

**DETAIL DESIGN
FOR
LABORATORY BUILDING
OF
DESALINATION RESEARCH PROJECT
IN
THE KINGDOM OF SAUDI ARABIA**

VOLUME 2 of 6 VOLUMES

AUGUST, 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

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DETAIL DESIGN FOR
LABORATORY BUILDING OF
DESALINATION RESEARCH PROJECT
IN THE KINGDOM OF SAUDI ARABIA

VOLUME 2 OF 6 VOLUMES

TECHNICAL SPECIFICATIONS

BUILDING WORKS
AIR-CONDITIONING WORKS
MECHANICAL WORKS
ELECTRICAL WORKS
LABORATORY FURNITURE

AUGUST 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

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BUILDING WORKS

BUILDING WORKS

TABLE OF CONTENTS

<u>CHAPTER</u>	<u>TITLE</u>	<u>PAGE</u>
1.	GENERAL	1
	1.1 Scope	1
	1.2 Codes and Standards	1
2.	EARTH WORK	2
	2.1 Excavation	2
	2.2 Backfilling	3
	2.3 Disposal of Soil	3
	2.4 Crush Stone	3
	2.5 Soil Bearing Capacity	3
3.	CONCRETE WORK	4
	3.1 Materials	4
	3.2 Concrete	5
	3.3 Performance and Tests	6
	3.4 Coating of Concrete Surfaces	6
4.	BLOCK WORK	7
	4.1 Applicable Publications	7
	4.2 Products	7
	4.3 Execution	9
5.	ROOFING WORK	11
	5.1 Applicable Publications	11
	5.2 Products	11
	5.3 Execution	12

CHAPTER	TITLE	PAGE
6.	FINISH WORK	13
	6.1 Applicable Publications	13
	6.2 In-situ Finishes	13
	6.3 Tiling Work	16
	6.4 Suspended Ceiling	20
	6.5 Lathin	21
7.	DOOR AND WINDOW WORK	22
	7.1 Applicable Publications	22
	7.2 Products	23
	7.3 Execution	27
	7.4 Joinery Work	30
8.	GLAZING WORK	33
	8.1 Applicable Publications	33
	8.2 Products	33
	8.3 Execution	33
9.	PAINTING WORK	35
	9.1 Applicable Publications	35
	9.2 Materials	35
	9.3 Execution	36
10.	REMODELING OF ADMINISTRATION BUILDING	41
	10.1 General	41
	10.2 Products	41
	10.3 Execution	41
	10.4 Lightweight Partitions	42

<u>CHAPTER</u>	<u>TITLE</u>	<u>PAGE</u>
11.	ROADS WORK	44
	11.1 General, Scope of Work	44
	11.2 Preparation of Ground	44
	11.3 Compaction of Sub-Base	44
	11.4 Base	44
	11.5 Tack Coat	45
	11.6 Bitumen Macadam	45
	11.7 Traffic and Construction Layers of Road	46
12.	CAR SHELTER	47
	12.1 General	47
	12.2 Material	47
	12.3 Erection	50
	12.4 Installation of Roof Panels	50
	12.5 Anchor Bolt	50

CHAPTER 1

GENERAL

1.1 Scope

This specification covers the requirements of building works for the Laboratory Building (remodeling of existing Administration Building) and Test Plant Building, and roads work.

1.2 Codes and Standards

Unless otherwise specified, this specification and the following standards shall be applied for the work.

- (1) British Standards (BS)
- (2) American National Standards (ANSI, ASTM, ACI etc.)

CHAPTER 2

EARTH WORK

2.1 Excavation

Excavation shall include the excavation of all materials of whatever nature encountered as required to complete the work. The equipment and construction methods used shall be to the approval of the Engineer.

Excavation shall be carried out to the lines, levels, dimensions and depths indicated on the drawings or as directed by the Engineer. If during the course of excavation any condition is encountered which might indicate a lower bearing capacity than that assumed the foundation of the building shall be placed at a deeper level providing the minimum bearing pressure used for calculation. Foundation pits shall be excavated to permit the placing of the full widths and lengths of foundations shown in the drawings with full horizontal beds.

All excavation shall be inspected and approved by the Engineer prior to placing of any kind of overlaying material (concrete, bedding-material, etc...)

All excavation shall be made in open cuts and tunneling shall not be permitted except by written permission of the Engineer. All excavations shall be carried out in such a manner as to create a minimum of inconvenience and interference with pedestrian and vehicular traffic and with access to buildings or other properties.

Care shall be taken to avoid disturbing the bottom of the excavation. In case the foundation material is unsuitable, the Engineer may require the Contractor to excavate to a greater depth and to backfill to grade with approved material. The backfill or disturbed strata shall be compacted properly to the satisfaction of the Engineer and in accordance with these Specifications.

Special care shall be taken not to destroy cables, pipes, and the like laid under the ground. When encountered underground objects during excavation work, following excavation shall be directed by the Engineer.

2.2 Backfilling

Backfilling shall be performed using only approved backfilling materials in layers not exceeding 30 cm, and each layer shall be compacted to a density of not less than 90 %.

Backfilling may be placed by machine and compaction must be carried out with approved mechanical equipment.

No backfilling shall be carried out until all debris and other objectionable materials have been removed from the excavation and until the Engineer has inspected and approved.

2.3 Disposal of Soil

Excess soil shall be stockpiled at locations designated by the Engineer.

2.4 Crush Stone

Crush stone under foundation shall be laid in accordance with Chapter 11, 11.4 Base.

2.5 Soil Bearing Capacity

More than 1 kg/cm² of soil bearing capacities shall be confirmed at the expected foundation on bottom.

CHAPTER 3

CONCRETE WORK

The Contractor shall comply with the recommendations of CP 110, unless otherwise specified or directed.

3.1 Materials

All materials used in the works shall comply in all respects with the latest edition of the relevant British Standard Specifications except for any deviations specifically described or authorized by the Engineer.

(1) Cement

Cement shall comply with B.S. 12 and B.S. 4027. Other cements not be used provided that a fully detailed application is made, in writing, by the Contractor in support of his request. Approval, when given, shall be in writing.

All cement used below groundlevel shall be "sulphate resisting portland cement".

(2) Aggregates

Fine and coarse aggregates shall comply with B.S. 882 except that other aggregates may be used if approved by the Engineer.

The nominal maximum size of coarse aggregate shall be 20 mm.

Before commencing work the Contractor shall submit for approval the source of aggregate that it is intended to use together with details of the methods that may be required to ensure compliance with B.S. 882 in respect of grading and impurities.

The salt content of exposed or sulphate resisting cement concretes expressed as the percentage of sodium chloride on the dry weight of aggregates shall not exceed 0.1% in accordance with C.P. 110.

For other concretes the total salt in a mix (sodium chloride from aggregate plus calcium chloride from any additive) shall not exceed 2.0% of the weight of cement.

(3) Water

Water shall comply with the requirements of the Appendix of B.S. 3148 and shall be clean and uncontaminated. Water shall be obtained from a Public Utility supply or from a source approved by the Engineer

(4) Admixtures

Admixtures shall not be used without approval of the Engineer. Any approved admixtures are to be used strictly in accordance with the manufacturer's instructions.

(5) Reinforcement

Bars for reinforcement shall be hot rolled high yield steel complying with B.S. 4449 (characteristic strength: 410 N/mm²).

Mesh for reinforcement shall comply with B.S. 4482.

3.2 Concrete

3.2.1 Mix design

The grade of concrete to be used in the works shall be as follows :

	Grading	Characteristic compressive strength at 28 days N/mm ²
Concrete for super structure	Grade 25 in accordance with C.P. 110. The minimum cement content to be 325 kg/m ³ . The maximum water/cement ratio to be 0.45.	25
Foundation, slab-on-grade, etc.	Grade 20 in accordance with C.P. 110.	20

3.2.2 Formwork and surface finish

Forms shall be so designed and constructed that the concrete can be properly placed and thoroughly compacted and that the hardened concrete whilst still supported by the forms shall conform accurately to the required shape, position and level, subject to the tolerances and standards of finish specified.

The quality of finish shall be :

- rough formwork for all parts which are not visible.
- smooth formwork for all parts which are visible.

3.3 Performance and Tests

All tests and checks on site shall be carried out in the presence of, or as directed by, the Engineer. The Contractor shall be responsible for carrying out all tests required by the Specifications, or called for by the Engineer and shall arrange for copies of test results to be supplied direct to the Engineer immediately they are available.

3.4 Coating of Concrete Surfaces

The Contractor shall cover the concrete surfaces in contact with soil and for groundwater with a protective coating.

All concrete surfaces shall be prepared to achieve a surface which ensures good bond.

All holes, cracks, defective joints and other defects shall be made good.

All dirt, grease, laitance, loosely adhering flakes shall be removed and repaired properly.

The concrete shall be thoroughly dry before application of the coating is started.

The coating shall be a thixotropic filled coal tar paint, obtained from a reputable manufacturer and applied in accordance with the Engineer's instructions.

The coating shall be applied in two layers, have a total uniform dry thickness of minimum 200 microns.

CHAPTER 4

BLOCK WORK

4.1 Applicable Publications

Following Standards are applicable :

4.1.1 SSA (Saudi Arabian Standards Organisation)

- 144 Solid concrete (cement) building bricks
- 145 Concrete (cement) hollow blocks for buildings

4.1.2 BS (British Standards)

Codes of Practice (CP)

- 121 Pt. 1 Brick and block masonry
- 122 Pt. 2 Walls and partitions of blocks and slabs

4.2 Products

4.2.1 Basic Materials

(1) Sand

See chapter 3 : Concrete Work

The sand for mortar shall be graded in accordance with the following tables and the various sizes of particles shall be uniformly distributed.

(1.1) For Natural Sand

Sieve size mm	Percent passing by weight	
	min.	max.
4.76	100	
2.36	95	
1.18	70	100
0.60	40	75
0.30	10	35
0.15	2	15
0.075	0	0

(1.2) For Manufactured Sand

Sieve size mm	Percent passing by weight	
	min.	max.
4.76	100	
2.36	95	
1.18	70	100
0.60	40	75
0.30	20	40
0.15	10	25
0.075	0	10

(2) Cement

See chapter 3 : Concrete Work

Cement shall be "Sulphate Resisting Cement" used for mortar and concrete blocks.

(3) Water

Only clean and fresh water shall be used for mixing the mortar.

(4) Additives

Additives, where used, shall be proprietary products used in the proportions and manner recommended by the manufacturer. The additives shall in no way adversely affect the mortar strength or contain chemicals which may be harmful to other building materials. To add gypsum to cement is strictly forbidden.

4.2.2 Mortar and Grout

Materials for mortar, sand, binding agent and water, shall be mixed by volume or by weight for at least 3 minutes with the minimum amount of water to produce a correctly mixed workable consistency in a mechanical batch mixer.

Mortar shall be as strong, but no stronger than the materials it bonds together. Mortars shall be mixed in batches which can be used within a period before the setting process commences. Once a mix begins to go off it shall be discarded, no ingredients may be added to it once the setting process has begun.

(1) Cement Based Mortar

Cement based mortar shall consist of cement and clean sharp sand mixed by volume in approved gauge boxes.

Mortar mixes shall be ;

Proportions by volume : Cement : Sand

1 : 3

4.2.3 Concrete Blocks

Concrete blocks shall comply with SSA 145 and shall be of regular standard to the required sizes, dimensions, crushing strengths, face textures and be uniform texture throughout the volume of unit.

Blocks shall be obtained from an approved manufacturer.

Block dimensions : 90 × 190 × 390 mm

190 × 190 × 390 mm

Solid concrete blocks are used around door and window openings in blockwork walls, other blocks are hollow core concrete blocks.

4.3 Execution

4.3.1 General Requirements for Blockwork

(1) Workmanship

The permissible variation of walls shall not exceed 15 mm above and below the plumb and horizontal lines and the specified dimensions.

(2) Materials and Source

Hollow and solid concrete blocks shall be obtained from one source of manufacturer and no section of the work shall be constructed with a mixture of units from differing sources.

Samples of blocks shall be submitted to the Engineer.

Blocks shall be properly stacked on level and hard standings and be adequately protected from inclement weather.

4.3.2 Laying

Concrete blocks shall be laid horizontally along their length with prepared or faced sides exposed. Blocks shall be laid upright bedded on one of the long "thin" -sides.

All beds of mortar shall be level and straight and vertical joints formed so as to present a uniform pattern of bond. Exposed joint width shall be 10 mm.

Concrete blocks erected when the ambient air has a temperature of more than 42°C in the shade and a relative humidity of less than 50% shall be protected from direct exposure to wind and sun for 48 hours after construction. The absorption rates of masonry units shall be adjusted by previously wetting to ensure a good solid bond with the mortar.

4.3.3 Bonding

All masonry for half blocks thick walls or single thickness block work shall be laid in stretcher bond.

4.3.4 Built-in items

Anchors, ties, pipe sleeves, flashings, lintels and the like required to be built into the work shall be correctly inserted and executed as the work proceeds.

Walls or partitions abutting concrete columns or walls shall be securely anchored and tied with metal anchors or ties at not more than 400 mm vertical centres.

Wall ties cast in with concrete shall be bent down after the removal of formwork and securely jointed into the mortar beds of walling.

4.3.5 Chases, Holes and the like

Chases, holes, sinkings and mortices for other trades shall be correctly located and formed to the sizes as required by the relevant trades.

4.3.6 Jointing and Pointing

Jointing is the forming of joints as work proceeds.

Pointing is the finishing of joints after the wall is complete. For pointing, masonry joints shall be raked out to a depth of 20 mm and left clean and ready for pointing. Pointing shall be carried out to the required colour, texture and finish.

Pointing shall be carried out from the top of the wall downwards.

The raked joints shall be well-brushed to remove dust and loose material and shall be lightly wetted with a brush.

CHAPTER 5

ROOFING WORK

5.1 Applicable Publications

5.1.1 BS (British Standards)

Code of practice (CP)

144 Roof coverings

5.2 Products

5.2.1 Damp-proof membranes

Vapor tightness PVC membrane shall be 200 micron thick.

5.2.2 Intermediate layers

Three layer built up glass fibre based felt roof covering the lower layers as (1) bonded to expanded polystyrene by heat transference from hot bonding compound of layer above: the upper layers as (2) fully bonded to each other.

- (1) Fine sand surfaced bitumen felt with glass fibre base:
to BS747: Part 2, type 3B, without sand or talc facing on underside.
- (2) Fine sand surfaced bitumen felt with glass fibre base:
to BS747: Part 2, type 3B.

5.2.3 Thermal insulation

40 mm thick polyurethane roof boards, rigid closed-cell polyurethane foam with an integral facing of polyethylene-coated glass fibre tissue on both sides and with rebate detail on all four edges.

5.2.4 Accessories

(1) Flashings

Flashings shall be aluminium alloy type 50 STS special profiled and waterproof sealed after installation with special sealant.

Profiles are pre-holed and comprise special corner pieces and connection pieces.

(2) Loading layer

Shall be light weight concrete layer ; 60 mm thick.

(3) Expansion Joints

Waterproofing over structural joints in roofs shall be formed from polyisobutylene (PIB) with polyester fibre backing, 2.5 mm total thickness.

5.3 Execution

5.3.1 Waterproofing of Roofs

Roof coverings are to be constructed from the bottom (concrete screed) as follows :

- (1) Subsurface shall be clean, dry and uniform. Surfaces shall be without concrete burrs, sharp edges and ridges. Any joints in the structure which may affect the functioning of the membrane shall be designed to meet the specific requirements.
- (2) A vapor tightness PVC 200 micron thickness laid over the area and with 50 mm laps between adjoining sheets;
- (3) A thermal insulation with rigid closed-cell polyurethane boards;
- (4) Three layer built up glass fibre based felt roof covering;
- (5) A layer of light weight concrete 60 mm thick.

