



THE UNITED NATIONS OFFICE PROJECT SERVICE(UNOPS)

PROJECT NAME RENOVATING TWO EXISTING BASEMENT FLOORS AT TWO MEDICAL CENTERS IN WB

THE PALESTINIAN MEDICAL COMPLEX

TECHNICAL SPECIFICATIONPNS

SECTION: 1

GENERAL CONDITIONS

1 General

These specifications are to specify the quality of materials, level of workmanship, and methods to followed and respected in executing and maintaining the internal and external works of the Project.

2 Drawings

The contractor shall be provided with a list of drawings included in this bid on page **A-00** of the drawings file. All expenses paid by the contractor, to execute the conditions included in this section, are on the contractor own cost and his unit rates in the bills of quantity shall be deemed to include all costs and expenses.

3 Bidding Documents

The bidding documents complete each other and to consider the case which gives the higher quality in executing as the Project Managers decides. The contractor is to consider this when he prices the bills.

The contractor who participates in the bid must returns all bidding document, 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.

4 Shop Drawings

If during executing the works or before, the Project Manager found that the contractor needs shop drawings to execute a certain task, the contractor must prepare these drawings and submit it to the Project Manager for approval. The Project Manager has the right to instruct the contractor at any time to submit shop drawings which the Project Manager consider necessary for executing a certain task. The contractor is to abide by this instruction and don't proceed with the task before the Project Manager 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 Project Manager shall within reasonable time from receiving the shop drawings audit and approve / disapprove the drawings. If the Project Manager returns the drawings with notes, the contractor shall adjust the drawings as instructed by the Project Manager and resubmit to the Project Manager for approval and he must point out the adjustment made to the first drawing according to standard procedure.

5 As – Built Drawings

The contractor, at his own cost, shall adjust the drawing copies with him as necessary during execution of works. The contractor is required to obtain the Project Managers approval on these adjustments. When the contractor hands over the works, he shall prepare a new set of the drawings for the project as executed with all adjustments (if any) and submit it to the Project Manager for approval. When the Project Manager approves the As-Built drawings, the contractor shall submit four copies including original one hard copies and one soft copy (Auto CAD) written on it the project name and the phrase "AS – BUILT DRAWINGS".

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

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 necessary safety measures related to these scaffoldings and repair any damages caused by the scaffoldings to the permanent works during execution period.

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 has to return these angles to its correct position as per the coordinate provided by the Project Manager. 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 Project Manager'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 Project Manager's instruction and satisfaction.

8 *Materials and its Equivalent*

All materials and goods must be according to technical specification. The contractor has to submit the specification and description of the materials that he intends to supply with all necessary information to the Project Manager 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 Project Manager.

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 Project Managers approval.

When alternative materials, other than mentioned in the contract, are approved and it was not in the same level of specification, the Project Manager has the right to make suitable 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 automatically understood that the required is these materials or equivalent even if the phrase "or equivalent" is not mentioned.

9 *Samples*

The contractor must be always ready to submit samples for materials and workmanship according to Project Manager's instruction. The Project Manager shall test and inspect these samples to determine its compliance with the technical specification and contract documents. The contractor shall execute the works according to the accepted samples and following conditions the cost of all samples shall be paid by the contractor.

1. The contractor is to submit samples before a reasonable time of starting the work to give the Project Manager time to inspect the samples and make the required tests.
2. The samples shall be submitted with a letter containing all the needed information to obtain the Project Managers approval.
3. The samples shall be kept at the Project Managers office in the site.

10 *Materials' Testing*

The Project Manager 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 Project Manager.

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

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

11 *Temporary Construction for the Contractor's Use*

The contractor must ,from the day of the order to start works, has an existence in the site in a movable or temporary office for the use of his staff to receive the Project Manager'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 Project Manager 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 pay all the costs of constructing these temporary constructions.

12 *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 Project Manager 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.

13 *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 Project Manager'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.

14 *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 Project Manager's attention. The Project Manager 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. The contractor has no right to claim any differences as a result of this.

15 *Site Meetings*

During executing the works and on periodical bases, 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 executed according to contract conditions and technical specification. Minutes of the meetings shall be prepared by the Project Manager 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.

