I. SCOPE OF WORK

The work shall include all labor, materials, equipment, plant and other facilities for the satisfactory performance of all works necessary to complete all concrete and reinforced concrete work shown on the Drawing and specified herein.

II. MATERIALS

a. Cement – Cement used shall be Type I Portland Cement conforming to the requirements of the latest revision of ASTM C 150 "Standard Specifications for Portland Cement".

b. Coarse Aggregates – Coarse Aggregates shall be washed, well graded, hard pieces of gravel, crushed gravel, rock or other approved inert materials of similar characteristics, or combination thereof, having hard, strong, durable pieces and free from any adherent coatings. It shall conform to the requirements of ASTM C 33 "Standard Specifications for Concrete Aggregates.

c. Fine Aggregates

Fine Aggregates shall be natural sand, stone screenings or other inert materials with similar characteristics, or any combination thereof, having clean, hard, strong and durable particles, uncoated grains and free from injurious amount of dust, lumps of clay, shale, and organic matter approved by the Engineer. It shall conform to the requirements of ASTM C33 "Standard Specifications for Concrete Aggregates". Beach Sand shall not be used unless approved by the Engineer. Fine aggregates from different sources shall not be mixed or stored in the same pile nor used in the same class of concrete without the approval of the Engineer.

d. Admixtures – Air-entraining admixtures shall conform to the requirements of AASHTO M154. Chemical admixtures, if specified or permitted, shall conform to the requirements of AASHTO M194. Unless otherwise required by Field conditions admixtures may be used subject to the expressed approval of the Engineer. The cost thereof shall be considered as already included in the unit cost bid of the Contractor for the concrete.

e. Water – Water used in mixing, curing and other designated application shall be reasonably clean and free of oil, salt, acid, alkali or other substance which would adversely affect the concrete. Water will be tested in accordance with, and shall meet the suggested requirements of AASHTO T26.

f. Reinforcing Bars – It shall be standard commercial deformed steel bars and must conform to the requirements of ASTM A 615, grade 40 and/or AASHTP M42, M31 and M53.

g. Tie Wire – It shall be commercial G.I. wires, gauge 16 and must be in accordance with ASTM A 615 and/or AASHTO M31 and M42.

h. Forms – It shall be of well-seasoned, quality lumber and well-graded plywood. All forms shall be straight, free from warps and of adequate

strength to resist distortion. Formwork shall be coated with form oil of approved make.

i. Storage of Materials – Cement shall be stored on waterproof building or watertight shed, and on platform off ground. The Contractor shall handle and store fine and coarse aggregates separately in a manner to provide good drainage, and to prevent segregation or inclusion of foreign materials. All reinforcing bars shall be protected from mechanical injury and surface deterioration caused by exposure to conditions producing rust until used.

III. TRIAL BATCH FOR CONCRETE

Thirty (30) calendar days before the start of concreting works, the Contractor shall submit design mixes and the corresponding test results made on sample thereof. Sampling and testing shall be in accordance with the ASTM Standard procedures for sampling and testing, for the particular design strenght9s0 required.

The particulars of the mix such as the slump and the proportionate weights of cement, saturated surface dry aggregates and water used shall be stated. Test results shall show 28-day strength(s) fifteen (15) percent higher than the ultimate strength(s) required.

IV. CONCRETE PROPORTIONAND CONSISTENCY

Concrete proportion should produce mix consistencies that will work readily into angles and corners of the forms and around reinforcements irrespective of the method of placing employed, without permitting the materials to segregate or excess water to collect on the surface of the concrete and with separate individual particles of aggregates showing coating of mortar with proportionate amount of sand. The total aggregate in the proportion used shall be such that when sieved, the weight passing the No. 4 standard sieve shall be thirty percent (30%) of the total.

The methods used for measuring materials going in to the concrete mix shall permit easy checking and control of proportions at any time during the work.

V. MIXING OF CONCRETE

All concrete used shall be machine-mixed at the site. Each batch shall be mixed at the mixer’s design speed, for at least 1-1/2 minutes after all concrete materials are simultaneously placed in the mixer. The ideal rotation speed of the mixer shall be between 14 and 20 rpm.