All waterproof work shall be applied by specialist-subcontractor experienced in this type of work. All products shall be applied in strict accordance with manufacturer's instructions and with relevant standards. No waterproofing work shall be done in wet or inclement or excessively hot weather and all work must be kept free from moisture during the progress of the works.

The roof coverings shall be protected from all traffic and plant by use of adequate material which shall not be used as building platforms for storage of materials, mixing concrete etc.

Roof covering shall be kept free from all dropping and injurious and the whole of the work shall be cleaned on completion and any damage made good.

Roof insulation shall be done together with the waterproofing of the roof areas.

5.3.2 Accessories

(1) Metal flashings

Metal flashings shall be plugged to parapets and care shall be taken to ensure that waterproofing membrane is fully clamped by the flashing.

CHAPTER 6

FINISH WORK

6.1 Applicable Publications

6.1.1 SSA

1400 Ceramic Tiles (Floor Tiles)

6.1.2 BS (British Standards)

1369 Metal Lathing (Steel) for Plastering.

Code of Practice (CP)

5385 Wall tiling Pt 1 & Pt 2

202 Tile Flooring and Slab Flooring

204 In situ floor finishes

290 Suspended ceilings and linings of dry construction using metal fixing systems

6.2 In-situ Finishes

6.2.1 Ordinary Cement Screeds and Floors

These shall consist of cement, natural aggregates, water and , where specified, colouring agents and/or additives.

(1) Cement

See chapter 3 : Concrete Work

(2) Aggregates

Aggregates shall comply with BS 882, Pt. 2, 1199 and 1201 Pt. 2.

(3) Sand

Sand shall consist of natural sand, crushed stone sand or crushed gravel sands or a combination of these. They shall be hard, durable, clean and free from adherent coatings.

The sand shall not contain harmful materials such as iron pyrites, salts, coal or other organic impurities in such a form or in sufficient quantity to adversely affect the hardening, the strength, the durability of the appearance of the final product or any materials in contact with it.

Sand less than 0.02 mm shall be limited to 3 % by weight. The aggregates 0-3 mm shall not exceed 75 % by weight.

(4) Water

See chapter 3 : Concrete Work

6.2.2 Ordinary cement based rendering

With a mixture consisting of only cement and sand a plasticiser is necessary.

Proportions by volume : Cement : Sand
1 : 3 to 8

For materials : see 6.2.1

(1) Accessories

Metal lathing shall be fabricated from sheet steel, and shall be of uniform quality and free from flaws, broken strands, cracks and corrosive pitting, shall be rectangular and true to shape, and shall comply with BS 1369.

All lathing shall be galvanized. Sheets shall be not less than 1.60 kg/m² when fabricated, using 0.7 mm thick steel sheet. Tying wire shall be 1.2 mm diameter galvanized annealed iron wire.

Angle beads, stop beads, architrave beads, depth gauge beads and the like shall all be manufactured from sheet steel and galvanized after fabrication; all beads shall be perforated at edges to ensure good adhesion of the plasterwork.

Thickness and dimensions shall suit particular locations and plasterwork thicknesses.

6.2.3 Execution

(1) Ordinary Cement Screeds and Floors

The screed shall be laid on set and hardened concrete.

The surface of the base concrete should be brushed to remove all laitance and loose aggregate and, at the same time, to roughen the surface to improve the bond. The hardened base should be thoroughly cleaned, wetted, preferably overnight, the surplus water removed, and a grout of cement and water brushed into the surface, keeping just ahead of the application of the screed.

The aggregates and cement shall be accurately batched by weight and the ratio of cement to aggregate shall not be greater than 1:3 nor less than 1:4.5.

The material for screeding shall be mixed in a mechanical mixer.

Each batch shall contain the minimum amount of water consistent with a mixture of adequate workability. Mixing shall continue until the mixture is of uniform colour and consistency.

Screed battens carefully levelled and trued should be fixed at the correct height for the required thickness of screed. The mix should be spread on the base with adequate surcharge, levelled with a screed board and thoroughly compacted. The wearing surface shall be trowelled smooth.

In hot or dry weather care has to be taken by the contractor to ensure that Portland cement mixes do not stiffen or dry out to an extent that prevents full compaction. After compaction the surface shall be covered with plastic sheeting, wet jute or curing compound to prevent rapid drying.

(2) Concrete screed for roofs

Screeds shall have a maximum allowable density of 2,000 Kg/m³ and be of grade 20 concrete in accordance with B.S. C.P. 110.

Screeds shall be laid in partitions not exceeding 20 m² with expansion joints 15 mm formed through softwood 12 mm thick. Roof screeds shall be laid with slopes of 2 % to falls. Minimum thickness at falls shall be 30 mm. The completed screed shall be smooth, dry and free from defects and shall be subject of roofing subcontractors approval.

(3) Cement based rendering

All plant and tools shall be kept clean and free from the residue of previous mixes.

Where the temperature exceeds 42 deg C, precautions shall be taken to protect the surface of plaster from direct sunshine both during application and for at least 48 hours after finishing.

Suitability of backing to receive plasterworks shall be checked. Bonding agent, if required, shall be applied.

Projections and concrete fins on in-situ concrete work shall be hacked off before plastering commences.

All efflorescence, laitence, dirt and other loose material shall be removed by thoroughly dry brushing.

All traces of mould oil, paint, grease, dirt and other materials incompatible with plasterwork shall be removed by scrubbing with water containing detergent.

Any organic growths shall be treated with fungicide and brushed off.

Hollow block partitions shall be thoroughly dampened immediately before coating to ensure good bonding.

Any piping, conduit, fixing clips or other metallic objects which will be covered by the plasterwork, shall be covered with metal lathing to avoid cracks.

Types of render for undercoats and finishing coats are listed in following table :

A. cement and Sand 1:3

B. cement and Sand 1:5

Types of Background	Types of finish	First and subsequent undercoats	Final coat
Dense, strongs, smooth e.g. dense clay or concrete blocks and struct. concrete	Wood float	A	B
Metal lathings	Wood float	A	B

The type of finish used for rendering is smooth and scrapped.

Smooth rendering shall be obtained by using a wood float.

Scrapped finish shall be obtained by using a fine saw blade on smooth finished rendering and applied during early stage of hardening process.

6.3 Tiling Work

6.3.1 Ceramic Floor Tiles

Unglazed ceramic tiles shall comply with SSA 1400.

The products when supplied shall be free from surface blemishes.

Tiles are manufactured by using 100% of local raw materials except some chemicals not available in the Kingdom.

Shade variation may occur in the manufacture of floor tiles, but the shade supplied shall be reasonably close to, and harmonise with, the colour selected.

The colour of the body of the products shall be basically the same throughout as that of the exposed surfaces, except in the case of special surface effects, the depth of which shall be such that there is no significant change in appearance under a reasonable amount of wear.

The minimum thickness of floor tiles shall be 9.5 mm.

Tile dimensions : 50 × 50 mm.

6.3.2 Glazed Ceramic wall tiles

Glazed ceramic wall tiles shall comply with SSA 1400.

Glazed tiles of fine ceramics, identified by fine grained crystalline porous body with more than 10% water absorption.

The glaze shall be semi-matt.

Tile dimensions : 108 × 108 × 6 mm.

Tiles are manufactured by using 100% of local raw materials except some chemicals not available in the Kingdom.

6.3.3 Bedding

Sand, cement and mortar : See 6.2 In-situ Finishes.

6.3.4 Pointing and Jointing

The mortar mixture shall consist of cement and fine sand in the proportions of 1:1.

6.3.5 Execution

(1) Floor tiling

When setting out the tiling, care shall be taken to establish the correct datum level for the floor. A gauge shall be used, indicating the overall measurement of a given number of tiles with specified joint width to reduce cutting.

(1.1) Sand and Thick Mortar Bedding

The sand bed shall be laid in a suitable number of layers with each layer well compacted by tamping before the next layer is applied.

The top layer shall be laid level, to falls or crossfalls as required, to leave a smooth even surface. The compaction of the bed shall be such that the tiles when laid and subjected to loading shall not show any differential settlement.

A 1:3 mix semi-dry mortar shall then be laid in manageable areas to prevent complete drying and the tiles pressed and levelled to leave the required bed thickness which shall generally 35 mm.

(1.2) Jointing and Pointing

The joints shall be aligned as fixing proceeds to provide for the correct tile layout and a uniform joint width. The joint width shall be 2 - 5 mm. Before the commencement of jointing, the dry mix bedding or adhesive shall be allowed to dry. The joints shall be filled with grout consisting of one part cement and one part fine sand squeezed over the tile surface, the surplus being removed and the tile thoroughly cleaned as work proceeds.

This shall be done by sprinkling neat dry cement evenly over the tile surface and rubbing off with clean rags.

(2) Wall tiling

The background must be compatible with cement, that is to say be a cement rendering, or concrete, or blockwork and not, for example, gypsum plaster, and it shall also be compatible in strength with the purposed bedding mortar. The mortar shall not be richer than 1:3 cement/sand by volume and not leaner than 1:4, the precise mix within these limits depending upon such factors as the amount of mixing water, the suction characteristics of the background and the consequent need to maintain workability. Additives to improve workability shall be used only with the utmost discretion and in accordance with the recommendation of the manufacturer.

Tiles shall be soaked in clean water until saturated and all surplus water drained off before bedding in mortar.

Prior to this procedure the wall shall receive a spatterdash coating. See Cement Rendering.

The back of the tile shall be buttered to a thickness slightly in excess of the finished thickness required and the tile then pressed to the wall and tapped into position. The finished backing shall average 30 mm thick.

(2.1) Jointing and Pointing

Tiles shall have a true and vertical face with continuous horizontal and vertical joints. Vertical joints shall be maintained plumb for the entire height of the tilework to ± 3 mm for every 1800 mm.

Closing tiles shall not be less than 50 mm. If not avoidable two tiles shall be cut.

As far as possible, the floor and wall tiles shall have coinciding joints.

The external angles and side and top edges of glazed wall tiling shall be formed with edgeglazed tiles or rounded edge (bullnose) tiles.

The joints shall not exceed 2 mm for tiles up to 150 x 150 mm, for larger sizes they shall not exceed 5 mm. The minimum joint shall in any case not be less than 1.5 mm. Movement joints shall be built every 5 m.

Immediately after fixing, the surface of the tiles shall be sprayed with water and all traces of glue and excess mortar shall be washed off. The surface shall then be wiped dry. The joints shall then be grouted up using grouting mortar, ensuring that all joints are completely filled for their full depth.

Surplus mortar shall be wiped off 48 hours after grouting, the surface shall be washed with a 25% solution of hydrochloric acid applied by brush. The surface shall then be sprayed several times with clean water and dried off with clean white rags. Damaged or defective tiles shall be replaced.

6.4 Suspended Ceiling

6.4.1 Ceiling panel

- (1) Acoustic fiber board
Thickness : 6 mm
Panel sizes: 600 x 600 mm
- (2) Glass wool cement board
Thickness : 6 mm
Panel sizes: 600 x 600 mm

6.4.2 Exposed grid suspension system

Suspension system shall be an exposed grid suspension system suspended with adjustable suspension rods. Ceiling panels shall be fixed to galvanized steel T-profiles with rustproofed screws.

6.4.3 Execution

Before execution the suspended ceiling has to be co-ordinated with the technical services, especially concerning outlets, lighting fixtures, location lines for air and electric installations.

The final appearance of the suspended ceiling shall be clean, even, squarely aligned and levelled, also in respect to adjoining rooms with full-height openings.

Offsets, incorrect alignments of visible grids, and non-parallel and badly finished edges will be rejected.

Hangers shall be spaced at the centres recommended by the manufacturer of the ceiling system.

Hangers shall be screwed and plugged to the structural slab. Shot-fixing of hanger supports shall not be allowed and hangers shall not be fixed to pipes, electrical conduit and the like.

Panels shall be fixed in accordance with the manufacturer's instructions and shall be permanently fixed.

Perimeter trim profiles for panel - and strip system shall be plugged and screwed to walls and shall have mitred joints at corners.

6.5 Lithin

6.5.1 Material

(1) Lithin

Materials shall be manufactured in factory.

(2) Water

Clean water shall be used for mixing of materials.

6.5.2 Mixing

Mixing ratio and coverage shall be applied in strict accordance with manufacturer's instruction and with relevant standards.

6.5.3 Execution

(1) Preparation of surfaces

Surface to receive Lithin spray shall be clean and free of efflorescence or any other foreign materials and free of voids in excess of 5mm in diameter.

Nails or wires that are exposed on the surface shall be removed, or painted after cutting off. Tie-rods shall be cut back 2~3 cm from face and filled and leveled with appropriate materials.

(2) Spray Gun

Orifice of spray gun and air pressure shall be by manufacturer specification.

CHAPTER 7
DOOR AND WINDOW WORK

7.1 Applicable Publications

7.1.1 SSA (Saudi Arabian Standards Organization)

- 79 Aluminium products Part 1 : Sheets, strips, plates, bars and structural sections
- 107 Tensile testing of steel
- 207 Bend test for structural steel Part 1 : Steel products, except sheets, strips less than 3 mm thickness
- 208 Bend test for steel Part 2 : Sheets and strips less than 3 mm thickness. A : Simple bend test
- 209 Bend test for steel Part 2 : Sheets and strips less than 3 mm thickness. B : Reverse bend test.

7.1.2 BS (British Standards)

(BS) British Standards and (DD) Special Issues

- 1161 Aluminium and aluminium alloy sections
- 1470 Wrought aluminium and aluminium alloys for general engineering purposes, plate sheet and strip
- 1471 Wrought aluminium and aluminium alloys for general engineering purposes, drawn tube
- 1474 Wrought aluminium and aluminium alloys for general engineering purposes
- 1615 Anodic oxydation coatings on aluminium
- 1227 Hinges
- 1245 Metal door frames (steel)
- 1331 Builder's hardware for housing
- DD4 Recommendations for the grading of windows.
Resistance to wind loads, air infiltration and water penetration, and notes on window security.

(CP) Code of Practice

- 118 The structural use of aluminium.

7.2 Products

7.2.1 Basic Materials

All metals shall be free from defects impairing strength or durability of the end product, and shall be of adequate commercial quality for each intended purpose. Fastenings which are exposed shall be of the same material, colour and finish as the metal to which they are applied.

Individual metals shall be uniform in colour, sound and free from surface, flaws, segregation, laminations and other defects which are detrimental to subsequent processing and ultimate use. Sheetting shall be uniform in thickness and free of camber.

(1) Steel

Steel for metalwork shall be SSA 107, 207, 208, 209 and BS 1448, 2994.

(2) Aluminium

Aluminium shall comply with SSA 79 and 80 and B.S. 1161, 1470, 1471 and 1474. Section and profiles shall generally be extruded and be of thicknesses appropriate to the use and design of the member.

7.2.2 Finishes

(1) Finishes for aluminium

Aluminium for window frames shall be anodized, grade AA25 ; (minimum thickness of coating 0.025 mm)

(2) Finishes for steel

Steel where used shall be rustproofed.

7.2.3 Fixing Devices

Fixings shall be as recommended by the manufacturer to give adequate support to the units in regard to their position, size and weight.

The fixings shall be capable of withstanding the design wind load and any operating forces on the doors, windows and gates.

Materials used for anchors, fastenings, fixings and the like should be corrosion-resistant and to the actual requirements.

7.2.4 Steel doors and frames

(1) Steel frames

Frames for doors shall be rigid, straight, square and uniform. They shall consist of two jambs, a head and, where applicable further transoms and mullions, each piece being of continuous length. Sills where required shall be fitted flush with the base of the frame.