16 *Daily Reports*

The contractor shall submit to the Project Manager (or his representative) a daily report containing the required information on the labor (Nose & types), equipment and materials arrived to the site and works executed in that day.

17 *Photographs of Progress of Works*

The contractor at his own expense shall submit once a month, or as the Project Managers 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 Project Manager. The original film negative and all copies shall be the ownership of the owner, and the photos can't be use without his approval.

18 *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 Project Manager.

The contractor has to make monthly (or as the Project Managers 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 Project Manager.

19 *Handing Over Works and Removing Residuals*

The contractor must hand over all works clean and insure removing all materials or construction residuals or rejected materials or remains in the site in general or in the buildings or nearby. The completion of the works as explained here shall be on the contractor's expense and according to the Project Manager's approval. If the contractor didn't fulfill this obligation, the Project Manager has the right to execute these works on the contractor expense and deduct it from the contractor payments or insurance.

20 *Measurement of Works*

The Engineering measurement shall be made 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.

21 *Codes and Standards*

Where ever B.S. 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, B.S. or approved equivalent.

SECTION: 2

EXCAVATION AND EARTHWORK

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 Project Manager, 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. Setting Out

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 Project Manager prior to commencing excavations.

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 Project Manager.

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 Project Manager'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.

5. 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 of soil to be excavated; also he is to use any equipment, including dewatering equipment, to carry out the work required by this Contract.

6. 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.

7. Required Bearing Capacity

The Contractor shall notify the Project Manager 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 Project Manager 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 Project Manager has been informed the excavations are ready for inspection, be such that the Project Manager deems it necessary to carry out tests, the Contractor shall perform such tests to the satisfaction of the Project Manager. Any expenses incurred in the performance of such tests are deemed to be included by the Contractor in his tender.

8 ***Preparation and Inspection of Excavation***

All excavations shall be kept free of water arising from whatever source, and shall be properly cleaned out of all loose and foreign matter, leveled and rammed. The Contractor is to report to the Project Manager when excavations are ready for inspection and all excavations are to be approved before any further work is done.

9 ***Filling***

All filling materials shall be approved by the Project Manager 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 250mm 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 Project Manager.

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, 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.

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

1) 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.

2) Fine Sand Materials

Shall consist of that portion of the total aggregate/fines passes no.4 sieve, such as sand, silt sand, etc

The fill materials shall consist 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
% Pass	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
	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
% Pass	100	80-100	30-50	4-8
	90-100	80-90	20-30	0-10
	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

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 Project Manager 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 Project Manager's instructions and also on completion of the Works.

SECTION: 3

CONCRETE WORK

General

All materials shall be subject to such tests as the Project Manager 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 Project Manager, 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 Project Manager's approval when required.

Where tests are required by the Project Manager, the Contractor shall take samples and send to a firm experienced in analysis of the material. Reports shall be submitted to the Project Manager. 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 Project Manager reserves the right to reject any material which, in his opinion is objectionable in any respect, notwithstanding its apparent compliance with the relevant Standards. Any such rejected material shall be removed from the site at the Contractor's expense at once.

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 2mm or 1/600 of the free span, whichever is less.

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 Project Manager before starting 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 Project Manager, or of metal, suitable to obtain a fair face finish on the concrete. All external angles or fair faced in-situ 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 Project Manager 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 arise and features.

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

	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 Project Manager 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 Project Manager 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 Project Manager.

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.

3 Reinforcement for Concrete

Steel reinforcement shall generally be hot rolled mild, medium or high yield steel smooth round or deformed bars complying with BS 4449 or similar approved standard.

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 Project Manager. 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 Project Manager.

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 Project Manager.

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, 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 is required. Type of spacers shall be approved by the Project Manager 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 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 Project Manager 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 Project Manager.

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 %.

4 *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 \pm 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 Project Manager.

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 Project Manager. 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 Project Manager.

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 Project Manager. 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 Project Manager. 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 Project Manager.

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 Project Manager.

The combined percentage of sulphate 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 sulphate, chlorides and other extraneous material.

