TECHNICAL SPECIFICATIONS

PART 1 CIVIL, STRUCTURAL AND ARCHITECTURAL

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CHAPTER ONE

SITE PREPARATION & DEMOLITION

CHAPTER ONE SITE PREPARATION & DEMOLITION

PART 1 - GENERAL

SCOPE OF WORK

The work comprises of the rehabilitation of the Building.

SITE PROTECTION

The contractor should take all measures to protect the site and to protect the users during the rehabilitation period as per the Engineer instructions.

- The contractor should not allow or add any load to the existing body to avoid any risk in construction works.
- At the beginning of the works, the contractor should clean the site and the surrounding from all obstacles and remove all debris to outside the site.
- After the completion of works, the contractor should clean the site and works location and make good all places related to his works.

DEMOLITION

SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of structures.
 - 2. Demolition and removal of site improvements adjacent to a building or structure to be demolished.
 - 3. Disconnecting, capping or sealing, and abandoning in place or removing site utilities.

DEFINITIONS

A. Remove and Salvage: Carefully dismantle and/or detach from existing construction. Store, protect, and transport and deliver to Employer.

SUBMITTALS

- A. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- B. Schedule of Building Demolition Activities: Indicate the following:
 - 1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity.
 - 2. Interruption of utility services.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Locations of temporary protection and means of entry and exit for Contractor, and occupants affected by building demolition operations.
 - 5. Coordination of continuing occupancy of adjacent buildings and partial use of premises.
- C. Pre-demolition Photographs: Take photographs to show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by building demolition operations. Submit before Work begins.
- D. Inventory: After building demolition is complete, submit lists of components and items that have been removed and salvaged or removed for re-use.
- E. Pre-demolition Meeting: Conduct meeting at Project site to review methods and procedures related to building demolition including, but not limited to, the following:
 - 1. Inspect and discuss condition of construction to be demolished.
 - 2. Review structural load limitations of existing structures.
 - 3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review and finalize protection requirements.

CHAPTER TWO

EXTERNAL WORKS

PLANTING

2.5.1 SCOPE

- A. These Works shall consist of the furnishing of all materials and the construction, installation and completion in all respects of landscape planting.
- B. Landscape planting refers to items associated with preparing areas of planting and the planting of trees, shrubs, ground cover, vines, grass, and turfing.

2.5.2 LANDSCAPE PLANTING STANDARDS

A. The Contractor shall be responsible for the quality of all items purchased and shall submit and inspection plans for review. The inspection plan shall cover those items intended for shop inspection and the procedures for carrying out such inspections.

2.5.3 PRODUCTS AND MATERIALS

A. Agricultural Soil

- A.1 Soil shall be obtained from well-drained arable land approved by the Engineer before its use. It shall be free draining, non-toxic and capable of sustaining healthy plant growth. Soil shall not contain subsoil, refuse, roots, heavy clay, noxious weed, phytotoxic materials, coarse sand, rocks, sticks, brush, litter or other deleterious materials.
- A.2 Agricultural soil brought on to the Site without prior inspection and approval shall be at the risk of the Contractor, who shall remove it at his own expense unless otherwise instructed by the Engineer.

B. Fertilizers

- B.1 Inorganic fertilizers shall be applied to the irrigation water by the use of injection equipment. Fertilizers shall be approved soluble NPK fertilizers in a suitable ratio applied at a dilution rate of one kg fertilizer to 1,000 ltr of water.
- B.2 Proposals for use of any of the following alternative fertilizer types and composition where injection equipment is not specified for use, may be submitted for consideration: However, the suitable fertilizer type and grade shall be determined, after testing the soil samples, to suit that type of plantation desired.

C. Plants Generally

- C.1 All plants shall comply with BS 3936, Part 1, and be of the size specified. No plant shall be less than the minimum size and at least 50% shall be in the upper part of the specified range. Plants that meet the measurements specified but do not possess the normal balance between height and spread will not be accepted.
- C.2 All planting stock shall be well-balanced and well formed, sound vigorous, healthy and free from disease, sunscald, abrasion, harmful insects or insect eggs and with a healthy unbroken root system. Unless otherwise specified, only nursery-grown plants shall be used.
- C.4 All plants supplied shall have been grown form the Contractor's own nursery stock or obtained from a reputable nursery, and shall be subject to approval by the Engineer at the source prior to digging for transport to the project site.
- C.5 If specified plants are unobtainable, details of alternatives shall be submitted with the Tender, stating how they differ from the plants specified. Such substitutions shall be subject to approval.

H. Trees (Other Than Palms)

- D.1 Trees shall be symmetrically developed, their structure and habit of growth typical of their species or variety with straight stems and an intact central leader. All trees shall be root pruned at the source prior to shipment to the project site and are to be supplied earthballed and Hessian covered or container grown. Bare root trees shall not be acceptable without prior approval of the Engineer. Trees shall have a minimum height of 1.8 m above planting level.
- D.2 Where trees of 1.8 m height are unobtainable, and subject to the submission of evidence to that effect, the Contractor may, if approved, substitute trees of 1.5 heights.
- D.3 Anti-desiccant shall be applied to all trees no more than 24 hours prior to shipment from the source to the project site. The Anti-desiccant sample shall be submitted to the Engineer for approval in unopened containers of the manufacturer prior to application.

E. Palms

- E.1 Palms shall be balled and burlapped unless container grown palms are available. Offshoots will not be accepted. They shall have a vigorous root system, a crown of new leaves, proper color of leaves of an adult palm and sufficient hardiness. Fronds shall exhibit no signs of moisture stress. All palms shall have straight 10 runks. Any tree having a weak or thin trunk not capable of supporting itself when planted in the open will not be accepted. They shall be of a quality equal to heavy trunk type palms designated as "Florida Fancy" in the Florida Department of Agriculture and Consumer Service Publication.
- E.2 Height of palms shall not be less than 1.5 from planting level to the base of the growing tip. Palms of 1.5 m height shall have a root-ball diameter of 0.75m to 0.9m; Palms of 2m heights shall have a root ball diameter of .90m to 1.10m Palms of 2.4m heights shall have a root ball diameter of 1.10m to 1.30m. Palms of 3.0m heights shall have a root ball diameter of 1.30m to 1.50m.
- E.3 Palms trees shall be root pruned one year before removal from the original growing site. The pruning trench shall be backfilled with wet peat or equal and the tree sprayed with anti-desiccant.
- E.4 Palms shall be dug and prepared for shipment in a manner that will not cause any damage to the fronds, bud, shape, root system and future development of the plants after replanting.
- E.5 Care shall be taken that the root ball is planted intact and the terminal bud is undamaged. Damaged palms shall be replaced at the Contractor's expense.
- E.6 Guying of the palm trees shall be specified by the Engineer.
- E.7 Palms shall be irrigated and basins shall be prepared to retain the water. The Contractor shall provide sub-soil drainage to the palm growing area in case the palm pits do not drain properly.
- E.8 The Contractor will be required to replace, at his own expense, planting material that does not grow and fails to survive while in the site nursery or holding area. All plants that show signs of failure to grow at any time, as determined by the Engineer, shall be removed ad replaced. The Engineer will inspect the nursery growing grounds once a week alor at longer intervals, at his discretion and will mark or indicate the plants to be replaced. Any plant requiring replacement should be replaced with a plant of equal size and age as the plant found unsuitable should have been at the date of replacement, removal, transporting and installing of the plants shall be performed by the Contractor at his own expense.

E.9 If the palms have been temporary heeled-in or held in a project nursery for more than 45 days. The following procedures shall be followed immediately prior to relocation for final planting:

- Trim off matured fronds using a very sharp knife.
- Trim semi-mature fronds by leave a total of 10 to 14 fronds, either mature of semi-mature, to protect the growth bud.
- Trim off all suckers and fruiting stalks.
- The remaining frond shall be tied upright with twine to surround the growth bud. The fronds shall be then trimmed to about 2/3 of their original length. These tied fronds shall then be neatly wrapped with burlap and tied again to hold the burlap in place.
- After wrapping fronds, the soil around the palm tree will be irrigated to field capacity. The palm will not be dug until the soil is in a friable condition. If the palms must remain in the ground in a wrapped condition for more than two days repeat this irrigation procedure daily.
- Excavate a trench approximately one meter from the trunk to a depth of 1.25 meters. Break
 the root ball loose from the ground by prying. (Use of a backhoe to excavate around the
 palm is permissible. It can also be used to remove the palm). The Contractor shall be
 especially careful not to bump the palm near the growth bud.
- Use a front loader, backhoe or crane and a heavy duty nylon or canvas sling to lift the palm vertically from the pit, with the palms suspended in the vertical position, using sharp machetes, shovels and shears, remove all the dirt and trim the roots to 0.50 meter from the trunk.

F. Tree Stakes and Ties (Excluding Palm Stakes)

- F.1 All stakes shall be of timber, straight, free of projections and pointed at one end. The lower ends shall be coated with a non-injurious wood preservative to a minimum height of 0.15m above ground level, to be applied at least 2 weeks before use. Stakes shall be 50mm thick, the minimum length below ground to be 1.3m and the length above to be for the full height of the stem or half full height for feathered species.
- F.2 Alternatively, tree stakes shall be mild steel tubes protected by a PVC coating in mid-green or similar approved color. The tops and bottoms of the steel tubes shall be sealed with plastic caps. The external covering shall have horizontal ridges at regular intervals to facilitate the fixing of tree ties. Steel tube shall have a diameter of 35 mm and a height as the timber stakes.
- F.3 Wooden and steel stakes shall not be used on the same site.
- F.4 Trees ties shall consist of a synthetic rubber compound hose, approved plastic, adjustable strap type or neoprene type approximately .03m in diameter and 0.3 in length, with rubber or Hessian buffer.

G. Guy Wires for Palms

Palms shall be stabilized with four 7-strand galvanized guy wires of 6mm diameter and of a length suited to each tree, fixed to approximately two thirds of the tree height. The wire guy shall be looped around the palm stem and protected by an approved tree tie.

H. Turnbuckles and Ground Anchors

Each guy wire shall be connected via a 50mm galvanized turnbuckle to a 150mm malleable iron ground anchor fixed by 1.2m long drive rods.

I. Trunk Wrapping Material

Trunk wrapping material shall be Hessian bands75 mm wide and of lengths as necessary for wrapping tree trunks and main branches. Alternatively, purpose made double thickness heavy Kraft crepe paper in rolls not less than 100mm wide with a stretch factor of 33% may be used.

J. Burlap

Burlap shall be jute of 0.20kg/m2 or cloth having same strength and resistance to tearing and capable of rotting in the ground.

K. Twine For Tying

Twine for tying shall be lightly tarred medium or coarse sisal yarn.

L. Plant Labels

Plant labels shall be durable, weatherproof and to state legibly the correct plant and size.

M. Chafing Guards

Chafing guards shall be two-ply reinforced rubber or plastic garden hose of uniform color throughout the work.

N. Cast Iron Tree Grating Frame and Cover

The frame and cover should be of heavy-duty quality and galvanized. The pattern, the overall size and opening as specified on drawings. The finish color to be black once painted with 3 coast of epoxy paint. Sample must be submitted to obtain approval before placing order with supplier.

O. WROUGHT IRON TREE GUARD

The over all sizes as specified on drawing. The galvanized finish having 3 coats of black paint.

2.5.4 MEASUREMENT

A. Trees, Palms, Shrubs, ground Cover, Succulents and Climbing Plants shall be measured by the number of each type furnished, installed, including preparation of planting areas and all necessary agricultural soil, planting medium, fertilizers, staking, tying and incidentals, and accepted.

B. Additional fertilizers, recommended by the Independent Soil Analyst and approved for use shall be measured by kilogram furnished, incorporated in the Works, and accepted.

PAY ITEMS

UNIT OF MEASUREMENT

(1) Trees	Number
(2) Palms	"
(3) Shrubs	"
(4) Ground Cover	"
(5) Succulents	"
(6) Climbing Plants	66
(7) Additional Fertilizers	
(each authorized type)	Kilogram (kg)

CHAPTER THREE

CONCRETE WORKS

CAST IN PLACE CONCRETE

PART 1 - GENERAL

SUMMARY

A. Extent of cast in place concrete work is shown on Drawings.

PROJECT CONDITIONS

- A. Protect adjacent finish materials against spatter during concrete placement.
- B. Protection of fresh concrete against hot weather: Cover completed fresh concrete with temporary cover as required to protect newly cast elements from direct sun light in hot weather above 35 deg. C; maintain cover for time period until curing starts.
- C. Protect surfaces from rain, wind and sun, detention and physical damage.
- D. Protect immature concrete from physical shock, movement, thermal shock and cold water.

PART 2 - PRODUCTS

REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615; BS 4449, 4461
- B. Steel Wire: ASTM A 82, plain, cold-drawn steel.
- C. Welded Wire Fabric: ASTM A 185; BS 4483
- D. Supports for Reinforcement; Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place.
 - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected or stainless steel protected.

CONCRETE MATERIALS

- A. Ordinary Portland cement: ASTM C 150 Type I; BS12.
- B. Sulphate-Resisting Portland cement: ASTM C 150 Type V; BS 4027
- C. Use one brand of cement throughout project, unless otherwise acceptable to Engineer.
- D. Normal Weight Aggregates: ASTM C 33; BS 882 and as herein specified. Provide aggregates from a single source for exposed concrete.
 - 1.Do not use fine or coarse aggregates containing sapling causing deleterious substances and this should have a sand equivalent more than 70.
 - 2.Local aggregates not complying with the standards stated but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to Engineer.
- E. Hourdi Blocks for hollow concrete suspended slabs: Machine made vibrated hollow concrete (cement and fine sand aggregate) blocks, withstanding compressive force applied at the ends of 40kg/cm2 based on the gross sectional area of the block (without deducting voids).
- F. Water: Potable, free from foreign material in amounts harmful to concrete or embedded steel.

RELATED MATERIALS

A. Epoxy Adhesive: ASTM C 8891, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.
- B. For information, submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until the acceptability of each mix has been adequately substantiated by the Contractor according to ACI 301, as judged by the Engineer.
- C. Design mixes in accordance with the following table. Ensure quantity of water used does not exceed that required to produce a concrete with sufficient workability to be placed and compacted where required.

DESIGNED MIXES

Class of Concrete	AA	<u>A</u>	<u>B</u>	<u>C</u>
Minimum cement quantity per m3 of concrete (kg)	450	400	350	250
Water cement ratio	0.48	0.48	0.49	0.58
Preliminary Test Cylinders: Minimum Compressive Strength at 28 Days (kg/cm2)	400	350	280	180
Works Test Cylinders Minimum: Compressive Strength at 28 Days (kg/cm2)	350	300	250	175
Method of compacting of concrete when placed	Vibrated	Vibrated	Vibrated	Rodded, or Tamped

Keep slump to the minimum compatible with approved placing requirements.

- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested from Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Employer and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.
- E. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
 - 1. Ramps, slabs, and sloping surfaces: Nor more than 100mm.
 - 2. Reinforced foundation systems: Not less than 25 mm and not more than 125 mm.
 - 3.Concrete containing HRWR admixture (super-plasticizer): Not more than 230 mm after addition of HRWR to site-verified 50-75 mm slump concrete.

CONCRETE MIXING

- A. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
- B. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.
- C. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required and shall be subject to the Engineer's approval.

PART 3 - EXECUTION

GENERAL

A. Coordinate the installation of joint materials and water proofing membranes with placement of forms and reinforcing steel.

FORMS

- A. Design, erect, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.
- B. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
- C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, regrets, recesses, and the like, to prevent swelling and for easy removal.
- D. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

PLACING REINFORCEMENT

- A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
 - 1. Avoid cutting or puncturing water proofing membranes during reinforcement placement and concreting operations.
- B. Clean reinforcement of loose rust and mill scale, earth, and other materials, which reduce or destroy bond with concrete
- C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
- D. Place reinforcement to obtain at least minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surface.
- E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

JOINTS

- A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Engineer.
 - 1. Where specific slab-on-ground construction joints are not shown on Drawings, cast slab on ground in strips, each strip width not to exceed 5 m or the typical bay width whichever is less.
 - 2. Construction joint spacing in basement walls and slabs on ground should not exceed 8m unless acceptable to Engineer.
 - 3. Locate construction joints in framed slabs within the middle third of any slab or beam span length, unless otherwise indicated on drawings.
 - 4. Lightly roughen face to expose coarse aggregate unless otherwise instructed. Wet and cover with 1:1 cement and sand grout immediately prior to placing fresh concrete. Stop roughening 25 mm form arises to surfaces exposed to view in finished work. Remove small mortar lips from exposed arises with carborundum stone. Face is to be clean and damp before fresh concrete is placed against it.
- B. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.
- C. Water stops: Provide water stops in construction joints as indicated. Install water stops to form continuous diaphragm in each joint. Make provisions to support and protect exposed water stops during progress of work. Fabricate field joints in water stops in accordance with manufacturer's printed instruction.
- D. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.
 - 1. Joint filler and sealant materials are specified in elsewhere in the specifications.

CONCRETE PLACEMENT

A. Replacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other trades to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

1. Apply temporary protective covering to lower 600 mm of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.

- B. General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.
- C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
- D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 600 mm and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
- E. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

- F. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not further than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 150 mm into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- G. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
- H. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
- I. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or derbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
- J. Maintain reinforcing in proper position during concrete placement operations.
- K. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.
- L. When air temperature has fallen to or is expected to fall below 36 deg F (2 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F (27 deg C) at point of placement.
- M. Do not use-frozen material or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
- N. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
- O. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
- P. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
- Q. Cover reinforcing steel with water-soaked burlap it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
- R. Fog spray forms, reinforcing steel, and sub grade just before concrete is placed.
- S. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from direct exposure to wind, from premature drying and from excessive cold or hot temperatures.
- B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep continuously moist and covered for not less than 7 days.
- C. Begin final curing procedures immediately following initial curing and before concrete have dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.
- D. Curing methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.
- E. Provide moisture curing by following methods.

1.Keep concrete surface continuously wet by covering with water.

2. Continuous water-fog spray.

- 3. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 100 mm lap over adjacent absorptive covers.
- F. Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 74 mm and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- G. Provide membrane curing and sealing compound to exposed interior slabs and to exterior slabs, walks, and curbs, as follows:
 - 1.Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
- H. Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, damp proofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting and other coatings and finish materials, unless otherwise acceptable to Engineer.
- I. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above as applicable.
- J. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.
- K. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

SHORES AND SUPPORTS

- A. Comply with ACI 347 for shoring and re-shoring in multistory construction, and as herein specified.
- B. Remove shores and re-shore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate re-shoring to safely support work without excessive street or deflection.
- C. Keep shores in place a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

REMOVAL OF FORMS

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at no less than 50 deg F (10 deg C) for 36 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and not until concrete has attained 28 day design strength unless authorized by Engineer. Determine potential compressive strength of in place concrete by testing field-cured specimens representative of concrete location or members.
- C. Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Engineer.

MISCELLANEOUS CONCRETE ITEMS

- A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer machines and equipment.
- D. Grout base plates and foundations as indicated, using specified non-shrink grout. Use nonmetallic grout for exposed conditions, unless otherwise indicated.
- E. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in-safety inserts and accessories as shown on drawings. Screed, tamp, and finish concrete surfaces as scheduled.

QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. The Contractor will employ a testing laboratory approved by the Engineer to perform tests and to submit test reports.
- B. Sampling and testing for quality control during placement of concrete may include the following, as directed by Engineer.
- C. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - 1. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
 - 2. Concrete Temperature: Test hourly when air temperature is 40 deg F (4 deg C) and below, and when 80 deg F (27 degC) and above; and each time a set of compression test specimens is made.
 - 3. Compression Test Specimen: ASTM C 31; one set of 6 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field cured test specimens are required.
 - 4. Compressive Strength Tests: ASTM C 39, one set for each day's pour exceeding 4 cu.m plus additional sets for each 40 cu.m over and above the first 20 cu.m of each concrete class placed in any one day; two specimens tested at 7 days, three specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
 - 5. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
 - 6. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
 - Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results exceed 10% of specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 3.5 MPa (500 psi)
- D. Test results will be reported in writing to. Engineer within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- F. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing service may conduct test to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such additional tests.

CONCRETE TOPPING

PART 1 – GENERAL

SUMMARY

- A. Section Includes:
 - 1. Decorative stamped concrete floor topping.

ACTION SUBMITTALS

A. Product Data: product indicated.

INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

CONCRETE FLOOR TOPPINGS

- A. Stamped-Aggregate Concrete Floor Topping: Factory-prepared and dry-packaged mixture of containing mineral oxide; Portland cement; plasticizers; and other admixtures to which only water needs to be added at Project site.
 - 1. Products: Subject to compliance with requirements, provide available products that may be incorporated into the Works and which are deemed in the market.
 - a. Compressive Strength (28 Days): 4000 psi; ASTM C 109/C 109M
 - b. Slump in concrete shall not exceed 10 cm

CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 25 percent solids content, minimum.
- F. Apply a color hardener at the minimum 30 kg / 10 sq.m

RELATED MATERIALS

- A. Semi-rigid Joint Filler: Two-component, semi-rigid, 100 percent solids, [epoxy resin with a Type A Shore durometer hardness of 80] per ASTM D 2240.
- B. Joint-Filler Strips: [ASTM D 1751, asphalt-saturated cellulosic fiber].
- C. Portland Cement: ASTM C 150, Type I or II.
- D. Sand: ASTM C 404, fine aggregate passing No. 16 (1.18-mm) sieve.
- E. Water: Potable.
- F. Acrylic-Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- G. Epoxy Adhesive: ASTM C 881/C 881M, Type V, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements.

MIXING

- A. Bonding Slurry: Mix Portland cement with water to a thick paint consistency.
- B. Bonding Slurry: Mix 1 part Portland cement and [1-1/2] parts sand with water [and an acrylicbonding agent according to manufacturer's written instructions] to a thick paint consistency.
- C. Floor Topping: Mix concrete floor topping materials and water in appropriate drum-type batch machine mixer or truck mixer according to manufacturer's written instructions.

PART 3 - EXECUTION

PREPARATION

- A. Existing Concrete: Remove existing surface treatments and deteriorated and unsound concrete. Mechanically abrade base slabs to produce a heavily scarified surface profile with amplitude of (6 mm).
 - 1. Prepare and clean existing base slabs according to concrete floor topping manufacturer's written instructions. Fill voids, cracks, and cavities in base slabs.
 - 2. Saw cut contraction and construction joints in existing concrete to a depth of (35-50 mm) and fill with semi-rigid joint filler.
 - 3. To both sides of joint edges and at perimeter of existing base slab [mechanically remove a (100-mm-) wide and (0- to 25-mm-) deep, tapered wedge of concrete and retexture surface].
- B. Install joint-filler strips where topping abuts vertical surfaces.

FLOOR TOPPING APPLICATION

- A. Start floor topping application in presence of manufacturer's technical representative.
- B. Monolithic Floor Topping: After textured-float finish is applied to fresh concrete of base slabs specified in Division 03 Section "Cast-in-Place Concrete," place concrete floor topping while concrete is still plastic.
- C. Deferred Floor Topping: Within 72 hours of placing base slabs, mix and scrub bonding slurry into dampened concrete to a thickness of (1.6 to 3 mm), without puddling. Place floor topping while slurry is still tacky.
- D. Existing Concrete: Apply epoxy-bonding adhesive, mixed according to manufacturer's written instructions, and scrub into dry base slabs to a thickness of (1.6 to 3 mm), without puddling. Place floor topping while adhesive is still tacky.
- E. Place concrete floor topping continuously in a single layer, tamping and consolidating to achieve tight contact with bonding surface. Do not permit cold joints or seams to develop within pour strip.
 - 1. Screed surface with a straightedge and strike off to correct elevations.
 - 2. Slope surfaces uniformly where indicated.
 - 3. Begin initial floating using bull floats to form a uniform and open-textured surface plane free of humps or hollows.
- F. Finishing: Consolidate surface with power-driven floats as soon as concrete floor topping can support equipment and operator. Straighten, cut down high spots, and fill low spots. Repeat float passes and straightening until concrete floor topping surface has a uniform, smooth, granular texture.
 - 1. Hard Trowel Finish: After floating surface, apply first trowel finish and consolidate concrete floor topping by power-driven trowel without allowing blisters to develop. Continue troweling passes and straighten until surface is smooth and uniform in texture.
- G. Construction Joints: Construct joints true to line with faces perpendicular to surface plane of concrete floor topping, at locations indicated or as approved by Architect.
 - 1. Coat face of construction joint with epoxy adhesive at locations where concrete floor topping is placed against hardened or partially hardened concrete floor topping.

- H. Contraction Joints: Form weakened-plane contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut (5-mm) wide joints into concrete floor topping when cutting action will not tear, abrade, or otherwise damage surface and before random contraction cracks develop.
 - 1. Form joints in concrete floor topping over contraction joints in base slabs, unless otherwise indicated.
 - 2. Construct contraction joints for a combined depth equal to topping thickness and not less than one-fourth of base-slab thickness.
 - 3. Construct contraction joints for a depth equal to one-half of concrete floor topping thickness, but not less than (13 mm) deep.

PROTECTING AND CURING

- A General: Protect freshly placed concrete floor topping from premature drying and excessive cold or hot temperatures.
- B Evaporation Retarder: Apply evaporation retarder to concrete floor topping surfaces in hot, dry, or windy conditions before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or dirtying floor topping, but before float finishing.
- C Begin curing immediately after finishing concrete floor topping. Cure by one or a combination of the following methods, according to concrete floor topping manufacturer's written instructions:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete for not less than seven days.
 - 3. Curing Compound: Apply uniformly in two coats in continuous operations by power spray or roller according to manufacturer's written instructions.

JOINT FILLING

- A Prepare and clean contraction joints and install semi-rigid joint filler, according to manufacturer's written instructions, once topping has fully cured.
- B Install semi rigid joint filler full depth of contraction joints. Overfill joint and trim semi-rigid joint filler flush with top of joint after hardening.

REPAIRS

A Defective Topping: Repair and patch defective concrete floor topping areas, including areas that have not bonded to concrete substrate.

CHAPTER FOUR MASONRY

EXTERIOR STONEWORK

PART 1 - GENERAL

SUMMARY

- A Extent of stonework is indicated on Drawings.
- B Types of stonework in this section include:
 - 1. Exterior stone veneers and facings.
- C Interior stone facing and flooring is specified in the Finishes section of the Specification.

SYSTEM DESCRIPTION

- A. General: Fabricate and install stonework to withstand normal loads from wind, gravity, movement of building structure, and thermally induced movement, as well as to resist deterioration under conditions of normal use including exposure to weather, without failure.
- B. Provide stonework, which is designed, fabricated and installed, based on the safety factors applied to minimum physical properties of the different stones indicated.
- C. Provide hand-set stone anchoring system which results in attachments developing the capability to sustain the following forces generated by the supported element (individual member or assembly) acting separately, based on the yield strength of the material:
 - 1. A total force of 4 times the dead weight of the element supported, applied vertically downward through the element's center of gravity, combined with loads caused by thermal movements.
 - 2. A total force of 3 times the dead weight of the element applied horizontally outwards through the center of gravity of the element, combined with loads caused by thermal movements.

QUALITY ASSURANCE

A. Single Source Responsibility for Stone: obtain each color, grade, finish, type and variety of stone from a single quarry with resources to provide materials of consistent quality in appearance and physical properties, including the capacity to cut and finish material without delaying the progress of the work.

PART 2 - PRODUCTS

MATERIALS, GENERAL

- A. Comply with relevant standards and other requirements indicated, as applicable to each type of material required.
- B. Provide matched blocks from a single quarry for each type similar to existing or where applicable, variety, color and quality of stone required. Extract blocks from a single bed of quarry stratum, unless stones from randomly selected blocks are acceptable to Engineer for aesthetic effect.
- C. Provide stones, which are free from vents, cracks, fissures, discoloration or other surface defects, which may adversely affect strength or appearance.

STONE FABRICATIONS

- A. General: fabricate stonework in sizes and shapes required to comply with requirements indicated, including details on Drawings and final shop drawings.
- B. Cut and drill sink ages and holes in stones for anchors, fasteners, supports and lifting devices as indicated or needed to set stonework securely in place; shape beds to fit supports.
- C. Cut stones to produce pieces of thickness, size and shape indicated or required and within fabrication tolerances recommended by applicable codes or standards or, if none, stone source, for faces, edges, beds, and backs.
 - 1. Quirk-miter corners, unless otherwise indicated; provide for cramp anchorage in top and bottom bed joints of corner pieces.
- D. Finish exposed faces and edges of stones to comply with requirements indicated for finish under each type and application of stone required and to match approved samples.

PART 3 - EXECUTION

EXAMINATION

A. Examine surfaces to receive stonework and conditions under which stonework will be installed. Do not proceed with installation until surfaces and conditions comply with requirements indicated in specifications or elsewhere for execution of other work, which affects stonework.

SETTING STONE, GENERAL

- A. Execute stonework by skilled masons, and stone fitters at the site to do necessary field cutting, as stones are set.
 - 1. Use power saws to cut stones; for exposed edges, produce edges, which are cut straight and true.
- B. Contiguous Work: Provide chases, reveals, regrets, openings and other spaces as required for accommodating contiguous work. Close-up openings in stonework after work is in place with stonework which matches that already set.
- C. Set stones to comply with requirements indicated on drawings and final shop drawings. Install anchors, supports, fasteners and other attachments indicated or necessary to secure stonework on place. Shim and adjust anchors, supports and accessories to set stones accurately in locations indicated with uniform joints of widths indicated and with edges and faces aligned according to established relationship and indicated tolerances.
- D. Construction Tolerances: set stones to comply with the following tolerances:
 - 1. Variation from Plumb: For lines and surfaces of columns, walls and arises, do not exceed 6mm in 3m, 10mm in a story height or 6m maximum, nor 15mm in 12m or more. For external corners, expansion joints and other conspicuous lines, do not exceed 6mm in any story or 6m maximum, nor 15mm in 12m or more.
 - 2. Variation from Level: for grades indicated for exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 15mm in any bay or 6m maximum, or 20mm in 12m or more.
 - 3. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 15mm in any bay or 500mm maximum, nor 20mm in 12m or more.
 - 4. Variation in Cross-Sectional Dimensions: For columns and thickness of walls from dimensions indicated, do not exceed minus 6mm nor plus 15mm.

ADJUSTING AND CLEANING

- A. Remove and replace stonework of the following description:
 - 1. Broken, chipped, stained or otherwise damaged stones.
 - 2. Defective joints.
 - 3. Stones and joints not matching approved samples.
 - 4. Stonework not complying with other requirements indicated.
- B. Replace in manner which results in stonework matching approved samples, complying with other requirements and showing no evidence of replacement.
- C. Clean stonework not less than 6 days after completion of work, using water and stiff bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods which could damage stone.

PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to the Engineer, which ensures stonework being without damage or deterioration at time of final handing over.

Civil, Structural & Architectural Specifications ANNEX VIII

CHAPTER FIVE METAL WORKS

METAL FABRICATIONS

PART 1 - GENERAL

SUMMARY

- A. Definition: Metal fabrications includes components and assemblies from ferrous and non-ferrous metal shapes, plates, bars, strips, tubes, pipes and castings which are not a part of structural steel or other metal systems specified elsewhere.
- B. Extent of metal fabrications is indicated on drawings, and includes but is not necessarily limited to the following:
 - 1. Ladders
 - 2. Floor drain covers
 - 3. Water tank access covers
 - 4. Steel gates
 - 5. Aluminum handrails and railing systems
 - 6. Miscellaneous steel pipe railings
 - 7. Miscellaneous checker plate fabrications
 - 8. Miscellaneous supports for overhead doors and the like.

PROJECT CONDITIONS

- A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrications; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.
 - 1. Where field measurements cannot be made without delaying the work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

PART 2 - PRODUCTS

MATERIALS

- A. Ferrous Metals
 - 1. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes and including pitting, seam marks, roller marks, rolled trade names and roughness.
 - 2. Steel Plates, Shapes and Bars: ASTM A 36 or BS 1449.
 - 3. Rolled Steel floor plates: ASTM A 786.
 - 4. Steel Bar Grating: ASTM A 569 or ASTM A 36.
 - 5. Steel Tubing: Cold formed, ASTM A 500; or hot-rolled, ASTM A 501, BS 4848, or BS 2994.
 - 6. Structural Steel Sheet: Hot-rolled, ASTM A 570; or cold-rolled ASTM A 611, of grade required for design loading.
 - 7. Galvanized Structural Steel Sheet: ASTM A 446, of grade required for design loading. Coating designation as indicated, or if not indicated, G90.
 - 8. Steel Pipe: ASTM A 53 or BS 4848. Type and grade as selected by fabricator and as required for design loading; black finish unless galvanizing is indicated; standard weight (schedule 40), unless otherwise indicated.
 - 9. Grey Iron Castings: ASTM A 48, Class 30, or BS 1452.
 - 10. Malleable Iron Castings: ASTM A 47, grade as selected by fabricator.
 - 11. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.
 - 12. Concrete Inserts: Threaded or wedge type, galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A 153.
- B. Aluminum
 - 1. All aluminum works should be as manufactured by Sidem Type 2000
- C. Grout
 - 1. Non-Shrink Non-Metallic Grout: Pre-mixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified and required.

