SHAHEED BENAZIR BHUTTO UNIVERSITY SHAHEED BENAZIRABAD

BIDDING DOCUMENTS

VOLUME-II (TECHNICAL SPECIFICATIONS)

Construction of Academic block-3 at Shaheed Benazir Bhutto University, Shaheed Benazirabad

MARCH, 2022

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TABLE OF CONTENTS

S.NO	DESCRIPTION	PAGE
1.	Section-0 GENERAL REQUIREMENTS	2 - 4
2.	Section-1 CLEARING, GRUBBING & SETTING OUT OF WORKS	5 - 6
3.	Section-2 EXCAVATION AND BACKFILLING	7 - 13
4.	Section-3 PLAIN AND REINFORCED CONCRETE	14 – 29
5.	Section-4 REINFORCEMENT STEEL	30 - 32
6.	Section-5 FORMWORK	33 – 36
7.	Section-6 BRICK MASONRY	37 – 39
8.	Section-7 PLASTERING AND RENDERING	40 – 43
9.	Section-8 WATER PROOFING	44 – 45
10.	Section-9 MISCELLANEOUS METAL WORK	46 - 50

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SECTION - 0
GENERAL REQUIREMENTS

0.01 GENERAL DESCRIPTION

0.1.01 Location of Site

The site of the project is located in Shaheed Benazirabad.

0.1.02 Work Under This Contract

The work under this Contract comprises the Construction, Completion, Handing over and Maintenance of Structure, Architectural, Finishes, Building Services relating to Electrical, Water Supply and Sewerage, site work and /or any other discipline necessary to be executed together with or incorporated in the structure works including but not limited to pipe sleeves, embedded parts, conduits, earthing pits, tube wells etc. as specified by the Contract/ necessitated by the project requirements/ instructed by the Engineer.

The Contractor shall be required to plan and execute the works in a manner such that the project is completed within the time specified in the Contract and in conformity with the provisions contained in the documents of Contract. The Contractor shall furnish a detailed construction Programe along with a list of plant and equipment with capacities and capabilities for the approval of the Engineer. The Contractor shall also be required to submit a site supervisory/ management chart.

0.1.03 Execution of Work

All Work shall be executed in accordance with the requirements and in a manner set forth in the documents of Contract and in accordance with the instructions of the Engineer or Engineer's Representative. The Contractor shall confine his operations to the areas that are actually designated, for the Works, by the Employer. The Contractor shall be required to supply and maintain his own storage facilities, site office, sanitary facilities, and all temporary connections for electricity, water, sewerage and telephone etc. at his cost, subject to the approval of the Engineer.

0.02 APPLICABLE STANDARDS

Unless specified otherwise in the Contract Documents, all the Work and materials shall conform to the requirements of American Society for Testing Materials (ASTM) Specifications, American Concrete Institute (ACI) and British Standard Specifications (BSS) and as per the Drawings and Specifications.

0.03 TEST LABORATORY AND TESTING

0.03.1 Testing unless specified otherwise in the Contract, shall be performed by an approved testing agency as proposed by the Contractor and at no extra cost to the Employer. The Engineer may require all testing to be carried out under his supervision.

0.03.2 The quality control testing shall be arranged and performed by the Contractor's competent personnel in accordance with a Site Testing and Quality Control Programe/Facility to be established by the Contractor, and approved by the Engineer. The Contractor shall keep complete record of all the quality tests performed including the date and time of testing and submit the same to the Engineer. All quality control and related tests shall be carried out in accordance with applicable standards and codes under the supervision of the Engineer. The Contractor shall establish a laboratory on site which shall have equipment for testing Compressive Strength of concrete, Sieve Analysis and Compaction Test, as per the instructions and to the satisfaction of the Engineer.

0.04 STORAGE AND HANDLING FACILITY

The Employer shall assign the Contractor storage space for the storage of plant, equipment and materials for Contract Works. However the Contractor shall ensure that, on no account shall such temporary installation conflict/interfere with any of the permanent installations, services and any operational function of the Employer. The handling and storage of all plants, equipment and materials at Site shall be the responsibility of the Contractor and at no risk or cost to the Employer.

The Contractor shall protect all materials against corrosion, damage of any kind or deterioration during storage and also during erection on Site. The protection methods shall be to the approval of the Engineer.

0.05 TEMPORARY FACILITIES

The Contractor shall provide, erect/install, maintain, alter as and when necessary and remove on completion except as otherwise directed by the Engineer all temporary facilities and services as described hereinafter and/or in the Contract documents and/or as instructed and approved by the Engineer, all at his own cost and expenses.

0.05.1 Contractor's Site Office

The Contractor's temporary site office and stores etc. including all buildings, utilities and facilities shall be available for use not later than 15 days after the date of the Site handing over.

0.05.2 Temporary Fencing & Lightning

The Contractor shall provide and maintain at his own cost all temporary lights, guards, fencing and watching to the approval of the Engineer for the safety and protection of the Works.

0.05.3 Site Sign Boards

Before manufacturing and installing sign boards at site, the Contractor shall present a design and obtain the approval of the Engineer.

0.05.4 Temporary Services

a. Water & Electricity

The Contractor shall make his own arrangement at his cost for water for construction, drinking and other purposes and shall also provide temporary power for the operation of construction equipment and lighting. The Contractor shall be responsible for the supply, maintenance, repair and operation of these services at his own costs throughout the construction period. The Contractor shall also provide adequate sanitary facilities for the use of his staff and Workmen and remove these services upon completion of Works at his own cost.

b. First Aid

The Contractor shall provide and maintain First Aid Facilities on the Site. First Aid kits of the type, model and number, equipped properly according to the requirements of the local health authorities and as approved by the Engineer must be furnished by the Contractor at Site.

c. Fire Fighting

The Contractor shall provide and maintain adequate firefighting facilities on the Site at his own cost to the approval of the local Fire Authority and Civil Authority and the Engineer. Firefighting equipment like fire buckets, fire extinguishers or other effective means ready for instant use shall be installed at suitable places at the project.

0.06 FACILITIES FOR THE ENGINEER

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0.06.1 **Supervisory Staff Site Office**

a. The Contractor shall provide and maintain suitably furnished Supervisory Staff Site Office for the Engineer and his staff as per the details approved by the Engineer. The site office shall be air-conditioned and provided with ceiling fans, utilities, security, kitchen and toilet facilities. The floor area and design of the site office shall be as approved by the Engineer. This duly furnished office shall be ready for possession of the Engineer within 15 days of Receipt of Engineer's notice to commence the work.

b. It shall be provided with Office attendants, Computers, printers, photocopy machines, phones, necessary office stationary etc. as listed in the tender documents

c. The Kitchen shall be equipped with all necessary Kitchen equipment, microwave oven and fridge.

d. Telephone and fax facilities as at (b) above shall be provided by the Contractor and all the installation and running costs shall be deemed to be included in the rates of the Contractor.

e. The Contractor shall provide and would be responsible for the daily cleaning, as well as the running and maintenance of the site office including, electricity supply, water, sewerage disposal etc.

f. The Site Office shall be removed from the site when the project is complete, leaving the site neat and clean and/or all as required by the Engineer. The cost on this account shall be deemed to be included in the unit rates of the Contractor.

0.06.2 **Supervisory Staff Transport**

The Contractor shall provide new air conditioned vehicles as listed in the tender document along with drivers for the use of the Engineer and his staff till the completion of the project. The Contractor shall be responsible for all the running and maintenance costs of the said vehicles. No separate payment shall be allowed on this account and all such costs shall be deemed included in the unit rates of the Contractor. All maintenance and repair works during the currency of the project shall be carried out promptly by the Contractor failing which all such works shall be got done by the Engineer at the cost of the Contractor.

0.07 PROJECT RECORD DOCUMENTS

The Contractor will submit shop drawings showing work sequence, work methodology, including location of construction joints, pouring sequences for the approval of Engineer prior to start of work on each stage of the project or at any time if requested by the Engineer.

The Contractor will maintain complete, accurate log of all construction work as it progresses through recording progress on the approved work-plan, progress reports and construction photographs stage wise.

The Contractor will submit weekly and monthly progress reports to the engineer, on approved format with photographs

On completion of foundation, retaining walls and other major construction milestones, prepare certified As-built drawing showing work done, dimensions, locations, angles and elevations of construction and site work.

0.08 MEASUREMENTS AND PAYMENT

No separate payment shall be made for the services and performance provided under this section of Specifications.

The Contractor is deemed to have covered the costs of all related supplies and performance in the unit prices of other contract items.

**** END OF SECTION****

SECTION - 1

CLEARING, GRUBBING & SETTING OUT OF WORKS

1.01 SCOPE OF WORK

The Work covered by this section of Specifications consists of furnishing all labour, materials, necessary equipment, services, miscellaneous and necessary items, required to satisfactorily complete the clearing, grubbing and setting out of the Works, as indicated on Drawings, specified herein and subject to the terms and conditions of the Contract.

1.02 CLEARING

Clearing shall consist of cutting up or trimming of trees, if any, and the satisfactory disposal of trees and other vegetation designated for removal, together with the down timber, snags, bushes, and rubbish occurring within the areas to be cleared. Trees, other vegetation, stumps, roots, and bushes in areas to be clear shall be cut-off below the original ground to extract the roots except such individual trees, groups of trees and vegetation as may be indicated on the Drawings or designated by the Engineer to be left standing. Individual trees, groups of trees, and other vegetation, to be standing, shall be thoroughly protected from damage incident to construction operations by the erection of barriers or by such other means as the circumstances required, and as approved by the Engineer. Clearing operations shall be conducted so as not to cause any damage or harm to existing structures and installations and to those under construction, and so as to provide for the safety of employees and others.

1.03 GRUBBING

Grubbing shall consist of the removal and disposal of all occurring stumps, roots larger than 38 mm in diameter, matted roots in the designated grubbing areas, stumps, roots, logs or other timber more than 38 mm in diameter, matted roots and other debris shall be excavated and removed to a depth not less than 450 mm below any subgrade, shoulder or slope. In areas where the cut is over 1.0m, grubbing shall not be necessary. In areas to be paved, or in areas indicated on the Drawings or designated by the Engineer as future paved areas where excess excavation from grading operations is placed, grubbing will be necessary.

1.04 DISPOSAL

Unless directed otherwise, timber and other refuse shall be disposed of by burning at locations approved by the Engineer in a manner that will avoid all hazards such as damage to existing structures, construction in progress, trees and vegetation's. The Contractor shall be responsible for compliance with all pertinent laws and regulations pertaining to the burning of fires and observance of any security regulations applicable thereto.

Disposal by burning shall be kept under constant attendance until the fires have burned out or have been extinguished. No materials will be permitted to be pushed or placed on adjacent property without prior written approval of the owner of such property.

1.05 SETTING OUT OF WORKS

The Contractor shall set out the Works and shall be responsible for true and perfect levels and setting out of the same and for correctness of the direction, positions, levels, dimensions and alignments of all parts thereof. If any error in this respect shall appear during the progress of the Work, the Contractor shall at his own expense rectify such error to the satisfaction of the Engineer. Any checking by the Engineer shall not relieve the Contractor from his complete unshared responsibility for correct setting out of Works. The Contractor shall construct and maintain accurate bench marks so that the lines and levels can be easily checked by the Engineer.

1.06 DRAINAGE DITCHES/ DEWATERING

The Contractor shall construct and maintain such ditches/drains in addition to those shown on Drawings or as may be ordered by the Engineer to adequately drain the areas under construction of the water from any source including subsoil water in foundations. If due to any negligence the area is flooded the same shall be drained with adequate measures by the Contractor at his own cost.

1.07 MEASUREMENT AND PAYMENT

The quantities for grubbing, clearing, disposal and protection works shall be taken into account on lump sum basis and payment shall be made accordingly at the rate entered in the Bill of Quantities.

No separate payment shall be made for setting out of Works. The Contractor shall be deemed to cover the costs for this item of work in the unit price of other Contract items.
Disposal of surplus material beyond initial 1000m lead

**** END OF SECTION****

SECTION - 2

EXCAVATION AND BACKFILLING

2.01 SCOPE OF WORK

The Work covered by this section of the Specifications consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations in connection with excavation, de-watering, filling, back-filling, stock piling of suitable excavated material and disposal of all surplus and unsuitable material for construction works and foundations for structure & services line trenches, complete, in strict accordance with this section of the Specifications and the applicable Drawings and subject to the terms and conditions of the Contract and as per existing laws imposed by the local authorities.

2.02 SUB-SOIL CONDITIONS

2.02.1 The Contractor shall acquaint himself with the nature of the ground, existing structures, foundations and subsoil conditions, which might be encountered during excavation or earthworks on the Site and his bid shall be fully covering the works involved. The Employer does not guarantee or warrant in any way that the materials to be found in the excavation will be similar in nature to that of any samples which may have been exhibited or indicated in the Geotechnical Report, Drawings or in any other Contract Documents or to material obtained from boring or trial holes.

2.02.2 The Contractor shall make his own deductions for sub-surface conditions which may affect methods or cost of constructions of the work hereunder and he shall make no claim whatsoever for damages or compensation, should he find conditions during the progress of the Work, different from those as calculated and/or anticipated by him.

2.02.3 The Contractor shall be deemed to have made local and independent inquiries as to and shall take the whole risk of the nature of the ground, subsoil or material to be excavated or penetrated and the Contractor shall not be entitled to receive any extra or additional payment nor to be relieved from any of his obligations by reasons of the nature of such ground, subsoil or material.

2.03 EXCAVATION

2.03.1 The Contractor shall perform a joint survey with the Engineer's Representative, of the area where earthwork is required, plot the ground levels on the drawings and obtain approval from the Engineer before starting the earthwork.

2.03.2 Excavation shall include the removal of all material of every name and nature. If rock or concrete is encountered, it should be removed carefully and without excessive noise and vibration. Use of explosives shall not be permitted and no extra rates or any payment in such a case shall be made to the Contractor.

2.03.3 The Contractor shall give reasonable notice to commence any excavation and he shall submit to the Engineer full details of his proposals. If the Engineer may require modifications to be made in the Contractor's proposals, the Contractor shall give effect to such modifications but shall not be relieved of his responsibility with respect to such work.

2.03.4 For major excavations, the Contractor shall submit for the prior approval of the Engineer full details and Drawings showing the proposed method and procedure for supporting and strutting, dewatering and maintenance of adjacent structures. The design, provision, installation, erection, maintenance and removal of such temporary works shall be the responsibility of the Contractor and all costs in these respects shall be deemed to be included in the rates quoted by the Contractor.

2.03.5 The Contractor's attention is drawn particularly to his obligations under the General Conditions of Contract in respect of those works which are in close proximity to existing buildings/structures.

2.03.6 The Contractor, if he deems necessary, for large excavations in soil including soft rock, can use excavators, caterpillars, backhoes and/or other excavating machinery as approved by the Engineer, to facilitate efficient operations on site.

2.03.7 The excavation shall conform to the dimensions and elevations as indicated on the Drawings or as directed by the Engineer. Foundations on made up ground shall have to be taken down to natural bottom soil as per Drawings, direction and approval of the Engineer.

