



ANNEX-2-B-TECHNICAL SPECIFICATIONS

CONSTRUCTION OF NEW ACCOMMODATION

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SECTION 1

GENERAL REQUIREMENTS

RESPONSIBILITY FOR ACCURACY

The Contractor shall be responsible for the accuracy of the Contractor's own layout work, and shall be liable for the preservation of all established lines and grades. The Contractor shall obtain all necessary measurements for and from the Work, and shall check dimensions, elevations, and grades for all layout and construction work and shall supervise such work; the accuracy for all of which the Contractor shall be responsible. The Contractor is responsible for adjusting, correcting, and coordinating the work of all Subcontractors so that no discrepancies result.

DUTIES AND POWERS OF INSPECTORS

Inspectors are the authorized representatives of the UNDP. Their duty is to inspect materials and workmanship of those portions of the Work to which they are assigned, either individually or collectively, under instructions of the UNDP Engineer, and to report all deviations from the Contract.

INSPECTION

The inspection of the Work does not relieve the Contractor of the obligation to fulfill all Contract requirements. Any work, materials, or equipment not meeting the requirements and intent of the Contract will be rejected, and unsuitable work or materials shall be made good, notwithstanding the fact that such work or materials may have previously been inspected or approved and payment may have been made. Reexamination of any part of the Work may be ordered by the UNDP, and such part of the Work shall be uncovered by the Contractor. The Contractor shall pay the entire cost of such uncovering, reexamination, and replacement if the reexamined work does not conform to the Contract.

All work and materials furnished pursuant to the Contract shall be subject to inspection and approval by the Engineer. The Contractor shall provide the UNDP and Inspectors with access to the Work during construction and shall furnish every reasonable facility and assistance for ascertaining that the materials and the workmanship are in accordance with the requirements and intent of the Contract.

Unless authorized in writing by the Engineer, any work done in the absence of an Inspector, whether completed or in progress, shall be subject to inspection. The Contractor shall furnish all tools, labor, materials, access facilities, and other facilities necessary to allow such inspection, even to the extent of uncovering or taking down completed portions of the Work.

The Contractor shall pay all costs incurred, whether or not any defective work is discovered.

The Contractor shall also be solely responsible for any costs associated with the removal of any defective work discovered during the inspection and the complete cost of reconstruction.

The Contractor shall notify the Engineer of the time and place of any factory tests and submit test procedures for approval thirty (30) Calendar Days in advance for any tests that are required by the

Contract. The Contractor shall report the time and place of preparation, manufacture or construction of any material for the Work, or any part of the Work, that the UNDP wishes to work on any such material or of the beginning of any such test to allow the Engineer to make arrangements for inspecting and testing or witnessing.

QUALITY OF MATERIALS AND WORKMANSHIP

Unless otherwise allowed or required by the UNDP Engineer, all materials shall be new and of a quality at least equal to that specified. When the Contractor is required to furnish materials or manufactured articles or shall do work for which no detailed specifications are set forth, the materials or manufactured articles shall be of the best grade in quality and workmanship obtainable in the market. If not ordinarily carried in stock, the articles shall conform to the usual standards for first-class materials or articles of the kind required. The work performed shall secure the best standard of construction and equipment of the work as a whole or in part. At a minimum, all work and materials shall be of the quality called for in the drawing and these specifications, the contract documents, and any pertinent or current industry standards or guidelines.

Materials shall be furnished in sufficient quantities and at such times to ensure uninterrupted progress of the Work. All required spare parts shall be delivered in new condition, not in a used or unknown condition, and with any certificates required. Materials, supplies, and equipment shall be stored properly and protected as required. The Contractor shall be entirely responsible for damage or loss by weather or other causes.

Any trench, fill, or roadway settlement occurring during the life of the contract, including the warranty period, shall be considered a workmanship defect and shall be reconstructed or replaced by the Contractor, notwithstanding any previous acceptance or approval by the Engineer.

SUBSTITUTIONS

Certain materials, articles, or equipment may be designated in the Contract by brand or trade name or manufacturer together with catalog designation or other identifying information.

Substitute material, article, or equipment which is of equal quality and of required characteristics for the intended purpose may be proposed for use, provided the Contractor complies with the requirements of the following paragraphs.

The Contractor shall submit any request for substitution in writing within 15 (thirty) Calendar Days after the award of the Contract.

DOCUMENTATION

If requested by the Engineer, a proposal for substitution must be accompanied by complete information and descriptive data, including cost of operation, cost of maintenance, and physical requirements necessary to determine the equality of offered materials, articles, or equipment.

The Contractor shall also submit such shop drawings, descriptive data, and samples as requested. The burden of proof of comparative quality, suitability, and performance of the offered proposal shall be upon

the Contractor. The determination of equal quality suitability and performance shall be at the sole discretion of the Engineer. The Agency will examine such submittals with reasonable promptness. If the Engineer rejects the request for such substitution, then one of the particular products designated by brand name in the Contract shall be furnished.

Acceptance of substitution by the Engineer shall not relieve the Contractor from responsibility for deviations from the Plans and Specifications or from responsibility for errors in submittals.

Failure by the Contractor to identify deviations in the request material from the Plans and Specifications shall void the submittal and any action taken thereon by the UNDP.

If mechanical, electrical, structural or other changes are required for proper installation and fit of substitute materials, articles or equipment, or because of deviations from the Contract, such changes shall not be made without the written consent of the Engineer and shall be made by the Contractor without additional cost to the Engineer. The Contractor shall pay the costs of design, drafting, architectural or engineering services and building alterations of the construction required to accommodate any Contractor substitution or construction error to maintain the original function and design.

PREPARATION FOR TESTING

The Contractor shall maintain proper facilities and provide safe access for inspection by the Engineer to all parts of the Work and to the shops wherein parts of the Work are in preparation. Where the Contract requires work to be tested or approved, such work shall not be tested or covered up without at least a five (5) Working Day notice to the Engineer of its readiness for inspection, unless the written approval of the Agency for such testing or covering is first obtained.

MATERIALS SAMPLING AND TESTING

Materials to be used in the Work will be subject to sampling and tests by the Engineer. The Contractor shall furnish the Engineer with a list of the Contractor's sources of materials and the locations at which such materials will be available for inspection. The list shall be submitted on an UNDP form and shall be furnished to the Engineer in time to permit the inspection and testing of materials in advance of their use.

Testing shall be done to such standards as set forth in the Plans, Specifications, or Special Provisions. References made in these documents to standard methods of testing materials shall make such standards a part of the Specifications.

Whenever a reference is made in the Specifications to a specification or test designation of any recognized national Organization or laboratories, and the number or other identification representing the year of adoption or the latest revision is omitted, it shall mean the specification or test designation in effect on the date of the original Notice to Contractors for the Work.

When requested by the Engineer, samples or test specimens of the proposed materials shall be prepared at the expense of the Contractor and furnished by the Contractor in such quantities and sizes required for proper examination and tests, and with complete information describing type, kind, or size of material, and its source. All samples shall be submitted in time to permit the making of proper tests, analyses, or examinations before incorporating the materials into the Work. No material shall be used in the Work

unless or until it has been approved by the Engineer. All material tests shall be made by the Engineer in accordance with recognized standard practice. The Contractor shall pay the cost of the second retest and any subsequent retest of any area or material. The Engineer will secure and test samples whenever necessary.

APPROVAL OF MATERIALS

A. Sources of Supply

The Engineer's approval at the source of supply may be required prior to procurement. Such approval shall not prevent subsequent disapproval or rejection of materials by the Engineer if the quality is less than required by the Contract.

Sand, gravel, or other minerals incorporated into UNDP work must comply with these specification and contract drawings. The Engineer may request written documentation of compliance.

B. Plant Inspection

The UNDP assumes no obligation to inspect materials at the source of supply. The Contractor is responsible for incorporating satisfactory materials into the Work, notwithstanding any prior inspections or tests.

The Engineer will inspect materials at the source if the Contractor submits a written request and if the Engineer deems the inspection necessary. The Contractor and the supplier will cooperate with and assist the Agency while performing the inspection. The Engineer shall have access to all production areas of the plant.

PROVISIONS FOR EMERGENCIES

The UNDP may provide necessary labor, material and equipment to correct any emergency resulting from the Contractor's operation including noncompliance with the Contract, public convenience, safety, traffic control, and protection of work, persons and property. The nature of the emergency may prevent the UNDP from notifying the Contractor prior to taking action. The costs of such labor, material, and equipment will be deducted from progress payments.

The performance of such emergency work under the direction of the UNDP shall not relieve the Contractor from any damages resulting from the emergency.

RIGHT TO RETAIN IMPERFECT WORK

If any portion of the work done or materials furnished under the Contract shall prove defective or not in accordance with the Contract, and if the defect in the work or materials is not of sufficient magnitude or importance to make the work dangerous or undesirable, or if the removal of such work or materials is impracticable or will create conditions which are dangerous or undesirable, the UNDP shall have the right and authority to retain the work or materials instead of requiring it to be removed and reconstructed or replaced. Progress payment deductions will be made for Imperfect Work", of these Specifications, and a deductive Contract Cost Amendment Order will be issued.