D. Fasteners

- 1. General: Provide stainless steel fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required.
- Bolts and Nuts: Regular-hexagon head type. Lag Bolts: Square head type. Machine Screws: Cadmium plated steel. Wood Screws: Flat head carbon steel. Plain Washers: Round, carbon steel. Anchorage Devices: Drilled in expansion anchor bolts. Toggle Bolts: Tumble-wing type, class and style as required. Lock Washers: Helical spring type carbon steel.

E. Paint

- 1. Shop Primer for Ferrous Metal: Manufacturer's or fabricator's standard, fast-curing, lead-free, "Epoxy" primer; selected for good resistance to aggressive atmospheric corrosion, for compatibility with finish paint systems indicated and for capability to provide a sound foundation for field applied topcoats despite prolonged exposure.
- 2. Galvanizing Repair Paint: High zinc dust content paint for galvanizing welds in galvanized steel.
- 3. Bituminous Paint: Cold applied asphaltic mastic.
- 4. Zinc Chromate Primer.

F. Stainless Steel

Where stainless steel is specified it shall be what is known to the trade as Austentic 18-8, type 316, with a content of from 17% to 19% chrome, 7% to 9% nickel and a maximum, carbon content of 0.11%.

Stainless steel shall be free from scale and all surfaces shall be polished to a No.4 commercial finish where specified.

PART 3 - EXECUTION

PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

INSTALLATION

- A. General:
 - 1. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.
 - 2. Cutting, Fitting and Placement: Perform cutting drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plus, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items, which are to be built into concrete masonry or similar construction.
 - 3. Fit exposed connections accurately together to form tight hairline joints. Weld connections, which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units, which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
 - 4. Field welding: Comply with relevant codes for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
 - 5. Corrosion Protection: Coat concealed surfaces of Aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint or zinc chromate primer.
- B. Railings and Handrails:
 - 1. Adjust railing prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated, or if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as indicated on drawings and as required.
 - a. Anchor posts in concrete by means of pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with non-shrink, non-metallic grout, mixed, placed and sealed to comply with grout manufacturer's directions.
 - 2. Secure handrails to wall with wall brackets and end fittings. Provide bracket with not less than 37mm clearance from inside face of handrail and finished wall surface. Locate brackets as indicated, or if not indicated, at spacing required for design loading. Secure wall brackets and wall return fittings to building construction as required.

ADJUST AND CLEAN

- 1. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- 2. For galvanized surfaces: Clean field welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780, or BS 729.
ROUND HANDRAIL DIAMETER 40 MM

DESCRIPTION

Round handrail with antibacterial PVC sheath with a diameter of 40 mm. The rail consists of an aluminum section covered by a sheath of smooth and antibacterial PVC achieving Bs2d0 fire rating with solid color. A protective film is specified to minimize cleaning before acceptance. The section comprises a groove into which brackets, accessories and matching closers slide and lock.

Perforated brackets are curved, 40 mm deep and made of satin silver anodized aluminum. Overall projection and depth are 80 mm. Accessories made of smooth antibacterial PVC achieving Bs2d0 fire rating (wall returns, round or flat and caps, external and internal 90° angle pieces or made-to-measure from 90° to 165°) are fitted on the section and fixed with locking screws accessories.

Bactericidal joints are provided for the junctions between profile sections and accessories. All technical solutions are available to ensure continuity around corners (90° or made-to-measure), in staircases across service ducts (Quick-removable assembly wedge and articulated elbow and around curved sections.

ENVIRONMENT

No heavy metals are used in its formulation, including lead or tin (insignificant levels, less than 50 ppm) or any CMR Cat. 1 or 2 substances. The calcium-zinc thermal stabilization process is used. The emission level of volatile substance in inside air has been tested according to ISO 16000 and is very low (A+) according to the French regulation (23 March 2011 No. 2011-321 Decree and 19 April 2011 Order). 100% of the product are recyclable.

COLOR

Selected by Architects from manufacturer's standard range.

INSTALLATION METHOD

Upper edge of section 0.90 m max. above floor level. Fixes to 2 – point self-locking perforated aluminum brackets at 1.20 m centers (0.80 m centers in heavy traffic areas and on light partitions like plasterboard).

PLEXIGLAS CORRUGATED SHEETS

DESCRIPTION

Plexiglas corrugated sheet is a colorless form and a crystal clear (with a transparency equal to optical glass), lightweight material having outstanding weather ability, high impact resistance, good chemical resistance, and excellent thermoform ability and machinability.

Plexiglas corrugated sheet is made by a cell-cast process. Plexiglas sheet to conform to ASTM D-4802, A-1 material, finish 1, and is supplied as a shrunk sheet. This means that when heated to forming temperatures, it will shrink about 2% in length and width, and will increase in thickness by about 4%.

Plexiglas corrugated sheet have excellent resistance to most chemicals, including solutions of inorganic alkalis and acids.

Plexiglas acrylic sheet will expand and contract with changes in temperature and humidity. Different temperature and/or humidity conditions on the inner and outer surfaces of Plexiglas sheet may cause it to bow slightly in the direction of the higher temperature and/or humidity. However, this type of bowing is reversible. The sheet will return to its original flat state when the temperature and humidity differentials become zero.

In construction, Plexiglas sheet is often used with other materials that undergo less expansion and contraction.

To ensure good performance in environments where temperature varies widely, Plexiglas sheet should be installed in a channel frame that permits the sheet to expand and contract freely. The channel frame should be deep enough for the sheet to contract fully and still stay within the frame.

INSTALLATION

Support spacing

Plexiglas corrugated sheets are installed on statically supporting structures (purlins or crossbars) that are positioned at right angles to the direction of slope or water flow. Given average snow loads and wind pressure, it is sufficient to install the crossbars or purlins at spaces of approx. 850 mm. The spacing should be reduced if greater loads apply.

Allowance for expansion

Plexiglas corrugated sheets expand due to heat and moisture. An allowance of approx. 6 mm/m sheet length and width therefore has to be made for expansion. The required distance from walls owing to the allowance for expansion can be bridged using suitable wall connecting systems.

Installation direction

Plexiglas corrugated sheets should be installed with the textured side facing downwards. The smooth surface keeps the sheet clean longer and is much easier to clean.

Material/Preventing heat buildup

The supporting structure must be non-warping and consist of laminated timber beams or metal. Dark colored surfaces heat up to a greater extent and faster than light-colored surfaces.

It is therefore very important to provide all structural surfaces facing the sheets with a durable white or reflective coating (e.g. light-resistant emulsion paint). The coating of the supporting structure must be allowed to dry properly before installing the sheets.

Cutting to size

High-speed circular (hand) saws with unset, multi-tooth carbide-tipped blades are most suitable for cutting the Plexiglas corrugated sheets to size.

We advise against the use of cutting disks to avoid possible damage to the sheets (subsequent stress cracking).

Drilling

Drilling should be performed using a conical drill that provides drill holes of 10, 12 and 13 mm in diameter. Corrugated sheets that overlap horizontally are drilled together. The holes in the lower sheet may need to be drilled open a few more millimeters (after lifting off the topmost sheet) so that the two sheets can expand against each other. Make sure the edges of the drill holes are smooth and clean.

Installing longer roofs with cutout corners

If two or more sheets have to be installed with a longitudinal overlap, for example on very long roofs, the sheet corners should be cut at the points where there is a multiple overlap so that they can lie next to each other.

Fastening Points

The Plexiglas corrugated sheets should always be fastened point wise to the supporting structure. On roofs, fastening is always performed at the crest of the corrugation.

When doing so, make sure to allow for expansion of the sheets, i.e. provide adequately dimensioned drill holes.

Fastening elements, screw fastening

The sheets are fastened to the supporting structure using façade screws, J-bolts etc., ideally in combination with calottes.

The most common way to fasten corrugated sheets is by means of special commercially available screws (6.5 mm \emptyset) for wood or metal (in some cases self-tapping), complete with an adequately sized washer. Owing to the superior material thickness and rigidity of Plexiglas corrugated sheets, there is no need to place shims beneath the crest of the corrugation (such as are required for thin or soft corrugated plastic sheets).

Fastening elements, J-bolts

Other items suitable for fastening the corrugated sheets, particularly to tubular purlins, are commercially available J-bolts with a 6mm thread and screw at the upper end, since these allow the plastic to move in an ideal manner.

Screws should only be tightened until initial resistance is encountered. J-bolts can also be used in conjunction with aluminum calottes.

Sealing caps

PE sealing caps are suitable for use with J-bolts.

The sealing caps should be compatible with Plexiglas corrugated sheets, seal the drill hole against water from the outside, distribute the bolt pressure and act as a spacer between the bolt and the edge of the drill hole.

Corrugated Galvanized Iron or steel

Corrugated Galvanized Iron or steel (CGI) sheets are used for general roofing purposes. Selection:

Length ft/in.			Width	
6 ft	8 ft	10 ft	36in. total width with 31in. usable width	
			33in. total width with 28in usable width (overlap = 5in, approx. 2 corrugations)	
Length metric				
1.83 m	2.44 m	3.05 m	0.92m total width with 0.80m usable width	
			0.84m total width with 0.72m usable width (overlap = 12cm, approx. 2 corrugations)	

Table: example of sizes

Thickness is an important factor for strength and durability. Minimum recommended thickness:

- 0.551 mm (26 gauge) for permanent shelters and shelters subject to snow loads.
- 0.475 mm (28 gauge) can be used for shelters when the wind speed is lower than 250 km/h, the distance between laths/battens/purlins is 0.50 m maximum and the area is not prone to snow.
- 0.4 mm (30 gauge) can be used for shelters when the wind speed is lower than 200 km/h, the distance between laths/battens/purlins is 0.60 m maximum and the area is not prone to snow.

In exceptional circumstances such as major difficulties of accessibility (mountainous and remote areas), it is possible to use exceptional solutions à choose thinner CGI sheets to reduce the weight of the transportation, if CGI sheets have to be carried by humans or animals. In this case, the roof frame must be modified à the spacing of the CGI sheet support (lath/batten/purlin) must be reduced to keep its strength. In such cases it is highly recommended to seek the advice of a shelter expert.

For a more accurate result, you can verify the appropriate CGI sheet thickness for your shelter design using the Roof Estimate Form (Excel spreadsheet) provided with the CGI sheet roof covering manual.

It is highly recommended to use measurement in millimetre instead of gauge when ordering or purchasing CGI sheets, as the conversion of galvanized steel sheets can be confusing.

The gauge conversion depends on the material and its shape. Below is the conversion for galvanized steel sheet (including CGI sheet, ridge cap and fascia cap). Table: Conversion table for galvanized steel sheet (only)

		Recommended for CGI sheet used for roofing	nded Acceptable sheet sheet us ofing roofing in a prone to sno		Not advisable for CGI sheet used for roofing as it may not withstand snow, wind (and other loads)
mm	0.7	0.551	0.475	0.4	0.34
inch	0.0276	0.0217	0.0187	0.0157	0.0134
gauge	24	26	28	30	32

Zinc coating thickness and method of galvanization are the most important factors for durability. CGI sheets are protected from corrosion by a zinc coating applied to the steel sheet.

The zinc coating should be thick enough to ensure the durability of the CGI sheet by preventing corrosion. A 20 μ m coat of zinc should be applied per side of the CGI sheet (total of 40 μ m for both sides of the CGI sheet equivalent to 275g/m²). This coating can be exceptionally lowered to 240g/m² when higher grade is not available.

The galvanization method used must be hot-dip galvanization as it better ensures the durability of the CGI sheets. Other methods such as electro-galvanization should be avoided because the coating thickness is thinner than hot-dip galvanization and the durability of the CGI sheet will be reduced, as a result. (Example: Electro-galvanized has a great finish but the zinc coating thickness can be 10 times lower than that of hot-dip galvanized, which means that in less than one year the CGI sheets lose their protection and corrosion starts).

It is possible to increase the zinc coating thickness in order to increase the service life (durability) of the CGI sheets.

In a marine environment (within 1 km of the coast), CGI sheets can be painted with zinc-rich paint to increase service life. More details are provided in the CGI sheet roof covering manual (link to be included).

Other metal and alloys such as aluminum-zinc and aluminum can also be used to protect the steel sheet from corrosion. Aluminum coating can be an alternative in very high corrosive environments (marine environment).

Quality control:

When purchasing CGI sheets, it is recommended to go to the suppliers with a caliper gauge and a coating thickness gauge in your hand, in order to show that you can verify the quality of the CGI sheets on the spot. This way you may avoid disappointments.

- The thickness of the CGI sheet can be verified using a caliper gauge (EMEAMETACG16).
- The zinc coating thickness can be verified using a coating thickness gauge or magnetometer (EMEAMEASGC01), which measures the thickness of the zinc coating applied to the CGI sheet.

Both verifications are crucial to ensure the durability and strength of the CGI sheets.

Safety and storage:

Always use gloves and hard shoes while manipulating CGI sheets.

Store in a dry and ventilated area. Avoid condensation. Place the CGI sheets on a wooden pallet and ensure that there is a slight slope. These measures will help in avoiding white rust.

Basic indications regarding the quantity of CGI sheets per roof:

Always add 0.05 to 0.075 m to the length of the roof slope to be covered with CGI sheets to allow for overlapping at the eaves. This extra length of CGI sheet allows for the rainwater to fall in the gutter or to the ground without wetting the roof frame. Example: if the roof slope measures 2.32 m, then the length of the CGI sheet should be 2.37 m (2.32 + 0.05 m).

Total quantity of CGI sheets to order must include the overlapping of each sheet with the next one which can be 5 to 26% of the surface to cover:

- Depends on the wind, the roof pitch, and if the length of the roof slope takes one or several CGI sheets (see the tables below).
- The overlapping of the CGI sheet sides (side overlap) is already deduced in the usable width (see in the first table). The suggested side overlap is 2 corrugations. The side overlap can be 1 corrugation only if the wind speed is lower than 100km/h and roof pitch higher than 15° (26%).

Percentage of overlapping if one CGI sheet for the entire roof slope:

	Wind speed < 100 km/h	Wind speed ≥ 100 km/h
Roof pitch < 15° (26%)	13% overlapping	13% overlapping
Roof pitch ≥ 15° (26%)	5% overlapping	13% overlapping

Percentage of overlapping if several CGI sheets for the entire roof slope:

	Wind speed < 100 km/h	Wind speed ≥ 100 km/h
Roof pitch < 15° (26%)	26% overlapping	26% overlapping
Roof pitch ≥15° (26%)	15% overlapping	22% overlapping

To have a good approximation of the quantity of CGI sheets needed to cover a gable roof (pitch = 20° , wind speed > 150 km/h), you need to:

- measure the length of the roof and the length of the roof slope (example: length of roof = 6.6 m, length of roof slope = 1.87 m)
- add 5 cm to the length of the roof slope (total length of roof slope = 1.87 + 0.05 = 1.92 m)
- multiply the two values to get the surface of one roof slope to cover (example: surface of one roof slope S = 6.6 x 1.92 = 12.67 m2)

Formula to determine the number of CGI sheets needed to cover the roof slope
N = S / (surface of CGI sheet x (1 - % overlapping))
N = Number of CGI sheets
S = surface of one roof slope to cover
surface of CGI sheet = total width x length of CGI sheet
% overlapping = percentage indicated in table above

- Example: the percentage of overlapping in our case is 13 % as one CGI sheet is enough for the entire roof slope, and the surface of the CGI sheet is 0.92 x 2 m à N = 12.67 / (0.92 x 2.00 x (1 - 0.13)) = 7.9 CGI sheets
- round up this value to get the quantity of CGI sheets to cover one roof slope (example: 7.9 à 8 CGI sheets / side)
- multiply this value by 2 as there are 2 roof slopes in a gable roof (example: 8 x 2 = 16 CGI sheets to cover the entire roof)

It is recommended to include a 10% loss to ensure that you will have enough CGI sheets to cover the roof. (Example: $16 \times 1.10 = 17.6 \text{ à } 18 \text{ CGI}$ sheets to be ordered for the entire roof)

Usage:

When purchasing CGI sheets to repair existing roofs, it is important to ensure that the pattern of corrugations is compatible, otherwise leakage may appear. You need to check the corrugation pitch and depth of the existing CGI sheets. In most cases, corrugation pitch is 76 mm and corrugation depth is 18 mm.

See drawing in item sheet header

Assemble the CGI sheets on wooden frames with roofing nails (see item EHDWNAILRS01). The quantity of roofing nails depends on the wind speed, location of the shelter and thickness of the laths/battens/purlins used. The values mentioned in the table below are approximate. They were calculated for a shelter with a 15-30° gable roof pitch built in a rural area with low vegetation, using a 38mm thick lath/batten/purlin. If the laths are thinner, then you need to multiply the quantity of roofing nails by 2.

Wind speed (km/h)	Number of roofing nails per m2
wind speed < 120 km/h	Approximately 7 roofing nails / m2
wind speed < 150 km/h	Approximately 9 roofing nails / m2
wind speed < 180 km/h	Approximately 13 roofing nails / m2
wind speed < 210 km/h	Approximately 17 roofing nails / m2 à recommended to use roofing
	screws with sealing washer
wind speed < 250 km/h	Approximately 17 roofing nails / m2 à recommended to use roofing
	screws with sealing washer

- The roofing nails must be placed at the top of the CGI sheets corrugations, never at the bottom, in order to avoid leakage.
- When positioning the roofing nails, you need to place more roofing nails all around the edges
 of the roof: at eaves overhang, ridge, verges and hip angles (areas submitted to increased wind
 pressure).
- When the shelter needs to withstand very high wind speed, using roofing screws (see item EHDWSCRSR046) with sealing washers may be more effective than roofing nails.

For a more accurate quantity of CGI sheets and quantity of fasteners/fixings needed to securely attach the CGI sheets to the roof, it is highly recommended to use the Roof Estimate Form (Excel spreadsheet) provided with the CGI sheet roof covering manual (link to be included).

Suggested materials to accompany the CGI sheets:

- Caliper gauge (EMEAMETACG16)
- Coating thickness gauge or magnetometer (EMEAMEASGC01)
- Ridge cap (EBUIBSHEGR20)
- Fascia cap 5 EBUIBSHEFC20)
- Roofing nails with sealing washers (EHDWNAILRS01)
- Roofing screws with sealing washers (EHDWSCRSR046)
- Gutters (EBUIBSHEGR20)

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents:

Drawings and general provisions of the Subcontract apply to this Section. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:

Fence framework, fabric, and accessories. Excavation for posts. Concrete encasement for posts. Manual gates and related hardware.

C. Related Sections:

Division 01 Section "General Requirements." Division 01 Section "Special Procedures."

1.2 REFERENCES

A. General:

The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

Federal Specifications (FS)

- B. FS RR-F-191/1C Fencing, Wire and Post Metal (Chain-Link Fence Fabric)
- C. State of California California Department of Transportation (CALTRANS): Standard Specifications: Chapter 80-4 excluding Section 80-4.04
- D. American Society for Testing and Materials (ASTM)
 - ASTM A123 / A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - ASTM C94 / C94M Standard Specification for Ready-Mixed Concrete ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension Standard Test Methods for Density and Specific Gravity **ASTM D 792** (Relative Density) of Plastics by Displacement Standard Practice for Filtered Open-Flame Carbon-Arc ASTM D 1499 **Exposures of Plastics** ASTM D 2240 Test Method for Rubber Property—Durometer Hardness ASTM F 668 Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric

1.3 SUBMITTALS

- A. Submit under provisions of Division 01 Section "General Requirements."
- B. Submit shop drawings and product data. Include accessories, fittings, hardware, anchorages, and schedule of components.
- C. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Vinyl Fencing: Materials for vinyl-coated chain link fence shall be as specified herein. Material shall be of the same color of vinyl coating. Painted finishes are not acceptable. The color for this job is the manufacturer's standard black as approved by the University.
- B. Posts and Braces: Section 80-4.01A of CALTRANS
- C. Fabric: Section 80-4.01B of CALTRANS
- D. Accessories: Section 80-4.01C of CALTRANS
- E. Gates: Section 80-4.01D of CALTRANS

2.2 CONCRETE MIX

A. Concrete: ASTM C 94; type II Portland Cement; 2500 psi at 28 days; 3-inch (75 mm) slump; 3/4-inch (20 mm) maximum size aggregate.

2.3 COMPONENTS

- A. Line Posts: 2.375-inch (59 mm) outside diameter, Schedule 40 galvanized steel pipe or galvanized "H" columns weighing not less than 2.7 lb./ft (13.18 kg/m²).
- B. Corner and Terminal Posts: 2.875-inch (73 mm) outside diameter, Schedule 40 galvanized steel pipe.
- C. Gate Posts: 3.500-inch (89 mm) diameter for man gates and 6.625-inch (168 mm) diameter for vehicular gates; gateposts to be galvanized steel pipe.
- D. Top, Bottom and Brace Rail: 1.660-inch (42.16 mm) outside diameter, plain end, sleeve coupled galvanized steel pipe.
- E. Gate Frame: 1.9-inch (48.26 mm) outside diameter Schedule 40 galvanized steel pipe for fittings and truss rod fabrication.
- F. Fabric/Vinyl Coated Steel: Chain link fence fabric shall be galvanized steel wire with a continuously bonded vinyl coating, with a finish size (i.e., size after coating) of 8 gauge, and shall comply with ASTM F 668. Fabric height shall be 8 feet (2.44 m), +/- 3/4 inch (20 mm), with knuckled, selvage edges on the bottom and top. Mesh shall be vertically-woven diamond mesh, with a nominal distance of 2 inches (50 mm) between parallel wires.
- G. Tension Bars: 3/16 inches by 3/4-inch (4.76 mm by 20 mm) galvanized steel flat bars.
- H. Caps: Cast steel or malleable iron, galvanized, sized to post dimension, set-screw retained.

- I. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings shall be galvanized steel.
- J. Extension Arms: Cast steel, to accommodate 3 strands of barbed wire, single arm, 12-inches (305 mm) high (measured vertically) above the top edge of the fence fabric, sloped to 45 degrees.
- K. Barbed Wire: 12-AWG wire, 3 strands, zinc-coated steel with bonded vinyl coating and 4 point barbs at 5-inches (127 mm) O.C., painted black.
- L. Gate Hardware: Fork type latch with gravity drop; center gate stop and drop rod; three 180 degree gate hinges per leaf.
- M. Privacy Slats: Plastic fencing slats manufactured from 97 percent recycled plastic containing 97 percent post-consumer recycled plastic.

2.4 FINISHES

- A. Galvanized Surfaces: Galvanize surfaces in accordance with ASTM A 123, with a coating of at least 1.20 oz/sq. ft.
- B. Accessories and Components: Same finish as fabric.

2.5 VINYL COATING

- A. The vinyl coating shall conform to FS RR-F-191/1C.
- B. Colors shall be stabilized, and shall have a light fastness to withstand a minimum Weather-O-Meter exposure of at least 1500 hours without deterioration when tested in accordance with ASTM D 1499.
- C. Specific gravity shall be between 1.26 and 1.30 in accordance with ASTM D 792.
- D. Hardness shall be A90 +/-5 in accordance with ASTM D 2240.
- E. Tensile strength shall be between 2600 and 3000 psi (17.94 MPa and 20.7 MPa) in accordance with ASTM D 412.
- F. Vinyl coating shall be exposure-resistant to dilute solutions of most common mineral acids, sea water, salts, and alkali.
- G. Vinyl coating shall be continuously bonded to the wire under 5000 psi (34.5 MPa) pressure before the wire is woven into fabric.

EXECUTION

2.6 INSTALLATION

- A. Install framework, fabric, accessories, and gates in accordance with section 80-4.02 of CALTRANS.
- B. Install security fence of 8-foot (2.45 m) fabric height with 1-foot (0.9 m) barbed extension on support arms as shown on Drawings.
- C. Space line posts at intervals not exceeding 10 feet (3 m).
- D. Set gate and posts plumb, in concrete footings with top of footing 1 inch (25 mm) above finish grade. Slope top of concrete for water runoff. Footings for line end and corner posts are to be 8 inches (203) diameter by 3 feet (0.09 m) deep below finish grade and for gates are to be 12 inches (305 mm) diameter by 3 feet 6 inches (1 m) deep below finish grade.
- E. Provide top rail through line-post tops and splice with 7-inch (178 mm) long rail sleeves.
- F. Brace each gate and corner post back to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail, one bay from end and gate posts.
- G. Install center and bottom brace rail on corner and gate leaves.
- H. Stretch fabric between terminal posts or at intervals of 100 feet (30,5 m) maximum, whichever is less.
- I. Position bottom of fabric to no more than 2 inches (50 mm) above concrete or asphalt grade and touching dirt finish grade.
- J. Fasten fabric to top rail, line posts, braces, and bottom tension wire with 11-AWG galvanized wire ties 24 inches (610 mm) maximum on centers.
- K. Attach fabric to end, corner, and gateposts with tension bars and tension bar clips.
- L. Install bottom rail supported at each line and terminal post in such a manner that a continuous brace between posts is formed.
- M. Install gates with fabric and barbed wire overhang to match fence. Install three hinges per leaf, latch, catches, drop bolt, foot bolts and sockets.

2.7 GROUNDING

A. 40 feet (13 m) on either side of overhead high voltage electrical transmission lines the fence is to be grounded as shown on the Drawings.

2.8 CONSTRUCTION WASTE MANAGEMENT

- A. Conform with Division 01 Section "Construction Waste Management."
- B. Before concrete pours, designate locations or uses for excess concrete and a location for clean out water from concrete trucks. Designated locations shall meet environmental standards and conform with Section 7-1.01 of CALTRANS.

ANTI CLIMBING FENCING CONCERTINA RAZOR WIRE LOOPS

Concertina Razor Wire is widely used for construction of high security fencing projects in military and national defense. We export directly and supply Razor Wire for Government tenders and contractors in various countries (Kuwait, Jordan, and other countries). Concertina Wire can be divided into Single Concertina and Crossed Concertina Wire.

Single Concertina or Crossed?

Concertina Cross Razor Wire Installation: Two pieces of Stainless Steel Razor Wire or Zinc-coated are bound together by clips to make it stronger. The spiral intersecting razor wire presents an intersecting shape after opening with beautiful feature and practicality.

Concertina Single Coiling Wire is installed without clips; it runs in natural loops on walls or fencings. Single razor wire ribbon is less frightening and can be easily installed.

Single Coil Razor Wire normally has 33 to 53 loops, in standard coil length 8m, 10m or 13m. Crossed Concertina Razor Wire has loop outside diameter ranging from 450mm to 960mm; number of loops can be 52 to 112.

Single coil barbed wire or crossed type razor wire meet different level of security demand. Crossed Concertina Wire brings more frightening effect compared with single coils either used individually or together with <u>mesh fencing</u> as topping barriers.

Materials Applied:

Hot Dipped Galvanized; Painted Color Galv.; P.V.C. or P.E Coated; Stainless Steel.

Razor Blades: Straight line or spiral. BTO - 10, BTO - 12, BTO-18, BTO - 22, BTO - 28, BTO - 30, BTO - 65.

Protection Level: High Security.

Razor Wire with Varied Blade Sizes:





Comparing of Blades:



Well Sold Concertina Wire Models for Export 304 Stainless Steel Concertina Fence



Razor Ribbon Helical, 304 Stainless Steel Razor Wire, Concertina CBT-65, 8.5 meters per coil, 41 or 56 loops per coil, for United Kingdom



SS Security Razor Wire Edges: Concertina Wire 700mm OD, 41 Loops, 10M Length, CBT-65 Single Coil Attached to Y Arm Post and Crimped Welded Mesh Panels

Concertina CBT-65 Razor Wire cross type in SS 304 supplied as per following details:

Concertina Wire for Boundary Wall Standard length: 8.5 meters per coil with 56 loops per coil, CBT-65 Razor barbed types: Cross type. Outside diameter: 800mm. Ring to ring distance: 15cm to 18cm. Razor distance: 100+/-2mm Stainless steel razor wire (SS304) blade thickness: 0.5+/-0.05mm, Core wire: 2.5+/-0.1mm, Blade length: 65+/-2mm Blade width: 21mm, Blade space: 100mm, 56 loops / coil. Minimum weight: 17kg per coil. Fastening clip (SS304) for joining of Coil (with required number) to be provided with Technical Details.

Material/ certificate of conformity and standard warranty with supply. Any deviation from stated sizes is clearly mentioned.

Galvanized Steel Concertina Wire Loops, 24" Diameter, 33 Loops

For Jordanian and Regional markets

Concertina Wire (Loops)

Single wire or cross type.



Model: RAZOR WIRE 24HEL 33L GA/GA STD, Barb Cross Sectional Width: 2.4 Inches Nominal

Galvanized Concertina Wire Loops, supplied as per following details: Wire Cross Sectional Width: 1.000 Inches Nominal Each unit package: 11 LB Single Wire Cross-Sectional Shape: Round Barb Cross-Sectional Shape: Rectangular Barb Point Quality: 4 Center to Center Distance between Barbs: 4.0 Inches Nominal Feature Provided: 24" Diameter, 33 Loops, Galvanized/Galvanized Material: Steel, Galvanized

CONCERTINA RAZOR WIRE BTO - 22 or BTO - 18 CROSS TYPE

Main Market: Netherland



Model: BTO - 22 Concertina Razor Wire, Loop DIA 900mm, 56 Spirals, Supplied in Full 20FT Container for Netherland, Material: Hot Dipped Galvanized

Supplied as per following details: Blade thickness: 0.5 mm Wire Dia.: 2.5 mm Barb Length: 22-24 mm Barb Width: 15 mm Barb Spacing: 34 mm

Weight per coil: BTO - 22 / 12 kgs; BTO - 18 / 9 kgs Clips Per Coil: 5 PCS Spiral Turns: 56

INSTALLED LENGTH: 900MM = 15 Meter - 155 Mtr Straight Unreeled **Packed** on Plastic or wooden fumigated pallets 50 coils each pallet

52 Loops Hot Dipped Galvanized Razor Barbed Type Concertina Wire (for Robot Installation)

For Kuwait Tender / Bids / Contractors

Roll Diameter 915 mm Loops 52 Exteneded Lenght 10-15 Spaceing of loop 200-280mm Strip Thickness 0.5mm Barb Lenght 10mm Barb width 12mm Barb Spacing 24mm



Single Coil Spiral Wire, Straight Line Concertina, Material: Electro Galvanised or Hot Dipped Galv.



Concertina Razor Wire Security Fencing Projects

Hot-Dip Galvanized BTO - 22 Razor Wire Fencing System with Green Powder Coated Y Post and 3D Steel Mesh Welded Fabrics

Fencing system supplied per following details:

Support Type: Y Post

Concertina 38" in diameter are fabricated from 0.020" thick, galvanized steel strip.

Strip is clinched around a galvanized steel core wire.

Each roll consists of 56 coil loops with pairs of coil loops alternately clipped together at five locations around the circumference.

Each coil extends to 50' when deployed at 21" coil spacing.

Mesh Style: Electro Welded Galvanized Wire Mesh.

Security Level: High Security.

Туре	Blade Style	Thick-ness	Wire Dia	Barb Length	Barb Width	Barb spacing
BTO - 10		0.5 ± 0.05	2.5 ± 0.1	10 ± 1	13 ± 1	25 ± 1
BTO - 12		0.5 ± 0.05	2.5 ± 0.1	12 ± 1	15 ± 1	25 ± 1
BTO - 18		0.5 ± 0.05	2.5 ± 0.1	18 ± 1	15 ± 1	35 ± 1
BTO - 22		0.5 ± 0.05	2.5 ± 0.1	22 ± 1	15 ± 1	36 ± 1
BTO - 28		0.5 ± 0.05	2.5	28	15	46 ± 1
BTO - 30		0.5 ± 0.05	2.5	30	18	46 ± 1
CBT-65		0.6 ± 0.05	2.5 ± 0.1	65 ± 2	21 ± 1	101 ± 2

Fencing Razor Blades Specification:

Barbed Tape Concertina (BTC);Barbed Tape Obstacle (BTO)

Standard materials are either galvanized or stainless steel.

Standard packages products are shown in the tables above, special specifications available on request.

Outside Diameter	No. of Loops	Standard Length per Coil	Туре	Notes
450mm	33	8M	CBT-65	Single coil
500mm	41	10M	CBT-65	Single coil
700mm	41	10M	CBT-65	Single coil
960mm	53	13M	CBT-65	Single coil
500mm	102	16M	BTO - 10.15.22	Cross type
600mm	86	14M	BTO - 10.15.22	Cross type
700mm	72	12M	BTO - 10.15.22	Cross type
800mm	64	10M	BTO - 10.15.22	Cross type
960mm	52	9M	BTO - 10.15.22	Cross type

Concertina Wire Coils Specification:

Anti Climbing Razor Wire Fencing Installation Tips

The installation of concertina wire fences requires special skills and equipment, and, to prevent accidents and to get a good-quality, reliable and durable fencing, it should be carried out only by specially-trained professionals.