2.03.8 Excavation shall extend to a sufficient distance from wall and footings to allow for placing and removal of forms, installation of services and for inspection but the same shall not be paid separately and is deemed to be included in the unit rates of the Contractor.

2.03.9 In the event of any excavations being carried out deeper than required/specified levels, the same shall be filled in by the Contractor at his own cost to the required levels with lean concrete 1:3:6 under the footings and foundation slabs as per the instructions of the Engineer.

2.03.10 In the event of any excavations being carried out wider than the required/specified dimensions, the same shall be filled in by the Contractor at his own cost to the required levels with properly compacted well graded sand free from any deleterious substance as per directions of the Engineer.

2.03.11 No excavation shall be back-filled nor any Permanent Work commenced until the foundation has been inspected by the Engineer and his permission to proceed given.

2.03.12 In case, any excavation is carried out and the pits and trenches, are filled with accumulated sand or debris from blowing windstorm, dust-storms, moving sand dunes or by any other reasons thereof after the levels were checked by Engineer, then the excavation or levelling shall have to be carried out again in the same manner as before unless and until concreting is done in the foundation/trenches. No separate payment shall be made on any such accounts.

2.03.13 The Contractor shall construct and maintain such ditches, in addition to those shown on the plans, as will adequately drain areas under construction.

2.04 SHORING AND BRACING

The Contractor shall provide at his own cost, where required, all shoring, bracing, walls, supports etc. to the sides of the excavation to prevent sliding or any movement. Where necessary, excavated sides shall be sloped as directed by the Engineer with no extra cost to the Employer.

Shoring including sheet piling, where required during excavation, shall be installed to protect workmen and the banks, adjacent, structures, paving and utilities. The term shoring shall also be deemed to cover whatever methods the Contractor selects to adopt with prior approval of the Engineer, for upholding the sides of excavation against the side of public roadways and adjoining properties in existing hardcore or any other material. The Contractor will be held responsible for upholding the sides of all excavations and no claim for additional excavation, concrete or other material will be considered in this respect and shall be deemed to be included in his rates.

2.05 DEWATERING AND DRAINAGE

If water is met with in the excavations due to springs, seepage, rain or any other causes, it shall be removed by suitable diversions, pumping or bailing out and the excavation kept dry at all times. Care shall be taken to discharge the drained water into suitable outlets as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the contractor, if any such damage is

caused, it shall be the sole responsibility of the contractor to repair/restore to the original condition at his own cost or compensate for the damage.

The Contractor shall control at his own cost all the grading in the vicinity of the Site of Work in order to prevent any water from running into the excavated areas.

The Contractor shall, at his own cost, keep bone dry all pits and trenches during construction and all dewatering and pumping out whether due to ground water seepage or otherwise shall be included in the rates as quoted by the Contractor. The method employed in all cases shall be approved and agreed by the Engineer.

2.06 PROTECTION OF UTILITY LINES

When any existing utility lines whether to be retained or to be removed are encountered within the area of operations, the Contractor shall notify the Employer/Engineer, and shall not proceed until necessary measures are taken for protection or removal of the lines and instructions are obtained from the Engineer/Employer. This will be done at no extra cost to the Employer.

2.07 FILL AND BACKFILL

2.07.1 After completion of foundations, footings, walls, slabs and other construction below the elevation of the final grades and prior to backfilling, forms shall be removed and excavation shall be cleaned of trash and debris. No backfilling shall be done until the entire foundations and footings etc. have been cured, inspected, approved and measured by the Engineer. Backfill shall be placed in horizontal layers not more than 6" thick and shall have a proper moisture content for the required degree of compaction of 95%. Each layer shall be compacted by mechanical tampers or by other suitable equipment approved by the Engineer. Backfill shall be brought to a suitable elevation above grade to provide for anticipated settlement and shrinkage thereof.

2.07.2 Where concrete slabs, floors and pavements are to be placed on the ground, any loam, organic and other unsuitable materials shall be removed.

2.07.3 Filling shall consist of approved selected material from excavation or approved granular material, free from lumps, debris, rubbish, wood, organic or other unsuitable matter and capable of compaction by approved means.

Fill, where required to raise the sub-grade for concrete slabs, shall be clean unadulterated earth, free from deleterious and organic substances and shall also be free from wood, stones and other debris. In case, sand shall be provided for filling, the same shall be clean and free from harmful substances.

2.07.4 All materials, when used in fill shall be compacted to 95% modified AASHTO density by power roller, mechanical rammer, or other approved equipment, in layers not more than 6" thick. In sand filling, each layer shall be uniformly spread, saturated with water or dried and then compacted. The Contractor shall arrange at his own cost the testing of the filling.

2.07.5 Backfill shall not be placed against foundation walls etc. before 14 days and not prior to the damp proofing /water proofing treatment as specified elsewhere in these documents. Backfills shall be brought up evenly on each side of structures as far as practicable. Heavy equipment for spreading and compacting backfill shall not be operated closer to the structures less than the distance equal to the height of the backfill above the top of footing.

2.07.6 The filling material shall be subject to the approval of the Engineer and shall conform to AASHTO Soil Classification System.

2.07.7 Filling around pipes and cables shall be carried out carefully by placing fine material to cover the pipe or cable completely before the normal filling is placed.

2.08 COMPACTION

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Fill and/or backfill within the building or wherever required within the premises shall be compacted to a density of not less than 95% of the maximum density at optimum moisture content.

2.09 ROUGH GRADING

2.09.1 Necessary rough grading shall be carried out by the Contractor to establish the finish grade or construction requirements of the Site, grades not otherwise indicated shall be uniform levels or slopes between points on existing and finished grades. Abrupt changes in slopes shall be rounded. Additional fill required to complete rough grading shall be provided as directed by the Engineer.

2.09.2 Where paving or slabs are specified, all rough grading shall be done to the sub-grade of the base course, removing all large stones and debris and shall be compacted uniformly to the correct lines and levels ready to receive the paving or slab. Refilling, where required shall be executed with suitable selected materials in layers not exceeding 6" in thickness and thoroughly compacted to the required density.

2.10 BOTTOM ELEVATIONS OF FOOTINGS/FOUNDATIONS

The elevations as noted in the Drawings are only approximate and must be adjusted in the field with the approval of the Engineer depending on the soil conditions encountered. No concreting shall begin until the design soil bearing capacity is substantiated by visual inspection by the Engineer. Where suitable foundation material is found lower than the underside of footings as detailed, the space between the founding material and footing soffit shall be backfilled with well compacted gravel/soling. Where soling is provided below the foundations, it shall be well compacted and the interspaces shall be properly filled with lean concrete.

The Contractor in planning his work shall make arrangements and provision to construct the lowest level footing first.

2.11 DISPOSAL OF SURPLUS EARTH AND RUBBISH

All surplus earth, unsuitable material and rubbish shall be disposed of the Site as directed by the Engineer. The term disposal shall include all operations of loading, unloading, stacking, spreading, re-handling, filling depressions, leveling and grading as per instructions of the Engineer. The maximum limit for disposal of surplus material shall be 18 miles.

2.12 SAND FILLING IN TRENCHES AND/OR UNDER FLOORS

Sand filling shall be done in layers not more than 4" (100 mm) thick and shall be rammed after saturation to such an extent that 4" (100 mm) layer is reduced to about 2.7" (68 mm) after compaction.

The required in situ density w.r.t. maximum density to optimum moisture content shall be in compliance with test 12 of B.S 1377-1967.

The base shall be perfectly level. A slope of 1:64 shall be provided in verandahs and bath rooms is required.

Sand shall conform in all respect to the specifications for fine aggregate except for its grading, i.e. shall pass through a Sieve No. 16 and not more than 30% shall pass through a Sieve No. 100.

2.13 GRAVEL LAYER UNDER FOOTINGS

A gravel layer, as shown in drawings, will be provided below footings/ rafts as a drainage layer. It shall conform to conditions set out in Section 29 of this specification.

2.14 HARD ROCK EXCAVATION

Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and un-stratified masses which cannot be removed without systematic drilling and blasting; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock and which cannot be removed without systematic drilling and blasting. Except where trees are indicated to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without express permission of the ENGINEER. Trees shall be supported during excavation by any means previously reviewed by the ENGINEER.

It is expected that nearly all excavation can be accomplished using conventional equipment.

a. For general excavation, a D-9N Caterpillar tractor with a single shank ripper, or equivalent equipment, is considered conventional equipment, if it can rip at a production rate of at least 300 bank cubic yards per hour.

b. For trench excavation, a 235C Caterpillar excavator with a medium stick and a rock ripping bucket, or equivalent equipment, is considered conventional equipment, if it can excavate at a production rate of at least 30 bank cubic yards per hour.

If material is encountered which the Contractor believes cannot be excavated by conventional equipment, the Engineer shall be immediately notified.

The Contractor shall provide performance tests of the specified conventional or equivalent equipment. If the Engineer confirms in writing that the specified conventional equipment cannot perform at the production rates specified, the excavation shall be considered rock excavation.

In areas to be later rip-rapped, large rock found during excavation of the stream channel may, upon approval of the Engineer, be left in place, excavated around and incorporated into the final riprap.

Should the Contractor encounter bedrock or excessive large boulders within the project site, which will require extensive excavation to achieve final grade, the Contractor shall immediately notify the Engineer. The Engineer shall review the hydraulic requirements of the stream in the affected area in a timely manner and advise the Contractor on acceptable alternate excavation.

The Contractor shall adopt a method of working such that at any time, control perimeter blasting operations including the drilling of perimeter holes do not advance by more than one panel ahead of bulk blasting operations and more than two panels ahead of mucking operations to remove all blasted materials to the perimeter face, unless specially approved by the Engineer, in order that adjustments to drilling, charging and detonation can be made, appropriate to the conditions being encountered.

Rock on the cut face that is loose, hanging, or creates a potentially dangerous situation during or upon completion of the excavation in each lift shall be removed or stabilized. No drilling for the next lift shall be carried out until this work is completed. Stabilization shall be performed at Contractors' own expense if caused by the Contractor's blasting operations

Slopes of cuttings formed in rock are to be cleaned of all rock fragments which move when pressed with a crowbar

Explosives and Blasting

It is not anticipated that blasting will be required for this project. Should the Contractor exhaust conventional equipment and methods for rock excavation and removal and desire to use explosives to accomplish this work, it shall comply with the following:

a. Blasting and storage and handling of explosives shall be in accordance with the Construction Safety Orders of the Division of Industrial Safety of the California Department of Industrial Relations, Federal Safety Requirements, the San Mateo County Sheriff, and other authorities which have jurisdiction.

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b. The Contractor shall obtain all necessary permits and furnish copies to the Engineer before explosives are transported to the site. The Contractor shall pay for permits at no additional cost to the Owner.

c. Blasting shall be done only by skilled operators under the direction of a licensed foreman.

d. The Contractor shall identify all property, structures, and persons which may be affected by blasting and shall take all safety precautions and protective measures to prevent damage or injury to same. All personal injury or damage to persons or property of any nature, whether in the WORK or appurtenant to it, shall be the responsibility of the Contractor.

e. The Contractor agrees by submission of a bid to indemnify and hold the Owner, its officers, agents, employees, and the Engineer harmless from any and all liability claims, costs and expenses including expenses of investigation and defending against same in regard thereto.

f. Blasting shall only be permitted in hours approved by the Engineer and regulatory agencies having jurisdiction. Blasting will not be permitted on legal holidays.

Pre-Blasting

a. Inspections of all structures within [300-feet] of the blast site shall be made more than 2 weeks prior to commencement of blasting. A qualified independent inspector shall perform the inspections for the purpose of detecting and documenting any visible or reasonable recognizable pre-existing defects or damages in structures.

b. Waiver of inspections shall be in writing, signed by structure owners or persons with control or custody of the structures.

c. Complete inspection reports listing findings with photographs or waivers shall be signed by the inspector. One copy of inspection reports and waivers, shall be submitted to the Engineer before blasting commences.

d. The Contractor shall give 30 and 5-day notices to all residence and businesses, and utility owners which may be affected by blasting.

Blasting

a. The Contractor shall perform instrumented seismographic monitoring on blasting. A seismograph shall be placed at [the nearest structure to the blast] to monitor the ground motion particle velocity and frequency during each blast. One copy of each daily seismograph chart shall be furnished to Engineer.

b. Fly rock from blasting shall be contained within the project site and shall not represent a hazard to persons, vehicles, existing improvements, or vegetation.

c. The blasting site shall be cleaned of all debris at the end of each day.

d. No blasting shall be done within 100-feet of concrete which has been placed in less than 7 days, except by permission of the Engineer.

Post-Blasting

The Contractor shall submit an As-built layout plan showing the extent of the rock excavation/blasting area (Before and after excavation within the claiming period) with indication of hard rock area rock's spot levels.

The independent inspector shall investigate each complaint of property damage and a written report shall be furnished to the Engineer within 30 days of receipt of the complaint.

2.15 MEASUREMENT & PAYMENT

Excavation shall be measured per cubic Meter/ft on the assumption of vertically excavated walls required for the nominal concrete dimensions of the structural members of the foundation shown on the Drawings and paid for at the unit rates entered in the Bill of Quantities, inclusive of backfilling, compaction, disposal of surplus earth, dewatering, bracing, shoring etc.

All horizontal measurements shall be taken from established reference point. At the option of the Engineer-in-charge, the contractor shall leave depth indicators during excavations of such shape and size and in such positions as directed so as to indicate the original ground level as accurately as possible. The contractor shall see that these remain intact till the final measurements are taken.

Disposal of surplus material beyond initial 100 ft lead up to a maximum of 18 miles shall be paid separately, at the rate approved by the Engineer.

Dewatering shall not be paid separately. All dewatering and pumping out whether due to ground water seepage or otherwise shall be included in the rates as quoted by the Contractor.

ROAD WORK CONSTRUCTION:
For the road work construction or where not specified in this documents National Highway Authority (NHA) specification will be followed.

**** END OF SECTION****

SECTION - 3

PLAIN AND REINFORCED CONCRETE

3.01 SCOPE OF WORK

The Work covered by this section of the Specifications consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations in connection with plain and/or reinforced concrete work complete in strict accordance with this section of Specifications, applicable Drawings and subject to the terms and conditions of this Contract.

3.02 APPLICABLE STANDARDS

Latest editions of the following Pakistan, British and ASTM ACI Standards are relevant to these specifications wherever applicable.

