

SPECIFICATIONS AND LIST OF DRAWINGS

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SECTION A

GENERAL

A 1 SCOPE OF WORK

These Specifications cover all the works necessary for the rehabilitation of Al Bahrain Library, testing and commissioning of all equipment and maintaining the whole works.

A 2 DRAWINGS

A list of Contract Drawing available at the date of tender is included on the front page of the Drawing Book and at the end of these Specifications

A 3 CONTRACTOR'S PRICE

The Contractor's price shall include for all materials labour and plant requirements necessary for the completion of the Contract in accordance with the Contract Drawing and specifications with exception only of items supplied by e Employer.

A 4 USE AND PROTECTION OF SITE

The Contractor shall take such measures and exercise such are to protect the Site as shown on the Site Plan during the course of the Works as directed by and to the entire satisfaction of the Engineer.

All temporary buildings and work areas such as Site Offices, Workshops Store Buildings and Yards, Living Accommodation, Messrooms, etc. shall be constructed in position approved by the Engineer.

The contractor shall confine his apparatus, the storage of materials and the operations of his workmen to limits indicated by law, ordinances, permits or directions of the Engineer. Th Contractor shall erect suitable temporary fences as required by the Engineer.

The Contractor shall not load or permit any part of the structures to be loaded with a weight that will endanger its safety.

On commencement of the Contract, the Contractor shall clear the Site and adjacent area of all rubbish and debris to the satisfaction of the Engineer.

USE AND PROTECTION OF SITE (Cont'd)

Upon completion of the Contract, the Site and any adjacent areas affected by the building operation shall be properly cleared of all temporary works, debris and other rubbish and all disturbed works and ground made good to the entire satisfaction of the Engineer.

A 5 MATERIALS FOUND ON SITE

Any sand, gravel or other building material found on the Site shall not be used in the execution of the Works without the prior written consent of the Engineer, which shall not be unreasonably withheld.

A 6 TEMPORARY STORMWATER DRAINAGE

The Contractor shall ensure that the whole of the Site, is kept free from the risk of stormwater flooding and shall provide such temporary ditches, gullies and the like as may be necessary and shall at completion of the Works backfill such excavation and make good all works disturbed.

A 7 SHOP DRAWINGS

If at any time before the commencement or during the progress of the work it appears to the Contractor that for the proper execution of specific part of the works, shop drawings are necessary, these drawings shall be prepared by the Contractor and submitted to the Engineer for approval. On the other hand, the Engineer shall have authority to order at any time and the Contractor agrees to provide any number of shop drawings which in the opinion of the Engineer are necessary for the proper execution of a specified work, the Contractor shall not proceed with the above mentioned work unless these shop drawings are approved by the Engineer.

Shop drawings shall be fully detailed and drawn to proper scale.

Unless otherwise specifically required in the drawings or Specifications, shop drawings shall be supplied in four copies with dark lines on a white background.

Shop drawings shall be approved or returned to the Contractor for alternation or amendment within four (4) weeks of their receipt by the Engineer. Shop Drawings returned for alternation or amendment shall be resubmitted for approval. Altered or amended shop drawings shall show the nature of the alternation or amendment in a revision

block on the drawings with a revision number or letter and the date of the revision.

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SPECIFICATIONS
GENERAL

A 8 " AS BUILT " DRAWINGS

All prints of the Drawings, where required, shall be corrected by the Contractor and submitted to the Engineer for approval as the works proceed. Upon the completion of the Works, the Contractor shall prepare a completely new set of drawings for the project as executed and submit same in duplicate to the Engineer for approval.

When approved by the Engineer, the Contractor shall submit one transparency and six copies of all drawings duly marked "As-Built". The final payment shall not be made except for the actual works that have been completed in accordance with the Specifications and have been duly presented on the "As-Built Drawings".

The Contractor shall not be entitled to any extra payment or extension of time for the correction, preparation and supplying of the above mentioned drawings and transparencies.

A 9 SCAFFOLDING

The Contractor shall provide, erect, maintain, and dismantle any clear away at completion proper and adequate scaffolding including that required for Sub-Contractors and Specialists. Put long holes shall be made good to match the adjacent surface as the scaffolding is dismantled. The Contractor shall be entirely responsible for all safety precautions in connection with the scaffolding and for its entire sufficiency for the work.

A 10 PROTECTION

In the pursuance of his obligations under the Conditions of Contract, the Contractor shall wherever required or directed by the Engineer cover up and protect the Works from the weather and from damage by him or other workmen performing subsequent operations. He shall provide all necessary dust sheets, barriers and guard rails and clear away same at completion.

The Contractor shall take all reasonable and proper steps for the protection of all places on or about the Works, which may be dangerous to his workmen or any other persons or to traffic. The Contractor shall provide and maintain warning signs, red warning lamps and barricades as necessary in all such places.

SPECIFICATIONS
GENERALA 11 SEPARATE CONTRACTS

The Employer reserves the right to let other separate contracts in connection with the work under similar conditions. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and co-ordinate his work with theirs.

If any part of the Contractor's work depends for proper execution or results upon the work of any other contractor, the Contractor shall inspect and promptly report to the Engineer and defects in such work shall render it unsuitable for such proper execution and results.

His failure so to inspect and report shall constitute an acceptance of the other Contractor's Works as fit and proper for the reception of this work, except as to defects which may develop in the other Contractor's work after the execution of his work.

To ensure the proper execution of his subsequent work, the Contractor shall measure work already in place and shall at once report to the Engineer any discrepancy between executed work and the Drawings.

A 12 DEFINITIONS

"Approved "directed "selected" means the approval, direction or selection by the Engineer.

"Instructions means the instructions in writing of the Engineer or Engineer's Representative unless specified otherwise.

"Manufacturer's Recommendation" means the Manufacturer's recommendations or instructions, printed or in writing and current at the date of tender.

" Or approved equal" means that materials of different manufacturer may be substituted if proper approval has been obtained. The rates or prices will be held to be based on the materials specified.

Where an item is denoted as N.I.C. on the Drawings it shall mean that item indicated is not included in the Contract.

Where the terms Architect or Engineer is used in this Contract they shall have the same meaning.

Where the terms Architect's Representative or Engineer's Representative are used they shall have the same meaning.

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SPECIFICATIONS
GENERAL

A 13 STANDARDS

In the Contract reference is made to the Standards, Codes of practice and Specifications issued by the following organizations, hereinafter referred to by the following abbreviations:

AASHO Means the American Association of State Highway Officials.

ACI Means the American Concrete Institute.

AFNOR Means the Association Francaise de Normalisation.

AISC Means the American Institute of Steel Structure.

ASA Means the American Standards Association.

ASHRAE Means the American Society of Heating, Refrigerating and Air-Conditioning Engineers

ASTM Means the American Society for Testing and materials.

AWWA Means the American Water Works Association.

B S Means the British Standards Institution.

CMA Means the Cable Manufacturers Association.

DIN Means the Deutscher Normenusschuss.

NEMA Means the National Electrical Manufacturers Association.

NFPA Means the National Fire Protection Association.

VDE Means the Verband Deutscher Elektrotechniker

These references shall in every case be deemed to include the latest edition or issue of such standards.

The Contractor upon receiving instructions shall supply the Engineer's Representative with single copies of all standards referred to on the Drawings or Specification and shall arrange for further copies for his own use.

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SPECIFICATIONS
GENERAL

A 14 MATERIALS GENERALLY

All materials and manufactured goods are to be the best of their respective kinds and as described in the Specifications and the Contractor shall submit for the approval of the Engineer a list of names and addresses of the manufacturers, the trade marks and types of all materials and articles he proposes to employ together with all specifications and descriptions that may be required in this connection before any orders are placed. Samples are to be provided if requested by the Engineer. Where a particular proprietary product, supplier's catalogue is referred to in the Specifications or shown on the drawings the material specified may be obtained from another source provided it is similar, equal and approved by the Engineer.

If during the course of the Contract certain materials required for use in the Works should be unobtainable despite the best efforts of the Contractor, then the Contractor may offer for the approval of the Engineer substitute materials.

The use of these substitute materials shall be at the sole discretion of the Engineer.

In the event of the acceptance of the substitute materials a suitable price reduction shall be made in the respect of decrease in quality or value but no price addition shall be made in respect of increase in quality or value.

In the event of refusal of the substitute materials the Contractor shall not be relieved of any of his obligations under the Contract and shall be solely liable for any delay or loss occasioned by his failure to provide materials as specified.

Where manufacturers recommendations have been entered into the contract documents, it is for the purpose of giving an indications to

the contractor of the Engineer's intentions on the application and use of the material.

It is deemed that the successful Contractor will make direct contact with the manufacturer to ensure that he is carrying out the works in accordance with their recommendations.

A 15 CONTRACTOR TO VERIFY SITE MEASUREMENTS

The Contractor shall check and verify all site measurements wherever requested by other specialist contractors or by nominated or other sub-contractors to enable them to prepare their own shop drawings, and pass on the information with sufficient promptness as will not in any way delay the Works. A copy of all such information passed or shall be given to the Engineer.

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SPECIFICATIONS GENERAL

A 16 SAMPLES

The Contractor shall furnish for approval, with reasonable promptness all samples of materials and workmanship required by the Engineer. The Engineer shall check and approve such samples with reasonable promptness for conformance with the design concept of the works and for compliance with the information given in the Contract Documents. The Work shall be in accordance with approved samples.

- a) All material samples shall be delivered to the Engineer's office with all charges in connection with therewith paid by the Contractor.
- b) Duplicate final approval samples, in addition to any required for the Contractor's use, shall be furnished to the Engineer.
- c) Samples shall be furnished so as to delay fabrication allowing the Engineer reasonable time for consideration of the sample submitted.
- d) Each sample shall be properly labelled with the name and quality of the material, manufacturer's name, name of project, the Contractor's name and the date of submission and the Specification number to which the sample refers.

A 17 CUTTING AND PATCHING

The Contractor shall be responsible for all cutting, patching and making good in all trades for all work and his prices will

be deemed to include for all such cutting and patching and making good.

A 18 SITE OFFICES, LATRINES, ETC.

The Contractor shall provide and maintain on the Site for the duration of the Contract the following: -

- a) A temporary office for the accommodation of his Agent/Engineer and Staff, including all necessary sanitary facilities, such offices shall be open at all reasonable hours to receive instructions, notices or other communications. Telephone and Electric installations shall also be provided.
- b) A suitable and adequate temporary office shall be provided and furnished by the Contractor for the sole use of the Engineer and his staff. Such office shall be to the approval of the Engineer.
- c) Adequate fire fighting equipment to the approval of the Local Fire Authority and the Engineer.
- d) An approved sign board, written in Arabic and English. The size of signboard and lettering including to wordings shall be as directed by the Engineer.

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SPECIFICATIONS
GENERAL

A 19 ATTENDANCE ON THE ENGINEER

The Contractor shall for the duration of the Contract supply sufficient attendance for the Engineer's supervisory staff and shall maintain and pay all water, electricity, and telephone charges shall keep the Site Office and supervision cabins in a clean and sound condition at all times.

The Contractor shall be responsible for the security of the Site Office and its contents at all times and shall employ watchman for this purpose

A 20 TESTING

The Contractor shall allow in his rates and prices for the cost of carrying out tests necessary for compliance with the Specification in independent laboratories outside the Site.

A 21 TEMPORARY BUILDINGS

The Contractor shall provide and maintain on the Site sheds, offices, messrooms, sanitary accommodation and other temporary works of any kind whatsoever for the Contractor's supervisory staff and work people and for Sub-Contractor's staff employed upon the works.

The Contractor's site office shall be open during working hours to receive instructions notices or other communications.

Sheds shall be suitable to store all materials equipment and furniture which in the opinion of the Engineer needs protecting from the weather.

The Contractor shall provide and maintain in approved positions on the Site Adequate sanitary accommodation for his staff workmen and sub-Contractors. This sanitary accommodation shall be kept in a clean and orderly condition to the approval of the Public Health Authority and the Engineer to ensure that no nuisance is caused.

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SPECIFICATIONS
GENERAL

A 22 TEMPORARY WORKS AND REINSTATEMENT

The Contractor shall provide and maintain all temporary roads and tracks necessary for movement of plant and materials, and clear same away at completion and make good all works damaged or disturbed.

The Contractor shall submit drawings and full particulars of all Temporary Works to the Engineer before commencing same. The Engineer may required modifications to be made if he considers them to be insufficient and the Contractor shall give effect to such modifications but shall not be relieved of his responsibilities for the sufficiency thereof.

The Contractor shall divert as required, at his cost and to the approval of the Engineer, all public utilities encountered during the progress of the Works, except those specially indicated on the drawings as being included in the Contract.

Where diversions of services are not required in connection with the permanent Works, the Contractor shall uphold, maintain and keep the same in working order in existing locations.

The Contractor shall make good, at his own expense, all damage to telephone, telegraph and electric cable or wires, sewers,

water, or other pipes except where the Public Authority or Private Party Owing or responsible for the same elects to make good the damage. The cost incurred in so doing shall be paid by the Contractor to the Public Authority or Private Party in demand.

All injury to the surface of the land, to the beds of water courses, projecting banks, etc. where disturbed by the Works (other than where specifically ordered by the Engineer) shall be repaired by the Contractor or the authorities concerned, at the Contractor's expense. All such making good shall be to the approval of the Engineer.

All requirements detailed above shall be provided and maintained at the expense of the Contractor.

The Employer shall not be liable for loss or injury to and Temporary Works.

A 23 WATER FOR THE WORKS

The Contractor shall make all necessary arrangements and provide all water for the proper execution of the Works, together with all transport temporary plumbing, storage and distribution, pay all charges and alter adapt and maintain temporary work as necessary remove and make good at completion.

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SPECIFICATIONS GENERAL

A 24 ELECTRICITY FOR THE WORKS

The Contractor shall make all necessary arrangements and provide all artificial lighting and power for the proper execution and security of the Works and its protection.

With all meters temporary wiring and fittings, pay all charges and alter, adapt and maintain the temporary works as necessary and remove and make good at completion

A 25 PROVISION OF PLANT AND TOOLS

The Contractor shall provide and install all necessary hoists, ladders, scaffolding. Staging, tackles, tarpaulins, tools, vehicles, and other plant (mechanical and otherwise) and allow for altering adapting and maintaining them in good condition as necessary and eventually removing from site and making good.

A 26 TEMPORARY BARRIERS, FENCING ETC...

The Contractor is to provide all temporary barriers, fencing, hoarding, guard rails, gates, and the like as may be necessary to protect the public and others, for proper execution of the Works and shall remove and clear away at completion of the Works and make good all work disturbed.

A 27 INCONSISTENCY IN CONTRACT DOCUMENTS

The Contractor shall execute the Works according to the provisions of the Contract Documents. Any work indicated in one of the documents but omitted and/or stated in one or more of the other documents shall be treated as though it were included in all of them.

If any two documents of the Contract conflict as to the quality of the work to be carried out, the discrepancy shall be brought to the notice of the Engineer, who shall instruct the Contractor which of the two conflicting documents to regard as correct.

If the Contractor should discover that any work has been omitted and/or not indicated entirely or partially from all the documents, but that such work is essential to the safety or proper functioning of the works, he shall report the facts immediately to the Engineer. If the work is something which in the opinion of the Engineer could not have been foreseen by an experienced Contractor, the Engineer should issue to the Contractor a variation order stipulating the details of the work to be done.

Save as aforesaid in the above paragraph, no additional payment shall be made in respect of work carried out in connection with discrepancies between the various Contract Documents.

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SPECIFICATIONS
GENERAL

A 28 ERRORS IN COMPUTING CONTRACT DOCUMENTS

The Contractor shall be responsible for any error which he makes in computing any quantities of material and labour required or costs involved or through any lack of knowledge of the Site or misunderstanding of anything shown or implied on the Drawings or in the Specifications and/or the Bills of Quantities.

The Contractor must refer any discrepancy in the Drawings or the Specifications to the Engineer before proceeding in any of the Works otherwise the decision of the Engineer as to the interpretation of the discrepancy will be final. Any item or items of work not specifically shown on the Drawings or referred to in the Specifications but which would be necessary for the proper construction of the works in accordance with the best practice is implied and must be included for as incidental to the Contract Sum. Any item for which the

Contractor has not inserted a price in the Bills of Quantities shall be deemed to be covered by other prices or rates therein.

A 29 SITE MEETINGS

During the course of the Works, site progress meetings shall be held at regular intervals at least once every two weeks in the presence of the Engineer for the purpose of co-ordinating the Contractor's work and to insure that full compliance with the various sequences of the contract are maintained. Minutes of such Site meetings will be recorded, copies will be distributed to all persons concerned and full effect shall be given to all instructions contained therein

Prior to such meetings the Contractor shall give to the Engineer's representative details in writing of that portion of the Works he proposes to construct during the coming two weeks with details of the plant and methods he proposes to employ. These proposals shall be discussed at the meeting and no work based on such proposals shall proceed without the approval of the Engineer's Representative

The Contractor shall have no claim against the Employer for costs incurred by him in changing the method of working or in the provision and use of other additional plant.

A 30 DAILY REPORTS

The Contractor shall deliver daily to the Engineer's Representative a report as to the number of workpeople employed on the Works in each Trade and copies of delivery notes of all materials and goods to the Site during the day.

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SPECIFICATIONS
GENERAL

A 31 ACCESS FOR THE ENGINEER

The Contractor shall provide at all times during the execution of the Works and the Maintenance Period proper means of access with ladders, gangways etc., and the necessary attendance to move and adapt same as directed for the inspection or measurement of the Works by the Engineer or the Engineer's Representative.

A 32 SETTING OUT AND LEVELLING

Prior to commencement of any site work the Contractor shall arrange to record on an approved grid existing site ground levels and agree with the Engineer's Representative the accuracy thereof by preparing a record drawing signed by the

Contractor's Agent and the Engineer's Representative. The Contractor shall set out and level the Works and obtain the approval of the Engineer's Representative before commencing construction.

A 33 PROGRAMME TO BE FURNISHED

The Contractor shall prepare a programme for the Works, including the work of subcontractors and other work concurrent with the Contract, using the critical path network method. The Contractor shall submit three (3) copies of programme to the Engineer with his tender. Submission of programme will not relieve the Contractor of his obligations to apply in writing for instructions as required by the Conditions of Contract. Receipt of programmes by the Engineer shall neither affect the Contract completion date nor relieve the Contractor of his responsibility to complete the Works by this date. The Contractor shall review the programme once each month to take account of any circumstances which arise affecting the progress of the Works, and shall produce a revised programme and submit copies to the Engineer.

A 34 CANCELLATION DUE TO SLOW PROGRESS

If the Engineer shall be of the opinion that having regard to the state of the Works at any time, the Contractor will be unable to complete any section of the Works by the time specified or by such extension thereof as he may be entitled to under the Contract and the Contractor has failed to carry out steps and to expedite the work in accordance with the Conditions of Contract or, if the Engineer is of the opinion that such steps are inadequate, the Engineer may, by written order omit the whole or any part of the uncompleted work included in that section and the Employer shall be at liberty to execute such omitted work by his own workman or by other Contractors. If the cost of such omitted or uncompleted work shall exceed the sum which would have been payable to the Contractor on the completion of the said work, then the Contractor shall, upon demand, pay to the Employer the amount of such excess and it shall be deemed a debt due by the Contractor to the Employer and shall be recoverable accordingly.

A 35 DELAYS

The Contractor will be deemed to have allowed for all delay caused by difficulty in obtaining labour and materials or by suspension of part or the whole of the Works due to adverse and inclement weather conditions.

A 36 NON-PRODUCTIVE TIME

The Contractor shall allow for all costs incurred by non-productive time and all other expenses in connection with overtime.

A 37 SAFETY, HEALTH AND WELFARE

The Contractor shall comply with enactments regulations and working rules relating to safety health and welfare of workpeople.

A 38 CONTRACTOR'S SITE REPRESENTATIVE

The Contractor's Representative in charge of the Works shall be a duly graduated Engineer having at least Three (3) years experience in the superintendence of similar works and shall be required to have a proper command of the Arabic and English languages.

A 39 ATTENDANCE

The Contractor shall allow for and be responsible for the general attendance of one trade upon another.

A 40 OFFICIAL VISITORS

The Contractor shall at all times when authorized by the Engineer give free undisputed access and all facilities to any authorized employee of the Employer, any representative of the U.N.D.P. or any person authorized by the U.N.D.P. wishing to view or inspect any part of the Works or the materials to be incorporated therein.

A 41 CARE OF THE WORKS, ETC.

The Contractor shall keep all persons (including those employed by Sub-Contractors) under control and within the boundaries of the Site. He will be held responsible for the care of the existing premises and of the works generally until their completion, including all work executed and materials, good and plant (including those Sub-Contractors and Suppliers) deposited on the Site; together with all risks arising from the weather, carelessness of work people, damage or loss by theft or any other cause; and he shall make good at his own expense or such damage and lose.

A 42 WORK AT COMPLETION

The Contractor shall clean the Works thoroughly inside and out removing all splashes, deposits, rubbish and surplus material. The Contractor shall remove all temporary markings, coverings and protective rappings unless otherwise instructed.

The Contractor shall touch up minor faults in painted surfaces carefully matching colour and brushing out edges. He shall repaint badly marked areas back to suitable breaks and junctions.

The Contractor shall adjust, ease and lubricate all doors, windows, drawers hardware, equipment, appliances controls and other moving parts as necessary to ensure easy and efficient operations.

The Contractor shall leave the Works secure with all access locked. He shall account for all keys and shall hand over to the Employer with itemized schedule signed by the Employer as receipt.

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I N D E X

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S E C T I O N B

EXCAVATION - EARTH WORKS AND ROAD WORKS

B 1

GENERAL

The Contractor shall carry out all excavations, filling, backfilling and all other earthworks required in whatever material may be encountered.

The Works shall be executed accurately to the dimensions, levels, lines and profiles as indicated on the drawings or directed by the Engineer.

All excavation works inside the building should be done by handtools, no mechanical equipments are allowed to be used.

The Contractor shall reconstruct to the proper level and profile any filled areas which settle or spread during the execution of the work or during the maintenance period.

The Contractor shall drain and dewater the underground water to a level below the excavation by lowering the water table with a proper drainage and dewatering system approved by the Engineer.

B 2

SOIL INFORMATION

The Contractor shall be deemed to have visited the Site of Works and satisfied himself as to the nature of the ground and made himself conversant with the local conditions to be encountered during the execution of the Contract. The contractor is requested to perform a soil test to determine the nature and bearing capacity of the soil surface as directed by the Engineer.

B 3

MATERIALS

B 3.01

Backfill and Fill

Backfill and fill shall be a structurally sound material such as: less than 1 gravel or native soil free of rocks, lumps, vegetables and other organic materials obtained from suitable excavated material and/or from approved borrow pits.

B 3.02

Water

Water shall be clean potable water as specified under "Concrete Work"

B 3.03

Concrete

Concrete used as fill for making up the correct level areas of over-excavation shall be, where required by the Engineer of Class "B" as specified under "Concrete Work".

SPECIFICATIONS
EXCAVATIONSB 3.04 Hardcore

Hard-core under floor paving, etc...)Where shown on the) shall consist of (drawings or as directed by the Engineer , (mm150 maximum) sound and durable rubble stones , tough seems or flows of any , drys , free from coatings
Fine aggregate for blind .charactering the interstices of hard-core bed shall be as described in "Concrete Work".

B 3.05 Agricultural Soil, Gravel and Sand Fill

Agricultural soil shall be first choice top soil rich in organic materials and free from roots, stones and rubbish suitable for plantation and shall be obtained from an approved source. Gravel fill shall consist of graded gravel 50mm. Down to 20mm. And blinded with clean coarse sand.

B 4 **SITE PREPARATION**B 4.01 Existing Public Utilities

The Contractor shall ascertain the whereabouts of all existing public utilities on the site, both above and below ground. Such utilities shall be removed, sealed or rerouted in a manner prescribed by the Public Authorities concerned at the Contractor's own expense. The Contractor shall also be held responsible for all damages entailed on any of the public utilities adjacent to the Site resulting from the Works.

B 4.02 Removal of Existing Structures and Other Obstructions

This work shall include, but not be limited to, the removal of existing structures and other obstructions interfering with the Works. The Salvaging of any of these materials for the use of the Employer shall be as directed by the Engineer and unwanted materials shall be disposed off the Site in a satisfactory Manner at the Contractor's expense.

B 4.03 Cleaning and Grubbing

The Contractor shall perform the clearing and grubbing (if any) of top soil consisting mainly of loose soil, vegetable and organic matters, drift sand, unsuitable soil and rubbish by scarifying the areas to be excavated and side-walks to a minimum depth of 300mm from the natural ground level. All materials resulting from the above operations shall be removed from the Site, loaded and transported and off loaded spread and levelled to approved dumps as directed by the Engineer.

B 5 **SETTING-OUT**

The Contractor shall stakeout the work as shown on the Drawings and secure the Engineer's approval of his stakeout before proceeding with construction. If, in the opinion of the Engineer, modification of the line or grade is advisable before or after stake-out the Engineer will issue detailed instructions in writing to the Contractor for such modification and the Contractor shall revise the stake-up for further approval in accordance with the relevant Clause of the Conditions of Contract.

B 6 **EXCAVATION**B 6.01 General

Excavation in any material whatsoever found including rock to reduce levels and to form foundations, bases, trenches, septic tanks, cesspools, pits and the like to depths shown on the drawings or as directed by the Engineer.

Completely remove all existing obstructions in the line of excavations such as wall, slabs, curbs, steps and the like.

Trim excavations to required profiles and levels. Remove all loose material.

Level and well ram and consolidate surface of ground and bottom of all excavations to receive concrete foundations, beds, etc.

Bottoms of excavations shall be approved by the Engineer's Representative before any concrete is laid.

Should the Contractor excavate deeper than is shown on the drawings or required by the Engineer's Representative to obtain a solid bottom he must fill up excavation to the proper level with concrete Class B at his own expense.

B 6.02 Excavation in Rock

Rock shall be defined as boulders, exceeding 0.25m³ in volume or any kind of stone or rock formation which in the opinion of the Engineer's Representative requires for its removal drilling and blasting wedging, sledging or barring or breaking up with power-operated hard tool..

The definition shall exclude any soft or disintegrated rock which can be removed with a hard pick or mechanical excavator or shovel or loose, shaken or previously blasted rock or broken stone in rock fillings or elsewhere.

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SPECIFICATIONS
EXCAVATIONS

Blasting by explosives shall not be permitted without obtaining the written approval of the Engineer. If such approval is given the Contractor shall be solely responsible for:-

- 1 - Obtaining permits, keeping record.
- 2 - Storing permits, keeping record.
- 3 - Taking all necessary precautions in compliance with the regulations pertinent to the use of Explosives.
- 4 - Any damage that may occur due to the blasting operations where rock is encountered it shall be carefully excavated and the Contractor shall not be entitled to additional compensation unless otherwise specified in the Bills of Quantities.

B 7

PLANKING AND STRUTTING

The terms "planking and strutting" will be deemed to cover whatever methods the Contractor elects to adopt for shoring the sides of excavation and also for planking and strutting the excavations against the sides of adjoining buildings, public roadways, etc... The Contractor will be held responsible for shoring the sides of all excavations, adjoining building and the like and no claim for additional excavation, concrete or other material or workmanship will be considered in this respect.

In the event of any collapse occurring the excavations, the Contractor shall re-excavate and re-instate such excavations at his own expense. No additional excavations will be paid or should the Contractor batter the sides of the excavations.

B 8

KEEPING EXCAVATIONS FREE FROM WATER

All excavations shall be kept clear of water by pumping or bailing or by well-point dewatering, but the latter system shall not be employed if any danger exists of withdrawing water from the foundations of the adjoining buildings and such water shall be discharged clear of the works and the method adopted shall in no way contravene the regulations of the Local Authorities.

The system or systems to be employed shall be approved by the Engineer. Such approval if given shall not waive the Contractor's responsibilities and liabilities under the Contract.

Particular attention shall be paid to the installation of sheeting and shoring as may be necessary for the protection of the work and for the safety of personnel and public.

3-18

SPECIFICATIONS
EXCAVATIONS

B 9 **STORING OF SUITABLE EXCAVATED MATERIAL**

During excavation, materials suitable for backfill and fill shall be stockpiled on the Site at sufficient distance from the sides of the excavation to avoid overloading and prevent caveins or mixing with the concrete during the construction of foundations.

B 10 **DISPOSAL OF UNSUITABLE AND SURPLUS EXCAVATED MATERIAL**

Upon the order of the Engineer, all unsuitable and surplus excavated materials shall be immediately removed. Loaded and transported off the site area by the Contractor to approved dumps and he shall abide by the relevant local regulations.

B 11 **EXCAVATION FOR FOUNDATIONS AND SUB-STRUCTURE**

The Contractor shall excavate to reach a suitable strata accepted by the Engineer or as shown by the Drawings during excavation for foundations, the bottom layer of excavation of minimum 200mm in thickness, shall be left undisturbed and subsequently removed manually only when the concrete in blinding is about to be placed in order to avoid softening or deterioration of the surfaces of the excavation.