Table 1: Coarse Aggregate

BS 410 Test Sieve mm	Percentage by weight passing BS sieves							
	Nominal size of Graded aggregate		Nominal size of Single-sized aggregate					
	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 mm	Percentage by weight passing BS sieves			
	Grading Zone 1	Grading Zone 2	Grading Zone 3	Grading Zone 4
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 stockpiles and the methods adopted to prevent segregation of component sizes shall be agreed with the Project Manager.

Coarse aggregate shall be stockpiled in three separate grading: 38-19mm, 19-10mm, and 10-5 mm. When aggregates of different grading 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 retained 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 extraneous 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 appropriate 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 Project Manager.

Water

Unless otherwise authorized in writing by the Project Manager, 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 dissolved 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 Project Manager.

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 Project Manager.

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 4: Mix Proportions, Workability and Strength Grades of Concrete

Grade	Minimum Works cube Strength kg/cm ²		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)	150	200	20	7:1	5:1	RC structures in general
B-200	150	200	37	8:1	6:1	RC Foundations
(B)	175	250	20	5.5:1	4:1	High load columns
B-250	175	250	37	6.5:1	4.5:1	High load foundations
(C)	200	300	20	5:1	3:1	High load columns
B-300	200	300	37	5:1	3:1	High load foundations

(D) B-150	100	150	20	10:1	8:1	Plain concrete foundations
	100	150	37	10:1	8:1	Blinding layer under RC Foundations
(E) B-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 Concrete	Minimum works Cube Strength Kg/cm²		Weight of dry sand per 50 k of cement							Max. design W/C ratio
				20mm max. size			37mm max. size			
	7 days	28 days		Low	Med.	High	Low	Med.	High	
			kg	kg	Kg	kg	kg	kg	kg	
B-200	150	200	91	193	159	136	226	193	170	0.55
B-250	175	250	80	170	136	113	204	170	147	0.50
B-300	200	300	68	147	113	91	170	136	113	0.45

**Table 4: 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 Project Manager.

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 m ³ or 10 batches	40 m ³
20 m ³ or 20 batches	80 m ³
50 m ³ or 50 batches	200 m ³

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 Project Manager 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 an 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 Project Manager 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. Hand mixing shall not be allowed except only upon the written permission of the Project Manager.

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 Project Manager and shall be kept in good condition while in use on the works. Checks are to be made as required by the Project Manager 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 Project Manager.

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 Project Manager, 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 Project Manager 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. In case additives will be used, the manufacturer specifications of such additives must be handed over to the Project Manager 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 Project Manager.

The plunger (poker) type vibrators shall have a diameter compatible with the lowest spacing of reinforcement, a sufficiently high frequency and be properly handled by experienced personnel. They shall 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 Project Manager, 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 Project Manager. 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 Project Manager 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 Project Manager. 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 Project Manager 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 Project Manager 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 Project Manager. 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 manufacturer's 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.

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 color resulting from the use of a form discoloration 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 Project Manager. All blowholes shall be filled with a matching mortar to an approved sample unless otherwise instructed by the Project Manager. All faces shall be protected from damage, especially arises.

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 Project Manager.

2 - Fine finishes (Fair Face)

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.

The finish is to be left as struck. All form tie holes are to be filled with a matching mortar to an approved sample. Wire form ties shall not be used. Approval of the Project Manager for the position of tie holes is to be obtained before use.

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 Project Manager.

All samples and testing shall be done in the presence of the Project Manager or his authorized 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 Project Manager.

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 Project Manager.

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

Concrete judged by the Project Manager 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 Project Manager.

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 Project Manager 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 Project Manager. 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 Project Manager but in no circumstances shall water be added in transit.

Unless otherwise agreed by the Project Manager 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 Project Manager details of the supplier and shall arrange for the Project Manager 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

1 General

Contractor must submit two sets of each type of stone, full size units as selected by the Project Manager to the project site, in sufficient number to indicate the full range of color, texture and each type of the full range of color, texture and each type of finish. One of each of the duplicate samples approved by the Project Manager, The other being returned to the stone supplier, for his guidance. Colors and types of stone – dressings are as mentioned under part 2- Products, paragraph B, "Stone Schedule".