3.02.1 Pakistan Standards

PS233	Portland Cement (ordinary & rapid hardening)
PS243	Natural aggregates for concrete
PS279	Abrasion of coarse aggregates by the use of Los Angeles machine.
PS280	Determination of aggregates crushing value
PS281	Organic impurities in sand for concrete aggregate.
PS282	Material finer than No. 200 BS test sieve in aggregates, method of test for
PS283	Soundness test for aggregates by the use of sodium sulphate or magnesium sulphate.
PS284	Sampling aggregates for concrete
PS285	Sieve or screen analysis of fine and coarse
PS286	Description and classification of mineral aggregates
PS421	Sampling fresh concrete
PS422	Slump test for concrete
PS560	Making and curing concrete compression test specimen in the field. Sulphate-resistant Portland cement type 'A' and sampling fresh concrete in the laboratory.
PS612	Mixing
PS716	Compacting factor test for concrete
PS717	Definitions and terminology of cements
PS746	Making and curing concrete compression test cubes.
PS849	

3.02.2 ASTM (American Society for Testing and Materials)

C33	Standard Test Method for Fine and coarse aggregates Organic impurities in sand for concrete.
C39	Standard Test Method for Compressive Strength of Cylindrical Concrete
C40	Specimens
C87	Effect of organic impurities in fine aggregates on strength of mortar. Soundness of aggregates.
C88	Ready mixed Concrete.
C91	Cement Standards and Concrete Standards
C94	Compressive strength of hydraulic cement mortars
C 109	Material finer than No. 200 (0.075mm) sieve
C 117	Light weight pieces in aggregates.
C 123	Concrete and concrete aggregates.
C 125	Specific gravity and absorption of coarse aggregate.
C 127	Specific gravity and absorption of fine aggregate.

C 128	Resistance to abrasion of small size coarse aggregate.
C 131	Sieve or screen analysis of fine and coarse aggregate.
C 136	Clay lumps and friable particles in aggregates.
C 142	Slump of Portland Cement Concrete
C 143	
C150	Standard Specification for Portland Cement
C156	Water retention by concrete curing material
C171	Sheet material for curing concrete.
C185	Air content or hydraulic cement mortar.
C188	Density of hydraulic cement.
C191	Time of setting of hydraulic cement by vicat needle
C260	Air entraining admixture for concrete.
C289	Potential reactivity of aggregate.
C309	Liquid membrane forming compounds for curing concrete.
C387	Chemical admixtures for concrete.
C494	Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete
C535	Resistance to abrasion of large size coarse aggregates.
C75	Aggregate sampling.
C994	Preformed expansion joint filler for concrete.
C1190	Concrete joint sealer (hot poured elastic type).
C1715	Preformed expansion joint filler for concrete paving and structural concrete.
D1850	Concrete joint sealer (cold application type).
E11	Wire cloth sleeves for testing purposes.
E96	Water vapor transmission of materials in sheet form.
E154	Materials for use as vapor barrier under concrete slabs.
E337	Relative humidity by wet and dry bulk psychrometer.

3.02.3 **ACI (American Concrete Institute)**

211	Recommended practice for selecting proportions for normal and heavy weight concrete.
214	Quality control charts
301	Specifications for structural concrete for building.
304	Recommended practice for measuring, mixing, transporting and placing concrete.
305	Hot weather concreting.
308	Recommended practice for curing concrete.
309	Recommended practice for consolidation of concrete
315	Manual of standard practice of detailing reinforcement concrete structure.
	Building code requirement of reinforced concrete.
318	Recommended practice for concrete formwork.
347	

3.02.4 **British Standards**

BS 12	Specifications for Portland cement, ordinary and rapid hardening
BS 410	Specifications for Test Sieve
BS 812	Specification for aggregates from natural sources for concrete Method of testing concrete
BS 822	Test for water making concrete
BS 1881	Method for determination of Compressive Strength of Concrete Cubes
BS 1348	Rigid expanded polyvinyl chloride for thermal insulation.
BS 3837	Sulphate-resisting Portland cement
BS 4027	Specification for Sulfate-Resisting Portland Cement
CP 8110	Specifications for Design and Construction of Reinforced and Pre-stressed
CP 114	Concrete

PROJECT MANAGEMENT UNIT PMU
PLANNING ENGINEERING & SERVICES CONSULTANT

BS 4550	The Structural Use of Reinforced Concrete in Buildings
BS 8500	Methods of Testing Cement Concrete – Complementary British Standard

In addition, the latest editions of other Pakistan and British Standards, American Concrete Institute Standards, American Society for Testing and Materials Standards and other Standards as may be specified by the Engineer for special Materials and Construction are also relevant.

3.03 GENERAL

3.03.1 Until and unless specified or directed otherwise by the Engineer, all materials and workmanship shall be based on the latest versions of applicable ASTM Standards in force at the time of inviting tenders.

3.03.2 Any defective work in the opinion of the Engineer shall be removed and reconstructed without undue delay to the approval of the Engineer and the Contractor shall bear all additional costs incurred.

3.03.3 Any previous checks by the Engineer shall not in any way relieve the Contractor of his responsibility in respect of quality and accuracy of Work.

3.03.4 Full care shall be taken to install embedded items. Embedded items shall be inspected and checks for reinforcements and other materials and items shall be completed and approved before concrete is placed.

3.03.5 The Contractor shall get the bar bending schedules of reinforcement checked and approved from the Engineer prior to the cutting of reinforcement.

3.03.6 The Contractor shall maintain an accurate record of ambient temperature of Site. Ambient temperature shall be measured using mercury thermometers or other thermometers acceptable to the Engineer.

3.03.7 Throughout the concrete work, the Contractor shall employ full time on the Works suitable number of qualified and experienced Engineers whose sole duties shall be as follows:

- Design of concrete mixes
- Quality control of concrete
- Supervision of mixing, transporting, placing, compacting, finishing, curing and protecting concrete.
- Supervision of sampling and testing.
- Preparation and submission of test certificates and reports.
- Completion and keeping of record.
- Such other duties as the Engineer may direct.

3.03.8 All concrete work including reinforcement etc. shall be carried out in accordance with the applicable requirements of ACI/ASTM/BSS Standards and to the instructions of the Engineer.

3.04 MATERIALS

3.04.1 Cement

a) Ordinary Portland cement shall be grey normal setting cement of approved make and source and of the specified gravity, fineness and chemical composition fully conforming to British Standard Specifications BS-12 and shall be capable of satisfying all tests such as the tensile strength tests contained therein.

b) Sulphate resistant cement where required shall be sulphate resistant Portland cement of the approved make fully conforming to BS-4027 and satisfying the requirements for fineness, chemical composition, strength, setting time and soundness, etc.

c) For all types of cement described in sub-clauses 4.03.1 (a) & (b) above, the cement shall have a tricalcium aluminate (C_3A) content by weight not less than 5% and not more than 8%.

d) For all types of cement described in sub-clauses 4.03.1 (a) & (b) above. The initial setting time shall not be less than 45 minutes and final setting time not more than 10 hours.

e) The supply of cement must be so programmed by the Contractor that at no time the quantity of cement stock shall be less than that required for an average consumption of four weeks. Lorry or truck or other means of transportation for the conveyance of cement to the Site of Work shall be clean, dry, metal-lined and covered from top with water proof sheets, so that cement is sufficiently protected from any deterioration during transit.

f) Cement shall be delivered in sealed bags and be stored in moisture-protected and well-ventilated sheds and each cement supply shall be stored separately.

g) The Contractor shall provide at his own cost on the Site all necessary sheds which shall be perfectly dry, waterproof and adequately protected against ingress of water for the storing of cement to be delivered to the Work, to ensure adequate supplies being available for the Work.

h) Cement, which is damp or contains lumps which cannot be broken to original fineness by finger pressure will be condemned irrespective of age and must be removed from the Site.

i) If any time the Engineer considers that any batch of cement may have deteriorated on Site during storage for any reason, he will direct that tests shall be made and the batch of cement on the Site which may be in question shall not be used until it has been shown by test to be of satisfactory quality at a laboratory approved or appointed by the Engineer. The Contractor shall bear all costs of such testing. The Contractor without delay shall remove any rejected cement from the Site. Cement reclaimed from cleaning bags or leaking containers shall not be used in the Works and immediately be removed from the Site.

j) Cement shall be consumed in the sequence of its arrival at Site unless otherwise directed by the Engineer.

3.04.2 **Aggregates**

a) All fine and coarse aggregates to be used shall be supplied from approved sources, which shall not be changed without permission in writing from the Engineer. Aggregates shall conform to the requirements of applicable ASTM C33-82.

b) Fine aggregates, shall be from an approved source of supply of a uniform quality conforming to ASTM C-33-82 and shall be clean and sharp and free from clay, earth, vegetable and organic matters, alkaline or acid reactions or other deleterious salts or such harmful matters and impurities.

c) Fine aggregates shall conform to the requirements of the relevant ASTM C-33-82 Specifications, and shall be graded as follows;

Sieve Number/Size	Percentage (by weight) passing
9.5 mm (3/8")	100
4.75 mm (No. 4)	95 - 100
2.36 mm (No. 8)	80 – 100
1.18 mm (No. 16)	50 – 85
0.6 mm (No. 30)	25 – 60

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0.3 mm (No. 50)	10 – 30
0.15 mm (No. 100)	2 – 10

d) Coarse aggregates shall be approved river gravel or hard crushed stone from a source approved by the Engineer and shall be clean, inert, hard, non-porous and free from laminated particles, sand, dust, salt, lime, chalk, clay, organic impurities or other deleterious matter.

e) Coarse aggregate shall also conform to the requirements of Table 2 of ASTM C-33 and shall be graded as follows:-

For Reinforced Concrete (Nominal Size of Graded Aggregates 20.0 mm to 2.36 mm)

Sieve Number/Size	Percentage (by weight) passing
25.0 mm	100
20.0 mm	90 – 100
9.5 mm	20 – 55
4.75 mm (No. 4)	0 – 10
2.36 mm (No .8)	0 – 5

f) All aggregates shall be stored on properly constructed paving and in bins and there shall be a physical partition between the stockpiles of coarse and fine aggregates. No mixed up aggregates shall be used in any concrete. Under no circumstances aggregates shall be allowed to be in contact with ground.

g) If required, aggregates shall be washed and screened to the sequence of receipt of supplies unless otherwise directed by the Engineer.

h) All aggregates shall be subjected to the approval of the Engineer. Any aggregates not found to be of the required standard shall be rejected by the Engineer and shall have to be removed from Site without delay. Concrete structures executed with rejected aggregates shall be dismantled and rebuilt at the Contractor's expense.

i) Special fine gravel of 9 mm. size shall be used if called for in the Drawings or as directed by the Engineer.

j) Physical properties of aggregates shall be in accordance with Table 3 of ASTM C33.

3.04.3 **Water**

Water to be used in the Work shall be potable water and shall be free from all impurities whether suspended or dissolved. Further, the water shall not contain any chemical impurities, salts etc. of any kind. Water shall be tested for its fitness in Works in accordance with AASHTO Method T26-51.

3.04.4 **Admixtures**

a) Suitable admixtures from BCR, Sika, Fosroc, Betocrete C-16 or Master Builders or other approved manufacturers may be used in concrete mixes with the prior approval of the Engineer. The amount of admixtures added to each batch of concrete requires careful control and shall be added in the doses as recommended by the manufacturers and approved by the Engineer. The cost of the admixtures shall be deemed to be included in the rates.

b) For use of an admixture, the information required by the Engineer shall be submitted to him for each admixture for his approval.

c) BASF 700 or approved equivalent concrete retarding agent, may be used if required with the approval of Engineer

3.05 CLASSIFICATION OF CONCRETE

Classification of concrete to be used in various parts of the Works shall be as indicated on the Drawings and mentioned in the Bill of Quantities. Unless noted otherwise, all blinding concrete shall be of Class E. The concrete of various grades shall be proportioned as set out in Table-1 appended hereto.

Table-1 showing minimum required compressive strengths on 6" x 12" long test cylinders and minimum quantity of cement required per m^3 of finished concrete for various mixes and under various conditions is given below:

TABLE – 1

Class of Concrete	Minimum Qty. of Cement Kg/m^3	Work Cylinder Strength		Max. Water-Cement Ratio
		@ 7 days (psi)	@ 28 days (psi)	
D2	540	4200	6000	0.33
D1	400	3500	5000	0.40
D	385	3150	4500	0.42
A3	350	2800	4000	0.45
A2	325	2450	3500	0.47
A1	300	2100	3000	0.50
C	300	1750	2500	0.50
E	275	1400	2000	0.52
F	217	875	1250	0.55
G	159	600	850	-

Non-structural Concrete

Non-structural concrete (NS concrete) shall be used only for non-structural purposes where shown on the Drawing. NS concrete shall be compound of ordinary Portland cement and aggregates complying with this Specification.

The weight of cement mixed with 0.3 cubic meters of combined aggregate shall not be less than 50 kg. The mix shall be proportioned by weight or by volume. The maximum aggregate size shall be 40 mm nominal.

The concrete shall be mixed by machine or by hand to a uniform colour and consistency before placing. The quantity of water used shall not exceed that required to produce a concrete with sufficient workability to be placed and compacted where required.

The concrete shall be compacted by hand towels or rammers or by mechanical vibration.

3.06 PROPORTIONING OF CONCRETE MIXES

All concrete shall be proportioned by weight for design of concrete mixes, unless specifically agreed by the Engineer to proportion them by volume, which permission shall be given only if the arrangements made at Site are satisfactory. The Contractor shall submit to the Engineer proposed mix designs for concrete to be used, based on preliminary laboratory tests to determine proportion of cement, aggregates and water in the concrete conforming to the quality and strength requirements specified herein. Preliminary test results of at least three different mixes of each class of concrete with varied water-cement ratio shall be submitted. The results of 7 days and 28 days cylinder tests shall be used to establish the ratio between 7 days and 28 days strengths of used concrete. The Engineer may make adjustments in the ratio of fine to coarse aggregates in the mix for a certain work. Preliminary design of mixes and testing shall be the responsibility of the Contractor at his own cost. The proportion of voids in between the coarse aggregate shall be controlled and if it exceeds 0.45%, the Contractor

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without any charge shall increase sand and consequently the cement. If the proportion is less than 0.45%, sand shall be decreased but not the cement.

The detailed data, calculations and test results shall be compiled in a report and the proposed mix be declared by the Contractor. The report shall be submitted to the Engineer in time before commencing the concrete works and all test results shall be to the Engineer's satisfaction.

Lack of approval by Engineer shall not constitute a reason for an extension of time or additional costs.

3.06.1 **No Fines Concrete**

"No Fines" concrete shall consist of approved aggregate graded between 40mm and 20mm with not more than 5% passing the 20mm sieve.

The mix shall consist of 0.25 cu m of aggregate to 50kg cement. The aggregate is to be damp at the time of mixing and the water/cement ratio is to be strictly controlled to evenly wet the aggregate with grout.

The concrete is to be placed as quickly as possible after mixing and is to be lightly rodded to assist placing. The concrete shall not be vibrated or rammed.

3.06.2 **Maximum Allowable Water Content**

All concrete specimens shall be made, cured and tested in accordance with ASTM Standard. A curve representing the relation between the water content and the average 28 days compressive strength or earlier strength at which the concrete is to receive its full working load shall be established for a range of values including all the compressive strengths shown on the plans. The curve shall be established by at least four points, each point representing average values for at least four test specimens. The maximum allowable water content for the concrete shall be as determined from this curve and shall correspond to a strength 15% greater than indicated on the plans. However, the water cement ratio shall not exceed the value given in Table-1 above for the class/strength of concrete specified. No substitution shall be made in the materials used in the work without additional tests in accordance herewith to indicate that the quality of the concrete is satisfactory.

3.06.3 **Slump Test**

The slump for concrete, determined in accordance with ASTM C-143 Test for Concrete, shall be minimum of 2" and maximum of 4" provided the requisite strength is obtained. Corrective additions to remedy deficiencies in aggregate gradations shall be used only with the written approval of the Engineer. When such additions are permitted, the material shall be measured separately for each batch of concrete.