Door frames shall be braced with an adjustable base tie to hold the frame rigid during transit and erection. Where applicable, base ties may be designed to suit the thickness of the floor for subsequent casing in.

Individual sections shall be pressed or extruded and may be solid, hollow or open channel. Rebates shall be formed within the frame and shall be minimally larger than the door leaf thickness to ensure that a close fit is obtained. Where compressible seals are used then the depth of the rebate shall be sufficient to allow for the seal and maintain it in a compressed state when the door is closed. Internal door frame rebates shall be a minimum of 13 mm deep and external door frames 19 mm deep.

Joints shall be mitred and ground to a flush close fit. They shall be reinforced and welded or be of a mechanical interlocking type with adjustable screws, bolts or cramps to permanently align abutting edges inconspicuously. Joints shall be of a strength to maintain the structural properties of the members connected. Where transoms or mullions are used the joints shall be straight and the rebates match the rebates of the adjoining frame member. After welding all welds shall be cleaned and ground smooth. Work shall be coordinated with hardware suppliers for templates and sizes of all applicable hardware and screws.

The tolerance for location of all applicable hardware and screws shall be ± 1.5 mm.

(2) Preparation for Hardware

Frames shall be cut, drilled and tapped ready to receive all necessary hardware. All hollow frames shall be strengthened and reinforced with solid plates where frames are to receive hinges, door closers, bolts, and striker plates.

Frames for single doors shall be fitted with an adjustable lock strike plate. Door frames shall be provided with continuous grooves to receive weather stripping or continuous seal. Grooves shall be designed to allow for easy replacement. Hinges shall be countersunk screwed to the frames and reinforcing plates.

The outer surface of the hinge leaf fitted to the frame shall not project above the surface of the rebate. Frames to support doors of less than 30 kg shall have two hinges and for doors above 30 kg there shall be three hinges.

However, all doors of more than 2.25 m in height shall have three hinges, irrespective of weight.

Where applicable glazing beads shall be matching in depth to the door frame rebate.

Beads may be solid or hollow, square-shaped or moulded and be securely fixed to the frame with clips or countersunk screws at 150 mm (min.) centres.

(3) Fixing Devices for Steel Frames

Ties for fixing shall be a minimum size of 25 x 3 x 250 mm long with one end welded to the back of the frame. The free end is flat for fixing with anchor bolts or fishtailed for fixing in preformed pockets.

Frames up to 2.25 m high shall have 3 anchors per frame each side.

Frames over 2.25 m high shall have an additional anchor for every 1 m or part thereof. Anchors shall be spaced out equally between the top and bottom anchors which shall be 150 mm from the top and bottom edges of the frame.

7.2.5 Aluminium Windows

(1) Performance requirements

The whole of the fabricated, assembled and erected work shall withstand safely and with sufficient factor of safety, the produced stresses due to followings :

1. Thermal expansion and contractions. Thermal movements shall be calculated on the basis of ambient air temperature variation range of 0° to 45°C.
2. Windload having a pressure of 1.5 KN/m² acting inward and outward and with a safety factor of 1.2.

The resulting deflection under heavy exposure to external forces or temperature variations shall not exceed 1/300 of span length.

(2) Construction

The dimensions and thickness of windows shall be in proportion to the static requirements of the windows. The profiles of members shall be as required and adequate to receive a good solid fixing, take the weight and fixing of the glazing, withstand wind load, suction pressures and the like without distorting or damaging the unit in any way.

(3) Frames

Frames shall be rigid, straight, square and uniform, and manufactured in accordance with the design details or manufacturer's standard.

Individual sections shall be of continuous length and shall be extruded into rebated and grooved profiles to receive seals.

Casements shall be defined as a part of a window which opens on hinges or pivots, and be of profiles adequately dimensioned to receive glazing.

Joints in frames shall be made by mechanical means (examples are cleating and screwing). Joints shall be flush.

Joint sealing materials shall not harm adjacent materials or finishes.

Tolerances for overall dimensions in height and width, ± 2 mm.

(4) Metal Glazing beads

Glazing beads and other members shall be adequately rigid and fixed at a sufficient number of points to withstand design wind load. Windows shall be such that glazing or re-glazing on site is possible from outside without the need to remove the frame from the structure of the building.

Glazing beads, gaskets, glass adaptors and glazing compounds shall be of materials that do not react with the framing material.

(5) Weatherstripping

Weatherstripping shall be made from materials known not to react with the framing material and such that any shrinkage, warping or adherence to sliding or closing surfaces shall not impair the performance of the window.

All openable windows are to be fully weatherstripped to prevent draughts.

Weatherstripping shall be in hollow or solid neoprene sections or brush pile as appropriate. Cellular foam weatherstrips will not be accepted and all materials used shall be in positions not exposed to direct ultra-violet light. The frames and extrusions are to be designed to allow replacement of weatherstrips without dismantling the frame or casement. Frames are to be provided with integral drainage to prevent build-up of water within the sections.

(6) Fixing Devices

Fixings shall be as recommended by the manufacturer to give adequate support to the units in regards to their position, size and weight. The fixings shall be capable of withstanding the design wind load and any operating forces on the windows.

Materials used for anchors, fastenings, fixings and the like should be corrosion-resistant and to the actual requirements.

(7) Hardware

Hardware items containing bolts, latch bolts, catches or other locking devices are to be supplied complete with the companion fittings with which the bolts and the like engage (e.g. with striking plate, staples).

Handles and knobs which are screwed on from the rear are to be supplied complete with caps for the inside.

Ironmongery articles requiring lubrication from time to time must be designed to facilitate such lubrication.

All metals used in hardware shall be rustproof or rustproofed.

7.3 Execution

7.3.1 Protection

All surfaces which are visible in complete work shall be protected during fabrication. Protecting materials shall be removed on completion of the Works and upon approval of the Engineer. All surfaces shall be cleaned as necessary.

7.3.2 Cold formed

Cold formed work shall be free from warping, buckling and fractures. Bends shall be formed with a brake press or by cold rolling.

7.3.3 Corners

Generally corners to be mitred junctions of identical sections.

Corners to aluminium windows doors and screens to be formed by means of accurately formed slots and tenons, and corners of outer frames to be caulked with suitable nonsetting gun grade mastic.

7.3.4 Holes

Work in connection with cutting, holing, riveting and bolting shall comply with B.S. 448, Part 5. Holes shall be formed without distortion of surrounding metal.

7.3.5 Accuracy

All components shall be accurately manufactured and assembled to the correct shape and size and fitted in accordance with the drawings.

An accurate fit shall be ensured using clamps and jigs where practical, or use tack welds for temporary attachment, where jiggling is not practical.

Clear dimensions of openings for doors and windows shall be taken by the Contractor, prior to fabrication.

7.3.6 Welding

Surfaces shall be prepared by removing grease, dirt moisture and oxide from edges to be welded. Scale and residue from arc and power cutting shall be removed by machine or hand grinding.

Welding of steel shall be by one of the following :

1. gas welding complying with B.S. 693;
2. metal-arc welding complying with B.S. 1856;
3. projection welding to B.S. 2630;
4. seam welding to B.S. 2737.

The manufacturer shall ensure that weld joint with parent metal and weld metal shall be fully fused throughout with no inclusions, holes, porosity, or cracks.

Weld spatter shall be prevented from falling on surfaces of material which will be self finished, or visible in completed work.

Butt joints which are visible in completed work shall be grounded to a smooth finish, flush to adjacent surfaces, and ensure complete removal of flux residues and slag.

7.3.7 Assembling

Aluminium windows are assembled with mechanically clamped angles. Sliding windows are assembled with screwed angles. All windows and doors shall comply with B.S. 4873.

7.3.8 Finished surfaces

Finished surfaces shall have a smooth, even texture and unless otherwise specified, sharp arises on visible surfaces shall be slightly rounded off or chamfered.

7.3.9 Hardware

When ironmongery articles are part of products supplid by the manufacturer, the procedure given in the manufacturer's instructions shall be followed.

When ironmongery articles are covered by operating instructions supplied by their manufacturer, these instructions shall be passed on to both the contractor and the Supervising Agency. Hardware shall be installed and adjusted plubm, level and aligned to windows and companion fittings so that windows operate freely. All windows shall be tightly and properly sealed at joints.

Hardware articles must bear all over on their seating surfaces; articles to be recessed (e.g. striking plates, reinforcing plates, forends of locks and hinges) must, in addition, lie perfectly flush with the surface of the component to which they are fitted.

Recesses shall be made so that they give an accurate fit.

Doors and windows shall be cut exactly to size for the fittings of hardware articles.

The fastening means (e.g. screws used fro fixing hardware articles to doors and windows) shall be of the type, material and size for the articles to be correctly fixed; when used with standard articles they shall conform to the provisions of the standards concerned.

7.4 Joinery Work

7.4.1 Timber Doors and Frames

Timber frames shall be rigid, straight, square and uniform and shall comply with the general requirements of BS 1567. Only hardwood may be used for framing material and this shall be of a species listed as suitable for door frames and linings in BS 1186. Frames shall consist of two jambs of continuous length, a head and, where applicable further transoms, and also where applicable a threshold.

Frames shall be made from hardwood and shall be rebated except for swinging doors. Internal door frame rebates shall be a minimum of 13 mm and external door rebates 19 mm deep.

The frames shall have timber architraves or cover beads to cover the gaps between frames and finishings.

(1) Preparation for Hardware

Frames shall be cut, drilled and mortised, ready to receive all necessary hardware. Hinges shall be countersunk screwed to frames at least two times for each hinge leaf. The outer surface of the hinged leaf fitted to the frame shall not project above the surface of the rebate. Frames up to 2.25 m high shall have 3 hinges, frames over 2.25 m high shall have an additional hinge for every 500 mm or part thereof. All hinges shall be spaced out equally between the top and bottom hinges which shall be 225 mm from top and bottom edges of the door leaf.

(2) Fixing Devices

For screw fixing expanding plugs shall be fixed into the structure. Screws for plug fixing shall be fixed through the frame of the door and be countersunk and capped. Provision shall be made for floor fixing cramps at the base of each jamb. Frames up to 2.25 m high shall have 3 fixings each side, frames over 2.25 m high shall have an additional fixing for every 1 m or part thereof. Ties shall be spaced approximately 150 mm from the top and bottom edges of the frame.

(3) Flush Timber Doors

Flush timber doors for interior use shall comply with BS 459 Part 2 and shall consist of a timber core of at least 50% solid wood and a timber frame faced both sides with plywood minimum thickness 6 mm and lipped with hardwood on all edges.

Completed doors shall be sound, rigid and free from defects and warp.

All edges shall be aligned and smooth. Doors shall be of minimum thickness of 40 mm.

For hardwood veneered doors, lippings shall match the veneer. The width of the lipping shall equal the thickness of the door and the lipping itself shall not be less than 6 mm thick. Lippings shall be glued to the frame. Edges are required to be rebated. Lipping shall be a minimum of 30 mm thick and the rebate shall be formed in the lipping.

Joints shall be close fittings, hardwood dowelled or mortised framed and of a strength to maintain the structural properties of the members connected. All adjoining faces and edges shall be flush and smooth.

Edges shall be rectangular and solid except that the leading edge shall be bevelled 3 mm from front to back. Rebated edges shall be at least 19 mm deep for external and 13 mm deep for internal doors.

(4) Veneers and Laminates

Doors to be painted shall be faced with grade 2 veneers. Doors to be self-finished shall be faced with grade 1 veneers of selected grain and colour of hardwood. Where more than one door leaf occurs within one opening the grain shall be uniform and matching.

Plastic-faced doors shall be faced and edged with laminated plastic glued under pressure, including cutting, drilling and sinkings for hardware.

7.4.2 Special doors and frames

Doors and partitions between toilets and showers shall be factory finished elements, 2000 mm high and made to dimensions as mentioned on the drawings.

Partitions and doors shall be sandwich panels \pm 30 mm thick, made from materials and finishings which have following properties :

- Resistance to hard body impact
- Resistance to water penetration
- Made from non-combustible materials (BS 476 : Part 4)
- Studs shall be resistant to permanent wet conditions (stainless steel 18/10/2)
- Shall have surfaces which are hygienic and easily cleaned and resist any disfigurement
- Shall be equipped with special toilet door furniture

7.4.3 Hardware for timber doors

Performance of locks and latches shall be to B.S. 2088.

Dimensions of locks and latches shall be to B.S. 455 unless specified otherwise.

Internal doors shall have deadlock and latches released by lever handles.

Each lock shall have a cylinder having a minimum of 6 pin locking device and two suitable keys.

Each lock shall have its individually matching key.

All keys, also keys of exterior doors shall be master keyed.

Hinges shall be to B.S. 1227 : Part 1A but in stainless steel 18/8.

Prices for fixing ironmongery shall include for :

- (a) labelling and handing over keys and master key;
- (b) testing, casing, adjusting, and oiling;
- (c) temporary removal for painter, labelling, storing and subsequently refixing;
- (d) fixing with countersunk matching stainless steel screw.

7.4.4 Furniture for doors

Internal doors shall have lever handles and key plates from polished stainless steel.

Door stops shall be stainless steel with black neoprene rubber buffer.

CHAPTER 8

GLAZING WORK

8.1 Applicable Publications

B5 (British Standards)

952 Glass for glazing

(CP) Code of Practice

145 Glazing systems

152 Glazing and fixing of glasses for buildings.

8.2 Products

8.2.1 Glass

Quality of glass shall comply with B.S. 952 and following specifications :

- clear plate glass, produced by the float process, quality GG.

8.2.2 Glazing compounds and fixing accessories

The Contractor is to ensure that compounds, sealant and paint, which are to be used together are compatible.

Following B.S. are applicable : B.S. 4252 for two part polysulphide based sealant compound, and B.S. 3712 parts 1, 2 & 3 for Methods of tests for building mastics. Bedding materials are glazing compound or preformed glazing sealants. They shall be compatible with the method of glazing. Under no circumstances shall non-skinning compound, non-resilient type preformed sealers or preformed impregnated type gaskets be used. Materials shall not require painting and where exposed to view shall be of standard colours of the manufacturer's colour card.

Fixing accessories include glazing blocks, clips, nylon shims, angles, beads, setting blocks, and spacer strips shall be of standard type and corrosion-resistant.

8.3 Execution

8.3.1 Preparation

All rebates and grooves shall be clean, dry and unobstructed at time of sealing and glazing.

8.3.2 Installation

Glazing compounds, putties and springs, clips, distance pieces and setting blocks shall be provided in accordance with C.P. 152.

All external glazing shall be wind and watertight on completion.

The edge clearance shall be equal all round each pane, and not less than 3 mm for single glazing.

Any surplus backing or bedding compound shall be stripped as follows :

1. to top and side edges, flush with top of rebate bead or groove;
2. to bottom edge at an angle to avoid collection of water.

8.3.3 Fixing beads

For external glazing, outside beads shall be bedded to rebate on mastic and surplus stripped flush with frame. For internal glazing, beads shall be bedded dry to rebate and to glazing tape.

Unless otherwise specified, beads, screw and clamped fixings shall be supplied by the manufacturer of doors and windows.

8.3.4 Cleaning

All smears and excess compound and sealant shall be removed and the glass left clean inside and outside, and free from scratches.

8.3.5 Protection

All glass and fixing materials broken or damaged before practical completion shall be replaced.

CHAPTER 9

PAINTING WORK

9.1 Applicable Publications

BS (British Standards)

Code of Practice (CP)

231 Painting of buildings

3012 Cleaning and preparation of metal surfaces

9.2 Materials

9.2.1 Sealers

Masonry and Other Porous Surfaces

Primer Sealers

These shall be based on an alkali-resistant substance suitable for sealing powdery residues on surfaces prior to the application of emulsions or oil paints.