Bottom of all excavations shall be formed to correct levels as shown on the Drawings or as directed in writing by the Engineer and shall be trimmed, levelled and well cleaned before pouring and concrete.

In the event of the contractor excavating deeper than the levels required, he shall make the difference between levels with concrete class "B" at his own expense.

After each excavation is complete, the Contractor shall notify the Engineer to that effect, and no concrete shall be placed until the Engineer has approved the excavation and the character of the foundation material.

B 12 **EXCAVATION FOR TRENCHES**

B 12.01 General

The Contractor shall provide all forms and bracings, and excavate trenches necessary to install all drainage, sewer water supply, electrical and telephone cables to the lines and grades complete in strict conformity with these specifications, applicable drawings and/or as directed by the Engineer.

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SPECIFICATIONS
EXCAVATIONS

B 12.02 Grading

The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its length, except for the portions of the pipe where it is necessary to excavate for bell-holes and for proper sealing of joints. Bell-holes and depressions for joints shall be dug after the trench has been graded.

Share shall be taken not to excavate below the depths indicated. Where rock shall be excavated to the required depth. Uneven surface of the bottom trench shall be excavated 15mm deeper. Such depth, if in rock, shall be back-filled with concrete Class "B" as specified under "Concrete Work" and when in earth, shall be back-filled with approved sand at the Contractor's own expense.

Whenever unstable soil, which in the opinion of the Engineer, is incapable of properly supporting the pipe or duct is encountered in the bottom of the trench, such soil shall be removed to the depth required and the trenchy back-filled to the proper grade with sand, fine gravel or other suitable material approved by the Engineer.

The width of the trench for Drainage at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench wall shall be 20mm on each side of the pipe. The width of the trench above that level may be as wide as necessary for sheeting and bracing and the proper performance of the work.

Trench for Water Supply System shall be of a depth to provide minimum cover over the top of 300mm and avoid interference of water lines with other utilities. Width of trench shall be a maximum of 200mm on each side of the pipe.

The width of trenches for electrical and telephone cables shall be as specified in their relative section. Banks may be sloped or widened to facilitate placement of cables, but not to an extent that will cause interference with other utilities.

Excavation for appurtenant structures for manholes, septic tank, percolating pit and similar structures shall be sufficient to allow a minimum of 300mm of clear space between their outer surfaces shoring timbers which may be used to protect the banks.

3-20

SPECIFICATIONS
EXCAVATIONS

B 13

BACKFILL AND FILL

Approved suitable excavated material as specified under "MATERIALS" shall be used in the backfilling and filling next to footings, foundations underground structures, under sub-floors, etc... and shall be laid in layers not exceeding 200mm and compacted with compaction equipment, as approved by the Engineer. Moisture content shall be adjusted as directed by the Engineer and 95% of dry weight compaction accordance to ASTM: D1557-70 shall be achieved.

Should the quantity of the excavated material be not sufficient for the process of backfill and fill, the Contractor shall obtain the quantity required of such backfill and fill from approved borrow pits and transport same to the Site of work at his own expense.

No backfill shall be executed until the footings, foundations, etc., have been inspected, measured and approved by the Engineer.

Trenches should be backfilled until all required tests are performed and until the Engineer has verified that the Utility systems have been installed in accordance with the

Specifications and the Drawings. The backfill in the pipe zone must be placed and completed so as to provide and maintain adequate and even support around the pipe wall. If mechanical compaction equipment is need, care must be taken to prevent direct contact with the pipe.

B 14

BED OF HARDCORE

The bed of hard-core, where shown on the Drawings or as directed by the Engineer shall be of an approved rubble

stone as specified under "MATERIALS" and shall be laid under floor pavings. The rubble stone for hard-core shall be hand-packed with sharp edge upward and wider (natural face) laid on the ground. The interstices of hard-core bed shall be filled with approved fines, wetted sufficiently and well consolidated. The thickness of the hard-core bed shall be as shown on the Drawings.

B 15

PLACING OF AGRICULTURAL SOIL, GRAVEL AND SAND

The agricultural sifted soil as specified under "MATERIALS" shall be spread in the flower boxes and beds to the thickness shown on the Drawings after thorough watering and on a bed of 100mm thick graded gravel blinded with clean coarse sand to the satisfaction of the Engineer.

3-21

SPECIFICATIONS
EXCAVATIONS

B 16

EXCAVATIONS OF CUTTINGS IN CARRIAGE WAYS

- 1- Hauling of material from cuttings or borrow pits to the embankments or other areas of fill shall proceed only when sufficient compaction plant is operating at the place of disposition to ensure compliance with the requirements of specifications.
- 2- Any excess depth excavated below formation level tolerance shall be made good by back filling with suitable material of similar characteristics to that removed, compacted in accordance with specification.
- 3- The slopes of cuttings shall be cleared of rock fragments which move when prized by a crow bar.
- 4- Construction traffic shall not use the surface of the bottom of a cutting unless the cutting is in rock or the Contractor maintains the level of the bottom surface at least 30cm above formation level. Any damage to the sub-grade arising from such use of the surface shall be made good by the Contractor at his own expense, with material having the same characteristics as the material which has been damaged.

B 17

FILL

FILLING AND FORMING OF EMBANKMENTS AND OTHER AREAS OF

- 1- Embankments and other areas of fill shall be formed of material defined as "suitable material".
- 2- All earthworks material placed in or below embankments, below formation level in cuttings or

else wherein the works shall be deposited and compacted as soon as practicable after excavation in layers of thickness appropriate to the compaction plant used or as a permitted departure therefrom. Embankments shall be built up evenly over the full width and shall be maintained at all times with a sufficient camber and a surface sufficiently even to enable surface water to drain readily from them. During the construction of embankments, the Contractor shall control and direct constructional traffic uniformly over their full width. Damage to compacted layers by constructional traffic shall be made good by the Contractor.

- 3- In areas of shallow filling where after removal of topsoil the ground level is within 30cccm of formation level constructional traffic shall not use the surface unless the Contractor brings up and maintains the surface level at least 30cm above formation level. Any damage to the sub-grade arising from such use shall be made good by the Contractor at his own expense with material having the same characteristics as the damaged materials.

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SPECIFICATIONS
EXCAVATIONS

B 18

COMPACTION OF EMBANKMENTS AND OTHER AREAS OF FILL

- 1- All materials used in embankments and as filling elsewhere shall be compacted as soon as practicable after deposition.
- 2- Variation from the method of compaction stated below or the use of plant not included therein will be permitted only if the Contractor demonstrates at site trials that a state of compaction is achieved by the alternative method equivalent to that obtained using the approved methods. This procedure shall be agree and approved by the Engineer.
- 3- The Engineer may at any time carry out comparative field density tests determined in accordance with S. S. 1377 test No. 14 on material, which he considers has been, inadequately compacted. If the test results when compared with the results of similar tests made on adjacent approved work in similar materials carried out in accordance with specification, show the state of compaction to be inadequate and this held to be due to failure of the Contractor to comply with the requirements of the Contract, the Contractor shall carry out such further work as the Engineer may decide is required to comply with the terms of the Contract.

- 5- The Contractor shall not less than 24 hours before he proposes to carry out compaction processes during periods of overtime, apply in writing to the Engineer for permission to do so.

B 19

ROAD WORKS

B 19.01

OVERALL REQUIREMENTS

- A) Horizontal alignments, surface levels and surface regularity of pavement courses:
- 1- Horizontal alignments shall be determined from one edge of the carriage way pavement surface as shown on the Drawings. The edge of the carriageway as constructed and all other parallel alignments shall be correct within a tolerance of 15mm there from.
 - 2- The levels of pavement courses shall be determined from the true pavement surface, which shall be the surface of the wearing course from flexible pavements calculated from the carriage way vertical profile and cross falls as shown on the Drawings. The vertical depth below the true pavement surface at any point on the constructed

surface of the formation or pavement courses shall be within the appropriate tolerances stated below:

Base course tolerance = ___ 10 mm
Road base tolerance = ___ 15 mm
Sub-base tolerance = ___ 20 mm
Formation tolerance = ___ 25 mm

- 3- The surface level of the laid wearing course shall not deviate vertically at any point from the true pavement surface by more than 10mm.
- 4- For checking compliance with the above tolerances, measurements of surface levels will be taken at a grid of points 20 meter centers longitudinally and at 2 meter centers trans-versely starting one meter from the edge of the carriage way.
- 5- Compliance with tolerance shall be tested by rolling straight edge, operated parallel to the center line of the carriage way and one meter from the near side edge of each lane of carriage way.

3-25

SPECIFICATIONS
EXCAVATIONS

- 6- For lengths less than 100 meter the laid pavement surface and the surface of the base course shall be tested with a 4 meter straightedge placed parallel to the centerline of the road. The laid pavement surface and the surface of the base course shall have no greater depression under the straightedge than 10mm and 10mm respectively.
- 7- Where any tolerance is exceeded the Contractor shall determine the full extent of the area which is out of tolerance and shall make good by rectifying the surface of the pavement course or formation in the manner described below:
 - a- Formation level:
If the surface is too high it shall be re-trimmed and re-compacted. If the surface is too low the deficiency shall be corrected by the addition of fresh suit-able material of the same classification laid and compacted to specification.

- b- Roadbases and Sub-bases:
Where this consist of unbound material the top shall be scarified, reshaped, with added material as necessary, and recompactd all to specification. The area treated shall normally be not less than 30 meter long and 2.5 meter wide or such less length to be determined by the Engineer as necessary to obtain compliance with specification.
- B) Use of surfaces by constructional traffic:
 - 1- Constructional traffic used on pavement under construction shall be suitable in relation to the thickness of the courses it traverses so that damage is not caused to sub-grade or the material already constructed.
 - 2- The wheels or tracks of plant moving over the various pavement courses shall be kept from deleterious materials.
- C) Transporting, laying and compacting of road pavement materials containing Tar or Bitumen Binder.
 - 1- Bituminous materials shall be transported in clean vehicles and shall be covered over when in transit or a waiting tripping. The use of dust,
Oil or water in the interior of the vehicles to facilitate discharge of the mixed materials is permissible but the amount shall be kept to a minimum and excess shall be removed by tipping or brushing.

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EXCAVATIONS

- 2- The mixed material shall as soon as possible after arrival at the site be supplied continuously to the paver and laid without delay. The rate of delivery of material to the paver shall be so regulated as to enable the paver to be operated continuously and it shall be so operated whenever practicable
- 3- The rate of travel of the paver and its method of operation shall be adjusted to ensure an oven and uniform flow of material across the full laying width, freedom from dragging or tearing of the material and minimum segregation.
- 4- The material shall be laid generally in conformity with the recommendations for laying in the British Standard to which it has been made.

- 5- Hand laying of any bituminous material will be permitted only in the following circumstances:
- a. For laying regulating courses of irregular shape and varying thickness.
 - b. In confined spaces where it is impracticable for a paver to operate.
 - c. For footways.
- 6- Material shall be compacted as soon as rolling can be effected without causing undue displacement of the mixed material and while this has at least the minimum rolling temperature stated in the appropriate British Standard. The material shall be uniformly compacted by an 8-10 tons smooth wheel roller having a width of roll not less than 45cm, or by a multi-wheeled pneumatic tyred roller of equivalent weight except that wearing course and base course material shall be surface finished with a smooth wheel roller.
- 7- The material shall be rolled in a longitudinal carriageway over lapping on successive passes by a pneumatic tyred roller, at least the nominal width of the tyre.
- 8- Hand-raking of wearing course material which has been laid by a paver and the addition of such material by handspreading to the paved area for adjustment of level will be permitted only in the following circumstances:
- a- At the edges of the layers of material and at gullies and manholes.
 - b- Where otherwise directed by the Engineer.

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SPECIFICATIONS
EXCAVATIONS

- 9- Rollers shall not stand on newly laid material while there is a risk that it will be deformed thereby.
- 10- a. By heating the joint with an approved joint heater at the time when the additional width is being laid but without cutting back or coating with binder. The heater shall raise the temperature of the full depth or the wearing course to figure within the rolling temperature range specified for the material and for a width not less than 75mm on each side of the joint. In this case, however the Contractor shall have available for use in the event of

- breakdown, equipment necessary for operating method (c).
- b. By using two or more pavers operating in echelon where there is practicable and in sufficient proximity for adjacent widths to be fully compacted by continuous rolling or by using a multiple-lane-width paver.
 - c. By cutting back the exposed joints to a vertical face of not less than the specified thickness, discarding all loosened material and cooling the vertical face completely with a grade of hot tar or hot bitumen suitable for the purpose before the next width is laid.
- 11- Base course material shall not remain uncovered by either the wearing course or surface treatment whichever is specified in the Contract for more than 3 consecutive days after being laid.

B 19.02

SUB-BASE AND ROAD BASE

- A. Constructions requirements for materials of base and sub-grade.
- 1- Transport vehicles carrying plant mixed material shall have a capacity suited to the output of the mixing point and the site conditions and be capable of discharging cleanly. Material when mixed shall be removed at once from the mixer, transported directly to the point where it is to be laid and protected from the weather both during transit from the mixer to the laying size and whilst tripping.

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EXCAVATIONS

- 2. All material shall be placed and spread evenly. Spreading shall be undertaken either concurrently with placing or without delay. Roadbase material shall be spread using a paving machine or spreader box operated with a mechanism which levels off the material to an even depth. Except where otherwise specified in individual clauses, the material shall be spread in one layer so that after compaction the total thickness is as specified.

- 3- Compaction shall be completed as soon as possible after the material has been spread.
- 4- Special care shall be taken to obtain full compaction in the vicinity of both longitudinal and transverse.
- 5- The surface of any layer of material shall be on completion of compaction be well closed, free from movement under compaction plant and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.
- 6- Compaction shall be carried out by the method specified in the table page () .

B) Granular sub-base and Road Material:

- 1- It shall comprise natural sands, gravels, crushed rock. The material shall be well graded and lie within the following grading limits:

B.S. Sieve Size passing	Percentage by weight
3 in	100
1 1/2 in	85 - 100
3/8 in	45 - 100
3/16 in	25 - 85
No. 25	8 - 45
No. 200	0 - 10

The particle size shall be determined in accordance with B.C. 1377.

- 2- The material passing no. 36B.S. sieve, when tested in accordance with B.S. 1377 shall have a plasticity index of less than 6.

SPECIFICATIONS
EXCAVATIONS

- 3- The material shall be laid and compacted to the requirements of specifications at a moisture content within the range one percent above to 2 percent below the optimum percentage determined in accordance with vibrating hammer method test in B.S. 1377
- 4- On completion of roadbase and until any surfacing is laid on it, the finished surface

shall be maintained free from potholes, ruts and undulations, irregularities depressions, loose material or other defects.

- 5- Paved hard shoulders shall be constructed of the materials and to the dimensions described in the contract. Alternatively if agreed by the Engineer the Contractor may construct hard shoulders to the same specification as the carriage way pavement.

B 19.03 FLEXIBLE SURFACING

A) Rolled Asphalt for Base:

- 1- This material shall be made in accordance with the requirements of B.S. 594 for base course mixtures subject to the under mentioned proviso relating to blastfurnace slag. It shall be laid and compacted to relevant clauses.
- 2- Coarse aggregate content 65 percent. When the bulk density of the slag coarse aggregate is less than 80lb per cubic foot, the coarse aggregate content shall be reduced to 55 per cent.
- 3- Petroleum bitumen in accordance with B.S. 594 of penetration as described in the contract.

B) Rolled Asphalt Wearing Coarse:

- 1- Rolled asphalt wearing coarse shall be in accordance with the general requirements of B.S.594.
- 2- Asphaltic Cement:
 - a. Equal proportions by weight of petroleum bitumen of appropriate penetration and refined asphalt or/
 - b. Pitch/Bitumen to the following specifications: A mixture of 75-80 percent of petroleum bitumen with 20-25 percent of a coal tar pitch produced by straight running predominately from a vertical retort crude source.

The softening point of the pitch shall lie between 55 C and 80 C and the petroleum bitumen shall have a penetration conforming to the requirements of B.S.594 tables 1, 2 or 3 as described in the Contract. The Engineer may require, from time to time, certificates

confirming that the mixture has a salability index not higher than 1.2 when tested according to the method described in the Road Research Laboratory Research Note No. RN/4112. The use of density-gradient column in a storage stability test for pitch/bitumen mixtures; or

c. Petroleum Bitumen.

- 3- Content of coarse aggregate for new works 3 percent by weight.
- 4- Binder Content/ Bulk of Blastfurnace Slag Relationship.

When the coarse aggregate is blastfurnace slag the binder content shall be related to the bulk density of the aggregate. When the bulk density is less than 87lb per cubic foot (1400Kg/M3) rounded to the nearest 1lb per cubic foot (16Kg/M3) the soluble bitumen content shown in the following table:

Percentage by weight of total mixture							
Coarse Aggregate retained on No. 7 B.S. Sieve		Soluble binder		Aggregate passing No.200 B.S. Sieve		Aggregate passing No. 7 and retained on No. 200 B.S. Sieve	
Aggregate						Sieve	
		Min.	Max.	Min.	Max.	Min.	Max.
Crushed rock	30	7.9	8.9	8.9	10.9	50.9	53.2
Blast-furnace slag	30	8.0	9.0	8.9	10.9	50.1	53.1

Shall be increased as shown below in the table and the percentage of aggregate passing the No.7 B.C. Sieve and retained on the No. 200 B.S. Sieve correspondingly reduced. Slag having a bulk density of less than 68lb per cubic foot shall not be used.

Addition to specified percentage of soluble bitumen content		
Bulk density of slag		
Lb/ft ³	New Works	Resurfacing
87 and above	Nil	Depending on the
81-86	0.1	coarse aggregate
74-80	0.2	content specified
68-73	0.3	

- 1- When it is necessary to prepare a surface for the application of a bituminous spray and to undertake the spraying and any specified binding, this shall be done in accordance with the recommendation of the Ministry of Transport Road notes relating to surface dressing in so far as they apply to work to be undertaken. The work shall also be undertaken in accordance with the under-mentioned general requirements and any specific requirements as described in the Contract.
- 2- The Engineer may require the contractor to provide a certificate stating that a particular binder distributor has been tested since the previous surface dressing season and that the test indicates conformity of the requirements for B.S.1707 for hot binder distributors or with the requirements of B.S. 3236 for emulsion distributors.
- 3- Before spraying is commenced, the surface shall be freed of all loose material. The surface as a whole shall be dry and any damp areas shall be completely free from standing water.
- 4- Binding material, where required by the contract, shall consist of a commercial grade of hard clean crushed rock or slag fine aggregate or sand; it shall contain not more than 15 percent retained on a $\frac{1}{4}$ inch B. S. Sieve.
- 5- Unless the Engineer permits otherwise, all loose material on the sprayed surface, including any building material, shall be removed before any further layer of the pavement is laid.

B 19.04

SIGNS AND ROAD MARKINGS

- A) Permanent Traffic signs and information signs:
 - 1- Permanent traffic signs shall be either externally or internally illuminated, reflecting or non-reflecting as described in the Contract and the local standards.
 - 2- Where illumination is to be provided, this shall be by lamps of tungsten filament or fluorescent type complying with B.S. 873 Where reflectorisation is required the means shall be of approved type all as described in the Contract.
 - 3- Signs shall be erected with approved fittings on posts made from rectangular or tubular steel. The construction and supports of large signs shall be as described in the Contract.

SECTION C - CONCRETE WORK

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S E C T I O N C

CONCRETE WORK

C 1

SCOPE

This section describes and specifies work required for plain and reinforced concrete, including formwork intended to be used for the Project under the Contract in accordance with the Drawings, Bills of Quantities and as directed by the Engineer.

At the beginning of each month, the Contractor shall submit to the Engineer his concreting programme for that month, stating the pouring dates, so that adequate checking and supervision can be provided before and during the pouring operation. No pouring shall be allowed unless the Engineer has been given a week-advanced notice of the intention to pour.

C 2

APPLICABLE TESTS AND CODES

Prior to commencement of concrete work, the Contractor shall submit samples to the Engineer before sending them to the laboratories for testing, to establish the probability of the materials passing tests for specified requirements.

After the Engineer is convinced that the samples with their sources are truly representative samples and sufficient materials are available on the Site for the completion of all concrete works under the Contract, the samples shall be approved and sent to the laboratories for testing. Upon the Engineer's request, the Contractor shall have the tests made, at his own expense in the laboratories approved by the Engineer.

All concrete aggregates, cement and water shall be sampled and tested as frequently as deemed necessary by the Engineer. All tests samples shall be obtained in accordance with the latest editions of the American Society for Testing and Material (ACI) Code or any equally approved standard.

C 3 MATERIALS**C 3.01 Cement****(A) General**

Cement shall be Portland Type originating from approved manufacturers in sealed and labelled bags, each 50 kgs. Not capacity, name and brand of the manufacturer shall plainly be identified thereon and Delivered to the Site in good condition Cement delivered in bulk shall be accepted only if a central mixing plant is used. The Quality of cement shall conform to the Standard Specification for PORTLAND CEMENT of ASIM Designation: C150-74 Type I- for use in general concrete construction and Type V- for use when high sulphate resistance is desired.

(B) Storage of Cement

All cement shall be stored in suitable weatherproof and approved storage sheds which will protect the cement from dampness. Storage sheds shall be erected in locations approved by the Engineer. Provision for storage shall be ample, and the consignment of cement as received shall be separately stored in such a manner as to provide easy access for the identification and inspection of each consignment Cement shall be used in the order of its delivery to site, new deliveries shall not be used unless the cement from earlier deliveries has been completely used. Stored cement shall meet the test requirements at any time after storage when a re-test is ordered by the Engineer all the expense of the Contractor.

The Contractor shall keep accurate records of the deliveries of cement and of its use in the work. Copies of these records shall be supplied to the Engineer in such form as may be required.

(C) Rejection

The Contractor shall notify the Engineer of dates of delivery so that there will be sufficient time for sampling the cement either at the mill or upon delivery.

The provisional acceptance of the cement at the mill shall not deprive the Engineer of the right to reject on a retest of soundness at the time of delivery of the cement to the Site.

Package of cement varying by 5 percent or more from the specified weight shall be rejected and if the average weight of packages in any consignment, as shown by weighing 50 packages taken at random, is less than that specified, the entire consignment shall be rejected and the Contractor shall remove it forthwith from the Site at his own expense and replace it with cement of satisfactory quality. Stale cement or cement reclaimed from cleaning bags shall not be used and cement which for any reason has become partially set, or contains lump or caked cement, shall be rejected.

C 3.02 Aggregates

(A) General Requirements

All aggregates shall consist of tough, hard, durable uncoated particles. The Contractor shall be responsible for the processing of this material to meet the requirements of the Specifications. Approval of aggregate quality and/or gradation shall not waive the responsibility of the Contractor to provide concrete of having the minimum strength specified.

(B) Storage

Coarse and fine aggregates shall be delivered and stored separately on site in such a manner as to prevent segregation and contamination or the admixture of foreign materials. Aggregate which has become seg-regated or contaminated with foreign matter during storage or handling will be rejected and shall be removed and replaced with material of acceptable quality at the Contractor's expense. Aggregates of the quality and colour selected shall be stored in sufficient quantity to avoid interruption of concreting work at any time.

C 3.03 Fine Aggregate

(A) General Requirements

All fine aggregate shall conform to Standard Specification for Concrete Aggregates of ASIM Designation: C-33 and also to the detailed requirements give in Table 300 A (appended herebelow). It shall not contain harmful materials such as iron pyrites, coal, mica, and shale. Alkali, coated grains, or similar laminated materials such as soft and flaky particles, or any material which may attack the reinforcement, in such a form and in sufficient quantity to affect adversely the strength and durability of the

concrete. Fine Aggregate passing sieve No. 4 shall not contain any voided shells.

Fine aggregates shall be washed thoroughly with demineralized water to ensure compliance with the appropriate requirements and limitations of the specifications.

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SPECIFICATIONS
CONCRETE WORK

The Contractor shall provide and maintain for this proposes sand-washing plant and equipment.

Fine Aggregate from different sources of supply shall not be mixed or stored in one pile nor used alternately in the same class of construction or mix.

Table 300 A

Grading : Sieve	Percent Passing
3/8	100
No. 4	95 - 100
8	80 - 100
16	50 - 85
30	25 - 60
50	10 - 30
100	2 - 10
200	0 - 3
Fineness modulus	2.50-2.15
Organic Impurities	The color shall have an intensity not darker than two-thirds the intensity of the standard color solution. (Not darker than Plate 2 as determined by the Standard Method of Test for Organic Impurities in Sands for Concrete of ASTM Designation C - 40
Chlorides soluble in dilute Nitric Acid	Not more than 0.10 percent by weight when expressed as sodium chloride (NaCl).
Total Acid soluble sulphates	Not more than 0.50 percent by weight when expressed as sulphur trioxide (SO ₃)
Silt	Not more than 2 percent
Mortar strength	Compression ratio not less than 95 percent.

Soundless

Weighted average loss when subjected to 5 cycles of the soundless test using magnesium sulfate, not more than 10 percent.

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C 3.04 Coarse Aggregate

(A) General Requirements

All coarse aggregate for concrete shall conform to Standard Specifications for Concrete Aggregates of ASTM Destination: C-33 Coarse aggregate shall consist of gravel, crushed gravel, or crushed stone, having hard, strong durable pieces, free from adherents. It shall not contain harmful materials such as iron pyrites, coal, mica, alkali, laminated materials, or any material which may attack the reinforcement, in such a for or in sufficient quantity to affect adversely the strength and durability of the Concrete. Coarse aggregates shall be washed thoroughly with demineralized water to ensure compliance with the appropriate requirements and limitations of the specifications. The Contractor shall provide and maintain for this purpose approved washing plant and equipment.

(B) Deleterious Substances

The amount of deleterious substances shall not exceed the following limits:

Max. Permissible Limit
Percent by Wt.

- Soft fragments	2.0
- Coal and lignite	0.5
- Clay lumps	0.25
- Materials passing the No.200 sieve	1.0
- Thin or clognated pieces(length greater than 5 times average thickness)	4.0
- Other local deleterious substances	0
- Chlorides soluble in dilute Nitric acid when expressed as Sodium Chloride (NaCL)	0.05
- Total acid soluble sulphates when	

expressed as sulphur trioxide (SO₃) 0.5

(C) Percentage of Wear

Coarse aggregate shall conform to the following requirements:

Percentage of wear, Los Angeles test, not more than 30

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(D) Grading

Coarse aggregate, when tested according to the requirements of ASTM, shall meet the following gradation and shall be uniformly graded within the limits stated in Table 1 herebelow:

Table 1

ASTM Passing		Percentage by Weight		
		Grading (3/4" to No.4)	Grading (1" to No.4)	Grading (2" to No.4)
2 1/2	inch	-	-	100
2	inch	-	-	95 - 100
1 1/2	inch	-	100	-
1	inch	100	95 - 100	35 - 70
3/4	inch	95 - 100	-	-
1/2	inch	-	25 - 60	10 - 30
3/8	inch	20 - 55	-	-
No. 4		0 - 10	0 - 10	0 - 5
No. 8		0 - 5	0 - 5	-
No. 200		0 - 1	0 - 1	0 - 1

(E) Combined Aggregate

Approved fine and coarse aggregate on each batch of concrete shall be combined in proportions as approved by the Engineer, according to test results giving the required compressive concrete stress as specified per type of Concrete.

The combined aggregate gradation using the 3/4 in. to No. 4 gradation shall be used for concrete members with reinforcement to close or permit proper placement and consolidation of the concrete. Change from one gradation to another shall not be made during the progress of the work unless approved by

the Engineer. Such changes are admitted only after being proved by test results.

C 3.05

Aggregate for Mortar

(A) General Requirements

Aggregate for mortar shall conform to the Standard Specification for Aggregate for Masonry Mortar of ASTM Designation : C-144 and shall consist of hard, strong, durable uncoated mineral or rock particles, free from injurious amounts of organic or other deleterious substances.

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(B) Organic Impurities

Fine aggregate for mortar when subjected to the Calorimetric test for organic impurities and producing a color darker than the standard color shall be rejected.

C 3.06

Water

(A) Quality of Water

Water for mixing of concrete shall be fresh, clean and free from injurious amounts of oil, acid, or any other deleterious mineral and/or organic matter. It shall not contain chlorides such as sodium chloride in excess of 700 ppm. It shall not contain any impurities in amount sufficient to cause a change in the time of setting of Portland Cement of more than 10 percent, nor a reduction in compressive strength of mortar of more than 5 percent compared to results obtained with distilled water.

The PH of the water for mixing and curing of concrete shall not be less than PH 4.5 or more than PH 8.5.

(B) Tests for Water

When required by the Engineer the quality of the mixing water shall be determined by the Standard Method of Test for quality of water to be used in concrete, as specified in B.S. 3148: 1959 Tests for Water for Making Concrete.

In sampling water for testing, care shall be taken to ensure the containers are clean and that samples are representative.

Admixtures

Admixtures in concrete shall be used only when approved by the Engineer and shall conform to the requirements of the ASTM Standard Specifications Designation C-494-68 for Water Reducing and Retarding Admixtures, and C-260-69 for Air entraining Admixtures for Concrete, and waterproofing and watertighting.