The following physical data on all proposed stone shall be submitted y the supplier: -

1. Analysis of mineral composition.
2. Analysis of chemical composition.
3. Thermal sufficient of expansion.
4. Absorption
5. Specific Gravity.
6. Modulus of Rupture
7. Abrasion Resistance.

Anchors: Two of each type to be incorporated in the work.

Submit samples of other materials specified herein upon request by the Project Manager.

2 MOCK UP

1. Furnish and install a typical stone wall, application required for the project at area designated by the Project Manager. The panel shall be constructed for Project Manager'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 Project Manager.

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 Project Manager 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 Project Manager. 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

1. Applicable provisions of the following standard publications shall apply throughout the work:

2. Building stone Institute: "Recommended Practices for the use of Natural Stones in Building Constructions".
3. American Welding Society (AWS): DI.1 Structural Welding Code.
4. Industrial Fasteners Institute (IFI): Handbook of Bolt, Nut and Rivet Standards.

REFERENCES

1. 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 Project Manager.

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 Project Manager, 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 stone 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. Packing
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

1. The
following environmental requirements are applicable to stone set in mortar, and when caulking stone joints with sealant:
 - During freezing or near freezing weather provide equipment and cover to maintain a minimum of 4 degrees C and to protect stonework completed or in progress.
 - At end of working day, or during rainy weather, cover stonework exposed to weather with waterproof coverings, securely anchored.
 - Maintain materials and surrounding air to minimum 10 degrees C prior to, during and 48 hours after completion of work.

3PRODUCTS

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. Color, texture and finish shall be within the range of samples approved by the Project Manager.
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. The contractor shall provide evidence to this effect.
3. Stone rejected for noncompliance with the submitted samples or the requirements of this specification shall be replaced with material acceptable to the Project Manager. Replacement shall be prompt and at the Contractor's own expense. Inspection of stone by the Project Manager 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 stonework shall be carried out and executed in accordance with the classifications of class "Special refers 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,Tubza, and Sand Blasted dressing, as noted on the drawings and details .

FINISH

1. The finish, of exposed to view surfaces of stone, shall be as specified above. The concealed from view surfaces of all stone types shall be sawn, hacked and / or roughened to allow key for the backing mortar, all as more particularly instructed by the Project Manager.
2. End matches the texture in the face of stone elements that abut one another to assure continuity in surface appearance.

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 stonework 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, sink ages 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 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 color of pointing mortar, as selected by the Project Manager, 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 Project Manager.

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 Plasticizer

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

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.

6 EXECUTIONS

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 Project Manager 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 Project Manager.

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 material. Not to use wire brushes or implements which mark or damage exposed surfaces, unless otherwise approved by the Project Manager.

1-Mortar and Grout Proportioning – By Volume

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 mortar and grout mixes included within this section to meet the Project Manager's satisfaction and approval.

2-Setting Mortar for Stone:

- Portland Cement - 1 part
- Hydrated lime - 0-0 .25 part
- Sand - 3 Parts
- Plasticizer
- Integral water proofer

3-Pointing Mortar:

- White Portland cement - 1 part
- Sand - 1-1/2 parts
- Add color additive to acquire the color of mortar approved by the Project Manager.
- 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 plasticizer shall be used in all mortars, unless otherwise instructed by the Project Manager.

4-Wall Grout

Fine grout shall be mixed in the following proportions by volume all in accordance with ASTM C476:

- | | |
|--------------------|----------------|
| a. Portland Cement | - 1 part |
| b. Hydrated Lime | - 0 .1 part |
| c. 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, pour-able consistency.

Mortars 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 Project Manager 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 re-tempered to restore its workability. Re-tempering of mortar and grout at the mixer shall not be permitted.

Setting of Exterior 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 should 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 Project Manager.

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 nuts from backing off.

5-All welding, where required, shall be done in accordance with the requirements of the Project Manager, 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 should 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 tooled 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 stonework.