Fluosilicate Sealers

These shall be fluosilicic acid or solutions of salts of fluosilicic acid :

- to reduce alkalinity in lime and cement plaster surfaces;
- to reduce absorbency;
- to combat efflorescence and mould formation;
- for surface consolidation of lime and cement plaster;
- for sealing of smoke and water stains.

9.2.2 Primers

Masonry and other Porous Surfaces

Constituents : synthetic resin lacquers suitably thinned.

Wood and wood Based Surfaces

Wood primers on a nitrocellulose basis.

Steel Surfaces

Corrosion protection primers

Constituents :

- pigments (e.g. zinc chromate);
- binders (e.g. alkyd resin lacquers, epoxy resin lacquers, polyurethane lacquers).

Galvanized Steel Surfaces

Synthetic resin zinc chromate paint

9.2.3 Water-thinnable paints

These are priming, intermediate and final coating materials for plaster surfaces and other mineral surfaces.

Plastic Dispersion Type Paints

Constituents :

- plastic dispersions;
- pigments;
- fillers, e.g. calcium carbonate, silica powder, barytes, fibre granulates, auxiliary materials such as fungicides.

Dispersion type paints may be thin or paste-like; according to their composition they are classified as wash resistant and scrub resistant and also weatherproof.

9.2.4 Synthetic Resin Varnishes (Pigmented Lacquers)

Alkyd resin paints.

Polymer resin paints, e.g. acrylic resin paints, polyvinyl chloride paints, alkali and acid resistant, but not resistant to solvents.

Polyurethane paints (PUR paints), single- and multi-component reaction paints, acid and condensate resistant to solvents and grease.

9.3 Execution

9.3.1 Preparation of Materials

The manufacturer's instructions are to be followed when thinning paints and in no case shall thinners exceed 5% by volume. In the case of polyvinyl acetate emulsion paint, undercoats shall be thinned with water to suit the porosity of the surface to be painted but in no case shall the water exceed 20% by volume.

Paints shall be stirred regularly unless otherwise recommended by the manufacturer.

9.3.2 Cleanliness

In all painting operations, including preparatory work, cleanliness is essential.

Furniture and components shall be protected by rags or polythene sheeting during painting operations.

9.3.3 Climatic Conditions

No exterior or interior painting, finishing or sealing shall be carried out during periods of rain, sandstorms or high winds unless the areas concerned can be protected until the paint has dried.

9.3.4 Application

Materials covered by processing instructions provided by the manufacturer are to be used according to these instructions. Paint, lacquer and varnish applications and coatings may be applied by hand or mechanically.

Paint, lacquer and varnish applications and coatings must adhere firmly and appear as a uniform finish without joins or streaks.

All paint, lacquer and varnish applications or coatings are to be carried out with uniform finish and proper flow in the case of varnish paints, using the specified materials in accordance with the following performance instructions.

If filling is necessary, the surfaces are to be covered all over with filling compound and smoothed down.

When two or more coats are applied, each preceding coat must be dry before the following coat is applied. This does not apply to wet-on-wet techniques.

Drying times stated by the manufacturer must be observed. Standing times must not be exceeded.

At doors, windows and skirtings, work must be finished off with sharp and straight lines.

9.3.5 Priming Coats

Priming coats shall be applied by brush or roller. Primer shall be worked into joints, angles and grain. Priming coats shall be of adequate thickness especially on sharp edges and shall be thinned slightly if necessary to suit surface porosity.

Any primed surfaces which have deteriorated on site or in transit shall be cleaned and touched up or rubbed down and re-primed.

All joinery surfaces to be painted shall be primed before components shall be cleaned and touched up or rubbed down and reprimed.

All joinery surfaces to be painted shall be primed before components leave the joiner's shop. Where components are primed on site they shall be primed immediately after approval.

When priming metal, a minimum drying time of 1 day shall be allowed.

Primer coats shall be executed in a manner suited to the absorbency of the surface, possibly with the addition of a suitable thinner.

9.3.6 Finishing Coats

Finishing coats shall be applied in a liquid, even film over all surfaces avoiding brush marks, sags, runs, orange-peel effect and other defects.

Where two hard gloss finishing coats are specified, the second coat shall be applied within 48 hours of the first coat.

Paint shall be applied by brush, roller or spray, whichever method is most suitable for the particular type of paint being used.

Spraying shall be carried out only with the approval of the Engineer.

All adjoining areas shall be masked and all necessary precautions taken to prevent contamination of adjoining areas by spray mist.

Adequate ventilation or air demand respirators shall be provided in areas where painting operations are being carried out.

9.3.7 Preparation of surfaces to be painted

Masonry and other Porous Surfaces

Plaster, masonry and similar surfaces shall be prepared by removing efflorescence, chalk, dust, dirt, grease, oil, asphalt, tar, excessive mortar and mortar droppings and shall be roughened where necessary to remove any glaze. On concrete surfaces form oil has to be removed before any coatings are applied.

Before filling, the surfaces shall be uniformly dampened with a fine spray of potable water which shall be allowed to be absorbed.

Wood and Wood Based Surfaces

Imperfections on planed surfaces shall be filled with putty or plastic wood filler to match the finish coat or natural finish and allowed to dry and be sandpapered smooth.

Shop-coated Iron and Steel Surfaces

Shop coated iron and steel surfaces shall be stored out of contact with the ground in such manner and location as will minimize the formation of water-holding pockets, soiling, contamination and deterioration of the paint film. Such metalwork shall be protected from corrosion before and after installation by treating corroded areas immediately upon detection. Abraded or corroded spots on shop-coated surfaces shall be wire-brushed and touched up with material similar to the shop-coat.

Galvanized Steel Surfaces

Galvanized surfaces shall be solvent cleaned before receiving a primer coat.

Non-ferrous Surfaces

Non-ferrous surfaces shall be solvent cleaned and treated with an etching primer.

9.3.8 Paint Systems

Definitions

Wash Resistance

A coat is wash resistant if, after the drying time and hardening time appropriate to the coat has elapsed, it can be washed with sponge and water to which a neutral mild detergent has been added without the water becoming discoloured.

Paints and coating materials :

Dispersion type paints, oil paints, oil varnish paints, lacquers and varnish paints.

9.3.9 Interior coats for masonry and other porous surfaces

Dispersion Type Paint

The following coats shall be made wash resistant :

A primer coat with primer according to Clause 9.2.2.

An intermediate coat with plastic dispersion type paint.

A final coat with plastic dispersion type paint.

9.3.10 Interior coats for wood and wood based surfaces

Synthetic Resin Varnish Paint (Pigmented lacquers)

A primer coat with thinned alkyd paint.

An intermediate coat with alkyd paint, according to Clause 9.2.4 Alkyd resin paint.

A final coat with alkyd paint.

9.3.11 Interior coats for iron and steel surfaces

Synthetic Resin Varnish Paint (Pigmented lacquers)

A primer coat with synthetic resin zinc chromate paint.

An intermediate coat with synthetic resin zinc chromate paint according to Clause 9.2.2.

An intermediate coat with alkyd paint.

A final coat with alkyd paint according to Clause 9.2.4.

9.3.12 Exterior coats for concrete surfaces

Solvent-thinnable paint

Single-pack, solvent deposited co-polymer liquid plastic coating.

Properties:

Temperature resistance	:	-40°C to 150°C
Flash point	:	40°C
Non-oxidizing	:	Almost entirely unaffected by the UV rays of sunlight
Sealing	:	waterproof, seals and stops dusting and powdering
Abrasion resistance	:	high resistance to abrasion
Scratch hardness	:	tested to BS 3900/E2 Product must give a result in excess of 1000 grammes.
Bend test	:	Resilient and flexible. Tested to BS3900/E1 using a 1/4" diameter mandrel. No signs of cracking after test
Chemical resistance	:	excellent resistance to a wide range of alkalis, acids, mineral oils and grease.
Weather	:	Weatherproof.

9.3.13 Exterior coats for iron and steel surfaces

Synthetic Resin Varnish Paint

A primer coat with synthetic resin zinc chromate paint according to Clause 9.2.2.

An intermediate coat with synthetic resin zinc chromate paint.

An intermediate coat with synthetic resin polyurethane paint.

A final coat with synthetic resin polyurethane paint Clause 9.2.4.

CHAPTER 10

REMODELING OF ADMINISTRATION BUILDING

10.1 General

10.1.1 Scope

The work covered by this chapter consists of providing all plant, labour and materials and performing all operations in connection with the remodeling and reconditioning and making good building components as specified in the project documents.

10.1.2 Applicable Publications

See standards and specifications of each concerning chapter of this specification.

10.2 Products

All products to be used for remodeling works shall comply with corresponding products as specified in each concerning chapter.

Other products which may be necessary to obtain identical executions as the existing building components shall meet the quality, colour and degree of finishing as used for the existing building components.

10.3 Execution

10.3.1 Building Works

Works comprise all necessary operations to obtain the specified remodeling instruction, completed in all aspects.

All works as specified in Bill of Quantities are to be performed, but specifications are not limitative.

The materials used shall be similar in kind, shape and standard to the materials used for the existing building.

The similarity of the materials will prevail over the conformity to the specifications. Samples of all materials will be submitted to the Engineer for approval.

10.3.2 Services

The adaptation of services shall include but shall not be limited to the adaptation and extension of the electrical, telephone and H.V.A.C. installation so that each room and/or function can be fully operated independently after remodeling to the standards and concept of the original installation. This may require splitting up the electrical and H.V.A.C. circuits, additional switches, electrical and telephone outlets, thermostats etc. and all related works to the satisfaction of the Engineer.

The contractor shall supply all materials, labour, products and perform all operations to complete the works and to deliver the building in perfect state of operation to the entire satisfaction of the Engineer.

10.4 Lightweight Partitions

10.4.1 General

Light-weight partitions are to be provided in the existing administration building and may be purpose made elements conform to following requirements :

10.4.2 Standards

Partitioning shall comply with B.S. 5234 and all other detailed specification referred to in this Clause.

Thickness of elements shall be ± 100 mm.

Weight of solid panel shall be maximum 45 kg/m^2 .

Height of partitions shall be 2700 mm and in any case from existing finished floor to finished (suspended) ceiling.

10.4.3 Acoustic properties

Partitions and components shall be designed, constructed and erected in such a way to reduce noise.

Special attention shall be paid at junctions between partitions and existing ceilings, windows, floors etc.

Additional acoustic insulation pads and other suitable components shall be used to avoid sound transfer.

10.4.4 Fire resistance

Partitions, solid as well as units with door(s), shall have a fire resistance of minimum 1/2 hour in case of fire at one side of the partition.

10.4.5 Materials and finishes

Materials or components used for construction and/or insulation of partitions may be selected from following list of allowable materials :

- steel box profiles
- gypsum plasterboard
- mineral wool
- blockboard
- laminboard
- plywood

Materials used for finishing of partitions and doors shall be hard wood veneer and hardwood complying with existing wood applied in the administration building.

10.4.6 Hardware and furniture for doors

Hardware shall comply with clause 7.4.3 and furniture shall comply with existing furniture used in the administration building.

10.4.7 Special components and fittings

Special components such as composite elements for connection of modular elements to columns other walls and other partitions and closer elements shall be such to comply with all requirements regarding acoustic requirements, stability, fire resistance and finishing of the partitions.

CHAPTER 11

ROADS WORK

11.1 General, Scope of Work

The Contractor shall provide equipments and shall be responsible for the supply of the necessary materials required for the construction of roads and surfacings.

The area of road works is shown on the drawings.

The thickness and types of construction shall be obtained after compaction, as shown on the drawings and as specified hereafter.

11.2 Preparation of Ground

Roadway areas shall be grubbed below natural grade and any soft or unsuitable material removed which would adversely affect the uniformity or stability of the fills. The in-situ subgrade shall be compacted prior to the placement of the sub-base so that a mean density of 95 % modified proctor be obtained. If necessary, in order to correct the subgrade granulometric gradation material shall be mixed with the subgrade and inspection of the successive layers executed by the Contractor.

11.3 Compaction of Sub-Base

Fill to a depth of 300 mm shall be compacted to a density that will give a C. B. R. value of 25 % or such other percentage as may be determined as practical by the Engineer.

Compaction shall be carried out by means approved by the Engineer. Where the required C. B. R. value cannot be obtained the Contractor shall excavate and refill with selected fill material and compact to 100 % modified proctor so as to give a C. B. R. value of not less than 25 %.

The sub-base shall be finished to within 10 mm of the levels indicated on the drawings.

11.4 Base

The thickness of the base after compaction shall be 150 mm. It shall comprise crushed rock sand and silt. The layer shall be compacted by means of a 10 ton roller to obtain a minimum C. B. R. ratio.

Before laying the bituminous surfacing, the base shall be finished to within 10 mm of the levels indicated and a prime coat of cut backs shall be applied between 52° and 108° (5C2). This prime coat shall be left to dry for at least 48 h. and shall be applied at a rate of 1 litre/m².

11.5 Tack Coat

Tack coat (RC-2) shall be applied between 65°C and 95°C. Before laying the tack coat the base shall be thoroughly cleared of loose materials. Bitumen tack coat shall be applied at a rate of 1.2 kg/m² or other approved rate by the Engineer.

11.6 Bitumen Macadam

Bitumen Macadam surfacing for roads shall be 100 mm finished compacted thickness in two layers comprising 60 mm binder course and 40 mm wearing course.

The combined aggregate grading for the binder course shall be within the following limits:

<u>Sieve Size</u>	<u>Percentage Passing</u>
38 mm	100
25 mm	50 - 100
19 mm	35 - 70
13 mm	20 - 40
6 mm	10 - 25
2.4 mm	5 - 15
75 microns	0 - 4
Binder % by weight	3.0 - 3.5

The combined aggregate grading for the wearing course shall be within the following limits:

<u>Sieve Size</u>	<u>Percentage Passing</u>
13 mm	100
10 mm	70 - 100
6 mm	50 - 70
5 mm	40 - 55
2.4 mm	25 - 35
75 microns	3 - 6
Binder % by weight	4.5 - 5.5

11.7 Traffic and Construction Layers of Road

Traffic shall be allowed on the road construction before the bitumen surface has been laid in order to assist in compacting the sub-base course and facilitate traffic within the site during construction.

The sub-base shall be reformed to the approved contours and gradients if necessary before surfacing is laid.

Final surfacing of permanent roads and areas shall be laid as late as practicable during the contract period and as required by the Engineer to avoid damage during construction.

CHAPTER 12

CAR SHELTER

This design of car shelter depend upon Kirby Building System which it is supposed that will be procured in local market.

Unless Kirby Building System is complied, this work shall be carried out as follows or equivalent.

12.1 General

All framing members shall be shop fabricated for bolted field assembly, unless otherwise noted on erection drawing. All framing members shall be cleaned by power or hand-wire brushing to remove all dirt, grease, oil, loose mill scale, weld slag, flux deposit and other foreign matter, and given one shop coat of red oxide, air drying, phenol modified alkyd resin primer. Primer shall equal or exceed the end performance requirements of U.S. Federal Specification TTP-636.

12.2 Material

12.2.1 Primary Mambers

Primary structural framing shall refer to the transverse rigid frames, lean-to rafters and columns, canopy rafters, interior columns (beam and column frames), bearing frame rafters and corner columns, and endwall wind columns.

- a. Members fabricated from plate or bar stock shall have flanges and webs joined on one side of the web by a continuous welding process. This plate or bar stock shall have a minimum yield strength of 290 MN/m² (42,000 psi) and will conform to the physical specifications of either.
 1. 290 MN/m² (42,000 psi) - ASTM A-572 (Grade 42) or equivalent
 2. 345 MN/m² (50,000 psi) - ASTM A-572 (Grade 50) or equivalent
- b. Members fabricated by cold forming process shall have a minimum yield strength of 345 MN/m² (50,000 psi) and will conform to the physical specifications of ASTM A-607 (Grade 50) or equivalent.
- c. Members fabricated from hot rolled structural shapes shall have a minimum yield strength of 250 MN/m² (36,000 psi) and will conform to the physical specifications of ASTM A-36 or equivalent.