3.07 BATCHING AND MIXING

Concrete shall be mixed by a mechanical batch type mixing plant with adequate facilities for accurate measurements and control of each material entering the mixer and for changing the proportions to conform to varying conditions of the Work. The mixing plant assembly shall permit ready inspection of operations at all times. The plant and its location shall be subject to approval of the Engineer.

Water shall be measured for every batch with due allowance for water already present in aggregates.

3.07.1 **Batching Units**

Batching units shall be supplied with the following items:-

a) Weighing unit shall be provided for each type of material to indicate the scale load at convenient stages of the weighing operations. Weighing units shall be checked at times directed by and in the presence of the Engineer and required adjustments shall be made before further use.

b) Water mechanism shall be tight, with the valves interlocked so that the discharge valve cannot be opened before the filling valve is fully closed and shall be fitted with a graduated gauge.

c) Discharge gate shall control the mix to produce a ribboning and mixing of cement with aggregates. Delivery of materials from the batching equipment to the mixer shall be accurate within the following limits:-

Materials	**Percentage by Weight**
Cement	+1%
Water	+1%
Aggregate smaller than 3/4"	+2%
Aggregate larger than 3/4"	+3%

3.07.2 **Mixing Units**

a) Mixers shall not be charged in excess of rated capacity nor be operated in excess of rated speed. Excessive mixing requiring addition of water to preserve required consistency shall not be permitted. The entire batch shall be discharged and discarded before re-charging.

b) Mixing time shall be measured from the instant water is introduced into the mixer drum containing all solids. All mixing water shall be introduced before one-fourth of the mixing time has elapsed. Mixing time for mixers of one cubic meter or less shall be not less than 2 minutes; for larger than one cubic meter capacity mixers, time shall be increased by 15 seconds for each additional half cubic meter or fraction thereof, which may be varied if the charging and mixing operations fail to result in the required uniformity in composition and consistence within a batch and from batch to batch. If an air-entraining agent is allowed to be used, additional mixing time shall be allowed so as to provide the specified air-content.

c) Unless waived by the Engineer, device such as discharge-lock to lock the discharge mechanism, until the required mixing time has elapsed, shall be provided on each mixer. Mixing shall continue for at least 40 revolutions of mixer drum.

d) No hand mixing under any circumstances even with extra cement shall be permitted. If during concreting, the mixing plant fails, the concrete already poured shall be removed, unless directed otherwise by the Engineer. Mixers, which have been out of use for more than 30 minutes shall be thoroughly cleaned before any further concrete is mixed.

e) The mixing water shall be regularly sampled and tested for salt content and contamination.

3.08 SAMPLES AND TESTING

3.08.1 **General**

Test cylinders of concrete shall be prepared and stored by the Contractor in accordance with the ASTM C-172, as and when directed by the Engineer. Test cylinders and the concrete materials shall be tested in an approved laboratory and the Contractor shall bear all charges for the same, including such other tests as may be determined by and acceptable to the Engineer.

3.08.2 **Water**

Water shall be tested in accordance with AASHTO Method of Test T26-51.

3.08.3 **Cement**

Cement shall be tested as prescribed in BS-12.

3.08.4 **Aggregate**

Aggregates shall be tested as prescribed in ASTM C-33. In addition, fine aggregates shall be tested for organic impurities in conformity with ASTM C-40.

3.08.5 **Reinforcement**

Reinforcement bars shall be tested as prescribed in BS 4449, BS-4461 and ASTM A-615-82(S1) for deformed steel bars and mild steel plain bars. Refer clause 4.10 of this section for specification requirements of reinforcement works.

3.08.6 **Testing of Concrete**

3.08.6.1 Concrete Compressive Strength Test

a) Works Test Cylinders shall be made of all structural concrete incorporated into the works. Unless otherwise directed by the Engineer, one set of cylinder of any particular mix shall be taken from either :-
   - Each 350 Cft or part thereof in columns
   - Each 1050 Cft in walls and small foundations
   - Each 1750 Cft in slabs, beams and large foundations, or
   - each day's production

   Whichever is the more frequent

b) Each set of the Works Test Cylinders shall comprise six 6"x12" Cylinders made from a single sample of concrete taken from the point of final deposition of the set concrete under the Engineer's supervision.

c) The sampling, making, curing and testing of Works Test Cylinders shall be carried out in accordance with ASTM C3 & C39. Test results shall be recorded on approved forms and submitted in duplicate to the Engineer immediately following the test.

d) A sample of concrete shall be taken at random on eight separate occasions during each of the first five days of using that mix. The number of samples per day and the times which they are taken shall be varied at random (thereafter at least one sample shall be taken each day the concrete of that particular mix is made).

e) From each sample six Cylinders shall be made, two for test at seven days, and the other four for test at twenty-eight days.

f) Specimens shall be cured under laboratory conditions except that the Engineer may require curing under field conditions in which case strength of field cured specimens shall not be less than 85% of that of companion laboratory condition cured specimens.

g) All cylinder moulds shall be steel moulds perfectly true, having all internal and meeting faces machined to a smooth surface.

h) If the strength tests of the laboratory cured specimens for any portion of the Work falls below the minimum allowable compressive strength at 28 days required for the class of concrete used in that portion, the Engineer shall have the right to order replacement of the affected work.

i) All test specimens shall bear distinguishing mark showing number, date of casting, quality of concrete and place from where sample was taken. A proper daily record of test specimens made and test results obtained shall be

maintained by the Contractor and weekly test results shall be submitted to the Engineer.

3.08.6.2 Testing for Chloride Ion Content

Maximum water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days contributed from the ingredients including water, aggregates, cementitious materials, and admixtures shall not exceed 0.15% by weight of cement. To determine water soluble chloride ion content, test procedures shall conform to ASTM C 1218.

3.08.7 **Concrete Members not complying with Specifications**

(i) Where concrete in the Works does not comply with the Specifications, the Engineer may order any or all of the following or any other appropriate action to be taken:

(a) The drilling of test cylinders in mass concrete and testing the cylinders to destruction by compression.

(b) The carrying out of load tests or other non-destructive tests on concrete structure.

(c) The cutting out and replacement of such volume as is considered defective by the Engineer.

(d) Strengthening of the structure in accordance with the requirements and as proposed by the Engineer.

(ii) The Contractor shall carry out all such tests, investigations, rehabilitation or replacement in coordination with and as acceptable to the Engineer at no additional cost to the Employer.

3.09 TRANSPORTING AND PLACING CONCRETE

3.09.1 General

a) Concreting shall be conveyed and deposited as quickly as possible after mixing and shall proceed so that, as far as possible, a complete section of the Work is done in one operation. The concrete may be distributed in barrows, skips, and chutes and by any other method such as pumps, conveyor belts etc. all to the approval of the Engineer.

b) Transportation of concrete shall be in a manner approved by the Engineer and shall be so as to avoid segregation or loss of ingredients of concrete.

c) All foundations and portions of Work to be concreted shall be approved by the Engineer in writing before concrete is poured.

d) All forms and reinforcement shall be completed, cleaned, inspected and approved before pouring of concrete. No concrete is to be deposited till the Engineer has inspected and approved in writing all reinforcement, foundations, forms, details, positioning of all fixtures and materials to be embedded in concrete, control levels and screeds, etc. and is satisfied with the arrangements the Contractor has made to efficiently proceed with the work such as sufficient labour, materials, plants etc. Such an approval will not relieve the Contractor from any of his obligations under this Contract. No concrete shall be deposited without the written permission from the Engineer who shall have no authority to waive off this condition. Any concrete without such written authorization shall be liable to be rejected.

e) Placing of concrete shall not be permitted when, in the opinion of the Engineer the sun, heat, wind, cold, snow, or limitations or facilities furnished by the Contractor prevent proper placing, finishing and curing of concrete.

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f) All concrete shall be thoroughly compacted and consolidated by means of pneumatic or mechanical immersion type vibrators of suitable size having minimum frequency of 8000 RPM. Care shall be taken to avoid segregation due to excessive vibration. The Contractor shall maintain on Site at all times one or more standby vibrators. Tapping or other external vibration of forms shall not be allowed unless so directed by the Engineer. In that case formwork shall be adequate to withstand vibrations. Compaction shall be done until the whole mass assumes a jelly like appearance and consistency with water just appearing on the surface. Concrete shall be sufficiently tamped and consolidated around the steel bars, care shall be taken that the vibrator does not touch steel or formwork, and is worked into all parts of the moulds in order that no voids or cavities are left. Steel shall not be disturbed during operations of concreting. Concrete shall be brought up in even layers not more than 8" thickness and worked against side of forms to give a smooth and uniform surface. No surplus water shall be allowed to come out and lie on the surface of concrete. The concrete must be of such a consistency that when ramming, consolidating and tamping is completed, a thin film of water is just appearing on the surface. In vibrating, care shall be taken to avoid displacing the reinforcement.

g) Hardened concrete, debris and foreign materials shall be removed from interior of forms and from inner surface of mixing and conveying equipment.

h) Runways and gangways shall be provided for wheeled concrete handling equipment and workmen, and such equipment shall not be wheeled over reinforcement, nor shall runways be supported on reinforcement.

i) Concrete shall not be dropped freely from a height of more than 10 ½ ft. in columns and 4 ft. elsewhere. In cases where an excessive drop is inevitable, the Contractor shall provide spouts, down pipes, chutes, or side ports to forms with pockets, which will let concrete stop and flow easily into the form without any risk of segregation. The discharge of the spouts, down pipes or chutes shall be controlled so that the concrete may be effectively compacted into horizontal layers not more than 8" thick.

j) Concrete is to be deposited as quickly as possible after mixing and to proceed continuously. Concrete which has attained its initial set or has contained its mixing water for more than 30 minutes shall not be allowed to be placed in the work.

k) When concrete is laid on hard core, such as sub-grade for floor slabs, or other absorbent material, the surface is to be watered, consolidated and, where specified, blinded before the concrete is deposited.

l) Fresh concrete shall not be placed on previously laid concrete or on old concrete surfaces until the latter has been cleaned of all dirt, scum and laitence by wire brushes. The clean surface shall then be thoroughly wetted and grouted with cement slurry as approved by the Engineer.

m) Care shall be taken not to disturb newly placed concrete by vibrator, indirect loading or otherwise. No traffic or loading shall be allowed on the concrete until it has thoroughly set and hardened.

n) Construction joints in concrete shall only be given at locations indicated on the drawings or as approved by the Engineer. If approved by the Engineer, the concrete at the end of the day's work shall be finished off against a temporary shutter stop, which shall be vertical and securely fixed. Such stops shall be removed within 24 hours of placing of concrete. Construction joints not shown on the Drawings shall be reinforced with steel bars or dowels, if deemed necessary by the Engineer, and shall be furnished by the Contractor without any additional cost.

o) No concrete shall be placed during rains or inclement weather and all fresh concrete shall be suitably protected from rain fall and excessive heat or cold.

p) Should any part of the exposed surface present a rough, uneven or imperfect appearance, when the shuttering is removed, it shall be picked out to such depth and refilled and properly re-surfaced and entirely redone as per directions and approval of the Engineer at the cost of the Contractor.

q) On removal of the forms and before the concrete skin has had time to harden, all faces of the concrete inside and outside to be kept exposed (i.e. unplastered) shall be rubbed over with carborundum stone, and washed with cement to remove all marks, projections, hollows, or any other defect. No extra payment shall be made for this work.

r) All exposed surfaces and lines of the concrete work are to be true and fair without cracks, bends, windings and distortions of all kinds, without any extra charges by the Contractor. All concrete work to remain exposed and unplastered is to be fairfaced, smooth, pleasing and to the entire satisfaction of the Engineer.

s) A float or screed is to be worked over the exposed surfaces of all concrete work on the flat or curve, so as to render the surfaces perfectly smooth, clear and to the necessary slopes or falls or as required to receive the floor or roof finishes according to the Drawings and as directed by the Engineer without any extra charge by the Contractor.

3.09.2 Temperature

No concrete shall be mixed or placed while the temperature is above 35 degrees centigrade (°C) on a rising thermometer or above 40 degrees centigrade (°C) on a falling thermometer. The Contractor shall supply an accurate maximum and minimum thermometer and hang it in an approved position in the Works.

The Contractor shall plan the day's concrete in such a manner as to ensure that each bay or panel is completed at a proper construction joint before the temperature rises above the permissible limit.

The Contractor shall allow in his rates for any additional expenses incurred by complying with this Clause in order to complete the works within the "Time for Completion".

3.09.3 Hot Weather Concreting

Hot Weather Concreting Operation should conform to the provisions of ACI Standard 305-72 "*Recommended Practice for Hot Weather Concreting*". The following precautions should be adopted as necessary to comply with the above limit:-

a. Shading of aggregate stock piles.

b. Insulation of water tanks and pipelines and formwork.

c. Refrigeration of mixing water.

d. Addition of ice to mix to lower temperature.

e. Shading of formwork and reinforcement from the sun and drying winds.

f. Cooling of formwork and reinforcement prior to and ahead of casting of the concrete by mist spraying.

g. Covering and spraying with water of hardening concrete surfaces.

h. Concreting during the cooler part of the day.

3.10 PROTECTION AND CURING

All exposed concrete shall be cured. Curing shall be accomplished by preventing loss of moisture, rapid temperature change and mechanical injury or injury from rain or flowing water for a period of at least seven (7) days. Curing shall be started as soon as the concrete has hardened sufficiently for the surface not to be marked. Curing shall be done either by covering with sand, hessian, canvas or other approved fabric mats, which shall be kept continuously wet. If required and so directed by the Engineer, formed surface with forms in position shall also be cured by keeping all forms continuously wet. As an alternative, curing of concrete on all exposed surfaces which could not be kept covered, such as sides of the beams, under side of the slabs, may also be done by sealing concrete surface with liquid membrane-forming curing compounds white pigment type conforming to ASTM C-309 or equal so as to arrest loss of moisture from concrete, with the approval of the Engineer. Care shall be taken so

as to spray the compound/chemical on all the exposed faces of concrete so that no loss of moisture takes place. The Contractor shall take special care that curing of concrete is satisfactorily carried out and in accordance with methods specified herein and/or as instructed by the Engineer.
Any negligence in this regard may result in total rejection of such concrete works, which in the opinion of the Engineer have not been adequately cured. Period of curing for any concrete shall be 7 days or more as directed by the Engineer. All concrete pours and concrete structures shall be clearly marked with non-washable paints to indicate the date of placing concrete. During hot weather, curing shall be done even at night. It shall be obligatory on the part of the Contractor to obtain a certificate from the Engineer that the curing has been properly done. A suitable format shall be printed and kept on Site to be signed by the Engineer for every part of the Work.

For sections 5 ft. or more thick, the Contractor shall ensure that the temperature differential between the inner and outer surfaces shall not exceed 20°C and shall submit to the Engineer his proposals to control and monitor this.