Cleaning

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

Final Inspection

1.Finish surfaces shall show no objectionable visual distinction in jointing, bedding, plane, color, texture, pattern, and finish. All stones which in the opinion of the Project Manager do not provide the required uniformity shall be relocated, or removed and replaced with new stone units to the satisfaction of the Project Manager 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 Project Manager. Repairs, when approved, shall be completed to the satisfaction of the Project Manager. When the repairs to stone are unsatisfactory to the Project Manager, 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

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 Grading 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

(a) Fine aggregate

Table of Grading

Sieve No.	Approximate Size: mm	Percentage (by weight) Passing Through Sieve
-	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

b) Coarse aggregate 10mm single size aggregate.

The blocks shall be hard, sound, square and clean with sharp well defined arises and shall, unless previously approved by the Project Manager, 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 Project Manager 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 Project Manager's approval)

Arises shall be sharp and true; blocks which have damaged arises 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 Project Manager. Blocks shall be cured by being kept thoroughly wet by means of water sprinklers or other approved means for a period determined by the Project Manager 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).

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 Grading 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 colored 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 m ³	Lime (Dry Hydrate) Kilos
1:4	360	1.00	as approved by the Project Manager

Table of Grading

Sieve No.	Approximate mm	Size:	Percentage (by weight) Passing Through Sieve
-	10		100
-	5		90-100
7	2.36		75-100
14	1.18		55-90
52	0.6		35-59
100	0.3		8-30
200	0.15		0-10

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 plasticizer 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 plasticizer shall be used strictly in accordance with the manufacturer's instructions, and subject to the Project Manager'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 block work.

3 **Construction**

All block work 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 Project Manager 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 block work 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 Project Manager. Broken blocks shall not be used except where required for bond (if approved by the Project Manager).

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 un-plastered 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.

Block work 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 block work. Gunning ties to concrete will not be permitted (other ways of bond must be approved by the Project Manager).

SECTION: 6

ROOFING

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 purling at centers 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 purling as described above.

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

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 Project Manager.

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 meters 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 trowel led 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.

3 *Insulation*

When asphalt sheets are used on the top of the screeds, it should have the following properties:

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

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

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

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

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

Sheets should 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 should prevent air pockets entrained under the sheets, which will be full flame applied.

4 Tiling

Tiled finishing to roofs shall be manufactured and laid as described in Section P (Plasterwork etc. . .)

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

5 Expansion Joints

The expansion joints shall generally be of 10mm thick fiberboard 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, skirting and fillets.

6 Felt Roofing

Felt roofing, below tiling, shall be two-ply, tropical grade, fiber- 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 Project Manager.

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

7 Bitumen Roofing

Where roof finishing is 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.

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 Particular Conditions with each successive coat breaking joints at least 300mm (12"); and with properly formed angles, double angle fillets and fair edges.

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

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

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

1 General

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

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 Project Manager, and shall be used as recommended by the manufacturer

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

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 m ³	(I) (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% (I)*	1:5:1	289	1.00	124
1:4 (I) with 10% cement	1:10:2	145	1.00	161

* I = 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 color and consistency. It is important to note that quantity of water used shall be carefully controlled.

4 *Plastering and Similar In-Situ Finishing's 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 trowel led 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.

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

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 *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 trowel led or floated	1:10:2.5 trowel led 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

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 arise.

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

Topcoat 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.

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 nails. 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 centers.

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, block work 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

1 General

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

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 Gradings. 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.

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 color 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 thickness mm	total
200x200	0.5	20	
250x250	0.5	25	
300x300	1.0	27	
400x400	1.0	30	

Colored 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 color 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.

4 Terrazzo Tiles

Terrazzo tiles shall be formed with a (1:2 1/2) mix of white or colored cement or white cement with a color 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 thickness mm	total
200x200	0.5	20	
250x250	0.5	25	
300x300	1.0	27	
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 color 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 or 200mm 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 sand 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 color 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 arises.

Terrazzo covering to items such as sills treads and risers to steps, skirting 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 Project Manager).