- d. Beam and Column interior columns will be fabricated from round pipe column sections which have a minimum yield strength of 250 MN/m^2 (36,000 psi).

12.2.2 Secondary Members

Secondary structural framing shall refer to purlins, girts, eave struts, wind bracing, flange bracing, base angles, clips and other miscellaneous structural parts.

- a. Purlins, girts and eave struts shall be cold formed from steel which has a minimum yield strength of 345 MN/m^2 (50,000 psi) and will conform to the physical specifications of ASTM A-607 (Grade 50) or equivalent.
 - 1. Purlins and girts shall be roll formed Z sections, 200 mm deep with 63 mm flanges. Each flange shall have a 17 mm stiffening lip formed at 45° to the flange.
 - 2. Eave struts are 200 mm deep with a 105 mm wide top flange, a 117.5 mm wide bottom flange, both are formed parallel to the roof slope. Each flange has a 22.5 mm stiffener.
- b. Rod bracing shall have a minimum yield strength of 250 MN/m^2 (36,000 psi) and will conform to the physical specifications of ASTM A-36 or equivalent.
- c. All other miscellaneous secondary members shall have a minimum yield strength of 250 MN/m^2 (36,000 psi).

12.2.3 Connections

- (1) All field connections shall be bolted (unless otherwise noted).
 - a. All primary bolted connections, as shown on drawings, shall be furnished with high strength bolts conforming to the physical specifications of ASTM A-325 (or equivalent). All high strength bolts, nuts and washers shall be zinc plated with a bronze iridite finish for easy identification.
 - b. All secondary bolted connections, as shown on drawings, shall be furnished with machine bolts conforming to the physical specifications of ASTM A-307 (or equivalent). Machine bolts, nuts and washers will be zinc plated.
- (2) All shop connections shall be welded using either submerged or shielded arc process, and welding shall be in accordance with the applicable sections, relating to design requirements and allowable stresses, of the latest editions of the American Welding Society "Structural Welding Code".

12.2.4 Roof Covering

- (1) Typical roof panels shall be colorcoated, 26 gauge, galvanized steel, ribbed panels.
- (2) Base material for colorcoated galvanized steel panels shall have a minimum yield strength of 345 MN/m² (50,000 psi) and will conform to the physical specifications of ASTM A-446 or equivalent.
- (3) The zinc coating is a hot dip galvanization process conforming to ASTM Specification A-525 with a coating class of G-90 (0.90 oz/ft² or 275 g/m²) or its equivalent.
- (4) The painting shall be baked enamel polyester (white) or silicon polyester (color-blue or gold) with a film thickness of 1.0 mil. The reverse side shall be white with 0.5 mil film thickness.

12.2.5 Fasteners

- (1) Standard fasteners shall be No. 14, Type A, self tapping sheet metal screws with metal and neoprene washers, which conform to American Standards Association Specifications. All screws shall have hex heads, be colorcoated to match roof or wall panels and shall be zinc plated steel.

12.2.6 Sealer

- (1) Sealer for sidelaps, endlaps and self-flashing windows shall be 6 mm wide x 5 mm thick, asbestos fiber filled, pressure sensitive butyl tape. The sealer shall be non-asphaltic, non-shrinking, non-drying and non-toxic and shall have superior adhesion to metals, plastics and painted surfaces at temperatures from -50°C to +104°C.

12.2.7 Eave Gutters and Downspouts

Eave gutters shall be box shaped, colorcoated, 0.5 mm nominal thickness (26 gauge) galvanized steel. The outside face of the gutters shall be supported with colorcoated, 0.5 mm nominal thickness (26 gauge) galvanized straps to the eave member at a maximum spacing of 1.20 m.

Downspouts shall be rectangular shaped, colorcoated, 0.5 mm nominal thickness (26 gauge) galvanized steel. Downspouts shall have a 45-degree elbow at the bottom and shall be supported by attachment to the wall covering at 3.0 m maximum spacing.

12.3 Erection

All erection work should be performed in accordance with the erection drawings approved by Engineer.

12.4 Installation of Roof Panels

Installation of roof panels basically shall be performed in accordance with manufacturer's specifications.

In case of Kirby Building Systems, installation of roof panels shall be as follows:

- (1) Roof panels shall be continuous from ridge to eave for buildings 18m wide or less, where endlaps are required, the width shall be approximately 150 mm (as specified on the drawings), and shall occur over a roof purlin.
- (2) All laps of roof panels shall be sealed with a continuous ribbon of tape sealer.
- (3) Roof panels shall be secured to intermediate framing members with No. 14 sheet metal screws at a maximum spacing of 333 mm. At endlaps, the maximum spacing of screws shall be 111 mm.
- (4) Sidelaps of roof panels shall be stitched through the high rib with two, equally spaced, No. 14 sheet metal screws between supports (screw spacing not to exceed 525 mm).

12.5 Anchor Bolts

- (1) Material should conform to ASTM A-307 (36 KSI = 2500 kg/cm² min. yield) or equivalent, unless otherwise specified embedment lengths are based on a minimum compressive strength of 3 KSI = 200 kg/cm² at 28 days.
- (2) Setting Anchor Bolts

Foundation must be square, level and smooth anchor bolts should be tied to reinforcing steel to maintain vertical alignment when concrete is poured. All anchor bolts should be located in their exact positions by means of templates. Nail template boards to outer form, mark exact location of anchor bolts and drill holes for anchor bolts.

Greasing the exposed threads will prevent concrete "splatter" from sticking to and fouling anchor bolt threads. Embedded portion should be free from grease or oil. Anchor bolts shall be accurately set as shown on anchor bolt plan with a tolerance of ± 2 mm within a set.

AIR CONDITIONING WORKS

AIR CONDITIONING WORKS

TABLE OF CONTENTS

<u>CHAPTER</u>	<u>TITLE</u>	<u>PAGE</u>
1	DESIGN CONDITIONS	1
	1.01 Basic Calculation	1
2	GENERAL CONDITIONS	2
	2.01 Scope of Work	2
	2.02 Coordination of Work	2
	2.03 Material Approval	3
	2.04 Materials Alternative	3
	2.05 Contract Price	4
	2.06 Mintenance of Equipment Prior to Final Acceptance	4
	2.07 Testing	4
	2.08 Catalogue and Performance	5
	2.09 Electrical Service and Connections	5
	2.10 Abbreviations	6
	2.11 Redesign and Check	6
	2.12 Performance Guarantee	6
3	AIR CONDITIONING EQUIPMENT	7
	3.01 Description of Work	7
	3.02 General Requirements	7
	3.03 Air Cooled Split System Air Conditioners	8
4	EXHAUST AND VENTILATION FANS	9
	4.01 Description of Work	9
	4.02 General Requirements	9
	4.03 Fans	9
	4.04 Air Filters	10

CHAPTER	TITLE	PAGE
5	PIPE	11
6	DUCT CONDUITS AND ACCESSORIES	13
	6.01 Description of Works	13
	6.02 General Requirements	13
	6.03 Ductwork Materials	14
	6.04 Sheet Thickness for Low Pressure Ductwork	14
	6.05 Duct Support	14
	6.06 Duct Vibration Connections	15
	6.07 Volume Control	15
	6.08 Fire Dampers	16
	6.09 Flashing and Counterflashing	16
	6.10 Dust Protection	16
	6.11 Duct Leak Test and Sealing	16
7	INSULATION GENERAL SPECIFICATION	17
	7.01 General	17
	7.02 General Requirements	17
	7.03 Pipe Insulation	17
	7.04 Duct Insulation	18
	7.05 Drain and Refrigerant Piping	18
	7.06 Insulation Thickness	18
8	GRILLES, DIFFUSERS AND AIR LOOVERS	19
	8.01 General	19
	8.02 Ceiling Air Diffusers	20
	8.03 Wall Diffuser	20
	8.04 Outside Air Looover	20
	8.05 Acceptable Manufacturers	20

CHAPTER	TITLE	PAGE
9	GENERAL ITEMS	21
	9.01 Labels and Identifications	21
	9.02 Guards for Moving Parts	21
	9.03 Painting	22
	9.04 Concrete Foundation Blocks	22
	9.05 Noise and Vibration Isolation	23
	9.06 Tools	23
	9.07 Spare Parts	23
10	TEST	24
	10.01 General	24
	10.02 Piping	24
	10.03 Refrigeration Machine	25
	10.04 Fans	25
	10.05 Air Outlets	25
	10.06 Controls	26

CHAPTER 1

DESIGN CONDITIONS

1.01 BASIC CALCULATION

1.01-1 - Climatic Conditions

The system is designed to provide the inside conditions below noted, When the outside conditions are as stated.

Summer

Maximum : Outside design conditions DB 118.4°F (48°C)

WB 89°F

- Inside design conditions for Air-conditioned space

Meeting room	:	DB 74°F (23.3°C)	RH 55 %
Entrance hall	:	DB 78°F (25.6°C)	"
Shower room	:	"	"
Toilet & Tea room	:	"	"
Storage	:	"	"
Machine Shop	:	DB 86°F (30°C)	Max.
R.O. Module test room	:	(only ventilated)	

1.02-2 - Lighting

- Meeting Room	:	3 WATT per Sq. Ft.
- Other Rooms	:	2.5 WATT per Sq. Ft.

1.01-3 - Fresh Air

Fresh air requirement for occupied areas shall be supplied with not less than 15 CFM (25 M³/H) per person or one (1) change per hour of outside air, whichever is greater.

CHAPER 2

GENERAL CONDITIONS

2.01 SCOPE OF WORK

The works covered under this contract shall include all equipment, necessary materials, required accessories and first class labor for the complete installation of the ventilating, and air conditioning systems, as described hereafter.

2.02 COORDINATION OF WORK

The Contractor shall be responsible for coordination the work of the Air conditioning services with that of other trades and prevent damage to work of other trades already completed.

All drawings issued with these Specifications are to be read in conjunction with each other and are to be considered as a whole.

The Contractor shall be responsible for determining in advance of purchase that equipment and materials proposed for installation shall fit into the confines indicated area, allowing adequate space around the equipment for maintenance.

2.03 MATERIAL APPROVAL

The Contractor shall submit to the Engineer for approval, samples of workmanship, materials, accessories and parts necessary for the construction whether specified, shown on the drawings or not.

The Contractor shall not place orders, supply or install any parts of equipment or materials, before receiving the written approval of the Engineer.

It remains the Contractor's responsibility if the workmanship or the materials and accessories used are not corresponding to those approved already. The Contractor shall replace at his own expenses the respective materials and workmanship to fulfill the entire satisfaction of the Engineer.

2.04 MATERIALS ALTERNATIVE

The nomination of Manufacturers in the Specifications shall not be construed as an intention to eliminate the products of other Manufacturers and Suppliers having equivalent products. Such equivalent products shall be approved by the Engineer.

The Contractor shall bear in mind that preference shall be given to materials and equipment of a type and make already in use or installed in the country and that proved to be durable and resistant to the elements.

The tender shall be based upon the trade described or catalogue reference named in the Specifications and products of approved Manufacturers.

2.05 CONTRACT PRICE

Unit prices given by the Contractor in the Bill of Quantities are deemed to cover the supply on Site, installation, erection, putting in good running order and testing of all the equipment and materials described in the Specifications. Any work indicated on the drawings and not specifically mentioned in the Specifications and vice-versa, are deemed to be included.

The Contractor shall undertake to make minor changes without any extra charges whenever necessary.

2.06 MAINTENANCE OF EQUIPMENT PRIOR TO FINAL ACCEPTANCE

Materials shall be delivered in unbroken packages bearing the brand and maker's name and shall be stored on platforms and properly covered to protect them from moisture.

The Contractor shall be responsible for the maintenance of all equipment and systems installed until final acceptance by the Engineer and shall take such measures as necessary to insure adequate protection of all equipment and materials during delivery, storage and installation.

Spare parts to be permanently available in the Saudi Markets.

2.07 TESTING

The whole system and every particular equipment shall not be accepted until the test described in this volume have been performed in the presence of the Engineer or his Representative and to his entire satisfaction.

2.08 CATALOGUE AND PERFORMANCE

The Contractor shall submit, the catalogues and performance curves or tables certified by the Manufacturer as well as samples, for all the equipment or materials to be used in the system.

2.09 ELECTRICAL SERVICE AND CONNECTIONS

2.09-1

Electrical power, receptacles and control circuits shall have the following characteristics :

3 phases, 4 wires, 60 cycles per sec.

220 Volts between phases.

127 Volts between phases and neutral with a solidly earthed neutral.

2.09-2

All motor starters, are integral components of equipment furnished under this division, with all required power and control wiring for all starters.

2.09-3 - Wiring Diagrams

Contractor shall prepare complete wiring diagrams of controls, electrical portions of automatic temperature control systems, and major equipment sequential interlock circuitry.

2.09-4

Motor shall be nameplate rated at the voltage indicated on the drawings and in the Specifications.

2.10 ABBREVIATIONS

AMCA	Air Moving and Conditioning Association, Inc.
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASME	American Society of Mechanical Engineers
NEC	National Electric Code
NEMA	National Electric Manufacturer's Association
SBI	Steel Boiler Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association.
ASHRAE	American Society of Heating Refrigerant and Air-conditioning Engineers, Inc.

2.11 REDESIGN AND CHECK

- The Tenderer, before submitting his offer should check the load calculation, unit sizes, pipes sizes, duct size, etc...with all quantities in the list price. He will be responsible to maintain the inside design conditions required for the system.

2.12 PERFORMANCE GUARANTEE

The Tenderer shall not, in any case, offer or submit equipment with capacity less than the specified. He shall submit the complete characteristic and performance data as required by the Specifications.

CHAPTER 3

AIR CONDITIONING EQUIPMENT

3.01 DESCRIPTION OF WORK

Work covered under this chapter include the supply installation and delivery in good running conditions of the following listed but not limited to equipment.

- a- Air cooled split system air conditioner for test plant building

3.02 GENERAL REQUIREMENTS

3.02-1 - Electrical Power

Units electrical power shall be 220 volts, 3 phases, 60 Hz. Unit shall be capable of operating within line voltage limits of 208 to 230 volts. Control power shall be 127 volts, single-phase 60 Hz.

3.02-2 - Construction and ratings

Construction and ratings shall be in accordance with latest ARI Standard 590 and shall comply with ANS B9.1 Safety Code, National Electrical Code and ASME Code.

3.02-3 - Types of Equipment

Units to be equivalent to Carrier, York or Trane models subject to the approval of the Engineer.

3.03 AIR COOLED SPLIT SYSTEM AIR CONDITIONERS

3.03-1 - General

- Furnish and install an air cooled split system air conditioner for the test plant building in location and manner shown on the drawings.

The each unit shall be properly assembled and tested at the factory. Units shall be completely charged at the factory with refrigerant 22.

All factory wiring and piping shall be contained within the unit enclosure. All electrical components shall be protected from the weather. The unit shall be enclosed in a galvanized steel casing, zinc phosphatized, with baked enamel finish to with and outside climatic conditions of Yanbu, near the sea shore.

3.03-2 - Fan Coil Unit

- The evaporator coil shall be direct expansion type with copper tube and aluminum cross fin.
- The evaporator fan shall be of dual suction multi-blade centrifugal type, driven by V-belt with variable pitch pulley.
- The evaporator fan motor shall be equipped with an over current relay for safe operation.