REMOVAL OF REJECTED MATERIALS OR WORK

The Contractor shall remove all rejected or condemned materials or structures brought to or incorporated in the Work within two (2) Working Days of the Engineer's written order. No such rejected or condemned materials shall again be offered for use in the Work. The Contractor shall, at the Contractor's expense, bring into Contract compliance all rejected material or work in a manner acceptable to the Engineer.

The Engineer may bring into Contract compliance the rejected material if the Contractor fails to comply with this Section. All costs will be deducted from the Progress Payment.

TEMPORARY SUSPENSION OR DELAY OF WORK

The UNDP has the authority to suspend or delay the Work, wholly or in part, for any period the UNDP deems necessary. The Contractor shall immediately comply with the UNDP's written order to suspend or delay the Work. The suspended or delayed work shall be resumed only when conditions are favorable or methods are corrected, as ordered or approved in writing by the Engineer. Public safety and convenience must be maintained throughout the suspension or delay in accordance with these Specifications.

Delays due to suspension of work shall be classified as Avoidable or Unavoidable Delays in accordance with these Specifications.

Such suspension shall not relieve the Contractor of the Contractor's responsibilities as described in the Contract.

Completion Delay

The UNDP may terminate the Contract if the Contractor has not completed the Work on or before the completion date adjusted by Contract Change Order. The Contractor is not entitled to any compensation and is liable to the UNDP for liquidated damages for all time beyond such Contract completion date until the Work is completed, if the UNDP chooses to complete the Work.

Unsatisfactory Performance

The UNDP may give the Contractor or the Contractor's Representative written notice that the Contract will be terminated if the following breaches are not corrected:

- The Contractor abandons the Work.
- The Work or any portion is sublet or assigned without the UNDP's consent.
- The rate of progress is not in accordance with the Contract.
- Any portion of the Work is unnecessarily delayed.
- The Contractor willingly violates any terms or conditions of the Contract.
- The Contractor does not supply sufficient materials or properly skilled labor.
- The Contractor fails to promptly pay its Subcontractors.

- The Contractor disregards laws, ordinances, or UNDP orders.
- The Contractor fails to respond to defective work notices.

The Contractor shall cease and terminate the Work if satisfactory arrangement for correction is not made within ten (10) Calendar Days from such notification.

RESPONSIBILITY OF THE CONTRACTOR

The Contractor shall be solely responsible for, and have exclusive control over, construction means, methods, techniques, sequences, procedures, and coordination of all portions of the Work under the Contract, unless otherwise provided in the Contract or in an emergency situation where specific direction regarding means, methods, techniques, sequences, procedures, and coordination is necessary to mitigate an imminent and serious health and safety hazard.

All Contractors, in coordination with the UNDP and its duly authorized representatives, as appropriate, shall implement measures that will create safety awareness and promote safe work practices at the jobsites and shall pursue the Contract in the safest manner possible.

The Contractor shall take appropriate action, up to and including termination, against any Contractor employee who willfully or repeatedly violates workplace safety rules.

The Work shall be under the Contractor's responsible care and charge until completion and final acceptance, and the Contractor shall bear the entire risk of injury, loss, or damage to any part by any cause. The Contractor shall rebuild, repair, restore, and make good all injuries; losses or damage to any portion of the Work or the materials occasioned by any cause, and shall bear the entire expense.

In no case shall the Contractor's use of Subcontractors in any way alter the position of the Contractor or the Contractor's obligations with relation to the Contract. When a Subcontractor is used, the responsibility for every portion of the Work shall remain with the Contractor. No Subcontractor will be recognized as having a direct contractual relationship with the Agency. All persons engaged in the Work under the Contract will be considered as employees of the Contractor and their work shall be subject to all the provisions of the Contract. The UNDP will deal only with the Contractor who is responsible for the proper execution of the Work. The Contractor shall pay when due all valid claims of Subcontractors, suppliers, and workmen with respect to the Work.

The mention herein of any specific duty or responsibility imposed upon the Contractor shall not be construed as a limitation or restriction of any other responsibility or duty imposed upon the Contractor by the Contract, said reference being made herein merely for the purpose of explaining the specific duty or responsibility.

SAFETY

1. Safety Plans and Documents

Safety is a prime consideration in all UNDP contracts. The Contractor shall conform to all applicable occupational safety and health standards, rules, regulations, and orders established

The Contractor, and all Subcontractors, shall, upon request, submit to the UNDP a copy of their Injury Illness Prevention Program, and Task Specific Safety Plan (TSSP) for review by the Engineer. The Contractor is required to fulfill the requirements of these programs during the prosecution of the Work. No work shall be started unless otherwise authorized by the UNDP until the UNDP has completed its review of all required safety documents and provided written authorization to proceed.

All plans shall be formatted in a logical and orderly fashion, including tabs and section dividers for ease of navigation and review. The Contractor and all Subcontractors are required to comply with the requirements of the Safety during the prosecution of the Work.

The UNDP has full authority to enforce, make exceptions to, or waive requirements of any of the required safety plans or documents on a case-by-case basis. Exceptions and or waivers will be provided in writing to the Contractor. Use of all or part of any safety and health manual or plan does not relieve the Contractor of the responsibility to comply with prevailing local laws and regulations.

2. Task Specific Safety Plan

Contractor shall be prepared for high-hazard activities including, but not limited to, excavations, permit-required confined spaces, traffic safety, tunneling, hazardous energy, critical crane lifts, lead or asbestos work, and use of radioactive materials or radiation generating devices. Specific requirements for TSSP's may be indicated in the Special Provisions. At a minimum, the TSSP shall include the following elements:

1. A detailed description of and step-by-step procedures for each high-hazard activity, including engineering and administrative hazard control measures;
2. Designation of responsibilities and authority for all key personnel;
3. Names of and training records for all Competent Persons and for all employees performing critical tasks;
4. Employee medical and equipment test records pertinent to the specific task such as respirator fit test records and medical evaluations;
5. List of all construction, safety and personal protective equipment (PPE) to be used;
6. Illustrations and calculations relevant to the mitigation of related hazards;
7. Copies of all forms and checklists to be used;
8. Copies of Material Safety Data Sheets (MSDSs) for all substances to be used.
9. Emergency response and rescue procedures.

Illumination

Work by the Contractor during the hours of darkness or in locations where natural light is inadequate shall be illuminated to conform to the applicable minimum illumination intensities established by the Occupational Safety and Health standard.

Personal Protective Equipment (PPE)

Safety standards for PPE shall be adhered to. The Contractor must provide the required PPE to employees and must ensure that it is used and maintained in a sanitary and reliable condition.

Hazard Communication

The Contractor is required to develop, implement and maintain a Hazard Communication Program in order to protect employees who may use or be exposed to hazardous substances during the course of construction. The Contractor's Hazard Communication Program will define responsibilities for the following activities:

- Maintaining a written hazard communication plan
- Maintaining a current inventory of hazardous chemicals at the work site
- Maintaining a current Material Safety Data Sheet (MSDS) for each hazardous chemical or chemical compound at the work site
- Labeling chemical containers properly
- Training employees

The Contractor shall provide copies of MSDS's to the Agency upon request.

Schedules

The Contractor shall submit a schedule, in accordance with the, "Contractor's Submittals", of these Specifications, which illustrates the Contractor's plans for carrying out the Work. The Engineer will review the schedule, and any updates or revisions, for conformance to the Contract. Engineer review of a schedule, update, or revision does not relieve the Contractor of responsibility for the feasibility of the schedule or requirements for accomplishments of mile BRICKs and completion within Contract Time, nor does the Engineer review warrant or acknowledge the reasonableness of the schedule's logic, durations, labor estimates, or equipment productivity. If no separate item is provided in the Bid Form, payment for schedules shall be included in payments for mobilization. If no bid item for mobilization is included in the Bid Form, conformance with this provision is incidental to and included in the various bid items and no additional payment will be made. Updates and revisions of the schedules are included in the prices paid for other items of work.

Because the Engineer places a high value on the importance and use of project scheduling information as a management tool in achieving the completion of the Work as planned, the UNDP may delay monthly Progress Payment until submission of Progress Schedule.

Progress Schedule

A bar chart or similar form of baseline and progress schedule will be required for all contracts. Unless otherwise agreed to in writing by the Engineer, the latest version of MS Project or Primavera shall be used. The Contractor shall submit three (3) copies, plus an electronic copy, of a complete baseline schedule at the preconstruction conference.

The baseline schedule shall show all major portions of the Work, the estimated dates on which the Contractor shall start each portion of the Work, and the contemplated dates for completing each portion of the Work or the approximate percentage of the Work or portions of the Work scheduled for completion at any time and/or the planned duration for each portion of the Work identified on the schedule.

Unless agreed to by the Engineer, progress schedules shall be updated and submitted to the UNDP with each Progress Payment request or when requested by the Engineer.

The Contractor shall submit three (3) copies, plus an electronic copy. All schedule updates or revisions shall show the effects of any occurrence upon which the Contractor will base a notice of potential claim or has based any claim, and shall expressly call the Engineer's attention to those effects. A revised or updated schedule shall be submitted within ten (10) Working Days of an Engineer request.

The Contractor shall carry out the various elements of the Work concurrently, as is practicable, and shall not defer construction of any portion of the Work in favor of any other portion, without the express written approval of the Engineer.