All mix contents of the mixer shall be thoroughly removed before any succeeding batch is placed.

The materials for the first batch shall contain sufficient excess cement, sand and water to coat the inside walls of the mixer without reducing the required mortar content of the mix.

The mixer shall be provided with devices for accurately measuring and controlling the amount of water used in each batch and for automatically recording the number of revolutions of the mixer.

Hand mixing of concrete will only be allowed in case of mixer breakdown, in which case it shall be stopped as soon as pouring for the particular section id completed, or at a construction joint as directed by the Engineer.

Retempering or remixing of partially hardened concrete with the addition of water will not be permitted.

Inserts, sleeves, anchors, bolts and other materials in connection with concrete construction shall be placed and secured in position before concrete is placed.

VI. JOINTS

No reinforcement, corner protection angles or other fixed metal items shall be run continuous through joints containing expansion-joint filler, through crack-control joints in slabs or grade and vertical surfaces.

Joints with Joint Sealant: At expansion joints in concrete slabs to be exposed, and at other joints indicated to receive joint sealant, pre-molded expansion joint filler strips shall be installed at the proper level below the elevation with a slightly tampered, dressed and wood strip temporarily secured to the top thereof to form a groove, when surface dry, shall be cleaned of foreign matter, loosed particles, and concrete protrusions, there filler approximately flush with joint sealant so as to be slightly concave after drying.

Finish of concrete at joints: Edges of exposed concrete slabs along expansion joint shall be nearly finished with a slightly rounded edging tools.

Construction Joints: Unless otherwise specified herein, all construction joints shall be subject to the approval of the Owner. Concrete shall be placed continuously so that the unit will be monolithic in construction. Fresh concrete may be placed against adjoining units, provided the set concrete is sufficiently hard not to be injured thereby. Joints not indicated shall be made and located in a manner not to impair strength and appearance of the structure.

Placement of concrete shall be at such rate that the surfaces of concrete not carried to joint levels will not have attained initial set before additional concrete is placed thereon. Lifts shall terminate at such levels as indicated or as to conform to structural requirements as directed. If horizontal construction joints are required, a strip of 25 mm square-edge lumber, leveled to facilitate removal shall be taken to the inside of the forms at the construction joints. Concrete shall be removed 1 hour after the concrete has been placed, any irregularities in the joint lines shall be leveled off with wood float, and all laitance removed. Prior to placing additional concrete, horizontal constructed joints shall be prepared as specified in “Bonding”.

VII. FORMS AND FALSEWORK

All forms and falsework to be used in the work must be designed, and constructed by the Contractor for rigidly and adequacy for carrying the loads of the green concrete and/or additional superimposed construction loads. The Authority may from time to time verify the adequacy and safety of such temporary works and

may require the Contractor to submit detailed designed drawings of forms and falsework proposed to be used. Approval of such drawings or design of forms, however, shall not relieve the Contractor of his liability on imperfections or damages to the finished concrete, or other damages which may directly result therefrom.

Forms may be re-used but shall be scrapped by a wire brush of all clinging mortar. Bulges should be planed and realignment prior to its use.

Prior to placing concrete form surfaces should be oiled for easy from removal. However, the oil coating should not be so thick as to stain and soften the concrete surface. Oil coatings should be applied before rebars are in placed.

VIII. PLACING REINFORCEMENTS

Metal reinforcement shall be placed as accurately detailed on drawings and properly secured by the approved means.

All bars shall be cold bent unless approved otherwise by the Engineer. Minimum distance between parallel bars shall be one and one half (1 ½) times the diameter for round bars and twice the side dimension for square bars. The clear distance between bars shall not be less than 2.54 cm. (1 in.) nor less that one and one third (1 1/3) times the maximum size of the coarse aggregate, whichever is bigger.

All reinforcing steel shall be cleaned of all rust or scale deleterious materials which tend to destroy the bond between the concrete and the steel.