5 Marble Paving

Marble paving 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. Protective slurry of lime putty at least 3 mm thick shall be applied to the marble paving 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. Skirting 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 paving. Rounded arises, nosing and moldings shall be adequately protected by means of timber casings. Treads, risers, skirting and window sills shall be grouted and protected in a manner similar to paving.

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.

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 moldings shall be accurately formed in accordance with the Drawings.

Exposed edges and moldings 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.

7 *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 manufacturer approved by the Project Manager.

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

Any admixtures to the mortar must be approved before use.

Grout pointing shall be white or colored 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 white or colored 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 Project Manager.

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.

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 *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 white or colored 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 from flaws, cracks and crazing and keyed on the reverse side and shall be of a manufacture approved by the Project Manager.

Bedding mortar shall be cement and sand (1:3) all in accordance with the materials stated in Concrete Work and Block work 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 Project Manager.

Grout pointing shall be neat white or colored 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.

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 not 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.

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 2mm 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.

9 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

1 Timber

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

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 approval of the Project Manager, well seasoned, close grained and free from all defects. Hardwood for polishing or clear treatment shall be selected and kept clean.

Any preservative treatment shall be approved by the Project Manager.

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, miters, ends, short lengths and any other sundry items of like nature and for priming all concealed surfaces of joinery. Aluminum 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 edges and no joinery shall be built in until inspected and approved by the Project Manager.

The whole of hardwood joinery shall be rubbed down to a smooth 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 trapped 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.

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.

3 Plywood

The minimum thickness shall be 5mm.

Plywood face veneers shall be approved by the Project Manager.

Plywood adhesives shall be approved by the Project Manager.

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

4 Timber Face Veneers

All timber face veneers that are exposed shall be selected to the approval of the Project Manager 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.

Timber for face veneers shall be as described in the Particular Specification or as shown on the Drawings.

5 *Fixing and Jointing*

Softwood in carpentry work shall be put together with steel nails except where described as framed when it shall be properly jointed and held together with glue and steel screws. Fixings shall be stout steel nails and screws.

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 face work shall have the heads let in and plated 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 Project Manager.

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.

6 *Spacing 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.

7 *Doors*

Doors shall be as specified below or in the Particular Conditions obtained from one of the approved manufacturers listed and shall be capable of withstanding the particular weather conditions of the Middle East.

Door leaves with a polished finish are to be veneered as described in the Particular Conditions with the 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 lip pings 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 Project Manager.

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.

Aluminum windows (Best quality) will be used. Color and type of section must be approved by the Project Manager.

9 *Fly Screens*

Fly screens to doors and windows shall be installed and shall be framed and braced with rails styles and braces and filled in with aluminum mesh, 18x16 meshes per inch.

10 *Frames*

Frames to doors, windows and fly screens shall be provided and built in to the sizes shown on the Drawings or as directed by the Project Manager.

Frames shall be securely tied to walls by means of steel or similar metal cramps, galvanized 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 Project Manager (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 rounds.

11 *Architraves, Door Stops etc.*

Architraves, doorstops etc. shall be as shown on the Drawings and all properly mitred at intersections as approved by the Project Manager.

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

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.

13 *Finish*

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

14 *Protection*

All joinery shall be protected from damage during the course of the Works and on completion shall be to the Project Manager'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

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 Project Manager.

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

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 doorstop plugged and screwed to the floor and 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 in the Particular Specification or as shown on the Drawings.

2 Finish

The finish of the various items of ironmongery shall be as described in the Particular Specification or as shown on the Drawings or as required and directed by the Project Manager.

3 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 Project Manager.

The hinges on which doors, windows, fly screen doors etc., are hung shall be carefully housed or let into the door, window, fly screen 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 Project Manager.

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 Project Manager.

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 Project Manager.

4 Standard Ironmongery for Internal Doors

Ironmongery is to be hard satin anodized 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 of other suppliers' items most nearly matching the general ironmongery and /or produce alternative ironmongery by the main supplier most closely conforming to the Specification for the approval of the Project Manager.

All locks are to be provided with 2 keys on a key ring neatly labeled to indicate clearly the corresponding lock.

Any requirements for ' Master key ' locking systems will be stated in the Particular Conditions and /or on the Drawings.