The Contractor shall ensure that the admixture supplied for use in the work is equivalent in composition to the admixture subjected to test under this Specification. Tests shall be made whenever practicable using the cement, aggregates, admixtures proposed for specific work, because the specific effects produced by chemical admixtures may vary with the properties of the other ingredients of the concrete.

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The specific effects produced by chemical admixtures may vary with the properties of the other ingredients of the concrete.

Admixture that contain relatively large amounts of chloride shall accelerate corrosion of reinforcing steel and shall be the cause of rejection.

Water reducing and retarding admixtures shall comply with the physical requirements of ASTM tests and shall be approved in writing by the Engineer.

When the admixture is delivered in packages or containers, the proprietary name of the admixture, the type and the weight or volume shall be plainly marked thereon. Similar information shall be provided in the shipping advises accompanying packaged or bulk shipments of admixtures.

The admixture shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment, and in a suitable weather-tight stores that will protect the admixture from dampness.

Costs of such admixtures, sampling and testing shall be at the Contractor's expense.

COMPOSITION OF CONCRETE

The cement content, coarse aggregate size, water content, consistency and the approximate weights of fine and coarse aggregate (saturated surface-dry basis) for the class of concrete shall be within the requirements of Table I and II Below.

The weight of fine and coarse aggregate given in Table II below are based on the use of aggregates having bulk specific gravities, in a saturated surface-dry condition, 2.65-5%. For reasonably well graded materials of normal physical characteristics, the use of the below indicated proportions, together with specified water content to obtain the required consistency, will result in concrete of the specified cement content, plus or minus two (2) percent.

For aggregate having specified gravities outside the ranges indicated in the Table II below, the weights shall be corrected by multiplying the weights shown in Table II below by the ration of the specific gravity of the aggregate and 2.65.

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The relative weights of fine and coarse aggregate per sack of cement given in Table II below are based on the use of natural sand having a fineness modulus within the range of 2.70 and 2.90 and methods of placing which do not involve high frequency vibration. When sharp, angular manufactured sands, or extremely coarsely graded sands are used, the relative amount of fine aggregate should be increased. For finer sands the relative amount of fine aggregate should be decreased. In general, the least amount of sand which will insure concrete of the required workability for the placing conditions involved should always be compensated for by changing the weight of coarse aggregate in the opposite direction by a corresponding amount.

Table I

Class of Concrete	Compressive Strength At 28 Days (in Kg/cm2) Cube	Minimum Cement Content Kgs	Coarse Aggregate Size	Max. Water Content Liters Per Bag	Consistency Range in	
					Slump Vibrated - Non Vibrated	
A	250	375	3/4in.or 1in.-No.4 as required by the En- gineer	27	m m 50-100	m m 75-125
B	200	350	Ditto	27	50-100	33-125
C	150	250	2in.-No 4	30	25-50	50-75

Table II

Class of Concrete	Cylinder Compressive Strength At 28 Days Kg/cm ²	Approximate Weight (Saturated Surface-Dry) of Fine and Coarse Aggregate Per Sack (50Kgs) of Cement			
		Rounded	Coarse	Aggregate	Angular Coarse
		Fine	Coarse	Fine	Coarse
		Kgs	Kgs	Kgs	Kgs
A	250	40	170	95	150
B	210	95	180	100	160
C	140	140	370	160	340

Table II is given for indicative purposes and is not binding.

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The total sodium chloride content of any materials used for making concrete shall be less than :

- For mass concrete 1.5 percent
- For reinforced concrete 0.7 percent

Expressed as a percentage, by weight of the cement. In calculations made under the provisions of this clause, any chloride, other than sodium chloride in the materials shall be converted to the equivalent of sodium chloride and be added to the amount of sodium chloride. The sulphate content shall not exceed 0.03 percent by weight of the cement.

C 5 **PROPORTIONS**

C 5.01 General

After the materials provided by the Contractor have been accepted for the works, the proportions and equivalent batch weights shall be determined which will produce concrete having not less than the strength required.

C 5.02 Trial Mixes

The actual proportions shall be determined on the basis trial mixes made by the Contractor and conducted with the content being determined by means of yield test in accordance with American Society for Testing Material (ASTM) Designation (C-138). The proportions will be such as to required (within a tolerance of plus or minus one

(1) percent, the cement content shown in Table I as the minimum cement content, provided, however, that if the materials supplied by the Contractor are of such a nature or are so graded that proportions based on the minimum cement content cannot be used without exceeding the maximum allowable water content specified in Table I, the proportions will be adjusted so as to require the least amount of cement which will produce concrete of the required plasticity and work- ability without exceeding such maximum allowable water content. No additional compensation will be made for the increase in quantity of cement required.

C 5.03 Contents

The mixes required will be designated in kilograms of fine and coarse aggregate exclusive of free water, per sack (50 Kilograms) of cement and in liters of total mixing water per sack of cement on the basis of the required amount of cement per cubic meter of concrete.

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C 5.04 Batch Weights

Since the proportions are designated in terms of aggregate in surface-dry condition, the equivalent batch weights to be used in the work shall be corrected periodically to take into account the actual moisture content of the aggregates at the time of use.

C 6 **CONCRETE COMPRESSION AND SLUMP TESTS**

C 6.01 Cubical Test

The Compression Strength of Concrete shall be obtained according to cubical tests locally done. Test cubes made in the field shall have a dimension of 10cm, At least 3 separate batches of concrete shall be made for trial and these shall be tested for compliance with the requirements of the table below, at least 3 test cubes being made from each batch of concrete. Once a mix is approved no substantial change in the materials or proportions of materials being used shall be made without the approval of the director of works who may then require further trial mixes to be produced. The compressive strength of the concrete will be taken as the arithmetic mean of the strength of all the cubes tested. The following table will be used to compare test results:

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[illegible]

(Mixed by Weight)

Slump tests shall be carried out periodically to ensure the appropriate water cement ratio in accordance with the

Standard Method of Test of Slump of Portland Cement Concrete of the ASTM Designation: C-143.

C 6.03 Test of Hardened Concrete in the Structure

Where the results of specimens indicate that the concrete does not meet specification requirements, coreboring tests conforming to the current issue of ASTM Designation: C-42 shall be performed, as directed by the Engineer, all at the Contractor's expense.

C 7 **MEASUREMENT OF MATERIALS**

Materials shall be measured by weight, except as otherwise specified or where other methods are specifically authorized by the Engineer. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Each size of an aggregate and the cement shall be weighed separately. The accuracy of all weighing devices shall be such that successive quantities can be measured to within 1% of the desired amount. Cement in standard packages (sack) need not be weighed. The mixing water shall be measured by a measuring device susceptible of control accurate to plus or minus half percent of the capacity of the tank but not exceeding 2 liters. All measuring devices shall be subject to the Engineer's approval.

Where volumetric measurements are exceptionally authorized by the Engineer for projects where the amount of concrete is small, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture condition of the aggregates, including the bulking effect in the fine aggregate.

C 8 **MIXING OF CONCRETE**

C 8.01 General

Unless otherwise authorized by the Engineer, concrete shall be machine mixed.

The mixing of concrete or mortar shall not be permitted when the temperature is above 40 C or when the temperature is below 5 C.

C 8.02 Mixing on Site

Concrete shall be thoroughly mixed in a batch mixer conforming to the requirements of B.S. 1305 Batch type concrete mixers which will ensure a uniform distribution of the materials throughout the mass.

The mixer shall be equipped with adequate storage and a device for accurately measuring and automatically controlling the amount of water used on each batch. Preferably mechanical means shall be provided for recording the number of revolutions for each batch and automatically preventing the discharge of the mixer until the materials have been mixed within the specified minimum time.

The entire contents of the mixer shall be removed from the drum before materials for a succeeding batch are placed therein.

All concrete shall be mixed for a period of not less than 1 ½ minutes after all materials, including water, are in the mixer. During the period of the mixing the mixer shall operate at the speed for which it has been designed, but this speed shall be not less than 14 nor more than 20 revolutions per minute.

The first batch of concrete material placed in the mixer shall contain sufficient excess of cement, sand and water to coat the inside of the drum without reducing the required mortar content of the mix. Upon the cessation of mixing for a considerable period, the mixer shall be thoroughly cleaned.

C 8.03

Truck Mixing

Truck mixers, unless otherwise authorized by the Engineer, shall be of the revolving drum type, watertight, and so constructed that the concrete can be mixed to ensure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured in accordance with Section C.7 and charged into the drum at the proportioning plant. Except as subsequently provided, the truck mixer shall be equipped with a tank for carrying mixing water. Only the prescribed amount of water shall be placed in the tank unless the tank is equipped with a device by which the quantity of water added can be readily verified. Truck mixers may be required to be provided with means by which the mixing time can be readily verified by the Engineer.

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The maximum size of batch in truck mixers shall not exceed the maximum rated capacity of the mixer as stated by the manufacturer and stamped in metal on the mixer. Truck mixing shall be continued for not less than 50 revolutions after all ingredients including the water, are in the drum. The speed shall not be less than 4 r.p.m., nor more than a speed resulting in a peripheral velocity of the drum of 70 meters per minute.

Nor more than 100 revolutions of mixing shall be at speed in excess of 6 r.p.m. Mixing shall begin within 30 minutes after the cement has been added either to the water or aggregate. When cement is charged into a mixer drum containing water or surface-wet aggregate and when the temperature is above (33 C) is used this limit shall be reduced to 1245 minutes; the limitation on time between the introduction of the cement to the aggregates and the beginning of the mixing may be waived when, in the judgement of the Engineer, the aggregates are sufficiently free from moisture, so that there will be no harmful effects on the cement.

C 8.04 Partial mixing at the Central Plant

When a truck mixer provided with adequate mixing blades is used for transpiration, the mixing time at the mixing plant may be reduced to 30 seconds and the mixing completed in the truck mixer. The mixing time in the truck mixer shall be as specified under the Section C.8.3 for truck mixing.

C 8.05 Plant Mix

Mixing at a central plant shall conform to the requirements for mixing at the Site and shall conform to the applicable requirements of the Standard Specification for Ready-Mixed Concrete of ASTM Designation: C-94.

C 8.06 Time of Hauling and Placing Concrete

If the distance from the mixing plant to the construction Site is so great that between the time of mixing and pouring the concrete, the temperature is below 40 C and the travelling time is more than 30 minutes, truck mixers must be employed.

When truck mixers are used, concrete shall be discharged and placed in its final position in the forms within thirty (30) minutes after water is first added to the mix.

C 8.07 Delivery

The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete. The rate shall be such that the interval between batches shall not exceed 20 minutes. The methods of delivering and handling the concrete shall be such as will facilitate placing with the minimum of rehandling and without damage to the structure of the concrete.

C 8.08 Retempering

The concrete shall be mixed only in such quantities as are required for immediate use and any concrete which has developed initial setting shall not be used. Concrete which has partially hardened shall not be retempered or remixed.

C 9 **HANDLING AND PLACING CONCRETE**C 9.01 General

Prior to pouring concrete in any structure, the Contractor shall secure a written order to commence from the Engineer. In preparation for the placing of concrete all sawdust, chips, and other construction debris and extraneous matters shall be removed from the interior of forms, structs, stays and braces, serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the firms and not buried in the concrete. Con-

crete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes and pipes for conveying concrete from the mixer to the forms shall not be permitted unless the authorization in writing of the Engineer is obtained. In case an inferior quality of concrete is produced by the use of such conveyers, the Engineer may order discontinuance of their use and the substitution of a satisfactory method of placing. Open troughs and chutes shall be of metal lined and shall be of rounded cross section to avoid the accumulation of concrete in corners. The chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement. The slope shall be steep enough (1 vertical to 2 or 2 ½ horizontal) to permit flow requiring a slump greater than specified or required for placement.

All chutes, troughs and pipes shall be kept clean and free from coating of hardened concrete by thoroughly flushing with water after each run. Water used for flushing shall be discharged clear of the structure. When placing operations would involve dropping the concrete more than 1.50 meter, It shall be deposited through sheet metal or other approved pipes. As far as practicable, the pipes shall be kept full of concrete during placing and their lower ends shall be kept buried in the newly placed concrete. After initial setting of concrete, the forms shall not be jarred and no strain shall be placed on the ends of reinforcement bars which project.

C 9.02 Hot Weather Concreting

The temperature of concrete when placed shall not exceed 27°C. When the relative humidity is 50 percent or less and shall not exceed 32 °C. For values of relative humidity between 50 percent and 70 percent, the max temperature of concrete shall be found by interpolation.

In lieu of above, the temperature of concrete when placed shall not exceed 32 °C, regardless of the relative humidity.

The Contractor shall comply with the above requirements by the following procedures:-

- Cooling the mixing water and/or replacing 50% of the mixing water by crushed ice. When crushed ice is used it shall be stored at a temperature that will prevent formation of lumps. The ice shall be completely melted by the time mixing is completed.
- Shading aggregate stockpiles and/or keeping moist by sprinkling then with water.
- Cement shall not be used if its temperature exceeds 77 °C.
- Painting the mixer drum white and spraying it with cool water or shading the mixer from direct sunrays.
- Maintaining the mixing time and delivery time to the minimum acceptable.
- Sprinkling of forms sub-grade and reinforcement with cool water prior to placement of concrete.

Water reducing and retarding admixture shall be used in all concrete work when the temperature of concrete exceeds 27 °C. The water cement ratio inclusive of free surface moisture on aggregates and any admixtures shall be kept to a minimum.

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C 9.03

Vibrating Concrete

Concrete, during and immediately after depositing, shall be thoroughly compacted. The compaction shall be done by mechanical vibration subject to the following provisions:

- Vibration shall be internal unless special authorization of other methods is given by the Engineer or as provided herein.
- Vibration shall be of a type and design approved by the Engineer. They shall be capable of transmitting vibration to the concrete at frequencies of not less than 4500 impulses per minute.
- The intensity of vibration shall be such as to visibly affect mass concrete of 25mm slump.
- Contractor shall provide a sufficient number of the vibrators to properly compact each batch immediately after it is placed in the forms.
- Vibration shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures, and into the corners and angles of the forms.
- Vibration shall be applied only by experienced operators under close supervision, at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any point to the extent that localized areas of grout are formed.
- Application of vibration shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective.
- Vibration shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibrations. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and

vibrators shall not be used to transport concrete in the forms.

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- Vibrator shall be supplement by such spading as it necessary to ensure smooth surface and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.
- The use of implements such as compressors which are likely to disturb or disarrange reinforcement or formwork shall not be permitted.

Concrete shall be placed in horizontal layers not more than 300mm thick as hereinafter provided. When less than q complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding batch has taken initial set to prevent injury to the green concrete and avoid surfaces of separation between the batches. Each layer shall be compacted so as to avoid the formation of a construction joint with preceding layer which has taken initial set.

When the placing of concrete is temporarily discontinued, the concrete after be coming firm enough to retain its form, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete. To avoid visible points as far as possible upon exposed faces, the top surface of the concrete adjacent to the forms shall be smoothed with a trowel.

Immediately following an approved discontinuance of placing concrete all accumulations of mortar splashed upon the reinforcement bars and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. If the accumulations are not removed prior to the concrete becoming set, care shall be exercised not to injure or break the concrete steel bond at and near the surface of the concrete while cleaning the reinforcement bars.

C 10 **PRECAST HOLLOW CONCRETE BLOCKS [HOURDIS]FOR RIBBED SLABS:**

C 10.01 Material and Manufacture
Aggregate shall be so sized, graded, proportioned and thoroughly mixed in a batch with such proportions of cement and clean water as to produce a homogeneous

concrete mixture. However, in no case shall the proportion of cement in the mixture be less than five (5) standard [each weighing 50 Kgs] per cubic meter of concrete.

Precast hollow concrete blocks (hourdis) for a ribbed slab shall be manufactured in approved vibrated, machine. If for any reason the strength requirements is not achieved,

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Cement shall be increased at the Contractor's own expense. The blocks shall be cured for twelve (12) consecutive days and shall be at least twenty-one (21) days old before incorporation in the Works. The blocks shall be of an approved pattern of withstanding a compressive force applied at the ends of 30 kgs/cm² based on the gross sectional area of the block obtained without deducting voids.

The blocks shall be hard, sound, durable, sharp, clean with well defined arises, free from cracks and flaws or other defects and of the dimensions shown on the Structural Drawings. The blocks shall be obtained from an approved local factory.

C 10.02

Workmanship

Precast hollow concrete blocks (hourdis) shall be laid exactly in a line with the cells on the long dimensions. Close edge blocks shall be used at the end; the dimensions of the ribs and size of reinforcing bards shall be exactly according to the Structural Drawings, In narrow width specially made half blocks shall be used and full block shall not be used along their length (with the calls along the long dimensions of the rib.)

The blocks are to be laid on adequate forms. All blocks shall be cleaned and thoroughly wetted with clean water before the concrete is poured and labourers shall not be allowed to walk on them, Any block found to be defective or damaged during concreting operations shall be removed and replaced before pouring the concrete, all at the Contractor's expense.

C 11

FORMWORK

General

The Contractor shall be responsible for the design and stability of the formwork. The Contractor shall submit a full program of work indicating the various phases for the erection and removal of forms and the manner in which he intends to execute all concrete works.

C 11.02 Material

All forms shall be of wrought lumber and shall be built mortar tight and of sufficient, rigidity to prevent distortion due to the pressure of the concrete and other loads incident to the construction operations. Forms shall be constructed and maintained so as to prevent warping and the opening of joints due to shrinkage of the lumber.

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The forms shall be substantial and unyielding and shall be so designed that the finished concrete will conform to the proper dimensions and contours. The Contractor shall take into consideration the effect of vibration on the formwork, and shall be responsible for any damage or default resulting thereof.

C 11.03 Workmanship

Forms shall be inspected by the Engineer prior to installation of reinforcement

The number of spacing of the form struts and braces shall be such that the forms will be braced rigidly and uniformly lock joints between form sections shall be free from play or movement.

The shape, strength rigidity, watertightness and surface smoothness of re-used forms shall be maintained at all times. Any warped or bulged lumber must be resized before being re-used. Forms which are unsatisfactory in any respect shall not be re-used.

Metal ties or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least 40mm from the face within injury to the concrete. In case ordinary wire ties are permitted, all wires, upon removal of the forms, shall be cut back at least 10mm. From the face of the concrete with chisels or nippers for green concrete, nippers are necessary. All fittings for metal ties shall be of such design that the cavities produced upon their removal are the smallest possible. The cavities shall be filled with cement mortar and the surface left sound, smooth, even and uniform in colour.

All forms shall be treated with oil and saturated with water immediately before placing the concrete. For members with exposed faces, the forms shall be treated with approval oil to prevent the adherence of concrete.

Any material which will adhere to or discolour the concrete shall not be used.

The Contractor shall provide means for accurately measuring the settlement of the forms during placement of the concrete and shall make all necessary corrections as directed by the Engineer

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C 11.04 Removal of Form-work

In the determining of the time for removal of forms, consideration shall be given to the location and character of the structure, the weather and other conditions influencing the setting of the concrete and the materials used in the mix. In general, the forms of any positions of the structure shall not be removed until the concrete is strong enough to prevent injury to the concrete.

When the forms are removed. Unless otherwise directed by the Engineer forms shall remain in place for the following specified period of time:

- Centering under beams : 21 days
- Floor slabs : 21 days
- Walls , sides of beams
 and other vertically
 formed surfaces : 3 days

Method of form removal likely to cause overstressing of the concrete shall not be used. In general, the forms shall be removed from the bottom upwards. Forms and their supports shall not be removed without the written approval of the Engineer. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight. Centers shall be gradually and uniformly lowered in such a manner as to avoid injurious stresses in any part of the structure.

The Contractor shall include in his prices for any formwork which may have to be left in position due to the impossibility of removal of same.

C 12 REINFORCEMENT

C 12.01 General

The Contractor shall prepare for his own use bar bending Schedules from the information given on the Drawings and in these Specifications. These Schedules shall be submitted to the Engineer for approval which shall in no way release the Contractor of his responsibility for the correctness of these Schedules.

All reinforcement shall be placed strictly in accordance with the Drawings and as instructed in writing by the Engineer. Nothing shall be allowed to interfere with the required disposition of the reinforcement, and the Contractor shall ensure that all parts of reinforcement are placed correctly in position and are temporarily fixed where necessary to prevent displacement before or during the process of tamping and ramming the concrete in place. The ties, links or stirrups connecting the bars shall be taut so that the bars are properly braced the inside of their curved part shall be in actual contact with the bars, around which they are intended to fit.

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Placed correctly in position and are temporarily fixed where necessary to prevent displacement before or during the process of tamping and ramming the concrete in place. The ties, links or stirrups connecting the bars shall be taut so that the bars are properly braced the inside of their curved part shall be in actual contact with the bars, around which they are intended to fit.

C 12.02 Type and Quality of Steel Reinforcement

A - Hot-Rolled Steel Plain Rods and Bars

Hot rolled steel plain rods and bars shall conform to the strength requirements and minimum elongation of the Standard Specification for Deformed Billet-Steel Bars of Grade 40 with minimum yield strength 2400Kg/cms (35000 psi) for concrete Reinforcement of ASTM Designation (A-615) or equivalent.

B - Deformed Steel Rod and Bars

Deformed steel and bars shall conform to the requirements of the Standard Specification for Deformed Billet-Steel Bars of grade 60 with minimum yield strength 4200 kg/cm² (60000 psi) for concrete reinforcement of ASTM Designation (A-615) or equivalent.

C 12.03 W i r e

Wire for bending reinforcement bars shall be of soft black annealed mild steel wire. The diameter of the Wire shall not be less than 16 S.W.G. (1.6mm) and the binding

shall be twisted tight with proper pliers. The free ends of the binding wire shall be bent inwards.

C 12.04 Order Lists

Before ordering material, all order lists and bending diagrams detailed in accordance with the latest revision of AGI Building Code shall be furnished by the Contractor for the approval of the Engineer, and no material shall be ordered until such lists and steel bending diagrams have been approved. The approval of order lists and bending diagrams by the Engineer shall in no way relieve the Contractor of his responsibility for the correctness of such lists and diagrams. Any expenses incurred to the revision of material furnished in accordance with such lists and diagrams to make and comply with the design drawings including cut and waste shall be borne by the Contractor.

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C 12.05 Protection of Material

Steel reinforcement shall be protected at all times from injury. When placed in the work, it shall be free from dirt, detrimental scale, paint, oil, loose, rust, grease or other foreign substances.

C 12.06 Fabrication

Bar reinforcement shall be bent to the shapes shown on the Drawings and Steel Bending (Diagrams), Bending dimensions and scheduling of bars for the reinforcement of concrete. All bars shall be bent cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be bent except as shown on the plans or specifically permitted by the Engineer.

C 12.07 Placing and Fastening

All steel reinforcement shall be accurately placed in the position shown on the Drawings and firmly held during the placing and setting of concrete. Bars shall be tied at all intersections except where spacing 300mm in each direction, in which case alternate intersections shall be tied.

Distance from the forms shall be maintained by means of stays, blocks ties, hangers, or other approved supports. Blocks for holding reinforcement from contact with the

forms shall be precast mortar blocks of approved shapes and dimensions or approved metal chairs. Metal chairs which are in contact with the exterior surface of the concrete shall be galvanized. Layers of bars shall be separated by precast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stone or brick, metal pipe and wooden blocks shall not be permitted. Reinforcement in any member shall be placed and then inspected and approved by the Engineer before the placing of concrete begins. Concrete placed in violation of this provision may be rejected and its removal is required.

C 12.08 Splicing

All reinforcement shall be furnished in the full lengths indicated on the Drawings. Splicing bars, except where shown on the drawing, will not be permitted without the written approval of the Engineer, Splices shall be staggered as far as possible.

Additional splices, other than those shown on the Drawings; and allowed by the Engineer, shall be at the Contractor's own expense.

The cost of all supports for holding reinforcement bars shall be borne by the Contractor.

3-55

SPECIFICATIONS
CONCRETE WORK

C 13 CURING AND PROTECTION

C 13.01 Water Curing

All concrete shall be cured for a period of time required to obtain the full-specified strength but not less than seven (7) consecutive days. Unformed surfaces shall be covered with sand burlap, or other approved fabric mats kept continually wet. If the forms are removed before the end of the curing period, curing shall be continued as on the unformed surfaces. When burlap, sand or other approved fabric materials are used, they shall not cause any undesirable finish such as rough surface and discolouring where exposed to light. Unhardened concrete shall be protected from heavy rains or flowing mechanical injury and the Contractor shall submit for the Engineer's approval his construction procedure which is designed to avoid such an eventually. No fire or excessive heat shall be permitted near or in direct contact with concrete at any time. Water for curing shall conform to Section C 3.6.

C 13.02 Curing with Curing Media

Curing medium shall meet all requirements of the specifications for Liquid Membrane-Forming Compounds for Curing Concrete of ASTM Designation: C-309 and test for

water retention by concrete curing materials of ASTM Designation: C-156.

The compound shall be applied to the concrete surface by means of a sprayer, roller or lamb's wool applicator and shall be sprayed on. Ample time be allowed for the concrete surface to harden and to prevent any damage. The compound shall give a drying time not to exceed thirty minutes, and shall be applied undiluted directly from the manufacturer's labelled container in accordance with the manufacturer's directions and to the satisfaction of the Engineer.

The compound shall be completely compatible with adhesives, joint sealants and cement grout.

C 13.03 Payment

No separate payment shall be made for curing with water or with curing media. The cost of such curing shall be deemed to be included in the Unit Prices of "CONCRETE WORK".

3-56

SPECIFICATIONS
CONCRETE WORK

C 14 CONCRETE [FAIR FACE] EXPOSED SURFACES

C 14.01 Formwork

Formwork for exposed concrete surface shall conform to the applicable requirements of Section C 14, in addition to those Specifications.

All concrete surfaces that are to be left exposed to view as a finished surface except for precast concrete units, shall be produced by vertical metal shuttering

The quantity of the surface of concrete exposed to view shall be consistent throughout the Project and the following methods shall be adopted to obtain the required finish.

- Metal forms of an approved type for precast units

The Contractor may submit alternative proposals for the Engineer's approval if he so desires.

The Contractor is to submit to the Engineer for his approval shuttering details and sequence of operation relating to fair face concrete work. Sample panels shall be constructed for all their face concrete finishes and following the Engineer's approval the panels will remain on site and constitute a standard which must be maintained throughout the duration of the Contract.

C 14.02 Coating Forms with Mineral Oil

In addition to the above forms or linings, the forms shall be coated before placing reinforcement with an approved colourless mineral oil free of kerosene.

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

c 14.03 Samples and Workmanship

The Contractor shall submit for approval a sample panel not less than 600x1200mm to demonstrate the quantity of the exposed concrete produced by forms at his own expense.

The quantity of the finished work shall be measured against the quality of the approved sample panel and the work of inferior quality shall be repaired or replaced as directed by the Engineer without any additional cost.

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SPECIFICATIONS
CONCRETE WORK

c 14.03 Samples and Workmanship (Cont'd)

The quality of the finished surfaces shall be uniform in colour and consistency, whether in colour or in texture, in any of the finished surfaces, the Engineer may order the repair or the demolition of the portion of concrete work and the reconstruction of same at the expense of the Contractor and the Contractor shall have no right to claim for any expenses or time delay incurred.

Alternatively the Engineer may order the Contractor to plaster all exposed surfaces and bush-hammer the entire area of, concrete in the Project so as to render all exposed surfaces of concrete consistent throughout the Project at the Contractor's own expense

C 15 MONOLITHIC SMOOTH FINISH SURFACES

All concrete surfaces which are not in acceptance condition and which are required to be surface-finished as designated herein, shall be rubbed to a smooth and uniform texture with a carborundum brick and clear water as soon as the forms are removed and the concrete is ready to hone. The loose material formed on the surface shall be removed as soon as it dries by rubbing the surface with burlap or other approval material. A cement wash shall not be used.

Concrete surface shall be free from honeycombing, air holes, fins and projections arising from defective mixings, placing or formwork. When the formwork has been stuck off, the surface of concrete shall be left untouched until inspected by the Engineer. Any defective concrete work shall at the discretion of the Engineer be demolished completely and rebuilt or cut out and made good with concrete of the same proportions as the original. Such rectifications shall be to the satisfaction of the Engineer and at the Contractor's own expense.

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I N D E X

SECTION D - BLOCKWORK

Division	Titles	Page No.
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D - 2	Materials	3 - 59
D - 3	Manufacture of Concrete Blocks	3 - 59

D - 4	Mortar	3 - 61
D - 5	Workmanship	3 - 61

SECTION D

B L O C K W O R K

D 1 SCOPE

These Specifications cover the supply if materials, manufacturer and workmanship of concrete blocks intended to be used for the construction of blockwalling, partitions, facings, claustras, etc., required for the Project in accordance with the Drawings, Bills of Quantities and as directed in writing by the Engineer.

D 2 MATERIALS

D 2.01 Cement

Cement for solid or hollow blocks and mortar shall be ordinary Portland Cement ASTM Designation C 150-74 and white cement ASTM: c 91-71 .