Despite the submission of a progress schedule, the Contractor shall be governed by the direction of the Agency if, in the judgment of the Engineer, it becomes necessary to accelerate the Work or any part thereof, or cease work at any particular point and concentrate the Contractor's forces at such other point or points, with the intent of preventing delays.

----End of Section---

SECTION 02

CONCRETE REINFORCING STEEL

PART 1 GENERAL

The following shall be submitted by the contractor:

Reinforcing Steel Submittals

Detailed drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

Product Data:

Include Origin, Suppliers certificate, Test result Submit certificates and tension test reports of reinforcing bars. Submit test report of the rebar for different types and sizes

Testing

Representative samples of all reinforcement steel that the Contractor proposes to use in the Works must be submitted, before work is commenced, to the Employer's Representative for written approval, together with manufacturer's certificates stating clearly, for each sample, the place of manufacture, expected date and size of deliveries to the Site, and all relevant details of composition, manufacture, strengths and other

qualities of the steel.

In the event a reinforcement steel sample under test fails to meet the specification requirements at any time, or the Employer's Representative considers that samples which were presented to him for test were not truly representative, or if it becomes apparent that reinforcement steel which has not been approved has been used on the Works, the Employer's Representative may instruct the Contractor to break out and remove completely all such sections of the work already constructed using such suspect reinforcement steel, and replace to an approved method with materials and workmanship meeting these specifications.

PART 2 PRODUCTS

2.1 Reinforcing Steel

All reinforcing steel bars shall be deformed billet steel and shall meet the requirements of Grade 420 Mpa. Testing shall be performed by the Contractor to verify tensile strength.

The Contractor shall perform tests and provide certified test results by an independent testing laboratory to the Engineer's representative of reinforcement steel which shall have minimum yield strength of (420Mpa).

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M or ASTM A 706/A 706M, grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82. In highly corrosive areas reinforcing steel shall conform to ASTM A 767/A 767M or ASTM A 775/A 775M.

2.2 Wire Ties

Wire ties shall be 1.6 mm (16 gauges) or heavier black annealed steel wire.

PART 3 EXECUTION

3.1 Reinforcement

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318M/318RM. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars greater than 12 mm diameter shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

3.2 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318M/318RM standards at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318M/318RM. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved

before concrete is placed. The reinforcement steel shall be assembled to the shapes and dimensions as indicated on the Drawings. The reinforcement steel shall be of the cross-sectional areas indicated and shall be fixed rigidly and accurately in the forms in the positions indicated on the Drawings.

The reinforcement steel shall be firmly bound together at intersections to ensure that the reinforcement steel framework as a whole shall retain its shape, and the framework shall be so temporarily supported with spacer bars and blocks as to retain its correct position in the forms during the process of depositing and consolidating the concrete. None of the reinforced bars shown in the drawings shall be displaced or used as top reinforcing supports. Inverted “U” shaped stands with horizontal projections (to prevent overturning) at the ends must be provided.

The end of all tying wires shall be turned into the main body of the concrete and not allowed to project towards the surface. No temporary metal supports to the reinforcement steel will be allowed and metal clips or supports shall not be placed in contact with forms for exposed surfaces.

At the time of concreting, all reinforcement steel shall have been thoroughly cleaned and freed from all loose rust, scale, mud, oil or any other coatings that might destroy or reduce the bond and it shall also have been cleaned of all set or partially set concrete which may have been deposited thereon during the placing of a previous lift of concrete.

The placing of all reinforcement steel bars will be checked by the Employer’s Representative and in no case is concrete to be placed around any reinforcement steel that has not been approved by the Employer’s Representative.

The insertion of bars into or the removal of bars from concrete already placed will not be permitted.

Reinforcement steel temporarily left projecting from the concrete at the joints shall not be bent without the prior approval of the Employer’s Representative.

Main reinforcement steel shall be spliced only where indicated on the Drawings or on approved shop drawings.

The minimum spacing, center to center, of parallel bars shall be 2.5 times the diameter of the bar, but in no case shall the clear distance between the bars be less than 1.5 times the maximum size of the coarse aggregate of 2.5 centimeters.

All reinforcement steel shall have a clear cover as indicated on the General Structural note. Steel reinforcing bar clearances between ground surfaces and formed surfaces are to be maintained through the use of pre-cast concrete bar supports. The supports are to be cast of concrete with the same strength indicated in the drawings.

3.3 Splicing

Splices of reinforcement shall conform to ACI 318M/318RM and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical connection; except that lap splices shall not be used for bars larger than No. 11 (35 mm) unless otherwise indicated. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of

each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 150 mm. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.4 Welded Wire Fabric Placement:

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost cross wires plus 50 mm. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 1.2 m. Fabric shall be positioned by the use of supports.

3.5 Dowels Installation:

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

3.6 Handling and Placing Reinforcement:

All reinforcement steel shall be protected as far as practicable from mechanical injury or surface deterioration, from rusting or other causes from the time of shipment until it is placed. Reinforcement steel stored at the site shall be laid on timber battens suitably spaced so that no reinforcement steel shall be laid upon or come in contact with the ground. When the weather is dry and the time for storage before installation is limited, housing may be omitted, but if rainy or exceptionally humid weather occurs or is anticipated, bars shall be stored under cover.

---- End of Section ----

REINFORCED CONCRETE

The work shown in this section consists of the construction of all concrete structures and requirements for concrete mixes and testing of concrete mixes. This work shall include, but not be limited to the construction of footings, floor slabs, columns, roof slabs and parapets.

Concrete structures shall be constructed in accordance with this Specification section and in conformity with the lines, grades, dimensions, and notes shown on the Drawings.

1. Materials

A. Portland Cement: Comply with ASTM C150 Type I or II.

B. Coarse Aggregate: ASTM C33.

1. Size 67 or Size 467 may be used for footings and walls over 300 mm thick.
2. Maximum size of coarse aggregates not more than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, nor three-fourth of minimum clear spacing between reinforcing bars.

C. Fine Aggregate: ASTM C33. Fine aggregate for applied concrete floor topping shall pass a 4.75 mm (No. 4) sieve, 10 percent maximum shall pass a 150 µm (No. 100) sieve.

D. Mixing Water: Fresh, clean, and potable.

E. Admixtures: On engineer's approval

1. Water Reducing Admixture: ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water.
2. Water Reducing, Retarding Admixture: ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.
3. High-Range Water-Reducing Admixture (Super plasticizer): ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.
4. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. Admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory of at least one year duration using an acceptable accelerated corrosion test method such as that using electrical potential measures.
5. Air Entraining Admixture: ASTM C260 Air Entraining Admixtures for Concrete structures and other areas of reinforced concrete subjected to deicers or water born chlorides.

F. Vapor Barriere: ASTM D4397, 0.25 mm (10 mil).

G. Reinforcing Steel: ASTM A615, or ASTM A996, deformed, grade as shown.

In accordance with section **8** of this specification

- 1. Reinforcing Bars to be welded:** ASTM A706.
- 2. Cold Drawn Steel Wire:** ASTM A82.
- 3. Supports, Spacers, and Chairs:** Types which will hold reinforcement in position shown in accordance with requirements of ACI 318 except as specified.
- H. Expansion Joint Filler:** ASTM D1751.
- I. Sheet Materials for Curing Concrete:** ASTM C171.

2. Submittals

- A. Submit SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.**
- B. Samples:**
 1. Portland cement: 3.5 kg (8 pounds).
- C. Shop Drawings: Reinforcing steel: Complete shop drawings**
- D. Mill Test Reports:**
 1. Reinforcing Steel.
 2. Cement.
- E. Manufacturer's Certificates:**
 9. Water stops.
 10. Expansion joint filler.
 11. Adhesive binder.
- F. Testing Agency for Concrete Mix Design:** Approval request including qualifications of principals and technicians.
- G. Test Report for Concrete Mix Designs:** Trial mixes including water-cement, concrete mix ingredients, and admixtures.
- H. Shoring and Re shoring Sequence:** Submit for approval a shoring and re shoring sequence for flat slab/flat plate portions, prepared by a registered Professional Engineer. As a minimum, include timing of form stripping, re shoring, number of floors to be re shored and timing of re-shore removal to serve as an initial outline of procedures subject to modification as construction progresses.

3. Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

4. TESTING

- A. Materials testing and inspection during construction
- B. Reinforced concrete, concrete roads, walks, and similar exterior site work

Tests: Each consignment of cement shall be accompanied by a manufacturer's certificate showing that the cement has been tested and analyzed by an Independent Testing Laboratory, and the date of such tests and analyses. Cement shall conform to the requirements of ASTM C 150 (AASHTO M 85).

The Contractor shall take cube and/or cylinder samples of each batch of concrete placed for testing at 7, and 28 day periods to ensure that the Contractor's materials and mix design achieve the required compressive strengths. The Contractor shall take and submit test results of concrete compressive strengths, which must have a minimum compressive strength of 31 MPa after 28 days, for all structural reinforced concrete.

4.1 TESTING AGENCY FOR CONCRETE MIX DESIGN

- A. Testing agency retained and reimbursed by the Contractor and
- B. Testing agency maintaining approval of USAID
- C. Testing agency shall furnish equipment and qualified technicians to establish proportions of ingredients for concrete mixes.