To get the <u>perimeter security fencing</u> properly installed, several factors need to be taken into consideration particularly:

Holding strength of the concertina fence;

Correct choice of brackets and anchors;

Proper positioning of the construction to preserve the springing properties of the concertina wire loops.



CHAPTER SIX WOOD WORKS NOT USED

CHAPTER SEVEN

THERMAL AND MOISTURE PROTECTION

NOT USED

CHAPTER EIGHT

DOORS AND WINDOWS

METAL DOOR AND FRAMES

PART 1 - GENERAL

DESCRIPTION

A. General

- 1. Furnish all labor, materials, tools, equipment, and services for metal doors and frame, in accord with provisions of Contract Documents.
- 2. Completely coordinate with work of other trades.
- 3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
- 4. See Division 1 for General Requirements.

B. Related work specified elsewhere:

- 1. Finish hardware:
- 2. Wood doors:
- 3. Glass and glazing:

Submittals

A. Product Data:

- 1. Manufacturer's technical information including specifications and catalog cuts for all products specified herein.
- B. Shop Drawings:
 - 1. Show details of each frame type and elevations of each door type. Show conditions at openings and details of construction.
 - 2. Show gages, location of reinforcements, anchorage and accessory items.
 - 3. Submit schedule of doors and frames. Use same scheduling system as that shown in the Door Schedule.

PART 2 - PRODUCTS

MATERIALS - GENERAL

- A. Steel sheet and strip: Commercial quality carbon steel, ASTM A568.
- B. Galvanized steel sheets: ASTM A525, G90 coating, phosphatized.
- C. Supports and anchors: Not less than 1.5 mm (16 ga) sheet steel. Galvanize items to be built into exterior walls after fabrication, ASTM A153, Class B.
- D. Inserts, bolts and fasteners: Manufacturer's standard units. Galvanize items to be built into exterior walls ASTM A153, Class C or D as applicable.
- E. Primer: Suitable for Galvanized metal sheets enamel or paint, air-drying or baked, suitable as base for specified finish paints.
- F. Galvanized repair paint: Mil. Spec. DOD-P-21035
- G. Lead sheet: ASTM B29, free from imperfection affecting performance, thickness as indicated.

Doors and Frames

- A. Doors, Timber or Melamine.
- B. Vision panels:
 - 1. Fixed, integral stops on exterior face, screw less snap-in stops or stops secured with countersunk Phillips head machine screws on interior face.
 - 2. Glass: Section 8.4.
- C. Frames, Timber or Melamine, types as indicated.
 - 1. Split-type frames are not acceptable.
 - 2. Conceal all fastenings.
 - 3. All joints: Tightly butted and fully welded.
 - 4. All frames should be painted from the back & bottom 15 cm with asphalt.

FABRICATION

- A. General:
 - 1. Fabricate rigid, neat in appearance and free from defects.
 - 2. Form to indicated sizes and profiles.
 - 3. Fit and assemble in shop, where practical.
 - 4. Mark work that cannot be fully assembled in shop, to assure proper assembly at site.

B. Prepare for finish hardware, in accord with hardware schedule, templates provided by hardware supplier, and ANSI A115 series "Specifications for Door and Frame Preparation ".

- 1. Locate finish hardware in accord with SDI 100.
- 2. Locate patient latches in accord with manufacturer's recommendations.
- C. Clean off mill scale and foreign materials, touch-up damaged steel and galvanized surfaces.
- D. Shop prime.

PART 3 - EXECUTION

INSPECTION

A. Examine structure, substrates, and conditions under which work in to be installed for conditions detrimental to correct and timely completion.

B. Installation constitutes acceptance of responsibility for performance.

INSTALLATION

A. Place frames prior to construction of enclosing walls and ceilings.

B. Separate structural lintels are to be installed over all doorframes in masonry. Do not use doorframes as lintels to carry masonry.

C. Plumb, align, and brace securely until permanently anchored.

D. After completion of walls, remove temporary braces and spreaders.

E. Install minimum of 3 anchors of type appropriate to wall construction per jamb. Minimum acceptable anchors: 1.5 mm (16 ga), 25 mm (1 IN) wide corrugated steel.

F. Provide removable spreaders at bottom of frame.

- G. Coordinate building-in of anchors and frame grouting with other trades.
- H. Grout all frames.
- I. Leave work complete and in proper operating condition.
- G. Remove defective work and provide new acceptable products.

WOOD DOORS

PART 1 - GENERAL

DESCRIPTION OF WORK

- A. Extent and location of each type of wood door is shown on Drawings and in schedules.
- B. Types of doors required include the following:
 - 1. Flush wood doors with plastic laminate faces.
 - 2. Melamine doors and partitions.
- C. Shop finishing of wood doors is included in this section.
- D. Factory-preparation for door hardware (pre-machining) for wood doors, melamine doors and partitions is included in this section.
- E. The following related work is specified elsewhere:
 - 1. Door hardware installation.
 - 2. Painting.

APPLICABLE CODES AND STANDARDS

ANSI/NWMA	I.S.I Industry standards for wood flush doors.
AWI	Quality Standard; Section 1300Architectural woodwork quality standards
BS 1186	Quality of timber and workmanship
BS 4787: part 1 Dimens	ions of wood door sets.
BS 5359	Methods of testing doors

PART 2 - PRODUCTS

MATERIALS AND COMPONENTS - GENERAL

- A. General: Provide wood doors, melamine doors and partitions complying with applicable requirements for kinds and types of doors indicated on drawings and as scheduled and specified.
- B. Face Panels: Manufacturer's standard 2 or 3-ply face panels, unless otherwise indicated.
- C. Exposed Surfaces: Provide decorative picture on of the shown on drawings or scheduled and as further specified and approved by the Engineer. The picture should be fixed by glue on boards on every door to be used printed on vinyl sheets 3 mm thick.

GENERAL FABRICATION REQUIREMENT

- A. Transom and Side Panels: Wherever transom panels or side panels of wood are shown in same framing systems as wood doors, provide panels which match quality and appearance of associated wood doors, unless otherwise indicated. Fabricate matching panels with same construction, exposed surfaces and finish as specified for associated doors or by adding a picture on each door.
- B. Openings: Cut and trim openings through doors and panels as shown. Comply with applicable requirements for kind(s) of doors required.
 - 1. Openings: Factory cut openings. Trim openings with solid wood edgings and moldings as indicated or required.
 - 2. Factory installs vision panel glass in prepared openings.

FLUSH DOORS: PLASTIC LAMINATE FACED

A. Typical Standard Doors:

- 1. Facing: Plastic laminate, premium grade complying with BS 3794; 1.5mm thickness.
 - a. Color, Texture and Pattern: as indicated or as selected by the Engineer from manufacturer's standard range with picture on.
- 2. Core: Precision planed softwood blackboard, butt-jointed and glued edge to edge to form a solid laminated construction.
- 3. Edge: exposed hardwood framed stiles, top and bottom rails; tongued and grooved to core.
- 4. Vision Panels: 6m thick glass as detailed.

ADHESIVE

A. Adhesive for all interior doors shall be of MR grade.

SHOP FINISH

- A. Prefinished wood doors requiring transparent finish at factory or finish shop.
- B. Doors requiring paint finish shall be sandpapered smooth, filled and primed at factory, ready for site painting.
- C. Comply with recommendations of Applicable Codes and Standards for factory finishing of doors, including final sanding immediately before application of finishing materials.
 - 1. Provide finishes of type indicated or agreed with the Engineer, to match samples held by the Engineer.

PRE-FITTING AND PREPARATION FOR HARDWARE

- A. Pre-machine wood doors at factory.
- B. Machine doors for hardware requiring cutting of doors.

PART 3 - EXECUTION

INSPECTION

A. Examine door frames and verify that frames are correct size and type and have been installed as required for proper hanging of corresponding doors. Do not proceed with installation until unsatisfactory conditions have been corrected.

INSTALLATION

- A. Condition doors to average prevailing humidity in installation area prior to hanging.
- B. Hardware: For installation refer to Door Hardware (Ironmongery) section of these specifications.
- C. Manufacturer's Instructions: Install wood doors in accordance with manufacturer's instructions and as indicated and required.
- D. Shop-Finished Doors: Restore finish on edges of shop finished doors before installation, if fitting or machining is required at the job site.

ADJUST AND CLEAN

A. Final Check:

1. Replace doors damaged during installation or which are warped, bowed or otherwise unacceptable.

2. Rehang or replace doors, which do not swing freely or operate smoothly and satisfactorily.

B. Protection: Provide protection and maintain conditions in a manner acceptable to the Engineer that will ensure doors and door hardware, are undamaged at time of Taking Over.

ALUMINUM DOORS AND WINDOWS

PART 1 - GENERAL

SUMMARY

A. Extent of aluminum doors and windows is indicated on Drawings and schedules.

- B. Types required for the project include:
 - 1. Exterior entrance doors and screens.
 - 2. Interior doors and screens.
 - 3. Exterior and interior windows.
 - 4. Louvers.

C. Glass and glazing is specified elsewhere.

D. Lock cylinders are specified in the Door Hardware (Ironmongery) of the specification. Cost is included within the cost of each item.

SYSTEM DESCRIPTION

- A. Performance Requirements: Provide aluminum assemblies that have been designed and fabricated to comply with the following specified performance characteristics. Compliance may be demonstrated by testing manufacturer's corresponding stock systems according to methods indicated.
- B. Thermal Movement: Provide exterior systems capable of withstanding thermal movements resulting from an ambient temperature range of 5 deg C. to external maximum in direct sunlight of 70 deg. C.
- C. Wind Loading: Provide assemblies capable of withstanding a uniform test pressure of 0.96 kPa (20 psf) inward and 0.96 kPa (20psf) outward when tested in accordance with ASTM E 330.
- D. Exterior Entrances Transmission Characteristics: Provide entrance doors with jamb and head frames that comply with requirements indicated for transmission characteristics.
 - Air Leakage: Provide doors with an air infiltration rate per linear foot of perimeter crack, of not more than 0.0025 m3/s/m2 (0.50 CFM) for single doors and 0.005 m3/s/m2 (1.0 CFM) for pairs of doors when tested in accordance with ASTM E 283 at pressure differential of 75 Pa (1.567 psf).
- E. Exterior Windows (and internal windows where applicable): Except as otherwise indicated, comply with air infiltration tests, water resistance tests, and applicable load tests, specified in ANSI/AAMA 302.9 for type and classification of window units required in each case; or, comply with applicable British Standards, i.e. BS 4873, 4315, Part 1.
- F. Applicable Codes and Standards: ASTM E 330 Structural Performance ASTM E 331 Water Penetration BS 1470 Aluminum Plate Sheet and Strip BS 1474 Aluminum Bars, Extrusions BS 4315 Methods of Tests for Resistance to Air and Water Penetration

SUBMITTALS

- A. Product Data: Submit manufacturer's product specifications, technical data, standard details, and installation recommendations for each type of product required. Include the following information:
 - 1. Fabrication methods.
 - 2. Finishing.
 - 3. Hardware.
 - 4. Accessories.
- B. Shop Drawings: submit shop drawings for fabrication and installation of Aluminum doors and windows, including the followings:
 - 1. Elevations.
 - 2. Details section of typical composite members.
 - 3. Hardware, mounting heights.
 - 4. Anchorages and reinforcements.
 - 5. Expansion provisions.
 - 6. Glazing details.
- C. Samples: submit pairs of samples of each type and color of Aluminum finish, on 300mm long sections of extrusions or formed shapes and on 150mm square sheets. Where color or texture variations are anticipated, include 2 or more units in each set of samples indicating extreme limits of variations.
- D. Certification: Provide certified test results showing that systems have been tested by a testing laboratory or agency acceptable to the Engineer, and comply with specified performance characteristics.

QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Unless otherwise acceptable to the Engineer provide doors and windows produced by a single manufacturer with not less than 5 years successful experience in the fabrication of assemblies of the type and quality required.
- B. Design Criteria: Drawings indicate sizes, spacing of members, profiles and dimensional requirements of doors and windows. Minor deviations will be accepted in order to utilize manufacturer's standard products when, in the Engineer's sole judgment; such deviations do not materially detract from the design concept or intended performances.

PROJECT CONDITIONS

A. Field Measurements: Check openings by field measurement before fabrication to ensure proper fitting of work; show measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay in the work. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit.

PART 2 - PRODUCTS

MANUFACTURERS

A. Available Manufacturers: subject to compliance with requirements, manufacturers offering products which may be incorporated in the work of a good factory.

MATERIALS

- A. Aluminum Members: Provide alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish; comply with ASTM B 221; BS 1474 for extrusions and ASTM B 209; BS 1470 for sheet or plate.
- B. Fasteners: Provide fasteners of Aluminum or non-magnetic stainless steel (316) and fully compatible with Aluminum components, hardware, anchors and other components.
 - 1. Reinforcement: Where fasteners screw-anchor into Aluminum less than 3mm thick, reinforce the interior with Aluminum or non-magnetic stainless steel to receive screw threads, or provide standard non corrosive pressed-in splined grommet nuts.
 - Exposed Fasteners: Use of exposed fasteners will not be acceptable unless specifically approved by the Engineer. For the application of hardware and subject to approval by the Engineer, use fasteners that match the finish of member or hardware being fastened.
 a. Provide Phillips flat-head machine screws for exposed fasteners.
- C. Brackets and Reinforcements: Where feasible, provide high strength aluminum brackets and reinforcements; otherwise provide non-magnetic stainless steel or hot-dip galvanized steel complying with ASTM A 386; BS 729.
- D. Concrete/Masonry Inserts: Provide concrete and masonry inserts fabricated from cast-iron, malleable iron, or hot-dip galvanized steel complying with ASTM A 386; BS 729.
- E. Compression Weather-stripping: Provide the manufacturer's standard replaceable compressible weather-stripping gaskets of molded neoprene complying with ASTM D 2000 or molded PVC complying with ASTM D 2287.
- F. Sliding Weather-stripping: Provide the manufacturer's standard replaceable weather-stripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing, complying with AAMA 701.2.
- G. Glass and Glazing Materials: Comply with requirements of Glass and Glazing section of the specifications.

COMPONENTS

- A. Aluminum Door, Window and Louver Frames: Fabricate from manufacturer's standard tubular and channel frame assemblies, with welded or mechanical joints in accordance with manufacturer's standards; reinforce as necessary to support required loads. Provide and incorporate all Aluminum components, accessories, and anchorages as indicated and required.
 - 1. Design: Provide doors and windows of thickness and design indicated.
 - Glazing: Fabricate doors and windows to facilitate replacement of glass or panels, without disassembly of frames. Provide Snap-On extruded aluminum glazing stops, with exterior stops anchored for non-removal, or heat-resisting PVC glazing sections of a type approved by the Engineer.
- B. Glass: Provide manufacturer's standard glass of the type and thickness indicated on drawings, or otherwise approved by the Engineer.

HARDWARE

- A. General: Refer to Door Hardware section of the specification for hardware items other than those indicated to be provided by the aluminum entrance manufacturer.
- B. Provide manufacturer's heavy-duty hardware units as indicated, scheduled, or required for operation of each door, of sizes, number, and type recommended by manufacturer and approved by the Engineer, for service required, finished to match door.
 - 1. Keyed Cylinders: Provide mortise type, 5-pin tumbler, outside cylinder units with cast aluminum face;
 - a. Co-ordinate and comply with master keying requirements specified in Door Hardware section of the specification.
 - 2. Exterior Entrance Thresholds: Provide extruded aluminum threshold or size and design indicated in mill finish, complete with anchors and clips, coordinated with pivots and floor-concealed closers.

FABRICATION

- A. General: Sizes of door, frame and window units, and profile requirements, are indicated on drawings. Variable dimensions are indicated, with maximum and minimum dimensions required to achieve design requirements and coordination with other work.
- B. Prefabrication: Before shipment to the project site, complete fabrication, assembly, finishing, hardware application, and other work to the greatest extent possible. Disassemble components only as necessary for shipment and installation.
 - 1. Preglaze door, and window units to greatest extent possible.
 - 2. Do not drill and tap for surface-mounted hardware items until time of installation at project site.
 - 3. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces. For hardware, perform these operations prior to application of finishes.
- C. Welding: Grind exposed welds smooth and restore mechanical finish.
- D. Reinforcing: Install reinforcing as required for hardware and necessary for performance requirements, sag resistance and rigidity.
- E. Dissimilar Metals: Separate dissimilar metals with bituminous paint, or other separator that will prevent corrosion.
- F. Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.
 - 1. Uniformity of Finish: Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample pair submittal.
- G. Fasteners: Conceal fasteners.
- H. Weather-stripping: For exterior doors and windows, provide compression weather-stripping against fixed stops; at other edges, provide sliding weather-stripping retained in adjustable strip mortised into door or window edge.

FINISHES

- A. General: Refer to drawings/schedules for type of finish required.
- B. Natural Anodized Finish: Provide non-specular as fabricated mechanical finish; chemical etch, medium matte; minimum thickness 0.025 mm clear anodic coating.
 - 1. Provide natural anodized finish for flush aluminum unless otherwise indicated.

PART 3 - EXECUTION

INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation.

ADJUSTING

A. Adjust operating hardware to function properly, for smooth operation without binding, and for weather tight closure.

CLEANING

- A. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.
- B. Clean glass surfaces after installation. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

PROTECTION

A. Institute protective measures required throughout the remainder of the construction period to ensure that aluminum doors, screens and windows will be without damage or deterioration, other than normal weathering, at time of Taking-Over.

GLASS & GLAZING

GENERAL

Glass and glazing shall be provided as specified and as shown, including entrances, curtain wall, windows, spandrels, skylights, glazed doors, transoms, sidelights, glazed partitions and mirrors.

DEFINITIONS

Manufacturer as used in this section to refer to a firm that produces primary glass or fabricated glass as defined in the referenced glazing standard.

A) **Deterioration of Insulating Glass:**

Failure of the hermetic seal under normal use due to causes other than glass breakage and improper practices for maintaining, and cleaning insulating glass. Evidence of failure is the obstruction of vision by dust, moisture, or film on the interior surfaces of glass. Improper practices for maintaining and cleaning glass do not comply with the manufacturer's directions.

SYSTEM PERFORMANCE REQUIREMENTS

A) <u>General</u>

Glazing systems that are produced, fabricated, and installed shall be provided to withstand normal thermal movement, wind loading, and impact loading (where applicable), without failure including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; and other defects in construction.
B) Glass Design

Glass thicknesses indicated on the drawings and herein are the minimum thicknesses required. Contractor shall confirm glass thicknesses by analyzing project loads, and in-service conditions. Provide glass lites for the various size openings in the thicknesses and strengths (annealed or heattreated or tempered) to meet or exceed the following criteria:

- Minimum glass thicknesses for exterior conditions shall be determined utilizing the structural performance criteria and the test methods of ASTM E997 and E998. Minimum thickness shall be determined using the most stringent of these requirements.
- Minimum glass thicknesses of lites, whether composed of annealed or heat-treated or tempered glass, are selected so the worst- case probability of failure does not exceed the following:
- a) 8 lites per 1000 for lites set vertically or not over 15 degrees off vertical and under wind action. Determine minimum thickness of monolithic annealed glass according to ASTM E1300. For other than monolithic annealed glass, determine thickness per glass manufacturer's standard method of analysis including applying adjustment factors to ASTM E 1300 based on type of glass.
- b) 1 lite per 1000 for lites set over 15 degree off vertical and under action of wind.

Normal thermal movement results from the following maximum change (range) in ambient and surface temperatures acting on glass-framing members and glazing components. Base engineering calculation on materials' actual surface temperatures due to both solar heat gain and night time sky heat loss.

- Temperature Change (Range): 500 C.

SUBMITTALS

The Contractor shall submit the following:

Product Data: Manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions. Indicate glass thicknesses to be used.

Samples: 300 mm square samples of each type of glass indicated, and 300 mm long samples of each color of gasket and sealant.

Certificates: Certificates from respective manufacturers attesting that glass and glazing materials furnished for project comply with requirements of agencies having jurisdiction.

- Separate certification will not be required for glazing materials bearing manufacturer's permanent labels that represent a quality control program of a certification agency or independent testing laboratory acceptable to authorities having jurisdiction.
- Certification that glass does not exceed the permissible stress by analysis.

Compatibility and Adhesion Test Report:

Statement from sealant manufacturer that glass and glazing materials have been tested for compatibility and adhesion, with interpretations and recommendations for primers and substrate preparation.

QUALITY ASSURANCE

A) Glazing Standards:

Comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" except where more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined.

B) Safety Glazing Standard:

Provide required safety glass which comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.

C) Insulating Glass Certification Program:

Provide insulating glass units permanently marked with appropriate certification label of Insulating Glass Certification Council (IGCC) for inspecting and testing.

D) <u>Glazier Qualifications:</u>

Engage an experienced glazier who has completed glazing similar in material, design, and extent to that indicated for this project with a record of successful in- service performance.

E) Single Source for Glass:

To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer of fabricator for each kind and condition of glass.

DELIVERY, STORAGE AND HANDLING

Glass and glazing materials shall be protected during delivery, storage and handling to comply with manufacturer's directions and to prevent damage to glass and glazing materials from moisture, temperature changes, direct exposure to sun and from other causes.

PROJECT CONDITIONS

Environmental Conditions:

No glazing works shall be carried out when air and substrate temperatures are outside the limits permitted by glazing material manufacturer or when joint substrates are wet or dirty.

WARRANTY

A) <u>General:</u>

The Contractor shall submit warranties to repair or replace defective glass and glazing materials or workmanship for a period of 10 years after date of issue of the Provisional Acceptance Certificate, or longer where specified. Defects include, but are not limited to the following:

- Glass breakage due to pressures up to specified values thermal stress, manufacturing defects and damage to glass.
- Spontaneous breakage of heat treated glass.
- Defects in spandrel glass opacifier material.
- Loss of effective glass bite due to shifting of glass.
- Loss of effective glass bearing on setting blocks due to shifting of glass and/or blocks.

B) Insulating Glass:

A warranty to replace defective insulating glass for a period of 10 years after date of issue of the Provisional Acceptance Certificate shall be submitted. Defects include, but are not limited to the following:

- Failure of insulating glass edge seal as shown by moisture, dust, corrosion or damage within sealed air space.
- Insulating glass spacer migration.
- Failure to meet specified performance requirements.
- Failure of structural silicone seals.

C) <u>Mirrors:</u>

During warranty period, mirrors which develop defects in mirror coating due to normal conditions and not due to practices contrary to manufacturer's instructions shall be replaced at no extra cost to the Client.

Warranty period shall not be less than 5 years after date of issue of the Provisional Acceptance Certificate.

PRIMARY FLOAT GLASS PRODUCTS

<u>Float Glass</u>: ASTM C1036, Type I (Transparent glass, flat Class as indicated below, and Quality q3 (glazing select).

- Class 1 (clear) unless otherwise indicated.
- Class 2 (tinted, heat-absorbing, and light-reducing where indicated).

Refer to coated glass product requirements for tint color and performance characteristics of coated tinted glass for monolithic glazing relative to visible light transmittance, U- values, shading coefficient, and visible reflectance.

Refer to requirements for sealed insulating glass units for performance characteristics of assembled units composed of tinted glass, coated or uncoated, relative to visible light transmittance, U-values, shading, coefficient, and visible reflectance.

INSULATING GLASS PRODUCTS

<u>Sealed Insulation Glass Units:</u> Preassembled units consisting of organically sealed lites of glass separated by dehydrated air spaces complying with ASTM E774 and with other requirements indicated.

- Provide heat-treated, coated float glass of kind indicated or, if not otherwise indicated, Kind HS (Heat Strengthened) where recommended by manufacturer to comply with system performance requirements specified and Kind FT (Fully Tempered) where safety glass is designated or required.
- Performance characteristics designated for coated insulating glass are nominal values based on manufacturer's published test data for units with lites 6.0 mm thick and nominal 12 mm dehydrated space between lites, unless otherwise indicated.

<u>Sealing System:</u> Dual seal; primary sealant (minimum width 3.0 mm): Polyisobutylene; secondary sealant: silicone.

Spacer Material: Manufacturer's standard metal.

Desiccant: Manufacturer's standard; either molecular sieve or silica gel or blend of both.

Corner Construction: Manufacturer's bent and welded construction.

Mirror Glass

Clear float glass conforming to specified standard, quality q1, silvering, 6 mm thick.

Cut glass to sizes indicated and complete edge treatment. Grind, polish and bevel mirror edges not framed. Coat back of glass with chemically deposited silver, covered by film of electrically or chemically deposited copper, and coated with manufacturer's standard 0.05 mm dry film of organic coating.

GLAZING SEALANTS

General:	Comply with the following requirements:
Elastomeric Sealant Standard:	Provide elastomeric sealant which complies with ASTM C 920 requirements.
Colors:	Provide color as selected by Engineer from manufacturer's standard colors.

MISCELLANEOUS GLAZING MATERIALS

Compatibility:

Provide materials with proven record of compatibility with surfaces contacted in installation.

Cleaners, Primers and Sealers:

Type recommended by sealant manufacturer.

Setting Blocks:

Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness, 100 mm minimum length by width to suit glass thickness.

Shims and Spacers:

Shims and spacers used with setting blocks shall be of the same material, hardness, length and width as the setting blocks.

Edge Blocks:

Same material as setting blocks, of 50 to 60 Shore A durometer, of size to limit lateral movement of glass.

GLASS TYPES

Provide the following glass types subject to compliance with the criteria approved by Engineer and as shown on drawings:

A) Insulated Glass

8 mm Tinted tempered glass.12 mm Air cavity.6 mm Tinted glass.

B) Clear Sheet Glass

Clear sheet glass shall be transparent, flat, relatively thin glass having a glossy, fire-finished, plain and smooth surface. The defects permitted in the central area of the type of glass are a few seeds, an occasional large seed not more than 6mm. long, faint strings or lines, and very light scratches and other surface defects detected only by close security. No pane (separate piece of glass) shall contain all of these defects and those present may not be clustered when in the central area. In general, the central area of light shall be as free from defects as possible and the appearance of the light as a whole shall be such that there is no perceptible interference with sight through the glass. The clear sheet glass shall not weight less than 10 kg/m2 when 4mm thick and not less than 15 kg/m2 when 6mm thick.

C) Polished Plate Glass

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

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

Tinted polished glass shall be "Parsol Bronze" as manufactured by "Saint Gobain" or of an approved equivalent.

D) <u>Tempered Float Glass</u>

Tempered float glass shall be "Securit" or approved equal. Tempered glass shall impart mechanical strength and shall be impact resistant. When under terrific impact, it shall disintegrate into innumerable small, blunt edged fragments and not into sharp-like ordinary glass.

E) <u>Putty</u>

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

WORKMANSHIP

Verify compliance with applicable tolerances; for functioning of weep system; for face and edge clearances; and for effective sealing of joinery. Report conditions detrimental to glazing work. Perform glazing work after unsatisfactory conditions have been corrected.

Clean glazing channels immediately before glazing. Remove coatings which are not firmly bonded to substrates.

GENERAL

Comply with the combined recommendations of glass manufacturers, of manufacturers of sealants and other glazing materials, except where more stringent requirements are indicated by referenced glazing standards.

Glazing channels are intended to provide for necessary bite on glass, minimum edge and face clearances and adequate sealant thickness, with reasonable tolerances. Adjust as required by Project conditions during installation.

Project glass from damage. Remove and dispose of glass units with damage or imperfections of kind that impairs performance or appearance.

Prime joint surfaces as required for adhesion of sealant.

Install setting blocks one quarter of glass width from each corner but with edge nearest corner not closer than 150 mm from corner of 0.125 times glass width, whichever is greater. Install blocks to prevent movement.

Provide spacers of correct size and spacing for clearances, for glass sizes larger than 1200 united millimeters (length plus height), except where gaskets or glazing tapes are used for glazing. Provide 3 mm minimum bit of spacers on glass and use thickness equal to sealant width, or slightly less than final compressed thickness of tape.

Provide edge blocking to comply with referenced glazing standard. Install edge blocks securely, between the mid height and top corner of the glass and anti-walk blocks as required.

Set units of glass in each series with uniformity of appearances.

Provide compressible filler rods as recommended by sealant and glass manufacturers, to prevent sealant from clogging weep systems and from adhering to joints back surface and to control depth of sealant.

Force sealants into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces. Tool exposed surfaces of sealants to provide a "wash" away from glass.

INSULATING GLASS

Insulating glass units shall be 24 mm thick, consisting of two panes of 6 mm glass separated by a desiccant filled metal spacer with bent, welded or fused corners, and welded or fused splices or joints to provide a continuous 12 mm hermetically sealed and dehydrated space. Insulating glass seal shall be dual seal with polyisobutylene and silicone sealants and certified for compliance with seal classification "CBA" by the Insulating Glass Certification Council (IGCC) and shall meet the requirements of ASTM E774 when tested in accordance with the following ASTM test methods. Secondary seal for structural silicone glazed units shall be a silicone edge seal certified for use in structural silicone glazing applications over the temperature range and structural loading as called for by the performance criteria section of this specification.

- E773 Test Method for Seal Durability of Sealed Insulating Glass Units.
- E774 Specification for Sealed Insulating Glass Units.
- E546 Test Method for Frost Point of Sealed Insulating Glass Units.
- E576 Test Method for Frost Point of Sealed Insulating Glass Units in Vertical Position.

The glass shall be fully heat strengthened or tempered as specified to assure adequate glass performance at the design pressures specified under the performance criteria. Glass manufacturer's recommendations are to be accompanied by wind load and thermal stress analysis.

The contractor shall provide certification from the glass producer/fabricator that the glass producer/fabricator has reviewed glass thickness and finds it suitable for the purpose intended in accordance with his published literature and in accordance with these specifications.

MIRRORS

Apply one additional coat of backing paint and allow to dry. Apply mirror mastic to cover not more than 25% of back of mirror. Set mirror on base support, on setting blocks or continuous gasket, and press against substrate to ensure bond of adhesive. Leave open ventilation space, 3 mm or more in thickness between mirror and substrate. Do not seal-off ventilation space at edge of mirror.

TAPE GLAZING

Position tapes on fixed stops so that when compressed by glass their exposed edges are flush with or protrude slightly above sightline of stops.

Install tapes continuously but not in one continuous length. Do not stretch tapes to make them fit opening.

Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.

Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

Do not remove release paper from tape until just before each lite is installed.

Apply heel bead of elastomeric sealant.

Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

Apply cap bead of elastomeric sealant over exposed edge of tape.

GASKET GLAZING (DRY)

Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

Secure compression gaskets in place with joints located at corners to compress gaskets producing a weather tight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer. Gaskets shall have moulded corners.

Install gaskets so they protrude past face of glazing stops.

SEALANT GLAZING (WET)

Install continuous spacers between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel weep systems until sealants cure. Secure spacers in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

Tool exposed surfaces of sealants to provide a substantial wash away from glass. Install pressurized gaskets to protrude slightly out of channel to eliminate dirt and moisture pockets.

HEAT SOAKING OF TEMPERED GLASS

All tempered glass shall be subject to heat soaking tested prior to delivery to site.

PROTECTION AND CLEANING

Promptly protect installed glass from breakage with crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove non-permanent labels and clean surfaces.

Protect glass from contact with contaminating substances. If contaminating substances do come into contact with glass, remove immediately as recommended by glass manufacturer.

Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

Wash glass on both faces not more than 4 days prior to date scheduled for inspections to establish date of issue of the Provisional Acceptance Certificate in each area of the Project. Wash glass as recommended by glass manufacturer.

DOOR HARDWARE (IRONMONGERY)

PART 1 - GENERAL

DESCRIPTION OF WORK

Section includes: Hardware for steel & Wooden Doors.

STANDARDS

A: BS EN 1303: 1998 B: BS 7352: 1990	Building Hardware Cylinders for Locks. Specification for strength and durability performance of metal hinges for side hung applications and dimensional requirements for template drilled hinges.
C: BS 3621: 1980	Defines what constitutes a minimum standard of good security within a lock.
D: BS 5872: 1980	Specifications for locks and latches for doors in buildings.
E: BS EN 1125	Panic exit devices – requirements and test methods.
F: BS 1154: 1997	Controlled door closing devices requirements and test methods.
G: BS 476	Applicable to all fire rated building materials and structures. This test is a must whenever fire rated elements are requested.
H: Fire Rating	All hardware used on fire rated doors should comply to same standards of fire rating as doors and in specific of same fire rating hours.