D 2.02 Aggregates

Aggregate or solid and hollow concrete blocks and mortar shall conform to the requirements for the aggregates in the "CONCRETE WORK" Section.

D 2.03 Water

Water to be used in blockwork shall conform to the requirements specified for water in the "CONCRETE WORK" Section.

D 2.04 Lime

Lime shall be non-hydraulic lime complying in all respects with B.S. 8980, and shall be prepared in accordance with the appropriate requirements of British Standard Code of Practice 121: Part 1: 1973, latest revision.

The Contractor must satisfy himself by analysis or otherwise that the ground lime is not adulterated or air-slaked.

Factory produced, dry hydrated, non-hydraulic or semi-hydraulic lime, ready for use, shall be mixed with sand and made into coarse mix or be soaked to putty by mixing with water and allowing to stand not less than (16) sixteen hours before use.

The lump or ground non-hydraulic or quicklime shall be slaked, run to putty and matured for not less than two (2) weeks.

D 3 MANUFACTURE OF CONCRETE BLOCKS

Aggregate shall be so sized, graded, proportioned and thoroughly mixed in a batch mixer with such proportions of cement and water as to produce homogeneous concrete mixture. However, in no case shall the proportion of cement in the mixture be less than five (5) standard bags (each weighing 50 kgs) per cubic meter of concrete.

Precast concrete blocks shall be manufactured in approved vibrated machines. If for any reason the strength requirements is not achieved, the cement shall be

increased at the Contractor's own expense. The water used in the mix shall be clean and of a sufficient quantity to allow complete hydration of the cement without providing an excess when moulding.

Concrete blocks shall be hard, sound, durable, sharp, rect- angular shape, clean with well define arises free from racks and flaws or other defects.

Concrete blocks shall be either obtained from an approved local factory or manufactured on the Site. If manufactured on Site, the blocks shall be pressmoulded in approved moulds and vibrating presswire machines with a minimum of 2800 cycles per minute.

Blocks manufactured on the Site shall be cured in the shade by being kept thoroughly moist with water applied by sprinklers or other approved means for a period of at least seven (7) days. The blocks shall be stocked on a clean and level platform free from earth or other impurities during the curing process, and shall be stocked in honeycomb fashion after curing. The blocks shall not be used prior to one (1) month after the date of manufacture, not shall any block be used that have not been inspected and approved by the Engineer.

Concrete blocks (solid or hollow) shall be of the following dimensions:

Height	=	200 mm	+ 1 % Tolerance
Length	=	400 mm	+ 1 % do .
Width	=	As required	+ do .

The nominal width of blocks shall be as indicated on the Drawings and as directed in writing by the Engineer.

Hollow concrete blocks shall comply with the following requirements:

Compressive strength at Twenty-Eight (28) Days over Cross- Sectional Area: -

- a) Load-Bearing Walls
 - 60 kgs/cm² average of 12 blocks
 - 50 kgs/cm² minimum for any block

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SPECIFICATIONS
BLOCKWORK

- b) Non-Load-Bearing Walls
 - 30 kgs/cm² average if 12 blocks
 - 25 kgs/cm² minimum for any block

Water Absorption
20 % or less of dry weight

The design of the cavities and webs of the hollow concrete blocks shall be submitted to the Engineer prior to manufacture. The thickness of the face shell and of the membrane of solid portions shall be nowhere less than forty (40). The combined thickness of the solid portions shall be not less than one fourth ($1/4$) of the width and length of the block respectively.

D 4

MORTAR

Mortar shall be prepared in the following proportions with the addition of the minimum quantity of clean water for workability.

Cement and sand mortar (1:3) shall be composed of one part cement to three parts of sand by volume.

Hydrated lime up to $1/4$ (one quarter) by volume of the dry cement may be added for bedding blocks, upon the approval of the Engineer, to improve workability without appreciably reducing the strength.

The ingredients for cement and sand shall be measured in proper clean gauge boxes and the mixing shall be carried out by means of an approved mechanical batch mixer.

In the cast of cement-lime mortar, the sand and lime shall be mixed first and the cement added. It shall be assumed that the lime has not increased the bulk of the sand.

Cement mortars shall be used within thirty

D 5

WORKMANSHIP

All blockwork shall be set out built to the respective dimensions, thickness and heights shown on the Drawings and/or instructed in writing by the Engineer.

All walls and partitions, where shown on the Drawings without indicating the type of the block to be used, shall be built in hollow concrete blocks, unless otherwise directed in writing by the Engineer.

The blocks shall be well soaked before being used and the tops of walls left off shall be wetted before work is recommenced. All blocks shall be well buttered with

mortar before being laid and all joints shall be in uniform manner and shall not exceed 10mm, no one portion being raised more than 1.00m above another at one time, and wall of partition necessarily left at different levels, must be racked back. All perpendes, quoins, internal and external angles, etc. properly bonded together and levelled round. All blockwork shall be plumbed vertically.

The surface of the walls and partitions prepared for plastering, shall have the joints raked out 20mm from the face of the wall to form key for the plaster.

All blockwalls shall be bonded to reinforced concrete columns by means of wall ties, complying in all respects with B.S. 1243 latest edition. The ties shall be minimum 200mm long of which 100mm shall be embedded in the re-d concrete column and the remainder set into the block wall at the rate of two (2) ties per meter. Partitions shall be bonded to main wall by toothing at every fourth course into main wall to a depth of not less than 100mm.inforce

All walls and partitions shall be properly cured by sprinkling water for a period not less than three (3) days after completion of laying the course.

Walls and partitions terminating against soffits of beams or slabs shall be lightly wedged with metal wedges after mortar in bed joints has attained its initial set, and the joint packed with mortar.

Cut and fit blockwork next to reinforced concrete door, window, jambs and sills, and form chases for the ends of the door and window lintels. No hollow blocks shall abut any built-in fixtures e.g. door and window frames, apertures, louvers, etc. .

The cavity between skins of blockwork shall be 100mm (nominal) wide and kept clear of mortar dropping throughout the construction of the hollow walls. The skins of hollow walls are to be tied together with butterfly twist type galvanized steel wire to the approval of the Engineer and built into each skin one meter apart horizontally and every alternate course, staggered.

SECTION E - STONEWORK

Division	Titles	Page No.
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E - 2	Materials	3 - 63
E - 3	Workmanship	3 - 64

S T O N E W O R K

E 1

Scope

These Specifications cover stonework building intended to be used form external walls, required for the Works in accordance with the Drawings, Bills of Quantities and as directed in writing by the Engineer

It also covers the copings covering the parapet of the roof

E 2

Materials

Stone building to walls shall be durable, local stone, Mizzi yahoudi or mizzi Hilou of a quality suitable to ensure permanence in the structure. It shall be (Toubzeh) dressed, free from cracks, seams, holes, shakes, objectional irregularities of colour, impurities, structural weaknesses and other defects that would tend to increase unduly the deteriorations from natural causes.

All stones shall be selected well in advance of the time required. Samples of stone materials and dressing shall be submitted for the Engineer's approval 30 days before delivery of any such material to Site.

Mortar for all masonry shall consist:

1 part cement

6 parts of fine aggregates

All copings for covering the parapet shall be durable, local stone as mentioned above. The height and width of copings will be as specified on the Drawings.

E 3

Workmanship

Walls shall be carried up in a uniform manner no one portion being allowed to rise more than four courses above one another at one time. The total thickness of stone building and concrete backing shall be 30cm as shown on Drawings.

All stone shall be hand placed. Courses shall be solidly bedded with full mortar beds and joints fully squeezed out. All stones shall be cleaned and thoroughly wetted before setting.

To ensure even and regular width of beds and joints when setting stones, the Contractor shall use hardwood wedges to ensure close and regular fitting between beds and joints.

All stones shall be solidly bedded and jointed in mortar. Copings shall be fixed on the top of the parapet by mortar.

At completion of masonry walls, joints shall be cleaned wetted and pointed with mortar composed of: part white cement and two parts of very fine crushed stone sand tinted to the colour selected.

The Contractor, when executing, shall ensure that the mortar is pressed tight into the joints by means of approved tools for pointing.

Care shall be exercised to avoid spreading in the faces of the stones.

The Contractor shall set up samples for the Engineer's approval before executing any pointing.

I N D E X

SECTION F - ROOFING AND WATERPROOFING

Division	Titles	Page No.
F - 1	Scope	3 - 65
F - 2	Materials	3 - 65

S E C T I O N F

ROOFING , WATERPROOFING AND THERMAL INSULATION

F 1 SCOPE

These specifications cover, waterproofing, roofing and thermal insulation, to be used for underground structures floors and roof decks required for the Works in accordance with the Drawings, Bills of Quantities and as directed in writing by the Engineer.

F 2 MATERIALS

F 2.01 Dampproofing

All substructures, floors of ground floor of kitchens + bathrooms have to be painted with a liquid waterproofing.

F 2.02 Waterproofing of exterior walls

This will be added to the exterior plastering of walls. An integral concrete waterproofing compound that will reduce moisture absorption in the plastering mixture

F 2.03 Waterproofing of the roof

A sloping screed consisting of lightweight concrete screed shall conform to B.S.3797: lightweight aggregate for concrete. The lightweight aggregate shall be such a Vermiculite, Alveolite, etc.... aggregate of an exfoliated micaceous mineral aggregate incombustible and chemically inert, obtained from an approved manufacturer, graded and mixed in accordance with the manufacturer's instructions.

The lightweight aggregate shall be delivered to the Site in the manufacturer's sealed and branded containers which shall be clearly marked to show the grade of lightweight aggregate contained therein. They shall be stored in a covered shed with floor raised off the ground and bags stacked not more than 3.00 meters high.

Mixing Proportions

The lightweight concrete screeds shall be measured, mixed applied and cured in accordance with the manufacturer's in- structions and to the satisfaction of the Engineer.

Gauges boxes shall be used for the measurement of light-weight aggregate and the following mixing table shall be strictly observed.

SPECIFICATIONS
ROOFING AND WATERPROOFING

No	Li	Me	Ce	Wa	_8	1.	Cu	15	44
mi	gh	te	me	te	:	00	be	0	ga
na	tw	r	nt	r	1			Kg	ll
l	ei		Co					s.	on
Mi	gh		nt						s
x	t		en						[2
	Ag		ts						00
	gr								Li
	eg								tr
	at								es
	e								

F 2.04 Waterproofing

An application of a bituminous waterproofing consisting of an unknown polyester reinforcement (250 grm/m² minimum) incorporated in thermofusible elastomeric bitumen.

F 2.05 Workmanship

Prior to the beginning of the roofing works, the Engineer and the roofing superintendent shall proceed to the inspection and approval of the receiving surfaces, the upstands at roof edges, the drains, vent pipes and other venting devices, the construction joints etc.

The general contractor will be notified in written of all defects of the flat surfaces or details and work shall not proceed until such defects have been corrected.

One coat of primer is painted over all the surface.

Installation of the bituminous layers shall be carried out in conformity with the manufacturer's specifications and using propane torch welding only

Asphalt coatings shall be softened but not melted as to avoid superheating using a single-nozzle torch of adequate size. Rolls shall overlap 75mm on sides and 150mm at ends. All inadequately welded seams will be refused. All superheated areas or parts will be refused and will require adequate repair in accordance with the degree of deterioration of the membrane.

Air blisters, wrinkles impact and tearing marks and protective granules pounding marks are not admissible. Should these defects occur roofing works shall be carried out again.

3-66

SPECIFICATIONS
ROOFING AND WATERPROOFING

F 2.06 Bituminous Flashings

A plain underlay bonded to the support with previously applied primer coating or welded to it with propane torch. This underlay shall be unrolled parallel to the upstanding element in one meter width extending 150mm onto the current surface underlay.

Apply the current surface-finishing layer onto the flashing underlay and then recover with the flashing-finishing layer extending 200mm onto the current finished surface.

This layer shall be welded with propane torch in full adherence that no air is entrapped between layers. Side and end laps shall be staggered over underlay seams and 75mm wide.

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I N D E X

SECTION G - JOINERY AND IRONMONGERY

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SECTION G

JOINERY AND IRONMONGERY

G 1 GENERALLY

Joiner's work shall be carried out in accordance with the drawings and the principles of first joinery construction. Unless specifically stated otherwise sizes on drawings are finished sizes.

G 2 TIMBER GENERALLY

Timber shall comply in all respects with B.S. 881/589 for Nomenclature of Commercial Timbers including Sources of Supply, and B.S. 1186 quality of timber and workmanship in joinery, latest editions.

Timber shall be of an approved variety and quality suitable for the purpose for which it is to be used and equal to samples approved by the Engineer.

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

- Sapwood slits, ring shakes and soft pith.
- Checks exceeding 1.5mm wide.
- Checks exceeding 1.5mm wide.
- Checks more than half the thickness of the timber in depth.
- Knots exceeding 20mm mean diameter.
- Knots exceeding half the width of the surface.
- Decayed or dead knots unless cut out and plugged.

- Loose knots or knot unless cut out and plugged.
- Pitch pockets.
- Decay and insect attack including pinworm holes.

Timber shall be pressure impregnated by a method to be approved by the Engineer. The timber is to be of the correct moisture content specified in B.S. 1886 Part 1 and shall be free from surface moisture and dirt. Treatment is to be carried out after all cutting and shaping is completed and care is to be taken to avoid damage to surfaces of treated timber in subsequent handling. If treated timber is unavoidably cut or damaged a liberal application of preservative is to be made to damaged surfaces.

Samples of every type which the Contractor proposes to use in the Works shall be sent to the Engineer for his approval. Each sample shall be labelled and the label shall state the species of the timber and the purpose for which it is to be used. Timber used in the Works shall be equal in strength characteristics and appearance to the approved samples.

3-68

SPECIFICATIONS
JOINERY & IRONMONGERY

In jointed panels each piece shall be of the same species. Joinery for staining or polishing has all surfaces of the same species and same character of grain running in the same direction.

All plugs inserted after cutting out defects shall be the full depth of the hole and the grain of the plug shall run in the same direction as the grain of the piece.

Timber connectors where used shall be two single-sided toothed plates (round or square) for demountable joints or one double sided toothed plate (round or square) for permanent joints to conform with B.S. 1579, latest addition.

Timber shown to be plugged to wall shall be properly and securely fixed by means of raw-plastic or hardwood plugs cut on the twist.

Nails shall be in accordance with B.S. 1202 Steel nails and screws shall conform to B.S. 1210 Wood Screws, of latest edition.

Timber to be used for each position of the Works shall be as indicated on the drawings and as stated in the Bill of quantities. In general joinery exposed work shall be executed in first grade hardwood as hereinafter specified.

All grounds and other timber to be built into concrete or blockwalls or otherwise covered shall first be coated all over with approved wood preservative, suitable for the position in which the member is to be incorporated.

G 3

SOFTWOOD

Softwood shall be Douglas fir, longleaf pine, European redwood or other approved softwood unless otherwise shown on the drawings.

Blocking timbers or the like shall be Russian whitewood "Shuh" or other equal and approved.

Where pine is required it shall be Parara Pine from South America of the sizes indicated on the drawings.

G 4

HARDWOOD

Hardwood shall be Teak, Canadian clear, Canadian Yellow Birch, Merranti, "Zeine" first grade dense timber or other equal and approved.

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SPECIFICATIONS
JOINERY & IRONMONGERY

Where mahogany is required it shall be first quality Honduras mahogany of sizes indicated on the drawings.

Where beech is required it shall be first quality European of the sizes indicated on the drawings.

G 5

PLYWOOD

Plywood shall consist of an odd number of plies arranged so that the grain of each layer is at right angles to the grain of the adjacent layer or layers. The plies shall be not pressed during adhesion and shall have a finished thickness as shown on drawings, or shall have refinished plywood 7mm thick such as obtained from vitrus-Werke and Simpson or equivalent.

In the case of plywood having 3 plies the core shall be not more than 60 percent of the total thickness.

In plywood having more than 3 plies the faces and all plies with the grain running in the same direction as the faces shall have a combined thickness of between 40 percent and 65 percent of the total thickness of the ply.

The plywood shall be free from end joints (including scarf-joints in veneers), overlaps in core veneers, dead

knots, patches and plugs, open defects, depressions due to defects in core, insect attack (except isolated pinworm holes through face veneers only), fungal attack and from discolouration differing from that normally associated with species.

All plywood shall be of Exterior Grade and shall conform to the applicable requirements of" B.S. 1455 "Ply-wood manufactured from tropical hardwoods " and B.S. 3493" information about plywood".

G 6

BLOCKBOARDS OR LATTE AND LAMINBOARD

Blockboards and laminboard shall be of an approved manufacturer and guaranteed not to warp or change in size or suffer any kind of deformation. It shall be of timber specified and glued with anti-insect synthetic resin waterproof glue all through. All strengthening boards shall be fixed during manufacture.

Blockboard and laminated shall conform to the requirements of B.S. 3444 " Blockboard and Laminboard" and B.S. 3583" Information about Blockboard and Laminboard".

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SPECIFICATION
JOINERY & IRONMONGERY

G 7

VENEERS

Timber for face veneer shall generally be first grade hardwood as indicated on the Drawings and/or in the Schedule of Doors obtained from an approved supplier.

The face veneers 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, dote, glue stains, filling and inlay of any kind or other defects.

The face veneers shall be applied to one or both sides of wood panels as shown on the Drawings.

Adhesives shall comply with the requirements of B.S. 1203 synthetic resin adhesives for plywood (Phenolic and amino- plastic) and shall ensure proper adhesion between plies.

G 8

PLASTIC LAMINATE

The plastic laminate facings conforming to B.S. 2572 Phenolic laminated sheet minimum 1.5mm shall be similar to Formica, Panelyte, Perstrop or other approved equal obtained from an approved manufacturer.

Colour and pattern shall conform to the sample approved by the Engineer.

Plastic laminate sheets shall be applied with a waterproof heat resistant adhesive of a type recommended by the plastic laminate manufacturer.

G 9 **MANUFACTURE AND WORKMANSHIP**

G 9.01 General

All Carpenter and Joiner Work shall be accurately set out, framed and executed in accordance with the detailed Drawings.

Joinery work shall be constructed to detailed drawings. Joints shall be made so as to comply with B.S. 1186 Part 2.

Joinery shall be cut and framed at an early stage, but shall not be glued or wedged until building is ready to receive it.

3-71

SPECIFICATIONS
JOINERY & IRONMONGERY

Framed work shall be properly morticed and renoned, wedged, glued and cramped together and dowelled where necessary. All external joinery work shall be put together with waterproofing glue.

The use of nails for fixing any items of joinery will not be permitted. Springs may be used for glazing beads only.

All screws shall be countersunk and puttied and all springs shall be punched and puttied.

All joinery such as architraves, beads etc.. required to fit against the contour of irregular surfaces shall be accurately scribed to ensure a close connection.

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

G 9.02 Doors

Doors shall be to sizes shown on the Drawings. Doors hung folding shall have meeting beads screwed on. Glazing bars if required shall be of twice rebated section.

Flush doors shall be core framed up in softwood and covered with 6mm thick ordinary plywood or as shown on the Drawings.

The horizontal framing members shall have ventilation holes drilled in the vertical direction to avoid damage due to expansion of trapped air.

Hardwood edging shall be securely joined and dowelled to the framing all round the exposed edges and shall be splayed or rebated to take the edge of the plywood facing. Lock rails of fixing blocks shall be built into the framing and their positions marked on the facing.

Glazing beads shall be of hardwood (beech or the like) moulded and screwed as detailed on the Drawings.

Doors and joinery items etc. shall be carefully and accurately fitted to give a uniform clearance of not more than 3mm all round.

G 9.03

Fittings Generally

Shelves, divisions, counter tops, panels, drawers and the like shall be of the dimensions and sizes shown on the drawings and shall be screwed to bearers, framing or brackets.

3-72

SPECIFICATIONS JOINERY & IRONMONGERY

Blockboards in shelves, divisions, counter tops, panels, drawings and the like shall have hardwood lipped to all edges.

Prefabricated fittings and fixtures such as floor and wall cabinets, cupboards, counters and the like shall be of the size, type and dimensions shown on the drawings and shall be fabricated of the materials shown on the drawings and described in the Specification. The fittings, etc. shall be accurately constructed. The doors, drawers, etc. shall all fit and open and close smoothly.

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

All components shall be made to B.S. 1186: Part.2.

Prefabricated fittings and fixtures shall be fixed in the positions indicated on the drawings after all floor, wall and ceiling surfaces have been formed or constructed, All work next to walls, floors and ceilings shall be soundly fixed and scribed to fit snugly against same.

The Contractor shall construct such ground works as are necessary to provide a suitable base and fixing for the prefabricated joinery works.

All blockboards in prefabricated fittings and fixtures shall have hardwood lipping to all edges.

Prefabricated fittings and fixtures shall be complete with hardware as shown on the drawings or as approved by the Engineer.

G 9.04 Veneering and Finishes

Veneering and finishes to doors, etc. shall be in accordance with the Drawings and as directed in writing by the Engineer.

The decorative veneer shall be laid at right angles to the grain of the face whether based on plywood or blockboards. Undulations shall be smoothed out by sanding or scraping and the moisture content of the panel and veneer matched to reduce differential shrinkage.

Laminated plastic sheets which are used as facing veneer on plywood or blockboard shall be applied with a waterproof, heat resistant adhesive of a type recommended by the manufacturer of laminated plastics.

Finishes with paint to faces of doors and cupboards shall be enamel oil paint as specified under Section "PAINTING AND DECORATING".

3-73

SPECIFICATIONS
JOINERY & IRONMONGERY

G 10 INSPECTION

Facilities shall be given to the Engineer for the inspection of all joinery works in progress in the shops and on the Site.

G 11 TRANSPORT AND PROTECTION

The joinery shall be kept well protected during transit and shall be handled and packed carefully to avoid its being damaged and shall be covered and kept clear of the ground where on the Site.

G 12 MAKING GOOD ALL DEFECTS

Should any shrinkage or warping occur or any other defects appear in the joinery work before the end of the

defects liability period, all defective work shall be taken down and renewed to the entire satisfaction

G 13

IRONMONGERY

Ironmongery shall be first quality to be obtained from an approved manufacturer as specified.

The Contractor shall submit a schedule of ironmongery for the approval of the Engineer before placing any supply order. The Engineer's approval of such schedule shall not relieve the Contractor from furnishing all items of hardware required under the Contract.

G 14

MASTER-KEYING

The Contractor shall set up the locks for a system of master keying. Two change keys shall be furnished for each lockset.

G 15

PROTECTION AND DEFECTIVE WORK

All joinery work shall be protected from damage during the course of the work and when handed over shall be to the entire satisfaction of the Engineer. Before handing over the Contractor shall ensure that all doors, fittings, etc. work easily and shall make all necessary adjustments including those needed during the maintenance period. Any joinery that splits, shrinks or warps from want of seasoning, unsoundness or bad workmanship shall be removed and replaced at the Contractor's expense. Ironmongery shall be over hauled, cased and oiled before handing over and all paint, etc. Shall be removed and left in a clean and perfect working order.

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I N D E X

SECTION H METALWORK

_Division
No.

Titles

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SECTION H

M E T A L W O R K

H -1 SCOPE

These Specifications cover ferrous and non-ferrous works intended to be used in the Project all in accordance with the Drawings and as directed by the Engineer.

H -2 MATERIALS

H -2.01 Steel

Steel plates, and structural steel shaped sections shall conform to the requirements of B.S. 4 latest edition for structural sections, Part 1 Hot rolled sections and Part 2 Hot-rolled hollow sections (Metric Series).

H -2.02 Bolts and Nuts

Bolts and nuts shall conform to the requirements of B.S. 4190: I.S.O. metric black hexagon bolts, screws and nuts.

H -2.03 Washers

Plain washers shall be made of steel. Taper or other specially shaped washers shall be made of steel or malleable cast iron and shall conform to the requirements of B.S. 4230 Metal washers for general engineering purposes.

H -2.04 Galvanized Steel Pipes

Galvanized steel pipes shall conform to the requirements of B.S. 1387 - I.S.O. "Medium Series" .

H -2.05 Paint

Paint for Metalworker shall comply with the applicable requirements as specified under " PAINTING."

H -2.06 Aluminium

All aluminium elements shall be manufactured of extruded sections of aluminium alloy, mechanically jointed. Fittings shall be aluminium alloy in accordance with B.S. 1331 the latest edition.

All parts and members shall be of aluminium commercial quality like (Al - Mg - Si) heat treated, free from defects impairing its strength and durability and containing not more than 0.4% copper. All exposed surfaces shall be polished to a mirror-like surface, free from defects, and shall be light etched and anodized in a dark brown finish as shown on Drawings and as directed in writing by the Engineer.

Aluminium shall be treated to comply with B.S. 1615 and B.S. 2987 to provide an anodization not less than 25 microns thickness.

All aluminium sections shall present clear straight and sharply define lines and shall be free from defects and imperfections that may impair their strength.

All screws, bolts and other necessary accessories shall be of aluminium or other non- corrodable material and shall match in colour and consistency the finish of the anodized aluminium.

Aluminium elastic glazing beads shall be provided to all windows and doors which are assembled by pressure to fit with the relevant groove in the profile.

The glazing bars shall be treated or interlaced at points of intersections and machine tenonned to frame.

H 3

MANUFACTURE

H 3.01

General

The Contractor shall be responsible for the correctness and accuracy of the dimensions of the finished articles.

He shall therefore carefully check the dimensions indicated on the Drawings, verify any change ascertain the sizes at Site which will enable him to prepare Final working Drawings for fabrication and erection purposes. Such drawings shall be submitted to the Engineer for his verification and approval.

Fabrication Orders can only be placed after Contractor has obtained in writing the approval of the Engineer on the above Drawings.

The steel sections where specified to be factory rustproof shall be rustproofed by hot dip galvanized, metalizing or sheradizing process. The rustproofing shall be sufficient to withstand the 72 hours salt-spray test as provided for in B.S. 1391. If the rustproof coating shall be damaged during the progress of work, the damaged part shall be recoated to minimum the original thickness to the satisfaction of the Engineer.

H -3.02

Flush Steel Door and Frame

Flush steel door shall be fabricated of hot rolled steel sections for framed skeleton with diagonal bracings and lined both faces with sheet steel of thickness as shown on Drawings or stated in the Bills of Quantities, riveted to framed skeleton as shown on the Drawings. The Frame shall be made of hot-rolled steel sections and shall be provided with No. 8 anchors, one end welded to frame and other end dovetailed.

H -3.03 Hollow Metal Door Frames

Hollow metal door frames shall be purpose made to the profiles and sizes shown on the drawings and obtained from an approved manufacturer. The doorframes shall be from 1,5mm thick twice laminated steel

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

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

H -3.04 Aluminium Windows, Doors

The anodized aluminium windows and doors etc... with all necessary accessories and fittings shall be of the pattern, design, dimensions and thickness shown on the Drawings and obtained from an approved manufacturer.

Prints of shop Drawings for aluminium Windows, doors, frames, etc.. showing the dimensions, sizes, thickness, materials, finishes, joinings, attachments, fasteners and the relation of this section to adjoining work, shall be submitted to the Engineer for approval before ordering any material. All work shall be fabricated and erected in accordance with the approved Drawings.

All aluminium windows, doors, frames, etc... shall be factory assembled and reinforced according to the Drawings, complete with hinges, glazing gaskets and anchors. The only Site work allowed on aluminium units is fixing in position and glazing. The finished surfaces shall present a clear surface free from alloy defects, scratches, or other surface blemishes.

H -4

WORKMANSHIP

H -4.01

Steel Elements

All steel parts shall be accurately set out, cut, framed, assembled and executed using proper bolts or welding electrodes. All cut parts shall be sawn cut, no oxygen burning shall be permitted except for pipe supports. All welding shall be electrical welding, clean and of proper workmanship. All cut parts and welded sections shall be ground, even and filed smooth with rounded edges.

All steel members in contact with the soil shall be painted with two (2) coats of protective asphalt paint. All doors, frames, staircases, etc... shall be given at least one (1) coat of approved rust inhibiting primer before delivery to Site.

Frames for doors and windows shall be provided with not less than (3) adjustable type anchors on each jamb, maximum distance between anchors shall be eight hundred (800mm).

All joints shall be machined to a close fit and all pins and screws shall be countersunk and dressed flush after assembly.

Forging shall be sharp and true curbs and intersections, members of the same size shall be halved together.

The plain surfaces shall be smooth, free from warp or buckle. Moulded members and mitres shall be clean, cut, straight and true. Construction joints shall be welded their full length and cleaned off flush on exposed surfaces.

All work shall be erected plumb and true to lines and rigidly secured to wall, floors or ceilings as shown on Drawings and to the satisfaction of the Engineer.

Hardware for steel doors, etc. shall be as specified under JOINERY & IRONWORK.

H 4.02

Aluminium Windows and Doors

The Contractor shall furnish and install all aluminium units as indicated on the Drawings. Workmanship and installation shall be in accordance with recommended standard of First Class Aluminium Manufacturers.