Generally, splice/s of reinforcement at points of maximum stress specially in slabs, beams and girders shall be avoided. Such splice/s may however be approved by the Engineer in writing provided the lap if bonded or butt welded is sufficient to transfer tensile stress between bars by at least 125% of the specified yield strength of the reinforcing bar. For adjacent bars splices shall be staggered.

IX. PLACING CONCRETE

Concrete shall be handled from mixer to transport to place of final deposit in a continuous manner, as rapidly as practicable, and without segregation of loss of ingredient until the approved unit of work is completed. Placing will not be permitted when the sun, heat wind or, limitations of facilities furnished by the Contractor prevent proper finishing and curing of the concrete. Concrete shall be placed in the forms, as closed as possible in the final position, in uniform approximately horizontal layers not over 300 mm deep. Forms splashed with concrete and reinforcement splashed with concrete of form coating shall be cleaned in advance of placing subsequent lifts. Concrete shall not be allowed to drop freely more than 10 meters in unexposed work nor more than 1 meter in exposed work; where greater drops are required, tremie or other approved means shall be employed. The discharged of the tremies shall be controlled so that the concrete may be effectively compacted into horizontal layers not more than 300 mm thick, and the spacing of the tremies shall be such that segregation does not occur. Concrete to receive other construction shall be screeded to the proper level to avoid exceesive skimming or grouting. Conduits and pipes shall not be embedded in concrete unless specifically indicated or as directed by the Owner.

Time Interval Between Mixing and Placing: Concrete mixed stationary mixers and transported by non-agitating equipment shall be placed in the forms within 45

minutes from the time ingredients are charged into the mixing drum. Concrete transported in truck mixers or truck agitators shall be delivered to the site of work discharge in the forms within 45 minutes from the time that the ingredients are discharged into the mixing drum. Concrete shall be placed in the forms within 45 minutes after discharged from the mixer at the jobsite.

Earth-foundation placement: Leveling concrete for concrete foundations, exterior slabs and exterior foundations receiving equipment or machinery shall be placed upon undisturbed surfaces. The surfaces shall be clean and free from mud and water. The concrete foundations may be placed over the leveling concrete surfaces.

Conveying Concrete by Chute, Conveyor or Pump: Concrete may be conveyed by chute, conveyor, or pump if approved in writing. In requesting approval, the contractor shall submit his entire plan of operation from time of discharge of concrete from the mixer to final placement in the forms, and the steps to be taken to prevent the formation of cold joints, in case the transporting of concrete by chute, conveyor or pump is disrupted. Conveyor and pump shall be capable of expeditiously placing concrete at the rate most advantageous to good workmanship. Approval will not be given fro chutes or conveyors requiring changes In the concrete materials or design mix for efficient operation.

a. Chutes and Conveyors: Chutes shall be of steel or steel line wood, rounded in cross section rigid in construction, and protected from overflow. Conveyors shall be designed and operated and chute sections shall be set, to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients loss of mortar, or change in slump. The discharge portion of each chute or conveyor shall be provided with a device to prevent segregation. The chute and conveyor shall be thoroughly cleaned before and after each run. Waste material and flushing water shall be discharge outside the forms. When using titled chutes, the inclination should not be flatter than (1) vertical and (2) horizontal. From the outlet/mouth of the chute to the concrete surface, the maximum allowable height shall be 1.50 meters.

b. Pumps shall be operated and maintained so that a continuous stream of concrete is delivered into the forms without air pocket, segregation of change in slump. When pumping is completed, concrete already placed.

   After each operation, equipment shall be thoroughly cleaned and the flushing water shall be splashed outside the forms.

Placing concrete reinforcement: Where congestion of the steel or other conditions will make placing or compaction of concrete difficult, a layer of mortar shall be first deposited in forms to a depth of approximately 25 cm. Mortar proportions shall be the same as the concrete minus the coarse aggregate.

X. COMPACTION

Immediately after placing, each layer of concrete shall be compacted by internal concrete vibrators supplemented by handspading, rodding, and tamping. Tapping or other external vibration of forms will not be permitted unless specifically approved by the Owner. Vibrations shall not be used to transport concrete inside forms. Internal vibrators submerged in concrete shall maintain a speed of not less than 7000 impulses. The vibrating equipment,

shall at all times be adequate in number of units and power to properly consolidate all concrete.