SUBMITTALS

- A. Product Data: Include installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings:
 - 1. Details of electrified door hardware. Include location, sequence of operation, and interface with other building control systems.
 - 2. Indicate type, locations and mounting heights of each type of hardware as scheduled, catalogue cuts, electrical characteristics and connection requirements.
 - 3. Submit manufacturer's parts, lists and templates.
- C. Samples for Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of door hardware indicated.
- D. Samples for Approval: For exposed door hardware, representative of each type required, in specified or selected finish, full size. Tag with identification for coordination with the Door Hardware Schedule.
 - 1. Submit samples before submission of the Door Hardware Schedule.

- E. Door Hardware Schedule: Prepared by or under the supervision of door hardware supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.
- F. Keying Schedule: Prepared by or under the supervision of door hardware supplier, detailing final keying instructions for locks. Include keying diagram and index each key set to unique door designations.
- G. Manufacturers Installation Instruction: Submit special procedure, perimeter conditions, requiring special information.

QUALITY ASSURANCE

A. Source Limitations: Obtain all door hardware from a single manufacturer or supplier, unless otherwise indicated.

PART 2 - PRODUCTS

MATERIALS AND FABRICATION - GENERAL

- A. Hand of door: The Drawings show the direction of slide, swing or hand of each door leaf. Provide each item of hardware for proper installation and operation of the door swing as shown.
- B. Manufacturer's Name Plate: Do not use products which have manufacturer's name or trade name displayed in a visible location.
- C. Products: Provide manufacturer's standard catalogue products, conforming to templates, and generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws.
- D. Provide screws for installation with each hardware item. Provide Phillips flathead screws except as otherwise required or approved by the Engineer. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces of other work, to match the finish of such other work as closely as possible.
- E. Concealed Fasteners: Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard units of the type specified are available with concealed fasteners. Do not use through bolts for installation where the bolt head or the nut on the opposite face is exposed in other work.
- F. Tools for Maintenance: Furnish two complete sets of any specialized tools as needed for Employer's continued adjustment, maintenance, and removal and replacement of hardware.
- G. HARDWARE FINISHES
 - 1. General: Exposed surfaces of hardware shall have manufacturer's standard satin anodized or stainless steel finish as indicated by the components listed in the Door Hardware Schedule.

COMPONENTS

A. GENERAL HARDWARE REQUIREMENTS

Where not specifically indicated, comply with applicable BS standards for each type of hardware required. Provide each type of hardware with accessories as required for the applications indicated and for complete, finished operational door.

- 1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently to avoid delay in work.
- 2. Reinforcement Units: Furnished by door and frame manufacturers; coordinated by hardware supplier.
- 3. Fasteners: Furnished as recommended by hardware manufacturers to comply with application involved (steel, wood...), and as required to secure hardware.
- 4. Hand of door: The drawing shows the direction of swinging or hand of each door leaf. Furnish each item of ironmongery for proper installation and operation of the door movement as shown.
- 5. Product finishes: the product finish to be as indicated in schedule as selected from manufacturers wide range of finishes.

B. HINGES, BUTTS AND PIVOTS:

Provide hinges, Butts and pivots as follows:

Number of Hinges: Unless otherwise indicated, supplier should provide number of hinges per leaf to comply with his product fire rating test / certificate. A proof of such test should be presented. As a general recommendation, three hinges should be provided for net leaf size of 2135mm X 915mm and a fourth hinge for bigger size.

- 1. Type of Hinges:
 - a. Provide full mortise 5-knuckle, two ball bearing hinges standard weight, and stainless steel in compliance with BS7352: 1990 class 9.
 - b. Provide full mortise rising hinges, standard weight, and stainless steel.
- 2. **Hinge size**: Unless otherwise indicated, or specified provide door hinge that comply with the requirements of and are sized in compliance with BS7352: 1990, being 4" x 3" x 3mm.
- 3. **Screws:** Furnish Philips Flat Head machine screws for installation of units, except furnish Philips flat-head all purpose or wood screws for installation of units into wood. Finish screw heads to match surface of hinges or pivots.
- 4. Hinge pins: Unless otherwise specified, provide hinge pins as follows:
 a. Interior doors: removable stainless steel pin
 b. Exterior doors: non-removable pin
- 5. **Pivots:** As recommended by manufacturer for size and weight and thickness of door, also check related drawings for further details.

C. LOCKS AND LATCHES:

- 1. Unless otherwise indicated or specified, provide locks and latches that comply with BS 5872: 1980.
- 2. Strikes: Provide manufactures standard strikes for each latch or lock bolt: with curved lip executed to protect frame, finish to match ironmongery sets.
- 3. Rabbeted doors: where rabbeted door stiles are indicated, provide special rabbeted front on lock and latch units and bolts.
- 4. Provide 76mm Euro profile mortise Sash lock case, 57mm backset 57mm centers, brass follower to suit 8mm spindle, with adjustable tension spring to suit heavy unsprang or sprung lever furniture meeting BS5872 and fire rated to BS476, Stainless steel finish.
- 5. Provide 76mm Euro profile mortise dead lock case 57mm back set, to meet BS5872 and fire rated to BS 476, stainless steel finish.
- 6. Provide 76mm mortise bathroom lock, 57mm backset centers with reversible latch bolt, to suit 8mm spindle with adjustable tension spring, and dead bolt follower 5mm, stainless steel.
- 7. Provide 76mm Euro profile mortise night latch lock case,57mm backset 57mm centers, brass follower to suit 8mm spindle, brass latch bolt automatic locking action without key, when door is closed with latch bolt out, reversible latch bolt, cylinder and lever handle, to suit either hand of door.
- 8. Equip locks with euro profile double cylinder, 5 pins with length to match with the door thickness and the related installed accessories.
- 9. Equip locks with Euro-profile single cylinder, 5 pins with length to match with the door thickness and the related installed accessories.
- 10. Equip locks with Euro-profile single cylinder plus thumb turn, 5 pins with length to match with the door thickness and the related installed accessories.
- 11. All locks are to differ and are suited to grand master key, with 5 pin cylinders.
- 12. Provide 3 keys for each lock, finish as manufacturers standard unless otherwise indicated.
- 13. Provide thumb turn with indicator monitor and emergency release to comply with the provided bathroom lock, stainless steel finish.

D. FLUSH BOLTS AND DUST PROOF STRIKES:

1. Flush Bolts:

- a. Lever action manual flush bolt to comply with steel leaf application and fire rating. Manufacturer standard finish unless otherwise indicated.
- b. Automatic flush bolt to comply with steel leaf application and fire rating. Manufacturer standard finish unless otherwise indicated.
- c. Lever action manual flush bolt to comply with wooden leaf application and fire rating. Manufacturer standard finish unless otherwise indicated.
- d. Automatic flush bolt to comply with wooden leaf application and fire rating. Manufacturer standard finish unless otherwise indicated.

Dust proof strike: provides dust proof strikes for foot bolts except where special threshold construction requires specific type. Finish as requested by the Engineer unless otherwise indicated. **E. LEVER HANDLES:**

- 1. Provide one set 19mm diameter 130mm length, 71mm projection lever handle on 50mm diameter rose manufactured from stainless steel.
- 2. Provide lever handle with half-spindle on one side to comply with the provided night latch lockset and to be 19mm diameter 130mm length 71mm projection on 50mm diameter rose, spring loaded, manufactured from stainless steel.
- F. PULL HANDLES / PUSH PLATES/MIDPLATES/KICKPLATES:
 - 1. **Pull Handles:** Provide 19mm diameter 225mm C/C pull handle bolt through. Manufactured from stainless steel sheet rolled. Mounting location as indicated on shop drawings.
 - 2. **Push Plate:** Provide 350mm x150mm, 1.2mm thick, stainless steel satin finish push plate. Round cornered with counter sunk screws. Mounting location as indicated on shop drawings
 - 3. **Mid-plates:** Provide 1.2mm thick, stainless steel satin finish with size to comply with the door width (DWx150mm) mid-plate. Mid-plates to be round cornered with counter sunk screws. Mounting location as indicated on shop drawings.
 - 4. **Kick-plates:** Provide 1.2mm thick, stainless steel satin finish with size to comply with the door width (DWx200mm) kick-plate. Kick-plates to be round cornered with counter sunk screws. Mounting location as indicated on shop drawings.

G. EXIT DEVICES:

- 1. **General:** Unless otherwise indicated or specified, emergency exit devices shall comply with BS EN 1125 specification requirements for panic bolts and panic latches. And fire rated to BS 476.
 - a. Cross bar exit device for single leaf with reversible panic latch and outside trim, silver finish. Location as indicated on hardware schedule.
 - b. Cross bar Vertical rod panic bolt to be installed on double leaf doors with outside trim location as indicated on hardware schedule, silver finish.

H. DOOR CLOSER:

- 1. **General:** Unless otherwise indicated or specified, closers and door control devices shall comply with the applicable requirements of BS EN 1154: 1997 and finish shall be subject to the approval of the engineer.
- 2. **Specification of Unit:** Door closer with silver cover which features a cast iron body with a hardened steel rack and pinion incorporating needle roller bearing housed beneath a precision zinc die cast cover. And to have the following:
 - a. Template and quick-fit back plate
 - b. 2-4 adjustable strength size or size to suit door weight and dimensions
 - c. Non-handed.
 - d. 180 deg. Opening/controlled closing
 - e. Separate adjustment of latch action & closing speed.
 - f. Temperature compensation –15deg C to +40deg C.
 - g. Matching arms.
 - h. Quick release arm assembly
 - i. Pre-assembled arm assembly
 - j. Tripacked for applications
 - 1. Regular, closer is fitted to the pull (hinge knuckle) face of the door.
 - 2. Transom mounted, closer is fitted to the transom on push face of the door. Bracket fitted to the door face.
 - 3. Parallel arm, closer is fitted to the push (opposite to hinge knuckle) face of the door. Bracket is fitted to underside of head frame.
 - k. Closer Cover design and finish is to be approved by the engineer in charge.

I. DOOR SELECTOR (DOOR COORDINATOR):

Provide door selector to comply with Application involved and the BS requirements for fire rating and performance. Type and finish to be approved by the Engineer in charge.

- J. DOOR STOP
 - 1. General: Unless otherwise indicated or specified door stops shall comply with the latest British standard applicable.
 - 2. Door Stop Units shall include but shall not be limited to door ironmongery as follows:
 - a. Dome Stop
 - b. Wall Bumpers
 - c. Security Door Stop

K. DOUBLE ACTING FLOOR SPRING;

1. **General:** Unless otherwise indicated or specified, double acting floor springs shall comply with the applicable requirements of the European standards for controlled door closing devices **BS EN 1154:1997.** Finish shall be subject to the approval of the engineer in charge.

L. ACCESSORIES:

- 1. Provide Escutcheon for euro profile cylinder finish to match ironmongery sets.
- 2. Provide room identification signs to comply with the application involved, shape and finish as approved by the Engineer in charge.
- 3. Provide Hat and Coat Hook buffered, finish to match ironmongery sets.
- 4. Provide Rubber door silencer manufacturer standard type.
- 5. Provide rubber seals for groove type frames manufacturer standard type.

EXAMINATION

- A Administrative requirements: coordination and project condition
- B Verify doors and frames are ready to receive door hardware and dimensions are as indicated on shop drawings.

PART 3 - EXECUTION

INSTALLATION

- A. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way coordinate removal, storage and reinstallation or application of surface protection with finishing work specified in other sections. Do not install surface-mounted items until finishes have been completed on the substrate.
- B. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- C. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

ACTIVE LEAF OF PAIRS OF DOORS

A. Active leaf of pairs of doors shall be RHRB except that where door leaves are unequal, active leaf shall be larger leaf.

HARDWARE MOUNTING HEIGHTS

- A. Mount hardware units at heights generally in accordance with the following, except as otherwise required by the Engineer, or specifically indicated on drawings or required to comply with governing regulations, or avoid interferences
 - 1. Lock Sets and Latches: 950 mm to center of lever or knob from floor.
 - 2. Butt Hinges: 250 mm to bottom of lowest hinge from floor; 125 mm to top of upper hinge from top of door; space other hinges equally between lower and upper hinges.
 - 3. Door Pulls: 1140 mm finish floor to center of pull; center line in 125 mm from edge of flush doors, and centered on stile of narrow stile glass doors.
 - 4. Deadlocks: Center line of cylinder to align with center line of cylinder for lock sets, except where location conflicts with pull handle or push plate, then provide at 1520 mm from finished floor to centerline of cylinder.
 - 5. Cross Bar Exit Devices: 910 mm for standard installations.
 - 6. Push Rail Exit Devices: 1040 mm for standard installations.
 - 7. Push Plate: 1220 mm finish floor to center of plate through mounted to pulls.
 - 8. Flush Bolt Operating Mechanisms: Top bolt 1675 mm to 1830 mm above finished floor, bottom bolt 300 mm above finished floor.
- B. Coordinate mounting heights with door and frame manufacturers. Use templates provided by hardware item manufacturer.
- C. Install each ironmongery item in compliance with the manufacturers instruction and recommendations whenever cutting and fitting is required to install ironmongery onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protection. Do not install surface mounted items until finishes have been complete the substrates.
- D. Set Units plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation. Separate aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials. Drill and countersink units which are factory prepared for anchorage fasteners, space fasteners and anchors in accordance with manufacturer's instructions or as directed.

ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted and lubricated to operate freely and smoothly as intended for the application made.
- B. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make a final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- C. Instruct Employer's Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

Hardware Schedule for Doors

Refer to Wooden Door Schedule, LEGEND & IRONMONGERY.

CHAPTER NINE

FINISHES

LATH AND PLASTER

PART 1 - GENERAL

SUMMARY

A. Extent of lath and plaster is indicated on Drawings and Schedules.

B. Types of work include:

1. Metal lathing.

2. Portland cement plastering.

QUALITY ASSURANCE

A. Field Construction Mock-up: Prior to installation of plaster work, fabricate mock-up panels for each type of finish and application required using materials, including lath accessories and support system (if any) indicated for final work. Build panels 1.2 m x1.2 m x full thickness in location indicated, or if not otherwise indicated, as directed by Engineer. Demonstrate the proposed range of color, texture and workmanship to be expected in completed work. Obtain Engineer acceptance of panel's visual quality before start of work. Retain panel during construction as a standard for judging completed work.

APPLICABLE CODES AND STANDARDS

ASTM C 150 Specification for Portland Cement.

BS 12 Specification for ordinary and rapid hardening Portland cement.

BS 890 Building limes.

BS 1198,

BS 1199,

BS 1200 Building sands from natural sources.

BS 1369 Metal lathing (steel) for plastering.

BS 4049 Glossary of terms applicable to internal plastering, external rendering and floor screeding.

BS 4721 Specification for ready-mixed building mortars.

BS 5262 Code of practice for internal plastering.

BS 6452 Beads for internal plastering and dry lining.

PART 2 - PRODUCTS

LATH

- A. Expanded Metal Lath: Fabricate expanded metal lath from galvanized steel sheet to produce lath complying with BS 1369 for type, configuration and other characteristics indicated below, with uncoated steel sheet painted after fabrication into lath.
 - 1. Diamond Mesh Lath: Comply with the following requirements:

Configuration: Flat. Weight: 1.60 kg/m2.

PLASTER ACCESSORIES FOR PORTLAND CEMENT PLASTER

- A. General: Comply with material provisions of BS 1369 and BS 5262; coordinate depth of accessories with thicknesses and number of coats required.
- B. Metal Corner Reinforcement: Expanded large mesh diamond mesh lath fabricated from tight coat galvanized sheet steel to comply with BS 5262, with weight 2.25 kg/m2 and formed to reinforce external corners of Portland cement plaster on exterior exposures while allowing full plaster encasement.
- C. Metal Corner Beads: Small nose corner beads fabricated from tight coat galvanized sheet steel, synthetic coated fitted with PVC strip.
- D. Casing Beads: Square-edged style, with expanded flanges and removable protective tape, of the following material:
 - 1. Material: Zinc-coated steel with PVC strip.
 - 2. Two-Piece type: Pair of casing beads with back flanges formed to provide slip joint action, adjustable for joint widths from 3 mm to 15 mm, with PVC edging.

PORTLAND CEMENT PLASTER MATERIALS

- A. Base Coat Cements: Type as indicated below:
 - 1. Portland cement, ASTM C 150, Type I or III; BS 12.
- B. Finish Coat Cement: Type as indicated below:
 - 1. Portland cement, ASTM C 150, Type I; BS 12.
- C. Factory-Prepared Finish Coat: Manufacturer's standard product requiring addition of water only.
 - 1. Product: Subject to compliance with requirements and approval of the Engineer.
- D. Lime: Special hydrated lime for finishing purposes, ASTM C 206, Type S; or BS 890 Type.
- E. Sand Aggregates: ASTM C 897; BS 1199.

MISCELLANEOUS MATERIALS

- A. Water for Mixing and Finishing Plaster: Drinkable, free of substances capable of affecting plaster set or of damaging plaster, lath or accessories.
- B. Bonding Agent for Portland cement Plaster: ASTM C 932.
- C. Plasticizer: Manufacturer's standard product, subject to compliance with requirements and approval of the Engineer may be used in accordance with manufacturer's recommendations and instructions.

PORTLAND CEMENT PLASTER MIXES AND COMPOSITIONS

- A. General: Comply with ASTM C 926 or BS 5262 for Portland cement plaster base and finish coat mixes as applicable to plaster bases, materials and other requirements indicated.
- B. Portland Cement Plaster Base Mixes and Compositions: Proportion materials for respective base coats in parts by volume for cementitious materials and in parts by volume per sum of cementitious materials for aggregates to comply with the following requirements for each method of application and plaster base indicated. Adjust mix proportions below within limits specified to attain workability.
 - 1. Three-Coat Work over Metal Lath: Base coats as indicated below:

Scratch Coat: 1 part Portland cement, 1/2 part lime, and 4 parts sand.

Brown Coat: 1 part Portland cement, ½ part lime, and 4 parts sand.

2. Two-Coat Work over Concrete Unit Masonry: Base coats as indicated below.

Base coats: 1 part Portland cement, ¹/₂ part lime, and 4 parts sand.

- C. At Contractor's option, provide one of the following:
 - 1. Job-Mixed Portland Cement Plaster Finish Coats: Proportion materials for finish coats in parts by volume for cementitious materials and parts by volume per sum of cementitious materials for aggregates to comply with the following requirements:
 - a. 1 part Portland cement, ³/₄ 1¹/₂ parts lime and 3 parts sand.
 - 2. Factory-Prepared Portland Cement Finish Coats: Add water only; comply with finish coat manufacturer's directions.
- D. Mixing: Mechanically mix cementations and aggregate materials for plasters to comply with applicable referenced application standard and with recommendations of plaster manufacturer.

PART 3 - EXECUTION

INSTALLATION OF LATHING AND FURRING, GENERAL

A. Portland Cement Plaster Lathing and Furring Installation Standard: Install lathing and furring materials indicated for Portland cement plaster to comply with ANSI A42.3 or BS 5262.

METAL LATHING

- A. Install expanded metal lath for the following applications where plaster base coats are required. Provide appropriate type, Configuration and weight of metal lath selected from materials indicated which comply with referenced lathing installation standards.
 - 1. At junctions and joints between differing materials and forms of construction, and at all chases and other places where making good occurs.
 - a. Install minimum 150 mm wide strip of lath, fixed to substrate on both edges at minimum 600 mm centers.

INSTALLATION OF PLASTERING ACCESSORIES

- A. General: Comply with referenced lathing and furring installation standards for provision and location of plaster accessories of type indicated. Miter or cope accessories at corners; install with tight joints and in alignment. Attach accessories securely to plaster bases to hold accessories in place and alignment during plastering.
- B. Accessories for Portland Cement Plaster:
 - 1. Corner Bead: Install at all external corners.
 - 2. Casing Beads: Install at termination of plasterwork unless otherwise indicated.
 - 3. Control joints: Install control joints at location indicated, or it not indicated, at locations complying with the following criteria and approved by the Engineer.
 - a. Where an expansion or control joint occurs in surface of construction directly behind plaster membrane.
 - b. Where distance between control joints in plaster surfaces exceed 5.5 m in either direction.
 - c. Where area within Portland cement panels exceed 10 m2.
 - d. Where Portland cement plaster panels sizes or dimensions change. Extend joints full width or height of plaster membrane.

PLASTER APPLICATION, GENERAL

- A. Prepare monolithic surfaces for bonded base coats and use bonding compound or agent to comply with requirements of referenced plaster application standards for conditioning of monolithic surfaces.
- B. Tolerances: Do not deviate more than 3 mm in 1.8 m from true plane in finished plaster surfaces, as measured by a 1.8 m straightedge placed at any location on surface.
- C. Grout hollow metal frames, bases and similar work occurring in plastered areas, with base coat plaster material and prior to lathing where necessary. Except where full grouting is indicated or required for fire-resistance rating, grout 150 mm lengths at each anchorage.
- D. Sequence plasters application with the installation and protection of other work, so that neither will be damaged by the installation of the other.
- E. Apply thicknesses and number of coats of plaster as indicated; or as required by reference standards.
- F. Concealed Plaster: Where plaster application will be concealed above suspended ceilings and similar locations, finish-coat may be omitted; where used as a base for adhesive application of tile and similar finishes, omit finish-coat and coordinate thickness with overall dimension as shown, and comply with tolerances specified.

PORTLAND CEMENT PLASTER APPLICATION

- A. Portland Cement Plaster Application Standard: Apply Portland cement plaster materials, compositions, and mixes to comply with ASTM C 926 or BS 5262.
- B. Number of Coats: Apply Portland cement plaster, of composition indicated, to comply with the following requirements:
 - 1. Use three-coat work over metal lath.
 - 2. Use two-coat work over the following plaster bases:
 - a. Concrete unit masonry.
 - b. Concrete cast-in-place or precast when surface complies with ASTM C 926 or BS 5262 for plaster bonded direct to solid base.
 - 3. Finish Coat: Floated finish unless otherwise indicated; match Engineer sample.
- C. Thickness:
 - 1. Thickness of external plaster (render) shall be 25 mm, 3 coat application over metal lath, having smooth wood float finish.
 - 2. Thickness of internal plaster shall be 15 mm, 2 coat application. Having smooth steel float finish.
- D. Moist cure Portland cement plaster base and finish coats to comply with ASTM C 926 or BS 5262, including recommendations for time between coats and curing.

CUTTING AND PATCHING

- A. Cut, patch, point-up and repair plaster as necessary to accommodate other work and to restore cracks, dents and imperfections. Repair or replace work to eliminate blisters, buckles, excessive crazing and check cracking, dry-outs, efflorescence, sweat-outs and similar defects, and where bond to the substrate has failed.
- B. Sand smooth troweled finishes lightly to remove trowel marks and arises.

CLEANING AND PROTECTION

- A. Remove temporary protection and enclosure of other work. Promptly remove plaster from doorframes, windows, and other surfaces, which are not to be plastered. Repair floors, walls and other surfaces, which have been stained, marred or otherwise damaged during the plastering work. When plastering work is completed, remove unused materials, containers and equipment and clean floors of plaster debris.
- B. Provide final protection and maintain conditions, in a manner acceptable to the Engineer, which ensures plasterwork being without damage or deterioration at time of Taking-Over.

FLOOR AND WALL CLADDING

SCOPE

These specifications cover floor and wall cladding intended to be used for the Project in accordance with the Drawings, Bills of Quantities and as directed in writing by the Engineer.

GENERAL

The Contractor shall perform all attendance upon other trades and protect all works specified under this Section from damage during subsequent operations, make good any defects clean throughout and leave all works in a perfect condition to the satisfaction of the Engineer.

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

All material and manufactured items that are liable to damage shall be delivered in the original package, containers, etc... bearing the name of the manufacturer and the brand, and shall be carefully loaded, transported, unloaded, stored in an approved manner, protected from damage and exposure to weather or dampness during transit and after delivery to the Site.

Damaged materials and manufactured items shall not be used in the works specified under this Section. Any materials and manufactured items damaged during and after bedding or setting in position shall be removed and replaced by and at the Contractor's expense.

MATERIALS AND MANUFACTURE

A) <u>Cement</u>

Cement shall be ordinary Portland cement and White (non- stain) cement as specified under "BLOCKWORK".

B) Sand (Fine Aggregate)

Sand (Fine Aggregate) for use in plaster, mortar and screed shall be as specified for Mortar under "CONCRETE WORK", except the requirement for gradation shall not apply for screed (maximum size 10 mm) and shall contain no more than 0.06% chlorides.

C) Water

Water shall be demineralized brackish water of maximum of a total dissolved solids of seven hundred ppm. as specified under "CONCRETE WORK".

D) Color Pigments

Color pigments shall conform to B.S. 1014.

E) Precast Cement Tiles

Precast Cement tiles, shall be obtained from an approved manufacturer. Tiles shall be formed with a (1:2 1/2) mix of Ordinary Portland Cement and hardwearing aggregate for the topping (wearing layer) 10mm thick set on a concrete backing of cement and fine aggregate (1:5) mix.

The size and thickness of tiles shall be as shown on the Drawings or stated in the Bills of Quantities and shall be of an approved design and pattern cast in heavy steel moulds under pressure.

F) Precast Terrazzo Tiles, Skirting, Etc..

The precast terrazzo tiles and skirting's shall be formed of white or tinted Portland Cement and granular granite chippings and shall be obtained from an approved manufacturer.

The tiles shall be cast in heavy steel moulds under pressure to the proportions and dimensions shown on the Drawings and approved by the Engineer.

Precast terrazzo skirting's shall be with fair square top edge and produced in the same proportions and mixes for tiles.

Precast terrazzo treads, risers, strings, thresholds, etc... Shall be of the design, dimensions and thicknesses shown on the Drawings and they shall be formed in the same proportions and mixes for tiles.

Grinding shall be done get by means of a No. 80 carborundum stone. Filling shall be with a neat cement grout of the same color as the facing mix and this shall be worked into the surface with a wooden scraper to fill all voids and air holes. After a minimum period of 24 hours polishing shall be carried out wet by means of a No. 140 carborundum stone with the addition of appropriate lead and salt pigments to produce a mirror like glossy finish.

G) Ceramic Floor Tiles

Ceramic floor tiles shall be unglazed heavy duty ceramic tiles manufactured in accordance with to B.S. 6431. Skirting shall be coved type 100 mm high. Acid resistant tiles shall be used where specified. Tiles pattern and color shall be to the Engineer approval.

H) Glazed Wall Tiles

Glazed wall tiles shall conform to the requirements of B.S. 6431 and the size shall be as shown on the Schedules of Finishes or the Drawings and of an approved pattern and color. Single edge and double edge rounded tiles, coves and corner pieces shall be of same quality, color and finish.

I) Cement Screed Floor Finish

The cement screed shall unless otherwise ordered by the Engineer, consist of one part of ordinary Portland cement to three parts of sand by volume. The ingredients shall be proportioned and mixed as specified for concrete work under "CONCRETE WORK".

The screed shall be trowelled smooth with steel trowel and shall be cured for at least 5 days and shall be left perfectly flat with clean and smooth surface finish, free of trowel marks and to the satisfaction of the Engineer.

J) Dressing for Cement Floors

The dressing shall be a granular abrasive in powder form, manufactured for trowel application into the upper surface of the Screed. It shall be manufactured for this purpose and delivered in containers bearing the name of the manufacturers and the instructions for its application.

K) Floor Seal

Floor seal shall be epoxy base sealant material manufactured for application on the finished surface of the screed. It shall be manufactured for this specified application and labelled as such.

It shall be delivered in containers bearing the name of the manufacturer and the instructions for its application.

L) Plasticizer

Plasticizer proposed by the Contractor and approved by the Engineer shall be used in the mortars. Use of lime will in no account be permitted.

WORKMANSHIP

A) Precast Cement and Terrazzo Tiles

The precast cement and terrazzo tiles shall be laid in accordance with BS 5385: Part 5: 1990, BS 8204: Part 4: 1993 and/or BS 8000: Section 11.1: 1989 as applicable and as directed by the Engineer. Precast cement and terrazzo tiles shall be laid on a (1:3) mix of cement and sand mortar and any admixtures approved by the Engineer. Approved PVC separator strips 8 mm thick of color to the approval of the Engineer shall be provided for every 9m² area of the tile works.

All tiles shall be laid with square joints and shall be grouted up on completion, care being taken to fill all joints completely.

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

All terrazzo surfaces shall be polished on completion. Large areas such as floors shall be wet polished by means of approved machines using a No. 140 carborundum wheel. Any narrow surfaces which cannot be polished conveniently by the machine, may be polished by hand using a No.140 carborundum stone and water. Care must be taken during any polishing operation not to damage any angles or arrises. Polishing shall be performed with addition of appropriate lead and salt pigments as approved by the Engineer to produce a mirror-like glossy finish.

Tiles shall be cut with a suitable cutting tool and rough edges shall be rubbed smooth. Cut-tile misfits shall be replaced with properly cut tiles. Straight edges shall be accurately set to the lines established and reset at suitable intervals to keep the joints parallel over the entire area.

Broken tiles or tiles showing the least signs of defects will not be accepted and if laid by the Contractor shall be removed and replaced with sound tiles, at his own expense.

Tiles shall be laid out from the center line of each space outward and adjustment made along walls, partitions, and borders, so as to symmetrize the pattern with a minimum of cut tiles. Tiles of less than half of their full size along one side after cutting should be avoided.

B) Ceramic Floor Tiles

Ceramic floor tiling shall be carried out in compliance with BS 5385:Part 3:1989 and/or BS 8000:Section 11.1 :1989 as applicable and as directed by the Engineer.

The overall thickness of tiles, mortar and screed shall be maximum of 80 mm.

Bedding shall consist of cement: sand mortar 1:3 of a stiff plastic consistency, spread, compacted and leveled to a thickness of 9-10 mm. Water content of mortar must be limited to prevent formation of surface water when mortar is compacted and surface water which does occur must be allowed to dry. Sufficient mortar for 2-3 hours' work maximum shall be laid at any one time.

Tiles shall be dipped in water and surface water allowed to drain off. The back of the tiles shall be buttered with neat cement/water mix (or cement based adhesive), and the tiles laid on bedding and tapped down to form a level surface. All joints shall be as close as possible and shall in no case exceed half (0.5) mm in width on face for areas less than ten (10) square meters and one (1) mm for areas over ten (10) square meters.

Tiles shall be left for at least twelve (12) hours before joints are grouted.

White or tinted cement and water to 1:1 mix of paste consistency shall be worked into the joints until flush with face of tiles.

Acid resistant tiles shall be grouted in a suitable acid-resistant grout to the Engineer's approval.

The surplus grout from the floor surface shall be gently wiped with fine sand. Sawdust shall not be used.

Walking on tiles shall not be allowed for five (5) days after laying.

Perimeter movement joints shall be provided to the full depth of finish, bedding and screed in all tiled floors.

C) Glazed Wall Tiles - Fixing with Adhesive

Wall tiling shall be carried out in compliance with BS 5385:Part 1: 1976 for Internal work and BS 5385: Part 2: 1976 for External work and/or BS 8000: Section 11.1 : 1989, as applicable and as directed by the Engineer.

The background for tiling shall be suitably prepared free from oil, grease, loose or friable materials and shall provide an adequate key for bedding.

The maximum deviation of background shall not exceed 3 mm when measured under a two meter straight edge.

Tiling work shall be carefully set out prior to starting to minimize the amount of tile cutting and to ensure alignment of vertical and horizontal joints.

Tiles shall be dry when fixed, using adhesive, mixed and used strictly in accordance with manufacturer's written instructions and within the stated working time of the adhesive. The manufacturer's recommendations for safe handling and ventilation of working area shall be carefully followed.

Adhesive shall be applied as a floated coat to a thickness of 5 to 6 mm. Tiles shall be firmly pressed into position within the stated working time of the adhesive.

Tiles and fittings shall be set in adhesive to true vertical face with continuous horizontal and vertical joints. Joints shall be straight, level, perpendicular and of even width not exceeding 1.5 mm. The

vertical joints shall be maintained plumb for the entire true level and plane by uniformly applied pressure under a straight edge of a rubber faced block. Misfits as well as damaged or defective tiles shall be removed and replaced at the Contractor's own expense.

Special tile fittings shall be located as shown on detail drawings and as directed by the Engineer.

Bedding shall be allowed to set before grouting to avoid disturbance to tiles. Grout shall be applied in matching color according to manufacturer's written instructions and worked in until joints are thoroughly filled flush with the finished face of joint. Surplus grout shall be removed with a damp cloth and joints tooled to a smooth finish. Acid resistant tiles shall be grouted with a suitable acid resistant grout to the Engineer's approval.

Immediately after the grouting has set, tiled surface shall be given a protective coat of non-corrosive soap or other approved method of protection and joints shall be cured for 72 hours.

Wall tiling operations shall not be started until the floor tiling in the same area has been completed.

D) Glazed Wall Tiles - Fixing with Cement: Sand Mortar

Wall tiling shall be carried out in compliance with BS 5385:Part 1:1976 for Internal work and BS 5385:Part 2:1976 for External work and/or BS 8000:Section 11.1 :1989, as applicable and as directed by the Engineer.