3.03-3 - Air Cooled Condensing Unit

- The type of compressor for air cooled condensing unit to be multi-type, compact and powerful full hermetically sealed type.
- The compressor shall be installed with vibration isolation rubber to reduce vibration from going outside.
- A complete set of the safety devices such as crank case heater, over current relay, compressor thermal protector encased in the motor coil, etc. are equipped, ensuring a long life and trouble-free operation.
- The condenser coil shall be copper tube and aluminum cross fin type.
- The condenser fan shall be direct driven propeller fan and draws the air from both side and rear of the unit and discharges it upwards together with operation noise, which ensures quiet operation.
- the condenser fan motor shall be water proof induction type, equipped with thermal protector for safe operation and with non-lubrication bearing for maintenance free operation.

CHAPTER 4

EXHAUST AND VENTILATION FANS

4.01 DESCRIPTION OF WORK

Work covered under this chapter include the supply, installation and delivery in good running conditions of the following listed but not restricted to, equipment.

- a- Centrifugal and wall mounted type axial fans of exhaust and ventilation for the Laboratory and Test Plant building.
- b- Filters.

4.02 GENERAL REQUIREMENTS

- Capacities to be as scheduled on the drawings.
- Fan shall work on 220 Volts 3 phases 60 Hz or 127 Volts 1 phase 60 Hz depending on the fan mortor capacity.

4.03 FANS

All fans shall deliver the capacities indicated on the drawings.

4.03 - 1 - Centrifugal Supply Fan

- Furnish and install package centrifugal supply fan where shown on the drawings and as specified hereafter.
- Fan shall have forward curved blades direct driven with steel housing.
- Wheel and shaft shall be statically and dynamically balanced.
- Unit shall be with horizontal discharge.
- Unit shall be mounted on vibration isolators.

4.03-2 - Wall type axial fans

- Furnish and install direct drive axial fan for exhaust and ventilation as shown on the plans.
- Fan casing shall be constructed of heavy-gage steel sheet.
- Propellers shall be precision balanced with die-formed blades keyed and locked to the drive shaft
- Motors shall be ball bearing, standard NEMA design
- Accessories shall be included.

4.04 AIR FILTERS

4.04-1 - General requirements

All air filters shall be cleaned and operating at or below the specified maximum initial resistance before the equipment is finally accepted. Air filters shall be replaced at the direction of the Engineer if the resistance is above the maximum resistance specified at the time of acceptance.

4.04-2 - Filters for fan coil units

Filters for fan coil units shall be all aluminium 1/2" thick permanent washable type sized to fit unit on cabinet type units and sized to fit return air filter grilles on concealed type units.

4.04-3 - Filters for air supply fans

Filters shall be low velocity 1" thick type constructed of strips of tapered crimped galvanized screen wire in galvanized steel channel frames American air filter NV-2 or units of equal quality as approved by the Engineer.

4.04-4 - Spare Filters

Furnish and store at the site as directed 10 spare air filters of each size and type specified.

CHAPTER 5

PIPE

5.01 PIPE WORK AND FITTINGS

5.01-1 - General Requirements

Supply and install all pipework as shown on the drawings and wherever specified in this book of Specifications.

Drainage pipe shall be installed with a slope of not less than 1 1/2%, before installing any pipe, it shall be internally cleaned from dirt, sand debris, etc...

Pipes shall be installed in a neat way with runs parallel and branching and change in direction at 90 degree or at 45 degrees. Elbows shall be used for changes in directions, or bending shall be resorted to in extreme cases and only after the Engineer written approval.

Sleeves shall be supplied and installed wherever pipes cross slabs, walls partitions, etc... Sleeves shall be cuts of pipes having an internal diameter of not less than 1 cm. larger than the bare sleeved pipe or the insulated sleeved pipe depending on the particular situation. Floor sleeves shall produce about 2 cm. above the finished floor level, all gaps shall be plugged with a non-flowing, plastic and water proof mastic paste.

All pipes shall be installed complete with :

- Metallic supports,
- Unions, flanges, couplings, elbows, etc...,
- All cuttings, patching and making good of walls, slabs partitions, etc... in connection with fixing supporting and anchoring of pipes,
- All connections and fixings to equipment and accessories.

5.01-2 - Refrigerant Pipes

Refrigerant pipes shall be provided using Type "L" hard draw copper tubing with wrought copper fittings. Fittings shall be the sweat type.

- Hard draw tubing shall not be bent.
- All joints shall be made by silver brazing using a phosphorus free brazing alloy consisting of 35 to 45 % silver
- All brazing shall be performed by welders experienced in the method and technique of brazing.
- During brazing, nitrogen shall be circulated through the system to prevent formation of copper oxide.
- To prevent wear from vibration, pipe hangers and supports shall have lead shield firmly clamped between the refrigerant pipe and pipe support.

CHAPTER 6

DUCT CONDUITS AND ACCESSORIES

6.01 DESCRIPTION OF WORKS

The work under this Chapter includes the supplying and installation of all duct work, plenums and accessories as specified hereater and as shown on the drawings.

6.02 GENERAL REQUIREMENTS

- Ducts shall be installed straight and smooth on inside with neatly finished joints. Construction is to be free from vibration under all operating conditions.
- Contractor shall be fully responsible for all off-sets, upslopes, downslopes, etc... necessary to avoid conflict with ducts of differencnt zones, lighting fixtures, sanitary soil piping, etc...
- No extra charges will be allowed for alterations due to lack co-ordination, and the Contractor shall be entirely responsible in this respect.
- All items used shall be manufactured from best quality materials and they shall be erected in such a manner as to produce a neat and workmanlike job.
- Ductwork dimensions shown on the Contract Drawings represent the nett free internal sizes exclusive of all excrescences or linings and shall be provided as such. Sections shall be truly square, rectangular as required.
- The positions of ducts, grilles and diffusers shown on the Contract Drawings are reasonably correct. The Contractor shall, however, make due allowance at the time of tendering for repositioning any of these items.
- Duct leakage shall not exceed 5%.
- Refer to the detail drawings for elbows, tees, vanes, joints, seams, etc...
- The Contractor shall provide the Engineer with two copies of shop drawings of all ductwork and plan for approval.
- No section of a system shall be erected until this approval has been obtained.

6.03 DUCTWORK MATERIALS

Ductwork materials shall be strip mill cold reduced sheet continuously hot-dip galvanized.

6.04 SHEET THICKNESS FOR LOW PRESSURE DUCTWORK

<u>Largest Side of Duct</u>	<u>Sheet Metal Thickness</u>
Up to 450 mm	0.5 mm
460 - 750 mm	0.6 mm
760 - 1500 mm	0.8 mm

6.05 DUCT SUPPORT

Duct shall be adequately supported. Standard details of supports are provided with the Contract drawings and these methods shall be employed by the Contractor as appropriate.

Unless detailed otherwise ducts shall be supported at intervals which do not exceed :

- 4 feet for ducts with long side less than 30 cm.
- 8 feet for ducts with long side greater than 30 cm.

Flexible ducts or connections shall be supported at 90 cms. centers.

Where ducts are to be insulated the supports shall be fitted over the insulation. The insulation shall be protected.

No screws, bolts or other fittings for brackets or supports shall penetrate the air duct.

6.06 DUCT VIBRATION CONNECTIONS

The Contractor shall provide an adequate number of canvas connections in the ductwork system to prevent the transmission of vibration. All connections shall be fire resistant to a fire penetration time of 15 mins. when tested in accordance with section of BS 476 Part 1.

He shall be entirely responsible in this respect and shall take all precautions necessary. Duct vibration connection shall be also installed at every expansion joint of the building.

Such connections shall be provided at discharge of fan coil unit and inlet and outlet connections to ventilating and exhaust fans, where such fans are ducted; be firmly secured to the metal work on each side, and made airtight.

6.07 VOLUME CONTROL

- Control and regulating dampers shall be provided by the Contractor so that the system may be properly balanced and regulated, and so that sections of the duct range may be isolated for maintenance and cleaning. Dampers shall be provided whether indicated on the drawings or not.

Dampers shall be provided in any event at the following points:

At each main low velocity supply branch duct,

- Dampers shall be of rigid and aerodynamic design, flat plate or butterfly dampers will not be permitted. Multi-blade dampers shall be employed for all ducts where the longest side is greater than 27". Where multi-blade dampers are used, a robust linkage shall be provided.
- Multi-leaf type shall conform to plate 29, page 7, SMACNA Low-Velocity Duct Manual. All dampers shall be opposed blade, except splitters. Outside air and relief air dampers shall have wind stops. Dampers shall have neoprene edges.

6.08 FIRE DAMPERS

- Fire dampers shall be provided as may be required by the Engineer.
- Dampers shall interfere with air flow to a minimum but the damper shall be of a design which will give effective closure.
- Fire dampers shall be fixed in accessible position so that fusible elements can be easily renewed. Visible indication shall be provided to show whether or not the dampers are open or closed.

6.09 FLASHING AND COUNTERFLASHING

Flash and counterflash all ductwork, air outlets, piping, pipe sleeves, etc...that penetrate walls and roofs. Flashing shall be 18 gauges galvanized steel unless otherwise shown on the drawings.

6.10 DUCT PROTECTION

The Contractor shall by means of polythene or similar sheeting protect all openings in ductwork during erection to prevent the collection of dust and dirt during the building construction.

He shall be responsible for removing all these sealers from the systems when the work is finished.

He shall nevertheless be responsible for cleaning all ducts internally before the plant is commissioned, the provision of the seals being a precaution aimed at reducing the amount of cleaning necessary.

6.11 DUCT LEAK TEST AND SEALING

The Contractor shall when the main fans are operable test all flanged joints, access doors or panels, hand-holes and test points with soap and water. Any joints failing the test shall be remade.

Insulation shall not be applied until this test has been made.

CHAPTER 7

INSULATION GENERAL SPECIFICATION

7.01 GENERAL

Supply and install all insulation and lagging wherever specified in this book of Specifications and in accordance with the following requirements :

7.02 GENERAL REQUIREMENTS

All insulation shall be applied by skilled labourers of a specialized sub-Contractor in accordance with the best pipe covering practice.

Insulation to be applied so as to give smooth homogeneous and fine surface. All round surfaces to be truly circular, all flat surfaces truly plane and parallel and all edges straight.

Insulation shall fit tight to the surfaces to be covered and any surface irregularities left shall be repaired.

7.03 PIPE INSULATION

7.03-1 - Materials

Insulation material shall be polyurethane having a thermal conductivity not greater than 0.24 BTU/sq.ft/hr/F/inch thickness for refrigerant piping system.

Pipe insulation shall be performed rigid sections. Equipment insulation shall be rigid slabs or mats. Insulation shall be applied after hydrostatic tests have been done.

7.03-2 - Method of Insulation

Before applying the insulation, surfaces shall be throughly clean and dry. All dirt, scale, rust, oil, grease or water shall be adequately removed. Pipes should be painted with rust paint.

7.03-3 - Insulation Finish

The finished insulated surface shall present a neat, uniform and parallel appearance, whether concealed or exposed to view.

7.04 DUCT INSULATION

All air conditioned duct shall be insulated with rigid fiber glass pannel having a thermal coefficient of :

$$K = 0,3 \text{ BTW/hr/}^\circ\text{F/Ft}^2.$$

Insulation to be rigidly fixed on duct by an approved method and recovered by asphalt paper with aluminium foil to be approved.

7.05 DRAIN AND REFRIGERANT PIPING

The drain and refrigerant piping systems shall be covered wih moulded Polyurethane section covered with Aluminium foil vapor seel. Thickness shall be one inch.

7.06 INSULATION THICKNESS

The minimum insultion thickness for the various items of the installation shall be as the following table:

Duct work in conditioned spaces	1" (2.5cms)
Duct work in unconditioned spaces and false ceiling	2" (5 cms)
Drain and refrigerant piping	1" (2.5cms)

All insulation materials shall be properly stored in a suitable manner so as to protect them from damage or deterioration before installation.

CHAPTER 8

GRILLES, DIFFUSERS AND AIR LOOVERS

8.01 GENERAL

Provided all grilles, diffusers, exhaust grilles, etc... shown and noted on the drawings. Grilles models and colour should be selected carefully so as to permit good air distribution inside the conditioned space and keep air motion and noise within acceptable limit.

All such items shall be :

a- be of the size and type listed and approved by the Engineer.

b- be provided with flow regulators as noted.

- Grilles should be strongly fastened from the inside and provisions made in the adjacent duct work to permit such installation.
- All grilles shall be provided with sponge rubber gasket around frame and fixed by means of chromium plated screws.
- All aluminium diffuser shall have a factory finish of anti-corrosive treatment as "Alodine".

8.02 CEILING AIR DIFFUSERS

All ceiling air diffusers shall be square round or rectangular pattern, of aluminium construction 1, 2, 3 or 4 throw as required.

Diffusers shall have a removable snap-in core permitting easy access to duct and neck connection.

Square diffusers shall have on their face a special design at the corners to enable diffused air to completely fill the air pattern perimeter (ULTRE-THRO of Krueger Mfg. CO. USA.).

Each diffuser shall be supplied with an air grid for directing the air flow and an opposed blade damper mounted on the neck of the diffuser

8.03 WALL DIFFUSER

Wall type diffuser shall have individually adjustable front bars and horizontal rear bars with a key operated volume damper.

8.04 OUTSIDE AIR LOUVER

Outside air intake louver shall be rainproof having fixed bars and they should be provided with galvanized screw mesh fixed inside the frame, all as shown on the detail drawings.

8.05 ACCEPTABLE MANUFACTURERS

Cherokee, krueger, Carnes, Tuttle and Baily, Roy Air, Carrier, or York.

All grilles model, size, etc... should be approved by the Engineer before ordering.

CHAPTER 9

GENERAL ITEMS

9.01 LABELS AND IDENTIFICATIONS

Each fans, etc... shall bear a metal label giving the makers name, date of manufacture and serial number, test and working pressures, duty, horse power, phasing, number of cycles per second, speeds, B.S. number, C.F.M., etc... as appropriate to the item of plant so that it may be identified at a later date with ease.

The Contractor may offer alternate permanent method of labelling valves, and equipment for approval at the time of Tender. If this is not done it will be assumed that the types specified above have been included.

At times, it is difficult to have permanent labels available for plant handover and at such times the Contractor shall provide free of charge temporary "tie on" labels so that all valves and equipment is identifiable.

Notation for labels shall be in Arabic and English.

9.02 GUARDS FOR MOVING PARTS

All exposed driving belts, shafts, pulleys, etc... shall be provided with suitable guards of stout woven wire mesh, adequately braced, and shall be fixed in a manner to allow for easy removal. All guards shall be free of vibration. Couplings shall be protected by means of galvanized sheet covers suitably fixed to allow each for removal.

9.03 PAINING

Supply and apply all painting wherever specified in this book of Specifications and in accordance with the following requirements :

9.3-01 - General Requirements

The surface requiring prime painting shall be cleaned thoroughly of all rust, loose scale, oil grease and dirt. Use wire brushes and solution for this purpose. No painting shall be done on damp surfaces. Job coated surfaces shall be cleaned thoroughly and retouched where necessary. The paint shall be evenly spread and well brushed out. Care shall be taken not to paint controls, label plates and name-plates.

All items that have rusted in storage or in place shall be recleaned and repainted upon request of the Engineer.

Finishing coats shall be made in accordance with a color code, based on ASHRAE recommendations after being submitted to the Engineer approval.

9.03-02 - Machinery

All machinery installed under this contract such as compressors, motors, etc... shall have a shop priming coat.

9.03-3 - Piping

All exposed uninsulated pipes, fittings, unions, flanges, valves, hangers and supports shall receive 2 coats of red lead primer and 2 coats of finishing paint.