4.2 TOLERANCES

- A. Formwork: ACI 117, except the elevation tolerance of formed surfaces before removal of shores is +0 mm and -20 mm
- B. Reinforcement Fabricating and Placing: ACI 117, except that fabrication tolerance for bar sizes Nos. 10, 13, and 16 (Nos. 3, 4, and 5) (Tolerance Symbol 1 in Fig. 2.1(a), ACI, 117) used as column ties or stirrups is +0 mm and -13 mm where gross bar length is less than 3600 mm or +0 mm and -20 mm where gross bar length is 3600 mm or more.
- C. Cross-Sectional Dimension: ACI 117, except tolerance for thickness of slabs 12 inches or less is +20 mm and - 6 mm Tolerance of thickness of beams more than 300 mm but less than 900 mm is +20 mm and -10 mm

D. Slab Finishes: ACI 117, Section 4.5.6, F-number method in accordance with ASTM E1155, except as follows:

1. Test entire slab surface, including those areas within 600 mm of construction joints and vertical elements that project through slab surface.
2. Maximum elevation change which may occur within 600 mm of any column or wall element is 6 mm
3. Allow sample measurement lines that are perpendicular to construction joints to extend past joint into previous placement no further than 1500 mm.

5. DELIVERY, STORAGE AND HANDLING

- A. Conform to ACI 304. Store aggregate separately for each kind or grade, to prevent segregation of sizes and avoid inclusion of dirt and other materials.
- B. Deliver cement in original sealed containers bearing name of brand and manufacturer, and marked with net weight of contents. Store in suitable watertight building in which floor is raised at least 300 mm above ground.
- C. Deliver other packaged materials for use in concrete in original sealed containers, plainly marked with manufacturer's name and brand, and protect from damage until used.

6. PRE-CONSTRUCTION CONFERENCE

- A. General: At least 15 days prior to submittal of design mixes, conduct a meeting to review proposed methods of concrete construction to achieve the required results.
- B. Agenda: Includes but is not limited to:
1. Submittals.
 2. Coordination of work.
 3. Availability of material.
 4. Concrete mix design including admixtures.
 5. Methods of placing, finishing, and curing.
 6. Finish criteria required to obtain required flatness and levelness.
 7. Timing of floor finish measurements.
 8. Material inspection and testing.
- C. Attendees: Include but not limited to UNDP, Contractor's representatives and subcontractors involved in supplying, conveying, placing, finishing, and curing concrete.
- D. Minutes of the meeting: Contractor shall take minutes and type and distribute the minutes to attendees within five days of the meeting.

7. CONCRETE MIXES

7.1 Mix Designs:

Proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318.

1. If trial mixes are used, make a set of at least 6 cylinders in accordance with ASTM C192 for test purposes from each trial mix; test three for compressive strength at 7 days and three at 28 days.
2. Submit a report of results of each test series, include a detailed listing of the proportions of trial mix or mixes, including cement, admixtures, weight of fine and coarse aggregate per m³ measured dry rodded and damp loose, specific gravity, fineness modulus, percentage of moisture, air content, water-cement -fly ash ratio, and consistency of each cylinder in terms of slump.
4. If the field experience method is used, submit complete standard deviation analysis.
2. Portland cement - 3.5 kg:

7.2 Approval Mixes

After approval of mixes no substitution in material or change in proportions of approval mixes may be made without additional tests and approval of QC Engineer or as specified. Making and testing of preliminary test cylinders may be carried on pending approval of cement and fly ash, providing Contractor and manufacturer certify that ingredients used in making test cylinders are the same. QC/ Field Engineer may allow Contractor to proceed with depositing concrete for certain portions of work, pending final approval of cement and fly ash and approval of design mix.

7.3 Cement Factor

Maintain minimum cement factors in Table I regardless of compressive strength developed above minimums.

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete Strength		Non-Air-Entrained	Air-Entrained	
Min. 28 Day Comp. Str. MPa	Min. Cement kg/m ³	Max. Water Cement Ratio	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio
35 (5000) ^{1,3}	375	0.40	385	0.35
	350	0.45	365	0.40
31 ^{1,3}	325	0.50	340	0.45
25 ^{1,3}	280	0.52	290	0.47
25 ^{1,2}	300	*	310	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa in excess of f'_c . For concrete strengths above 35 Mpa the proposed mix design shall achieve a compressive strength 9.7 MPa in excess of f'_c .
 2. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
- * Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

7.4 Maximum Slump

Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

TABLE II - MAXIMUM SLUMP, mm.

Type of Construction	Normal Weight Concrete
Reinforced Footings and Substructure Walls	75mm
Slabs, Beams, Reinforced Walls, and Building Columns	100 mm

7.5: Air-entrainment

Air entrainment of normal weight concrete shall conform with Table III. Air-entrainment of lightweight structural concrete shall conform with Table IV. Determine air content by either ASTM C173 or ASTM C231.

TABLE III - TOTAL AIR CONTENT
FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)

Nominal Maximum Size of Total Air Content	Coarse Aggregate, mm (Inches) Percentage by Volume
10 mm 6 to 10	13 mm 5 to 9
20 mm to 8	25 mm 3-1/2 to 6-1/2
40 mm 3 to 6	

7.6 Batching and Mixing

A. General: Concrete shall be "Ready-Mixed" and comply with ACI 318 and ASTM C94, except as specified. Batch mixing at the site is permitted. Mixing process and equipment must be approved by UNDP QC Manager. With each batch of concrete, furnish certified delivery tickets listing information in Paragraph 16.1 and 16.2 of ASTM C94. Maximum delivery temperature of concrete is 38⁰C.

8. EXECUTION

8.1 FORMWORK

General: Design in accordance with ACI 347 is the responsibility of the Contractor.

8.1.1 Form Materials

Manufacturer's data including literature describing form materials, accessories, and form releasing agents.

A. Forms

Forms for finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

B. Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

C. Execution of Formwork

A. Installation

1. Formwork

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in and conforming to construction tolerances given in table B. Where forms for continuous surfaces are placed in successive units, the forms shall fit over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a non-staining bond breaker.

2. Chamfering

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

3. Coating

The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

4. Removal of forms

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of

concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

B. Tolerances for Formed Surfaces

1. Variations from the plumb:	In any 3 m of length ----- 6 mm
a. In the lines and surfaces of walls	Maximum for entire length -- 25 mm
2. Variation from the level or from the grades indicated on the drawings:	In any 3 m of length ----- 6 mm
	In any bay or in any 6 m of length ----- 10 mm
a. In beam soffits	Maximum for entire length - 20 mm
b. In exposed lintels, sills, bond beams, and other conspicuous lines	In any bay or in any 6 m of length ----- 6 mm
	Maximum for entire length - 13 mm
3. Variation of the linear building lines from established position in plan	In any 6 m ----- 13 mm
	Maximum ----- 25 mm
4. Variation in cross-sectional dimensions of beams and wall	Minus ----- 6 mm
	Plus ----- 13 mm

5. Footings:	
a. Variation of dimensions in plan	Minus ----- 13 mm Plus ----- 50 mm when formed or plus 75 mm when placed against unformed excavation
b. Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than ----- 50 mm
c. Reduction in thickness	Minus ----- 5 percent of specified thickness

9. CONSTRUCTION REQUIREMENTS AND PROCEDURES

9.1 Concrete Mixing

All concrete shall be power machine mixed and machine vibrated. If concrete mix is not produced on The Contractor must also submit its proposals for conveying the mixed concrete from the mixer to the points of deposit.

The approved type of mixer shall have a drum rotating about a horizontal or inclined axis and must be kept in good condition at all times. The drum shall rotate at the appropriate speed as approved by the Employer's Representative.

About 10 percent of the water required for the batch shall enter the drum in advance of the cement and aggregates, and the remainder of the water shall be added gradually while the drum is in action so that all the water is in the drum by the end of the first quarter of the mixing time. The concrete shall be mixed until a mixture of uniform color and consistency is obtained. For a mixer with a capacity of 750 liters or less, mixing shall continue for at least one and one half minutes after all the water has been added. For each additional 500-litre capacity or fraction thereof, the minimum mixing time shall be increased by 15 seconds.

The amount of concrete mixed in any one batch shall not exceed the rated capacity of the mixer. The whole of the batch shall be removed before materials for a fresh batch enter the drum. On cessation of work, including all stoppages exceeding 20 minutes, the mixers and all handling plant shall be washed with clean water. Any deposits of old concrete in the drum shall be cleaned out by rotating clean aggregate and water in the drum before any fresh concrete is mixed.

Concrete mixed as shown above shall not be modified by the addition of water or in any other manner to facilitate handling or for any other reason.

The Contractor shall carry out the design of concrete mixes under the supervision of the Employer's Representative.

The mix proportions shall be prepared and proposed by the Contractor to obtain the concrete having an appropriate water-cement ratio, suitable workability, durability, low shrinkage and required design strength with the minimum cement content and amount of fine aggregate.

The Contractor shall furnish samples of cement used for the works in sufficient quantity required for such design of concrete mixes, cost of which shall be deemed to be included in the lump sum price.