Cement and sand mortar (1:4) ten (10) mm. thick shall be laid as base for wall tiling. The surface of the mortar so laid shall be scratched in an approved manner when nearly set, to form key and shall be cured for five (5) days before tiling starts. The surface shall be well wetted before the actual tiling operation is commenced.

Tiles and fittings shall be set in cement and sand mortar (1:4) mix, 6 mm. thick to a true vertical face with continuous horizontal and vertical joints. Joints shall be straight, level, perpendicular and of even width not exceeding 1.5 mm. The vertical joints shall be maintained plumb for the entire true level and plane by uniformly applied pressure under a straight edge of a rubber-faced block. Misfits as well as damaged or defective tiles shall be removed and replaced by and at the Contractor's expense.

The external and internal angles and side edges of glazed wall tiling shall be formed with angle beads whereas top edges of tiles, shall be formed with rounded edge tiles. Joints shall match the general tiling and special fittings shall be used.

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

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

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

Immediately after the grout has had its initial set glazed wall tile surfaces shall be given a protective coat of a non-corrosive soap or other approved method of protection and joints cured for 72 hours.

Wall tiles operations in spaces requiring floor tiles shall not be started until the floor tiles installation had been completed.

E) Floor Dressing

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

F) Floor Sealing

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

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

AGGLOMERATED TERRAZZO TILES

GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

SUMMARY

Section Includes agglomerated (marble aggregate) cement tiles.

SUBMITTALS

Product Data: For each type of product indicated.

Shop Drawings: Include agglomerated cement installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:

Samples for Initial Selection: Color plates showing the full range of colors and patterns available for each agglomerated cement type indicated.

Samples for Verification: For each type, material, color, and pattern of agglomerated cement and accessory required showing the full range of color, texture, and pattern variations expected. Label each agglomerated cement sample to identify matrix color and marble-chip types, sizes, and proportions. Prepare samples of same thickness and from same material to be used for the Work.

Qualification Data: For qualified Installer.

Material Certificates: For each type of agglomerated cement material or product, from manufacturer.

Maintenance Data: For agglomerated cement to include in maintenance manuals.

QUALITY ASSURANCE

Installer Qualifications: An installer who has proven experience.

Source Limitations for Marble Chips: Obtain each color, grade, type, and variety of granular materials from one source with resources to provide materials of consistent quality in appearance and physical properties.

Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

Reinstallation Conference: Conduct conference at Project site.

DELIVERY, STORAGE, AND HANDLING

Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.

Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

PROJECT CONDITIONS

Environmental Limitations: Maintain temperature above (10 deg C) for 48 hours before and during agglomerated cement installation.

Field Measurements: Verify actual dimensions of construction contiguous with precast agglomerated cement by field measurements before fabrication.

Control and collect dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

PRODUCTS

A PRECAST AGGLOMERATED CEMENT

Precast Agglomerated Cement tiles. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product.

> Polished Tile size 500 x 500mm. Rough Textured Tile size 500 x 500mm.

Type and Top Edge: As selected by Engineer from manufacturer's full range and matching approved sample and matching approved sample and mockup.

Color, Pattern and Finish: As selected by Engineer from manufacturer full range.

Portland Cement Agglomerated cement Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on agglomerated cement type indicated.

B MORTAR SETTING-BED MATERIALS

Portland cement: ASTM C 150, Type I or II.

Hydrated Lime: ASTM C 207, Type S.

Aggregate: ASTM C 144.

Latex Additive: Styrene-butadiene-rubber or acrylic-resin water emulsion serving as replacement for part or all of gaging water, of type specifically recommended by manufacturer for use with job-mixed Portland cement and aggregate, and not containing a retarder.

Cleavage Membrane: Asphalt-saturated felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.

Reinforcing Wire Fabric: Galvanized, welded wire fabric, (50.8 by 50.8 mm) by (1.57-mm) diameter; comply with ASTM A 185 and ASTM A 82, except for minimum wire size.

Thin-Set Materials: For setting floor brick on cured mortar bed, use latex-Portland cement mortar complying with ANSI A118.4, and consisting of the following:

1. Prepackaged Dry-Mortar Mix: Factory-prepared mixture of Portland cement; dry, redispersible, ethylene vinyl acetate additive; and other ingredients to which only water needs to be added at Project site.

Mixture of Dry-Mortar Mix and Latex Additive: Mixture of prepackaged dry-mortar mix and styrene-butadiene-rubber or acrylic-resin liquid-latex additive.

C GROUT MATERIALS

- 1. Portland cement: ASTM C 150, Type I or II.
- 2. Color: Natural color or white as required to produce joint color indicated.
- 3. Aggregate: ASTM C 144.
- 4. White Aggregate: Natural white sand or ground white stone.
- 5. Colored Aggregate: Ground marble, Stone, or other sound stone; selected to produce required grout color.
- 6. Colored Mortar Pigments for Grout: Natural and synthetic iron and chromium oxides, compounded for use in mortar and grout mixes. Use only pigments that have proved through testing and experience to be satisfactory for use in Portland cement grout.
- 7. Polymer-Modified Grout: ANSI A118.7.
- 8. Packaged, dry grout mix consisting of Portland cement, graded aggregate, and ethylene vinyl acetate in the form of a reemulsifiable powder to which only water is added at Project site.
- 9. Water: Potable.

D MIXES

- 1. General: Comply with referenced standards and with manufacturers' **written** instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimum performance characteristics. Discard mortars and grout when they have reached their initial set.
- 2. Portland Cement-Lime Setting-Bed Mortar: Type S, N complying with ASTM C 270, Proportion Specification.
- 3. Latex-Modified Portland Cement Setting-Bed Mortar: Proportion and mix Portland cement, aggregate, and liquid latex for setting bed to comply with directions of liquid-latex manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive brick.
- 4. Mortar-Bed Bond Coat: Mix neat cement and latex additive or water to a creamy consistency.
- 5. Latex-modified Portland Cement Slurry Bond Coat: Proportion and mix Portland cement, aggregate, and liquid latex for slurry bond coat to comply with directions of liquid-latex manufacturer.
- 6. Thin-Set Mortar: Proportion and mix thin-set mortar ingredients per directions of liquid-latex manufacturer.
- 7. Job-Mixed Portland Cement Grout: Proportion and mix job-mixed Portland cement and aggregate grout to match setting-bed mortar, except omit hydrated lime and use enough water to produce a pourable mixture.
- 8. Job-Mixed Polymer-Modified Portland Cement Grout: Add liquid-latex additive to dry grout mix in proportion and concentration recommended by liquid-latex manufacturer. Proportion cement and aggregate to comply with directions of latex-additive manufacturer.
- 9. Pigmented Grout: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1 to 10, by weight.
- 10. Colored-Aggregate Grout: Produce color required by combining colored aggregates with Portland cement of selected color.
- 11. Packaged, Polymer-Modified Grout Mix: Proportion and mix grout ingredients according to grout manufacturer's written instructions.

EXECUTION

E PREPARATION

- 1. Clean substrates to produce clean, dry, and neutral substrate for agglomerated cement application.
- 2. Remove substances, including oil, grease, and curing compounds, that might impair bond of agglomerated cement system.
- 3. Roughen concrete substrates before installing agglomerated cement system.
- 4. Protect other work from dust generated by grinding operations. Control dust to prevent air pollution and comply with environmental protection regulations.
- 5. Erect and maintain temporary enclosures and other suitable methods to limit dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

F INSTALLATION, GENERAL

- 1. Do not use tiles with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- 2. Mix tiles from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- 3. Cut tiles with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
- 4. Joint Pattern: As indicated.
- 5. Hand-Tight Joints: Set tile with hand-tight joints where indicated.
- 6. Spaced Joint Widths: Provide nominal (10-mm) (13-mm) joint width with variations not exceeding plus or minus (1.6 mm) (3 mm), unless otherwise indicated.
- 7. Finished-Surface Tolerances: Do not exceed (1-mm) tile-to-tile offset from flush (lippage) nor (3 mm in 3 m) from level, or indicated slope, for finished surface of tile flooring.
- Finished-Surface Tolerances: Do not exceed (1.6-mm) tile-to-tile offset from flush (lippage) nor (3 mm in 600 mm) and (6 mm in 3 m) from level, or indicated slope, for finished surface of tile flooring.
- Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide joint filler as backing for sealant-filled joints where indicated. Install joint filler before setting tile flooring. Sealant materials and installation are specified in Division 5 Section "Joint Sealants."
G PRECAST AGGLOMERATED CEMENT INSTALLATION

- 1. Install precast agglomerated cement units using method recommended by NTMA and manufacturer unless otherwise indicated.
- 2. Installation Tolerance: Set units with alignment level and true to dimensions, varying (3.2 mm) maximum in length, height, or width; noncumulative.
- 3. Do not install units that are chipped, cracked, discolored, or improperly finished.
- 4. Seal joints between units with cement grout matching precast agglomerated cement matrix.

H THIN-SET MORTARED AGGLOMERATED CEMENT FLOORING

- 1. Install agglomerated cement flooring on concrete subfloor with thin-set mortar to comply with the following requirements:
- 2. Wet tile before laying if the initial rate of absorption exceeds (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow tile to absorb the water so it is damp but not wet at the time of laying.
- 3. Apply thin-set mortar to substrate with notched trowel complying with admixture manufacturer's specifications for notch depth and configuration and in heavy enough layer to provide a minimum mortar-bed thickness of (2.5 to 3 mm) after bricks are fully embedded. Key the mortar into substrate with flat side of trowel and comb with notched side of trowel in one direction. Apply only as much mortar as can be covered with brick before initial set (15 to 30 minutes).
- 4. Place tile while mortar is still tacky and before initial set takes place. Immediately before placing tile, apply skim coat of thin-set mortar to back of tile. Place tile by sliding in direction perpendicular to combed ridges and tamp or beat tile with a small beating block to obtain full contact with mortar and to bring finished surfaces within indicated tolerances; do not return to areas already set and disturb tiles for purposes of realigning finished surfaces or adjusting joints.

I CLEANING AND PROTECTION

Precast agglomerated cement cleaning:

- 1. Remove grinding dust from installation and adjacent areas.
- 2. Wash surfaces with cleaner immediately after grouting precast agglomerated cement tiles and final cleaning of agglomerated cement flooring.
- 3. Rinse surfaces with water and allow to dry thoroughly.
- 4. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that agglomerated cement is without damage or deterioration at time of Substantial Completion.

MARBLE FLOORING AND CLADDING

General

1. Work Included

This section covers the furnishing and installation of all marble flooring and related accessories. The contractor shall furnish all labor, materials, tools and equipment required to complete the work.

2. Applicable codes and Standards

The following codes and standards are intended to provide an acceptable level of quality for materials and products. The contractor may propose alternative codes and standards provided they give an equivalent degree of quality as the referenced codes and standards are submitted to the Engineer for review and approval in advance of their use.

a. DIN - Deutsches Institute fur Normung e.v.

18352 Tile and Slab Laying Works

b. ASTM - American Society for Testing and Materials

- C150 Portland Cement
- C241 Marble abrasive hardness
- C33 Fine Aggregates
- C206 Types-S Hydrated Lime for masonry purposes

3. Submittals

The following shall be submitted to the Engineer for review and approval:

a. Samples

Samples of marble tiles measuring 400 x 400 mm, showing the range of variations.

b. Shop and Installation Drawings

Submit shop and installation drawings for Engineer's approval prior to fabrication or installation, showing pattern and constructural details.

c. Certification

Furnish a certificate from marble producer/supplier and duly attested by the contractor, stating that the marble meets the specified requirements. Certification shall be based on tests made by an independent laboratory.

d. Mock Ups

Before proceeding with the work of this section install at the Engineer Site Office the followings:

One complete panel of patterned marble flooring technique, jointing, finishing.

4. Product Handling

a. Do not allow scattering of materials on the job site and use all means necessary to ensure neatness.

b. The rejected materials shall immediately be removed from the site and replaced with the fresh materials.

c. Cementitious materials and aggregates should be stored in such a manner as to prevent deterioration or intrusion of foreign materials.

d. Upon receipt at the job site, the material shall be stacked on timber or platforms at least 100 mm above the ground, and extreme care shall be taken to prevent staining during storage. If the storage is to be for a prolonged period, polyethylene film shall be placed between any wood and finished surface, and shall be used also as an overall protective covering.

5. Extra Stock

The contractor shall furnish an extra supply of tile equal to 2% of each type and colour used in the work. This extra supply is over and above the normal allowance for breakage and waste and is to be furnished to the Engineer at the completion of the work. No separate payment will be made for this extra stock. The tiles shall be provided in clean, marked containers.

MATERIALS

1. Marble Tiles

Marble tiles shall be obtained from quarries having sufficient quantities to complete the work as indicated on the drawings. Tiles shall be sound with uniform and favorable working qualities. Color and texture shall be within the range of variations represented by samples accepted by the Engineer. Minor natural variations in color and markings which are characteristic of the materials and which do not impair strength or appearance will be permitted. The material shall have the following physical properties:

2. Cement

Portland cement conforming to ASTM C150 cement for jointing shall be white Portland.

3. Sand

Shall be clean, washed, sharp, and natural or manufactured conforming to ASTM C35. Sand for jointing shall be "white" sand to Engineer's approval.

4. Water

Water shall be portable and free from injurious amounts of soils, acids, alkalines, salts, organic materials or other substances that may be deleterious.

5. Hydrated Lime

Shall conform to ASTM specification C206 or C207 type-S

6. Materials and Accepted Manufacturers

Floor and Skirting shall be in mortar bed tiles as shown on drawings.

Tiles shall be laid in pattern in conformity with architect's special design and as shown on drawings.

Execution

1. Marble

a. Tolerances

Maximum variations in dimensions for face dimensions shall be +1mm from the approved shop drawings. Maximum variations in slab thickness shall be +3mm.

Variation from true plane or flat surfaces shall be determined by the use of a 1.2 meter long straightedge applied in any direction on the surface. Such variation shall not exceed 2 mm.

b. Jointing and Bedding

Jointing and bedding shall be carried out in accordance with International common practice.

Paving shall be laid on compacted sand with a minimum 30 mm mortar bedding to falls and levels indicated on the drawings. The mortar bedding shall be continuous such that no voids or pockets remain. Any slabs which sound "Hollow" or which move upon inspection shall be replaced.

2. Inspection

a. Inspection

1. Examine surfaces to receive granite tiles, mortar beds, or accessories before granite installation begins.

- 2. Correct the following conditions before proceeding with Tiling:
 - Defects, or condition adversely affecting quality, execution and permanence of marble installation.
 - Maximum deviation of surfaces to receive tiles veneer:

Vertical surfaces: 6 mm in 2.5 m

b. Condition of surface to receive tiling.

- 1. Firm, dry, clean and free of oily or waxy films.
- 2. Anchors, hangers, electrical and mechanical work in or behind marble to be installed prior to proceeding with tiling.

3) Execution

1. Setting

a. All setting shall be done by competent tile setters, in accordance with approved shop drawings.

b. Before being set, all marble shall be clean. Unless otherwise shown on approved shop drawings, each piece shall be carefully bedded in a full bed of mortar and tapped home with a rawhide mallet to full and solid bearing. Particular care shall be exercised to equalize bed and joint openings and eliminate the need for redressing of exposed surfaces. Exposed surfaces shall be kept free of mortar at all times.

c. Except for expansion joints and where otherwise specified, all joints and beds shall be completely filled, then raked out to depth specified, and every precaution shall be taken to prevent direct bearing contact between pieces.

d. Surfaces of the tiles shall correspond to the surface of the samples submitted and approved. Slabs disturbing the conformity of floor covering areas (difference in texture, pattern and color) shall be replaced at the contractor's expense.

e. Marble slabs for flooring and stairs shall be selected in such a way that the appearance of the complete finish will be as homogeneous as possible.

2. Backing

Backing shall be in accordance with drawings and as directed by the Engineer.

3. Cleaning and Protection

a. Cleaning

After being pointed, the Marble slabs shall be carefully cleaned, starting at the top, removing all dirt, excess mortar, stains and other defacements. Stainless steel wire brushes or wool may be used, but the use of other wire brushes or of acid or other solutions which may cause discoloration is expressly prohibited.

b. Protection of finished work

1. After the stonework is installed, it shall be the responsibility of the contractor to see that it is properly and adequately protected from damage. Boxing or other suitable protection shall be provided wherever required, but no lumber which may stain or deface the work shall be used. All nails used shall be galvanized or non-rusting.

2. All work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.

INTERLOCKING CONCRETE BLOCK SURFACING

A) Form of Construction

Concrete block surfacing shall consist of precast concrete blocks on a sand laying course laid on a 100 mm or 150 mm sub-base as shown on the drawings, laid on subgrade. In general blocks should conform to the requirements of the Specification for Precast Concrete Paving Blocks as per B.S.6717.

B) Subgrade

The subgrade shall be prepared in accordance with Roadway Excavation.

C) Base

The base shall be 100 mm or 150 mm thick and shall be laid in accordance with either Aggregate Road Base specification or that for subkha. The material used in any instance shall be as shown on the drawings.

Due allowance shall be made in the final levels of the base for the compaction of the laying course above, which occurs when the paving blocks are being vibrated. The amount of compaction of the laying course shall be determined by site trials prior to commencement of the actual surfacing.

D) Laying course

The laying course shall consist of washed sand with a particle size of 0-5 mm containing not more than 3% silt plus clay by weight. The sand shall be obtained from a single source, allowed to drain before use and shall be covered with suitable sheeting to minimize moisture changes.

Permissible chloride and sulphate contents shall as specified under Section 3 for aggregate.

The laying course shall be laid to a compacted depth of 50 mm. During laying the sand shall be uniform in moisture content and shall be carefully screeded to form a smooth compacted surface to receive the paving blocks.

The profile of the laying course before compaction shall be similar to that of the finished surface. The maximum deviation from the design levels shall be +/- 5 mm.

The edge restraints to the paved area shall be laid in advance of the laying course.

E) Surface Course

The surface course shall consist of precast concrete blocks, 80 mm thick, black color, for roads and 60 mm thick, red color, for sidewalks/footpaths of approved size, shape and pattern and manufactured on an approved machine, unless otherwise specified on the drawings or directed by the Engineer.

F) Admixtures

Block mix 'W' from Cormix additive shall be added at 1% by weight of cement while manufacturing the blocks.

Other admixtures will only be permitted to be used in the concrete with the express permission of the Engineer.

Admixtures used in the manufacture of the blocks shall be strictly controlled at all times to ensure that the correct quantity is administered. The equipment to be used for dispensing and the method of incorporating the admixture in the concrete shall be subject to the approval of the Engineer.

G) Cement, Water and Aggregates Generally

Cement, Water and Aggregates both coarse and fine, shall be as specified under section 3.

H) Concrete Mix

The concrete mix shall be designed to provide the required average compressive strength for the blocks to be not less than 49N/mm² plus the appropriate correction factor for the thickness and chamfer condition in a wet condition. No individual blocks shall have a strength of less than 40N/mm² plus the correction factor. These values shall be required at the date of testing. However generally they should be considered as 28 day strengths.

Adequate measures shall be taken to ensure that the concrete paving blocks are properly cured in a manner that is to the satisfaction of the Engineer.

I) Sampling Blocks

Two blocks shall be drawn from each group of 1000 blocks for sampling giving 10 blocks for every designated 5000 block section or part thereof in a consignment. All samples shall be clearly marked at the time of sampling in such a way that the designated section or part thereof and the consignment represented by the sample, are clearly defined.

These blocks shall be tested for dimensional accuracy, compressive strength and water absorption.

Should any of the 10 test blocks not comply with the tests detailed under "Test for dimensional accuracy" it shall be left to the discretion of the Engineer whether the whole consignment from which these blocks are selected shall be deemed not to comply with the Specification.

J) Compressive Strength

The average compressive strength of the block on delivery when sampled and tested in the manner described below shall not be less than 49 N/mm² in wet condition for 60 mm thick blocks. No individual block strength shall fall below 40 N/mm² in wet condition. Thickness and chamfer correction factor for compressive strength expressing the value to the nearest 1 N/mm² shall be as shown.

Block thickness	Correction factors	
	Plain block	chamfered
60 or 65 mm	1.00	1.06
80 mm	1.12	1.18

K) Test for Compressive Strength

The sample specimens shall be tested in a wet condition after being stored for at least 24 hours in water maintained at a temperature of $20^{\circ}C$ +/- $5^{\circ}C$. Before the specimens are sub-merged in water, the necessary area shall be determined as follows:-

(i) Where possible, the plan area or the wearing surface area shall be calculated by multiplying the length by the width.

ii) Alternatively the plan area or the wearing area shall be calculated by cutting out shapes of cardboard and weighing it to the nearest 0.05 g.

 $A_{S} = 20000 \, m_{S}$

m

Where $A_s = Area of block (mm²)$

 m_{s} = Mass of cardboard shape matching test block (g) the block shall be placed wearing surface uppermost on the cardboard.

m = Mass of 200 x 100 mm cardboard rectangle (g) cut from the same cardboard.

In case of chamfer or radius, the width of chamfer or radius shall be measured and marked on the cardboard shape. This shape shall then be cut out accurately and weighed for the above calculation of the wearing surface area.

Plywood, nominally 4 mm thick, shall be used as packing between the upper and lower faces of the specimen and the machine platens, and these boards shall be larger than the specimen by a margin of at least 5 mm at all points. Fresh packing shall be used for each specimen tested.

The load shall be applied without shock and increased continuously at a rate of approximately 15 N/mm² per minute until no greater load can be sustained. The maximum load applied to the specimen shall be recorded. The strength shall be expressed to the nearest 0.1 N/mm².

L) Test for Dimensional Accuracy

Standard rectangular blocks shall be manufactured with a nominal length of 200 mm and a nominal width of 100 mm.

Alternative sizes and shapes shall have a ratio of length to width on plan of not less than 1 1/2 or greater than 2 1/2 the width shall not be less than 80 mm or greater than 115 mm. The minimum normal thickness for paving blocks of any size shall be 60 mm. The preferred nominal thickness shall be 60, 80 and 100mm.

All arrises shall be clean, plane and of uniform dimension. Wearing surface area shall be not less than 70% of the plan area.

Tolerances: Length +/- 2 mm; Width +/- 2 mm; Thickness +/- 2 mm.

M) Water Absorption

Concrete paving blocks shall be tested as the Engineer may direct for water absorption. This test shall be based upon that specified in BS 1881 and the maximum acceptable limits for water absorption shall be:

2% absorbed after 10 mins 5% absorbed after 24 hours

The Engineer may also require tests for Drying Shrinkage and Moisture Movement for which purpose a specimen cut from a typical concrete paving block would be used and the methods of testing would be based upon those specified in BS7263 : Part 1 (Appendix B) and BS 1881 but agreed with Engineer.

Based upon the results of tests specified above, the Engineer may vary the acceptable limits for water absorption to achieve the minimum absorption with the aggregate approved for use in the paving blocks.

N) Color

The colors of the concrete paving blocks shall be as indicated under surface course unless otherwise shown on drawings or instructed by the Engineer and shall be maintained at a uniformity that is acceptable to the Engineer. Pigments shall comply with BS1014.

O) Laying the Blocks

Laying of the paving blocks shall commence at right angles to the main pavement axis starting at one end of the area. The paving blocks shall be laid in a herringbone pattern unless otherwise shown on the drawings or instructed by the Engineer at 45[°] to the main pavement axis.

The paving blocks shall be laid on the sand laying course in such a manner as not to disturb the blocks already laid. Each block shall be placed firmly against its neighbor so that they fit closely together. The joints between blocks shall not exceed 3 mm.

P) Edge Details

Where blocks do not fit at the edge restraints or other obstructions such as manholes

or

Up stands the gaps shall be filled using cut blocks. Blocks shall preferably be cut using a mechanical block splitter but may be cut by hand using a club hammer and bolster chisel after having scored the cutting line on all faces of the block.

Dimensional accuracy, uniformity of joints gaps, alignment and squareness shall be checked after laying the first three rows of blocks and thereafter at regular intervals. If joints begin to open, the blocks shall be knocked together using a hide mallet.

Q) Compaction by Vibration

After each 20 sq.m., or such area that has been agreed with the Engineer, has been laid the blocks shall be compacted to the required levels using a plate vibrator. The plate vibrator shall have a plate area of 0.2 to 0.3 sq.m and have a compaction

force of 9-16 KN. Two passes of the plate vibrator shall be made in each direction, i.e. at 90° to each other.

R) Filling Joints

Fine dry sand with a particle size of 0-3 mm and which complies with Section 3 of the specifications shall be brushed over the paving, filling the joints. Filling of joints shall be ensured by plate vibrator passes made in each direction.

The plate vibrator shall not pass closer than 1 meter to a temporary unrestrained edge during laying.

No paving shall be left uncompact overnight except for the 1 m strip at the temporarily unrestrained edge.

S) Laying Tolerance

On completion, the finished surface level shall be within 5 mm of the design level and the maximum deviation within the compacted surface, measured by a 3 m straight edge, shall not exceed 5 mm. The level of any two adjacent blocks shall not differ by more than 2 mm. Any areas of paving which do not comply with these tolerances shall be removed, the sand laying course adjusted and the paving blocks re-laid to the correct levels.

SUSPENDED CEILINGS

PART I - GENERAL

SCOPE

These specifications cover suspended ceiling systems intended for use in the Project in accordance with the Drawings, Bills of Quantities and manufacturer's specifications.

MATERIALS

A) Acoustical False Ceiling

Acoustical Mineral Fiber tiles 600 x 600mm shall be non- combustible conforming with the requirements of the Americal Federal Specifications SS - A 118b and shall be as described in the current Acoustical Materials Association Bulletin. Sound-Absorption Coefficients of Architectural Acoustical Materials.

Acoustical ceiling tiles or panels shall be as manufactured by "ARMSTRONG CORK COMPANY Ltd" or "Johns - Manville" and/or approved equivalent.

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

Samples of acoustical ceiling tiles or panels in suspension system members, with catalog data, shall be submitted to the Engineer for approval at least two weeks prior to order.

B) Glass Reinforced Gypsum Tile (Concealed) Suspended Ceiling

Glass reinforced gypsum decorative tile suspended ceiling shall be 600 x 600 x 20 mm thick fully accessible and demountable decorative tiles in a concealed metal suspension system as indicated on drawings.

The tile pattern and colour shall be to the approval of the Engineer.

Gypsum false ceiling shall be composed of moulded decorative panels 600 x 600 x 20 mm thick made of fibrous plaster suitably reinforced with standard backings. The contractor shall produce workshop drawings for the approval of the Engineer before ordering the material. Necessary openings shall be provided for lighting fixtures and A/C grills in coordination with the respective services and the gaps sealed to the satisfaction of the Engineer. The false ceiling shall be finished as recommended by the manufacturer and/or as directed by the Engineer.

Suspended ceilings shall be fixed strictly in accordance with the manufacturer's written instructions using fixing accessories supplied by the chosen manufacturer.

C) Decorative Gypsum Board Suspended Ceiling

Gypsum board suspended ceiling system shall be installed as detailed on the drawings to the approval of the Engineer.

Gypsum board suspended ceiling system shall be manufactured and installed as detailed on the drawings by an approved sub-Contractor who has successfully engaged himself in similar works for at least 7 years.

Plaster board ceiling shall comprise of 13 mm thick layer of approved proprietary plaster boards screw fastened to approve support framing at 600 mm centers both ways. Joints shall be sealed with vinyl based cement and perforated paper type and all caulkings shall be with vermiculite plaster (1½ parts exfoliated vermiculite to 1 part plaster). The suspension system shall be designed to suit the layout, spans, and the design loads and all substantiating design calculations and details shall be submitted to the Engineer for his approval. Approval accorded by the Engineer shall not relieve the Contractor of his obligations to provide a safe and aesthetic ceiling.

Plaster boards shall be manufactured with gypsum plaster complying to BS 1191, Class A Plaster of Paris using necessary reinforcements fibers, hardeners and additives.

The suspended ceiling shall be provided with mouldings at all edges, corners, etc., to achieve the desired effect as detailed on the drawings and to the approval of the Engineer.

Fibrous gypsum suspended ceiling mouldings cornices, etc. shall be formed using the approved design mix with all constituent materials being gauged, batched or weighed accurately. Moulds shall be dimensionally and geometrically accurate and release agents/waxes that will allow a clean release of the casting without adversely affecting the component surfaces shall be used. The moulding and castings shall include all necessary fixing holes, brackets, etc. Mouldings and coatings shall be individually inspected for any surface blemishes shall be rectified in an approved manner.

The components shall be true in shape and free from cup and bow. The dimensional accuracy shall be + or -2 mm per m and the horizontal plane deviation shall not exceed 0.3% of the component length. The squareness of rectangular components shall be such that the difference between the diagonals shall not exceed 0.5% of the shorter diagonal.

The formed components shall be asbestos free, antistatic and shall have a density not exceeding 1500 kg/m3, be unaffected by ultra violet light and not support fungoid attack. Their thermal conductivity (k) value shall not be greater than 0.375 W/m2/deg C and shall have a thermal coefficient of expansion not exceeding 14.94 x 10-6 mm/deg. C. They shall not absorb moisture present in internal locations through excessive humidity.

Components shall have an ultimate tensile strength of not less than 8.27 N/mm2, an impact strength 16812-17232N/mm2 and a Rockwell hardness classification of M 72. Components shall be classed non-combustible when tested to BS 476 Part 4: 1970 (1984).

Component thickness shall be as recommended by the manufacturer or as directed by the Engineer.

The contractor shall form necessary opening for various services including any access panels as required and finish them appropriately to the satisfaction of the Engineer.

The Contractor shall prepare detailed shop drawings after verifying the dimensions at site, of the components and fixings and submit them for the approval of the Engineer prior to casting.

The shop drawings shall also detail the various suspension materials and the methods of fixing the casting along with his proposed method of erecting each compact. The Contractor shall prepare for the Engineers approval samples of the various mouldings cornices and decoration works.

The Contractor shall protect all Gypsum works from damage until the completion of the Works. Should any damages be caused it shall be made good to the satisfaction of the Engineer at the Contractors expense. All inlaid materials, mirrors, air conditioning grilles and the like shall be cleaned and left in perfect condition.

D) Aluminum Ceiling System

The suspended ceiling system shall consist of Aluminum panel with acoustic infill suspended by proprietary Suspension system with rigid galvanized, suspenders, U channels, cross channels, connecting clips, anchors, matching edge trims, etc.. Fixed and spaced strictly in accordance with the Manufacturer's instructions as detailed on drawings and/or as directed by the Engineer.

The surface treatment shall be polyester powder coating by electro static spraying to not less than 60 microns as per BS 6496:1984 (1991) to a color as shown on the Drawing and/or as directed by the Engineer.

E) <u>Aluminum Strip Ceilings</u>

Aluminum ceiling panels shall be similar to " Luxalon Aluminum Panel Ceiling, the product of "Hunter Duglas" or Mirawal - Dampa Aluminum Acoustical Ceiling Systems, the product of "Mirawal Company" and/or approved equivalent.

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

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

F) Metallic Grid. Hangers and Fixing Accessories

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

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

WORKMANSHIP

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

False ceiling materials shall be installed under temperature and humidity conditions similar to those which will exist when the building is occupied. They should not be installed when buildings are damp and cold or dry and hot. Plastering, floor and wall cladding shall be completed and allowed to dry before the installation of acoustical materials commences. All windows and doors shall be in place and glazed. Poured or precast concrete or similar roof decks shall be thoroughly dry.

Buildings shall be examined before beginning work to determine that it is properly enclosed and the structure is in proper conditions to receive acoustical materials and/or suspended system. Areas shall be broom cleaned and uninterrupted for free movement of rolling scaffold.

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

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

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

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

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

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

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

SUMMARY

A. Section Includes:

- 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
- 2. Suspension systems for interior gypsum ceilings and soffits.

PART 2 - PRODUCTS

PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested according to ASTM E 119.
- B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413.
- C. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of pre-consumer recycled content is not less than [25] percent.

FRAMING SYSTEMS

- A. Steel Studs and Runners: ASTM C 645. [Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.]
 - 1. Minimum Base-Metal Thickness: [As indicated on Drawings]
 - 2. Depth: [As indicated on Drawings].
- B. Slip-Type Head Joints: Where indicated, provide[one of] the following in thick-ness not less than indicated for studs and in width to accommodate depth of studs:
 - 1.Single Long-Leg Runner System: ASTM C 645 top runner with (51-mm) deep flanges, installed with studs friction fit into top runner and with continuous bridging located within (305 mm) of the top of studs to provide lateral bracing.
 - 2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch (51-mm) deep flanges and fastened to studs, and outer runner sized to friction fit inside runner.
 - 3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above.
 - a. Products: Subject to compliance with requirements, [available products that may be incorporated into the Work].
- C. Fire stop Tracks: Manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 1. Products: Subject to compliance with requirements, [available products that may be incorporated into the Work].
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: [As indicated on Drawings].