All insulated metal surfaces shall receive two coats of red lead primer before applying the insulation.

All insulation surfaces exposed to view shall receive 3 coats of finishing paint.

9.04 CONCRETE FOUNDATION BLOCKS

A reinforced concrete foundation block for each machine is to be constructed with a minimum weight equal to at least two times that of the equipment and in accordance with the recommendations of the equipment manufacturer. The price of cork under the concrete shall be included.

9.05 NOISE AND VIBRATION ISOLATION

All equipment likely to generate noise or vibration shall be mounted on bases or supports incorporating noise and vibration eliminators to effectively damp out all noise and vibration and block their transmission to the structure or to interconnecting piping or other equipment.

Such equipment shall be equivalent to Metalastic Limited Manufacturer.

All fan sets and other moving plant associated with the ventilation and air conditioning systems shall be mounted as "Cushy foot" mountings of Messrs. Metalastic Limited Manufacturer.

The Contractor shall also take every precaution needed to ensure that noise and vibration are eliminated from the installations. He shall erect piping, ductwork, fans, plant and machinery so that the assembled plants maximum working will be suitable for silent operation under the conditions. He shall include in his Tender for all the necessary equipment to ensure silent operation.

9.06 TOOLS

The Contractor shall supply on a tool panel a full sets of tools suitable for erection of all components of the plant including the electrical equipment. Another new set of tools for maintenance shall be also supplied after taking over. The full list of tools shall be submitted by the Tenderer in this offer.

9.07 SPARE PARTS

The Contractor shall submit a priced list of recommended spare parts for all the equipment supplied. The price shall remain valid until the completion of the project.

CHAPTER 10

TEST

10.01 GENERAL

All piping and equipment shall be tested as specified under this Chapter or as specified in previous Chapters of this volume. Labour materials, instruments, power, etc..., required for testing shall be furnished by the Contractor. Test shall be performed in the presence of representatives of the Engineer and such other parties as may legal jurisdiction.

10.02 REFRIGERANT PIPING

In general, pressure test shall be applied to piping system only before connection of fixtures, equipment, and appliances. In no case shall any piping, fixtures, equipment or appliances be subjected to pressure exceeding the ratings as prescribed by the manufacturers of fixtures, equipment and appliances, or accepted engineering standards for piping and fittings.

All defective work shall be promptly repaired or replaced and the tests shall be repeated until the particular system and component parts thereof receive the approval of the engineer and the authorities having jurisdiction, and at no additional cost to the Employer.

In the event of any repair or any adjustment having to be made, otherthan normal running adjustment, the test shall be void and shall be recommenced after the adjustment or repairs have been made.

When pipes, valves ducts, equipment, etc... are to be covered or inbedded or inslulated, their specific tests shall be carried out on them before any covering is applied. These tests shall not relieve the Contractor of any of his responsibilities, and he shall take all necessary precautions to insure the safety and protection of such tested items until the termination of the work.

Three copies of all test results shall be submitted to the Engineer.

All refrigerant piping work shall be tested for leakage using nitrogen gas or other inert gas of 28kg/cm² pressure.

After that they shall be purged with air vacume pump, for a minimum of one (1) hour.

Repair all leaks or defects uncovered by the tests and are retest the system.

After tests have been completed, drain the system and clean it of all dust and foreign matters. Clean all strainers valves and fittings of all dirt, fillings and debris.

Do not insulate or conceal piping until after tests have been completed and the results approved.

Drain piping shall be tested at 40 psig for 2 hours without loss of pressure.

10.03 REFRIGERATION MACHINE

The following tests shall be carried out on the refrigeration machines and the cooling tower :

- Electric power consumption
- Control system shall be tested to insure that it conforms with the sequence specified.

10.04 FANS

Fans shall be tested for actual C.F.M. against design C.F.M. for actual R.P.M. and electric power consumption.

10.05 AIR OUTLETS

All air outlets shall be tested for actual C.F.M. against design C.F.M.

10.06 CONTROLS

All controls shall be tested for proper functioning in accordance with the requirements of the Specifications.

MECHANICAL WORKS

MECHANICAL WORK

TABLE OF CONTENTS

<u>CHAPTER</u>	<u>TITLE</u>	<u>PAGE</u>
1	GENERAL TECHNICAL REQUIREMENTS FOR ENGINEERING SERVICES	1
	1.01 Scope of Work	1
	1.02 Coordination of Work	1
	1.03 Material Approval	2
	1.04 Laws and ordinances	2
	1.05 Contract Price	3
	1.06 Catalogue and Performance	3
	1.07 Materials Alternative	3
	1.08 Maintenance of Equipment Prior to Final Acceptance	4
	1.09 Testing	4
	1.10 Operation Manual	4
2	PIPES VALVES AND ACCESSORIES	5
	2.01 General	5
	2.02 Pipes Materials	5
	2.03 Installation Requirements	5
	2.04 Valves	8
	2.05 Strainer	9
	2.06 Pipe Accessories and Fittings	9
	2.07 Pipe Protection	10
	2.08 Pipe Insulation for Domestic Hot Water	10

CHAPTER	TITLE	PAGE
3	SOIL AND WASTER AND RAIN WATER SYSTEM	11
	3.01 Description of Work	11
	3.02 General Requirements	11
	3.03 Floor Drains	12
	3.04 Cleanouts	12
	3.05 Vent Cap	12
	3.06 Manholes	13
	3.07 Neutralization Pit	13
	3.08 Testing and Installation	14
4	FIRE FIGHTING SYSTEM	15
	4.01 Fire Extinguishers	15
5	PLUMBING FIXTURES AND ACCESSORIES	16
	5.01 Scope of Work	16
	5.02 General Requirements	16
	5.03 Plumbing Fixtures	16
	5.04 Fixtures Setting	17
	5.05 Water Closets	17
	5.06 Lavatories	18
	5.07 Shower	19
	5.08 Kitchen Sink	19
	5.09 Mirrors in Toilets	20
	5.10 Accessories	20
6	TESTING	21
	6.01 General Requirements	21
	6.02 Water Piping	22
	6.03 Interior Drainage	22
	6.04 Main Drainage Lines and Manholes	23

CHAPTER 1

GENERAL TECHNICAL REQUIREMENTS FOR ENGINEERING SERVICES

1.01 SCOPE OF WORK

The work covered under this Volume includes the supply installation, testing and delivery in good running order the plumbing and drainage systems as described in the following chapters and as shown on the drawings.

The works applied to the following parts:

- Laboratory Building
- Test Plant Building

1.02 COORDINATION OF WORK

The Contractor shall be responsible for coordinating the work of the plumbing and drainage services with that of other trades and prevent damage to work of other trades already completed.

All drawings issued with these Specifications are to be read in conjunction with each other and are to be considered as a whole.

1.03 MATERIAL APPROVAL

The Contractor shall submit to the Engineer for approval, samples of workmanship, materials, accessories and parts necessary for the construction whether specified, shown on the drawings or not.

The Contractor shall not place orders, supply or install any parts of equipment or materials, before receiving the written approval of the Engineer.

It remains the Contractor's responsibility if the workmanship or the materials and accessories used are not corresponding to those approved already. The Contractor shall replace at his own expenses the respective materials and workmanship to fulfill the entire satisfaction of the Engineer.

1.04 LAWS AND ORDINANCES

The Contractor shall install his work in accordance with all applicable rules and regulations as prescribed by the Authorities having jurisdiction.

The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the drawings and specifications are at variance therewith, he shall notify the Engineer in writing before tendering. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations and without such notice to the Engineer, he shall make the necessary correction and bear all costs arising therefrom.

1.05 CONTRACT PRICE

Unit prices given by the Contractor in the Bill of Quantities are deemed to cover the supply on Site, installation, erection, putting in good running order and testing of all the equipment and materials described in the Specifications. Any work indicated on the drawings and not specifically mentioned in the Specifications and vice-versa, are deemed to be included.

The Contractor shall undertake to make minor changes without any extra charges whenever necessary.

Before signing the Contract, the Contractor is supposed to have visited the Site and made a detailed examination of the Site Conditions along with the Tender drawings. The Contractor shall present in writing to the Engineer a full report concerning any condition which may affect him delivering a first class job.

1.06 CATALOGUE AND PREFORMANCE

The Contractor shall submit with his offer, the catalogues and performance curves or tables certified by The Manufacturer as well as samples, for all the equipment or materials to be used in the system.

1.07 MATERIALS ALTERNATIVE

The nomination of Manufacturers in the Specifications shall not be construed as an intention to eliminate the products of other Manufacturers and Suppliers having equivalent products. Such equivalent products shall be approved by the Engineer. The Contractor shall bear in mind that preference shall be given to materials and equipment of a type and make already in use or installed in the country and that proved to be durable and resistant to the elements.

The Tender shall be based upon the trade name or catalogue reference named in the Specifications and products of approved Manufacturers. Should the Contractor wish to use any materials or products other than those specified, he should so state as an alternative at the time of tendering naming the proposed substitutions and indicating what difference, if any, will be made in the Contract price and what detailed physical differences exist for such substitution, all to the approval of the Engineer.

1.08 MAINTENANCE OF EQUIPMENT PRIOR TO FINAL ACCEPTANCE

Materials shall be delivered in unbroken packages bearing the brand and maker's name and shall be stored on platforms and properly covered to protect them from moisture.

The Contractor shall be responsible for the maintenance of all equipment and systems installed until final acceptance by the Engineer and shall take such measures as necessary to insure adequate protection of all equipment and materials during delivery, storage and installation.

1.09 TESTING

The whole system and every particular equipment shall not be accepted until the tests described in this volume have been performed in the presence of the Engineer or his Representative and to his entire satisfaction.

All defective work or equipment shall be promptly repaired or replaced and the tests shall be repeated until the particular work or their equipment shall receive the approval of the Engineer or his Representative and fulfill the entire satisfaction of the Employer.

1.10 OPERATION MANUAL

The Contractor shall prepare operation manuals both in Arabic and English for the different systems and installations constructed and include schematic diagrams and all necessary instructions for the proper operation of these systems and installations.

CHAPTER 2

PIPES VALVES AND ACCESSORIES

2.01 GENERAL

This section comprises the supply and installation of pipes valves and their accessories needed in all trades used in the Mechanical Works, namely domestic water, rain water, sewage drainage and fire fighting.

2.02 PIPES MATERIALS

2.02-1 - Pipes for Domestic Water

Inside and outside the building : UPVC Pipe.

2.02-2 - Pipes for Drainage and Ventilation

Inside and Outside the building : Polychloride Vinyl Pipe(PVC) "Schedule 40"

2.02-3 - L.P. Gas Pipes

Hard draw copper pipes : Type "M"

2.02-4 - Pipes for Hot Water

Hard draw copper pipes : Type "M" with insulation.

2.03 INSTALLATION REQUIREMENTS

2.03-1 - Drawings

The drawings generally indicate the approximate location and sizes of the pipelines, but right is reserved to direct changes in run of pipes as necessitated by Site conditions and if so requested by the Engineer. The pipe sizes not indicated on the drawings shall be the same as the sizes of other pipes serving the same application or else the size shall conform to the instruction of the Engineer.

2.03-2 - Location of Pipes

- a- Generally pipes(not include PVC pipes) of concealed in the floor or walls shall be wrapped with PVC tape as specified.

The Engineer's approval shall be essential for installing pipes under tiles.

- b- Waste and vent pipes shall be installed true to plumbing line to the direction indicated on the drawings, slope of 1% for all horizontal pipes inside the building. All waste pipes shall be located under floor unless otherwise indicated. The minimum of slab breaking shall be permitted.

- c- All soil and vent stacks shall extend above the highest point of the roof and shall be equipped with a vent head and cap as specified and shown on the drawings.

2.03-3 - Pipes Jointing

- a- Jointing steel pipes

Galvanized steel pipes are jointed with screwed socket joints of wrought iron or steel. Care must be taken to remove any burr from the ends of pipes after screwing.

A jointing compound shall be used together with few strands of fine hemp. Any threads exposed after jointing should be painted, or in the case of underground piping, thickly coated with bituminous or other suitable composition to prevent corrosion. In some cases, steel piping may also be jointed with screwed flanges or wrought iron steel.

- b- Jointing PVC Pipes

PVC pipes shall be jointed with inserted in related receiving pipes, and the depths thereof shall be marked.

Dirt or fouling matter on the circumference of the pipe ends extracted from the receiving pipes shall be removed, and adhesive for vinyl shall be applied to pipe ends.

- c- Jointing Copper Pipes

Copper pipes for L.P. gas piping shall be jointed made by silver brazing using a brazing alloy consisting of 35 % to 45 % silver.

All brazing shall be performed by welders experienced in the method and technique of brazing.

2.03-4 - Pipe Workmanship

- a- Before installation all pipes shall be cleaned of all foreign matter and shall be deemed smooth after cutting, and trenches shall be cleaned up.
- b- Pipes shall be spaced to permit their installation.
- c- Pipes shall be carefully cut by hacksaw or by special pipe cutting machine. The pipes shall be cleaned and smoothed on edges before welding or threading.
- d- Threading shall be done for the total length of joint or accessory with a reliable threading machine.
- e- All changes in pipe sizes and direction shall be made with fittings. Excentric reducing fittings shall be used to prevent pocketing.
- f- No reduction in pipe sizes shall be allowed when connecting to pumps. If equipment inlet and outlet connections are different from the specified pipe size, the pipe size changes shall be allowed only with a conical reducer.
- g- Concealed pipes shall be installed in such a way as to permit their maintenance and inspection. Pipes shall be installed to the direction indicated on the drawings, and parallel to the building lines with the necessary slopes needed for venting and draining.
- h- Open ends of pipes shall be plugged until their use. Plugging shall be perfected with gate valves, counter-flange plug or thread plugs.
- i- All piping subject to expansion and contraction shall be installed with expansion bends, swing joints made up of fittings or other approved methods or devices. Branch lines from lines subject to expansion and contraction shall have a swing joint at the point of connection with the main. Expansion joint shall be installed even if not shown on the drawings.

2.03-5 - Pipes Embeded in Ground

The pipes shall be laid in trenches, the trench bottom shall be filled with padding of fine sand up to a depth of fifteen (15) cm. and shall be compacted and finished to the required elevations and slopes.

Pipes shall be lowered carefully into the trench and supported over its entire straight length by the sand padding. A recess in the trench bottom shall be provided at the end of each pipe to facilitate coupling.

After the pipe is laid, it shall be covered up to half its diameter with well tamped fine sand, then covered with sand up to twenty (20) cm. above crown and then the trench shall be backfilled and compacted as described under "Concrete Works".

All excavation work for piping embedment shall be carried out independently from other excavation works intended for the different services. This excavation shall only be carried after the ground has received its final compaction as called for in the Specifications.

2.04 VALVES

All valves shall be as manufactured by Hattersly, Crane or approved equal.

2.04-1 - Gate Valves

Gate valves shall be designed for packing under pressure with valves opened or closed.

Valves shall have non rising stems, shall open clockwise and shall permit straight line flow and complete shut-off. The screwed valves shall have joints with B.S. pipe threads. Flanged valves shall have the bolt holes to match the equipments or pipes on which they are installed. Gat valves shall be used for shut off purposes on the inlet and outlet side of pumps and in each principal branching supplying the bathrooms. They shall be also used for isolating purposes whenever indicated on the drawings or requested by the Engineer.

Gate valves up to 3 inches, inclusive, shall be bronze screwed conforming to B.S. 1952, class 125.

2.05 STRAINER

Strainer shall be installed whenever shown on the drawings. They shall be suitable for 125 psi working pressure.

Strainer, shall have stainless steel screen designed for servicing without being dismantled from the pipe.