Spare units shall be on hand as necessary to insure such adequacy. Duration of vibrating equipment shall be limited to time necessary to produce satisfactory consolidation without causing objectionable segregation. The vibrators shall not be inserted into lower courses that have begun to set.

Vibrators shall be applied at uniformity spaced points not further apart than the visible effectiveness of the machine.

XI. BONDING

Bonding/depositing new concrete on or against concrete has set. The surfaces of the set concrete shall be thoroughly cleaned so as to exposed coarse aggregate and be free of laitance, coatings, foreign matter and loose particles. Forms shall be retightened. The cleaned surfaces shall be moistened, but shall be without flowing water when concrete is placed.

XII. SLABS ON GRADE

Concrete shall be compacted, screeded to grade, and prepared for the specified finish. Concrete shall be placed continuously so that each unit of operation will be monolithic in construction. Concrete shall be placed in alternate checkboard pattern terminating at crack-control joints or may be placed in alternative paving lanes as limited expansion, and contraction joints. Crack-control joints shall be expansion, contraction, or construction joints. Joints not shown shall be lifted at column center lines and at intermediate intervals so that such panel shall not be more than 55 sq.m. in area. Panels shall be approximately square with dimension of one side not more than 7.5 meters. Forms shall remain in place for at least 12 hours after complete placement.

Construction joints may be formed by the insertion of hard pressed fiberboard strips inserted in the plastic concrete or may be cut with an approved concrete sawing machine after the concrete has set. Unless otherwise indicated or directed, the joints shall be 3 mm wide and depth equal to approximately ¼ of the slab thickness of the maximum size of the coarse aggregate whichever is greater.

Sampling: Concrete joints, where sawed or formed, shall be filled with joints sealants except where a floor covering is required.

XIII. FINISHES OF CONCRETE

Within 12 hours after forms are removed, surface defects shall be reminded as specified herein. Fine and loose material shall be removed. Honeycomb, aggregate pockets, voids over 13 mm in diameter, and holes left by the rods or bolts shall be cut out to solid concrete, reamed, thoroughly wetted, brush-coated with neat cement grout, and filled with mortar. Mortar shall be a stiff mix of 1 part Portland cement to not ore than 2 parts fine aggregates passing the no. 16 mesh sieve, and minimum amount of water. The color of the mortar shall match the adjoining concrete color. Mortar shall be thoroughly compacted in place.

Holes passing through walls shall be completely filled from the inside face by forcing mortar through to the outside face. Holes which do not pass entirely through wall shall be packed full. Patchworks shall be finished to match adjoining

surfaces in texture and color. Patchworks shall be damp cured for 72 hours. Ambient temperature shall not be less than 10 degrees C. Dusting of finish surfaces with dry material or adding water to concrete surfaces will not be permitted.

XIV. CONCRETE FINISHEDD FOR SLABS

Slabs Receiving Concrete Paving: After concrete is placed and consolidated, slab shall be screeded or struck off. No further finish is required.

Smooth Finish: Required only where specified; screed concrete and float to required level with no coarse aggregate visible. After surface moisture has disappeared and laitance has been removed, the surface shall be finished by float and steel trowel.

Broom Finish: Required for paving, stairs and landings; the concrete shall be screeded and floated to required finish level with no coarse aggregate visible. After the surface moisture has disappeared and laitance has been removed, surface shall be float finished to an even, smooth finish. The floated surface shall be broomed with a fiber bristle brush in a direction transverse to the direction of the main traffic.

Tolerance: Smooth and broom finished surfaces shall be true to plane with no deviation in excess of 3mm in any direction when tested with a 3 m. straight edge.