3.11 CONSTRUCTION JOINTS

Construction joints shall be located as indicated on the Drawings and/or as approved or directed by the Engineer. Prior to construction of any structure, the Contractor shall submit a proposal showing location of construction joints and sequence of construction to suit his concreting programmed for the approval of the Engineer. Joint in columns shall be made at the underside of the deepest beam framing thereto. Beam stems and slabs shall be poured monolithically unless allowed otherwise by the Engineer in writing. Joints not specified or shown on the Drawings if so required and approved by the Engineer, shall be so located as to least impair the strength and appearance of the Work. Except and where indicated on the Drawings, no jointing shall be made in footings or foundations without written approval of the Engineer. Construction joints shall be at right angles to the member and shall be formed against firm stop boards. The stop board shall be removed as soon as possible after placing the concrete but without the risk of movement of the concrete and the concrete surface shall be well brushed with a hard brush and washed off with a spray of water, two to four hours after casting, to expose the aggregate and provide key for the next pour.
In all water retaining structures and other substructure pits and trenches, P.V.C. or any other approved water stops shall be provided at the construction joints in the manner shown on the Drawings and/or approved by the Engineer.

Whenever a section of concrete is left unfinished, for any reasons with the approval of the Engineer, leaving surface which will be hard-set before additional concrete can be joined to it, such dovetails, grooves or other bonds shall be provided as may be necessary to ensure a good bond with the new work, at the cost of the Contractor. Before deposition fresh concrete upon or against any concrete which is already set, the surface of the set concrete shall be roughened with a cutting tool, any laitance removed, thoroughly cleaned from all foreign matter, well-watered and covered with approved bonding agent and cement grout, and special care shall be taken to ram the fresh concrete thoroughly up and against the set concrete; and, if deemed necessary by the Engineer, the joints shall be reinforced with steel bars or dowels to be all furnished and done by the Contractor without any additional cost.

3.12 CONCRETE FLOOR SLAB FINISHING

Concrete slabs shall be finished as described herein. In preparation for finishing, floor slabs shall be struck off to the required level at or below the elevation or grade of the finished floors as shown on the Drawings. Floors shall be levelled with a tolerance of 1 mm in 1m. Where drains occur, the floor surface shall be pitched to the drains as indicated on the Drawings or as directed by the Engineer.

3.13 MONOLITHIC FINISH

All concrete surfaces in floors, except where other finish is specified, shall be finished by steel floats or straight edges to bring the surface to the required finish level as shown on the Drawings. While the concrete is still green, but sufficiently hardened to bear a man's weight without deep imprint, it shall be wood floated to a true even plane with no coarse aggregate visible. Sufficient pressure shall be used on the wood floats to bring moisture to the surface. The concrete shall then be hand trowelled to produce smooth impervious surface free from trowel marks. If necessary, the process shall be repeated so that

the final finish shall produce ringing sound from the trowel. No complete payment shall be made for finishing floor slabs in the aforementioned manner.

3.14 CONCRETE TOPPING

Where indicated on the Drawings, base slab under concrete topping shall receive a screeded finish. After the base slab is thoroughly cured and when directed, concrete topping shall be laid to the thickness as indicated on the Drawings in alternate panels of suitable sizes as directed by the Engineer.

3.15 ANCHOR BOLTS, INSERTS, SLEEVES, CHASSIS, RECESSES, STEEL FRAMES

The Contractor shall provide chases and openings required for other sections of the Works and will cooperate and coordinate with other trades in placing their pipes, ducts, recesses and other built-in items as the Work proceeds, entirely at his own cost and risk.

The Contractor shall furnish and place in position accurately, as shown on the Drawings, all inserts, sleeves, chases, recesses, etc., supplied by the Contractor, subcontractors or other contractors, as directed. Full cooperation and coordination shall be maintained with other contractors, subcontractors in this regard.

3.16 WATERPROOF CONCRETE

Waterproof concrete shall consist of structural concrete as specified herein and with the addition of an approved waterproofing additive. This shall be mixed in accordance with the manufacturer's instructions and as detailed in the Bill of Quantities.

Contractor's attention is drawn to the special care required for casting roof framing, ponds, swimming pools and all underground structures including basement floor, retaining walls, sumps, pits, etc. These are all designed to BS 8007, British Standard for water retaining structures. The contractor shall ensure that workmanship and curing is up to the required standard. The crack widths in such structures shall not exceed 0.2mm.

The Contractor shall take full responsibility for ensuring that the resulting construction is completely watertight and free from penetration of moisture.

When in the opinion of the Engineer, damp patches and/or leakage of water in the finished work are due to failure of the Contractor to comply with this specification, the affected work shall be made good at the Contractor's expense.

Water-stoppers shall be provided in all construction joints and the type of Water-stoppers will be as specified or to the approval of the Engineer. All Water-stoppers will be joined by welding strictly in accordance with the manufacturer's recommendations and all multiple joints and special intersections shall be manufactured by the supplier.

Before commencement of work, the Contractor shall obtain the Engineer's approval of the methods to be used to support and maintain the Water-stoppers in the correct location while the concrete is placed and also the layout and form of all additional construction joints other than those shown on the drawings. Unless indicated otherwise on the drawings, all construction joints in waterproof concrete shall be formed incorporating Water-stoppers to Engineer's approval.

All service holes cast in shall incorporate sleeves with puddle flanges and temporary openings for services should incorporate Water-stoppers.

Care shall be taken at all times to ensure that Water-stoppers are not perforated or damaged in any way and the concrete shall be carefully placed and compacted around the Water-stoppers to ensure void free impervious concrete.

All kickers or starter plinths to walls (if used) on the periphery of the watertight construction shall be cast monolithically with the base.

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The formwork shall comply with this Specification and in addition any bolt or fastening embedded in or passing through the concrete shall be to the approval of the Engineer and not impair the water tightness of the structure. The use of through bolts and sleeves is strictly prohibited.
Special attention shall be given to the elimination of shrinkage or thermal cracking. The size of any bay or slab or wall and sequence of pouring shall be such as to minimize cracking.

Slotted inserts or sockets cast into the structural concrete shall be provided for all fixings including services. The cutting of holes in watertight concrete is strictly prohibited.

The Contractor is completely responsible for making all basements and swimming pools absolutely watertight. If any leakages or moist patches occur, the cost of any repairs, etc. to make the basement and swimming pool fully watertight will be borne by him. The Contractor is to give a ten year guarantee for water tightness, reckoned from the date of completion of roof framing, basement and swimming pool. The form of guarantee is to be to the satisfaction of the Client. Should any leaks or dampness occur during the Guarantee period of ten years, the Contractor shall, at no cost to the Client, immediately re-waterproof the defective area or areas and make good all damages to surface finishes such as plaster, painting, paneling, tiling, etc. electrical or other installations or other property, caused by leaks or dampness or reimburse the Client for making good such damages.

Water tightness of swimming pools shall be inspected and tested in accordance with BS 8007:1987 and/or ACI-350.

3.17 CLEANING AND REMOVAL OF RUBBISH

On completion of Works herein, the Contractor shall remove all concrete debris, rubbish, shuttering materials, scraps etc., from the vicinity of the structures completed. All areas shall be cleaned to the satisfaction and approval of the Engineer. The rubbish shall be disposed of within or outside the Site premises, free of cost as directed by the Engineer.

3.18 MEASUREMENT AND PAYMENT

a) Concrete works shall be measured and paid for as per theoretical volumes calculated on the basis of the Drawings, or as otherwise approved by the Engineer and paid at per cubic foot at the rates entered in the Bill of Quantities.

   Recesses (e.g. openings in slabs, break-through and the like) with an individual volume of more than 1 sq. ft. or 2 cft shall be deducted.

b) The prices for concrete works shall include all cost for the complete work and are not limited to the cost of formwork, its support, anchoring's, chamfers, construction joints etc., the required scaffolding, falsework, temporary works, post-treatment and, if necessary, repair of concrete, all preliminary and routine tests, as well as the required statical checks and drawings for Temporary Works in connection with the concrete works.

c) The cost for special finishing of exposed concrete surfaces such as fair-faced finish etc. shall be included in the unit price applicable to the respective structural member and will not be compensated for separately.

d) The cost of all concrete admixtures and additives shall not be paid for separately and is deemed to be included in the unit rates of respective items of the BOQ.

Joints

a) Expansion Joints

   Expansion joints will be paid per number, according to the Drawings. The prices shall include all costs for the different materials and performances relative to the laying and sealing of the joints.

b) Dummy Joints

Dummy joints required by the Contractor with the Engineer's consent for the sound execution of the Works will not be paid for separately, but the costs involved are deemed to be covered by the concrete prices applicable to the respective structural member.

c) Construction Joints

Construction joints will be measured and paid for as below:

The Contractor is deemed to have covered the costs for all related supplies, laying, formation and performances of construction joints included in the respective concrete prices. However, the cost of PVC water stoppers and or swell bars shall be measured and paid for separately per running foot of accepted lengths.

It the approved pouring sequence has not been followed by the contractor. Any increase in quantity of materials (pvc water stoppers, swell bars, rear guards, sealants, SBR etc.) associated with the construction joints and or additional reinforcement required shall be paid for by the Contractor at his own cost.

Tamping of Equipment and Grouting of Recesses

The costs resulting from materials and performances in connection with the tamping of installed items or the grouting of recesses are deemed to be included in the prices for the supply and/or installation of the respective items, and will therefore not be separately compensated for.

**** END OF SECTION****

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SECTION - 4

REINFORCEMENT STEEL

4.01 SCOPE OF WORK

The work covered by this subsection of the specifications consists of furnishing all materials, tools, labor and in performing all operations in connection with the providing, straightening, cutting, bending, fixing, binding including binding wire, chairs, pins, spacer blocks complete in strict accordance with this subsection of the Specifications, the applicable Drawings, approved bar bending schedule, and the terms and conditions of the Contract.

4.02 GENERAL

a) The Contractor shall procure reinforcing steel only from reputable manufacturers/ suppliers duly approved by the Engineer.

b) Verification of the source of supply shall be prepared by the Contractor and submitted to the Engineer along with necessary certificates and test reports.

c) The Contractor shall prepare detailed bar cutting and bending schedules on the basis of the working Drawings and in consideration of BS-4466 and of any requirement resulting from the applied bar bending process.

d) The Contractor shall inform the Engineer of the completion of any reinforcement in time, in order to facilitate its inspection and check of conformity with the working Drawings well before the concreting. Relevant formalities shall be agreed upon between the Contractor and the Engineer at the appropriate time.

e) Reinforcement bar sizes have generally been shown on the Drawings in the form of designated bar numbers.

4.03 MATERIAL

a) Reinforcement shall be deformed reinforcement, except that plain reinforcement bars are permitted for spirals. Reinforcing steel bars (Plain and deformed) shall be from the new billet stock of mild steel and shall conform to the British Standard Specifications mentioned below and as indicated on the Drawings and Bill of Quantities.

i. Hot rolled deformed bars conforming to ASTM A-615 / BS 4449
ii. Cold worked deformed bars to conforming to BS 4461 (revised 4449-1988)
iii. Plain round steel bars to conforming to BS 4449

b) For each consignment, the Contractor shall furnish to the Engineer the manufacturer's mill test certificates to guarantee that the steel supplied meets all the requirements of the relevant specifications and further meets the requirements of specified characteristic strength and minimum tensile strength requirements given as under:-

High Yield Deformed Steel Bars:

i. Specified Characteristic Strength:

up to 16 mm (5/8")	460 N/mm2 (66,700 psi)
over 16 mm (5/8")	425 N/mm2 (61,625 psi)

ii. Tensile Strength:
Minimum Tensile Strength shall be 10% greater than the Specified Characteristic Strength.

iii. Minimum Elongation

up to 16 mm (5/8")	12%
over 16 mm (5/8")	14%

Mild Steel Plain Steel Bars:

(i) Specified Characteristic Strength 250 N/mm2 (36,000 psi)

(ii) Tensile Strength:
Minimum Tensile Strength shall be at least 15% more than the Specified Characteristic Strength.

(iii) Minimum Elongation 22%

a) **Bendability**
All the bars shall be capable of being bent cold through 180 degree round a pin without cracking on the outside of the bent portion as per ASTM-A615.

b) 18 gauge galvanized wire to BS 4482 shall be used for binding the steel reinforcement.

c) Samples shall be tested for above requirements in an approved laboratory before starting the cutting of bars or when so required by the Engineer; and all cost of such tests shall be borne by the Contractor.

d) All reinforcing steel bars shall be free from loose mill scale, loose rust, oil, grease, dirt or other harmful substances.

Wire Gauze

General
Unless otherwise specified the wire gauze shall be of best quality approved uniformly, woven wire webbing of 12 x 12 meshes to 645 mm square (one Sq. Inch) made from 22 gauge galvanized iron wire. All panels shall be in one piece and no joints shall be allowed.

Fixing
Wire gauze shall be fixed as shown on the drawings or as directed. The gauze shall remain tight to the fill width without any sag.

4.04 STORAGE

Reinforcement bars shall be stored on platform sufficiently above ground surface and be free from scales, oil, and structural defects prior to placement in Works. Rusted or dirty steel bars shall not be used in the Works unless brushed and cleaned by proper steel wire brushes and after being approved for use by the Engineer.

4.05 REINFORCEMENT CUTTING AND PLACING

All reinforcement steel shall be cut and bent cold in strict accordance with bar bending schedules prepared by the Contractor and approved by the Engineer. The Contractor shall prepare bar bending schedule from approved structural working Drawings and as per instructions of the Engineer. The bending schedules shall be drawn on approved forms and submitted to the Engineer for checking and approval. The steel reinforcement shall be cut and bent to sizes as per Drawings and approved bending schedules. In case, any bars cut, bent or even fixed in position are found incorrect in dimensions, size and shape and are not according to the requirements of the Drawings or instructions of the Engineer, notwithstanding any previous approval of the Engineer, the Contractor shall replace such steel bars, cut, bent or fixed in position, by correct sizes bars at his own cost and no extra payment shall be made to the Contractor on such account. Suitable spacers, chairs as approved by the Engineer shall be used for the purpose of supporting and spacing of bars. In case, any bars are bent or displaced they shall be straightened or replaced prior to pouring. All reinforcement bars within the limit of a day's pour shall be in place and firmly tied with 18 gauge wires. Bars with kinks or bends not shown on the Drawings shall not be used. Reinforcement bars shall not be used for supporting the workmen and concreting work. Separate supporting system shall be used for this purpose.

Concrete cover to all reinforcement bars shall be provided as shown in the Drawings using steel chairs and concrete spacer blocks.

The concrete spacer blocks shall be cast from cement sand mix in a ratio of 1:2 in suitable required sizes. These shall be well cured and dry before use in the Works. The spacers shall meet the specified requirements of water absorption. All spacers shall be properly fixed in their required positions and as directed by the Engineer.

For any structural member which shall receive fair-forced concrete surfaces, special spacers shall be used while do not impair the specified appearance of concrete surfaces.

4.05.1 Laps and Splices

No splicing of bars shall be allowed at positions other than shown on the Drawings. All lap lengths shall be of the minimum sizes as indicated on the Drawings and in accordance with ACI 318-95. Splices of adjacent bars shall be staggered, unless approved otherwise by the Engineer. All reinforcing steel fixed in position shall be inspected by the Engineer and no concrete shall be poured until steel placement has been approved in writing by the Engineer. For inspection purposes, the Contractor shall give to the Engineer reasonable notice before the scheduled pouring time. Clear concrete cover to reinforcement steel shall be as specified or indicated on the Drawings.