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

SECTION: 11

METAL WORKS

1 Cleanliness

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

All metalwork shall be approved by the Project Manager before starting painting works.

2 Aluminum Windows and Doors

Extruded aluminum sections should be used as approved by the Project Manager.

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

The sections shall be anodized to a minimum thickness of 25 microns. The supplier must submit necessary evidence to the satisfaction of the Project Manager that the thickness of anodizing is not less than 25 microns. In case of doubt the Project Manager 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 anodizing 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 frames 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 as approved by the Project Manager.

At all opening windows and doors and where there are louvered screens and doors a fly screen shall be provided to the approval of the Project Manager, 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 Project Manager 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 Project Manager.

The Contractor shall provide shop drawings for aluminum windows and doors, which shall be submitted in quadruplicate to the Project Manager for approval.

Approval by the Project Manager 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

Weather-stripping, high-density acryl and 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 fly screens as required or as directed by the Project Manager.

The handle-latch set shall have all visible surfaces of anodized 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 weather-stripped with heat resistant PVC sections. The weather fighting action shall be achieved by a positive compressive action against the PVC section and shall not depend on an external contact with the PVC section. At every contact between two profiles two weather-stripping 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 anodized aluminum with stainless steel pins and nylon washers. Handles shall be in anodized aluminum and mounted with self - lubricating nylon washers.

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

Windows shall have anodized aluminum 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 Project Manager

3 Fly Screens

Fly screens shall be fitted to all opening leaves of windows, consisting of a separate metal sub-frame filled in with fly wire as previously described. The fly screens shall be adequately secured with suitable clips, set screws or turn buckles and shall be removable for maintenance purposes. Fly screen doors shall consist of similar sections to the metal casement doors and shall be fitted with removable panels of fly wire, in a manner similar to that described for window fly screens. Fly screen doors shall be mounted where indicated on the Drawings or as directed by the Project Manager.

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 Project Manager.

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 and jointed with sealant in accordance with the manufacturer's recommendations.

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.

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.

Floor joint covers shall be 2" deep. Butt joints within continuing runs shall be a maximum of 20 feet apart and will be sealed during installation.

Wall and ceiling joint covers shall be standard gray.

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

SECTION: 12

PAINTING AND DECORATING

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.

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 re-fixed 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 Project Manager.

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.

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

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 Project Manager.

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 Project Manager.

Stopping for internal woodwork, plywood, hardboard, and fiberboard, shall be linseed oil putty, tinted to match the color 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 gray 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: gray 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. Colors 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 Project Manager.

Petrifying liquid shall be used undiluted as supplied by the manufacturer a small quantity of water paint of the finishing color 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 Polyvinyl 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 of an approved manufacture.

Preparation Process

3 *Internal Plaster, Fair Faced Concrete and Block work*

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.

4 *Fiber Boards etc.*

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.

ASBESTOS: if surfaces are to receive oil paint later one coat of priming paint should be applied. If surfaces are to receive water paint or emulsion paint no priming paint will be necessary.

5 *Steelwork Including Windows, Louvers etc. Internally and Externally*

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 re-primed. 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.

6 *Exposed Service Pipes*

Copper and brass pipe work 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.

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. 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 Project Manager 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.

8 *Wood Work required to be 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

9 *Internal Plaster*

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

Where water paint is specified two coats shall be applied by brush 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.

10 *Fiber Boards etc.*

Both acoustic and plain soft or hard boards will be treated as for plaster, but the paint may 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.

11 *Unflustered Block work Or Concrete*

As for internal plastered surfaces

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

12 *Steelwork and Exposed Service Pipes*

Internally, apply one coat gloss 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.

13 *Woodwork Required To Be Painted*

As for steel work

14 *Woodwork Required To Be Stained and Polyurethane*

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

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

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	0.122-0.138	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

2 Plate Glass

Plate glass shall be cast, rolled or drawn glass ground and polished on both surfaces, of the thicknesses 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

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

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 Substance or thickness	Limits of thickness		Approximate Weight	Normal Maximum Size
	mm	inch	lb/ft2	inch
1/4	5.5-7.2	0.216-0.283	3 1/2	130x72

5 ***Heat - Absorbing Glass***

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

Limits for Heat Absorbing Plate Glass

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

6 ***Armor plate Glass***

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

Limits For Armor plate Glass

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

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.