- E. Cold-Rolled Channel Bridging: Steel, (1.34-mm) minimum base-metal thick-ness, with minimum (13-mm-) wide flanges.
 - 1. Depth: [As indicated on Drawings].
 - 2. Clip Angle: Not less than (38 by 38 mm), (1.72-mm-) thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: [As indicated on Drawings].
 - 2. Depth: [As indicated on Drawings].

- G. Resilient Furring Channels: (13-mm) deep, steel sheet members designed to reduce sound transmission.
 - 1. Configuration: [hat shaped].
- H. Cold-Rolled Furring Channels: (1.34-mm) uncoated-steel thickness, with mini-mum (13-mm) wide flanges.
 - 1. Depth: [As indicated on Drawings].
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoatedsteel thickness of (0.8 mm).
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, (1.59-mm) diameter wire, or double strand of (1.21-mm) diameter wire.
- I. Z-Shaped Furring: With slotted or no slotted web, face flange of [(31.8 mm)], wall attachment flange of (22 mm), minimum uncoated-metal thickness of (0.45 mm), and depth required to fit insulation thickness indicated.

SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Anchors: Capable of sustaining load equal to [5] times that imposed as determined by ASTM E 488.
 - a. Type: [Post installed, expansion anchor].
 - 2. Powder-Actuated Fasteners: Capable of sustaining, a load equal to [10] times that imposed as determined by ASTM E 1190.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Flat Hangers: Steel sheet, [in size indicated on Drawings].
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of (1.34 mm) and minimum (13-mm) wide flanges.
 - 1. Depth: [As indicated on Drawings].
- F. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: (1.34-mm) uncoated-steel thickness, with minimum (13-mm) wide flanges, (19 mm) deep.
 - Steel Studs and Runners: ASTM C 645. [Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.]

 a. Minimum Base-Metal Thickness: [As indicated on Drawings]
 b. Depth: [As indicated on Drawings].
 - Hat-Shaped, Rigid Furring Channels: ASTM C 645, (22 mm) deep.
 a. Minimum Base-Metal Thickness: [As indicated on Drawings].
 - 4. Resilient Furring Channels: (13-mm) deep members designed to reduce sound transmission. a. Configuration: [hat shaped].

AUXILIARY MATERIALS

- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide [foam gasket].

PART 3 – EXECUTION

INSTALLATION, GENERAL

- A. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- B. Install bracing at terminations in assemblies.
- C. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacing's indicated, but not greater than spacing's required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to under-side of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Fire stop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs (150 mm) o.c.
- E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced (610 mm) o.c.

- F. Z-Furring Members:
 - 1. Erect insulation vertically and hold in place with Z-furring members' spaced [600 mm] o.c.
 - Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced (610 mm) o.c.
 - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than (305 mm) from corner and cut insulation to fit.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than (3 mm) from the plane formed by faces of adjacent framing.

INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacing indicated, but not greater than spacing required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counters playing, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacing that interfere with locations of hangers, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - 3. Do not attach hangers to steel roof deck.
 - 4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems [with hangers used for support].
- F. Installation Tolerances: Install suspension systems that are level to within [(3 mm in 3.6 m)] measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

GYPSUM BOARD

PART I - GENERAL

SUMMARY

A. Section Includes:

- 1. Interior gypsum board.
- 2. Tile backing panels.
- 3. Texture finishes.

ACTION SUBMITTALS

A. Samples:

1. Textured Finishes: [Manufacturer's standard size] for each textured finish indicated and on same backing indicated for Work.

PART 2 - PRODUCTS

PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Low Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

GYPSUM BOARD, GENERAL

- A. Regional Materials: Gypsum panel products shall be manufactured within (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within (800 km) of Project site.
- B. Regional Materials: Gypsum panel products shall be manufactured within (800 km) of Project site.

INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M
 - 1. Thickness: (12.7 mm)
 - 2. Long Edges: [Tapered]
- C. Gypsum Ceiling Board: ASTM C 1396/C 1396M:
 - 1. Thickness: (12.7 mm)
 - 2. Long Edges: [Tapered]
- D. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M.
 - 1. Core: [As indicated on Drawings] [(12.7 mm), regular type].
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D 3273, score of 10.
- E. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: [As indicated] [(12.7 mm), regular type] [(15.9 mm), Type X].
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D 3273, score of 10.

EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Exterior Gypsum Soffit Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
 - 1. Manufacturers: Subject to compliance with requirements.
 - 2. Core: [As indicated] [(12.7 mm), regular type].
 - a. Waterproofing
 - b. Moisture and mold resistance
 - c. Fire resistance
 - d. Impact resistance

INTERIOR STONEWORK

PART 1 - GENERAL

SUMMARY

- A. Extent of interior stonework is indicated on Drawings and in schedules.
- B. Interior stonework includes the following:
 - 1. Marble tile flooring including stair treads and risers.
 - 2. Marble bases and thresholds.
 - 3. Marble cladding facing to walls and columns.
 - 4. Marble partitions at WC cubicles and urinals.
- C. Stonework incorporated into joinery and architectural woodwork is specified in Joinery Section.
- D. Sealing joints in interior stonework is specified in Joint Sealers section.

QUALITY ASSURANCE

- A. Single Source Responsibility for Stone: Obtain each color, grade, finish, type and variety of stone from a single source with adequate resources to provide materials of consistent quality in appearance and physical properties, including the capacity to cut and finish material without delaying the progress of the Work.
- B. Single Source Responsibility for Setting Materials: Obtain mortar ingredients of uniform quality and from one manufacturer for each cementations and admixture component and from one source or producer for each aggregate.
- C. Standards: Unless otherwise approved by the Engineer, comply with recommendation of:
 - 1. Marble Institute of America (MIA), or the Stone Federation of the UK.
- D. Field-Constructed Mock-Up: Prepare mock-ups for the following types of interior stonework. Purpose of mock-ups is further verification of selections made for color and finish under sample submittals and establishing standard of quality for aesthetic effects expected in completed work. Build mock-ups to comply with following requirements:
 - 1. Locate mock-ups on site where indicated or, if not indicated, as directed by Engineer.
 - 2. Build mock-ups for the following types of interior stonework:
 - a. Marble flooring including base in form of panel as indicated on drawings.
 - b. Marble wall cladding in form of panel as indicated on drawings, incorporating one vertical external corner.
 - 3. Erect mock-ups in presence of Engineer.
 - 4. Retain mock-ups during construction as a standard for judging completed stonework. Do not alter, move or destroy mock-up until work is completed.

PART 2 - PRODUCTS

MATERIALS, GENERAL

- A. Comply with referenced standards and other requirements indicated applicable to each type of material required.
- B. Provide premier quality matched stones obtained from an approved a single quarry for each type, variety, color and quality of stone required. Extract blocks from a single bed of quarry stratum, unless stones from randomly selected blocks are acceptable to Engineer for aesthetic effect.
- C. Provide stones, which are free from vents, cracks, fissures, discoloration or other surface defects, which may adversely affect strength or appearance.

INTERIOR MARBLE

- A. Match Engineer's approved sample for each marble type, including variety, group, color, surface finish, and other characteristics relating to aesthetic effects.
 - 1. Marble: white Italian Carrara first choice; polished finish
 - a. Tile flooring, and staircase treads and risers.
 - b. Bases, thresholds, etc.
 - c. Fronts and partitions at WC cubicles and urinals.
 - 2. Marble: Greek Thassous, Crystal; polished finish a. Cladding and facing to wall and columns, including copings, returns, reveals, etc.

MORTAR AND GROUT MATERIALS

- A. Portland cement: ASTM C 150 Type I; or BS.12. Provide gray or white cement as needed to produce mortar color required.
- B. Hydrated Lime: ASTM C 207 Type S; or BS. 890
- C. Aggregate: ASTM C 144; or BS. 1198/1200; non-staining and as indicated below:
 - 1. For joints narrower than 6 mm use aggregate graded with 100 percent passing the No. 8 sieve and 95 percent the No. 16 sieve.
 - 2. For pointing mortar use aggregate graded with 100 percent passing the No. 16 sieve.
 - 3. White Aggregates: Natural white sand or ground white stone.
- D. Colored Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with record of satisfactory performance in stone mortars.
- E. Latex-Portland Cement Grout: ANSI A118.6, of the following composition and requirements:
 - 1. Latex additive (water emulsion) serving as a replacement for part or all of gauging water, added at job site to prepackaged dry grout mix.
 - 2. Manufacturers standard. Prepackaged latex Portland cement dry mix grout specified or supplied by latex manufacturer.
 - 3. Provide grout colors approved by the Engineer to match color of stone.
- F. Water: Clean, non-alkaline and potable.

STONE ACCESSORIES

- A. Stone Anchors: Stainless steel, type and size shown or, if not shown, as required and approved by the Engineer for securely anchoring and fastening interior stonework in place.
- B. Setting Buttons: Lead or resilient plastic buttons, non- staining to stone, sized to suit joint thicknesses and bed depths of stonework involved.
- C. Metal Edge Strips: Stainless steel strips, 3 mm wide at top edge, with integral provision for anchorage to mortar bed or substrate, unless otherwise indicated.
- D. Cleaner: Provide stone cleaners of proper formulation for kinds of stones, finishes and applications indicated, as recommended by stone producer and, if sealer specified, by sealer manufacturer. Do not use acid-type cleaning agents or other cleaning compounds containing caustic or harsh fillers, except where expressly approved by stone producer for type of condition involved.
- E. Sealer for Floors: Colorless, slip and stain resistant sealer which will not affect color or physical properties of stone surface, as recommended by sealer manufacturer and by stone producer for application intended.

MORTAR AND GROUT MIXES

- A. General: Do not add admixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds, or calcium chloride, unless otherwise indicated.
- B. Mixing: Combine and thoroughly mix cementations materials, water and aggregates in a mechanical batch mixer; comply with ASTM, ANSI, BS or other acceptable standard, as applicable, for mixing time and water content.
- C. Spotting Plaster: Stiff mix of molding plaster and water.
- D. Setting Mortars and Grout for Flooring: Comply with mixing requirements of referenced ANSI or other acceptable standards for materials and installation methods.
- E. Pointing Mortar: Provide pointing mortar mixed to match Engineer's approved sample and complying with requirements indicated above for setting mortar including type and the following:
 - 1. Colored Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1-to-10, by weight.

PART 3 - EXECUTION

EXAMINATION

A. Examine surfaces to receive stonework and conditions under which stonework will be installed. Do not proceed with installation until surfaces and conditions comply with requirements indicated or for execution of other work which affects stonework.

PREPARATION

- A. Advise installers of other work about specific requirements relating to placement of inserts, regrets and similar items which will be used by Stonework Installer for anchoring and supporting stonework. Furnish Installers of other work with drawings or templates showing locations of these items.
- B. Prior to setting, clean stone surfaces to remove soil, stains and foreign materials. Clean stones by thoroughly scrubbing stones with fiber brushes followed by a thorough drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh filler or abrasives.

SETTING STONE, GENERAL

- A. Execute stonework by skilled tradesmen, and employ skilled stone fitters at the site to perform any necessary field cutting, as stones are set.
 - 1. Use power saws to cut stones; produce exposed edges, which are cut straight and true.
- B. Set stones to comply with requirements indicated on drawings and final shop drawings. Install anchors, supports, fasteners and other attachments indicated or necessary to secure stonework in place. Shim and adjust anchors, supports and accessories to set stones accurately in locations indicated with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.
- C. Construction Tolerances: Set stones to comply with the following tolerances:
 - 1. Variation from Plumb: For lines and surfaces of columns, walls and arises. Do not exceed 6mm in 3m, 10mm in a story height or 6m maximum, nor 15mm in 12m or more. For external corners, expansion joints and other conspicuous lines, do not exceed 6mm in any story or 6m maximum, nor 15mm in 12m or more.
 - 2. Variation from Level: For grades indicated, horizontal grooves and other conspicuous lines, do not exceed 15mm in any bay or 6mm maximum, nor 20mm in 12m or more.
 - Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 15mm in any bay or 500mm maximum, nor 20mm in 12m or more.
 - 4. Variation in Surface Plane of flooring: Do not exceed 3mm from level or slope indicated, when tested with 3m straight edge.
 - 5. Variation in Cross-Sectional Dimensions: For columns and thickness of walls from dimensions indicated, do not exceed minus 6mm nor plus 15mm.
- D. Expansion and Control Joints: Provide for expansion and control joints of widths and at locations indicated, or as required.
 - 1. Sealant for expansion and other joints is specified Joint Sealers section.

INSTALLATION OF STONE FLOORING

- A. Extend flooring into recesses and under or behind equipment and fixtures, to form a complete covering without interruptions, except as otherwise shown. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignments.
- B. Accurately form intersections and returns. Perform cutting and drilling of stones without marring visible surfaces. Carefully grind cut edges of stones abutting trim, finish or built-in items for straight aligned joints. Fit stones closely to electrical outlets, piping, fixtures and other penetrations so that plates, collars, or covers overlap stones.
- C. Metal Edge Strips: Install at locations indicated or where exposed edge of stone flooring meets carpet, wood, or other flooring which finishes flush with top of stones.
- D. Jointing Pattern for Tile: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are same size. Layout tile work and center tile fields in both directions in each space or on each wall area.
- E. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise shown.
- F. Match tiles for color and other appearance characteristics by using tiles in same sequence as manufactured and packaged.
- G. Stone Flooring Set in Portland Cement Mortar Bed:
 - 1. Saturate concrete subfloor with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
 - Apply slurry of cement grout over surface of concrete subfloor about 15 minutes prior to placing setting bed. Limit area to avoid its drying out prior to placing setting bed. Mix slurry to a consistency similar to that of thick cream and consisting of either neat cement and water, or cement, sand and water. Do not exceed 1.5mm thickness for slurry coat.
 - 3. Mix setting bed in proportions of 1:2:6 cement/lime/sand to quantity of water to produce a stiff mixture with a moist surface when setting bed is ready to receive stone flooring.
 - 4. Spread and screed setting bed to uniform thickness indicated to produce subgrade elevations required for accurate shown. Mix and place only the amount, which can be covered with stone prior to initial set. Cut back, bevel edge, remove and discard setting bed material, which has reached initial set prior to placing stone.
 - 5. Butter backs of stone flooring units until firmly bedded to proper finished floor elevation indicated. Set and level each stone unit in single operation, prior to initial set of cement bed; do not return to areas already set and disturb stone for leveling purposes.
- H. Grouting Stone Flooring:
 - 1. Mix grout consisting if factory prepared color pigmented grout and liquid latex admixture in proportions recommended by manufacturer.
 - Grout joints in stone flooring units, except at expansion and control joints indicated as required to be filled with sealant. Finish grout flush with finished surface of stone. Fill all gaps and skips to produce a finished joint which is uniform in color, smooth and without voids, pinholes, or low spots.
 - 3. Remove grout spillage from face of stone as work progresses.
 - 4. Cure grout by maintaining in a moist condition for 7 days.
 - 5. Do not permit traffic on stone flooring during setting of units for at least 24 hours after final grouting of joints.

INSTALLATION OF INTERIOR WALL FACING AND TRIM; AND PARTITIONS

- A. Erect interior wall facing and trim plumb and true with joints uniform in width and accurately aligned. Provide setting buttons as required to maintain joint width.
- B. Erect interior WC cubicle fronts/ partition and urinal partitions plumb, true and accurately aligned as indicated.
 - 1. Provide all necessary metal supports, brackets, anchors, fixings, fasteners and the like; chromium plated or stainless steel exposed finish.
- C. Point joints after setting with pointing mortar of color indicated, mixed in proportions of 1-part Portland cement, 1-part time and 3-parts sand, unless otherwise indicated. Rub joints smooth with plastic tool.

ADJUSTINGS, CLEANING, AND SEALING

- A. Remove and replace stonework of the following description.
 - 1. Broken, chipped, stained or otherwise damaged stones.
 - 2. Defective joints.
 - 3. Stones and joints not matching approved samples and field constructed mock-ups.
 - 4. Stonework not complying with other requirements indicated.
- B. Replace in manner which results in stonework matching approved samples and field-constructed mock-ups, complying with other requirements and showing no evidence of replacement.
- C. Clean interior stonework after setting, pointing, grouting and curing is complete; use procedures recommended by stone producer for types of application indicated.
- D. Apply stone sealer to cleaned interior stone flooring in compliance with sealer manufacturer's instructions.
- E. Protect interior stone flooring during construction period with Kraft paper or other heavy covering of type that will not stain or discolor stone.
- F. Before inspection for substantial completion, remove protective covering and clean sealed surfaces using procedures and materials recommended by sealer manufacturer.

PAINTING

PART 1- GENERAL

SUMMARY

- A. Extent of painting work is indicated and Drawings, schedules and herein, and includes surface preparation, painting, and finishing of exposed interior and exterior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.
- B. Paint exposed surfaces whether or not colors are designated in "schedules," except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Engineer will select from standard manufacturer's colors or finishes available.
 - 1. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- C. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.
 - 1. Prefinished items not to be painted include all factory-finished components such as:
 - a. Prefinished metal fabrications.
 - b. Acoustic ceilings.
 - c. Joinery and architectural woodwork.
 - d. Elevator equipment.
 - e. Finished mechanical and electrical equipment.
 - f. Light fixtures.
 - g. Switchgear.
 - h. Distribution cabinets.
 - 2. Finished metal surfaces not to be painted include:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - 3. Operating parts not to be painted include moving parts of operating equipment such as the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 - 4. Labels: Do not paint over regulation or code-required labels or equipment name, identification, performance rating, or nomenclature plates.

DEFINITIONS

A. "Paint" includes coating systems materials; primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.

QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.
- B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

PART 2 - PRODUCTS

MATERIALS, GENERAL

- A. Material Quality: Provide only best quality grades for the various types of coatings and paint systems required, as regularly manufactured and recommended by acceptable paint manufacturers. Paint material containers not displaying manufacturer's names and product identification will not be acceptable.
 - 1. Proprietary names used to designate colors or materials are not intended to imply that products of named manufacturers are required or to exclude equivalent products of other manufacturers.
- B. Color Pigments: Pure, non-fading, applicable types to suit substrates and services indicated.
 - 1. Lead contents in pigment, if any, is limited to contain no more than 0.06% lead, as lead metal based on the total non-volatile (dry-film) of paint be weight.

FIELD QUALITY CONTROL

- A. The Engineer reserves the right to request the following test procedure at any time and as often as the Engineer deems necessary during the period when paint is being applied:
 - 1. The Contractor shall engage the services of an independent testing laboratory approved by the Engineer to sample the paint material being used. Samples of material delivered to the project will be taken, identified, sealed, and certified in the presence of the Contractor.
 - 2. The testing laboratory will perform appropriate tests for all or any of the following characteristics as required by the Engineer:
 - a. Quantitative materials analysis.
 - b. Abrasion resistance.
 - c. Apparent reflectivity.
 - d. Flexibility.
 - e. Wash ability.
 - f. Absorption.
 - g. Accelerated weathering.
 - h. Dry opacity.
 - i. Accelerated yellowness.
 - j. Recoating.
 - k. Skinning.
 - I. Color retention.
 - m. Alkali and mildew resistance.
 - 3. If test results show material being used does not comply with specified requirements, the Contractor may be directed to stop painting, remove noncomplying paint from the site and repaint surfaces coated with rejected paint, and remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are no compatible.

PART 3 - EXECUTION

EXAMINATION

A. Examine substrates, areas, and conditions under which painting will be performed for compliance with paint application requirements. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean/prepare surfaces according to manufacturer's written instructions for each particular substrate condition to be painted.
- D. Materials Preparation: Mix/prepare paint materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 - 1. Surface treatments and paint finishes are indicated in the schedules.
 - 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 3. Provide finish coats that are compatible with primers used.
 - 4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 5. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 - 6. Sand lightly between each succeeding enamel and varnish coat.

- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - 1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions sand between applications.
 - 2. Omit primer on metal surfaces that have been shop primed and touchup painted.
 - 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, or other applicators according to manufacturer's written instructions.
 - 1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
- D. Minimum Coating Thickness: Apply paint no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.
- F. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- G. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Engineer.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 - 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

PART 4 - PAINT SCHEDULES

EXTERIOR PAINT SCHEDULE

- A. General: Provide the following paint systems for the various substrates indicated.
- B. Ferrous Metal: Primer is not required on shop-primed items.
 - Full-Gloss Alkyd Enamel: 2 finish coats over primer.
 a. Primer: Synthetic Rust-Inhibiting Primer.
 b. First and Second Coats: Alkyd Gloss Enamel.

 - 2. Lusterless Alkyd Enamel: 2 finish coats over primer. a. Primer: Synthetic Rust-Inhibiting Primer.
 - b. First and Second Coats: Lusterless Alkyd Enamel.
- C. Zinc-Coated Metal:
 - 1. Full-Gloss Alkyd Enamel: 2 finish coats over primer.
 - a. Primer: Galvanized Metal Primer.
 - b. First and Second Coats: Alkyd Gloss Enamel.

INTERIOR PAINT SCHEDULE

- A. General: Provide the following paint systems for the various substrates, as indicated.
- B. Concrete and Plasters.
 - 1. Lusterless (Flat) Emulsion Finish: 3 coats.
 - a. Primer: Latex-Based Interior Flat Paint.
 - b. Under Coat: Latex-Based Interior Flat Paint.
 - c. Finish Coat: Latex-Based Interior Flat Paint.
 - 2. Odorless Lusterless (Flat) Latex Finish: 3 coats.
 - a. Primer: Latex-Based Interior Flat Paint.
 - b. First Coat: Latex-Based Interior Flat Paint.
 - c. Second Coat: Interior Flat Odorless Alkyd Paint.

3. Semi-gloss Enamel Finish: 3 coats with total dry film thickness not less than: 0.09 mm, on concrete, 0.06mm on plaster.

- a. Primer: Latex-Based Interior Flat Paint.
- b. Undercoat: Interior Enamel Undercoat.
- c. Finish Coat: Interior Semi-gloss Odorless Alkyd Enamel.

4. Plastic Coating Finish: Multiple coating system including preparation sealer, primer and undercoats; applied in strict accordance with manufacturer recommendations and instructions for substrate and purpose of use.

- a. Purpose: Provision of a heavy duty washable, monolithic and anti-bacterial surface finish to cement plastered walls and ceilings in hospital rooms and areas requiring a high degree of cleanliness and hygiene.
- b. Available Products: subject to compliance with requirements, products which may be incorporated, in the work include, but are not limited to:

- C. Concrete Masonry Units:
 - 1. Lusterless (Flat) Emulsion Finish: 2 finish coats over filled surface.
 - a. Latex Block Filler.
 - b. First and Second Coats: Latex-Based Interior Flat Paint.

2. Semi-gloss Alkyd Enamel Finish: 2 coats over filled surface with total dry film thickness not less than 0.09 mm, excluding filler coat.

- a. Latex Block Filler.
- b. Undercoat: Interior Enamel Undercoat.
- c. Finish Coat: Interior Semi-gloss Odorless Alkyd Enamel.
- D. Painted Wood and Hardboard:

1. Semi-gloss Enamel Finish: 3 coats.

- a. Undercoat: Interior Enamel Undercoat.
- b. First and Second Coats: Interior Semi-gloss Odorless Alkyd Enamel.
- 2. Full-Gloss Enamel Finish: 3 coats.
 - a. Undercoat: Interior Enamel Undercoat.
 - b. First and Second Coats: Alkyd Gloss Enamel.
- E. Ferrous Metal:

1. Lusterless (Flat) Finish: 3 finish coats over primer with total dry film thickness not less than 0.06 mm.

- a. Primer: Synthetic Rust-Inhibiting Primer.
- b. First and Second Coats: Latex-Based Interior Flat Paint.

2. Semi-gloss Enamel Finish: 2 coats over primer with total dry film thickness not less than 0.06 mm.

- a. Primer: Synthetic Rust-Inhibiting Primer.
- b. Undercoat: Interior Enamel Undercoat.
- c. Finish Coat: Interior Semi-gloss Odorless Alkyd Enamel.
- F. Zinc-Coated Metal:

1. Lusterless (Flat) Finish: 2 finish coats over primer with total dry film thickness not less than 0.06 mm.

- a. Primer: Galvanized Metal Primer.
- b. First and Second Coats: Latex-Based Interior Flat Paint.
- 2. Semi-gloss Finish: 2 coats over primer, with total dry film thickness not less than 0.06 mm.
 - a. Primer: Galvanized Metal Primer.
 - b. Undercoat: Interior Enamel Undercoat.
 - c. Finish Coat: Interior Semi-gloss Odorless Alkyd Enamel.

3. Full-Gloss Enamel Finish: 2 Coats over primer with total dry film thickness not less than 0.06mm.

- a. Primer: Galvanized Metal Primer.
- b. Undercoat: Interior Enamel Undercoat.
- c. Finish Coat: Alkyd Gloss Enamel.
Anticorrosion Epoxy Coating

1. <u>SCOPE :</u>

This standard prescribes the technical requirements and methods of testing for two pack Epoxy Paint system intended to be used at areas where improved corrosion resistance is needed under severe corrosive condition. The material shall be suitable for application on interior of coaches like lavatory area, turn under etc. The material may be used on surfaces having surface finish equivalent to Sa 2.5 preferably or St3 of ISO Specification No.:8501-1-88. It should be suitable for application by air / air-less spray with 10% (max.) thinner / without using thinner depending upon prevailing condition, and shall also be suitable for brush application, for touching-up small areas. The material should be compatible with aliphatic type polyurethane finish coat.

2. <u>TERMINOLOGY</u>:

2.1 For the purpose of this standard apart from the glossary of terms given in

IS: 1303-83 and terminology as per clause 2 of IS : 9162-79 and IS:9954-81 , the following shall also apply. Rounding off, of observed values on different tests shall be in accordance with IS: 2-1960.

2.1.1 **Pack :** The term used to describe each of the two packs of the paint which when mixed Together, form High Performance Epoxy Paint.

2.1.2 **Paint :** The mixture of the two packs in the proportion recommended by The manufacturer.

3. <u>REQUIREMENTS:</u>

3.1 The mixing ratio of the Pack A and Pack B shall be in a simple ratio by volume 1:1 .or as recommended by manufacturer.

3.2 <u>Composition :</u> The paint shall consist essentially of two packs namely Pack A and Pack B

3.2.1 Pack A: Normally referred to as Base, shall consist of epoxy resin with or without diluents.

In the formulation of paint, epoxy resin of the following grade shall be used.

Table - I Requirements for epoxy resin

S.No	Characteristics	Requirements	Method of test
1.	Weight per epoxy equivalent on	250-450	Cl.4 of IS:9162-79
	non-volatile vehicle content basis		

3.2.2 <u>**Pack B:**</u> Normally referred to as Hardener shall consist of any liquid hardener.

3.2.3 <u>Liquid Hardener</u>: This shall be liquid type such as an aliphatic amine, an aliphatic or aromatic amine adduct, a polyamide or amido polyamine or any other suitable hardener. It shall react with epoxy resin at normal ambient temperature.

4. <u>PROPERTIES:</u>

4.1 **General:** The paint shall comply with the requirements specified in Table II of this specification.

4.2 Unless otherwise specified the following testing conditions shall apply.

4.2.1 The preparation of steel, tinned and glass panels shall be in accordance with Cl. 2, Cl.3 and Cl.5 respectively of IS: 101(Pt.1/Sec.3)-87.

4.2.2 All the tests shall be conducted at room temperature $(27 \pm 2^{0}C)$ and a relative humidity at 65 ± 5%, in a well- ventilated chamber free from draughts and dust. The temperature of the surface to be painted must be at least $3^{0}C$ above the dew point to prevent moisture condensation. The minimum temperature for satisfactory cure is $10^{0}C$.

4.2.3 The two components i.e. base and hardener shall be mixed in the ratio recommended by the manufacturer before conducting the test or tests. Where the paint is required to be applied on panels, it shall be done so by using suitable air/airless spray/brush application.

4.2.4 For touch-up/patch painting, the material shall be supplied in one litre containers.

4.2.5 For preparation of painted panels for conducting different tests mentioned in Table-II, the details given in Table III shall be followed.

4.2.6 TABLE-II: REQUIREMENTS FOR HIGH PERFORMANCE	EPOXY PAINT (Two Pack)
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S.No.	Characteristics	Requirements	Method of test
1.	Drying time at 27±2 ⁰ C a) Surface dry, max b) Recoating time, min. c) Hard dry, max. d) Curing time,max.	2 hours 4 hours 16 hrs. 07 days	IS: 101(Pt.3 /Sec.1)-86
2.	Consistency	Smooth ,uniform and suitable for air/air- less spray/brush	IS: 101 (Pt.1/ Sec.5)-89
3.	Finish	Smooth – matt/semi- glossy, free from sagging & wrinkling	IS: 101 (Pt.3/Sec.4)-87
4.	Color	As desired	IS: 101(Pt.4/Sec.2)-
5.	Dry film thickness per coat, min., by brush /air / airless spray	(75-125) microns	IS: 101(Pt.3/Sec.2)- 89 By
6.	Volume solids, % min	65 <u>+</u> 10	See Appendix-I
7.	Scratch hardness(at 1.5 Kg. load)	No such scratch as to show bare metal	IS: 101(Pt.5/Sec.2)- 88
8.	Flexibility & Adhesion	No visible damage or detachment of film	IS: 101(Pt.5/ Sec.2)-88
		*	

9.	Flash Point for both the packs	Above 25 ⁰ C	IS: 101(Pt.1/ Sec.6)-87
10.	Resistance to salt spray*	No sign of corrosion & no sign of	ASTM: B-117
11.	Protection* against corrosion under condition of condensation	No sign of corrosion & no sign of deterioration up	IS: 101(Pt.6 /Sec.1)-88
12.	Keeping Properties for both the packs	Not less than 12 months	IS: 101(Pt.6/ Sec.2)-89
13.	Covering Capacity, min. I) 100microns DFT II) 75 microns DFT)	5.5 sq. m./litre 7.0 sq. m /litre	IS:101(Pt.4 /Sec.1)-88
14.	Resistance to chemicals *I) 25% caustic sodasolution (w/v)II) 30% sulphuricacid solution (v/v)III) 20% hydrochloric acid	Shall not show any sign of blistering, wrinkling & lifting of paint film up to 2000 hrs. -do-	Appendix -II
15.	Pot life at 27± 2°C min.	3hours	Appendix-III
16.	Mass in kg/10 litres, min.	12.0	IS:101Pt.1 Sec.7- 87
17.	Impact resistance test, height 100 inch, load 3.464 pound, painted side should face indentor	Shall be free from cracking in the deformed coating	ASTM:D 2794- 93
18.	Resistance to distilled Wate	rShall not show any sign of blistering, wrinkling & lifting of paint film up to 500 hours	IS:101 Part 7/Sec.1-
19.	Cathodic disbondment test, max	8. 0 m m.	CAN-CSA- Z245.0 2- 98, Cl.12.8

*In case of approval and / or bulk supply, every 5th batch or the last batch if the batches are less than 05 may be tested. The duration of the test shall be 2000 hrs. Edges of the test panels may be resealed with wax if it gets damaged/thinned down during testing period.

TABLE-III: DETAILS OF PREPARING PAINTED PANELS FOR TESTING OF HIGH PERFORMANCE EPOXY PAINT (TWO PACK)

S.N o.	Test	Type of Metal Panel	Size in m.m.	Painting Detail	DFT	Method of Applicat -ion	Duration of Air Drying before comence- ment of test	Special Instruction
1.	Drying Time	M.S.	150 x 100 x 1.25	One coat of H.P. Epoxy Paint	75-125 microns	Brush/ Spray	-	-
2.	Finish	-do-	-do-	-do-	-do-	-do-	48 Hours	-
3. 4.	Colour Dry Film thickness	-do-	-do-	-do-	-do-	-do-	24 Hours	-
	a) By brush b) By air/airles s spray	-do- -do-	-do- -do-	-do- -do-	-do- -do-	Brush Spray	-do- -do-	-
5.	Scratch Hardne ss	Tinned M.S.	150 x 50 x .315	-do-	-do-	Brush/ Spray	7 days*	-
6.	Flexibility & Adhesion	-do-	-do-	-do-	-do-	-do-	-do-	-
7.	Resistance to Salt Spray	M.S.	150 x 100 x 1.25	Two coats of High Performa nce Epoxy Paint	150-250 microns	-do-	-do-	Paint both sides of panels and seal the edges with wax.

| 8. | Protection
against
corrosion
under
conditions
of
condensatio | -do- |
|-----|---|------|------|------|------|------|------|------|
| 9. | n
Resist-ance
to chemicals
i) 5%
(w/v)
caustic
soda sol.
ii) 0%
(v/v)
sulphuric
acid sol.
iii) 20%
(v/v)
hydrochlori | -do- |
| 10. | Resistance
to distt.
water | -do- |

5. MARKING AND PACKING

- 5.1 Each container shall be marked with the following :
- a) Name of the material
- b) Source of manufacture
- c) Volume of the material
- d) Batch No. or Lot No. in code or otherwise and
- e) Month & year of manufacture
- 5.2 For touch up/patch painting, the material shall be supplied in one litre container.