All aluminium work shall be performed in a shop where grade of metalwork is of recognized quality acceptable to the Engineer. All items shall be installed plumb, straight, square level and in proper elevation, plane location and

SPECIFICATIONS
METAL WORK

level and in proper elevation, plane and alignment with other work. All work shall be designed for adjustment to field variations, fitted with proper joints and intersections, adequately anchored in place, strictly in accordance with best practice.

Where aluminium surfaces come in contact with metals other than stainless steel, zinc, white bronze or small areas of other metals compatible with aluminium surfaces they shall be kept from direct contact with such parts by painting the dissimilar metal with a prime coat of zinc-chromate primer or other suitable primer, followed by one or two coats of aluminium metal-masonry paint or other suitable protective coating, excluding those containing lead pigments or a non-absorptive tape or gasket shall be placed between aluminium and dissimilar metals. Steel anchors and connecting members shall be hot dip galvanized or zinc plated after fabrication.

Aluminium surfaces in contact with lime mortar, concrete, plaster or other masonry materials, shall be painted with alkaline-resistant coatings such as heavy-bodied bituminous paint or waterwhite methacrylate lacquer.

Aluminium in contact with wood or absorptive materials which may become repeatedly wet shall be painted with two coats of aluminium metal-and-masonry paint or a coat of heavy-bodies bituminous paint. Alternately paint the wood or other absorptive material with two coats of aluminium house paint and seal joints with a good quality of caulking compound.

Where aluminium is in contact with treated, wood shall be treated with pentachlorophenol, 5% minimum concentration or approved equal, followed with the protective measures described for aluminium in contact with wood or other absorptive materials.

The aluminium work shall be designed and anchored to that the work will not be distorted nor the fasteners overstressed from the expansion and contraction of the metal.

Before shipment from the factory, aluminium surfaces requiring protection shall be given a coating which will protect the metal during construction in areas where appearance of the finish on aluminium items is important, a coating of methacrylate type lacquer shall be applied as specified hereinafter.

SPECIFICATIONS
METAL WORK

Apply two sprayed coats of water-white methacrylate lacquer having a total minimum thickness of 0.015mm, which when applied to the aluminium surface shall be capable of withstanding the action of lime mortar for a period of at least one week in an atmosphere of 100% relative humidity at 40 °C, the action of 10% (by weight) muriatic acid for a period of six hours at 20 °C, and the action of atmospheric weathering for a period of 12 months. The coating shall be applied in the manufacturer's plant to the exposed surfaces of all aluminium components subject to staining from alkaline mortar and plaster, abrasion and other construction abuses. Before application of lacquer, the manufacturers shall remove all fabrication compounds, moisture, dirt accumulations and other foreign materials to ensure proper lacquer adhesion.

Upon completion, the Contractor shall clean all aluminium work as required by removing protective tape or other coating, using mild soap or detergents and clear petroleum spirits.

Acids, caustics and abrasives not be used. Where cleaners are used to remove excess sealings compounds care shall be exercised to prevent damage to seals or staining or damage to adjacent work.

The Contractor shall be responsible for the protection of all aluminium work until the completion of the works, and only units in perfect working order and in perfect condition shall be accepted.

H -4.03 Hollow Metal Door Frames

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

The rates for hollow metal door frames are to include for the supply and assembly of the complete unit including all necessary holes for hinges and lock, cutting off torsion threshold bar if necessary and fixing in walls in accordance with the manufacturer's printed instructions and plain concrete or mortar filling as shown on the drawings.

H 5 BALUSTRADES AND RAILING

Balustrades and railings shall be of the materials and made to the sizes, dimensions and designs shown on the drawings.

I N D E X

SECTION I SANITARY INSTALLATIONS

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S E C T I O N I

SANITARY INSTALLATIONS

I - 1

GENERAL

a. Scope of work

The Contractor shall furnish all labour, materials equipments, tools, appurtenances, services and temporary work to provide complete the several plumbing and drainage systems all in perfect working order.

This work shall include but not be limited to the following:

- Sanitary fixtures.
 - Water supply systems including cold water services.
 - Soil, waste and ventilating systems.
 - Rain water services.
 - External gravity sewer net work.
 - Testing of all piping systems and equipment and other devices to demonstrate that the entire installations are in perfect working order.
- All fixtures and materials shall be brand new bearing stamped ratings as required and must be approved by the engineer prior to their use.

b. General description of the work

The sanitary works shall consist of all water supply to and water discharge from all the sanitary fixtures.

City water is stored in steel water tanks at the roof of the building. Water distribution to all floors is by gravity from these roof tanks.

Drainage of all floors is discharged by gravity from individual points to risers which are inter connected to a system of manholes which will be later discharged to a local sewage treatment plant. Rain water is collected from roof and discharged out of the building by means of risers.

c. Working drawings and ordering

Immediately the contract has been awarded, the Contractor shall prepare detailed working drawings showing exact position of all sanitary fixtures and position and size of all water pipe work and drainage, soil, waste and vent piping, clearly indicated fittings proposed. These drawings, when approved by the engineer, shall be used for ordering purposes.

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SPECIFICATIONS
SANITARY INSTALLATIONS

I 2. P.V.C PIPES

- a. Supply and installation of 2", 4", & 6" P.V.C. pipes as manufactured by "Psalm" as shown in drawings either within slab and wall or exposed and hung under ceiling.
- b. P.V.C. pipes and fittings such as elbow, T, Trap shall be spigot and socket, and jointed by rubber seal ring.
- c. Clean out opening must be provided where shown on drawings and where required.
- d. All riser branches must be provided by elbow or nipple with gate and with T with opening at point of conic-tin with branches.
- e. P.V.C. pipes and fittings shall be fixed in shaft by means of approved galvanized, two pieces, holderbates of pipe fixed vertically and at not more than 2m. centers on pipes fixed horizontally. Horizontal 4" and 6" P.V.C. pipe in pipe turned must be approved clamp.
- f. Slope of drain pipes to be 1cm/mr unless noted other- wise.
- g. Vent for sewage pipes to be 1 meter above finished roof and including wire dome grating.
- h. Where vent pipes penetrate roof slabs, sleeve must be provided above it, and roof finishes and water proofing, must be carried up around the pipe and covered with sleeves to prevent water penetration, all to the approval of the Engineer.
- i. For testing soil and waste stack the system shall be subjected to water test prior to being covered and also tested for water tightness after back filling. On any section of pipe under test the head of water applied shall not be less than 3 meter and not more than 6 meter. Test shall be rectified and the test re-applied to the complete satisfaction of the Engineer.

I 3 DOMESTIC WATER PIPING

- a. Pipe Installation
All piping shall be properly supported or suspended on stands, clamps, hangers, etc.. of approved design. Supports shall be designated to permit free

expansion and contraction while minimizing vibration. Pipes shall be anchored as directed by means of steel clamps securely fastened to the pipe and rigidly attached to the building structure. Screw threads shall be cut clean and true and joints made tight without caulking. No bushing shall be used. Reducing fittings shall be used to change pipe size, and reductions to be made with eccentric reducers short radius fittings shall not be used.

3-82

SPECIFICATIONS
SANITARY INSTALLATIONS

The drawings indicate generally the size and location of piping as designed for space conditional ceiling heights and may not be changed until coordinated with other contractors.

Pipe work shall confirm fully of the following requirements

- Piping shall be properly graded to secure easy circulations and prevent noise and water hammer. As much pitch as space conditions allow must be given. Capped dirt pockets to be installed at all riser heel, low points, and other places where dirt may accumulate must be provided. Allowance must be made for proper provision for expansion and contraction in all portions of pipe work to prevent undue strain in piping. Expansion joints to be installed as directed by the Engineer.
- All fittings such as elbows, tees, bushes, etc. shall be of best quality, foreign made or local made [Class A] according to local standard with smooth interior surfaces. Approved screw unions with bronze or steel bodies and ground brass taper or spherical joints shall be installed at trapes instruments, etc. and where else directed to permit easy connection and disconnection. Final connection to all equipment and fixtures shall be made in a manner that will permit the complete removal of any fixture or any piece of equipment without cutting of pipeline. If after the plant is in operation any system do not circulate quickly and noiselessly [due to trapped or airbound connections]. The Contractor shall make proper alternations in these defective connections. If connections are concealed in furring floors or ceilings, the contractor shall bear all expenses of tearing up and rebuilding construction and finish.
- All main shall have a slope of not less than 5mm in 3 meters in direction of flow. All branches shall have a slope of not less than 1mm in 3 meters towards the main. All branches from mains shall be connected at the angle of 45 if possible. Each

piece of pipe and each fitting shall be carefully inspected on the inside to see that there is not defective workmanship on the pipe or obstructions in the pipes or fittings. Joints in all screwed piping shall be made with red lead and boiled in seed oil, completely covered the male threads.

- Straight elbows, bushing, long screws or bull head tees shall not be installed, and all offsets shall be made with fittings. Pipes shall not be bend at any time.
- Pipe work shall be installed in manner to allow for ease of air escape and system draining. It shall be endeavoured to obtain this naturally by gravity.

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SPECIFICATIONS
SANITARY INSTALLATIONS

However, where conditions don't permit it an automatic air vent shall be installed at all air pocket locations and drain gate valves shall be supplied and installed at all low points and risers legs or as shown on drawing. Before turning the project over to owner, contractor shall thoroughly disinfect the entire water system, include underground main. Systems shall be thoroughly flushed of all dirt and foreign matter.

- Pipes material is galvanized steel "blue sign" local made "class A".
- All pipe fittings such as elbow, tee, reducer, union, etc. shall be galvanized forged steel of the same quality of the pipe. Pipes and fittings shall be suitable for threaded connections.

b) Hangers, supports, anchors, etc.

The Contractor shall provide suitable and substantial hangers and supports for all piping. Piping shall be carried by pipe hangers supported from concrete insets. In general supports for pipes shall be not more than 2.5m, apart for 2" and smaller pipes according to the conditions of the job and directions of the engineer. Copper piping shall have hanger every 1.5 meter. All vertical piping be supported by heavy pipe clamps resting on the building structure. No piping shall be hung from other piping and all hangers shall be of heavy construction suitable for the size of pipes supported. All horizontal pipes shall be supported by split ring hangers of malleable iron, with sockets for hangers of solid rod the length of each shall be adjustable. All vertical pipe line passing up through the building shall be hung from each floor of the building. Malleable iron clamps of sample size bolted around the pipes, shall be used for these supports. These pipes shall be secured midway between the floor and the ceiling of each story by means of malleable iron, solid hangers

around the pipe and fastened to adjacent walls by means of inverted bolts cast in concrete walls anchors shall be separate and independent from all hangers and supports. All anchors shall be of heavy angle iron construction and suitable in every way for the work, and shall be installed where necessary or as directed by the architect.

c) Valves

Hand valves and check valves shall be of an approved quality "KIM" or equivalent and shall be furnished and installed as shown on the drawings or as directed during construction.

The Contractor shall include for the finishing the required valve tag and a schedule of valves with a schematic drawing showing position of each. The drawing shall be glazed, framed and hung in the machine room.

3-84

SPECIFICATION
SANITARY INSTALLATIONS

d) Float Valves

Supply and install all float valves as shown on the drawings and wherever specified in this book of specifications.

Float valves shall be all bronze, screwed ends, float operated. Float shall be all copper and mounted at the end of a brass or copper rod, which actuates valve operation.

e) Cleaning of Pipe

During constructions, the contractor shall cap all lines so as to prevent the entrance of sand, dirt, etc. All pipe, fittings, valve etc. shall be cleaned of grease, dirt, scale and foreign material before installation.

Before turning the project over to the owner all piping system shall be thoroughly cleaned following the hereinafter specified instructions:

Piping shall be cleaned by operating system at normal operating pressure approximately 48 hours, wasting the condensate. At the end of the 48 hours period, contractor shall clean all strainers by removing baskets and flushing with clean water. Blowing down through strainer blow down valve will not be acceptable.

f) Testing

The piping system shall be tested by accepted method and under 150 psi hydrostatic pressure. Test shall be maintained under inspection by consulting engineer for period of not less than 8 hours. No part of piping system shall be repeated after leaks are corrected. No part of piping system shall be covered or concealed until it has been tested, inspected and approved by engineer.

I-4

MANHOLES

- a. All manholes shall be built from concrete or solid brick laid on 10cm. Concrete base over a 15cm. Hard-core , dimensions and level of inverts of manhole are shown on drawings.
- b. Work shall include excavation, back filling, concrete base, hard-core installation, reinforced concrete cover slab, benching and rendering internally.
- c. Benching of manholes to be semi circular of diameter equivalent to adjacent pipes and to be rendered and plastered perfectly smooth, inclination in manhole to be 2cm minimum.
- d. Manholes over 1 meter deep shall be supplied by Cast iron steps well anchored to the concrete walls at a spacing of 30cms.
- e. Manholes exceeding 2 meters deep shall be reinforced concrete base and walls cast in place as shown in drawings.

3-85

SPECIFICATIONS
SANITARY INSTALLATIONS

I-4

MANHOLES (CONT'D)

- f. Drop manholes exceeding 2 meters to be also of reinforced concrete base above.

I-5

CLEAN - OUT BOXES

Clear - out boxes shall be approved quality P.V.C. 4"/2". They shall be provided with air tight, sealing cover of chrome plated bronze.

I-6

CLEAN - OUT OPENINGS

- a. Clean out opening is exposed P.V.C. soil and waste pipes shall be provided where shown on drawings and where required.
- b. All elbows for under ceiling piping connection shall be provided with gates.

I-7

FLOOR DRAIN

Floor drain shall be obtained from an approved manufacturer P.V.C. 4"/2" minimum water seal complete with chrome plated duty strainer tightly sealed to drain body. All 2" P.V.C. drain pipes are connected to floor trap by rubber sealed record fittings.

I-8

ROOF DRAIN

Each roof drain shall be of P.V.C. pipe constructed with no trap, having and integral flange and wire Dome type

strainer, fixed by screwing into the drain body. Rain drain shall be installed as shown on drawings.

I-9

WATER TANKS

Tanks shall be constructed of anti-corrosive steel sheet of 0.08mm thickness. The work shall include installation on steel bases and also connection of galvanized pipes from the main public pipe with a water meter, valves and installation of diaphragm ball valve. Also the supply pipe from the tanks includes a vent pipe. A test will be made against any leakage or defect and according to the approval of the Engineer.

I-10

PLUMBING FIXTURES

Contractor shall supply and install the plumbing fixtures. All fixtures shall be set true and level. All necessary supports for fixtures shall be installed before plaster work. All exposed connections and fittings shall be of chromium plated brass. All nipples through wall to fixture connections shall be copper with compression connections.

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SPECIFICATIONS
SANITARY INSTALLATIONS

I-10 **PLUMBING FIXTURES** [**COND'T'D**]

No water supply shall be less than 1/2".

- a. Supply and installation of wash basin, porcelain local made class "A" size 56x41, with chrome plated cold water faucet, size 1/2" of approved manufacturer such as [Grohhe or equivalent] including chrome P-trap same kind of faucet connected with over flow and with the floor trap by plastic P.V.C. pipe 2" and with chain and rubber plug. Height of basin 80 cm. From floor.
- b. Supply and install of porcelain W.C. bowel including internal S-Siphon local made class "A" or equivalent. The price includes plastic flushing tank, plastic W.C. seat cover of heavy duty such as [Keter], chrome plated angle valve 1/2" chrome plated flexible hose 1/2" . The W.C.'s connected with the 4 inch P.V.C. main sewage pipes, connecting the flushing tank to main cold water line by 1/2" galvanized pipe . W.C. bowels shall be fixed to floor- by cadmium screws and tightly grouted.
- c. Supply and installation of best quality class "A" Porcelain laundry sink of size 60x39x36cm with chrome plated cold water faucet size 1/2" of approved manufacture such as [Grohhe or equivalent] including 2" plastic P-trap connected with the floor by P.V.C. pipe 2", and with chain and rubber plug. The price includes connection to

cold water mainline by ½" galvanized steel pipe. Height of sinks 60 cm from floor.

- d. Supply and installation of stainless steel kitchen single sink size 100x56cm including the supply of chrome plated cold water faucet of approved quality [Grohhe or equivalent] connected to cold water mainline by ½" galvanized steel pipe and connected to floor drain trap by 2" P.V.C. pipe.

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I N D E X

SECTION J FLOOR WALL AND CEILING FINISHES

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SECTION J FLOOR, WALL AND CEILING FINISHING

J 1 **GENERAL** This section of the specifications covers plasterwork and other floor, wall and ceiling finishes intended for the works all in accordance with the Drawings, Bills of Quantities and as directed by the Engineer..The Contractor shall attend upon other trades and protect all work specified under this section from damage during subsequent operations. Make good any defects, clear away debris upon completion clean throughout and leave all work in perfect condition to the satisfaction of the Engineer's representative.

The Contractor shall be responsible for the design and stability of the scaffolding and for all safety precautions in connection with works specified under this Section.

Damaged or defective materials shall not be used in the works. Any defective materials or materials damaged during or after installation shall be removed and replaced at the Contractor's expense.

J 2 **MATERIALS** **GENERALLY** The cement and water used for plastering shall be as before described in Section C -Concrete Work and the sand shall be as before describe in Section D - Blockwork. White (Nonstain) cement for tinted plaster shall conform to the requirements of the Standard Specification for Masonry Cement of the ASTM Designation (C-91) latest

edition. Lime shall be imported and of the hydrate type complying with Class B of B.S. 890. Marble chippings shall be irregular in size and roughly cubical in shape. Samples shall be submitted to the Engineer for approval. Sizes shall be as required by the Engineer and as selected from the following table next page:

3-88

SPECIFICATIONS
FINISHINGS

	_B	Ap	In	Ma	_	-	13	1	-
	.	S	pr	ch	rb	-	.	0	/
Si	.	ox	es	le	-	0	2	95	
ze	Si	im		Ch	7	10	3/	-	
s	ev	at		ip	14	.	0	8	10
Pe	e	e		pi	25	0	3/	0	
rc		mm		ng	52		16	25	
en				s	10	5.	0.	-	
ta					0	00	09	60	
ge							5	5	
Pa					2.	0.	-		
ss					40	04	30		
in						7	0		
g					1.	0.	-		
					20	02	10		
By						4	-		
we					0.	0.	-		
ig					60	01	-		
ht						2			
					0.	0.			
					30	00			
					0.	6			
					15				

Any pigments or colouring materials incorporated in mortar shall comply with B.S. 1014:1961.

Waterproofer additives shall be to the approval of the Engineer. The materials shall be delivered in containers

bearing the name of the manufacturer and the instructions for use.

Angle beads, casing beads and shop beads where shown on the drawings shall be galvanized steel 26 gauge or pressed steel 24 gauge complying with B.S. 1246.

Metal lath for use in plaster shall be plain expanded metal type complying to B.S. 1369, weighing not less than 1 kg/sq.m. All metal lathing shall be zinc coated.

Metal lath shall be secured to the carcass and blockwork by means of galvanized steel nails. If the wire for securing metal lath is to be used it shall be of zinc coated wire not less than 1.2mm in diameter.

Plaster expansion joint strips, where shown on the Drawings or indicated in the Bills of Quantities, shall be of aluminium channels maximum size 20x20mm and 1mm. Thick and shall be perforated at side to form a suitable bond to plaster.

3-89

SPECIFICATIONS
FINISHINGS

J 3

PLASTERWORK

J 3.01

Mixing of Ingredients

Except where hand mixing of small batches is approved by the Engineer, mechanical mixers of an approved type shall be used for the mixing of plaster.

Frozen, caked or lumped materials shall not be used.

Mechanical mixers, mixing boxes and tools shall be cleaned after the mixing of each batch and kept free of plaster from previous mixes. Plaster shall be thoroughly mixed with the proper amount of water until uniform in colour and consistency. Retempering will not be permitted and all plaster which has begun to stiffen shall be discharged.

All plastering shall be executed in a neat workmanlike manner and internal and external angles shall be true, straight and plumb. Plaster shall be made good adjacent

to wood or metal frames, skirting and around pipes or other fittings.

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

J 3.02 Preparation of Surfaces

All surfaces to be plastered shall be clean and free from dust, grease, loose or projecting mortar and all traces of salts are to be thoroughly sprayed with water, but all free water shall be allowed to dry and disappear from the surface before the plaster is applied.

Plastering shall not be commenced until the background has been suitably prepared. Blockwork joints shall be deeply raked out, efflorescence brushed off and all dust and foreign matter removed.

Before plastering is commenced all junctions between differing materials shall be reinforced. This shall apply where wall join columns and beams, particularly where flush, and similar situations where cracks are likely to develop and as directed by the Engineer. The reinforcement shall consist of strip of galvanized wire mesh (10 to 15mm hexagonal mesh) 15cm wide which shall be plugged, nailed or stapled as required at intervals of not exceeding 45cm at both edges.

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SPECIFICATIONS
FINISHINGS

On all external surfaces and on all smooth internal surfaces spatter dash of cement and sand which shall contain 500 kgs of cement per one meter cube of sand shall be applied and allowed to dry before rendering is commenced. All surfaces of walls shall be wetted immediately prior to applying the first coat of rendering and this shall be allowed to thoroughly dry out before the next coat is applied.

The Contractor shall form vertical guide screeds 5cm wide. The spacing shall not exceed 1.50 meters.

The screeds shall be plumb and in the same plane with each other. The sides of the screed shall be kept rough to bond with plaster, the surface shall be smooth.

The finished surface shall be true to shape and angle over in all directions, with straight rises free of cracks and trowel marks and to the entire satisfaction of the Engineer.

Application of Coatsa) Base-Coat (Rendering)

After the application of the spatterdash "rasheh" the base coat shall be applied after the spatterdash coat has set but in no case earlier than 24 hours after the application of the spatterdash coat.

When applied to masonry or to concrete surfaces the base coat shall be applied with sufficient force to prevent air pockets and to secure a good bond.

The base coat shall be lightly scratched in both directions to provide a key for the finishing coat and shall be kept moist with a fog spray for 2 days and then allowed to dry out.

b) Finishing Coat

Shall not be applied until the rendering or base coat has seasoned for seven days; just before the application of the finish coat, the rendering or base coat shall be wetted evenly with a fog spray. Where cement plaster with a smooth trowelled finish is specified or indicated on the drawings, the finish coat shall be first floated to a true even surface, then trowelled in a manner that will force the sand particles down into the plaster and with the final trowelling, leave the surface finished smooth and free from rough areas, trowel marks, checks or other blemishes.

Proportions for Internal and External Plaster

Internal and external plaster shall be composed of 400kg of cement per one cubic meter of salt free sand.

Plastering shall be applied in two (2) coats unless otherwise specified or indicated on the drawings.

Finishing coat shall have a reasonably uniform thickness of approximately 5mm.

Screed shall be laid and ruled as necessary to allow for a total thickness of 15mm for external and internal plaster and the rendering shall be applied to the required thickness.

The metal grid system shall be a patent system suitable for use with in-situ plaster and expanded metal lathing

and shall have, flat metal hangers to suit suspended ceilings depths as shown on the drawings and described in the Bills of Quantities. The system shall include all main and cross runners, necessary splicers, hangers, clips and wall mounting next to walls. The system shall be installed complete in accordance with the manufacturer's instructions.

The metal grid suspension system shall be concealed and shall allow for the whole of the ceiling to be demountable.

All concealed ferrous metal members such as channel runners, z-bars, clips and splines shall have an approved corrosive-resistant finish.

J 3.05 Metal Lath

At all junctions of dissimilar materials (i.e. concrete and blockwork or steel elements) the joint shall be covered by metal lath strips not less than 200mm in width securely fixed to the surface.

J 4 **WATERPROOFING PLASTER TO ALL EXTERNAL WALLS**

Mixing of plaster ingredients and preparation of surfaces to be plastered with waterproofing plaster shall be as specified above.

Rendering coat shall contain 450kg. Of Ordinary Portland Cement per cubic meter of clean coarse salt free sand and with admixture of waterproofing compound as specified added in accordance with the printed instructions of the manufacturer, shall be applied and the surfaces shall be trowelled hard smooth and allowed to dry. All surfaces of plastered areas shall be cured for a minimum of 7 days.

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SPECIFICATIONS
FINISHINGS

J 5 **TYROLEAN PLASTER (FINE GRAIN)**

J 5.01 General

The tyrolean plaster shall be executed to the extent shown on the Drawings and as directed by the Engineer.

The contractor shall provide sample (s) of Tyrolean plaster for the approval of the Engineer prior to commencement of Tyrolean work.

J 5.02 Mixing

Cement and aggregate for each batch shall be accurately measured and mixed dry until evenly distributed and the mass is uniform in colour. All batches shall be of such size that they can be entirely used within half an hour. Mechanical mixers of an approved type shall be used for

mixing tyrolean plaster, except when hand mixing of small batches is specifically approved by the Engineer. Mechanical mixers, mixing boxes and tools shall be cleaned after mixing each batch and kept free of tyrolean mortar from previous mixes. Water content shall be maintained at a minimum. Mixing shall be continued until plasticity be maintained at a minimum. Mixing shall be continued until plasticity is obtained.

J 5.03

Proportions

Proportions of materials for tyrolean, by volume shall be as follows:

- a) Scratch Coat
 - 1 part Ordinary Portland Cement
 - 3 parts fine aggregate
- b) Finish Coat
 - 1 part of white Portland cement
 - 3 parts fine selected aggregate

No lime shall be allowed in either scratch or finishing coat, scratch coat shall be set on spatterdash.

J 5.04

Application of Tyrolean

a) Workmanship

Surfaces to receive tyrolean shall be clean, free from dust, dirt, oil, or other particles that might interfere with a satisfactory bond. Surfaces to receive tyrolean shall be evenly dampened (not soaked) with a fog spray before tyrolean is applied. If surfaces become dry in spots, the dry areas shall be dampened again to restore uniform suction. Tyrolean coats shall be applied continuously in one general direction without allowing mortar to dry at edges. Edges to be jointed shall be dampened slightly to produce a smooth confluence. Tyrolean unless otherwise shown or specified shall be two coats work not less than 20mm. thick (i.e. spatterdash, crotch coat and one tyrolean coat).

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FINISHINGS

All exterior corners of tyrolean shall be slightly rounded. Tyrolean on soffit surfaces shall be pitched forward to form a drip.

b) Scratch Coat

Shall be approximately 14mm. thick and shall be applied under sufficient pressure to form good keys and shall be brought to a plumb true even surface. The scratch coat shall be damp-cured 48 hours before the finish coat is applied under sufficient pressure to form good keys and shall be brought to a plumb, true even surface. The

scratch coat shall be damp-cured 48 hours before the finish coat is applied.

c) Finish Coat

Shall be approximately 6mm, thick. Surfaces of the scratch coat shall be dampened several hours before the finish coat is to be applied. Additional dampening at time of application shall be by fogspraying. Dampening by brush will not be permitted. When measure with a 2meter long, straight- edge applied in all directions the finish surface shall not vary from a true plane by more than 1.5mm. The finishing coat shall be applied by means of a proper spraying machine and the degree of the finishing coat shall be determined by the Engineer.

J 6 BEDS AND BACKINGS

Cement and sand beds and bedding under floor finishings and backing behind wall and column finishings shall be cement and sand (1:3) mix by volume unless otherwise specified.

J 7 CEMENT SCREED TO CHANNELS

Cement screed shall, unless otherwise ordered by the Engineer, consist of one part of Ordinary Portland Cement to four parts of sand by volume. Ingredients shall be proportioned and mixed specified under concrete work and laid to falls with smooth trowelled finish as shown on the Drawings.

J 8 PRECAST TERRAZZO TILING

Precast terrazzo units shall be firmed with a (1:2 ½) mix of white or tinted Portland cement and granular marble chippings for the topping (wearing layer) it on cement and sand backing (1:5) mix shall be obtained from an approved manufacturer. These units shall be cast in heavy steel mould under pressure to the proportions and sieve sizes approved by the Engineer. The thickness of waring layer

shall not be less than 10mm and the pattern and dimensions shall be as shown on the drawings and/or stated in the Bills of quantities.

Grinding shall be done wet by means of a No. 50 carborundum stone. Filling shall be carried out with a neat cement grout of the same colour as the facing mix and this shall be worked into the surface with a wooden scraper 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 units shall be cured by totally immersing them after the initial set has been taken place in a tank of clean water for at least 24 hours.

The precast terrazzo units shall be laid on a bed of sand with a (1:3) mix of cement and sand mortar with admixture of lime.

The grout shall consist of neat cement of a colour to match the tiling. Any surplus grout shall be cleaned off the face of the tiling and surrounding surfaces immediately and all tiling shall be carefully cleaned off.

All terrazzo surfaces shall be polished on completion. Large areas such as floors shall be wet polished by means of approved machine using a No. 140 Carborundum wheel. Any surfaces 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 angles or arises.

All units shall be well shaped with straight edges perfectly flat and free from defects which affect appearance or serviceability.

Chipped units or units with cracks or other defects will not be accepted and if laid in place the Contractor shall replace the defective units at his own expense to the satisfaction of the Engineer.

