cable is be securely earthed in the conduit box, socket or ceiling rose and the lighting fitting. These connections shall be effected in purpose made terminations and the fixing screws of the conduit box lid, hook plate or similar means not specifically intended as a conductor termination shall not be used for securing the earthing. The connection of the third core to the lighting fitting shall be effected in a similar manner as described above.

The Subcontractor shall allow in his tender for all the necessary supports steelwork and other accessories required for the supporting and /or mounting of all the lighting fittings as shown on the Contract Drawings.

Where fluorescent lighting fittings are mounted direct to purpose made lighting trucking, the lighting trunking manufacturer's purpose made fixings and supports are to be utilised for the mounting of the lighting fittings. The connection and earthing of the lighting fittings is to be effected as previously described herein.

At every lighting point an earthing terminal shall be provided and connected to the earth-continuity conductor of the final sub-circuit.

Pendant lighting fittings
The Subcontractor is to supply and install all plain pendant lighting fittings as shown on the Drawings.

All ceiling roses containing permanently 'live' terminals shall be of such a manufacture that 'live' terminals are completely shielded and contact cannot be made there with the normal replacement of the flexible pendant.

Every ceiling rose shall be provided with an earthing terminal.

17.9. Switches and Switch Lighting

The Subcontractor shall supply and install the lighting switches in accordance with the type specified. Where they are indicated on the Drawings, switches shall be of the two-way or intermediate type, and in some instances shall be ganged in various numbers in a single box with a common cover plate.

All switches shall have 15 Amp interiors for lighting circuit loads in excess of 600 watts.

The lighting switches shall be mounted at a height of 1.4m (4-'8") form finished floor level to the center of the switches unless deemed otherwise by the Engineer. The switches shall be fixed by any fixing device approved by the Engineer.

Where ceiling mounted cord operated "PULL" switches are called for on the Drawings they shall be positioned such that the cord will hang free at a distance of 75 mm (3") from any wall surface or door opening. The cords for such switches shall be of a length sufficient to reach a point 1.5m (5'0") above finished floor level.

All switches shall be wired in the live side of the circuit they control.

Where six or more switches are ganged together in one box with a common switch plate, the switch plate shall be engraved to indicate the area, row or points controlled.

Socket Outlets
All socket outlets unless otherwise specified or indicated on the Contract Drawings shall be of the 13 Amp shuttered rectangular pin type complying with BS 1363.

The contacts shall be housed in a track resistant moulding, controlled where indicted on the Drawings by integral A.C. type single pole switch.

The finishes of socket outlet plates may vary depending upon the area and these will be as specified in the Particular Specification. However, socket outlets in plant rooms shall have steel front plates.

Mounting boxes shall be either of aluminium or enamelled steel for flush installations, or aluminium only for surface installations. All boxes shall incorporate an earthing terminal.

The Subcontractor shall supply and install all socket outlets in accordance with the types and ratings specified and /or indicated on the Contract Drawings.

The positions of all socket outlets as shown on the Contract Drawings must be checked with the Main Contractor, attention being given to type of wall finish required and the method of mounting thereon.

17.10. Telephones and Audio Equipment:

The Subcontractor shall be responsible for the supply and installation of the necessary enclosers, cable trays and draw wires for a complete telephone installation throughout the premises.

The Subcontractor shall ensure that the main cable entry duct is installed by the Main Contractor to the requirements of the local Telephone Company. In all cases the main duct shall have a minimum size of 10cm, be of plastic manufacture, and have no right angle bends.

Each 2.5cm telephone conduit will serve no more than 4 telephone outlets. At the junction point of risers and conduits and at the main entry duct point the Subcontractor must ensure a clear wall space of at least 1 sq.m for the installation of the telephone company's distribution boxes.

If it is a requirement of the local Telephone Company that the Subcontractor is to install the necessary telephone cables, the Subcontractor shall liaise closely with the Telephone Company and obtain prior approval for any telephone cables installed.

Horn type loud speaker should be weather proof with matching transformer 45W European made.

Internal loud speakers should be 6/9W circular in a wooden box with matching transformer European made.

Audio amplifier 360W with charger and at least four outlets, built in CD and cassette player and recorder with prerecorded tones (piano), daily – weekly go off bill timer unit, tuner, rack cabinet 14U metal with aluminum and glass door for housing the system. European made.

17.11 Maintenance Tools, Keys and Spare Equipment

The Subcontractor is to provide two sets of any special tools and keys necessary for the maintenance of the items of equipment supplied under the Contract.

Spare items of equipment shall only be supplied where particularly specified, as for fuses.

All keys, tools and spare equipment are to be handed over to the Employer, with a detailed list of all items. The Subcontractor is to obtain two receipted copies of the list and forward one to the Engineer.

17.12. Outside Lighting (all lighting fixtures shall be low energy systems bulbs and tubes)

The Subcontractor shall supply and install an outside lighting system as shown on the Drawings and in accordance with the Schedule of Lighting Fittings.

The Subcontractor shall be responsible for the supply and erection of the lighting columns, and shall also be responsible for advising the Main Contractor of the routes of the trenches for the mains cables to each column and the siting of the holes for the column bases.

The excavation and backfilling of the trenches and the concreting in of the column bases shall be carried out by the Main Contractor.

Each column shall be fitted with O.C.C. Bs manufacture connecting to the lighting units mounted on the column.

The termination of the cables to each column and the fusing of each column shall be as detailed in the Drawings.

Wiring to floodlights mounted on the building shall be routed on the inside of the building. Cables fixed to the outside face of the building will only be permitted at the discretion of the Engineer.

SECTION 18: EXTERNAL WORKS

Planting trees

Different types (Tout, Fruit-trees, Aspen, Olives – as per specifications in the drawings).

All trees shall be at least 3 years old with stem diameter of not less than 3 cm.

The trees are to be planted according to Engineer's instructions and the contractor will guarantee their growth for a period of not less 12 months. If trees die – the contractor will replace such trees, whereby the 12-month-period shall begin again.