2.06 PIPE ACCESSORIES AND FITTINGS

2.06-1 - General

The accessories shall be of the same standard as the pipes on which they are fitted, they shall be either flanged or threaded or welded depending on the type and the diameter of the pipe and the location in which the pipes are installed.

All fittings, elbows, tees, unions, flanges, etc... shall be galvanized as manufactured by A.F.L., Crane, G.W.H. or approved equal.

Nipples of 5, 8 and 10 cm. long must be from the same Manufacturers as mentioned above or approved equal.

2.06-2 - Pipe Hangers and Supports

The pipe hangers shall be of the individual or trapeze type as condition require, and shall be constructed of structural steel hanger rods with adjusting nuts.

Horizontal pipes shall be supported at not more than 2 metres intervals and at all changes in direction to ensure a maximum deflection of 3 mm.

Vertical pipes shall be provided with heavy iron clamps, one at every 2-5 metres.

Hangers and supports shall be secured to the structure by providing inserts in the concrete, or by means of fish plates in cases of heavy loads.

2.06-3 - Pipe Sleeve

Sleeve shall be galvanized steel pipe of approved weight, they shall be provided where pipes pass through roofs, floors, walls, partitions or similar.

Sleeve passing through wall partition and ceiling shall terminate flush with finished wall or ceiling surface. Sleeves passing through floor shall extend 50 mm. above finished floor.

Sleeve passing through roof shall extend 0.15 meter above the finished surface and shall be provided with a 1 mm. lead flashing to prevent roof water penetration.

2.07 PIPE PROTECTION

2.07-1 - Underground Pipe Protection

All steel and iron pipes buried in ground shall be protected against corrosion by tape wrapping after applying a protective painting. Tape wrapping shall be achieved by means of a self adhesive PVC tape applied with the necessary overlap in accordance with the instruction of the Manufacturer. Tape shall be as "Danso Tape" or "3M" or approved equal.

2.07-2 - Painting

All steelwork in connection with supports of pipes and equipment exposed to the elements is to be painted with two coats of an approved rust preventive paint. All exposed surfaces of equipment, valves, etc... shall be painted with two undercoats and two finishing coats of enamel paint to approved colour.

2.08 PIPE INSULATION FOR DOMESTIC HOT WATER

2.08-1 - General

Insulation material shall be fiber-glass, rock-wool, or expanded polystyrene, having a thermal conductivity not greater than 0.29 B.T.U. sq. ft./hr./ft./inch thickness. Cork shall not be used for insulating purposes.

Pipe insulation to be in prefomed 1" thick rigid sections. Insulation shall be applied after hydrostatic tests have been carried out.

2.08-2 - Method of Insulation

Before applying the insulation, surfaces shall be thoroughly clean and dry. All dirt, scale, rust, oil, grease or water shall be adequately removed.

Pipes shall be individually insulated.

2.08-3 - Insulation Finish

Insulation shall be protected against humidity by an approved vapour barrier.

The finished insulated surface shall present a neat, uniform and parallel appearance, whether concealed or exposed to view.

CHAPTER 3

SOIL AND WASTE AND RAIN WATER SYSTEM

3.01 DESCRIPTION OF WORK

Work described hereunder include the supply, installation, testing, and delivering in good running conditions of the following listed, but not limited to, systems :

- a- Soil and waste and ventilation for the Administration Building and Mosque until its connection with the Treatment Plant.
- b- Rain water collection for the Administration Building and Mosque until the discharge point on the shore line.
All as specified and shown on the drawings.

3.02 GENERAL REQUIREMENTS

- All horizontal drainage piping shall be installed with a fall of not less than 10 mm. per metre, unless otherwise shown or described.
- All fixtures shall be individually trapped.
- Vent piping shall not be trapped and shall be graded to drip back to waste or soil line.
- Change in direction of piping shall be made with long radius fittings.
- All pipes and fittings shall be kept clean, and the exposed ends of incomplete or unconnected work shall be plugged.
- Cleanouts shall be placed at all changes in direction whether shown on the drawings or not.

3.03 FLOOR DRAINS

Floor drains shall be clamped to flashing or to water proofing membrane. Clamping collars shall be supplied with drains only where flashing is required.

All floor drains shall be set 3 mm. below the normal finished floor, with a gradual pitch extending away from the drains.

Floor drains shall be provided in all toilet rooms, shower rooms and tea room.

Traps shall be cast iron or cast bronze complete with hinged cromium plated gratings and shall be threaded to frame as shown onthe detail drawing.

3.04 CLEANOUTS

3.04-1 - Galvanized Cleanout

Shall be formed directly on end of galvanized branch by means of a galvanized plug with a chrome plated cover if not in flase ceiling.

3.04-2 - In Line Cast Iron Cleanout

Shall be formed directly on end of horizontal or vertical case iron branches by means of a case iron adapter and a threaded brass plug as shown on the detail drawing.

3.05 VENT CAP

Shall be of cast iron cap with a CI flashing sleeve as shown on the detail drawing and as manufactured by Zurn Ref. z-193 or approved equal.

3.06 MANHOLES

Manhole shall be constructed of class "B" concrete as shown on the Drawings.

3.06-1 - Manhole Base

Shall be of precast class "B" reinforced concrete.

3.06-2 - Manhole Shaft

Shall be constructed of poured reinforced concrete to suit the required depth.

3.06-3 - Manhole Top

Manhole top shall be of class "B" reinforced concrete.

An opening suitable for the cover shall be left in the top around which the radial concrete bricks are built for proper adjustment of levels. Bricks shall be fully bedded in mortar and inside surface of joints finished flush and clean.

After three (3) days of curing, the manhole cover and frame shall be placed on the bricks and cast in with class "B" concrete which shall fill all openings and joints between the concrete top, bricks and frame.

The cover shall not be disturbed or even stepped on for at least three (3) days during which time the concrete shall be kept continuously wet. The inside surface of brick work shall be smoothly plastered.

3.07 NEUTRALIZATION PIT

The neutralization pit shall be constructed with reinforced concrete, and inside of the pit shall be finished with strong cement mortar durable to acid or alkali.

(Acid or Alkali etc. less than 10% concentration)

(Ambient temperature. less than 80°C)

Heavy duty cast iron cover (Approx. 600 mm dia.) shall be equipped on the top of the neutralization pit and shall be dumped LIMESTONE cubes of 10 cm to 15 cm of side dimension as shown on the detail drawing.

3.07-1 - Backfilling

When the structure is ready for backfilling, such work shall be done as specified under "Civil Works". Any damage done to the waterproofing works during backfilling shall be repaired and replaced by the Constructor at his own expense.

3.08 TESTING AND INSTALLATION

When the roughing in work is complete, the entire system shall be tested as specified in Chapter 8.

Installation shall be as specified in Chapter 2.

Chapter 4

FIRE FIGHTING SYSTEM

4.01 FIRE EXTINGUISHERS

4.01-1 - Portable CO2 Extinguishers

The Contractor shall supply and install one (1) CO2 portable extinguisher in each fire hose cabinet and where shown on the drawing

Extinguisher shall be of 8 liters capacity as manufactured by Brevo-Horgen, model LS8 or approved equal.

CHAPTER 5

PLUMBING FIXTURES AND ACCESSORIES

5.01 SCOPE OF WORK

The work covered under this Chapter consists of furnishing all labour, materials and equipment necessary to complete the plumbing fixture work as detailed on the drawings, and specified herein.

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

- European and Asiatic water closets, lavatories, showers, bath tub, bidet, sink, and all necessary accessories.

5.02 GENERAL REQUIREMENTS

- Fixtures and accessories shall be identical to the models indicated below. The catalogue numbers are mentioned only to indicate shape, size and material to be used. However, the Contractor can offer any equipment model subject to approval of the Engineer.
- All exposed piping and trim shall be chromium plated and fully protected during installation. Strap or padded wrenches shall be used on chrome plated pipe fittings and valves.

5.03 PLUMBING FIXTURES

- Plumbing fixtures shall be complete with all required trimmings, including faucets, waste plugs, traps, casings, hangers, brackets, anchors and supports.
- Vitreous china fixture shall be of first quality with smooth glazed surfaces, free from warp, cracks, discolorations or other imperfections.

5.04 FIXTURES SETTING

- Fixtures shall be set in a neat, finished and uniform manner making the connections to all fixtures at right angles to the wall.
- Roughing for this work must be accurately laid out so as to conform with finished wall material.

5.05 WATER CLOSETS

5.05-1 - European Water Closet

- Bowl : white vitreous china with horizontal discharge similar to French Ideal Standard N° 92853A0 super actibloc.
- Seat : Plastic black seat with cover similar to French Ideal Standard N° 6871 OY4.
- Flush tank : white vitreous china eleven (11) liters capacity similar to French Ideal Standard N° 9296 9AO.
- Pull bottom : chromium plated set for flush tank similar to French Ideal Standard N° 9 200 107.
- Fixing Bolts : chromium plated head similar to French Ideal Standard N° 9 200 203.
- Regulating angle valve : chromium plated with gate valve similar to Kugler N° 507 URS 352.
- Flexible spary hose : 1/2" chromium plated with gate valve similar to Kugler N° 4079 special.

With all necessary accessories.

5.05-2 - Asiatic Water Closet

- Bowl : White vitreous china with integral foot threads similar to Italian Ideal Standard IF 4004 SMIRNE.
- Rrap : 4" cast iron P trap.
- Flush tank : PVC construction with metallic chain and all necessary connection to the bowl, similar to GEBERIT-PVC Model N°12400.
- Flexible spray hose : 1/2" chromium plated with gate valve, similar to Kugler N° 4079 special.

With all necessary accessories.

5.06 LAVATORIES

5.06-1 - Wall Hung Lavatory with Cold Water Only

- Bowl : White vitreous china 62 x 49 cm. with one hole similar to French Ideal Standard N° 0 811 6A 1.
- Hangers : Chromium plated, concealed similar to French Ideal Standard N° 6 910 131.
- Faucet : 1/2" chromium plated similar to KUGLER N° 149 URS 470.
- Trap 1 1/4" chromium plated similar to KUGLER N° 3282 with arm similar to KUGLER N° 3320.
- Pop-Up-Waste : Chromium Plated similar to KUGLER N° 3282 with arm similar to KUGLER N° 3281.
- Angle valve : Chromium plated 1/2" wall angle valve similar to KUGLER N° 506.

With all necessary accessories.

5.06-2 - Wall Hung Lavatory with Cold and Hot Water

Ditto as above, but with 1/2" chromium plated mixer similar to KUGLER N° 3442, instead of faucet.

5.07 SHOWER

- Plate : White vitreous china 75 x 75 cm. similar to Italian Ideal Standard N° 1050 PIATTO DOCCIA With waste strainer.
- Trap : 1 1/2" galvanized "P" type.
- Mixer : 1/2" chromium plated with shower outlet similar to KUGLER N° 3846.
- Shower Head : Chromium plated similar to KUGLER N° 4062, with 1/2" chromium plated tube similar to KUGLER N° 4076.

With all necessary accessories.

5.08 KITCHEN SINK

5.8-1 - Kitchen Sink with One Bowl

- Sink : Stainless steel sink 90 x 60 cm. similar to BENTHOR, Ref. B-69-91 N.
- Mixer : 1/2" chromium plated mixer with wall flanges and swivel nozzle similar to KUGLER N° 3449.
- Waste : 1 1/2" chromium plated waste outlet with 25 cm. ball chain and slag as Hans-Grohe N° 63516.
- Trap : 1 1/2" chromium plated "P" trap with wall flange as Hans-Grohe N° 53004.

With all necessary accessories.

5.9 MIRRORS IN TOILETS

5.9-1 - Mirror without Shelf

Mirror shall have a stainless steel channel frame with round corners. It shall be supplied complete with key-hole hangres with theft resistant arrangement and as manufactured by Charles Parker, N° 1020, 40 x 60 cm. size or approved equal.

5.10 ACCESSORIES

The Contractor shall supply and install the following accessories in the positions indicated on the Architectural drawings :

- Paper Holder : white vitreous china 15 x 15 cm. recessed similar to Italian Ideal Standard N° IF 9674.
- Soap Holder for Lavatories : White vitreous china 15 x 15 cm. recessed similar to Italian Ideal Standard N° IF 9617.
- Soap Holder for Shower of bath tub: White vitreous china 15 x 30 cm. recessed similar to Italian Ideal Standard N° IF 9904.

CHAPTER 6

TESTING

6.01 GENERAL REQUIREMENTS

- a- All works shall be inspected during erection and upon completion according to the direction of the Engineer.
- b- All systems shall be thoroughly cleaned both externally and internally before test are performed.
- c- All tests shall be made before systems are painted, covered or enclosed in buiding construction whenever conditions permit. When so directed by the Engineer, systems shall be tested in sections.
- d- The Contractor shall supply the skilled staff and necessary instruments and carry out any test of any kind on a piece of equipment, part of system or on a complete system if the Engineer requests such a test for determining specified or guaranteed data, as given in the Specifications.
- e- Any damage resulting from the tests shall be repaired and/or damage material replaced, all to the satisfaction of the Engineer and at no additional cost to the Employer.
In the event of any repair or any adjustment having to be made, other than normal running adjustment, the tests shall be void and shall be recommenced after the adjustment or repair have been completed.
- f- The duration of tests shall be as determined by all parties having jurisdiction, but in no case less than the time prescribed hereafter.
- g- Test shall be performed in the presence of representatives of the Engineer and such other parties as may have legal jurisdiction.

- h- In general, pressure tests shall be applied to piping only, before connection of equipment and appliances. In no case shall piping, equipment, or appliances be subjected to pressure exceeding their rating.
- i- When all pressure tests of piping has been performed, a discharge test shall be carried out for each group at the normal operating pressure.
- j- After tests have been completed, the system shall be drained and cleaned of all dust and foreign matter. All strainers, valves and fittings shall be cleaned of all dirt, fillings, and debris.

6.02 WATER PIPING

- a- Water piping shall be tested for the whole building. All openings shall be vented and plugged then subjected to pressure of 5 kg/sq.cm. at roof level.
The pressure must be maintained in the piping system for at least 8 hours any pressure drop will mean improper and defective installation.
- b- Flow test : after the hydraulic test, the Contractor shall test all the sanitary fixtures connected to the pipes at full load according to the instruction of the Engineer.

6.03 INTERIOR DRAINAGE

After completion of the installation related to each stack for each floor, the connection openings together with the lower end of the stack shall be plugged and filled with clean water for a height of at least 3 meters above the tested joint, and the line inspected for any visible leaks.

The water must remain without any dropping level for at least 8 hours and any such drop will mean improper and defective installation.

The Contractor may perform the test after the complete installation of the sanitary piping. In this case, tee connections must be introduced on the stack at each floor interval in order to make it easy to plug the stack for testing purposes.

6.04 MAIN DRAINAGE LINES AND MANHOLES

All test shall be carried out, after completely emptying the pipes and manholes from water entrapped in them, in the following manner :

6.04-1 - Preparation

The downstream or outgoing pipe from each manhole shall be closed to achieve a completely water tight plug to the entire satisfaction of the Engineer.

6.04-2 - Filling

The manholes shall be filled with clean water to about five (5) cm, above the benching in the downstream manhole and the level marked.

6.04-3 - Inspection

The Contractor shall make such time allowance as may be necessary for the water level to settle before subjecting the pipe to test, after which the rise or fall in water level shall be noted.

The rise in water level in the manhole in question shall be considered as the infiltration of the upstream pipe, the fall in water level shall be considered as leakage.

Any leakage higher than the above maxima shall be considered as indicating improper laying, and the Contractor shall carry out all work required to locate, repair and/or replace any part or parts of the work causing this leakage. After carrying out all the corrective measures required for any line, the line shall be retested as described above. In all cases, no part of the work shall be considered as laid unless it passes the tests specified.