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SPECIFICATIONS
FINISHINGS

J 9

CERAMIC FLOOR TILING

Ceramic floor tiles shall be first quality vitreous clay non-slip tiles with keyed backs and a minimum 8mm thick

of the sizes indicated on the drawings to comply with B.S.1286 type B and shall be obtained from an approved manufacturer. The colour and pattern of the ceramic tiles shall be selected by the Engineer. Samples shall be submitted to the Engineer for his approval prior to order.

Ceramic Floor tiles shall be laid on top of cement sand screed (1:3) mix of predetermined level such that total thickness of screed bonding layer and tiles shall be as shown on the drawings or mentioned in the Bills of Quantities with a minimum of cutting. The tiles shall be thoroughly soaked in water for a minimum of twenty-four (24) hours before laying. Tiles and skirtings shall be bedded in cement and sand (1:3) mix with addition of approved plasticisers.

All joints shall be as close as possible and shall in no case exceed half (0.5) mm in width on face. Tiles shall be neatly cut and fitted around pipes and other obstructions.

A thick creamy slurry of neat white or tinted cement mixed with sufficient water shall be brushed over the floor until all joints are thoroughly filled.

The surface of the floor shall be very gently rubbed with a wood block to bring tile surface to true planes, excess slurry shall be removed, and the floor shall be rubbed with burlap to clean the tiles and finish the joints to the satisfaction of the Engineer.

J 10

GLAZED WALL TILES

Glazed tiles shall be best quality white or coloured glazed ceramic tiles to the sizes approved by the Engineer conforming to B.S. 1281 and shall be obtained from an approved manufacturer. Coloured or patterned tiles shall be as selected by the engineer.

Cement and sand (1:4 nominal mix) plaster ten (10) mm thick shall be laid as base for wall tiling. The surface of plaster shall be scratched in an approved manner, when be well wetted before the tiling is applied. Plaster shall be cured for five (5) days before starting application of tiling.

All tiles shall be immersed in clean demineralized water for twenty-four (24) hours and all surplus water drained off before bedding.

Tiles shall be set in cement and sand mortar (1:4) mix, to a true vertical face with continuous horizontal and vertical joints. Joints shall be straight, level, perpendicular and of even width not exceeding 1.5mm. The vertical joints shall be maintained plumb for the entire true level and plumb by uniformly applied pressure under a straight edged or rubber-faced block, misfits as well as damaged or defective tiles shall be removed and replaced by and at the Contractor's expense.

The external, internal angles, top edges and side edges of glazed wall tiling shall be formed with rounded edges tiles.

Joints in glazed wall tiles, after the edges of tiles have been thoroughly wet, shall be grouted with a plastic mix of neat white or coloured cement immediately after a suitable area of tile has been set.

The joints shall be tooled slightly concave and the excess mortar shall be cut off and wiped off with a damp cloth from the face of tile, before it sets hard.

Interstices or depressions in the mortar joints after the grout has been cleaned from the surface shall be roughened at once and filled to the spring line of the cushion edge before the mortar begins to harden.

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.

Immediately after the grout has had its initial set, glazed wall tile surfaces shall be given a protective coat of a non-corrosive soap or other approved method of protection and joints cured for 71 hours.

J 11

POLYVINYL CHLORIDE FLOOR TILING

Polyvinyl chloride (PVC) tiles shall be flexible homogeneous vinyl tiles manufactured according to B.S. 3261-60, the tiles shall be 300x300x3mm thick of matt finish and of colour as approved by the Engineer, unless otherwise directed. Edges shall be factory prepared to receive hot welding during laying.

FINISHINGS

Skirting shall be coved type and of height as shown on the Drawings and/or stated in the Bills of Quantities.

PVC tiles shall be bedded in polyvinyl chloride binder on dry surfaces of concrete tiles according to the manufacturer's instructions at the recommended rate. Hot welding of tiles joints shall be carried out according to recommendations of tile manufacturers.

Dampness of surface in contact must be prevented during tiling.

J 12

MARBLE FLOOR TILING

Marble slabs for flooring, skirtings and the like shall be first quality Bethlehem Marble obtained from an approved supplier.

The marble slabs shall be of the dimensions and thickness shown on the drawings and in the Bills of Quantities and shall be uniform in colour and texture, smooth and free from voids, earth veins, lamination and the like, and shall be of an approved colour and to the pattern and sizes shown on the drawings.

Samples of marble slabs shall be submitted to the Engineer for approval prior to order.

Marble slabs shall be cut square, true and shall be uniform in shape and thickness. Mortices shall be carefully cut without causing any damage to marble, and rebates shall be carefully formed by special machines to the width and depth required to the satisfaction of the Engineer.

Marble slabs for floor finish and marble treads shall be laid on a bed of sand with cement and sand mortar (1:3) mix.

All marble slabs shall be backed with stain proofing in accordance with the manufacturer's instructions.

Marble skirtings and risers shall be bedded with same mix as for floor marble but without the bed of sand.

All joints shall be thoroughly grouted with unstained cement and cleaned well before it sets hard.

All exposed faces and edges of marble shall be polished smooth, free from scratches or other defects and properly protected from damage by means of timber casings.

All workmanship shall be of the best of its kind and shall be carried out in a manner satisfactory to the Engineer.

J 13

MARBLE THRESHOLDS

Unless otherwise shown on the drawings or stated in the Bills of Quantities, marble thresholds shall be first quality carrarra marble obtained from an approved manufacturer. Thresholds shall be of the thickness and widths shown, of one piece and full length if the opening, levelled on both sides with hone finish on all exposed surfaces. Ends of thresholds shall be fitted accurately to jambs.

J 14

PROTECTION AND CLEANING MARBLE

Great care shall be taken to protect delivered and erected marble from chipping and staining during the course of the work. Delivered marble shall be stored in a water from area on raised platforms and shall be covered with tarpaulins or similar material until required for use.

Erected work shall be protected at corners, etc., with non- staining wood formwork, boards, etc. Floors shall be protected with suitable boarding, etc, after laying. Any work damaged or stained at the time of handing over shall be replaced or cleaned as required by the Engineer.

After completion of setting, all marble work shall be thoroughly cleaned by scrubbing with fibber brushes and mild alkaline solution that contains no caustic or harsh fillers. The use of wire brush or acid solution will not be permitted. Cleaning shall begin at the top of the building and proceed downwards. Upon completion all marble shall be left clean and free from stains or traces of cleaning fluid and with all joints pointed and to the entire satisfaction of the Engineer.

J 15

FLOOR DRESSING

The granular abrasive powder shall be trowelled into the finishing surfaces of the screed applied as desired hereinabove, working out of the dressing shall strictly conform to the method of application recommended by the manufacturer of material.

J 16 **FLOOR SEALING**

The floor seal shall be applied on the surface of screed which has been prepared and applied as described hereinabove. Screed shall be cured for a minimum of five (5) days before application of floor seal.

The priming and the working out of the floor seal shall be strictly conform to the method of application recommended by the manufacturer of the material.

J 17 **SUSPENDED CEILINGS**J 17.01 General

The Contractor shall provide shop drawings to show the final layout and sizes of members of all suspension systems and to co0ordinate the design and work of suspended ceilings with other trades to provide for the reception and installation of outlets, fixtures, diffusers, etc, pertaining to mechanical or electrical work, all to the Engineer's approval before any work is commenced.

J 17.02 Materials

a) Acoustical Materials

Acoustical materials shall be non-combustible conforming with the requirements of the American Federal Specifications SS-A-118b and shall be described in the current Acoustical Materials Association Bulletin, Sound-Absorption Coefficients of Architectural Acous- tical Materials.

Acoustical ceiling tiles or panels shall be as manufactured by "ROCKWOOL CO.", OR "ARSTRONG CORK COMPANY Ltd." Or Johns Manville" and/or approved equivalent.

Acoustical ceiling tiles or panels shall be of the size thickness, whether perforated or non-perforated, design and finishes shown on the Drawings and/or stated in the Bills of Quantities.

Samples of acoustical ceiling tiles or panes in suspension system members, with catalog data, shall be submitted to the Engineer for approval.

b) Aluminium Ceiling Panels

Aluminium ceiling panels shall be similar to "luxalon Aluminium Panel Ceiling, the product of "Hunter Douglas" or "MIRAWAL DAMPA Aluminium Acoustical Ceiling Systems, the product of MIRAWAL COMPANY" and or approved equivalent.

Aluminium ceiling panels shall be of the size, thickness whether perforated or non-perforated, design or type and finishes shown on the drawings and/or stated in the Bills of Quantities.

Samples of aluminium ceiling panels with carriers shall be submitted to the Engineer for approval prior to order.

c) Plain Asbestos Cement Panels

Plain asbestos cement panels, shall be minimum 8mm, thick of an approved manufacturer. Asbestos cement sheets shall meet the requirements of B.S. 4036 "Asbestos cement fully compressed flat sheets". Panels shall be of the non-perforated type.

d) Metallic Grid, Hangers and Fixing Accessories

All suspension members, hangers, wires, strips, clips, clamps, etc., shall be of the sizes and types recommended by the manufacturer of the suspended ceiling systems.

The metal grid for suspended ceilings shall be either concealed or exposed system as indicated on the Drawings and/or stated in the Bills of Quantities.

The exposed metal grid system for suspended ceilings shall be made of aluminium sections or factory hot dopped galvanized steel sections and the concealed system shall be made of steel sections painted with approved rust inhibitive primer as recommended by the manufacturer of suspended ceilings and approved by the Engineer.

J 17.03

Workmanship

Acoustical materials shall be installed under temperature and humidity conditions similar to those which will exist when the building is occupied. They should not be installed when buildings are damp and cold or dry and hot. Plastering floor and wall cladding shall be completed and allowed to dry before the installation of

acoustical materials commences. All windows and doors shall be in place and glazed. Poured or precast concrete or similar roof decks shall be thoroughly dry.

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FINISHINGS

Buildings shall be examined before beginning work to determine that it is properly enclosed and the structure is in proper condition to receive acoustical material and/or suspension system. Areas shall be from cleaned and uninterrupted for free movement or rolling scaffold.

All products covered by these specifications shall be installed in accordance with the latest edition of the approved manufacturer's specifications.

All acoustical materials and suspension systems shall be installed by skilled labour, thoroughly experienced with this type of installation and in strict conformity with the manufacturer's specifications and to the approval of the Engineer.

Suspended ceilings shall be constructed in accordance with the details and instructions supplied by the manufacturer and approved by the Engineer. The grid shall be constructed to true level and to produce a perfect alignment of the joints truly parallel to the buildings lines, and completely free from waviness.

Special access hatches as required shall be provided next to air conditioning and ventilation units and wherever required by the Engineer. Mounting details shall be applied for the surrounding edge of lighting fixtures and air inlets and outlets and edge of ceiling.

After the installation of the panel carriers for the aluminium ceiling panels, the panels shall be clipped on-to the carriers without the use of any tools.

Plain asbestos cement panels for closing and gaps of suspended ceilings and access panels to gear boxes or ducts shall be cut to true sizes and screwed to galvanized steel angle framing in accordance with the manufacturer's directions and to the satisfaction of the Engineer.

Following installation, the Contractor shall clean soiled or discoloured surfaces of units, remove and replace any unit which is damaged or improperly installed to the satisfaction of the Engineer.

All wall, floor and ceiling finishes shall be protected from damage until the completion of the Works. Should any damage be caused it shall be made good to the satisfaction of the Engineer at the Contractor's expense.

All floors, skirtings and unpainted wall finishing shall be cleaned and left perfect on completion.

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I N D E X

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SECTION K

GLAZING

K 1 SCOPE

These specifications cover Glazier work intended for the glazing of doors, windows, etc. for the project in accordance with the schedule of Doors and Windows Drawings, Bills of Quantities and as instructed in writing by the Engineer.

K 2 MATERIALS

K 2.01 General

All glazing shall conform to the requirements of B.S. 952 and shall be of uniform thickness free from waviness, air bubbles and all other defects; they shall be of first quality such as manufactured by "PILKINGTON", SAINT GOBAIN" or approved equivalent.

All glass shall be delivered to Site in proper containers with maker's name, guarantee, type of glass and thickness or weight of glass attached to the outside of the containers.

K 2.02 Clear Sheet Glass

Clear sheet glass shall be transparent, flat, relatively thin glass having a glossy, fire-finished, plain and smooth surface. The defects permitted in the central area of the type of glass are a few seeds, an occasional large seed not more than 6mm. long, faint strings or lines, and very light scratches and other surfaces defects detected only by close scrutiny. No pane (separate piece of glass) shall contain all of these defects and those present may not be clustered when in the central area. In general, the central area of light shall be as free from defects as possible and the appearance of the light as a whole shall be such that there is no perceptible interference with sight through the glass.

The clear sheet glass shall not weigh less than 10 kg/m² when 4mm thick and not less than 15 kg/m² when 6mm thick.

K 2.03 Polished Plate Glass

Polished plate glass shall be of light and/or medium bronze colour and shall have its two surfaces perfectly flat and parallel so that they provide undistorted vision and reflection. Polished plate or float glass shall not weigh less than 10 kgs/m² when 4mm thick and not less than 15 kgs/m² when 6 mm thick. The respective weights of the 8, 10 and 12mm, thick polished plate glass shall be as manufactured by "PILKINGTON", "SAINT GOBAIN" or approved equivalent.

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SPECIFICATIONS
GLAZING

Mirror glass shall be 6mm. thick or as shown on the Drawings or stated in the Bills of Quantities. It shall be of selected quality plate glass silvered on one side, electro- copper-backed followed by a coating of shellac varnish and painted to the satisfaction of the Engineer.

Tempered float glass shall have been subjected to a special tempering process. Security glass shall be used in places and thickness as shown on the Drawings it shall impact mechanical strength comparatively light weight and impact resistance characteristics. When under terrific impact, it shall disintegrate into innumerable small, blunt-edged fragments and not into sharp-like ordinary glass.

K 2.04 Putty

Putty for glazing to wood other than non-absorbent hardwood shall be tropical grade wood glazing. Putty for glazing to metal and non-absorbent hardwood shall be tropical grade metallic glazing.

K 2.05 Neoprene

Neoprene strips for aluminium elements shall be supplied by the manufacturer of aluminium elements. Neoprene strips shall be stored in a safe location and shall be protected from the sun and excessive heat.

K 2.06 Bead Glazing in Aluminium Frames

The bead glazing in aluminium frames doors and windows shall be special P.V.C. sections that fit into the aluminium frame and hold it firmly in position. Approved special mastic possessing the required adhesion and elasticity shall be used. In the case of heads where one end is free, mastic alone shall not be allowed,

additional cleats of timber or metal shall be used to secure the proper fixing of the glass.

K 3 WORKMANSHIP

K 3.01 General

Prior to proceeding with any work, the Contractor must take all necessary measurements on Site to verify and supplement dimensions and conditions shown on the Drawings and the Schedule of Finishes.

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SPECIFICATIONS
GLAZING

The Contractor shall protect all glazing work from damage during subsequent operations, made good any defects, clear away upon completion, clean throughout and leave all work in perfect condition to the satisfaction of the Engineer.

All accessories and other items essential for the proper execution of the glazing work, though not specifically shown on the Drawings or specified, shall also be provided under this chapter.

The Contractor shall fix all glass frames with all the required gaskets, clips, points, etc. all glass panes shall have rounded edges to prevent any damage to the gasket. All glass shall be cleaned by the Contractor before completion of the works.

K 3.02 Glazing to Metal

Only glazing to metal with beads shall be permitted. The rebates shall be previously treated as specified under "PAINTING" and the bedding putty inserted. The glass shall be embedded in the putty and secured by the beads. The bedding out shall be trimmed off level with the sight line to form a neat putty and painting shall be carried out.

K 3.03 Glazing without Putty

Where specified, flannel, felt, asbestos, rubber. Neoprene or similar materials shall be used in place of putty for internal glazing in conjunction with beads. The material should be so fitted as to cover all parts of the glass which will be covered by the rebate and beads.

K 3.04 Fixing of Mirrors

Mirrors shall be fixed to walls with rubber sleeves and chromium plated dome-headed screws driven into rawl plugs set into walls.

K 4 PROTECTION AND CLEANING

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

K 5 METHOD OF MEASUREMENT

Glass panes shall be measured net as executed.

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I N D E X

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S E C T I O N L

PAINTING

L 1 SCOPE

The Specifications cover paint work to exposed concrete and plastered surfaces, wood work, ferrous and non-ferrous surfaces in accordance with the Schedule of Finishes, Drawings, Bills of Quantities and as directed in writing by the Engineer.

The term "Paint" as used herein includes emulsions, enamels, lacquers sealers and other coatings, organic or inorganic, whether used as prime intermediate or finish coats.

All painting works shall be applied by skilled workmen experienced in this work.

L 2 MATERIALS

L 2.01 Materials in General

The materials to be used, shall be of the best quality and of approved types, obtained from an approved manufacturer (s).

All paints shall comply with the following requirements:

- a) The product shall be thoroughly mixed and ground.

- b) The colour of the paint shall match the approved sample.
- c) Paint shall show no evidence of cracking, chipping of flaking.
- d. Paint in the containers during and after application shall not be abnormally pungent, offensive or dis-agreable.
- e. Paint shall shown easy brushing, good flowing and spreading and levelling properties. These properties shall be demonstrated on test specimens at the request of the Engineer. Coats that have any noticeable pull under a large brush and that show poor spreading and flowing properties will not be ac-ceptable.
- f. Paint shall dry to a uniform, smooth, flat or semigloss finish under ordinary conditions or illumination and wearing. There shall be no laps, skips, high-lighted spot or brush marks. Tinted paints shall dry to a uniform colour.
- g. Recoating of a previous painted surface shall produce no lighting softening or other film irregularities.

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SPECIFICATIONS
PAINTING

L 2.02 Flintcoat Protective Coating

Flintcoat protective coating on fire escape staircase floors shall be coloured, "Decoralt" the product of "Flintcoat" or approved equivalent. It shall be especially compound acrylic resin latex colour coating, heavy bodied, flexible and abrasive resistant.

L 2.03 Knotting

Shall be composed of dissolving shellac or other resin remains unaffected by the resinous materials in the timber leaching into the paint film and causing discoloration or defective drying

L 2.04 Mordant Solution

Shall be composed of a solution slightly acidic in nature and containing solvents, for applying to new smooth metallic surface to remove grease, organic soaps and provide a physical key and shall be obtained from an approved supplier.

- L 2.05 Fillers
- Shall be "Polyfilla ", Alabastine" or approved equal.
- L 2.06 Stopping
- Shall be hard stopping composed of white lead paste, gold size (oleo resinous medium) and other fillers obtained from an approved supplier.
- L 2.07 Putty Filler
- Shall be composed of white lead and dry filler mixed with pure linseed oil, the content of the white lead shall be not less than ten percent (10%) of the mixture by volume and shall be obtained from an approved supplier.
- L 2.08 Thinners
- Shall be approved turpentine or white spirit, except where the paints are specified to be water thinned, fresh water shall be used.
- L 2.09 Stain for woodwork shall be of an approved brand of oil stain complying with B.S. 1215.

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SPECIFICATIONS
PAINTING

- L 2.10 Shall be pure tinty colour that will easily dissolve and mix with the various coatings and shall conform to the requirements of B.S. 1014: 1961 "Pigments for cement, magnesium oxychloride and concrete".
- L 2.11 Rust Inhibitor
- Shall be "galvanized" primer, manufactured by "Seconrastic Ltd. Brackwell Berks, England" or Crown Chlorinated Rubber Zinc Rich Primer-Product Data Sheet No. 56, manufactured by the Walsby Co. Ltd., Darwen Lancs" and/or approved equivalent.
- L 2.12 Primers
- Primers applied to surfaces of different materials shall be as follows:
- a) Interior or exterior) Alkali resistant primer as plastered surfaces) recommended by the manufacturer.

- b) Ferrous Surfaces) Lead based or zinc Chromate and
) Calcium Plumbate as recommended
) by the Manufacturer.
- c) Non-ferrous surfaces) Mordant solution of an approved
) brand and rust inhibiting
) primer.
- d) Woodwork Surfaces) Leadless grey primer in accor-
) dance with B.S. 2524 latest
) edition.

L 2.13 Undercoating Paints

For exterior or interior shall be as follows:

- a) 2 coats of whitewash or colorwash as shown on the
 Schedule of Finishes and the Drawings.
- b) White lead bases undercoating in accordance with
 B.S. 2525:Colours shall be similar to the finishing
 paint.
- c) Other undercoating paints to be applied as
 recommended by the manufacturers of the finishing
 paint.

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SPECIFICATIONS
PAINTING

L 2.14 Finishing Paints

Shall be as follows unless otherwise indicated on the
Drawings:

- a) Interior plastered surfaces and exposed concrete sur-
 faces as shown on the Sche-
 dule of Finishes and the
 Drawings.) Float enamel paint or ap-
) proved emulsion paint for
) interior use of an ap -
) proved colour and sup-
) plier.
- b) Exterior exposed and plas-
 tered surfaces as shown on
 the Drawings.) Approved emulsion paint
) for exterior use of the
) colour indicated on the
) the Drawings.
- c) Plastered surfaces of toi-
 let, kitchen etc.. ditto) Float enamel paint for
) interior use of an ap-
) proved colour and sup-
) plier.

- | | |
|---|--|
| d) Interior or exterior ferrous and non-ferrous surfaces. ditto |) R.I.W.No.424 Chlorinated
) rubber paint interior or
) exterior grade, manufac-
) tured by "R.I.W. protec-
) tive Product Co. Ltd. 25
) Whitehouse Rd.Croydon"or
) or "Detel Products td.,
) South Ruuslip, iddlesex,
) England" or Crown hlori-
) nated finish-Product ata
) Sheet 7 as anufactured
) by the Walpamur Co. Ltd.
) Darwen Lancs" and orqui-
) valent. |
| e) Interior woodwork surfaces other than hardwood |) Oil paint semi-gloss
) finish of an approved
) manufacturer. |
| f) Hardwood surfaces |) Approveñ oil stain and
) ducco spray, or flat
) enamel paint. |

L 3

WORKMANSHIP

L 3.01

General

The Contractor shall submit to the Engineer for approval the brand and quality of the paints he proposes to use.

If approval is given to a brand of paint the Contractor shall use the primers, undercoats etc... manufactured or recommended by the manufacturers of that brand.

3-109

SPECIFICATIONS PAINTING

All paints to be used under this contract shall be delivered and stored on the Site in sealed, labelled containers, a minimum of 30 days prior to application by the Contractor that the material is at the Site, samples of each material shall be obtained at random from sealed container by the Engineer in the presence of an authorized representative of the Contractor.

Samples shall be clearly identified by commercial name, type of paint and intended use. If judged necessary by the Engineer the paint samples may be tested in a laboratory designated by the Engineer at the Contractor's expense,

Complete colour charts for the paints to be used shall be submitted to the Engineer for approval.

Pigmented paints shall be furnished in containers not larger than 25 kgs. All paints shall be produced that have a minimum of 2 years satisfactory field services.

Mixing and application of paint shall be in accordance with the Specifications of the manufacturers concerned and to the approval of the Engineer.

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

Hardware, hardware accessories, machine surfaces, plates, lighting fixtures and similar items in place prior to cleaning and painting, which are not intended to be painted, shall be removed or protected prior to painting operations and repositioned upon completion of painting work as directed by the Engineer.

Equipment adjacent or against walls shall be disconnected by workmen skilled in these trades and moved to permit the wall surfaces to be painted, and following completion of painting shall be replaced and reconnected.

Cleaning solvents shall be of low toxicity. Cleaning and painting shall be so programmed that dust and other contaminants from the cleaning process will not fall on wet or newly painted surfaces.

Brushes, pails, kettles, 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.

3-110

SPECIFICATIONS
PAINTING

No exterior or exposed painting shall be carried out under adverse weather conditions such as rain, extreme humidity, dust storms, etc.

Painting shall preferably be shaded from direct sun light to avoid blistering and wrinkling. Wherever possible, painting of exterior surfaces shall "follow" the sun such that it is carried out in shadow.

Edges, corners, crevices, welds and rivets shall receive special attention to insure that they receive an adequate thickness of paint.

All cracks and holes shall be cut out properly square and made good with suitable hard plaster or cement sand mix as appropriate such repaired portions being allowed to dry out and sandpapered smooth.

L 3.02

Plastered Surfaces with Emulsion or Enamel Paint

Such works shall be allowed to dry out completely before carrying out the painting operation. Plaster applied in the winter season shall be at least five weeks old and that applied in the summer shall be at least two weeks old before commencing painting operations.

Preparation of surfaces shall consist of vigorous brushing and rubbing down to remove loose surface material and dust.

Surfaces shall then be left for a week to determine whether efflorescence reappears in which case it shall be brushed off dry and a further waiting period of one week allowed.

Alternatively, the surfaces may be neutralized by brushing on a solution of 3 percent phosphoric acid and 2 percent zinc chloride and removing all loose particles after drying. No painting shall be carried out until the Engineer is satisfied that no efflorescence is occurring.

Where required by the Engineer one or two coats of "Alkali resistant" primer shall be applied, sufficiently thinned to penetrate the surface.

All plastered and concrete surfaces shall be twice stopped with approved putty filler. The first coat of stopping shall be applied after the primer coat dried out completely and the second coat after the first undercoat application. Each coat of stopping shall be allowed to dry and harden thoroughly and shall then be rubbed by sandpaper until smooth surface is achieved.

A minimum of two (2) approved undercoats recommended by the manufacturers of finishing coat shall be applied by brushing well into the surface. Each coat shall be allowed to dry and harden thoroughly before the next coat is applied.

The finishing coat of paint shall be applied after the completion and testing of the mechanical and electrical works.

L 3.03

Ferrous Surfaces

Surfaces shall be thoroughly cleaned to remove dirt, wire brushed and scraped to remove scale and rust. One coat of approval putty shall be applied on the surfaces and left to dry for at least twenty four (24) hours, surfaces shall then be rubbed by sandpaper or other approved means before primer is applied.

One coat of rust inhibiting "Galvanized" primer or other approved equal shall be applied by brushing well into the surface and shall be allowed to dry and harden thoroughly before the application of subsequent coats.

If ferrous works delivered primed, the surfaces shall be examined to ascertain that the primer coat is hard. If not satisfactory the primer coat shall be removed and the surfaces cleaned to remove grease and dirt and reprimed as described above for ferrous. Abraded spots on shop-coated surfaces shall be wire-coated surfaces, shall be wire-brushed and touched up with same materials as the shopcoat.

The under-coat and finishing coat shall be chlorinated rubber paint interior or exterior grades and used all in accordance with the directions of the approved manufacturer.

Chlorinated rubber paint, interior or exterior grades, shall not be applied in damp, foggy or freezing weather or to any surface which is not perfectly dry. Ferrous surfaces shall be thoroughly cleaned free of all rust, scale, dirt, oil and grease, etc..

Brush application is recommended although this material may be sprayed if desired, only special thinners produced by the approved manufacturer may be added to achieve the spraying consistency required.

Special approved thinners may be used for cleaning brushes after use.

Ferrous works such as frames, covers to expansion joints, etc... which are to be built into walls shall be primed before installation.

L 3.04 Non-Ferrous Surfaces

Galvanized steel surfaces to be painted shall be solvent-cleaned or painted with mordant solution before the application of paints as described above for ferrous surfaces.

L 3.05 Wood Surfaces

Wood surfaces except surfaces to be given natural finish or other finish specified shall be primed, undercoated twice with undercoating paint as recommended by the manufacturer of finishing coat and final coat with semi-gloss enamel paint of approved manufacturer.

Wood surfaces shall be scrubbed with abrasive paper to obtain a smooth surface. Surface mould where present shall be removed by washing, rubbing down and burning off as necessary. Oil wood shall be swabbed with white spirit. Resinous exudation and large knots shall be removed and replaced by approved filler or knot sealer and the surface shall be primed.

Parts of wood to be enclosed in walls shall be primed unless already impregnated with creosote or other preservative. Priming shall be brushed on and a minimum of two coats applied to end grain. After the primer coat is hard, all cracks, holes, open joints, etc... shall be made good with hard stopping and rubbed with fine abrasive paper. If the first process of stopping found to be unsatisfactory it shall be repeated after the first undercoating is applied and well it shall be repeated after the first undercoating is applied and well dried.

Priming of joinery shall be applied only on the site after the Engineer has approved such joinery and before it is fixed. The two undercoat paints shall be applied on wood doors, panels, etc. before they are fixed, to ensure that the bottom and top edge and sides are thoroughly painted. The finishing coat of paint to such wood doors, panels etc... shall be applied after fixing in position and as directed by the Engineer.

Wood surfaces specified as stained shall only be rubbed down with fine abrasive paper and two coats of oil stain ducco sprayed to the satisfaction of the Engineer.

Wood surfaces specified as varnished shall be thoroughly cleaned down of all dirt, oil, grease, etc... and rubbed to a smooth finish, knots shall be treated with knotting and 2 coats of approved oil varnish applied.

L 3.06 Flintcoat Protective Coating

Two coats of flintcoat Decoralt coloured coatings should be applied at normal dilution i.e.: two (2) columns Decoralt and one (1) volume water, using no primer. The first coat should be allowed to dry before applying the second one.