XV. FINISHES OF CONCRETE OTHER THAN FLOOR SLABS

Within 12 hours after forms are removed, surfaces defects should be remedied as specified herein. Honeycomb, aggregate, pockets, voids over 12 mm in diameter, and holes left by the rods or bolts shall be cutout to solid concrete, reamed, thoroughly wetted, brush coated with neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to not more than 2 parts fine aggregates passing the no. 16 mesh sieve, and minimum amount of water using portland cement for all or part of the cement so that

when dry, the color of the mortar shall be thoroughly compacted in place. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through the wall and shall be packed full. Patch works shall be damp cured for 72 hours. Protruding portions of bar supports shall be ground flushed with concrete surfaces that will be exposed, painted, or plastered, or plastered directly.

Smooth Finish: After the above operation have been completed, smooth finish shall be given to interior and exterior concrete surfaces that are to be painted or exposed to view. Smooth finished shall consist of thoroughly wetting and then brush-coating the surfaces with cement grout composed by volume of 1 part fine aggregate passing the no. 30 mesh sieve and mix with water to the consistency of thick mixes, so that the final color of grout when dry, will be approximately the same as the color of the surrounding concrete. Grout shall be cork or wood-floated to fill all pits and air bubbles; visible grout film. The grout shall be kept damp by means of fog spray during the setting period. The finish of any area shall be completed in the same day and the limits of a finished area shall be made at natural breaks in the finished surface.

Rough Slab Finish: Slabs to receive full and mortar setting beds shall be screeded with straight-edges to bring the surface to the required finish plane with no aggregate visible.

Broom Finish shall be given to exterior surfaces except concrete stairs treads, entrances, and landings for buildings. The concrete shall be screeded and floated to the required finish level with no coarse aggregate visible. After the surface moisture has disappeared and laitance has been removed, surfaces shall be still troweled to an even, smooth finish. The troweled surfaces shall be broomed with a fiber bristled brush in a direction transverse to that of the main traffic.

XVI. CURING

Concrete shall be protected against moisture loss, rapid temperature change, mechanical injury from rain or flowing water, for a minimum period of 7 days.

Concrete shall be maintained in a moist condition at temperature above 10 degrees C throughout the specified curing period and until remedied work started. Curing activities shall be started as soon as free water has disappeared from surface of the concrete after placing and finishing.

Form under surface shall moist cured with forms in place for the full curing period or, if forms are removed prior to the end of the curing period by other approved means. Curing shall be accomplished by any of the following methods of combination thereof, as approved.

Water: Water used in curing shall be reasonably cleaned and free of oil, salt, acid, alkali, or other substances injurious to the concrete. Drinking water may be used for curing test.

Moist Curing: Uniformed surfaces shall be covered with burlap or mats, wetted before placing and over-lap at least 150 mm. Burlap or mats shall be kept continually wet and in intimate contact with the surface. If the forms are removed before the end of the curing period, curing shall be continued on uniformed surfaces, using suitable materials.

XVII. LIQUIDATED DAMAGES

For failure to meet the specified strength required for concrete, designed, prepared and laid by him, the Contractor shall pay the AUTHORITY as liquidated damages, not as penalty or forfeiture the following to be applied only to the quantity of concrete which the particular sample/s represent.

a. Payment of 30% contract unit cost per cubic meter of concrete affected for test resulting to strength between 90 to 100 percent of specified strength;

b. Payment of 50% contract unit cost per cubic meter of concrete affected for test resulting to strength between 80 to 90 percent of specified strength.;

c. Non-payment and removal and replacement at cost to the Contractor affected for test resulting to strengths below 80 percent of that specified; provided that;

To determine the adequacy of the affected pavement or structure the General Manager may order load test on parts of the pavement/structure where concrete

strength is below 80% of that specified, all in accordance with ACI-318, and at cost to the Contractor.

XVIII. FIELD TESTS

Field tests as may be deemed necessary to check on the quantity of the materials and mixtures and the manner of construction employed shall be conducted by the Project Engineer assigned to the project. And when such tests result to values less than that tolerated by standards set in applicable provisions of the ASTM Specifications referred to herein, or contrary to accepted good engineering practice, the Contractor shall comply to any instructions given by the project Engineer to upgrade the materials used and method of construction employed.