6. INSPECTION

6.1 At the time of initial approval, full testing shall be done.

6.2 In case of acceptance testing, Inspecting Authority shall draw the sample from the batch under consideration and tests shall be done as per Table II, except for long duration tests as per S. No. 10, 11&14. By way of purchase Inspection, OEM's original work Test Certificate specific to each batch can be accepted by Inspection Authority.

6.3 For bulk supply, frequency of full testing of the material as per table-II may be decided by the purchaser'. Purchaser reserves the right to conduct tests for any parameter at any time.

<u>APPENDIX- I</u>

PROCEDURE FOR DETEMINING VOLUME SOLIDS PERCENTAGE

1. SCOPE

This method is applicable for determination of the volume of non-volatile matter of paint coatings.

2. SIGNIFICANCE

This method is intended to provide a measure of the volume of dry coating obtainable from a given volume of liquid coating. This volume is considered to be the most equitable means of comparing the coverage (sq. meter of surface covered at a specific film thickness, per unit volume) and also for calculating the wet film thickness of the given paint.

3. APPARATUS

i)	Analytical balance
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ii) Steel disc – Preferably stainless steel, 60 mm dia and 0.70 mm thickness with a small hole 2 to 3 mm from the edge. A fine wire such as chromel is attached through the hole and made of the appropriate length for suspending the disc in a liquid.

- iii) Weight box
- iv) Beaker 1 litre , for weighing the disc in liquid.

v) Weight per litre cup for determining the specific gravity of the paint material and of the suspending liquid if not known.

vi) Oven.

4. **PROCEDURE:**

i) Dry the disc in an oven at 105	5 ⁰ C for 10 minutes and cool.
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- ii) Weigh the disc in air. Let it be W1 grams.
- iii) Suspend the disc in water and weight again .Let it be W2 grams.
- iv) Calculate the volume of the disc V as follows :
 - W1 W2

V = ----- where d is the density of the water at room temperature. d

v) Determine the weight of non-volatile content of the liquid coating material by drying a

known amount of paint at 105[°] C for 3 hours. Let it be W grams.

vi) Determine the specific gravity of the paint to the nearest 0.001 g/ml by using weight per gallon cup. Let it be P.

vii) Dip the disc in the paint sample for 10 minutes and take out the disc and allow the excess coating material to drain off. Blot the coating material off the bottom edge of the disc so that heads or drops do not dry on the bottom edge of the disc.

- viii) Dry the disc. in an oven for 3 hours at 105⁰C and cool.
- ix) Weigh the coated disc in air. Let it be W3 grams.
- x) Suspend the coated disc in water and weigh again. Let it be W4 grams.

xi)	Calculate the volume of the coated disc as follows : $W3 - W4$
	V1= where d is the density of the water at room temperature. d
xii)	Calculate the volume of the dried coating as follows :-
	Volume of dried coating = $V1 - V$ (Vd)
xiii)	Calculate the volume of wet coating as follows : $W3 - W1$
	V1= where W = grams of non-volatile matter.
	W X P $P = $ specific gravity of the paint.
xiv)	Calculate the percentage volume solids of the paints as follows : V1 – V $$
	Vd X 100 OR X 100 Vw The volume of non-volatile matter or the percentage volume solids of a paint is related to the covering capacity and thickness in the following manner :-% Volume solids
	a) X 10 = Covering Capacity
	Dry film thickness (microns)
	Dry film thickness (microns)
	b) X 100 = wet film thickness

% Volume solids

APPENDIX-II

Accelerated Tests: (Resistance to Chemicals) :

The following short - term tests of chemical resistance, do not categorize the

type of service for which High performance epoxy paint coatings are intended but are included to assure the customer that the coating contains a sufficiently cured resin to exhibit the long term requirements.

Prepare the panels as per clause 9 of Table -III. Allow the panels

to air dry for 7 days and seal the edges with wax.

a) Resistance to 25% caustic soda solution: Immerse $3\!/\!4^{th}$ of the panel in 25% (w/v) caustic soda solution for 2000

hours. Remove the panel, wash in running water and allow it to air dry for an hour and record the observations.

b) Resistance to 30% sulphuric acid solution: Immerse $3/4^{th}$ of the panel in 30% (v/v) sulphuric acid solution for 2000 hours. Remove the panel, wash in running water and allow it to air dry for an hour and record the observations.

c) Resistance to 20% hydrochloric acid solution : Immerse $3/4^{th}$ of the panel in 20% (v/v) hydrochloric acid for 2000 hours. Remove the panel, wash in running water and allow it to air dry for an hour and record the observations.

APPENDIX-III

PROCEDURE FOR DETERMINING POT LIFE

(AS PER U.S.DEPPT.OF TRANSPORTATION/FED.RAIL ROAD ADMN.OFFICE OF SAFETY, FED. TEST NO.2.7.1)

Take the usable time as the pot life of paint. Condition the components of the coating for one hour at 27^{0} C and mix immediately in proper ratio to get approx. 200 ml. of paint in 250ml.of container. The lid should be loosely placed on the container.

1 Measure the viscosity initially and every half an hour thereafter.

However, the interval May be shortened, if desired.

2. Near the end of the coating's working life, the viscosity builds-up rapidly.

During this period, when the paint may be too viscous to spray, remove a small portion and add the appropriate thinner. If the paint can still be thinned, the end of the working life has not been reached. The end of the working life is reached when the paint gels, becomes stringy or cannot be thinned for application.



SIGNS AND SIGNALS

Part 1 - GENERAL

SUMMARY

- A. Section Includes: Traffic signs as shown on the drawings or inferable there from and/or as specified in accordance with requirements of the Contract Documents, work includes but not limited to the following:
 - 1. Ceiling hung signs including illuminated signs
 - 2. Wall mounted signs including illuminated signs
 - 3. Post mounted signs including illuminated signs.
 - 4. Fabrication of sign and sign post.
 - 5. Graphic/Lettering.
 - 6.Foundation.
 - 7. Installations.

REFERENCES

- A. British Standards Institute (BSI):
 1.BS 381 : "Specification for Colors for Identification Coding and Special purposes"
 2.BS 873 : "Road Traffic Signs and Internally Illuminated Bollards"
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 53: "Specification for Pipe, Steel, Black and Hot Dipped Zinc Coated Welded and Seamless.
 - 2. ASTM A 366: "Specification for Steel, Carbon, Cold Rolled Sheet, Commercial Quality"
 - 3. ASTM A 512 : "Specification for Cold Drawn Buttweld Carbon
 - 4. Steel Mechanical Tubing"
 - 5. ASTM A 568 "Specification for General Requirements for Steel Carbon and High Strength Low-Alloy Hot Rolled Sheet and Cold Rolled Sheet"
 - 6. ASTM D 790: "Test Methods for Flexible Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials"
 - 7. ASTM D 1003: "Test Method for Haze and Luminous Transmittance of Transparent Plastics"
- C. Comply with the relevant schedules and requirements with local regulations.
- D. Unless otherwise stated, the design, materials, construction and erection of signs shall comply with the standards in the General Specification for Hospital signage.

SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Unless otherwise stated, all road signs shall be of the types used for 85% ile speed of under 45 km/hr. category in the Traffic Signs Manual by Local Municipality.
 - 2. Sign plates or boards employing any method of construction, irrespective of their size and shape, shall be capable of passing the rigidity tests stated in the relevant standards.

SUBMITTALS

- A. Manufacturers Data: Submit to the Engineer, in accordance with the requirements of the Contract Documents, copies of manufacturer's specifications and installation instructions and other data as may be required to show compliance with these Specifications.
- B. Shop Drawings: Submit shop drawings for the fabrication and erection of traffic sign work outdoor sign board and indoor sign board. Include details of sections and connections at not less than 1:4 scales. Show anchorage and accessory items and finishes.
- C. Samples: Submit to the Engineer, in accordance with the requirements of the Contract Documents, samples as follows:
 1.150 x 150mm Samples of each metal and finish required.
 200 mm Samples of each time of each time of each time.
 - 2. 300 x 300mm Samples of each type of acrylic sheet.

QUALITY ASSURANCE

- A. Provide traffic sign work (outdoor and indoor) fabricated by a firm specializing in the fabrication of traffic and similar signs and who are capable of producing work of the highest standard of quality in the industry.
- B. Locate all signs as required. However, the final arrangement and number of signs shall be subject to the approval of the Owner and the Engineer.

DELIVERY, STORAGE AND HANDLING

A. Deliver all components to project site completely identified. Store in accordance with manufacturer's instructions, protected from the weather, construction activities and other possibility of damage or loss.

Part 2 - PRODUCTS

METALS

- A. Materials and Surfaces: For the fabrication of metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes. Do not use materials which have stains and discolorations including welds which do not match the materials.
- B. Flatness and Edges: For exposed work provide materials which have been cold-rolled, cold finished, cold-drawn, extruded, stretcher leveled, machine cut and otherwise produced to the highest commercial standard for flatness with edges and corners sharp and true to angle or curvature as required.
- C. Welding Electrodes and Filler Metal: Provide the alloy and type required for strength, workability, compatibility and color match after grinding smooth and finishing the fabricated product.
- D. Ferrous Metal (Steel): Provide the forms and types shown and specified complying with the following or other equal and approved standards and finish.
 - 1. Cold-Rolled Sheet Steel: ASTM A 366 and ASTM A 568, commercial quality with type E matt finish.
 - 2. Steel Pipe: ASTM A53, standard weight (Schedule 40), galvanized, type as required to meet the assigned performance.
 - 3. Steel Tubing: ASTM A512, sunk drawn, butt welded, cold-finished and stress relieved.
 - 4. Base Plates, Anchor Bolts, etc.: Non-corrosive, zinc coated of the type and sizes approved and required to withstand the imposed load.
- E. Fasteners: Manufactured from the following and as approved by the Engineer:
 - 1. Brackets: Strip aluminum alloy.
 - 2. Clips: Aluminum extruded sections.
 - 3. Screws, bolts, nuts and washers shall be of steel, stainless steel, aluminum alloy or of a high tensile non-corroding metal. Steel screws, bolts, nuts and washers which are in contact with aluminum shall be coated with zinc or cadmium.
- F. Sign Plate and Stiffening Frame:
 - 1. Sign Plate
 - a. Steel Construction: Sheet steel not less than 1.25mm thick.
 - b. Aluminum Construction: Aluminum sheet not less than 3mm thick.
 - 2. Stiffening Frame: Manufactured from approved aluminum sections. Provide stiffening frames for plate signs having the following dimensions:
 - a. Circular signs size over 600mm diameter.
 - b. Triangular signs with base width over 600mm.
 - c. All other signs where:
 - i) The horizontal or vertical dimension of the sign exceeds 1000mm.
 - ii) The maximum dimension is greater than 600mm and the ratio W/D or D/W is equal to or greater than 2.5; where D is the depth and W is the width of the sign.
- G. Mounting Posts for Plate Signs
 - 1. Circular hollow section steel of approved size.
 - 2. Post Caps: Cast or sheet metal, or a suitable weather resistant type of plastic, as approved.
- H. Height Limit Gauge Frame: Fabricated from continuous circular hollow section steel complying with B.S. 873 or other approved standards; size 75mm diameter for frame spanning up to 5.00m and size 100mm diameter for frames spanning over 5.00m.
- I. All steel used for the complete work shall be of hot dipped galvanized and all aluminum shall be of anodized finish, as approved.

Part 3 - EXECUTION

INSTALLATION

- A. General: Locate sign units. Use mounting methods in compliance with manufacturer's instructions. Install sign units level, plumb and at heights indicated or required, with sign surface free from distortion or other defects or appearance.
- B. Metal Signs: Attach metal signs to vertical surfaces of walls, poles, etc., using bolting system, clamping system or other fastening devices recommended by the manufacturer and approved by the Engineer.
- C. Acrylic Plastic Signs: Mount the acrylic plastic signs in the light fittings as recommended by the manufacturer and approved by the Engineer.
- D. Comply with the relevant requirements for placements and mounting heights for post mounted signs. Mounting height shall be 2100 mm from the kerb level to the lower edge of the sign unless shown or approved otherwise. Provide mounting posts with breakaway joints where required.
- E. Treat all sign posts located in areas used by pedestrians with alternate 150mm wide bands of black paint and white reflective tape.
- F. Protect aluminum by a bituminous coating where it is in contact with concrete. Protect portions of posts which are buried below ground by coating internally and externally with bitumen.

CLEANING

A. Upon completion of installations, clean soiled sign surfaces in accordance with manufacturer's instructions prior to handing over to the Employer.

PROTECTION

A. Delay the installation of work with exposed painted metal finishes, acrylic and graphics, wherever possible until other work which might damage such finishes has been completed. When such delay of installation is not possible, or would delay the project, protect such exposed work by maintaining suitable temporary coverings to ensure that no damage thereto will result from other work being performed.

APPENDIX 1

GENERAL SAFETY, HEALTH AND ENVIRONMENTAL REGULATIONS

Appendix 1

General Safety, Health and Environmental Regulations

1 Introduction

1.1 The prevention of injury and/or illness to site personnel and the public, damage to the Works and to public and private property, protection of the environment, and compliance with applicable laws, are primary objectives of the Employer, and because of the importance the Employer places on meeting these objectives, selected minimum requirements are outlined in these Safety, Health and Environmental Regulations with which Contractors shall comply while working on Government contracts. Given that these Regulations cannot cover every eventuality, the Contractor shall be expected to exercise good judgment in all such matters, even though not mentioned in these Regulations, and shall take any and all additional measures, as required or necessary, to meet his responsibility for safety, health and environmental matters during the period of the Contract.

The Employer and its representatives shall not be held liable for any actions taken by the Contractor that are attributed to following the minimum requirements stated hereinafter.

- 1.2 The Contractor shall, throughout the execution and completion of the Works and the remedying of any defects therein:
 - (a) Have full regard for the safety of all persons on the Site and keep the Site and the Works in an orderly state appropriate to the avoidance of danger to any person;
 - (b) Know and understand all laws governing his activities along with any site requirements and work site hazards. Such information shall be communicated by the Contractor to his personnel and subcontractors;
 - (c) Take all necessary measures to protect his personnel, the Employer's personnel, other persons, the general public and the environment;
 - (d) Avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of carrying out the Works.

2 Compliance with Regulations

- 2.1 The Contractor shall comply with the requirements of these Safety, Health and Environmental Regulations and all other applicable regulations or requirements under Lebanese laws, laid down by relevant authorities or issued by the Employer or the Engineer concerning safety, health and the environment, in force or introduced or issued from time to time during the period of the Contract. In so far as these Regulations are applicable, they shall apply to sites and personnel outside the Site associated with the performance of the Contract.
- 2.2 The Regulations equally apply to subcontractors and all other parties engaged by the Contractor and their personnel. The Contractor shall ensure all such parties are fully aware of and comply with the Regulations.
- 2.3 The Contractor shall comply with all notifications and written or verbal instruction regarding safety issued pursuant to these Regulations by the Employer, Engineer or relevant authorities within the time specified in the notification or instruction.

Whenever the Contractor is required to obtain the approval, agreement, permission, etc of the Engineer, such approval, agreement, permission, etc shall not relieve the Contractor of his responsibilities and obligations under these Regulations or the Contract.

- 2.4 The Contractor shall adopt a positive approach, awareness and responsibility towards safety, health and the environment, and take appropriate action, by:
 - (a) Ensuring the Regulations are enforced and followed by the Contractor's personnel. Any failure by the Contractor's personnel to follow the Regulations shall be regarded as a failure by the Contractor.

- (b) Paying attention to possible injury to unauthorized persons entering the site, particularly children.
- 2.5 Whenever in these Regulations the Contractor is required to provide test certificates for equipment and personnel or to comply the relevant authorities' requirements and no independent test facilities are available or no relevant authorities exist in Lebanon, the Contractor shall provide:
 - A) in lieu of independent test certificates:
 - □ For equipment details of the tests and the date of the tests that have been carried out by the Contractor and a written statement that the Contractor has satisfied himself that the item of equipment is fit and safe for use;
 - □ For personnel details of the training and experience and a written statement that the Contractor has satisfied himself that the person has the required level of competency;
 - B) In lieu of relevant authorities' requirements details of the Contractor's own rules, regulations, requirements and procedures regarding safety, health and the environment.

If the Engineer is dissatisfied with the details provided by the Contractor, the Contractor shall provide further details or carry out further tests or provide further written statements as may be reasonably required by the Engineer.

When the Engineer has satisfied himself regarding the Contractor's own rules, regulations, requirements and procedures provided in accordance with (b) above, such rules, etc. shall be deemed to form part of these Regulations and to which Clause 3 shall equally apply.

3 Failure to Comply with Regulations

3.1 General

- 3.1.1 Should the Contractor fail to comply with any of the Regulations or requirement:
 - (a) The Engineer may suspend the Works or part of the Works until the Contractor has taken necessary steps, to the satisfaction of the Engineer, to comply with the regulations or requirements.
 - (b) The Employer may, following written notice to the Contractor, carry out themselves or arrange for another contractor to carry out such measures as they consider appropriate on behalf of the Contractor. Any such actions by the Employer shall not affect or diminish the Contractor's obligations or responsibilities under the Contract.
 - (c) The Engineer may, following written notice to the Contractor specifying the breach or breaches of these Regulations by the Contractor, impose the fines stipulated in Sub-Clause 3.2. All deductions for fines by the Engineer will be subject to the approval of the Employer.
 - (d) The Engineer may, by written notice of suspension to the Contractor, suspend all payments to the Contractor under the Contract if the Contractor fails to rectify any breach of the Regulations within the period specified by the Engineer, provided that such notice of suspension:
 - (i) Shall specify the nature of the failure or failures; and
 - (ii) Shall request the contractor to remedy each such failure within a specified period after receipt by the Contractors of such notice of suspension.

Such suspension of payment will remain in force until such time as the Contractor has rectified the breach or breaches to the satisfaction of the Engineer. No interest shall be paid on the suspended payments.

- 3.1.2 Failure to comply with the Regulations or requirements shall be considered a breach of contract by the Contractor and may result in termination of the Contract by the Employer.
- 3.1.3 In the event of the Employer or Engineer taking action based on Sub-Clause 3.1.1(a) or (b) or 3.1.2, the Contractor shall not be entitled to any additional costs or extension to the Contract Completion Date.
- 3.1.4 All costs incurred by the Employer pursuant to Sub-Clause 3.1.1(b) and the fines imposed on the Contractor by the Engineer under Sub-Clause 3.1.1(c) shall be deducted from amounts otherwise due to the Contractor.

3.2 Fines

- 3.2.1 Failures by the Contractor to comply with the Regulations or requirements are classified as follows:
 - F1 Breaches of Sub-Clause 5.6 (personal protective equipment);

F2 - Breaches of Clause 7 (work in Public Areas);

- F3 Breaches other than F1 and F2.
- 3.2.2 The basic fine for each classification in Sub-Clause 3.2.1, is as follows:

For F1 - US\$100; For F2 - US\$500; For F3 - US\$200.

- 3.2.3 Fines will be applied as follows:
 - (a) For the first breach of each regulation or requirement the basic fine. If the same or similar breaches occur in different situations or locations at the same time, the Engineer may apply fines for each situation or location; this will not apply to breaches related to personal protective equipment.
 - (b) For a second or subsequent breach of the same Regulation or requirement or failure to rectify a previous failure within the time specified by the Engineer twice the basic fine.

4 General Requirements

4.1 Preamble

4.1.1 All references to safety shall be deemed to include health and the environment.

4.2 Safety Officer

4.2.1 The Contractor shall appoint a competent Safety Officer who shall be responsible for safety, health and the environment. The Safety Officer shall be given sufficient time by the Contractor to carry out his duties; minimum requirements shall be as follows: Workforce on Site of over 250 - full time Safety Officer;

Workforce on Site of 100-250 - 50% of Safety Officer's time;

Workforce on Site below 100 - as required for the Works but a minimum of 5 hours per week of Safety Officer's time where more than 20 workers.

- 4.2.2 The Contractor shall provide the Safety Officer with appropriate identification, including a white hard hat with Red Cross symbol and an identification badge. The appointment of the Safety Officer shall be in writing and copied to the Engineer. The appointment shall include specific instructions to enforce these Regulations and delegated authority to take any action, measure or to issue instructions regarding their enforcement. All persons on Site shall be made aware of the name and authority of the Safety Officer and instructed to comply with any instruction or direction on safety matters, verbal or in writing, issued by the Safety Officer.
- 4.2.3 The Safety Officer shall be provided with a mobile phone or other similar means of communication. The Safety Officer shall be accessible and available at all times including outside normal working hours.

4.3 Safety Training

- 4.3.1 The Contractor shall provide safety induction training for all site personnel upon starting on site.
- 4.3.2 The Contractor shall provide safety refresher/reinforcement training at regular intervals for his staff.

4.4 Safety Meetings

4.4.1 The Contractor shall hold regular safety meetings to provide safety instructions and receive feedback from site personnel on safety, health and environmental matters. A weekly Safety Meeting shall be chaired by the Safety Officer and minutes shall be taken of the meeting. The meeting/minutes shall cover all relevant issues including actions to be taken. A copy of the minutes shall be given to the Engineer. The Safety Officer should attend the Contractor's weekly site meetings and "Safety" should be an item on the agenda.

4.5 Safety Inspections

4.5.1 The Safety Officer shall make regular safety inspections of the work site. The Safety Officer shall prepare a report of each inspection. This report shall include details of all breaches of these Regulations and any other matters or situations relating to safety found during the inspection, instructions issued by the Safety Officer and actions taken by the Contractor. A copy of the Safety Officer's inspection reports shall be given to the Engineer.

4.6 Control of Substances Hazardous to Health

- 4.6.1 Hazardous materials shall be stored in approved safety containers and handled in a manner specified by the manufactures and/or prescribed by relevant Authorities (see Sub-Clause 2.5).
- 4.6.2 Only properly trained and equipped personnel shall handle hazardous materials.

4.7 Potential Hazards

- 4.7.1 The Contractor shall inform employees of potential hazards, take appropriate steps to reduce hazards and be prepared for emergency situations.
- 4.7.2 The Contractor shall make an assessment of every operation involving hazardous substances. The assessment shall be recorded on a Hazardous and Flammable Substances Assessment Method Statement which shall be submitted to the Engineer prior to the delivery and use of the substance on Site.

4.8 Accident Reporting

- 4.8.1 The Contractor shall report all accidents and dangerous occurrences to the Engineer. The Contractor shall prepare a report on each accident or dangerous occurrence and a copy of the report, together with witness statements and any other relevant information, shall be submitted to the Engineer. A reportable accident or dangerous occurrence shall include any accident to any person on Site requiring medical attention or resulting in the loss of working hours or any incident that resulted, or could have resulted, in injury, damage or a danger to the Works, persons, property or the environment.
- 4.8.2 In the event of an accident or dangerous occurrence, the Contractor shall be responsible for completing all statutory notifications and reports. Copies of all statutory notifications and reports shall be passed to the Engineer.
- 4.8.3 All accidents and dangerous occurrences shall be recorded in a Site Accident Book. The Site Accident Book shall be available at all times for inspection by the Engineer.
- 4.8.4 The Contractor shall immediately rectify any situation or condition that could result in injury, damage or a danger to the Works, person, property or the environment. If the situation or condition cannot be corrected immediately, the Contractor shall provide temporary barriers and appropriate warning signs and devices and/or take other appropriate action necessary for the protection of persons, property and the environment.

4.9 Notices, Signs, Etc.

4.9.1 All safety, health, environmental and other notices and signs shall be clearly displayed and written in both Arabic and English. All requirements, instructions, procedures, etc issued by the Contractor concerning these Regulations shall be printed in both Arabic and English and displayed and readily available to Contractor's personnel.

4.10 First Aid and Medical Attention

- 4.10.1 The Contractor shall have comprehensive First Aid Kit(s) on Site at all times. First Aid Kits shall be conveniently located and clearly identifiable.
- 4.10.2 The Contractor shall have one employee on site trained in first aid for every 25 employees. Such persons shall be provided with appropriate identification, including a red hard hat with a white "red cross" symbol and an identification badge.
- 4.10.3 The Contractor shall make contingency arrangements for calling a Doctor and transporting injured persons to hospital. The telephone numbers of the emergency services and the name address and telephone number of the Doctor and nearest hospital shall be prominently displayed in the Contractor's site office.

4.11 Employee Qualifications and Conduct

- 4.11.1 The Contractor shall employ only persons who are fit, qualified and skilled in the work to be performed. All persons shall be above the minimum working age.
- 4.11.2 Contractor's personnel shall use the toilet facilities provided by the Contractor.
- 4.11.3 The Contractor shall ensure:
- (a) That no firearms, weapons, controlled or illegal substances or alcoholic beverages are brought onto the Site and that no personnel under the influence of alcohol or drugs are permitted on Site.
- (b) That all personnel obey warning signs, product or process labels and posted instructions.
- (c) That drivers or operators of vehicles, machinery, plant and equipment follow the rules for safe operations. Drivers shall wear seat belts and obey all signs and posted speed limits.

5 Safety Requirements

5.1 Personal Protective Equipment

- 5.1.1 The Contractor shall provide personal protective equipment, including hard hats, safety glasses, respirators, gloves, safety shoes, and such other equipment as required, and shall take all measures or actions for the protection and safety of Contractor's personnel.
- 5.1.2 Non-metallic hard hats shall be worn at all times by all personnel at the worksite with the exception of those areas where the Engineer has indicated it is not necessary to do so.
- 5.1.3 Safety glasses shall meet international standards and be available for use and worn in specified worksite areas. As a minimum, safety glasses shall be worn for the following types of work: hammering, chipping, welding, grinding, use of electrically powered or pneumatic equipment, insulation handling, spray painting, working with solvents, and other jobs where the potential of an eye injury exists. Face shields and/or monogoggles shall be worn where possible exposure to hazardous chemicals, cryogenic fluids, acids, caustics, or dust exists and where safety glasses may not provide adequate protection.
- 5.1.4 When handling acids, caustics, and chemicals with corrosive or toxic properties, suitable protection, such as acid suits or chemical resistant aprons and gloves, shall be worn to prevent accidental contact with the substance.
- 5.1.5 Personnel shall not be permitted to work whilst wearing personal clothing or footwear likely to be hazardous to themselves or others.

- 5.1.6 The wearing of safety shoes with steel reinforced toes is recommended for all Contractor's personnel on site. In all cases, Contractor's personnel shall wear substantial work shoes that are commensurate with the hazards of the work and the worksite area.
- 5.1.7 Hearing protection, including muffs, plugs or a combination thereof, shall be provided for all personnel operating in areas where the noise level exceeds 90 decibels. Such protection shall also be provided for operators working with equipment exceeding such a level. This may include equipment such as excavators, shovels, jackhammers, saws, drills, grinders, and the like are being used.
- 5.1.8 The Contractor shall encourage employees to wear substantial work gloves whenever practical and safe to do so.

5.2 Fire Protection and Prevention

- 5.2.1 The Contractor shall comply with fire protection instructions given by the Authorities having jurisdiction in regard to fire protection regulations.
- 5.2.2 The Contractor shall, upon moving on site, provide to the Engineer and the Authorities a fire prevention and evacuation plan. This shall include drawing(s) showing the fire assembly points. The fire prevention and evacuation plan and drawing(s) shall be updated from time to time as the Works progress. The Contractor shall ensure all personnel are fully informed on escape routes and assembly points and any changes thereto.
- 5.2.3 Fuel storage will not be permitted in construction work areas. Contractors may establish fuel storage tanks in special areas set aside for the purpose and approved by the Engineer. Storage tanks shall be adequately bunded to control spillage. Fire extinguishers shall be provided and installed in a suitable nearby location.
- 5.2.4 Highly combustible or volatile materials shall be stored separately from other materials and as prescribed by relevant authorities and under no circumstances within buildings or structures forming part of the permanent Works. All such materials shall be protected and not exposed to open flame or other situations which could result in a fire risk.
- 5.2.5 No combustible site accommodation shall be located inside or within 10 meters of a building or structure forming part of the permanent Works, Where units have to be used in these circumstances, they shall be constructed of non-combustible materials and have a half-hour fire rating inside to outside and outside to inside. Non-combustible furniture shall be used where practical.
- 5.2.6 All temporary accommodation and stores shall be provided with smoke detectors and fire alarms.
- 5.2.7 Smoking shall be banned in high risk areas.
- 5.2.8 Expanded polystyrene with or without flame retarding additive, polythene, cardboard and hardboard shall not be used as protection materials.
- 5.2.9 Plywood and chipboard shall only be used as protection on floors. Vertical protection shall be non-combustible. Debris netting and weather protection sheeting shall be fire retardant.
- 5.2.10 When using cutting or welding torches or other equipment with an open flame, the Contractor shall provide a fire extinguisher close by at all times. All flammable material shall be cleared from areas of hot works, or work locations prior to welding or oxy/gas burning operations. All hot works shall cease half an hour before the end of a work shift to allow for thorough checking for fires or smoldering materials. Where appropriate, areas of hot works are to be doused in water before the shift ends.
- 5.2.11 An adequate number of fire extinguishers of types suited to the fire risk and the materials exposed shall be provided. These shall be placed in accessible, well-marked locations throughout the job site. Contractor's personnel shall be trained in their use. Extinguishers shall be checked monthly for service condition and replaced or recharged, as appropriate after use.

- 5.2.12 Only approved containers shall be used for the storage, transport and dispensing of flammable substances. Portable containers used for transporting or transferring gasoline or other flammable liquids shall be approved safety cans.
- 5.2.13 Fuel burning engines shall be shut off while being refueled.
- 5.2.14 Adequate ventilation to prevent an accumulation of flammable vapors shall be provided where solvents or volatile cleaning agents are used.
- 5.2.15 Flammables shall not be stored under overhead pipelines, cable trays, electrical wires, or stairways used for emergency egress.
- 5.2.16 Paints shall be stored and mixed in a room assigned for the purpose. This room shall be kept under lock and key.
- 5.2.17 Oily waste, rags and any other such combustible materials shall be stored in proper metal containers with self-closing lids and removed every night to a safe area or off site. Every precaution shall be taken to prevent spontaneous combustion.

5.3 Electrical Safety

- 5.3.1 All temporary electrical installations, tools and equipment shall comply with current regulations dealing with on-site electrical installations.
- 5.3.2 The Contractor shall establish a permit-to-work system for work on or in proximity to energized circuits of any voltage. Contractor's personnel shall not commence work on such circuits unless a permit to work has been issued and adequate safety measures have been taken and the work operation has been reviewed and approved by the Engineer.
- 5.3.3 Only authorized personnel shall be allowed to work or repair electrical installations and equipment.
- 5.3.4 Portable tools and equipment shall be 110 volt, unless otherwise agreed by the Engineer.
- 5.3.5 When portable or semi-mobile equipment operates at voltages in excess of 110 volts, the supply shall be protected by a Residual Current Device (RCD) regardless of any such device fitted to the equipment. The RCD must have a tripping characteristic of 30 milliamps at 30 milliseconds maximum.
- 5.3.6 All static electrically powered equipment, including motors, transformers, generators, welders, and other machinery, shall be properly earthed, insulated, and/or protected by a ground fault interruption device. In addition, the skin of metal buildings and trailers with electric service shall be earthed. Metal steps, when used, shall be securely fixed to the trailer.
- 5.3.7 Lamp holders on festoon lighting shall be moulded to flexible cable and be of the screw in type. Clip on guards shall be fitted to each lamp unit.
- 5.3.8 All tungsten-halogen lamps shall be fitted with a glass guard to the element. These lamps must be permanently fixed at high level.
- 5.3.9 Electrical equipment shall be periodically inspected and repaired as necessary by competent persons.
- 5.3.10 Any work on electrical equipment and systems shall be made safe through locking, tagging, and/or isolation of the equipment before work commences. Prior to the start of the work, the equipment or systems shall be tested to insure that they have been properly de-energized and isolated.
- 5.3.11 Electrical repair work on energized systems shall be avoided whenever possible.
- 5.3.12 Electrical trouble shooting shall be conducted only after getting written approval of the Engineer.

- 5.3.13 Unauthorized personnel shall not enter enclosures or areas containing high voltage equipment such as switch gear, transformers, or substations.
- 5.4 Oxygen/Acetylene/Fuel Gases/Cartridge Tools
- 5.4.1 Compressed oxygen shall never be used in the place of compressed air.
- 5.4.2 Flash-back (Spark) arrestors shall be fitted to all gas equipment.
- 5.4.3 Liquid Petroleum Gas (LPG) cylinders shall not be stored or left in areas below ground level overnight. Cylinders must be stored upright.
- 5.4.4 The quantity of oxygen, acetylene and LPG cylinders at the point of work shall be restricted to a maximum of one day's supply. Cylinders shall be kept in upright vertical rack containers or be safely secured to a vertical support.
- 5.4.5 Cartridge tools shall be of the low velocity type. Operators must have received adequate training in the safe use and operation of the tool to be used.