L 3.07 Oil Stain Finish to Woodwork

The stain finish to woodwork shall be an approved manufacturer's oil stain system applied strictly in accordance with the manufacturer's instructions.

All surfaces are to be thoroughly dry and cleaned and sanded down and all nail holes or similar defects shall be filled and levelled up with approved hard stopping

The finish shall be applied in two coats. The first coat shall be pigmented stain wax brush applied. The surface shall be allowed to dry for 2-10 minutes and then rubbed with a cloth in rotary motion to remove excess stain and produce an even surface.

The first coat shall be allowed to dry completely before application of the second coat.

The second coat shall be natural (clear) stain wax, buffed.

The Engineer shall select the stain colour and the Contractor shall allow for preparing sample panels for the Engineer's approval and these sample panels will provide the standard for the work.

I N D E X

SECTION M ELECTRICAL WORKS

<u>Division</u>	<u>Titles</u>	<u>Page No.</u>
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SECTION M

ELECTRICAL WORKS

Electrical contractors are invited to quote for the supply of all labour and materials required for the completion of part of all the electrical installation.

M-1 GENERAL REQUIREMENT:-

1- Prerequisite Conditions:-

All applicable sections of the general Specifications are included by reference to the work required by this division of the specifications.

2- Extend of Work:-

a- The work shall include all necessary labour, materials, plant services machinery and appliances and at the Contractor's own risk and expense, to deliver construct and in- stall complete in good working condition the electrical installation in accordance with the drawings, specifications and bills of quantities. All materials and wormanship shall, except where otherwise directed, comply with the requirements and regulations of the appropriate local Electrical Authority, and I.E.E. and shall be subject to the approval of the Electrical Engineer.

b- Work shall also include: -

- 1- The procurement of and payment for all permits and licenses required for the performance of the work.
- 2- All hoits, scaffolds, staging, runways and equipment required for the performance of the work.
- 3- All job measurements and shop layouts required for the proper installation of material and equipment included in the work.
- 4- All lights, guards and signs as required by safety regulations applicable to the work.
- 5- The removal from the premises, as it accumulates, of all dirt and refuse resulting from the performance of the work.
- 6- All equipment under this heading shall be installed under competent supervisory service finished by this Contractor and where necessary this shall include the services of special erection and operation engineers.

3 - Miscellaneous Conditions

- a. All installed material and equipment shall be new, shall be of the best quality and design, and shall be free from defects and imperfections.

3 - Miscellaneous Conditions [condt'd]

- b. All labour for the installation and adjustment of material and equipment shall be done by experienced mechanics of the proper trade and all workmanship shall be first class.
- c. Installed material and equipment included in the work shall be protected from dirt and damage and maintained in a clean condition during the performance of the work.
- d. Apparatus, equipment and material required for the performance of the work shall be stored under requirements of applicable regulations and of direction from the Architect.
- e. This Contractor shall cooperate with all other Contractors on the project, be responsible for prompt delivery of all materials and equipments and for the installation of all works under this division at a time and in a manner so that there will be no delay in the construction schedule.
- f. Acceptance of the work shall be subject to the condition that all installed systems, equipment, apparatus and appliances included in the work shall operate and perform as designed and as selected with respect to efficiency capacity and quietness and shall operate and perform without producing objectionable noise within occupied areas of the building.
- g. Acceptance of the work shall be subject to the conditions that any time within one year after date of final approval, any defective part of the work resulting from the supply of faulty workmanship or material shall be immediately amended, repaired or replaced as a part of the contract work without cost to the owner.

4 - POWER SUPPLY: -

The system of distribution will be fed from a 230/400 volts 3-phase, 4 wire 50 Hz, system.

5 - SYSTEM OF DISTRIBUTION

The system of distribution to be used for lighting and power is to be the radial type, including branch circuits and ring circuits system where shown in drawings.

SPECIFICATIONS
ELECTRICAL WORKS6 - DRAWINGS AND SPECIFICATIONS

- a - All electrical drawings are intended to cover the layout and design of the work, but are not to be scaled for exact measurements. Where special detail and dimensions are not shown on the drawings, this Contractor shall take measurements and make electrical layouts as required for the proper installation of electrical work so that interference with all other work will be avoided.
- b - All drawings and specifications on the project are complementary, each set to all other sets, and they shall be used in combination for the execution of this work. Electrical work shown on any set drawings, including all architectural drawings for general work and equipment, and electrical work called for under any section of the project specifications, shall be considered as included in this work unless specifically excluded by inclusion in some other branch of the work. This shall include roughing in for fixtures and equipment as called for or inferred. This Contractor shall check all drawings and specifications for the project and shall be responsible for the installation of all electrical work.

7 - INSPECTION OF SITE

Contractor of this work shall inspect the Site, study existing conditions, check with the drawings and specification and be fully informed as to the work required the Contract.

8 - OPERATION AND MAINTENANCE INSTRUCTIONS: -

- a - This Contractor shall furnish all services as required for adequate verbal and printed instructions to the Owner's operating and maintenance personnel for operation and maintenance of all equipment and systems installed under this heading. Two complete copies of a service manual in hard back binders shall be furnished at the end of the project and shall include printed operating and maintenance instructions for systems specified under this heading, all approved shop drawings and

- all manufacturer's printed instructions for equipment operation and maintenance.
- b- When the work is complete and at a time designed by the Owner, the Contractor shall furnish the services of a qualified instructor to instruct the Owner's personnel in the operation and maintenance the systems and equipment.

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SPECIFICATIONS
ELECTRICAL WORKS

9 - RECORD DRAWINGS: -

- a - Contractor shall be required to keep a day to day record of changes in location of all equipment, conduit, and devices on one or more sets of contract drawings, underground utilities, use to be dimensioned from building walls, foundations or other readily indentifiable feature.
- b - The Contractor shall record such changes in red ink on black line prints, the record prints shall be submitted to the Architect for approval prior to final payment.

10- CUTTING AND PATCHING: -

Any cutting of new construction which is required for the installation of electrical work after the construction of walls and floor slabs, shall be done by this Contractor. Cutting shall be done with extreme care so that the strength of the structure will not be endangered. Adequate protection shall be provided to prevent damage to adjacent areas. Patching and finishing of opening shall be the responsibility of the Electrical Contractor.

11- EXISTING EQUIPMENT: -

- a - All existing equipment that indicated to be removed shall remain the property of the Owner if he so desires. Such equipment shall be removed by the Contractor and delivered to a point on the project site as designated by the Owner. Any equipment that the Owner does not desire to retain shall be promptly removed from the Site by this Contractor.
- b - Any existing equipment or material that is to remain in service and is damaged by the Contractor during the course of the Contract, shall be repaired and refinished or replaced to the satisfaction of the Owner, at his discretion.

12- CONDUCT OF WORK: -

All work under this Contract which may interference with the Owner's Operation shall be done in such a manner and at such time as may be satisfactory to the Owner. Make temporary alternations and connections as required to

execute work so that all services in the building are maintained with the minimum possible interruption. Temporary shutdowns shall be segregated and shall be of the shortest possible duration. All services shall be kept on continuous operation unless permissions are otherwise granted by the Owner. All temporary wiring shall be the responsibility of the Contractor at no additional cost of the Owner.

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SPECIFICATIONS
ELECTRICAL WORKS

13- OMISSIONS

If anything necessary to the proper installation or operation of the electric system is omitted from the drawings or specifications, or bill of quantities, or indicated incorrectly, the Contractor shall call the attention of the electrical Engineer to these omissions or inaccuracy immediately before work proceeds. Should the Contractor shall fail to do so, he shall be held responsible and shall make good at his own expense such errors or any damage caused.

14- SAMPLES:-

Single samples of the following shall be submitted to Electrical Engineer by the Contractor before the work commences. Section of conduit, section of wire and cable, junction boxes, switches and plates, outlet box isolating switches, lamp holders, ceiling roses distribution boxes, circuits breakers, earth leakage relay and any fixtures supplied by the Contractor and other materials to be incorporated in the installation, the work done by the Contractor shall not vary in any manner from the samples submitted and approved without written permission from the electrical engineer.

15- LAYOUT: -

Before the Contractor commences the installation he shall discuss the exact timing and the whole layout in detail with the Engineer, in order to determinate the exact position of distribution boards, fittings and accessories, and the runs of cable and conduits unless instructions are given after the relevant section of the work is completed.

16- DRAWINGS: -

The design of the accompanied drawings and the quantities in the attached schedules are not definite and are subject to any variations made by the Electrical Engineer

during constructions. No variations or amendments in the drawings and the specifications shall be made to the Contractor except as directed in writing by the Electrical Engineer who has the right to refuse all the materials and works which are not, in line with the drawings and specifications.

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SPECIFICATIONS
ELECTRICAL WORKS

17- TESTING:-

The Contractor shall make or cause to be made at his own expense and in the presence of the electrical engineer tests for perfect operation for installation ,insulation resis- tance and earth continuity,

18- Tenderers for this work have the previous experience in this field of work and an official license of three phase installation from the Electric Company-Jerusalem District.

19- The Contractor should provide on his own expense and all risks insurance policy for his workers during all the period of his work.

20- The Contractor or his representatives should be on the Site or work daily for taking any instructions from the director of works.

21- The Owner reserves, the right to accept any tender, either as regards the whole of the work indicated therein, or as regards any one or, more parts so included. The Owner does not bind himself to accept the lowest of any Tender.

M - 2 MISCELLANEOUS WORK: -1 - EQUIPMENT IDENTIFICATION AND LABELS

- a - All electrical equipment, such as disconnect switches, motor starters, controls, pushbuttons, panelboards, and other similar items shall be adequately identified with labels. Labels shall clearly designate name and use of equipment. Labels shall be made with embossed plastic tape except where engraved plates are called for elsewhere in the specification or on the drawings.

2 - GROUNDING: -

- a- Grounding shall be in accordance with the local Electrical Authority requirements and regulations, and with the I.E.E. regulations.
- b- All branch circuit conduit wiring shall include an insulated copper wire for grounding of all non-current carrying conductive surfaces of electrical equipment subject to person contact, and for every electrical outlet.
- c- Earth Electrode must be provided. This to consist of 3 driven copper rods 1,5 meter long of standard type, and must be installed as near as possible to the main board.
The earth wire has to be copper conductor as specified making loop connection between the rods and the earth (ground) bus bar, the distance between each rod and the other have to be at least 7 meters with a checking man hole at least 60cm depth.

- d- Other similar P.V.C. copper conductor has to be bonded to the main water supply pipe from the earth bus bar.

3 - ADJUSTING, ALIGNING AND TESTING:-

- a - All-electrical equipment furnished under this heading and all electrical equipment furnished by others shall be adjusted and tested by this Contractor.
- b - Mechanism of all electrical equipment shall be checked for alignment with drive and adjusted as required. Protective devices and parts shall be checked and tested for specified and required application and adjusted as required. Adjustable parts of all lighting fixtures and electrical equipment shall be checked, tested and adjusted as required to produce the intended performance.

3-121

SPECIFICATIONS
ELECTRICAL WORKS

3 - ADJUSTING, ALIGNING AND TESTING [CONT'D]

- c- Complete wiring system shall be free from short circuits and after completion the Contractor shall perform tests for insulation resistance in accordance with the requirements of the I.E.E.
- b- The Contractor shall be held responsible for the operation, service and maintenance of all new electrical equipment, furnished by him, during construction and prior to acceptance by the Owner of the complete project under this Contract. All electrical equipment shall be maintained in the best operating condition including proper Lubrication. Operational failure caused by defective material and/or labour covered under other headings or furnished by others.

4 - MOTOR AND OTHER CONTROL EQUIPMENT

- a- This Contract shall install and mount miscellaneous disconnect switches and motor controls furnished by other Contractors in accordance with their instructions, wiring diagrams and approved shop drawings, but he shall be responsible for the operation of such devices only to the extend of proper mounting and wiring. Work shall include mountings and supports as required for all equipments including angle frames, steel plates, bars, bolts, etc. This Contract shall furnish and install all conduit, wire, etc., as required to connect all equipment furnished by him and other

Contractors including motors, dis-connect switches, starters, controls, pushbuttons, etc.

- b- This Contractor shall perform all work required to rough in and connect to all equipment required electrical connections, except equipment that is furnished by the Owner which shall be roughed in only. This work shall be as indicated on drawings, by approved equipment shop drawings and by direction on the job.
- c- The Electrical Contractor shall run feeders to control and motors as shown on drawings, make connections and install and wire all mechanical components, except temperature control, in accordance with wiring diagrams furnished by Mechanical Contractor. The Electrical Contractor shall coordinate with other traders involved for the proper coil voltages for control of magnetic starters and contractors.

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SPECIFICATIONS
ELECTRICAL WORKS

5 - OPENING AND SETTING OF CONDUIT:-

- a - Work shall include the direction for other work as required to provide openings for the admittance into the building of material and equipment included in the work. Work shall include all cutting required for the installation of material and equipment included in the work.
- b - Any cutting and/or patching of new construction which is required for the installation of Electrical work after new walls and floors have been constructed shall be the responsibility of the Electrical Contractor if the cutting and patching is due to errors or omissions on the part of the Electrical Contractors.

6 - EXCAVATION AND BACKFILLING:-

- a - This Contractor shall excavate as required for the installation of all underground work under this heading. Surplus material not needed for backfilling shall be deposited or distributed on the premises as directed. Trenches shall be of sufficient width and shall be cribbed or braced to prevent cave-in or settlement. Trenches close to walls and columns shall not be excavated without prior consultation with the Architect or his representative. Pumping equipment shall be furnished to keep trenches free of water. Dry earth shall be rammed into place at sides of conduits,

leaving joints and top of conduits exposed until approved. After approval, all trenches for work installed by the Contractor shall be backfilled by him in 15cm layers of well-tamped dry earth in a manner to prevent future settlement. Rocks debris, bricks, and like material shall not be used for backfill. Where direct burial cable is installed the trenches shall have 5cm of medium sand installed in bottom of trench and put over the sand.

- b - Any trenches improperly backfilled or where settlement occurs, shall be reopened to a depth required for the proper compaction, then refilled and compacted with the surface restored to the required grade.
- c - As a part of this Contract, all roads, streets, and sidewalks damaged by the installation of building services or other work under this heading shall be repaired to the satisfaction of the authorities and regulations having jurisdiction.

3-123

SPECIFICATIONS
ELECTRICAL WORKS

M - 3 GENERAL CONDITION OF THE DIFFERENT PARTS OF INSTALLATIONS

1 - CONDUITS

- a - Conduit shall be installed for all wires and cables except where otherwise stated or directed . The conduits shall be P.V.C. pipe of the thinner type (Merikaf) or similar under plaster.
- b - of a fireproof plastic type should be used whenever exposed installations are used. And it shall Conduits be securely fastened in place with approved straps.
- c - Steel conduit should be used in the boiler, and wherelse directed by the Electrical Engineer.
- d - No conduits used should have an internal diameter less that 13mm. The Conductors area within the conduit should not exceed 50% of the area of the conduit. .
- e - The conduit has to be away from heat mechanical pressure.
- f - The contractor shall be responsible for ensuring that the conduits are so laid that water cannot infiltrate or accumulate at any point.

- g - The Contractor shall be responsible to ensure that placing of the conduit is done prior to pouring of concrete without delaying the concrete work.
- h - In conduit installation the Contractor should make all his effort to run all the pipes in horizontal or vertical lines and not inclined and to be at the same level from the floor in all rooms.
- i - The conduits should have at least cover of 2cm of plaster or concrete.
- j - Separate conduits have to be used for separate systems of different voltage.
- k - Conduits between any two connection boxes have to be of one piece with no connection in the pipes.
- l - Where finish wall surfaces are to be plastered, the Electrical Contractor shall cooperate with the General Contractor during construction of these walls and use care in the installation of all conduits and boxes so that wall surfaces will have a finished appearance
- m - Conduit shall be installed to requirements of structure and to requirements of all other work on the project. Conduit shall be installed to clear all openings, depressions, pipes, ducts, reinforcing steel, etc., and conduit set in forms for concrete structure shall be installed in a manner that installation will not affect the strength of the structure.

3-124

SPECIFICATIONS
ELECTRICAL WORKS

1 - CONDUITS (cont'd)

- n - All electrical work shall be protected against damage during construction and any work damaged or moved out of line after roughing-in shall be repaired and reset to the approval of the Electrical Engineer, without additional cost to the owner.
- o - All conduits have to be approved by local standard.

2 - PULL BOXES AND CONNECTION BOXES

- a - The contractor has to make his best to use the minimum number of these boxes.
- b - All boxes should be of the same material as that of the conduits.
- c - Boxes should be wide enough to contain easily all connections of cables.
- d - Pull boxes and connection boxes should be installed all at the same level from ceiling.
- e - All boxes should be covered.

- f - Installed connectors should be used in all the connections inside the boxes.
- g - Cables of different voltage should not be drawn or connected in the same connection box.

3 - OUTLET BOXES

- a- Suitable outlet boxes shall be installed for all electrical service outlets, including plug receptacles. Lighting fixtures, switches.
- b - Location of outlets on drawings is approximate and, except where dimensions are shown, exact location of outlets shall be taken from plans and details on general drawings or as directed by the Architect. Outlets shall be located generally from column centers and finished wall lin4s or to center of acoustical and decorative ceiling panels and to centers or joints of wall panels.
- c - Outlets shall be installed in an accessible location.

4 - SWITCHES

- a - Outlet boxes for switches are to be fixed 140cm above finished floor level and 12cm horizontally from the outside edge of the nearest door.
- b - Switches should be of 10 amp. With different signs for emergency switches if used.
- c - Switches should be of waterproof type DIG or equivalent for the bathrooms and where otherelse shown.

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SPECIFICATIONS
ELECTRICAL WORKS

4 - SWITCHES (cont'd)

- d - All switches should be all-installed rockers flush of Tadiran kind or equivalent.
- e - Switches shall be wired in the phase lines only.
- f - The neutral conductors shall not be broken.
- g - Switches panels shall have a similar assembly to switches and it should be group-mounted in a common box if possible, and if it is without pilot tamp. Otherwise it has to be group-mounted in aluminium or stainless steel cover to the approval of the Engineer.

5 - SOCKETS

- a - Boxes for sockets outlets are to be installed 60cm or, as shown in the drawings above finished floor level.
- b - Socket should be of 13 amp. For the power socket with different color for socket and non-emergency.
- c - Sockets should be of Tadiran kind or equivalent type.
- d - Sockets in the boiler room should be industrial heavy duty.
- e - Sockets in the bathrooms and where Therese shown shall be waterproof type DIG or equivalent.
- f - All sockets shall be wired in the same manner with the phase always connected to the same pole [rightpole].

6 - WIRES, WIRING

- a - All wires and cables, except where otherwise stated are to have a soft copper core, refined and tinned, with an electric conductivity of not less than 98% the core shall be insulated with rubber with braid for 600 volley service.
- b - Samples, of cabling and wiring proposed the contractor, are to be submitted prior to commencement of the work. These must comply with the requirements of the I.E.E., and local standard to ensure a constant voltage in every part of the building.
- c - All wires are to be standard. [for lighting and power, the neutral wire shall be different in color from the phase wires].
- d - All wires shall be run on conduit and shall be continuous between outlets and boxes. At least 20cm of wire be left at outlets for fixture connections.
- e - Where wire size is shown on drawings, or specified, it shall be the same size throughout the circuit.
- f - Wiring inside panel boards shall be neat and well arranged, using appropriate lugs for termination and connection of conductors.
- g - Joints in the cables or wires are not allowed to be made inside conduits.

3-126

SPECIFICATIONS
ELECTRICAL WORKS

6 - WIRES, WIRING [CONDT'D]

- h - Wires are to be fixed to boards with an appliance ensuring perfect electrical contact, to the approval of the Electrical Engineer.
- i - In drawing wires through conduits, no lubricant is permitted.
- j - Cable shoes have to be used for wires of 6 sq. mm. or above.
- k - All boxes and distribution boards have to be carefully cleaned from plaster and other foreign material before drawing any electric wires or cables.

- 1 - Colours of the cables should be as follows:
 - a. Single phase circuits :

Brown	for the phase
Black	for the neutral
Green & Yellow or White	for the earth
Blue	for direct [switch Wires].
 - b. 3 Phase circuits :

Brown, Yellow & Blue	for the threephase.
Black	for the neutral
Green & Yellow or white	for the earth
- m - Cables
 - a - All the cables should be of the following type N.Y.Y. 5 or 4 cores, 11000 volt, plain annealed high conductivity copper wire conductors P.V.C. sheathed. Under Ground cables should be of type NYBY.
 - b - Colours of cores in the cable should be red, yellow, blue & black. Colours of the sheathes shall be black.
 - c - Cables terminations should be through brass cable glands. Glands should be complete with brass earth tags and steel locknuts.
 - d - Cable connection at both ends should be through cable shoes.
 - e - Cables should be covered with soft sand, concrete slabs and special warning in 3 languages.
- n - Wire Size
 - a - Sizes of wires are shown in the drawings
 - b - The size of the earth cable for any circuit should be the same size as that of the phase or as shown on the drawings.
 - c - The size of the wire for the bells, loud speakers and sound outlets should not be less than 0.6sq.mm.
 - d - Size of wire for Fir Alarm should be at least 1.5 sq. mm. .

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SPECIFICATIONS
ELECTRICAL WORKS

7 - ELECTRICAL BOARDS

- 1 - a - All boards should be manufactured by a qualified factory who has a wide experience in this field.
- b - The tenderer should supply with his tender complete drawings for each board which shows

the electrical and mechanical design of the boards with dimensions.

- c - Therefore, the contractor gets the approval of the engineer before he commences with the manu-facturing of these boards.
- d - Electrical boards should be erected complete with all conduits terminated to it before installation of any cable in the conduit.

2 - B O D Y

- a - Electrical boards and panels shall be ready made otherwise it should be manufactured from 2mm steel sheet with all angles and channels needed for supporting and mounting the equipment, and it should be full finished steel with electrostatic painting. Colour should be beige.
- b - All screws. Nuts and washers should be galvanized.
- c - Boards to be designed with removable front plates for easy access to the interior for cabling up and maintenance.
- d - A special compartment with separate cover shall be made for terminals, neutral and earth bars.
- e - All panel boards shall be with doors.
- f - All doors which have equipment mounted on them shall be shielded from inside with isolation sheets.
- g - Distribution Boards in wet areas should be of waterproof type.
- h - All electrical boards shall have spare space of at least 25% of their area.

3 - BUS - BARS

- a - All bus bars shall be of hard drawn electrolytic copper.
- b - Bus bars shall be supported by suitable bus bar insulator to protect the bars from any electrical, mechanical and dynamic stresses.
- c - Bus bars shall be rated at a max. of 2 amps/sq. mm.

4 - NEUTRAL AND EARTH BARS

Suitable bars for neutral and earth shall be mounted on the top compartment of each board, for terminating the outgoing circuits on them.

A bolt with suitable size shall be welded on the body of each board for earthing.

- 5 - L A B E L S
All circuits shall be labelled in English language. Labels shall be of the black sandwich type and engraved.
- 6- MAIN C.B.S
These C.Bs shall be air insulated, adjustable, with magnetic and thermal protection, and have a min. rupturing capacity of 25 K.A.
These C.Bs shall be of the best quality and preferably of the Simmons or NZM-type made K.L.M. in Germany or equivalent.
- 7 - MINIATURE C.BS, AUTOMATIC CHANGE OVER SWITCH,[MECHANICAL INTERLOCK] AND E.L.Rs.
These M.C.Bs shall be of the air insulated type with magnetic and thermal protection and fixed adjustment, the main rupturing capacity if these M.C.Bs, shall not be less than /5 K.A. The M.C.Bsm type N and E.L.R. shall be of the best quality and preferably Simmons or K.L.M. made or equivalent. All E.L.R. shall be 4-pole with 0,03 amp. Sensitivity.
- 8 - ON - OFF SWITCHES
All these switches shall be hand operated, air insulated and able to withstand any load and fault conditions. These switches shall be Siemens type N. or K.L.M. made or equivalent.
- 9 - INSTRUMENTS
All the measuring shall be very accurate which have dimensions of 120x100 mm. and mounted on the boards.
All amperemeters shall be with selector switches to measure the voltage between phases and between phases and the neutral.
- 10- CONNECTORS
All outgoing shall be terminated on connectors mounted on the compartment of the boards.
Connectors must have a copper strip between the wire and the screws. All connectors shall have special paper fixed on them for writing the names of the circuits.
Connectors shall be of or best quality.

8 - T E L E P H O N E S

- a - 1" conduit should be installed from each telephone box to the telephone box in the floor where shown in drawing with galvanized wire installed within for the telephone company.
- b - The telephone box should be 1 meter high from floor level.
- c - Main conduits from the floor boxes and the operator have to be shown in drawings with a galvanized wire.
- d - Telephones cables for the main boxes and the telephone outlet should be drawn with the presence of the telephone department.

LIGHTING FIXTURES SCHEDULE

TYPE	DESCRIPTION	MANUFAC- TURER	TYPE OF LAMPS
_____	_____	_____	_____
A	Single Fluorescent Fixture on ceiling similar to GAASH No. 0403	Local Made	Fl. 1x36 W
B	Double Fluorescent Fixture on ceiling similar to GAASH No. 0403	Local made	Fl. 2x36 W
C	Globe on ceiling with Incandescent lamp , Similar to GAASH No. 73321	Local Made	Fl. 1x75 W
D	Recessed spotlight(Recessed spotlight with reflector lamp and white colour).	Local Made	Fl. 1x60 W

SECTION N

MECHANICAL WORKS

CENTRAL HEATING SYSTEM

1 - GENERAL

01 - SCOPE OF WORK - GENERAL

The Contractor shall include for supply, delivery, installation, testing and commissioning as specified of central heating plants each complete in every respect together with the provision of all materials, labor, supervision, tools ladders, trestles, scaffolding, temporary lighting offices lockup, stores equipment and matters of all kinds necessary for the efficient completion and sage operation of the works in the manner specified and to the complete satisfaction of the owner, or his duty appointed representative or supervisor.

02 - WORKS INCLUDED

The following works will be carried out free of charge:

A-Builders work, such as making good of holes in floors and walls, the provision of pipe, excavation and back filling if necessary and the forming of bases for machinery.

B-The contractor shall provide all necessary fixing, screws, anchors, bolts, brackets and where necessary position those ready for grouting in, where pipes pass through walls and floor. The contractor shall be further responsible of:

- 1 - The accurate making out of all positions of holes, machines and equipment foundation.
- 2 - All wiring and cabling necessary inside Boiler Rooms and electric panels.

03 - CONTRACTORS STAFF AND LABOUR

The contractor shall make his own arrangement for transport, accommodation and messing of his own staff and labor employed on the work.

04 - APPROVAL For CUTTING AND LABOUR

Before undertaking any work on Site which includes the cutting away, notching or drilling of any of the permanent works, the contractor shall secure the approval of the owner or his duly appointed representative.

05 - SUPERVISION

The contractor shall engage the services of a qualified and competent foreman to supervise the execution of the works.

06 - MATERIALS AND WORKMANSHIP

All materials supplied under this contract and all works carried out shall be of best quality and in accordance with best modern practice. The owner or his engineer or the authorized supervisor has the right to examine all materials and equipment before installation and to reject parts or whole if proven defective or not in agreement with specification. The local material shall be according to local standard.

SPECIFICATIONS
MECHANICAL WORKS07 - TESTS ON COMPLETION

Upon completion of the installation, the whole of the circulating water system network shall be subjected to a hydraulic test of 150 psi and according to the instruction of the owner or his representative. Any leaks or defective pipes shall be fixed according to the instructions of the engineer who has the right to reject any defective part of the installation. Furthermore, the contractor shall submit a fully comprehensive technical report on the overall system operation and performance. The contractor shall provide at his own expense all such labor, apparatus and instruments as are necessary for the efficient execution of these tests and shall submit to the owner two copies of a report embodying the results of these tests.

08 - REMOVAL OF DEBRIS

The contractor shall promptly remove from the site all debris arising from the works and shall maintain the site in a clean and tidy condition to the satisfaction of the owner.

09 - MAINTENANCE INSTRUCTIONS

The contractor shall furnish to the owner upon handing over of the works latest edition of manufacturers maintenance instructions to all equipment supplied in this contract.

10 - COORDINATION OF WORK

The contractor, before commencing work, shall examine all adjoining work on which this work is in any way dependent for perfect workmanship according to the intend of this specification. It is to be noted that various other items of apparatus and equipment will be furnished and set under other contracts. The contractor shall familiarize himself with requirements to the other contractors and shall examine the plans and specifications covering these contracts.

11 - TENDER DRAWING

Drawing showing approximate locations of machines, pipe, together with details of services required are listed at the beginning of the specifications.

12 - WORKING DRAWINGS

Within six weeks of receiving notification that the contractor has been awarded the tender he shall submit to the engineer for approval two copies of the following:

- a- Machine room layout showing exact size of machines.
- b- Complete detailed dimensioned drawings of all foundations for machinery.