The exact proportions in which concrete materials are to be mixed will be verified by the testing agency periodically during the performance of the work. The Contractor shall not be entitled to compensation due to changes that the Employer's Representative may make in the mix proportions.

Compliance with concrete compressive strength requirement shall be based on compressive strength tests carried out in accordance with the appropriate standard being used.

Cement contents for various mix proportions of concrete shall be determined from the design approved mixes.

9.2 Concrete Placing

Immediately after mixing, the concrete shall be transported to the place of final deposit by methods which will prevent the separation, loss or contamination of any of the ingredients. Any method involving the use of pipes or chutes for transporting concrete will not be permitted, except with the written approval of the Employer's Representative. Transport of concrete from the mixers shall be as rapid as possible and the Contractor shall be responsible for the concrete being placed and compacted within such a time from the addition of the water to the mixer that the previous lift of concrete has not commenced setting. Prior to placing, and at the point of mixing, the Contractor shall carry out a concrete slump test under the supervision of the Employer's Representative.

Before any concrete is placed, the formwork shall be thoroughly cleaned of all dirt, shavings, loose BRICKs, and other debris. Forms shall be treated with a non-staining material or shall be saturated with water immediately before the concrete is placed. For all exposed surfaces, the forms shall be treated with a non-staining material, as approved by the Employer's Representative, to prevent the adherence to the concrete. The forms shall be free from any material that shall adhere to or discolor the concrete.

The concrete shall be placed gently in position and shall normally not have a free fall of more than one meter. To convey the concrete as near as possible to its final position, drop chutes of rubber or metal shall be used for small sections and bottom dump buckets or other suitable vessels for large sections. The concrete shall be placed so as to prevent collecting at the ends, corners or along the faces of the forms, and shall not be placed in large quantities at a given point and allowed to run or be worked over a long distance in the form. All concrete shall be placed and compacted in even layers with each batch vibrated to the previously placed batch to ensure homogeneity.

The concrete shall be carefully and continually compacted and worked around the reinforcement steel and into the corners of the formwork so that the concrete shall be in close contact with the reinforcement steel and free from honeycombing.

All vibration, compaction and finishing operations shall be completed immediately after the placing of concrete in its final position. Workers shall not be permitted to walk over freshly placed concrete until it has hardened sufficiently to carry their weight without distortion and great care shall be taken to ensure that reinforcement projecting from concrete recently placed is not shaken or disturbed so as to destroy or damage the initial set of the concrete in contact with it.

Concreting in any one part or section of the work shall be carried out in one continuous operation and no interruption of concerning work will be allowed without the approval of the Employer's Representative.

Where beams and slabs together form an integral part of the structure, they shall be poured in one operation. After a beam, wall or column has been cast, an interval of one hour shall be allowed before casting the continuous slab. The same applies for all abrupt changes in sections.

Freshly placed concrete shall be adequately protected from rain, dust storms, chemical attack and the harmful effects of sun, heat, wind, flowing water, vibrations and shocks. It shall also be fenced off or otherwise protected to prevent persons from walking thereon or articles being placed or thrown thereon. This protection shall continue until the concrete is sufficiently set such that it can no longer be damaged by these factors. The Engineer's Representative will determine when the protection is no longer required, but in any case this shall not be less than 24 hours after the time of placing.

9.3 Weather Precautions

During hot weather, steps shall be taken to reduce the concrete temperature and rate of water evaporation by proper attention to the cooling of the mixing water before use, production methods and the handling and curing. The concrete mixing plant shall be screened and covered as a protection from wind, rain and sun, and adequate similar precautions taken throughout the transit, placing and curing of the concrete whenever conditions require them.

When the shade air temperature is 35 degrees C and rising, special precautions shall be taken during all concrete operations so that the temperature of the concrete when placed does not exceed 32 degrees C. Shading of aggregates and plant, the cooling of mixing water and other steps taken shall be to the approval of the Employer's Representative. Fresh concrete placed at these temperatures shall be shaded from the direct rays of the sun to the satisfaction of the Employer's Representative.

9.4 Continuity of Concrete Work

The Contractor shall carry out the work in such a manner that the placing of the concrete in any particular section of the structure shall be executed without any interruption whatsoever from the beginning to the end of the operation.

When interruptions are permitted by the Engineer's Representative, no fresh concrete shall be deposited on or against the concrete placed before the interruption until the latter is sufficiently set to resist injury.

Particular care shall be taken to ensure that partially set concrete shall not be damaged by shock or any other cause whatsoever.

Casting of concrete shall not commence until a sufficient quantity of approved material is at hand to ensure continuity of operation, nor shall work commence until there is sufficient equipment in reserve in case of breakdown.

9.5 Concrete Curing and Protection

Concrete shall be protected during the first stage of hardening from the harmful effects of sunshine, drying winds, rain or running water. The protection shall be applied as soon as practicable after completion or placing by covering concrete with a layer of plastic, sacking, canvas, Hessian, straw mat or similar material, or a layer of sand kept constantly wet for 7 days.

9.6 Concrete Finishing

All concrete shall be given an ordinary clean surface steel trowel led or wood float finish as directed by the Employer's Representative.

9.6.1. Ordinary Surface Finish

Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces on all surfaces, the cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges and other defects shall be thoroughly cleaned, and after having been kept saturated with water for a period of not less than three hours, shall be carefully pointed and trued with a mortar of cement and fine sand. Mortar used in pointing shall not be more than one hour old. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges. The resulting surfaces shall be smooth, true and uniform in shape and uniform in color.

Concrete Finishes for Monolithic Slabs

9.6.2 Scratch finish for surfaces to receive concrete floor topping or mortar setting bed.

9.6.3 Steel trowel finish for surfaces to be exposed to view or covered with resilient flooring, carpet, tile, or other thin finish system.

Trowel and fine broom finish for surfaces to receive thin-set ceramic or quarry tile.

9.6.4 Non-slip broom finishes for exterior concrete platforms, steps, and ramps.

9.6.5 Non-slip aggregate finish for concrete stair treads platforms, Ramps and sloped walks.

Floor Flatness and Levelness Tolerances must be applied.

---End of Section---

1. GENERAL

1.1 SUBMITTALS

Submit BRICK samples for approval

1.2 Inspection

Notice

Give sufficient notice so that inspection may be made of the following:

The prepared BRICK sample range.

Lintels in position.

Damp proof courses in position.

2 PRODUCTS

BRICK Types

Sand BRICK defects: Minor shale laminates and minor concentrations of carbonaceous material (tea leaves) are acceptable in visible faces. Neither defect is acceptable in carved or molded work.

Granite defects: Igneous BRICK (e.g. granite) obtained from quarry BRICK extracted in blocks sufficiently large to suit the project requirements, and containing no more than a small degree of micro cracking.

BRICK Selection Grading: Select BRICK of the designated quality grade.

Matching: Within each grade, select BRICK for the best match of color and pattern.

Source of BRICK Supply

Ensure the BRICK quarry or supplier can provide all BRICK required for the project without the need to find alternative supplies.

2.3 MORTAR

Mortar Materials

Cement shall conform to the requirements of ASTM specification C-150 Type 1 or similar approved standard for normal Portland cement.

White cement: Iron salts content _ 1%. Off-white cement: Iron salts content _ 2.5%.

A. Sand: Fine aggregate with a low clay content selected for grading, sharp and free from efflorescing salts. River or pit sand should be sharp, angular, hard, clean uncoated particles free from clay and organic

impurities.

Water: Water to be used for the mixing of mortar should be clean and free from oil, acid, alkali, salts, organic materials or other substances that are harmful to the mortar mix.

Crushed BRICK: Fine aggregate consisting partly or wholly of crushed BRICK, made from material of the same type as the BRICK facing.

Measurement of volume: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.

B. Mortar

Standard and ratio of mix for all mortar shall be M-400 (1:3), M-300 (1:4), M-250 (1:5) and M-200 (1:6). Provide minimum water.

Mortar Mix

Mortar mixing shall be done in a mechanical mixer unless the Engineer specifically permits hand mixing. If hand-mixing is done, the operation shall be carried out on a clean watertight platform and cement & sand shall be first mixed dry in the required proportion to obtain a uniform color and then the mortar shall be mixed for at least two minutes after addition of water.

Cement Mortar shall be mixed in such quantities as can be used in the work within 30 minutes.

Mortar, which has taken initial set, shall not be used, nor shall it be re-mixed with fresh mortar.

Sand stockpile: Ensure sand is dry and stored undercover to avoid errors in volume batching during the mixing process.

3. EXCUTION

Refer to BRICK work construction schedule for details of BRICK work and mortar types.

3.1 Workmanship

Cutting

Perform the necessary cutting and shaping of BRICK to designated profiles including weathering, jointing, chasing, forming grooves. Make the bed, face and back joints of the BRICK Square and true where dimensioned BRICK is required.

Carving and Molding achieve a clean sharp finish. Carry out all work identified on the drawings to the approval of the Engineer.

3.2 Laying Units

A. Bedding

Remove dust and foreign material from the bedding surfaces. Water the face of the BRICK units so that full strength joints are achieved. Where possible, bed and joint the BRICK in one operation. Lay each BRICK on a full bed of mortar. Solidly fill and grout vertical joints as the work proceeds. Point unpoints around flashings as necessary.