4.05.2 Mesh Reinforcement

a) Where indicated mesh shall be of the sizes as shown on the Drawings and conform to BS 4482 or 4449 with mesh sizes to BS 4483 or ASTM A-185 (Welded Steel Wire Fabric for Concrete Reinforcement). Mesh reinforcement when used in slabs shall be supported at proper elevations by standard accessories. In slabs on ground (porous fill), precast concrete spacer blocks may be substituted for chairs.

b) Overlaps in fabric reinforcement shall be a minimum of two meshes, except where otherwise shown on the Drawings, correctly aligned and at least 50% of the wire intersections shall be tied with 18 gauge tying wire. Laps shall be staggered in adjacent rows of sheets.

4.06 MEASUREMENT AND PAYMENT

Reinforcing bars will be measured as per Drawings in consideration of the volumetric weight of 7.85 t/m3, without additions for rolling tolerances, deformations, waste lengths and binding wires and paid per ton at the unit rate entered in the Bill of Quantities.

The prices shall include all costs involved with the supply, transportation, storage and protection, the cutting, bending and placing, inclusive of concrete spacers, supports, stands, tying into position, etc.

Assembly stands, spacers etc., whether designated in the Drawings or not or otherwise demanded by the Engineer will not be measured and paid for separately.

If installed reinforcement must be dismantled under certain circumstances or where additional reinforcing bars are to be provided on Engineer's instruction, the Contractor is not entitled to any compensation, if such additional supplies and/or performances are required and demanded by the Engineer due to the Contractor's faulty execution of the respective work.

**** END OF SECTION****

SECTION - 5

FORMWORK

5.01 GENERAL

The formwork shall be inclusive of all labor, material, workmanship and alike. All formwork and supports thereto shall be designed by the Contractor and relevant drawings shall be submitted to the Engineer for approval before the Work is put in hand. Such an approval shall not relieve the Contractor from all or any of the obligations of the Contractor or give rise to any claims.

5.02 MAKING FORMS

The formwork for columns, beams, slabs, foundations, pits, lintels, fins, panels, purdees, parapets and all other works whether to be precast or cast-in-situ shall be of steel plates, scaffolding pipes and joints or other approved material and shall be rigidly formed and designed by the Contractor to the shapes and forms as per Drawings in accordance with the best of the existing practices, so as to be able to withstand without displacement, deflection or deformation or movements of any kind, the pressure of the moist concrete and all other loads. No plank timber formwork will be accepted at any location. Only system formwork will be accepted.

5.03 FAIR FACED FINISH

a) Facing Material
The form facing material shall produce a smooth, hard, uniform texture on the concrete. It shall be M.S. steel sheets, plywood, tempered concrete grade hardboard, metal or plastic, or other approved material capable of producing the desired finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surface, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface, shall not be used. Tie holes and defects shall be patched. All fins shall be completely removed.

b) Shop Drawings
Shop Drawings shall be submitted by the Contractor for Engineer's approval, showing grooves, joints etc. if indicated on the Drawings or instructed by the Engineer before taking up the job of formwork in hand.

c) Repair
No repair of surfaces designated `fair faced' shall be allowed. Any concrete failing to achieve the desired finish or with defective surfaces shall be removed and replaced at Contractor's expense. The Engineer may reject any defective concrete surface and order it to be cut out in part or in whole and replaced at the Contractor's expenses.

5.04 RIGID WITH ALLOWANCE FOR CAMBER & BULGES

The formwork shall be fabricated and erected in position, perfect in alignment, levels and true to plumb and shape and securely braced so as to enable it to withstand all weights, dead and live, to be endured during placing of concrete and its subsequent hardening till the formwork is struck. It shall be sufficiently rigid as not to lose its shape and shall be made to compensate for bulging, and deflection to give the finished concrete the required lines, plumb, size and shape.

5.05 EXPOSED SURFACES LEFT UN-PLASTERED

In addition to the provision made elsewhere, for all the concrete work covered in this Contract which are to remain exposed in the finished work and left un-plastered, the formwork shall be smoothly faced by using M.S. steel sheets or lining the shuttering with smooth G.I. sheets or non-absorbent material like Formica sheets or in any manner as approved by the Engineer so as to make a perfectly smooth surface of the finished concrete. Where any surface defects on the exposed concrete surfaces occur and which do not impair the structural performance, being in excess of the designed surfaces and the

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architectural appearance of the Work in the opinion of the Engineer such defects may be removed by guniting and grinding with carborundum stone or in any other approved manner, at the cost of the Contractor, otherwise the whole or part of the Work shall be removed and made good by the Contractor, at his own cost. For precast concrete members, the forms shall be rigid, exact and smooth.

5.06 MATERIALS AND LABORS

The Contractor shall supply all materials runners, and labor, necessary for a good and speedy erection of formwork such as steel plates, shuttering planks, struts, bolts, stays, gangways, boards, fillets etc. and shall do all that is essential in executing the job in a workman-like manner to the satisfaction of the Engineer.

5.07 FORMWORK NOT TO INTERFERE OR INJURE WORK

The formwork shall be so designed and arranged as to not unduly interfere with concrete during its placing and easy to be removed without injuring the finished concrete. Wedges, clamps, bolts and rods shall be used, when permitted and where practicable, in making the formwork rigid and in holding it to true position.

5.08 OPENINGS IN FORMWORK

Wherever concreting is required to be carried out within forms of depth exceeding 6.5 feet, temporary openings in the side of the form shall be provided to facilitate the pouring and consolidation of the concrete. Small temporary openings shall be provided at bottom of the forms to permit the removal of rubbish etc. but the same shall be suitably closed before pouring.

5.09 OPENING AND OTHER DETAILS

Provision shall be kept in the formwork such as openings, recesses, holes, pockets, fillets, etc. for housing services and other architectural details in the finished concrete or on its surface and edges as shown on the Drawings or as directed by the Engineer and to fix all necessary inserts, dowels, pipes, holdfasts etc. in concrete as shown on the Drawings or as directed by the Engineer.

5.10 JOINTS IN FORMWORK

All joints in the formwork shall be sufficiently closed to prevent leakage of mortar from concrete for concrete surfaces not to be exposed in the finished work. The joints in the finished work shall be close jointed and perfectly smooth so as not to allow any leakage of the mortar from the concrete and show any appearance of leaking mortar on concrete surfaces.

5.11 TREATMENT AND INSPECTION OF FORMS

All rubbish particularly chippings, shavings and saw dust shall be removed from the interior of the forms, before placing concrete. Forms shall be coated with approved shuttering oil before reinforcement is placed. Surplus oil on forms and any oil thus applied on reinforcing steel shall be removed. If the forms are not used within 24 hours, a fresh coat of oil shall be given before placing of concrete.

5.12 STRIPPING SHUTTERING

Formwork should not be removed until the concrete has developed sufficiently strength to support all loads placed upon it. The time required before formwork removal depends on the structural function of the member and the rate of strength gain of the concrete. The grade of concrete, type of cement, water/cement ratio, temperature during curing etc. influence the rate of strength gain of concrete.

No struts or timbering which serve the purpose of supporting the shuttering or centering shall be struck and removed without permission from the Engineer in writing and the work of striking and removal after the receipt of such permission shall be conducted under the personal supervision of the competent foremen in the employment of the Contractor and the Contractor even after the permission from the Engineer shall hold himself fully responsible for any consequences whatsoever.

In all cases the Engineer will direct and control the minimum period of time for which the forms, shuttering or centering shall remain in place before being struck; but, for the general guidance of the Contractor, the following are to be considered as the minimum periods for the main classes of Work.

Type of Formwork	Normal Weather	Cold Weather
Footing Sides	24 hours	36 hours
Vertical sides of Beams, Walls and Columns (unloaded)	24 hours	36 hours
Slab soffits (up to 15 ft span)	10 days	14 days
Slab soffits (> 15 ft span)	14 days	21 days
Beam soffits (up to 15 ft span)	14 days	21 days
Beam soffits (> 15 ft span)	21 days	28 days

The Engineer may require, however, that any walings, soldiers, struts or other timbers or supports, the removal of which may cause the transference of load to the finished work, to be kept in place for three weeks after the placing of the concrete.

The formwork parts and connections should be arranged in a way that makes formwork removal easy and simple, prevents damage to concrete and formwork panels so that it can be reused without extensive repair.

The formwork removal procedure should be supervised by the engineer to ensure that quality of hardened concrete in structural member, i.e. it should be free from or has minimum casting defects such as honeycombing, size and shape defects etc. These defects in concrete influence the strength and stability of structure. Thus immediate repair works can be done or the members can be rejected.

The separation of forms should not be done by forcing crowbars against the concrete. It may damage the hardened concrete. This should be achieved by using wooden wedges.

Beam and joist bottoms should remain in place until final removal of all shoring under them are done.

Joist forms should be designed and removed so that the shores may be removed temporarily to permit removal of joist forms but must be replaced at once. The shores and joists will be dismantled beginning from the middle of the member's span, continuing symmetrically up the supports.

The approval from the engineer should be obtained for the sequence and pattern of formwork removal, prior to start of removal.

5.13 INJURY OR DAMAGE

The Contractor shall be responsible for any injury to the Work and any consequential damages caused by or arising from the removal and striking of forms, centering and supports, due to striking too soon. Any advice, permission or approval given by the Engineer relative to the removal and striking of forms, centering and supports shall not relieve the Contractor from the responsibilities herein defined.

5.14 TREATMENT AFTER REMOVAL OF FORMS

Any minor surface honey-combing or other irregularities are to be properly made good immediately upon the removal of the formwork and the surface made good to the satisfaction of the Engineer at the Contractor's own expense. Any small voids shall be neatly repaired with cement mortar consisting of one part of cement to two parts of sand and the whole surface rubbed over with carborundum stone and cement wash to bring the whole to a smooth and pleasing finish and uniform color.

5.15 TOLERANCES

The structure shall be built to dimensions and levels shown on the Architect's drawings. Deviation from true positions and/or levels will be accepted only if they do not affect the finished dimensions, positions and levels as shown on the Architect's drawings.

Permitted tolerances shall be in accordance with the current issue of BS 5606, Code of Practice for Accuracy in building with up-to-date amendments.

Construction Tolerances of Structural Elements Supporting curtain walls or surfaces affecting curtain wall set out:-

- Maximum deviation vertically from defined position immediately after stripping of formwork ±12mm.
- Maximum deviation laterally from defined position immediately after stripping formwork and prior to any pre-stressing (if used) ±12mm or building height/4000 whichever is greater. This laterally out of position tolerance includes all local deviations in edge of slab or edge beams as well as overall building tolerance.

NOTE: All structural tolerances given above are for curtain walls (if used) and for all external structural faces of building affecting set out of masonry, windows and other cladding/finishes.

5.16 EXTERNAL EXPOSED CONCRETE SURFACE

All external exposed concrete surfaces of cast-in-situ or precast units shall be given smooth or pattern finish as shown in the Drawings schedule or as directed by the Engineer.

5.17 MEASUREMENT AND PAYMENT

All costs for formwork must be included in the concrete prices and will not be measured and paid for separately.

**** END OF SECTION****

SECTION - 6

BRICK MASONRY

6.01 SCOPE

The work under this section of the specifications consists of furnishing all plant, labor, equipment, appliances and materials and performing all operations in connection with furnishing and installing brick masonry in position including Portland cement and sand for mortar & masonry, complete in strict accordance with this section of the specifications and applicable drawings and subject to the terms and conditions of the Contract.

6.02 MATERIALS

2.1 Portland cement for mortar shall conform to the applicable requirements specified in the section "Plain and Reinforced Concrete".

2.2 Sand for mortar shall be furnished by the Contractor and shall conform to the applicable requirements for sand specified in the section "Plain and Reinforced Concrete".

2.3 Water used in the manufacture of bricks and in the preparation of mortar shall be free from objectionable quantities of silt, organic matter, alkali, salts and other impurities, and will be tested and approved by the Engineer.

6.03 MORTAR

3.1 Mortar for first class brick masonry, except where otherwise directed by the Engineer, shall consist of one part Portland cement to six parts of damp loose mortar sand by volume and sufficient water to produce proper consistency for the intended use. Where directed by the Engineer for increased workability, hydrated lime putty, approved by the Engineer, shall be added to the mortar but shall not exceed 25 percent, by volume of the dry cement.

3.2 Methods and equipment used for mixing mortar be such as will accurately determine and control the amount of each separate ingredient entering into the mortar and shall be subject to the approval of the Engineer. Mortar shall be mixed only in sufficient quantities for immediate use and all mortar not used within 30 minutes after addition of water to the mix shall be rejected. Retempering of mortar shall not be allowed.

The mixers shall be thoroughly cleaned and washed at the end of each day's work.

6.04 BRICK

4.1 All bricks, except otherwise specified, shall be of first class quality made from good brick earth, free from saline deposit and shall be hand molded. They shall be thoroughly burnt without being vitrified, shall be regular, uniform in shape and size with sharp and square edges, parallel faces and of deep red or copper color. First class bricks shall be homogeneous in texture and shall emit a clear ringing sound when struck, and shall be free from flaws, cracks, chips, stones and modules of lime. First class brick in an oven dried condition shall not absorb more than 1/5 of its weight of water when immersed one hour in water at 21 to 27 degrees centigrade and shall show no signs of efflorescence on subsequent drying. The average compressive strength of five representative first class bricks shall be not less than 2000 psi and not less than 1500 psi for any individual brick.

4.2 All bricks shall be manufactured by the Trench Kiln Method or other standard methods approved by the Engineer. The earth used in manufacturing bricks shall be carefully selected and shall be free from objectionable quantities of lime, gravel coarse sand, roots, or other organic matter. Salts shall not exceed 0.3 percent and calcium carbonate shall not exceed 2.0 percent.

4.3 The moulds used in the manufacture of bricks shall be thoroughly sanded before each use and shall be sufficiently larger than the size of the bricks being manufactured to allow for shrinkage in drying and burning. Over-size, irregular and worn moulds shall be destroyed. Each finished brick for brick masonry shall be 9 inch by 4-1/2 inch by 3 inch in size and shall weigh between 3.2 to 4.2 kilograms. All bricks shall have a "frog" 1/4 inch deep on one face.

4.4 Samples of the bricks shall be submitted to the Engineer with test reports for his approval. Bricks of approved samples shall only be used in the works. If at any time, during the progress of the work, use of sub-standard material is found by the Engineer, such work shall be rejected and the Contractor shall replace the rejected work at his cost.

6.05 PLACING

5.1 The methods and equipment used for transporting the bricks and mortar shall be such as will not damage the brick nor the use of mixed mortar. Brick shall not be placed during rains sufficiently heavy or prolonged to wash the mortar from the brick. Mortar already spread which becomes diluted by rain shall be removed and replaced before continuing with the work. All brick to be used in brick masonry shall be moistened with water for three to four hours before they are used by a method which will ensure that each brick is thoroughly and uniformly wetted. All bricks shall be free from water adhering to their surface when they are placed in the brick masonry.