SPECIFICATIONS
MECHANICAL WORKS13 - AS INSTALLED DRAWINGS

Within the months of the final handing over the works, the contractor shall submit to the engineer two copies of fully dimensioned tracings showing full details of installed equipment, exact location of pipes with sizes, position of air vent, controls, etc. Furthermore, the contractor shall also submit two copies of boiler room valve charts with valves labeled clearly, one copy must be glazed formed and hung in each boiler room.

14 - WATER SUPPLY QUALITY AND TEMPERATURE

The water will be supplied from the city water main pipelines. The chemical analysis of water are to be verified by contractor. The temperature of water mains will vary from about 4 °c [39 °F] in winter to 30 °C [86 °F] in summer.

15 - INSTRUCTION FOR WORKING AND MAINTENANCE

Framed and glazed instructions for the working and maintenance for the installation. Framed and glazed straight line and wire diagrams of the electrical connections. They shall be of the black on a white type in which the diagram, lettering etc., appear black on a white ground and will not fade.

During the delivery and erection of the installation, the contractor shall keep on the work a thoroughly qualified and efficient supervisor and shall use well-trained workers. The supervisor shall represent the contractor in his absence and if he is found in the opinion of the owner representative, to be incompetent or instantive, shall have authority to require his removal from job. The Tenderer must be able to show that he has had successful experience in the complete erection, setting to work and maintenance of similar plants, employs competent personnel to handle this service and maintains locally adequate stocks of parts for replacement or emergency purposes. The maintenance service, to be carried out by the contractor during the guarantee period for the entire equipment described herein the Contractor also shall repair or replace at his own expense, any electrical or mechanical parts of the equipment which fail or show sign of considerable wear or in any way prove unsatisfactory, [beyond the limits of fair wear from ordinary usage] within a period of one year from the date of the final acceptance and taking over, through faulty manufacture or design or through defective material or workmanship.

16 - PAINTING

All painted surfaces of all supplies under this contract shall be thoroughly clean, smooth and given not less than two coats of red lead or anti-corrosion paint and with two finishing coats of the best quality paint of compositions

chosen and approved for their resistance to heat, oil or weather etc. as the case may require.

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SPECIFICATIONS
MECHANICAL WORKS

2 - HEATING INSTALLATIONS

01 - WATER CIRCULATING PUMPS

The contractor shall supply and install a range of either "SALMSON" or "ARMSTRONG" centrifugal pumps as indicated on drawings and bills of quantities.

All pumps shall be centrifugal type single stage directly coupled to a squirrel cage, totally enclosed fan cooled induction motor by a flexible coupling.

The pump shall have cast iron casing, stainless steel shaft, and good quality bronze impellers. Each pump shall be fitted with pressure gauge. The gauges shall be equipped with approved type cocks in order to take readings when required.

Each pump shall be fitted with a check valve on the discharge and an approved type strainer in the suction. Furthermore, each pump shall include with it a shut-off gate valve in the suction and a globe valve in the discharge for balancing purposes. The pump heads shall be confirmed after equipment selection and drawings are complete.

02 - P I P I N G

A - Pipe Installation

All piping shall be properly supported or suspended on stands, clamps, hangers, etc., of approved design. Supports shall be designated to permit free expansion and contraction while minimizing vibration. Pipes shall be anchored as directed by means of steel clamps securely fastened to the pipe and rigidly attached to the building structure. Screw threads shall be cut clean and true and joints made tight without caulking. No bushing shall be used. Reducing fittings shall be used to change pipe size. The drawings indicated generally the size and location of piping as designed for space conditions, ceilings heights, and may not be changed until coordinated with other contractors. If it is seemed necessary to modify the piping system the contractor shall size the pipes on the basis of 3-7 fps. Velocity and recheck pump heads which are presently indicative and for purposes of an estimate. Pipe work shall confirm fully of the following requirements:

- Piping shall be properly graded to secure easy circulation and prevent noise and water hammer. As much pitch as space conditions allow must be given. Capped dirt pockets to be installed at all riser heel, low points, and other places where dirt may accumulate must be provided. Allowance must be made

for proper provision for expansion and contraction in all portions of pipe work to prevent undue strain in piping or machines. Expansion joints to be installed as directed by the engineer.

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SPECIFICATIONS
MECHANICAL WORKS

Pipe Installation [CONDT'D]

- All Fittings such as elbows, tees etc. shall be of best quality, foreign made or local made "Class A" according to the local standard with smooth interior surfaces. Approved screw unions with bronze or steel bodies and ground brass raper or spherical joints shall be installed at traps, instruments, etc. and where else directed to permit easy connection and disconnection. Final connection to all equipment and fixtures shall be made in a manner that will permit the complete removal of any fixture or any piece of equipment without cutting of pipe line. If after the plant is in operation any system do not circulate quickly and noiselessly [due to trapped or airbound connections], the contractor shall make proper alternations in these defective connections. If connections are concealed in furring floors or ceilings, the contractor shall bear all expenses of tearing up and rebuilding construction and finish.
- All main shall have a slope of not less than 5 mm in 3 meters in the direction of flow. All branches shall have a slope of not less than 1mm in 3 meters towards the main. Each piece of pipe and each fitting shall be carefully inspected on the inside to see that there is no defective workmanship on the pipe or obstructions in the pipes or fittings. Joints in all screwed piping shall be made with red lead and boiled in seed oil, completely covered the male threads.
- Straight elbows, bushing, long screws or bull head tees shall not be installed, and all offsets shall be made with fittings.
Pipes shall not be bend at any time.
- Pipe work shall be installed in manner to allow for ease of air escape and system draining. It shall be endeavoured to obtain this naturally by gravity. However, where conditions do not permit it an automatic air vent shall be installed at all air pocket locations and drain gate valves shall be supplied and installed at all low points and risers legs or as shown on drawings.

B - Materials for pipings

Se	Ma	Ty	_H	St	Bl	_F	St	Ga	_F	St	Bl
rv	te	pe	ot	ee	ac	ee	ee	lv	ue	ee	ac

ic ri	wal	k	d l	an	l l	k
e al	te	sc	Wa	iz	oi	sc
	r	he	te	ed	l	he
	fo	du	r	"B	pi	du
	r	le		lu	pi	le
	he	40		e	ng	40
	at			si		
	in			gn		
	g			"		

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SPECIFICATIONS
MECHANICAL WORKS

C - Hangers, Supports, Anchors, etc.

The contractor shall provide suitable and substantial hangers and supports for all piping. Piping shall be carried by pipe hangers supported from concrete inserts. In general supports for pipes shall be not more than 2.5m, apart for 2" and smaller pipes according to the conditions of the job and directions of the engineer. All vertical piping be supported by heavy pipe clamps resting on the building structure. No piping shall be hung from other piping and all hangers shall be of heavy construction suitable for the size of pipes being supported. All piping in the Boiler Room shall be provided with rubber in shear vibration eliminating hangers.

All horizontal pipes shall be supported by split ring hangers of malleable iron, with sockets for hangers of solid rod the length of each shall be adjustable. Under concrete slabs hanger rod shall be hung from cast iron inserts during concrete pouring, or by use of inserts chilled into concrete after the floor is poured.

Anchors shall be separate and independent from all hangers and supports. All anchors shall be of heavy angle iron construction and suitable in every way for the work, and shall be installed where necessary or as directed by the Engineer.

D - Valves

Hand valves and check valves shall be of an approved quality "KIM" or equivalent and shall be furnished and installed as shown on the drawings or as directed during construction. All valves for balancing purposes in pumps discharges shall be globe type. Other valves for shut-off purposes shall be gate type. Check valves in horizontal positions shall be 15 swing checks; valves in vertical position shall be balanced check valves of the low pressure drop type.

The contractor shall also include for furnishing the required valve tag as well as a schedule of valves with a schematic drawing showing position of each. The drawing shall be glazed, framed and hung in the Boiler Room.

E - Strainers

All strainers in water lines shall be Y-pattern set in a horizontal run of the pipe. All strainers shall have cast iron or bronze bodies of same strength for the pressure to which they are subject to under operation. They shall have removable cylindrical or conical screens of nickel. They shall be of such a design as to allow blowing out of accumulate dirt and to facilities removal and replacement of a strainer screen without disconnections of the main piping.

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SPECIFICATIONS
MECHANICAL WORKS

F - Automatic Air Vents

Supply and install all automatic air vents as shown on the drawings and wherever specified in this book of specifications.

Automatic air vents of the ball float type shall be installed at all high points in the piping. A ½" lock shield valve shall be directly installed ahead of each automatic air vent and a ½" drain line shall be provided to discharge at a convenient point.

G - Thermometers

Supply and install all thermometers as shown on the drawings and wherever specified in this book of specifications.

Thermometers shall be of the bulb, mercury type 10" long with immersed bulb and brass protective shield. Graduations shall be on a white background in °C and °F.

H - Pressure Gauges

Supply and install all pressure gauges as shown on the drawings and wherever specified in this book of specifications.

Pressure gauges shall be of the Borden type 4" diameter with protective glass and stop pressure gauge cock. Graduations shall be in psi and kg/sq.cm.

I - Expansion Joints

Expansion Joints shall be supplied on hot water pipes. Expansion Joints shall be of the packless type and shall have a free movement equal to at least 150% of the calculated expansion of the pipe served. U-bends shall not be accepted as expansion joints.

Expansion Joints should be provided wherever pipes cross the building expansion joint.

J - Union and Flanges

Union shall be provided on both sides of each piece of equipment, also where required to facilitate removal of valve for repair.

K - Cleaning of Pipe

During constructions, the contractor shall properly cap all lines so as to prevent the entrance of sand, dirt, etc. All pipe, fittings, valve etc. shall be cleaned of grease, dirt, scale and foreign material before installation.

Before turning the project over to the owner prior to start-up of any mechanical equipment, all piping system shall be thoroughly cleaned following the hereinafter specified instructions:

Piping shall be cleaned by operating system at normal operating pressure approximately 48 hours, wasting the condensate. At the end of the 48 hours period, contractor shall clean all strainers by removing baskets and flushing with clean water.

L - Testing

The piping system shall be tested by accepted method and under 150 psi hydrostatic pressure. The test shall be maintained under inspection by consulting engineer for period of not less than 8 hours. If leaks develop, test shall be repeated after leaks are corrected. No part of piping system shall be covered or concealed until it has been tested, inspected and approved by engineer.

M - Balance of piping system

After installation is complete, entire hot water system shall be balanced to provide flows and temperature differentials across radiators, pumps to agree with values specified and shown on drawings.

03 - Pipe Insulation

All insulating materials required for piping, mechanical equipment shall be furnished and installed by the contractor.

Insulation shall not be applied until all piping and equipment have been tested, approved and thoroughly cleaned. All insulation work shall present a neat appearing installation with smooth and uniform surface.

All insulation joints shall be carefully fitted and lightly butted. Exposed edges and ends of all insulation shall be sealed and finished. Pipe insulation shall be rigid sections.

Pipes above ground in Boiler Room, or outside heated areas, or under ground or under tiles, will be insulated with Armoflex or equivalent including all valves and

fittings with 1" thickness minimum. All adjoining sections of the rigid pipe insulation shall be joined together with an approved adhesive tape and 10 cm wide plastic bands around insulated pipes, and shall be covered with a galvanized sheet metal jacket.

04 - RADIATORS

Contractor shall supply and install Cast Iron radiators as shown in plans. Radiators shall be of the following types only:

Either "Ideal Standard" Rafael 76/4

Or "Chappee" Savan S 4

Or "De Dietrich" Toundra TT 04

Radiators shall be wall mounted hooks anchored to wall, with air vents and valves, pipes connecting them to the main heating pipes. Before painting and mounting the radiators, they would be tested with all piping net work.

05 - FAN COIL UNITS

The contractor shall supply and install as indicated on drawings a range of locally made Fan Coil Units "PEREG" or equivalent. The fan coil unit cabinet shall be constructed from best quality sheet steel branched for maximum rigidity and removable access panel. It shall be water and corrosion proof, internally insulated and shall be factory finished.

The coil shall be constructed from heavy gauge copper, three rows type, and aluminium fins not exceeding 12 fins/inch. The coil must be suitable for hot water heating system, Each fan coil unit must be provided with an approved type air vent. The fans shall be of the multiblade type statically and dynamically balanced and directly coupled to an electric motor suitable for 220V /1/50HZ electrical operation. Each unit shall be supplied with on-off three speed switch and built in thermostat factory fitted with two hand shut-off valves and one balancing valves. The fan coils must be mounted or hanged with approved supports and hangers, and rubber rings and joints to prevent vibrations.

06 - B O I L E R S

A - General Description

Contractor shall furnish and install packaged cast iron hot water boiler units as shown in the plans.

Boilers shall be of the following types only:

Either " Ideal Standard "

Or " Chappee "
Or " De Dietrich "

Capacities are as indicated on drawings and bill of quantities. Each unit shall be of three fire tube passes type with over all outise insulation and to include boiler fittings burner equipment and automatic controls. Both boiler and burner must be the product of the same manufacture or as approved by the Engineer to insure undivided responsibility and simplified servicing.

- B - An adequate Vent connection shall be provided for venting air liberate within the boiler. A controlled volume air cushion shall be provided at the top of the boiler to provide adequate air release area and cushion any hydromatic surges imposed on the boiler. This air space shall be fitted with an air vent, connection designed to limit the maximum volume of the space and vent the excess air.

C - Boiler fittings

- 1 - Relief valves shall be of ASME approved type. Their number and pressure shall be in accordance with code requirement.
- 2 - Drain connection to be provided on bottom centerline of shell near rear.
- 3 - Pressure and temperature gauges shall be installed
- 4 - A flue gas thermometer shall be mounted at the breeching collar
- 5 - Thermometer.
- 6 - Flow meter

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SPECIFICATIONS
MECHANICAL WORKS

D - Burner Equipment

Burner shall be of forced draft type equipped with fuel arrangement for firing No. 2 oil. Blower shall be fitted with an air inlet silencer to insure quiet operation. Burner location and firing method to be such that combustion takes place within the water-backed furnace of the boiler. Vital Burner parts such as fuel nozzles, flame scanner and ignition assembly are to be enclosed in a protective steel housing. Burner controls shall be modulating type and are to include the following:

- 1 - Temperature limit control for automatic start and stop of burner operation.
- 2 - On modulating units a temperature actuated potentiometer control to vary firing as rate in relation to demand.
- 3 - Low water cut-off control to cause shut-down of unit when water level drops to minimum safe level.
- 4 - Air safety switch to prevent operation until sufficient combustion air is assured.
- 5 - An electronic type combustion flame safeguard and programming until provided pre-purge and post purge cycles with full protection against flame failure. Safety shutdowns shall require manual reset.

- 6 - Burner motor controller with thermal overload and under voltage protection.
- 7 - Control circuit fuse.

All controls to be panel mounted and so located on the boiler as to provide ease of servicing the burner and boiler without disturbing the controls, and also located to prevent possible damage by water, fuel or heat of combustion gases.

Controls connected to water or fuel shall be installed outside the main boiler control panel.

E - Operating Manual

Instructions for installation, operation and maintenance of the boiler shall be contained in a manual provided with each boiler unit.

Record of fire tests shall be included in this manual.

07 - C H I M N E Y S

The contractor shall furnish and install asbestos pipes chimney with all fittings such as socket and steel clamp, and shall supply and install the necessary horizontal and vertical sheet steel metal chimney connected between boilers and asbestos pipes.

The sheet metal thickness shall not be less than 2 mm, and provided by suitable sliding doors for inspection and cleaning.

08 - FEED WATER TANKS

Supply and install galvanized sheet metal tanks of capacities as indicated on drawings. The tank of boiler room No.1 [for main building] will be installed on roof of first floor of the main building, and the tank of boiler room No.2 [for Annex] will be installed on roof of the boiler room itself.

The water supply to the tanks will be from the existing main water tanks installed on roof of the main building, and through connection to nearby main distribution pipes. Each tank should be complete with cover, automatic float valve, 10x10cm hardwood bearers, and all necessary fittings.

09 - FUEL TANKS

Contractor shall furnish and install fuel tanks for the boilers.

Fuel tanks should be made of steel sheets 4mm thick with an overall sizes as indicated on drawings and bill of quantities, and should be furnished with all fittings and accessories [inlets, outlets, vents, level indicators, connections].

All walls of tanks should be properly braced on the inside.

Two layers of anti corrosion primary coat should be applied on all external faces.

10 - THERMOSTATIC VALVES

The Contractor shall supply and install at the high point inlet of each radiator a thermostatic valve "Danfoss", angle type of built in sensor as indicated on drawings and bill of quantities.

It should allow for maximum or minimum setting ranges (highest and lowest setting point) in addition to facility of locking the setting range at a fixed setting point.

Required room temperature is 20 °C, with the possibility of changing the setting to any other required temperature. Valve thermostatic head must be exchangeable without having to drain the heating system.

11 - HEATING CONTROLLER AND PROGRAMMER

A - Supply and install in the boiler room for each main loop of the main building an electronic controller and programmer "COSTER" type RTE353 with a three way modulating valve type 3FDN corresponding in size to that of related main flow and return pipe sizes of the loop together with the required electric motor, in addition to all shut off and regulating valves.

The three-way valve should be installed on the suction side of the loop-circulating pump on the flow pipe as shown on drawings. Every controller includes one flow and one return sensor to be installed inside the flow and the return pipes in addition to an outside sensor installed on north or west wall. Controller also includes a weekly timer with daytime settings and nighttime settings and special knob for fixing daytime temperature, nighttime temperature in addition to

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SPECIFICATIONS
MECHANICAL WORKS

HEATING CONTROLLER AND PROGRAMMER [CONDT'D]

continuous lighting signal to show direction of three way valve movement whether fully open, fully closed or undergoing modulation. That is it should be possible for example to control the inside temperature between 7 am. And 2 pm. At 20 °C, then between 2 pm and 7 am. At 10 °C. All this should be controlled through changing the temperature of flow water by mixing with return water through a three way modulating valve programmed through the suggested electronic controller. The exact room temperatures and time settings should be programmed for the seven days of the week according to the requirements of our client.

B - Supply and install for each sub loop of the Annex buildings an electronic controller and programmer "COSTER" type RMD 736 with a three way modulating valve type 3A corresponding in size to that of

related main flow and return pipe sizes of the sub loop together with the required electric motor, in addition to all shut-off and regulating valves. The three way valve and sensor shall be installed on the return main pipe of the sub loop inside each Annex building together with the controller and accessories as shown on drawings to maintain a programmed maximum temperature of water in the return pipe at a point before mixing with the flow water through the three way valve and return to the boiler room. The sensor should be installed at the mentioned point.

- C - Supply and install a complete two boilers sequence controller "COSTER" consisting of regulator model RC2 and the motorized valves and all necessary probes, sensors and accessories causing the two boilers to function in sequence in accordance with the thermal load. A manual selector switch is to be supplied and installed to change the sequence order of the boilers to maintain equal running hours.

Heating, Ventilation, and Air conditioning (HVAC):

Description of the system:

The HVAC system can be briefly described as follows:

The building, with the exception of the four courtrooms, is heated by means of a conventional central heating system consisting of two boilers situated in the basement level (272kW each). The heating water is circulated in a central heating water network by means of circulating pumps into free convection cast iron heating radiators placed in the designated heated areas. The building in general, with the exception of the courtrooms, has no cooling system. Meanwhile, the courtrooms are centrally cooled and heated by means of packaged heat pumps located on the roof of the building. There are four heat

pumps varying from 14 to 17 ton capacity, each serving one courtroom. Each heat pump is equipped with additional water heating coil as heat supplement or stand by source in case respectively the heat pump fails to provide the required full heat load or the refrigeration cycle fails completely. The heat pump is selected to heat and cool 100% fresh air. To that effect, four exhaust fans, one for each courtroom, are introduced on the roof to expel the used air from within the courtrooms. In addition to the courtrooms exhaust system, there is a second exhaust system for the toilets only. No other exhaust or ventilation system is proposed in the building.

Heat Pump Package Unit:

The air conditioning units shall be of the packaged heat pump type, designed and manufactured for outdoor installation, and factory assembled, tested, packed and shipped, all with hermetic reciprocating compressor(s), and ready for hook-up and operation. Unit shall be designed to meet CE standards listed under TUV and American standard listed under UL, and manufactured to ISO 9001. The unit shall be designed to handle 100% fresh air at 95 degree Feh. ambient temperature.

The unit casing shall be made of heavy gauge galvanized sheet metal coated with epoxy powder electro-statically oven-baked. The frames shall be made of high quality extruded aluminum profile. The evaporator side shall be of double skin; the outer skin made of 0.7mm galvanized sheet metal while the inner skin made of 0.9mm aluminum sheet, all stuffed with 1" thick injected polyurethane foam of 40 Kg/M3 density. The casing shall be mounted on heavy duty mounting chassis with lifting lugs. The chassis shall be isolated from the designated concrete pedestal by means of flex neoprene pads. The chassis shall be coated with multiple layer electro-statically oven-baked epoxy polyester. The casing shall have two access doors on each side of the unit for servicing purpose, being two door at the evaporator section and two doors at the condenser section. Each access door shall be fitted with two hinges and a lock with handle, and shall be constructed of the same designated material of the particular unit's section, which is fitted in. The doors shall be tightly air sealed by means of high quality gasket. The fresh air intake shall be fitted with manual volume damper and 2" thick synthetic fiber media flat filter.

The evaporator and condenser sections shall be designed to deliver their respective duties at optimum performance for all design conditions. Coils in both sections shall be manufactured from seamless copper tubes mechanically expanded into aluminum fins and coated with Accra-clad anti corrosion protection film. Additionally, the unit shall be equipped with an extra hot water heating coil in the evaporator section to be used when there exists a failure in the heat pump operation. Meanwhile, condenser coil shall have four rows in each 12-inch length, and the evaporator coil shall have four rows in each 10-inch length. The condenser coil outer face section shall have mechanical protection made of plastic mesh. Condenser fans shall be statically and dynamically balanced all of the propeller axial type with low dB noise operation. The fan motor shall be of the

induction type with six poles, directly driving the propeller. The motor casing shall be of the totally enclosed squirrel cage type with class IP55 enclosure protection, with internal thermal current protection, and with class "F" insulation. On the other hand, evaporator fan shall be belt driven of the backward curved centrifugal type with double inlet and double width. The fan shaft shall be fitted on Bee block bearing with lubrication nozzle. The fan motor shall be enclosed in drip proof squirrel cage housing, with internal 4-pole class "F" winding and thermal current protection. All motors of 5.5kW capacity and above, utilized in the unit, shall be wired to take Star-Delta connection for the initial start-up. The evaporator fan discharge side shall be connected to the unit supply air outlet by means of flexible canvas connector. The driving belt shall be provided with belt guard for protection.

The refrigeration cycle of the unit shall be pressurized by reciprocating hermetic compressor(s) with suction gas cooled motor(s). The cycle line shall contains disposal type filter dryer, thermostatic expansion valve, service valve on liquid line, charging point, and freon R-22 refrigeration cycle upgradable to R-407C refrigerant.

All moving and rotating parts and components within the unit shall be factory mounted on vibration isolators to ensure low noise and vibration operation.

The unit shall be provided with galvanized sheet metal drain pan for condensate water with drain outlet. The pan shall be externally coated with thermal insulation and internally with anti-fungal anti corrosion coating. The drain plug shall be equipped with siphon to ensure easy draining of the condensed water vapor in the pan regardless to the negative pressure being built in the evaporator section.

The unit shall be equipped with the following components, all factory built:

- Weather proof, control and power panel integrated in the unit, ready to take all connections onto wire terminals.
- The control panel shall contain contractors for compressors and fans, microprocessor, 220-volt control circuit breaker, main power circuit breaker with door interlocked external handle for use during service and repair time.

- The microprocessor shall be able to perform the following functions:
 - Display alarms for coded faults such as anti-frost, probe error, air flow, high/low pressure, compressor high thermal conditions.
 - General alarm output relay for units utilized more than one compressor.
 - Selection for manual re-store mode alarms re-setting.
 - Management of lead-lag compressors running time.

- Temperature indication in the Celsius scale.
- Remote ON-OFF cooling/heating
- Control mechanism of cooling and heat pump mode.
- Delay relays for the time between energizing and de-energizing of first and second compressors, for the minimum allowable stop time of the compressor after de-energizing, for the allowable number of starts per one time frame, and for the fan energizing/de-energizing time intervals.
- Control the defrost cycle.
- Control of condenser fan(s) by ON-OFF mechanism at low ambient temperatures according to the sense of the probe at the condenser air inlet.
- Run the evaporator fan independently in case the heating water coil is in use to compensate the failure in the heat pump.

Exhaust Fans:

Exhaust Fans shall be of the centrifugal roof mounted blower type. They shall be tailored for high efficiency and extreme reliability in terms of air movement. They shall be supplied in a factory assembled, set and tested state.

The housing shall be made of heavy gauge zinc coated galvanized sheet metal to ensure long corrosion resistant life. The housing shall be stiffened by heavy-duty iron angle supporting frame. The unit shall be supplied at the seating bottom with sturdy support angles for easy assembly mounting on support surface. The whole assembly shall be mounted on spring type vibration isolators. The unit shall be coated with multi-coating enamel paint fit for galvanized surface adhesion. A drain outlet shall be fitted in the bottom of the blower housing. A gravity shutter shall be provided at outlet of fan.

The driven part of the unit shall be a belt driven blower of the backward inclined galvanized blades type, with single inlet single width. The blower shall be designed for low sound power level, all in accordance with the allowable dB level for courtrooms set in the latest edition of ASHRAE handbook.

The driving part shall be an electric motor of high quality induction type. The motor shall be of the open drip proof type with 6 poles, enclosed inside weatherproof housing within the body of the unit. The motor shall be equipped with weather proof power disconnect switch for service and maintenance purposes.

The motor torque shall be transferred to the blower by means of dual V-belts rotating on two properly aligned double grooved pulleys sized for 165% of the driven horsepower minimum. The driven pulley shall be attached to the blower shaft, which is restrained by two self-aligning pillow block bearings with lubrication nozzles. The shaft shall be made of solid steel, precision ground, polished, and treated

for rust resistance. The shaft shall be sized to withstand a minimum of 125% of maximum designed operating speed. The fans shall be electrically interlocked, each with its corresponding heat pump.

Duct Work:

Air duct shall be made of zinc coated galvanized sheet metal of top quality. The duct shall be manufactured and erected by qualified technicians, all in accordance with the latest SMACNA standards. The air supply duct sheet thickness shall not be under any circumstances less than 0.7mm, while the air exhaust duct sheet 0.5mm. The air supply duct laid in voids, shafts and above false ceiling shall be thermally insulated by 1" thick fiberglass insulation of 24Kg/M3 density minimum with reinforced aluminum vapor barrier. The same duct, when exposed on the roof, shall be protected by an additional outer skin of 0.5mm thick galvanized sheet metal. The seam lines shall be sealed by special water and weather proof mastic-silicone compound, being pre-approved by the Engineer. The duct works shall be connected to the designated equipment by means of factory made canvas flexible connectors to prevent the transmission of the equipment vibration to the air duct.

Silencers and Acoustic Lining:

The noise generated by the air conditioning and exhaust equipment on roof shall be eliminated by the introduction of silencers along the duct path and acoustic lining within the duct. Silencers shall be introduced at the discharge sides of the heat pumps, and at the suction side of the roof top exhaust blowers. Meanwhile, acoustic lining of 40Kg/M3 minimum density shall be introduced inside the air supply duct before and after the silencer in case the required low sound pressure level is not met by the silencer alone.

The silencer shall be of the flanged square type with splitters, all in accordance with ASHRAE standard and as made by Sound Attenuators Ltd. The outer skin of the silencer shall be made of 0.7mm thick galvanized sheet metal, the inner skin shall be made of 0.5mm thick perforated galvanized sheet metal, and the filling in between and inside the splitters shall be made of fiberglass sheet with 48Kg/M3 density minimum. The final N/R level inside the courtrooms shall be within an acceptable range, as specified in latest edition of ASRAE handbook.

Air Diffuses and Grills:

All air supply diffusers as well as air supply and exhaust grills shall be made of aluminum profiles, all supplied with volume dampers. The color of the aluminum shall be coordinated with the Engineer prior to ordering the approved quantity.

Volume Dampers and Splitters:

Volume dampers and splitters shall be used for proper air balancing during commissioning. The main balancing of the CFM flow shall be carried out through the adjustment of the volume and splitter dampers' blades. However, the fine tuning of the air flow out of the diffusers and grills shall be carried out by their respective dampers. The dampers shall be made of heavy gauge galvanized sheet metal, and their fittings shall be of top quality, all in accordance with SMACNA latest edition. All dampers with more than single leaf or blade, shall be of the opposite blade configuration. All dampers' blades shall be provided with rubber seal at their edges to ensure air tightness during closing position. Meanwhile, the positioning of the dampers and splitters shall be in accordance with SMACNA instructions, even if such dampers are not shown on the drawings and/or are not stipulated in the Bill of Quantities. Anywhere a regular volume damper is fitted in the duct, an access door shall be fitted adjacent to it. The access door shall be supplied with hinges and ear type lock with relevant insulation, and sealing gasket, all in accordance with the latest SMACNA manual for sheet metal works.

I N D E X

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