B. Natural Bed

Lay load bearing sedimentary BRICK with its natural bed at 90 degrees to the load, except for the following:

Cladding panels: In non-load bearing cladding panels, form each panel with its natural bed at right angles to the face.

Temporary Support

Provide support as necessary to the BRICK while the mortar is curing, using bracing, joint spacers, or both.

Bracing and joint spacers: Non-damaging and non-staining softwood wedges soaked in water. Do not allow metal pinch bars to bear directly on the BRICK.

C. Raking and Teething

Raise advanced work no more than 1.5 m above the general level, and rake back. Do not tooth BRICK work for subsequent additions except where tooting is shown on the drawings.

D. Bonding

Bond the masonry so as to provide stability and monolithic structural action to the BRICK work assembly.

3.3 Tolerances

Dimensions of BRICK Units

Maximum deviation from required dimensions:

Load bearing BRICK in cut blocks: ± 4 mm.

Other BRICK used in foundations or not exposed to view: No size requirement unless noted otherwise in this work section.

3.4 BRICK foundations

BRICK Footings

Construct the footing course entirely of through BRICKs, and if stepping is necessary, overlap the stepped courses at least 300 mm.

Sub floor BRICK Foundation Walls

Minimum foundation wall thicknesses:

Supporting masonry walls 100 mm thick: 300 mm.

Supporting masonry walls 250 mm thick: 450 mm.

Supporting masonry walls 370 mm thick: 600 mm.

BRICK sizes:

Maximum height: 350 mm.

Minimum height: Generally 175 mm; through BRICKs 300 mm.

Bond pattern: Provide through BRICKs as follows:

All BRICKs in top and bottom courses.

Elsewhere as header units.

Slab bearings: Provide continuous bearing at least 100 mm wide to the edge of suspended slabs.

3.5 Damp-Proof Courses

Material

Material: Embossed Polyethylene sheeting. Install sheeting at base of all walls to stop moisture rising up wall structures.

Location

Provide damp-proof courses as follows:

Walls built off slabs on ground: In the bottom course of the wall on top of the slab.

Walls adjoining infill floor slabs: In the course above the slab. Project 40 mm and dress down over the membrane turned up against the wall.

Installation

Lay in long lengths. Lap full width at angles and intersections and at least 150 mm at joints. Step as necessary, but not exceeding 2 courses per step. Sandwich damp-proof courses between mortars.

3.6 Jointing and Pointing

Joints

Size (mm): Not less than 3mm or more than 5mm for dimensioned BRICKwork. Size may vary for non-dimensioned BRICKwork from 10mm to 30mm. Joint size should not exceed this without approval of the Engineer.

Jointing material: Mortar with a strength less than the BRICKwork.

Pointing material: Colored mortar or mortar as above, refer to Schedule or drawings.

B. Sealant Jointing

Preparation for Jointing

Immediately before jointing remove loose particles from the joint, using brushes or compressed air.

C. Taping

Protect the BRICKwork surface on each side of the joint using 50 mm wide masking tape or equivalent means. On completion of pointing remove the tape and remove any stains or marks from the BRICKwork surface.

D. Jointing Materials

Use recommended jointing and pointing materials which are compatible with each other and with the contact surfaces and non-staining to finished surfaces.

Priming: Apply the recommended primer to the surfaces in contact with sealant materials.

Sealant color: Refer to Schedule or drawings.

Foamed materials (in compressible fillers and backing rods): Closed cell or impregnated types which do not absorb water.

E. Sealant Application

Apply the sealant to dry joint surfaces. Do not apply the sealant in unsuitable weather conditions (e.g. when the ambient temperature is outside the range 5 – 50°C) or outside the recommended working time for the material or the primer.

---End of section---

SECTION 05

WELDING OF STRUCTURAL STEEL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360 Specification for Structural Steel Buildings, with Commentary, Latest Editors

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A (2001) Recommended Practice

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2007) Standard Symbols for Welding, Brazing and Nondestructive Examination
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AWS A3.0	(2001) Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting and Thermal Spraying
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AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel
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AWS D1.3/D1.3M	(2008) Structural Welding Code - Sheet Steel
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AWS D1.4/D1.4M	(2005; Errata 2005) Structural Welding Code - Reinforcing Steel
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Equipment AWS Z49.1 (2005) Safety in Welding, Cutting and Allied Processes
ASTM INTERNATIONAL (ASTM)

ASTM E 165	(2002) Standard Test Method for Liquid Penetrant Examination
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ASTM E 709	(2001) Standard Guide for Magnetic Particle Examination
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1.2 DEFINITIONS

Definitions of welding terms are in accordance with AWS A3.0. The following classifications Class 1 (highest class) to Class 6 (lowest class)] indicate the project's class (es) of weld joints.

1.2.1 Class 1 Weld Joints

This covers complete penetration weld joints only. These weld joints apply where failure would cause a loss of the system and/or be hazardous to personnel. Class 1 weld joints are highly stressed (including

dynamic and cyclic loading) and characterized as a single point of failure with no redundancy for the redistribution of stress into another member.

1.2.2 Class 2 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would reduce the overall efficiency of a system but loss of the system or a hazard to personnel would not be experienced.

1.2.3 Class 3 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would not affect the efficiency of a system nor create a hazard to personnel. Class 3 weld joints are connections of secondary members not subject to dynamic action and/or low stressed miscellaneous applications.

1.2.4 Class 4 Weld Joints

This covers weld joints applicable to welding reinforcing steel to primary structural members.

1.2.5 Class 5 Weld Joints

This covers weld joints applicable to, steel connection devices, and inserts and anchors required in concrete construction.

1.2.6 Class 6 Weld Joints

This covers plug and slot weld joints as applicable to the requirements of the project's code(s).

1.3 GENERAL REQUIREMENTS

Confirm the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Perform all testing at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.3.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of shop fabrication. Mandatory attendance is required by all Contractors' welding production and inspection personnel and other appropriate personnel. Include for

discussion: responsibilities of various parties; welding procedures and processes to be followed; welding sequence inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary UNDP.

1.3.2 Mock-up Model

Perform first the welded connection designated as the mock-up model on the drawings by UNDP. All welders qualified and designated to perform welded joints must be present during the welding of the mock-up model connections and each one shall perform a part of the welding. Execute all inspection procedures required for welded joints, including NDE tests, on the mock-up model. All Contractor inspection and testing personnel designated to perform QC of welded joints must be present during the welding of the mock-up model and each one shall perform the inspection procedures to be performed on production welding of these joints. This mock-up model connection represents the standard of performance, both for the welding and inspection procedures used and the results to be achieved in the production welding for these welded joints.

1.4 SUBMITTALS

SD-03 Product Data

Welding Procedure Qualifications Welder, Welding Operator, and Tacker Qualification Inspector
Qualification Previous Qualifications Pre-qualified Procedures

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

SD-06 Test Reports

Quality Control Nondestructive Examination

A quality assurance plan and records of tests and inspections. Submit all records of nondestructive examination in accordance with paragraph "Acceptance Requirements".

SD-07 Certificates

Certified Welding Procedure Specifications (WPS) Certified Brazing Procedure Specifications (BPS)
Certified Procedure Qualification Records (PQR) Certified Welder Performance Qualifications (WPQ)
Certified Brazer Performance Qualifications (BPQ)

Certificates in accordance with paragraph "Other Applications".

1.5 WELDING PROCEDURE QUALIFICATIONS

Each Contractor performing welding shall record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform qualification of welding

procedures to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.5.1 General Requirements

The organization performing this work must submit evidence to three similar welding project, recently completed and utilizing the same personal as as proposed for this project.

1.5.2 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, the procedure specification must be revised and re-qualified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, must be submitted with the welding procedure.

1.6.2 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is

qualified as specified. The certification must state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

1.6.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.

A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker is required to pass the prescribed tack welding test.

1.7 SYMBOLS

Symbols must be in accordance with AWS A2.4, unless otherwise indicated.

1.9 SAFETY

Safe welding practices and safety precautions during welding must conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes must be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of

AWS D1.1/D1.1M govern.

3.1.2 Identification

Identify all welds in one of the following ways:

Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.

Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 1 meter 3 foot intervals. Identification with die stamps or electric etchers is not allowed.

3.2 QUALITY CONTROL

Perform testing using the approved inspection or testing laboratory or technical consultant Perform visual radiographic, ultrasonic, magnetic particle, and liquid penetrant, dye penetrant, inspections as required to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, ASTM E 165, ASTM E 709, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," are acceptable.

3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Perform nondestructive testing by visual inspection [and radiographic, ultrasonic, magnetic particle or dye penetrant methods as required.