5.5 Scaffolding/Temporary Works

- 5.5.1 No aluminum tube shall be used, except for proprietary mobile towers, unless otherwise agreed with the Engineer.
- 5.5.2 Drawings and calculations shall be submitted to the Engineer, prior to commencement of work on site, for all Temporary Works, including excavations, false work, tower cranes, hoists, services and scaffolding. Design shall conform to international standards.
- 5.5.3 The Engineer will not approve Temporary Work designs but the Contractor shall take account of any comments on such designs made by the Engineer.
- 5.5.4 The Contractor shall inspect and approve all Temporary Works after erection and before access, loading or use is allowed. Completed and approved Temporary Works shall be tagged with a scafftag or similar safety system and the Safe Structure insert displayed. For scaffolding, one tag shall be displayed every 32 m² of face area. A central record system shall be kept on all Temporary Work. Temporary Works shall be inspected weekly and similarly recorded.
- 5.5.5 All mobile scaffold towers shall be erected in accordance with the manufacturer's instructions and a copy of these shall be submitted to the Engineer prior to any use on site. Additionally, all towers shall be erected complete with access ladder, safety rails and kick boards whatever the height.
- 5.5.6 The Contractor shall repair or replace, immediately, any scaffold including accessories, damaged or weakened from any cause.
- 5.5.7 The Contractor shall ensure that any slippery conditions on scaffolds are eliminated as soon as possible after they occur.
- 5.5.8 All scaffolds used for storing materials, for brick or block laying, for access to formwork or for any other purpose where materials may accidentally fall, shall be provided with wire mesh guards or guards of a substantial material, in addition to kick boards.

5.6 Use of Ladders

- 5.6.1 Manufactured ladders shall meet the applicable safety codes for wood or metal ladders. Metal ladders shall not be used where there is any likelihood of contact with electric cables and equipment. All metal ladders shall be clearly marked: "Caution Do not use around electrical equipment".
- 5.6.2 Job made ladders shall not be permitted.
- 5.6.3 Extension or straight ladders shall be equipped with non-skid safety feet, and shall be no more than 12 m in height. The maximum height of a step ladder shall be 2 m. Ladders shall not be used as platforms or scaffold planks.
- 5.6.4 Ladders rungs and steps shall be kept clean and free of grease and oil.
- 5.6.5 Extension and straight ladders shall be tied off at the top and/or bottom when in use. Only one person shall be allowed on a ladder at a time.
- 5.6.6 Defective ladders shall be taken out of service and not used. Ladders shall not be painted and shall be inspected for defects prior to use.

5.7 Elevated Work

- 5.7.1 The Contractor shall provide all personnel, while working at an elevated position, with adequate protection from falls. Details of such protection shall be submitted to and approved by the Engineer.
- 5.7.2 The Contractor shall carry out daily inspections of all elevated work platforms. Defects shall be corrected prior to use.
- 5.7.3 Roofing & Sheet Material Laying
- (a) A Method Statement detailing the procedures to be adopted shall be submitted to and agreed with the Engineer prior to commencement of work on site.
- (b) Mobile elevating work platforms or the equivalent shall be used to install roofing and sheet materials wherever practicable and a suitable base is available.
- 5.7.4 Erection of Structures
- (a) A Method Statement detailing the procedures to be adopted shall be submitted and agreed with the Engineer prior to commencement of work on site.
- (b) Safety harnesses and lines shall be provided by the Contractor for use by the erection personnel and worn at all times.
- (c) Mobile elevating work platforms or the equivalent shall be used to erect structures wherever practicable and a suitable base is available.
- 5.7.5 Mobile Elevating Work Platforms Operators shall be trained in the safe use of such platforms and hold a current Certificate of Competence (see Sub-Clause 2.5).
- 5.7.6 Hoists
- (a) A copy of the current Test Certificate (see Sub-Clause 2.5) shall be submitted to the Engineer before any hoist (personnel or material) is brought into operation on the site. Where the range of travel is increased or reduced a copy of the revised Test Certificate shall be submitted.
- (b) Each landing gate shall be fitted with a mechanical or electrical interlock to prevent movement of the hoist when any such gate is in the open position.
- (c) Safety harnesses must be worn and used by personnel erecting, altering and dismantling hoists.

5.7.7 Suspended Cradles

- (a) Suspended cradles shall be installed, moved and dismantled by a specialist contractor.
- (b) Suspended cradles shall comply with local regulations.
- (c) All powered suspended cradles shall incorporate independent safety lines to overspeed braking devices and independent suspension lines for personal safety harness attachment.

5.8 Use of Temporary Equipment

- 5.8.1 The safe design capacity of any piece of equipment shall not be exceeded, nor shall the equipment be modified in any manner that alters the original factor of safety or capacity.
- 5.8.2 Mobile equipment shall be fitted with suitable alarm and motion sensing devices, including backup alarm, when required.
- 5.8.3 The Contractor shall ensure that the installation and use of equipment are in accordance with the safety rules and recommendations laid down by the manufacturer, taking into account the other installations already in place or to be installed in the future.
- 5.8.4 The Contractor shall inspect Equipment prior to its use on the Works and periodically thereafter to ensure that it is in safe working order. Special attention shall be given to such items as cables, hoses, guards, booms, blocks, hooks and safety devices. Equipment found to be defective shall not be used and immediately removed from service, and a warning tag attached.
- 5.8.5 Natural and synthetic fiber rope made of material such as manila, nylon, polyester, or polypropylene shall not be used as slings unless approved by the Engineer.
- 5.8.6 Only trained, qualified and authorized personnel shall operate equipment. All drivers and operators shall hold a current Certificate of Training Achievement for the equipment being used (see Sub-Clause 2.5).
- 5.8.7 A safety observer shall be assigned to watch movements of heavy mobile equipment where hazards may exist to other personnel from the movement of such equipment, or where equipment could hit overhead lines or structures. The observer shall also ensure that people are kept clear of mobile equipment and suspended loads.
- 5.8.8 When mobile or heavy equipment is traveling onto a public thoroughfare or roadway, a flagman shall insure that traffic has been stopped prior to such equipment proceeding. While the mobile or heavy equipment is traveling on a public roadway, a trailing escort vehicle with a sign warning of a slow-moving vehicle that is dangerous to pass shall be provided.

5.8.9 Cranes:

- (a) The Contractor shall give a minimum of 48 hours' notice to the Engineer prior to bringing a mobile crane on site.
- (b) No cranes shall be erected on the site without the prior approval of the Engineer. The Engineer may direct the Contractor as to locations where cranes may not be located. The Contractor shall take such directions into account when submitting his proposals for crane location points, base footings, pick up points and swing radius. Compliance with any such direction shall not entitle the Contractor to any extension of the Period of Completion or to any increase in the Contract Price.
- (c) Safety harnesses shall be worn and used at all times by personnel engaged on the erection, alterations and dismantling of tower cranes.
- (d) The Contractor shall provide a copy of the current Test Certificate (see Sub-Clause 2.5) to the Engineer before any crane (tower or mobile) is brought into operation on the Site.

- (e) All lifting tackle must hold a current Test Certificate (see Sub-Clause 2.5). All lifting tackle must be thoroughly examined every 6 months and an inspection report raised.
- (f) All fibrous/Webb slings shall be destroyed and replaced 6 months after first use.
- (g) All crane drivers/operators shall hold a Certificate of Training Achievement for the class of crane operated (see Sub-Clause 2.5).
- (h) All banksman/slingers shall hold a Training Certificate from a recognized training agency (see Sub-Clause 2.5).
- (i) Only certified slingers/banksmans shall sling loads or guide crane/load movement.
- (j) The maximum weekly working hours of a crane driver or banksman shall be restricted to 60 hours.
- (k) Under no circumstances, shall a crane or load come within 4 m of any energized overhead power line or other critical structure.

5.9 Locking-out, Isolating, and Tagging of Equipment

- 5.9.1 Equipment that could present a hazard to personnel if accidentally activated during the performance of installation, repair, alteration, cleaning, or inspection work shall be made inoperable and free of stored energy and/or material prior to the start of work. Such equipment shall include circuit breakers, compressors, conveyors, elevators, machine tools, pipelines, pumps, valves, and similar equipment.
- 5.9.2 Where equipment is subject to unexpected external physical movement such as rotating, turning, dropping, falling, rolling, sliding, etc., mechanical and/or structural constraints shall be applied to prevent such movement.
- 5.9.3 Equipment which has been locked-out, immobilized, or taken out of service for repair or because of a potentially hazardous condition shall be appropriately tagged indicating the reason it has been isolated and/or taken out of service.
- 5.9.4 Where safety locks are used for locking out or isolating equipment, the lock shall be specially identified and easily recognized as a safety lock.

5.10 Installation of Temporary or Permanent Equipment

- 5.10.1 During installation and testing the Contractor's specialist engineer shall be in attendance.
- 5.10.2 All control mechanism panel and wiring diagrams shall be available and printed in both Arabic and English.

5.11 Laser Survey Instruments

5.11.1 Details of the types and use of laser instruments shall be submitted and agreed with the Engineer.

5.12 Working in Confined Spaces

- 5.12.1 Confined spaces, including tanks, vessels, containers, pits, bins, vaults, tunnels, shafts, trenches, ventilation ducts, or other enclosures where known or potential hazards may exist, shall not be entered without prior inspection by and authorization from the Site Safety Officer and the issuance of a Hazardous Work Permit.
- 5.12.2 Prior to entering the confined space, the area shall be completely isolated to prevent the entry of any hazardous substances or materials which could cause an oxygen deficient atmosphere. All equipment that could become energized or mobilized shall be physically restrained and tagged. All lines going into the confined space shall be isolated and/or blanked.

- 5.12.3 Personnel working in a confined space where emergency escape or rescue could be difficult shall wear a safety harness attached to a lifeline.
- 5.12.4 A qualified attendant(s), trained and knowledgeable in job-related emergency procedures, shall be present at all times while persons are working within the confined space. The attendant shall be capable of effecting a rescue, have necessary rescue equipment immediately available, and be equipped with at least the same protective equipment as the person making entry.
- 5.12.5 All equipment to be used in a confined space shall be inspected to determine its acceptability for use. Where a hazard from electricity may exist, equipment utilized shall be of low voltage type.
- 5.12.6 The atmosphere within the confined space shall be tested to determine it is safe to enter. Acceptable limits are:
 - Oxygen: 19.5% lower, 22% higher;
 - Flammable gas: not to exceed 10% of lower explosion limit;
 - Toxic contaminants: not to exceed the permissible exposure limit.
 - Subsequent testing shall be done after each interruption and before re-entering the confined space, as well as at intervals not exceeding 4 hours. Continuous monitoring is preferable and may be necessary in certain situations.
- 5.12.7 Adequate ventilation shall be provided to ensure the atmosphere is maintained within acceptable limits.

5.13 Demolition

5.13.1 A detailed Method Statement detailing the demolition procedures/techniques to be used shall be submitted to and approved by the Engineer prior to commencement of work on site. The Method Statement must include full details of measures to be taken to ensure that there are no persons remaining in the building/structure and to distance members of the public and Contractor's personnel from the building/structure prior to demolition.

5.14 Use of Explosives

- 5.14.1 The Contractor shall not use explosives without the written permission from the Engineer and relevant authorities (see Sub-Clause 2.5).
- 5.14.2 The Contractor shall observe all regulations regarding proper purchasing, transportation, storage, handling and use of explosives.
- 5.14.3 The Contractor shall ensure that explosives and detonators are stored in separate special buildings. These secured buildings shall be constructed, located and clearly marked in Arabic and English:
 - "DANGER EXPLOSIVES"

all as approved by the Engineer and relevant authorities (see Sub-Clause 2.5).

- 5.14.4 The Contractor shall ensure that all possible precautions are taken against accidental fire or explosion, and ensure that explosives and detonators are kept in a proper and safe condition.
- 5.14.5 The Contractor shall ensure that explosives and detonators are always transported in separate vehicles and kept apart until the last possible moment and that metallic tools are not used to open boxes of explosives or detonators.
- 5.14.6 Blasting Procedure: the Contractor shall carry out blasting operations in a manner that will not endanger the safety of persons and property. The Contractor shall, along with other necessary precautions:
- (a) Clear all persons from buildings and the area affected by the blasting. All such persons shall be given adequate notice of the actual time and date of blasting,
- (b) Ensure that police and other local authorities are kept fully informed, in advance, of the blasting program so that they may be present when blasting takes place if they so require,

- (c) Erect warning notices around the area affected that blasting operations are in progress,
- (d) Carry out a thorough search of buildings and the area affected prior to blasting,
- (e) Ensure that blasting is only carried out by experienced shot firers. Priming, charging, stemming and shot firing shall be carried out with greatest regard for safety and in strict accordance with the rules and regulations of the relevant authorities (see Sub-Clause 2.5).
- (f) Ensure that explosive charges are not excessive, charged boreholes are properly protected and proper precautions are taken for the safety of persons and property,
- 5.14.7 The Contractor shall maintain an up-to-date inventory of all explosives and explosive devices and shall submit a monthly report to the Engineer, detailing the use of all explosives by date and location.

5.15 Excavation and Trenching

- 5.15.1 The Contractor shall obtain an excavation permit from the relevant local authority before commencing excavation in any public place and he shall observe any restrictions imposed by the authority. He shall produce any such permit for the Engineer's inspection when requested to do so. If he fails to produce the permit, the Engineer shall have the right to order cessation of the relevant work.
- 5.15.2 The side of all excavations and trenches exceeding 1.3 meters in depth which might expose personnel or facilities to danger resulting from shifting earth shall be protected by adequate temporary supports or sloped to the appropriate angle of repose.
- 5.15.3 All excavations, slopes and temporary supports shall be inspected daily and after each rain, before allowing personnel to enter the excavation.
- 5.15.4 Excavations 1.3 meters or more in depth and occupied by personnel shall be provided with ladders as a means for entrance and egress. Ladders shall extend not less than 1 meter above the top of the excavation.
- 3.15.5 The Contractor shall provide adequate barrier protection to all excavations. Barriers shall be readily visible by day or night.
- 5.15.6 Excavated or other materials shall not be stored at least 0.65 meters from the side of excavations.

5.16 Concrete Reinforcement Starter Bars

5.16.1 The Contractor shall ensure concrete reinforcement starter bars are not a danger to personnel. Where permitted by the Engineer, starter bars shall be bent down. Alternatively, the starter bars shall be protected using either hooked starters, plastic caps, plywood covers or other methods agreed with the Engineer.

6 Environmental and Health Requirements

6.1 Protection of the Environment

- 6.1.1 The Contractor shall be knowledgeable of and comply with all environmental laws, rules and regulations for materials, including hazardous substances or wastes under his control. The Contractor shall not dump, release or otherwise discharge or dispose of any such material without the authorization of the Engineer.
- 6.1.2 Any release of a hazardous substance to the environment, whether air, water or ground, must be reported to the Engineer immediately. When releases resulting from Contractor action occur, the Contractor shall take proper precautionary measures to counter any known environmental or health hazards associated with such release. These would include remedial procedures such as spill control and containment and notification of the proper authorities.

6.2 Air Pollution

- 6.2.1 The Contractor, depending on the type and quantity of materials being used, may be required to have an emergency episode plan for any releases to the atmosphere. The Contractor shall also be aware of local ordinances affecting air pollution.
- 6.2.2 The Contractor shall take all necessary measures to limit pollution from dust and any windblown materials during the Works, including damping down with water on a regular basis during dry climatic conditions.
- 6.2.3 The Contractor shall ensure that all trucks leaving the Site are properly covered to prevent discharge of dust, rocks, sand, etc.

6.3 Water Pollution

6.3.1 The Contractor shall not dispose of waste solvents, petroleum products, toxic chemicals or solutions in the city drainage system or watercourse, and shall not dump or bury garbage on the Site. These types of waste shall be taken to an approved disposal facility regularly, and in accordance with requirements of relevant Authorities. The Contractor shall also be responsible to control all run-offs, erosion, etc.

6.4 Solid Waste

- 6.4.1 General Housekeeping
- (a) The Contractor shall maintain the site and any ancillary areas used and occupied for performance of the Works in a clean, tidy and rubbish-free condition at all times.
- (b) Upon the issue of any Taking-Over Certificate, the Contractor shall clear away and remove from the Works and the Site to which the Taking-Over Certificate relates, all Contractor's Equipment, surplus material, rubbish and Temporary Works of every kind, and leave the said Works and Site in a clean condition to the satisfaction of the Engineer. Provided that the Contractor shall be entitled to retain on Site, until the end of the Defects Liability Period, such materials, Contractor's Equipment and Temporary Works as are required by him for the purpose of fulfilling his obligations during the Defects Liability Period.

6.4.2 Rubbish Removal and Disposal

- (a) The Contractor shall comply with statutory and municipal regulations and requirements for the disposal of rubbish and waste.
- (b) The Contractor shall provide suitable metal containers for the temporary storage of waste.
- (c) The Contractor shall remove rubbish containers from site as soon as they are full. Rubbish containers shall not be allowed to overflow.
- (d) The Contractor shall provide hard standings for and clear vehicle access to rubbish containers.
- (e) The Contractor shall provide enclosed chutes of wood or metal where materials are dropped more than 7 meters. The area onto which the material is dropped shall be provided with suitable enclosed protection barriers and warning signs of the hazard of falling materials. Waste materials shall not be removed from the lower area until handling of materials above has ceased.
- (f) Domestic and biodegradable waste from offices, canteens and welfare facilities shall be removed daily from the site.
- (g) Toxic and hazardous waste shall be collected separately and be disposed of in accordance with current regulations.
- (h) No waste shall be burnt on Site unless approved by the Engineer.

- 6.4.3 Asbestos Handling and Removal
- The Contractor shall comply with all local regulations regarding the handling of asbestos materials. In the absence of local regulations, relevant International Standards shall apply.
- 6.4.5 Pest Control
- The Contractor shall be responsible for rodent and pest control on the Site. If requested, the Contractor shall submit to the Engineer, for approval, a detailed programme of the measures to be taken for the control and eradication of rodents and pests.

6.5 Noise Control

- 6.5.1 The Contractor shall ensure that the work is conducted in a manner so as to comply with all restrictions of the Authorities having jurisdiction, as they relate to noise.
- 6.5.2 The Contractor shall, in all cases, adopt the best practicable means of minimizing noise. For any particular job, the quietest available plant/and or machinery shall be used. All equipment shall be maintained in good mechanical order and fitted with the appropriate silencers, mufflers or acoustic covers where applicable. Stationary noise sources shall be sited as far away as possible from noise-sensitive areas, and where necessary acoustic barriers shall be used to shield them. Such barriers may be proprietary types, or may consist of site materials such as bricks or earth mounds as appropriate.
- 6.5.3 Compressors, percussion tools and vehicles shall be fitted with effective silencers of a type recommended by the manufacturers of the equipment. Pneumatic drills and other noisy appliances shall not be used during days of rest or after normal working hours without the consent of the Engineer.
- 6.5.4 Areas where noise levels exceed 90 decibels, even on a temporary basis, shall be posted as high noise level areas.

7 Additional Requirements for Work in Public Areas

7.1 General

- 7.1.1 These additional requirements shall apply to all works carried out in Public Areas.
- 7.1.2 Public Areas are defined as areas still used by or accessible to the public. These include public roads and pavements, occupied buildings and areas outside the Contractor's boundary fencing.
- 7.1.3 All work in Public Areas shall be carried out to minimize disturbance and avoid dangers to the public.
- 7.1.4 Before commencing work, the Contractor shall ensure that all necessary resources, including labor, plant and materials, will be available when required and that the works will proceed without delays and be completed in the shortest possible time. Periods of inactivity and slow progress or delays in meeting the agreed program for the works, resulting from the Contractor's failure to provide necessary resources or other causes within the control of the Contractor, will not be accepted. In the event of such inactivity, slow progress or delays, the Contractor shall take immediate action to rectify the situation, including all possible acceleration measures to complete the works within the agreed program. Details of the actions and acceleration measures shall be submitted to the Engineer. If the Engineer is dissatisfied with the Contractor's proposals, the Contractor shall take such further actions or measures as required by the Engineer. All costs incurred shall be the responsibility of the Contractor.

7.2 Method Statement

- 7.2.1 The Contractor shall submit to the Engineer a method statement for each separate area of work in Public Areas. The Method Statement shall include:
- (a) a general description of the Works and methodology of how it will be carried out.
- (b) Details of the measures and temporary works to minimize disturbance and safeguard the public. These shall include temporary diversions, safety barriers, screens, signs, lighting, watchmen and arrangements for control of traffic and pedestrians and advance warning to be given to the public.
- (c) Details of temporary reinstatement and maintenance of same prior to final reinstatement.
- (d) For works involving long lengths of trenches or works to be completed in sections, the lengths or sections of each activity (eg up to temporary reinstatement, temporary reinstatement, final reinstatement) to be carried out at any one time.
- (e) Details of the availability of necessary resources (labor, plant, materials, etc) to complete the work.
- (f) A program showing start and completion dates and periods for all activities of each length or section, including temporary works, and the works overall.
- (g) Such further information as necessary or required by the Engineer.
- 7.2.2 The Contractor shall not commence work, including temporary works, until approval of the Contractor's Method Statement by the Engineer.
- 7.2.3 Method Statements shall be updated based on actual progress or as and when required by the Engineer.

7.3 Closure of Roads, Etc.

7.3.1 The closure or partial closure of roads, pavements and other public areas will only be permitted if approved by the Relevant Authorities and the relevant closure permit has been issued by the Authority. The Contractor shall detail for each closure the extent of area to be closed, the reasons and duration of the closure and, where appropriate, proposed diversions. The Contractor shall produce the Closure Permit for inspection by the Engineer if requested. The Engineer shall have the right to order cessation of the relevant work if the Contractor does not produce the Closure Permit.

7.4 Trench and Other Excavations

- 7.4.1 The requirements covering trench and other excavations will depend on the location and type of the excavation and the potential risks to the public.
- 7.4.2 The following guidelines apply particularly to trenches but shall also apply to other types of excavations:
- (a) Before commencing work the Contractor shall:
- Notify the Engineer on the location and duration of the work. An excavation permit signed by the Engineer must be issued in accordance with Sub-Clause 5.15.1 before excavation proceeds in any work location.;
- □ Obtain permission from relevant authorities including the police when required;
- □ Erect all temporary works such as barriers, warning signs, lighting, etc.
- □ Have available adequate materials for temporary supports to sides of excavations and necessary labor, plant and materials to complete the work within the shortest possible time;

- (b) In carrying out the works the Contractor shall, unless otherwise permitted or required by the Engineer: Not open more than one excavation within a radius of 250 meters;
- □ Limit the length of trench excavation open at one time to 150 meters;
- □ Maintain and alter or adapt all temporary works including supports to sides of excavations;
- □ Remove all surplus excavated material the same day it is excavated;
- □ Complete the works, including final reinstatement within ten days;
- □ Where final reinstatement is not achieved within the required time, to carry out temporary reinstatement;
- □ Ensure that any temporary reinstatement is maintained at the correct level until final reinstatement is achieved.
- 7.4.3 The above guidelines shall not relieve the Contractor of his obligations and responsibilities.

7.5 Safety Barriers

- 7.5.1 Safety barriers shall be provided to the perimeter of work areas and to trench and other types of excavations and to existing openings such as manholes, drawpits and the like. When exposed to the public, safety barriers shall be provided to both sides of trenches and around all sides of openings.
- 7.5.2 The Contractor shall provide details of the type or types of safety barriers for each excavation for the approval of the Engineer prior to commencing work. No work shall commence until the safety barriers are in place.
- 7.5.3 The type of safety barrier used shall be appropriate to the particular location and the potential risks to the public. Examples of different types of safety barriers are given below:
- □ Type 1 excavated material;
- □ Type 2 non-rigid barrier of rope or florescent tape strung between metal rods driven into the ground;
- □ Type 3 rigid barrier of timber, steel or concrete, such barriers could be in the form of horizontal rail(s) or sheet material secured to posts driven or concreted into the ground.
- 7.5.4 The following are guidelines on the type of safety barriers that could be used in differing situations. They apply particularly to trenches but also apply to other types of excavations, existing openings and to the perimeter of work areas:
- □ Areas not subject to vehicular traffic Types 1 or 2;
- □ Roadways (low traffic speed) Types 1 or 2;
- □ Roadways (high traffic speed) Types 1 or 3.
- 7.5.5 The above examples of the types of barriers and the guidelines on situations in which they could be used shall not relieve the Contractor of his obligations and responsibilities.

8 Contractor's Site Check List

- 8.1 A sample Contractor's Site Check List is included in Annex 1. This is included to assist contractors should they wish to introduce such a system as part of their site management procedures. The list is not exhaustive and further items will need to be added by the Contractor.
- 8.2 The list is issued for guidance only, and does not, in any way, revise or limit the requirements covered elsewhere in these Regulations.

Annex 1

Sample Contractor's Site Check List

Safe Access:

- $\hfill\square$ Arrangements for visitors and new workers to the site
- $\hfill\square$ Safe access to working locations
- $\hfill\square$ Walkways free from obstructions
- $\hfill\square$ Edge protection to walkways over 2m above ground
- $\hfill\square$ Holes fenced or protected with fixed covers
- $\hfill\square$ Tidy site and safe storage of materials
- □ Waste collection and disposal
- □ Chutes for waste disposal, where applicable
- □ Removal or hammering down of nails in timber
- □ Safe lighting for dark or poor light conditions
- □ Props or shores in place to secure structures, where applicable

Ladders:

- □ To be used only if appropriate
- $\hfill\square$ Good condition and properly positioned
- □ Located on firm, level ground
- $\hfill\square$ Secure near top. If not possible, to be secured near the bottom, weighted or footed to prevent slipping
- □ Top of ladder minimum 1 meter above landing place

Scaffolding:

- □ Design calculations submitted
- □ Proper access to scaffold platform
- □ Properly founded uprights with base plates
- □ Secured to the building with strong ties to prevent collapse
- □ Braced for stability
- □ Loadbearing fittings, where required
- Uprights, ledgers, braces and struts not to be removed during use
- □ Fully boarded working platforms, free from defects and arranged to avoid tipping or tripping
- □ Securely fixed boards against strong winds
- □ Adequate guard rails and toe boards where scaffold 2m above ground
- $\hfill\square$ Designed for loading with materials, where appropriate
- Evenly distributed materials
- □ Barriers or warning notices for incomplete scaffold (ie not fully boarded)
- □ Weekly inspections and after bad weather by competent person
- $\hfill\square$ Record of inspections

Excavation:

□ Underground services to be located and marked and precautions taken to avoid them

 $\hfill\square$ Adequate and suitable timber, trench sheets, props and other supporting materials available on site before excavation starts

- □ Safe method for erecting/removal of timber supports
- □ Sloped or battered sides to prevent collapse
- □ Daily inspections after use of explosives or after unexpected falls of materials
- □ Safe access to excavations (eg sufficiently long ladder)
- □ Barriers to restrict personnel/plant
- □ Stability of neighboring buildings
- □ Risk of flooding
- $\hfill\square$ Materials stacked, spoil and vehicles away from top of excavations to avoid collapse
- $\hfill\square$ Secured stop blocks for vehicles tipping into excavations

Roof work:

- □ Crawling ladders or boards on roofs more than 10 degrees
- $\hfill\square$ If applicable, roof battens to provide a safe handhold and foothold
- □ Barriers or other edge protection
- Crawling boards for working on fragile roof materials such as asbestos cement sheets or glass.
- Guard rails and notices to same
- □ Roof lights properly covered or provided with barriers
- □ During sheeting operations, precautions to stop people falling from edge of sheet
- □ Precautions to stop debris falling onto others working under the roof work

Transport and mobile plant:

- □ In good repair (eg steering, handbrake, footbrake)
- □ Trained drivers and operators and safe use of plant
- □ Secured loads on vehicles
- □ Passengers prohibited from riding in dangerous positions
- □ Propping raised bodies of tipping Lorries prior to inspections
- □ Control of on-site movements to avoid danger to pedestrians, etc.
- □ Control of reversing vehicles by properly trained banksmen, following safe system of work

Machinery and equipment:

□ Adequate and secured guards in good repair to dangerous parts, eg exposed gears, chain drives, projecting engine shafts

Cranes and lifting appliances:

- □ Weekly recorded inspections
- □ Regular inspections by a competent persons
- Test certificates
- □ Competent and trained drivers over 18 years of age
- □ Clearly marked controls
- □ Checks by driver and banksman on weight of load before lifting
- □ Efficient automatic safe load indicator, inspected weekly, for jib cranes with a capacity of more than one tonne
- □ Firm level base for cranes
- □ Sufficient space for safe operation

□ Trained banksman/slinger to give signals and to attach loads correctly, with knowledge of lifting limitations of crane

 $\hfill\square$ For cranes with varying operating radius, clearly marked safe working loads and corresponding radii

- □ Regularly maintenance
- □ Lifting gear in good condition and regularly examined

Electricity:

 $\hfill\square$ Measures to protect portable electric tools and equipment from mechanical damage and wet conditions

- □ Checks for damage to or interference with equipment, wires and cables
- □ Use of the correct plugs to connect to power points
- □ Proper connections to plugs; firm cable grips to prevent earth wire from pulling out
- □ "Permit-to-work" procedures, to ensure safety

□ Disconnection of supplies to overhead lines or other precautions where cranes, tipper lorries, scaffolding, etc might touch lines or cause arcing

Cartridge operated tools:

- □ Maker's instruction being followed
- □ Properly trained operators, awareness of dangers and ability to deal with misfires
- □ Safety goggles
- □ Regular cleaning of gun
- □ Secure place for gun and cartridges when not in use

False work/formwork:

- □ Design calculations submitted
- □ Method statement dealing with preventing falls of workers
- □ Appointment of false work coordinator
- □ Checks on design and the supports for shuttering and formwork
- □ Safe erection from steps or proper platforms
- □ Adequate bases and ground conditions for loads
- □ Plump props, on level bases and properly set out
- □ Correct pins used in the props
- □ Timberwork in good condition

□ Inspection by competent person, against agreed design before pouring concrete

Risks to the Public:

□ Identify all risks to members of the public on and off site, eg materials falling from scaffold etc., site plant and transport (access/egress) and implement precautions, eg scaffold fans/nets, banksmen, warning notices etc.

□ Barriers to protect/isolate persons and vehicles

□ Adequate site perimeter fencing to keep out the public and particularly children. Secure the site during non-working periods

□ Make safe specific dangers on site during non-working periods, eg excavations and openings covered or fenced, materials safely stacked, plant immobilized, ladders removed or boarded

Fire - general:

□ Sufficient number and types of fire extinguishers

- □ Adequate escape routes, kept clear
- □ Worker awareness of what to do in an emergency

Fire - flammable liquids:

- □ Proper storage area
- □ Amount of flammable liquid on site kept to a minimum for the day's work
- □ Smoking prohibited; other ignition sources kept away from flammable liquids
- □ Proper safety containers

Fire - compressed gases, eg oxygen, LPG, acetylene:

- □ Properly stored cylinders
- □ Valves fully closed on cylinders when not in use
- □ Adopt "hot work" procedures
- □ Site cylinders in use outside huts

Fire - other combustible materials:

- □ Minimum amount kept on site
- Proper waste bins
- □ Regular removal of waste material
Noise:

- □ Assessment of noise risks
- □ Noisy plant and machinery fitted with silencers/muffs
- $\hfill\square$ Ear protection for workers if they work in very noisy surroundings

Health:

- □ Identify hazardous substances, eg asbestos, lead, solvents etc and assess the risks
- $\hfill\square$ Use of safer substances where possible
- □ Control exposure by means other than by using protective equipment
- □ Safety information sheets available from the supplier
- □ Safety equipment and instructions for use
- □ Keep other workers who are not protected out of danger areas

□ Testing of atmosphere in confined spaces; provision of fresh air supply if necessary. Emergency procedures for rescue from confined spaces

Manual handling:

- □ Avoid where risk of injury
- □ If unavoidable, assess and reduce risks

Protective clothing:

- □ Suitable equipment to protect the head, eyes, hands and feet where appropriate
- $\hfill\square$ Enforce wearing of protective equipment

Welfare:

- □ Suitable toilets
- □ Clean wash basin, hot/warm water, soap and towel
- □ Room or area where clothes can be dried
- □ Wet weather gear for those working in wet conditions
- □ Heated site hut where workers can take shelter and have meals with the facility for boiling water
- □ Suitable first aid facilities

Work in Public Areas

- \square All risks to the public identified
- □ Method statement approved
- □ Road closures approved
- □ Temporary diversions in place
- □ Safety barriers erected/maintained
- □ Safety signs and lighting installed/maintained
- □ Labor, materials, plant and other resources sufficient to meet program
- Temporary reinstatement completed and properly maintained
- □ Permanent reinstatement completed at earliest possible date