8 ***Putty***

Putty shall only be used when specified in the Particular Specification and where possible materials described in 14.01 shall be used.

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

9 ***Glazing Beads***

Wooden glazing beads shall be of teak, splayed and rounded to the sizes shown on the Drawings and neatly mitred and braded.

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

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.

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.

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 form a triangular mitered 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 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 *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 form neat back putty and painting shall be carried out.

14 *Glazing without Putty*

Where specified, wash leather, ribbon velvet, flannel, felt, asbestos or similar materials shall be used in place 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.

15 *Mirrors*

Mirrors shall be fixed to walls with compressive spacers, fiber 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.

16 *Cleaning etc*

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

SECTION: 14

ASPHALT WORKS

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 Project Manager .

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.

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
1 1/2 inch (38.10 mm)	100
1 inch (25.40 mm)	75-100
3/4 inch (19.10 mm)	60-90
1/2 inch (12.70 mm)	45-80
3/8 inch (09.52 mm)	40-70
No.4 (04.76 mm)	35-65
No.10 (02.00 mm)	20-40
No.40 (00.42 mm)	8-20
No.200 (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.
Liquide 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 Project Manager, 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 Project Manager, and the total thickness of the base-course shall not vary by more +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.

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.

Method of Measurement

Base-course shall be measured per sq.m in place, acceptably laid and compacted according to the dimensions shown on the Drawings.

Method of Payment

Payment shall be made at the Contract unit rate for "compacted aggregate base-course" per cu.m. This price shall constitute full compensation for furnishing and placing all materials including watering, compacting, shaping and all labor, equipment, tools, supplies, tests, and incidentals necessary to complete the work.

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.

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 Project Manager. Other equipment is to be used in addition to, or in lieu of the specified equipment when approved by the Project Manager.

The pressure distributor shall be designed and operated to distribute the asphalt material in a uniform spray with atomization, 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 byte meter having a dial registering liters, 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 Prime coat

The Project Manager 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. 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 Project Manager, 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 Project Manager .

Method of Payment

Payment shall be based on the Contract unit rate for "Prime Coat" per sq.m.

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 Project Manager.

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
1 inch (25.40 mm)	100
3/4 inch (19.10 mm)	90-100

3/8 inch (90.52 mm)	56-80
No.4 (04.76 mm)	35-65
No.8 (02.00 mm)	23-49
No.50 (00.42 mm)	5-19
No.200 (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 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 from 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 Project Manager'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 comp active 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	max.25
(Soaking 24 hours compared with 30 min. at 60OC for All specimens in water bath)	
Plasticity Index for material	non plastic
Passing sieve No.40(from hot bins)	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 from 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-ordinate and operated to produce a uniform mix within the specified job mix tolerances.

Job Mix Formula

The Project Manager 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 Project Manager, 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 80 C of that temperature.

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 pave shall be designated by the Project Manager'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 Project Manager'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 pavers 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 Pavers

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 pavers to follow will be established by the Project Manager's Representative parallel to the centerline of the proposed roadway. The pavers shall be positioned and operated to follow closely the established lines.

In backing trucks against the pavers, 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 pavers 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 pavers. 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 authorized by the Project Manager's Representative. Wood or steel form, approved by the Project Manager'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 does 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

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 centistokes, as follows:

148+30C 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 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 shall be removed from 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 Project Manager'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 pavers 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 coverage) 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 Project Manager'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 Project Manager's Representative until the course is thoroughly compacted. Hand tamping, manual or mechanical, may be used in such areas if it proved to the Project Manager'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 from 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 Project Manager'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 Project Manager'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 Project Manager'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 Project Manager's Representative.

Method of Measurement

Asphalt concrete shall be measured by square meters of the actual area paved and accepted in place including the bitumen according to the dimensions shown on the Drawings.
Edge slopes shall be done but will not be measured for payment.

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 .