5.2 Bricks shall be laid "frog" upward with mortar joints and in English and Flemish bond as shown on the Drawings or as directed by the Engineer. Both bed and vertical joints shall be 1/4 inch in thickness completely filled with cement mortar as specified herein, and each brick shall be bedded by firmly tapping with the handle of the trowel. All horizontal joints shall be parallel and all vertical joints in alternate courses shall be directly over one another. Excess mortar at the outer edges shall be removed and joints drawn straight with the edge of a trowel and a straight edge. All anchors and similar work required to be embedded in the brick masonry shall be installed as the work progresses. At the completion of the work all holes or defective mortar joints shall be cut out and re-pointed.

5.3 Where shown on the drawing the exterior faces of the walls shall be finished by striking the joints as the work proceeds. The joints shall be struck by raking the green mortar after the brick work has been laid and finishing the joint with a pointing tool. Horizontal joints shall be struck to form a weathered joint and vertical joints shall be struck with a V notch. Care shall be taken that the striking tools do not develop a cutting edge as the object of striking the joint is to compress the mortar into the joints.

5.4 The exposed faces of all brick masonry shall be thoroughly cleaned and left bare with struck joints as specified above.

6.06 CURING AND REPAIR

6.1 All brick masonry shall be water cured and shall be kept wet for at least seven days by an approved method, which will keep all surfaces to be cured continuously wet. Water used for curing shall meet the requirements of the Specifications for water used in the manufacture of bricks.

6.2 If, after the completion of any brick masonry work, the brick is not in alignment or level, or does not conform to the lines and levels shown on the Drawings, or shows a defective surface, it shall be removed and replaced by the Contractor at his expense unless the Engineer grants permission, in writing, to patch or replace the defective area.

6.07 SCAFFOLDING

Contractor shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights at his own expense. Scaffolding which is unsafe in the opinion of the Engineer shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the Contractor in the unit rate for masonry items.

Damage to masonry from scaffolding or from any other cause shall be repaired by the Contractor at his own cost.

6.08 TOLERANCES

All brick work shall be erected plumb and true to line and level with maximum variation in any storey height or any length of wall being one mm in one meter. The maximum tolerance in the length, height or width of any single masonry unit shall be ± 1/8 inch.

6.09 DAMP PROOF COURSE

9.1 **In walls - Horizontal Application**

All damp proof course unless otherwise specified shall consist of class 'C' cement concrete 2 inch thick shall be laid at required levels as per drawings and instructions of the Engineer. The D.P.C shall be tamped, consolidated, levelled and edges and corners made to the requirements of the relevant drawings including finishing and curing complete. After the DPC has dried apply two coat of bitumen 10/20 grade @ 20 lb. /100 sq.ft.

9.2 **In walls - Vertical Application**

A damp proof course shall be applied if shown on the drawings, on wall below plinth shall consist of cement sand plaster (1:6) ¾" thick shall be applied on walls below plinth on interior and exterior faces as shown in the drawings or as directed by the Engineer. After a curing

period of 3 days, hot bitumen 10/20 grade be applied on dried surface of mortar @ 20 Ib./100 sq.ft. in two coats.

9.3 **Under Floors**

A damp proof course if shown on the drawings shall be applied under the floors in the same way as specified under walls-horizontal application.

***** END OF SECTION*****

SECTION - 7
PLASTERING AND RENDERING

7.01 SCOPE OF WORK

The Work covered by this section of the Specifications consists of furnishing all plant, labor, appliances/ equipments and materials for performing all operations in connection with lathing, plastering and rendering, complete in all respect; in strict accordance with this section of the Specifications and the applicable Drawings and subject to the terms and conditions of the Contract.

7.02 APPLICABLE STANDARDS

Latest editions of following Pakistan, British & ASTM standards are relevant to these specifications wherever applicable.

Pakistan Standard
PS 232 Ordinary Portland Cement

ISO (International Organization for Standardization)
R 597 Definitions and terminology of cement.

R 679 Method of testing strength of cements, compressive and flexural strength of plastic mortar (Rilem - Embureau method).

R 680 Chemical analysis of cement& main constituents of Portland cement.

R 681 Chemical analysis of cements-mixer Constituents of Portland cement.

R 682 Chemical analysis of cements - determination of Sulphur as Sulphide.

ASTM (American Society for Testing and Material)
C 144 Aggregate for Masonry mortar
C 631 Bonding compounds for interior plastering

BSI (British Standards Institution)
812 Methods for sampling and testing of mineral aggregates, sands and fillers.

1199 Sands for external renderings internal plastering with lime and Portland cement and floor screeds.

1369 Metal lathing (steel) for plastering.

5262 External rendered finishes.

5492 Internal plastering.

7.03 GENERAL

Except as may be otherwise shown or specified, all interior & exterior plaster shall be cement plaster in specified thickness shown on Drawings & BOQ. Plastered ceilings and walls shall include partitions, piers, columns, beams, ceilings, plastered jambs and other returns, reveals, and backs of recesses and alcoves, and joints and heads of windows and doors, unless otherwise specified or shown on the Drawings. Plaster on walls shall be carried down to dado, skirting and projected bases. Plasterwork shall also include all plasterwork on and under concrete surfaces and masonry. Concrete surfaces to be left exposed and concrete not specified to be left fair faced, as indicated on Drawings.

A 3/8" render coat shall be applied to walls with a slightly roughened surface where wall finishes of applied nature, such as ceramic tiles, marble tiles, granite tiles, textured paint etc., are to be installed over wall surfaces.

Plastering shall not commence until all electric conduits, drainage and sanitary pipes, inlets to tanks, brackets, clamps, doors and window frames and all sorts of inserts and embedded items are fixed in position. It shall be the responsibility of the Contractor to make sure that other contractors carry out all such work before starting of plasterwork. Chiseling and repairing of cement plaster shall not be permitted without the approval of the Engineer.

7.04 MATERIALS

a. Cement for plaster shall be Ordinary Portland Cement (BS 12 or PS 232) or Sulphate Resisting Cement (BS 4027 or P.S. 612) as specified and shall conform to requirements specified in the section "Plain and Reinforced Concrete".

b. Sand for plaster shall comply with the requirements of BS 1199, BS 1200, ASTM C-33 and/or the Pakistan Standard "Sand for Plaster" as directed by the Engineer.

c. Water shall be clean and free from oils, acids, alkalis, salts and organic or other injurious matter and as described in section for "Plain and Reinforced Concrete".

d. All materials and workmanship for plaster not explained in these Specifications, shall comply with the requirements of relevant BS CP 211 and CP 221 as directed by the Engineer.

e. External rendered finishes should comply with appropriate clauses of BS 882.

f. Mortar plasticizer shall comply with BS 4887 and shall be used in accordance with the manufacturer's instructions.

g. Pigments to be used shall comply with BS 1104.

h. Galvanized metal angle beads and plaster stops shall be as manufactured by the Expanded Metal Co. Ltd., London or other equal and approved.

7.05 MIXING OF PLASTER

Measurement of materials by volume shall be by containers of known capacity to maintain consistent proportions. No lumpy or caked material shall be used. Mixing equipment boxes and tools shall be clean. Materials shall be proportioned as specified on the Drawings or as directed by the Engineer. Mixing shall be continuous until all ingredients are evenly distributed and thoroughly mixed. Only limited water shall be added for proper workability and such quantity of mortar shall be prepared which can be consumed in thirty minutes after preparation. Preparation of mortar in bulk quantity for use during the entire day or for any other time more than that stipulated above is expressly prohibited. Re-tempering shall not be permitted and all mortar, which has begun to stiffen, shall be discarded.

Except where hand mixing of small batches is approved by the Engineer, mechanical mixers of an approved type shall be used for the mixing of plaster. Frozen, caked, or lumped materials shall not be used. Mechanical mixers, mixing boxes and tools shall be cleaned after mixing each batch and kept free of plaster from previous mixes. Plaster shall be thoroughly mixed with the proper amount of water until uniform in color and consistency.
Re-tempering will not be permitted, and all plaster which has begun to stiffen shall be discarded.
Plaster ingredients shall be thoroughly mixed either by hand on a clean cement concrete platform or by a mechanical mixer, as directed by the Engineer.

Water Proofing Plaster 1/2 inch. (13mm) thick 1:4 cement sand plaster mixed with approved water proofing agent.

Re-tempering will not be permitted, and all plaster which has begun to stiffen shall be discarded.

7.06 PROPORTIONING OF PLASTER ON INTERNAL AND EXTERNAL WALLS

All plaster shall be Portland cement plaster, all coats of which shall be mixed in the following proportions by volume:

- One part cement and 4 parts sand or specified otherwise.

All coats of plaster in water retaining structures shall be waterproofed by the addition of an approved waterproofing additive/admixture from BCR, Sika, Fosroc, Betocrete C-16or Master Builders or approved imported equivalent.

External plaster shall be pigmented plaster in the shades/ colors to the approval of the Engineer.

7.07 PREPARATION OF SURFACES OF PLASTER

a. Surfaces to receive plastering shall be brushed to remove all loose particles, dust, laitance, efflorescence, etc. and any projecting fins on concrete surfaces shall be hacked off.

b. Glossy or greasy surfaces shall also be suitably cleaned and chipped off to remove all traces of mould oil.
c. Where unduly smooth in-situ concrete surfaces are encountered, such surfaces must be hacked properly before applying plaster.
d. Surfaces shall thoroughly be sprayed with water and all free water allowed to disappear before plaster is applied.
e. Irregularities in the surfaces to be plastered shall be filled with cement mortar 24 hours before plastering is commenced.
f. Before plastering is commenced, all junctions between differing materials shall be reinforced. This shall apply where walls join columns and beams particularly where cracks are likely to develop and places directed by the Engineer. The reinforcement of such joints shall consist of a strip of galvanized expanded metal lathe/mesh, at least 6" wide, which shall be plugged, nailed or stapled to the surfaces to be plastered at the intervals not exceeding 12". The joints in mesh shall be lapped minimum 6".
g. Metal angle beads shall be fixed with plaster dabs at 24" centers applied to the wall on either side of the arise and the wings of the beads pressed well in.
h. The Plaster stops shall also be fixed in a similar manner or plugged, nailed or stapled to the surfaces to be plastered to the approval of the Engineer.
i. Metal angle beads and plaster stops shall be fixed at places shown on the Drawings or as directed by the Engineer.
j. It shall be responsibility of the Contractor to ensure that all electrical conduits, pipes, concealed or embedded items, ducts, brackets, doors, window and ventilator frames, and all other fixtures on walls, ceilings, columns or required elsewhere have been fixed in position before the plastering is commenced.
k. Cuttings and chasings in the blockwork shall be repaired as per the instructions of the Engineer at least twenty four hours before the plastering is commenced.

7.08 APPLICATION OF PLASTER

The Contractor shall not start any work till the surfaces are inspected by the Engineer. In case, any plaster work is done without obtaining the consent of the Engineer, the Engineer shall have the right to order removal of all such work and cleaning and preparation of the surfaces to his full satisfaction and the Contractor shall comply with such orders without any delay.

All surfaces to be plastered shall be treated with cement slurry as a base coat for proper bond. Any approved bonding agent may also be used as an alternative to cement slurry.

Plaster to internal and external surfaces shall be applied in the thickness shown on the Drawings or specified elsewhere. In any case, the plaster thickness shall not be less than the specified thickness.

Plaster shall be applied in two (2) coats on masonry and concrete surfaces where thickness is more than 3/4". The thickness of each coat shall not exceed 3/4".

a. In case of 2 coats, the first coat or the under coat shall be full and thick and shall be applied with sufficient force to form good keys. The under coat shall be roughened and cross-scratched upon attaining its initial set to provide a proper bond to the next coat and shall be kept damp with a fog spray.
b. Finish coat shall not be applied until the under coat has seasoned for 2 days. Just before application of the finish coat, the under coat shall again be wetted evenly with a fog spray.
c. Finish coat shall be smooth finished.
d. The finish coat shall be kept moist with a fog spray for at least 2 days and thereafter shall be protected against rapid drying until properly and thoroughly cured.

Plastering shall be executed in a neat workmanlike manner and shall be finished off with a wood or steel float, straight and plumb and shall not have wavy surface. The surface shall be of even texture and entirely free from all marks. The edges and corners shall represent a straight line. All the arises shall be rounded to 6 mm radius unless otherwise specified.

Plastering shall neatly be made good around pipes or fittings.

As far as practical, plastering shall not be commenced until all mechanical, electrical and plumbing items, conduits, pipes, fittings and fixtures have been installed in their sequence of operations.

Plaster is to be maintained in moist condition for at least four days after it has developed enough strength not to be damaged by water.

Plaster stops and angle beads of expanded metal shall be used for protection of arises, edges and plaster ends as shown on the Drawings and as directed by the Engineer.

Plaster containing cracks, blisters, pits, discoloration or any defects shall not be acceptable. Any such defective plaster rejected by the Engineer shall be removed and replaced in conformity with these Specifications by the Contractor at his own cost to the satisfaction and approval of the Engineer.

7.09 SAMPLING OF PLASTER

Samples may be taken by the Engineer at any time from plaster work in place. Areas represented by samples which show over sanding will be rejected.

7.10 PATCHING

Plaster containing cracks, blisters, pits, checks, or discoloration will not be acceptable. Such plaster shall be removed and replaced with plaster conforming to this Specification and approved by the Engineer. Patching shall match with existing work in texture and colour.

7.11 CONCRETE / MASONRY JOINTS

All joints of concrete and block walls shall be specially treated as described here or as shown on Drawings. A 150 mm wide approved expanded metal shall be fixed at the joints and then plaster shall be applied. The expanded metal shall be with a weight of 3.0 lbs./sq. yd.

7.12 CLEANING AND PROTECTION

Rubbish and debris shall be removed as necessary to make way for work of other trades and as directed by the Engineer. As each room or space is completed al! Rubbish, debris, scaffolding and tools should be removed to leave the room clean.

Prior to plastering all aluminum windows, finished metals should be covered by sheet of plastic or tarpaulin to protect it from damage.

Protect finished plaster from injury by any source. Contractor shall also protect walls, floors and work of other trades from plaster materials.

7.13 TOLERANCES

The work shall be carried out while maintaining the following tolerances:

- Surfaces of plaster work shall be finished with a true plane to correct line and level unless otherwise specified and with walls and reveals plumb and square.
- Maximum permitted tolerances shall not exceed 1/8 inch. (3mm) in 6ft. (2 meter), but not exceeding 12 mm, maximum over the length of the building.
- Variation from plumb or level in any exposed line or surface and 1/16 inch (1.5 mm)
- Variation between planes of abutting edges or ends 1/16 inch (1.5 mm)
- Maximum permissible Offset at joints is1.5 mm maximum

7.14 MEASUREMENT AND PAYMENT

Plaster shall be measured and paid per square Meter/feet, complete and approved, at the unit rates entered in the Bill of Quantities, including preparations, junction reinforcements, angle beads, plaster stops, framing and metal furring, metal lathe, chamfered edges, rounding off corners etc. and in the thickness as specified in Bill of Quantities.