3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds shall meet the inspection requirements for the original welds. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

--- End of Section ---

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

ALSC 360 Specification for Structural Steel Buildings with Commentary Latest Edition

AISC 316 ASD Manual of Steel Construction Latest Edition

AISC 317 Errata 1994 Connections, Lattes Edition

AISC 326 Detailing for Steel Construction, Latest Edition

AISC 303 Code of Standard Practice for Steel Buildings and Bridges, Latest Edition

AISC 335 Structural Steel Buildings Allowable Stress Design, and Plastic Design, Latest Edition

AISC S340 Metric Properties of Structural Shapes with Dimensions According to ASTM A6M

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (2000a) Carbon Structural Steel

ASTM A 53 (1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 307 (2000) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

ASTM A 500 (1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 563M (2001) Specification for Carbon and Alloy Steel Nuts (Metric)

ASTM A 563 (1997) Carbon and Alloy Steel Nuts

ASTM C 827 (1995; R 1997) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures

ASTM C 1107 (2002) Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

ASTM F 436M (2000) Hardened Steel Washers (Metric)

ASTM F 844 (1998) Washers, Steel, Plain (Flat), Unhardened for General Use

AMERICAN WELDING SOCIETY (AWS)

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 25 (1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)

1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC 316 and AISC 317.

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

Submit fabrication shop drawings for approval prior to fabrication. Prepare in accordance with AISC 326, AISC 316 and AISC 317. Drawings shall not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS standard welding symbols. If the contractor fails to submit shop drawing in accordance with the project schedule, and or submit that do not meet the above requirements, UNDP may elect to have a third party prepare shop drawings at the contractors expenses.

1.5.2 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

ASTM A 36/A 36M; General purpose structural grade, with minimum yield strength of 250 MPa.

2.1.2 Structural Steel Tubing

ASTM A 500, Grade B; Cold-formed, welded or seamless, carbon steel structural tubing with minimum tensile strength of 310 MPa and minimum yield strength of 248 MPa.

2.1.3 Steel Pipe

ASTM A 53, Type E or S, Grade B , with minimum yield strength of 245 MPa.

2.2 BOLTS, NUTS, AND WASHERS

As indicated on the drawings

2.2.1.1 Bolts

ASTM A 307, Grade A ; Carbon steel bolts with minimum tensile strength of 414 MPa. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts

ASTM A 563M standards, heavy hex style, except nuts under M36 may be provided in hex style.

2.2.1.3 Washers

ASTM F 844 Plain, flat, unhardened steel washers for ASTM A 307 bolts, and

2.2.2 Foundation Anchorage

2.2.2.1 Bolts

ASTM A 307 or equivalent DIN, BS or EN standards. Carbon steel bolts with minimum tensile strength of 414 MPa. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified.

2.2.2.2 Nuts

ASTM A 563, Grade A, hex style. Carbon steel bolts with minimum tensile strength of 414 MPa. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified.

2.2.2.3 Washers

In accordance with ASTM F 844 standards.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

Will be in accordance with AWS D1.1/D1.1M standards.

2.3.2 Non shrink Grout

ASTM C 1107 standards; Packaged, dry, non-shrink hydraulic cement, structural grout, with no ASTM C 827 standard shrinkage. Grout shall be nonmetallic.

2.4 SHOP PRIMER

SSPC Paint 25 standards; Provide marine alkyd metal primer.

2.5 FABRICATION

2.5.1 Shop Primer

2.5.1.1 Cleaning

Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.5.1.2 Primer

Apply primer to a minimum dry film thickness of 0.05 mm. Repair damaged primed surfaces with an additional coat of primer.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 316 standards. Fabrication and assembly shall be done in the shop to the greatest extent possible.

3.2 ERECTION

3.2.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.3 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC 335 standards. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, sub punch and ream, or drill bolt holes. Bolts, nuts, and washers shall be clean of dirt and rust and lubricated immediately prior to installation.

3.3.1 Common Grade Bolts

All bolts, studs, nut and washers shall be in accordance with ASTM A 307 standards; bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact.

3.4 WELDING

Will be in accordance with AWS D1.1/D1.1M standards

3.5 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.5.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop

coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.6 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.6.1 Welds

3.6.1.1 Visual Inspection

AWS D1.1/D1.1M standards. Furnish the services of certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.6.1.2 Nondestructive Testing

AWS D1.1/D1.1M. Test locations shall be selected by the Contracting Officer or Government. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Government. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

---End of section-

SECTION 07

ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (2003) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2603 (2002) Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels

AAMA 2604 (2005) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M (2005) Standard Specification for Carbon Structural Steel

ASTM B 209 (2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 209M (2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) Differences Across the Specimen

ASTM E 331	(2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
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ASTM F 1642	(2004) Standard Test Method for Glazing and Glazing Systems Subject to Air blast Loadings
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ASTM F 2248	(2003) Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass
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ASTM B 221 (2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM B 221M (2007) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

ASTM E 1300 (2007e1) Determining Load Resistance of Glass in Buildings

ASTM E 283 (2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure

Exterior doors, frames and hardware shall be designed to resist equivalent static design loads in accordance with ASTM F 1642. Frame deflections shall not exceed $L/160$ of the unsupported member lengths. Equivalent static design loads for connections of window or door frame to the surrounding walls or hardware and associated connections, and glazing stop connections shall be in accordance with ASTM F 2248 and ASTM E 1300. Design supporting elements and their connections based on their ultimate capacities. Provide calculations of a Professional Engineer that substantiates compliance with these requirements. Use frames that provide an equivalent level of performance. Shapes and thicknesses of framing members shall be sufficient to withstand a design wind load of not less than 1.4m square foot of supported area the design wind load indicated] with a deflection of not more than $1/175$ times the length of the member and a safety factor of not less than

1.65. Provide glazing beads, moldings, and trim of not less than 1.25 mm

PERFORMANCE REQUIREMENTS

1.2.1 Structural

1.2.2 Air Infiltration

When tested in accordance with ASTM E 283, air infiltration shall not exceed

2.63 by 10-5 cm per square meter per minute of fixed area at a test pressure of 0.30 kPa 6.24 pounds per square foot (80 kilometers per hour wind).

1.2.3 Water Penetration

When tested in accordance with ASTM E 331, there shall be no water penetration at a pressure of 0.38 kPa per square foot of fixed area.

SUBMITTALS

SD-02 Shop Drawings

Doors[, windows] and frames

Show elevations of each door type, size of doors and frames, metal gages, details of door and frame construction, methods of anchorage, glazing details, weather-stripping, provisions for and location of hardware, and details of installation.

SD-04 Samples

Finish sample

SD-05 Design Data

Structural calculations for deflection

SD-08 Manufacturer's Instructions

Doors and frames

Submit detail specifications and instructions for installation, adjustments, cleaning, and maintenance.

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water, and easily accessible for inspection and handling. Stack materials on no absorptive strips or wood platforms. Do not cover doors and frames with tarps, polyethylene film, or similar coverings. Protect finished surfaces during shipping and handling using manufacturer's standard method, except that no coatings or lacquers shall be applied to surfaces to which calking and glazing compounds must adhere.

1.5 QUALITY CONTROL

1.5.1 Shop Drawing Requirements

Drawings shall indicate elevations of doors, windows and frames, full-size sections, thickness and gages of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, details of operating hardware, mullion details, method and materials for weather-stripping, material and method of attaching sub frames trim, installation details, and other related items.

1.5.2 Sample Requirements

1.5.2.1 Finish Sample Requirements

Submit color chart of standard factory-finish color coatings.

2.1 DOORS AND FRAMES

Swing-type aluminum doors and frames of size, design, and location indicated. Provide doors complete with frames, framing members, sub frames, transoms adjoining sidelights adjoining window wall trim, and accessories.

2.2 MATERIALS

2.2.1 Anchors Stainless steel or steel with hot-dipped galvanized finish.

2.2.2 Weather-stripping

Continuous wool pile, silicone treated, or type recommended by door manufacturer.

2.2.3 Aluminum Alloy for Doors and Frames

ASTM B 221M ASTM B 221, Alloy 6063-T5 for extrusions. ASTM B 209M

ASTM B 209, alloy and temper best suited for aluminum sheets and strips.

2.2.4 Fasteners

Hard aluminum or stainless steel.

2.2.5 Structural Steel

ASTM A 36/A 36M.

2.2.6 Aluminum Paint

Aluminum door manufacturer's standard aluminum paint.

2.3 FABRICATION

2.3.1 Aluminum Frames

Extruded aluminum shapes with contours approximately as indicated. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 300 mm on center. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.

2.3.2 Aluminum Doors

Of type, size, and design indicated and not less than 45 mm thick. Minimum wall thickness, 3 mm, except beads and trim, 1.25 mm. Door sizes shown are nominal and shall include standard clearances as follows: 2.5 mm at hinge and lock stiles, 3 mm between meeting stiles, 3 mm at top rails, 5 mm between bottom and threshold, and 17 mm between bottom and floor. Bevel single-acting doors 2 or 3 mm at lock, hinge, and meeting stile edges. Double-acting doors shall have rounded edges at hinge stile, lock stile, and meeting stile edges.

2.3.2.1 Full Glazed Stile and Rail Doors

Doors shall have narrow medium wide stiles and rails as indicated. Fabricate from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Fasten top and bottom rail together by means of welding or by 10 or 13 mm diameter cadmium-plated tensioned steel tie rods. Provide an adjustable mechanism of jack screws or other methods in the top rail to allow for minor clearance adjustments after installation.