**** END OF SECTION****

SECTION - 8

ROOF WATER PROOFING

8.01 SCOPE OF WORK

The works under this section of the Specifications consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations in any floor and at any height in connection with installation of insulation, water-proofing and built-up roofing, including water proof treatment to roof, terraces, balconies and other roofing structures complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

8.02 SUBMITTAL

2.1 Shop Drawings: Shop drawings showing layout and all the details for construction.

2.2 Samples of all materials proposed for use under this section shall be submitted to the Engineer for approval.

8.03 MATERIALS

a. 2" Thick Damp Proof Course with Cement Mortar 1:2:4

b. hot bitumen (maxphalt 80/100 or equivalent) using 35 Lbs. per hundred square feet (1.71 Kg/sm)

8.04 DELIVERY STORAGE AND HANDLING

Materials shall be protected from damage during loading shipment delivery and storage non-staining materials shall be used for blocking and packing.

8.05 PREPARATORY WORK

All scuppers and roof drains shall be placed and metal flashing, cant strips flanges etc. shall be provided in time to be installed along with the roofing assembly.

All surfaces, to be treated shall be dust free and dry. Application of roof finishes shall not start unless the preparatory work has been inspected and approved by the Engineer.

8.06 APPLICATION

a. All water proofing treatment shall be done as specified, as indicated on the drawings, as per manufacturer/ supplier instruction and to the approval of Engineer.

b. Waterproofing shall not be applied during rain or while surfaces are damp, it shall be applied only to surfaces that are clean and dry.

c. Mopping of surface with bitumen shall be performed so that the surface shall be completely covered. Coats of bitumen shall be as specified in drawings. All bitumen shall be applied with mops except that the hot surfacing application shall be poured from a dipper.

d. Polyethylene sheet shall be laid in position wherever shown in drawings. Where joint is necessary at the side or end of the sheet, this shall be a double weld folded joint made by placing the edges together and folding over twice continuously taking the top edge prior to plastering or screeding. The contractor shall protect the sheets from damages during laying and subsequent operation and shall replace at his own cost all damaged sheets to the satisfaction of the Engineer.

e. Mud mortar/concrete screed of specified thickness as indicated on drawing shall be laid in slope.

f. Brick tiles of specified size laid over prepared bed to be grouted and flush pointed with cement sand mortar.

8.07 MEASUREMENT AND PAYMENT

The waterproofing shall be measured per square meter and paid as per unit rates entered in the Bill of Quantities inclusive of all overlaps, complete in accordance with the terms and Conditions of Contract.

PVC water stop shall be measured per running meter and paid at per unit rates entered in the Bill of Quantities of accepted lengths a complete with accordance with the terms and Conditions of the Contract.

***** END OF SECTION*****

SECTION - 9

MISCELLANEOUS METAL WORK

9.01 SCOPE OF WORK

The Work covered in this section of the Specifications consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations in connection with the fabrication and installation of miscellaneous metal works, complete in strict accordance with this section of the Specifications and the applicable Drawings and subject to the terms and conditions of the Contract.

9.02 GENERAL

All metal shall be well formed to shape and size, with sharp lines or angles. Shearing and punching shall be left clean to true lines and surfaces. Shop connections shall be welded or riveted and site connections bolted unless otherwise noted. Use flat headed countersunk rivets where riveted connections are exposed to view in finished work. Bolts shall be turned up tight and threads nicked to prevent loosening. All bolts shall be provided with washers.

For exposed connections with hair line joints which are flush and smooth, concealed fasteners shall be used wherever possible. If exposed fasteners are unavoidable, use countersunk flathead screws or bolts.

All metals shall be free from corrosion, scale, distortion and other damage, and only new material shall be used for fabrication purposes.

9.03 MATERIALS

9.03.1 Steel

a. All steel sections shall comply with BS 4, parts 1 and 2, and BS 4848. Steel shall be mild steel complying with BS 4360, Grades 43A, 43B and 43C as appropriate.

b. Steel tubes for structural and general engineering purposes shall comply with BS 1775.

c. Steel tubes and tubulars for balustrades shall comply with BS 1387 designation of either light, medium or heavy and the steel pipe fittings shall comply with BS 1740.

d. Galvanized MS tube shall comply with BS4 and BS 1387 medium grade.

e. Stainless steel sections shall be to BS 970, quality En. 58A. stainless steel pipes shall be to BS 3605.

f. All steel shall be supplied from a specifically approved source, from approved manufacturers, and certificates of origin and mill test certificates shall be supplied in all cases, proof of compliance with the relevant standards shall be a condition of approval.

9.03.2 Nuts, Bolts and Screws

a. Nuts and bolts etc. shall comply with BS 4190 and BS 1494 and shall have SI metric threads complying with BS 3643.

b. Stainless steel bolts are to be set bolts and shall comply with BS 4190. The stainless steel for bolts, nuts and washers shall comply with BS 970, quality En 58 A.M.

c. Self-tapping screws shall comply with BS 4194.

9.04 COORDINATION WITH OTHER TRADES

a. All work under this section shall be coordinated with the work to be done as specified under other sections of the Specifications and as well as with other trades.

b. The Contractor shall furnish all information and instructions required for work by other trades.

c. The Contractor shall drill, tap, cut and fit the work included herein as required to accommodate work of other trades in conjunction with it.

d. The Contractor shall be responsible for obtaining exact site dimensions and accurate execution of all parts of the work specified.

e. All the works shall be carried out strictly in accordance with the approved shop drawings.

9.05 SAMPLES

Samples or materials specified shall be submitted for approval when required by the Engineer.

9.06 FABRICATION

9.06.1 General Fabrication

a. All steel and other metals are to be cut, drilled, formed, bent, worked and otherwise fabricated to the details, forms and dimensions indicated on the approved shop drawings; setting out joints and fixings are to be such as to produce finished components that are perfectly square, sound and rigid. All members are to be of the sizes specified, and no alterations, additions or omissions in the size or arrangements of members may be made without Engineer's approval. The inclusion of gussets, bracing plates, fixing lugs, spacers, packings, etc. in the interests of rigidity or ease of fixing may be considered, but on a specific approval from the Engineer.

b. All open-ended members, including hollow sections, shall be capped off with welded plates or caps; no hollow surfaces which cannot be galvanized or maintained are to be left exposed to atmosphere, whether shown so on Drawings or not.

c. The provision of BS 449 shall apply generally to fabrication workmanship.

9.06.2 Joints

All steel joints specified as welded shall be cleanly and solidly welded, in general accordance with the provisions of BS 5135, using electrodes as specified in BS 639. All welds shall be continuous, solid, with no spot welding, and shall be ground off smooth flush and perfect on completion.

All joints specified as bolted, screwed or otherwise mechanically connected shall be properly set out to provide sufficient but not excessive tolerance, holes drilled accurately, and then soundly and solidly connected. All bolts, screws and connectors shall be either hot-dipped galvanized steel, stainless steel or non-ferrous metal, no untreated steel fixing device is to be used in any circumstances. Fixings shall be selected suitable for the particular purposes, and Engineer's approval obtained.

9.06.3 Tolerances

All metalwork shall be fabricated to overall dimensions so as to provide sufficient but not excessive tolerances between the components and adjoining work, and between adjoining metal components, bearing in mind building materials tolerances, thermal expansion, erection distortions and all other factors.

9.06.4 Drawings and Calculations

Detailed fabrication and shop drawings and, where appropriate, structural calculations shall be prepared by the Contractor for the approval of the Engineer for all the fabricated components. These shall be approved before commencement of work and should indicate all connections, fixing, methods of fabrication, and all other relevant details.

9.06.5 Finishes and Protection

All steel and other metal components specified for painting shall be finished in a smooth workmanlike fashion, free of irregularities of surface, burrs, galvanizing excess, mill marks, oil, grease, dirt, etc. ready for painting.

All metalwork shall be protected during transportation delivery, storage on Site, and after erection, by such measures as shall be agreed with the Engineer, to prevent damage of any

type, in particular scratching, denting, distortion, and other mistreatment. Materials so damaged will not be acceptable, and shall have to be replaced.

9.06.6 **Riveting**

Riveting where exposed shall be flush unless otherwise indicated on Drawings or directed by the Engineer.

9.06.7 **Bolting**

Bolting, where permitted, shall be done with proper size bolts. Nuts shall be drawn tight and thread nicked.

9.06.8 **Steel**

The use of Structural Steel in Buildings shall comply with BS 449 Part 2.

9.06.9 **Welding**

a. Welding of all steel shall comply with BS 5135. All welded joints which will be exposed shall be ground to a smooth finish. All welding shall be executed by experienced certified welders.

b. Welding shall be continuous except where tack-welding is specifically permitted. Tack welding will not be permitted on exposed surfaces.

c. Where galvanized items are to be welded, the weld and joint shall be ground smooth. Only complete welded assemblies may be hot pip galvanized. No cold galvanizing paint permitted cold galvanizing zinc.

d. No black bolts will be accepted. Only H.D. galvanized bolts shall be allowed.

9.06.10 **Shop Finishing**

a. Provide a 6 micron thick zinc coating for the items shown or specified to be galvanized using the hot dip process after fabrication.

b. Shop paint all ferrous metalwork except galvanized work and those portions of items which are to be embedded in concrete or masonry and surfaces and edges which are to be site welded.

c. Remove scale, rust and other deleterious materials before the shop coat of paint is applied.

d. Immediately after surface preparation, anticorrosion metal primer paint be applied in accordance with the manufacturer's instructions. Use painting methods which will result in full coverage of joints, corners, edges and all exposed surfaces.

9.06.11 **Installation**

a. Provide anchorage devices and fasteners where necessary for securing to finished work including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, rag-bolts, wood screws and other connectors as necessary.

b. Cut, drill and fit as necessary for installation. Set the work accurately in location, alignment and elevation, plumb, level and true. Provide temporary bracing or anchors in formwork for items which are to be cast or built into concrete, masonry or similar construction. Form right joints with exposed connections accurately fitted together. Do not cut or abrade members with finishes which cannot be completely restored on Site. Where cutting, welding and grinding are required for fitting and jointing of the work, restore finishes to eliminate any evidence of such corrective work.

c. Carry out all welds and carefully make good on completion.

d. Immediately after erection, clean all site welds, bolted connections and rough areas of the shop paint and coat all exposed areas with the same material as used for shop painting.

e. No site welding to galvanized item will be permitted.

9.06.12 **Storage and Handling**

a. All items described under this Section shall be handled, delivered and stored in a manner that will avoid damage, rust or deformation. Items shall be stored off-ground and shall be entirely covered with weatherproof coverings in storage area.

b. Items which become rusted or damaged because of non-compliance with these conditions will be subject to rejection, and such items shall be replaced without additional cost to the Employer.

9.06.13 **Protection**

a. Before arriving on Site, all surfaces of hot-dip galvanized method which are damaged, have rough spots or joints may be permitted to be by the Engineer be touched up, using an approved zinc primer coat. Damaged hot dip galvanized components will however generally be rejected. Primer shall be compatible for finish paint. Hot dip galvanized items shall not receive a shop coat of primer so that there may be a visual inspection on Site of such items by the Engineer.

b. Thoroughly insulate all non-ferrous items in contact with dissimilar metals, concrete, masonry and mortar with approved zinc-chromate coating or plastic membrane on contact surfaces before installation.

9.07 MISCELLANEOUS ITEMS

9.07.1 **Hollow Metal Frames and Doors**

Metal doors shall comprises of M.S. frames and shutters. All shapes and sizes of complete unit as well as components shall be strictly in accordance with details shown on the Drawings, fabricated, painted and fixed to hollow metal frame as per details shown on the Drawings.

a. **Frames**

i. All hollow metal frames shall be fabricated using 16 gauge M.S. sheets of best quality, free from all defects, and in accordance with the details indicated on the Drawings and Bill of Quantities.

ii. Frames shall be constructed as full welded units from approved manufacturers as per approved shop drawings.

iii. All corners mitred and back-welded and any exposed welds at all joints ground and dressed smooth.

iv. Anchors shall be provided as per approved details, 9" long, three to jambs and welded to frame at shop for embedding in blockwork.

v. All frames shall have channel spreaders. Frames cut, reinforced, mortised, drilled and tapped as required for application of all hardware. All frames shall be fabricated as per final approved hardware schedule.

vi. Rubber/Neoprene bumper or sound absorbers shall be installed 3 per strike jamb.

vii. All contact edges shall be closed tight.

viii. Finished work shall be strong and rigid, neat in appearance and free from defects, warps, bulges or buckles. Moulded members shall be clean-cut straight with true edges.

ix. All cut-outs shall be protected against mortar or plaster with mortar guards of approved gauge.

x. After the frame is fabricated, all tool marks shall be ground smooth, all exposed surfaces degreased and thoroughly cleaned of rust, oil and other impurities and coated with approved primer to enable the surface of the metal to resist corrosion and promote paint adhesion. The remaining irregularities specially welding shall be dressed smooth.

b. **Doors**

Single or double leaf doors shall be fabricated from 20 gauge M.S. sheets of best quality and free from all defects and in accordance with the details indicated on the Drawings and Bill of Quantities.

The doors shall be manufactured from approved manufacturer as per the approved shop drawings. The door shall be provided with hinges and ready to receive locks etc.

c. **Installation**

i. Doors and frames that are fabricated and brought on the Site shall be approved by the Engineer before installation. Any defective or substandard work shall not be acceptable.

ii. Doors and frames shall be installed in accordance with the manufacturer's drawings and recommendations, all to the satisfaction of the Engineer.

d. **Painting**

i. One coat of anti-corrosion primer paint shall be applied to all exposed surfaces before the door and frame is installed. After this another base coat of enamel paint should be given.

ii. After the door and frame has been installed properly, three coats of enamel paint of an approved quality and shade shall be finally applied to all exposed surfaces.

e. **Storage and Handling**

The Contractor shall be responsible for storage, handling and protection of the material on the job. Scratches, holes, dents and nicks and other marring of the paint film will have to be made good and touched up without any extra cost.

9.07.2 **Pipe Handrail**

M.S. pipe hand rail shall be fabricated and installed, as per details indicated on Drawings & Bill of Quantities, by approved manufacturers in accordance with approved shop drawings. The pipe handrail shall be of 2 ½" dia M.S. balusters, M.S. fixing brackets/plates and screws etc., painted and installed.

9.07.3 **M.S. Ladder**

M.S. ladder shall be fabricated and installed, as per details indicated on Drawings & Bill of Quantities, by approved manufacturers in accordance with approved shop drawings.

9.08 MEASUREMENT AND PAYMENT

Metal doors shall be measured per square meter and paid for at the unit rates entered in the Bill of Quantities, inclusive of hollow metal frame, anchors, hardware, painting, installation, complete in all respect.

M.S. pipe handrail shall be measured per-running foot and paid for at the unit rate entered in the Bill of Quantities, inclusive of M.S. balusters, M.S. fixing brackets / plates, screws etc., painting and installation, complete in all respect.

M.S. ladder shall be measured and paid for at the unit rate entered in the Bill of Quantities, inclusive of all materials etc., painting and installation, complete in all respect.

***** END OF SECTION *****