2.3.2.2 Flush Doors

Use facing sheets with a vertical ribbed an embossed or a plain smooth surface. Use one of the following constructions:

- a. A phenolic resin-impregnated Kraft paper honeycomb core, surrounded at edges and around glass and louvered areas with extruded aluminum shapes. The impregnation of core shall have a minimum of 18 percent resin content. Provide sheet aluminum door facings, not less than 0.8 mm thick laminated to 2.5 mm thick tempered hardboard backing, and bond the backing to the honeycomb core. Bond facing sheets to core under heat and pressure with a thermosetting adhesive, and mechanically lock to the extruded edge members.
- b. A phenolic resin-impregnated Kraft paper honeycomb core. Use aluminum facing sheets not less than 1.25 mm thick and form into two pans which will eliminate seams on the faces. Bond honeycomb core to the face sheets using an epoxy resin or contact cement-type adhesive.
- c. A solid fibrous core, surrounded at edges and around glass and louvered areas and cross-braced at

intermediate points with extruded aluminum shapes. Use aluminum facing sheets of not less than 1.25 thicknesses. Bond facing sheets to core under heat and pressure with a thermosetting adhesive, and mechanically lock to the extruded edge members.

d. Form from extruded tubular stiles and rails mitered at corners, reinforce, and continuously weld at miters. Facing sheets shall consist of 0.8 mm thick sheet aluminum internally reinforced with aluminum channels or Z-bars placed horizontally not more than 400 mm apart and extending full width of panel. Fit spaces between reinforcing with sound-deadening insulation. Facing sheets shall finish flush with faces of stiles and rails and be welded to reinforcing bars or channels and to stiles and rails.

e. Form from an internal grid system composed of extruded aluminum tubular sections. Provide extruded aluminum tubular sections at both sides, and at perimeters of louver and glass cutouts. Provide three extruded aluminum tubular sections at top and bottom of door. Wall thickness of tubular sections shall be not less than 2.25 mm except that lock rail shall be not less than 3 mm thick, hinge lock rail shall be not less than 3 mm thick, and hinge rail edge shall be not less than 5 mm thick. Fill spaces in door with mineral insulation. Facing sheets shall be of aluminum not less than 2.25 mm thick.

f. Form from extruded aluminum members at top and bottom, both sides, and at perimeters of louver and glass cutouts. Wall sections of extruded aluminum members shall be not less than 2.25 mm thick and be properly reinforced for application of hardware. Framing members shall be covered on both sides with aluminum facing sheets not less than 2 mm thick. Fill door with foamed-in urethane with a 48 kg per cubic meter density.

2.3.3 Welding and Fastening

Where possible, locate welds on unexposed surfaces. Dress welds on exposed surfaces smoothly. Select welding rods, filler wire, and flux to produce a uniform texture and color in finished work. Remove flux and spatter from surfaces immediately after welding. Exposed screws or bolts will be permitted only in inconspicuous locations, and shall have countersunk heads. Weld concealed reinforcements for hardware in place.

2.3.4 Weather-stripping

Provide on stiles and rails of exterior doors. Fit into slots which are integral with doors or frames. Weather-stripping shall be replaceable without special tools, and adjustable at meeting rails of pairs of doors. Installation shall allow doors to swing freely and close positively. Air leakage of a single leaf weather-stripped door shall not exceed 2.19×10^{-5} or 5.48×10^{-5} cubic meter per second of air per square meter of door area when tested in accordance with ASTM E 283.

2.3.5 Anchors

On the backs of sub frames, provide anchors of the sizes and shapes indicated for securing sub frames to adjacent construction. Anchor transom bars at ends and mullions at head and sill. Where indicated, reinforce vertical mullions with structural steel members of sufficient length to extend up to the overhead structural slab or framing and secure thereto. Reinforce and anchor freestanding door frames to floor construction as indicated on approved shop drawings and in accordance with manufacturer's recommendation. Place anchors as indicated near top and bottom of each jamb and at intermediate points

not more than 635 mm apart.

2.3.6 Provisions for Hardware

Coordinate with Section DOOR HARDWARE. Deliver hardware templates and hardware (except field-applied hardware) to the door manufacturer for use in fabrication of aluminum doors and frames. Cut, reinforce, drill, and tap doors and frames at the factory to receive template hardware. Provide doors to receive surface-applied hardware, except push plates, kick plates, and mop plates, with reinforcing only; drill and tap in the field. Provide hardware reinforcements of stainless steel or steel with hot-dipped galvanized finish, and secure with stainless steel screws. Provide reinforcement in core of flush doors as required to receive locks, door closers, and other hardware.

2.3.7 Provisions for Glazing

Provide extruded aluminum snap-in glazing beads on interior side of doors. Provide extruded aluminum, theft-proof, snap-in glazing beads or fixed glazing beads on exterior or security side of doors. Glazing beads shall have vinyl insert glazing gaskets. Design glazing beads to receive glass of thickness indicated or specified.

2.3.8 Finishes

Provide exposed aluminum surfaces with [mill finish] [factory finish of anodic coating or organic coating].

2.3.8.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF-45. Finish shall be clear (natural), designation AA-M10-C22-A31, Architectural Class II 0.01 to 0.0175 mm clear (natural), designation AA-M10-C22-A41, Architectural Class I 0.0175 mm or thicker integral color-anodized, designation AA-M10-C22-A32, Architectural Class II 0.01 to 0.0175 0.4 mil to 0.7 mil] [integral color-anodized, designation AA-M10-C22-A42, Architectural Class I 0.0175 mm 0.7 mil or thicker] [electrolytically deposited color-anodized, designation AA-M10-C22-A34, Architectural Class II 0.01 to 0.0175 mm to [electrolytically deposited color-anodized, designation AA-M10-C22-A44, Architectural Class I 0.0175 mm 0.7 mil or thicker].

2.3.8.2 Organic Coating

Clean and prime exposed aluminum surfaces. Provide [a baked enamel finish in accordance with AAMA 2603 with total dry film thickness not less than 0.02 mm a high-performance finish in accordance with AAMA 2604 with total dry film thickness of not less than 0.03 mm. The finish color shall be as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

Plumb, square, level, and align frames and framing members to receive doors [, transoms adjoining sidelights and adjoining window walls. Anchor frames to adjacent construction as indicated and in accordance with manufacturer's printed instructions. Anchor bottom of each frame to rough floor

construction with 2.4 mm thick stainless steel angle clips secured to back of each jamb and to floor construction; use stainless steel bolts and expansion rivets for fastening clip anchors. Hang doors to produce clearances specified in paragraph entitled "Aluminum Doors," of this section. After erection and glazing, adjust doors and hardware to operate properly.

3.2 PROTECTION FROM DISSIMILAR MATERIALS

3.2.1 Dissimilar Metals

Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact to dissimilar metals.

3.2.1.1 Protection

Provide one of the following systems to protect surfaces in contact with dissimilar metals:

Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.

Apply a good quality elastomeric sealant between the aluminum and the dissimilar metal.

Paint the dissimilar metal with one coat of primer and one coat of aluminum paint.

Use a non absorptive tape or gasket in permanently dry locations.

3.2.2 Drainage from Dissimilar Metals

In locations where drainage from dissimilar metals has direct contact with aluminum, provide protective paint to prevent aluminum discoloration.

3.2.3 Masonry and Concrete

Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

3.2.4 Wood or Other Absorptive Materials

Provide aluminum surfaces in contact with absorptive materials subject to frequent moisture, and aluminum surfaces in contact with treated wood, with two coats of aluminum paint or one coat of heavy-bodied bituminous paint. In lieu of painting the aluminum, the Contractor shall have the option of painting the wood or other absorptive surface with two coats of aluminum paint and sealing the joints with elastomeric sealant.

3.3 CLEANING

Upon completion of installation, clean door and frame surfaces in accordance with door manufacturer's written recommended procedure. Do not use abrasive, caustic, or acid cleaning agents.

3.4 PROTECTION

Protect doors and frames from damage and from contamination by other materials such as cement mortar. Prior to completion and acceptance of the work, restore damaged doors and frames to original condition, or replace with new ones.

--- End of Section ---

SECTION 08

DOOR HARDWARE

PART 1 GENERAL

Door hardware shall be supplied and installed in accordance with design drawings and this specification when indicated.

1.1 REFERENCES

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1 (1997) Butts and Hinges (BHMA 101)

BHMA A156.3 (1994) Exit Devices (BHMA 701)

BHMA A156.4 (1992) Door Controls - Closers (BHMA 301)

BHMA A156.16 (1997) Auxiliary Hardware

BHMA A156.18 (1993) Materials and Finishes (BHMA 1301)

BHMA A156.22 (1996) Door Gasketing Systems

1.2 Submittals

The following shall be submitted:

Product Data

Hardware items

Manufacturer's Installation instructions

1.3 Delivery, Storage, and Handling

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule.

PART 2 PRODUCTS

All Hardware of doors to be approved by UNDP Engineer

2.1 Template Hardware

Hardware to be applied to metal shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Coordinate hardware items to prevent interference with other hardware.

2.2 Hardware Items

Hinges, locks, latches, exit devices, bolts, and closers shall be clearly and permanently marked with the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover. Provide hardware items in quantities and locations as per approved hardware schedule.

2.2.1 Hinges

BHMA A156.1 standards, 120 by 83 by 4 (thick) millimeters unless otherwise specified. Construct 5-knuckle, 4-hole, satin finish hinges so that pins will be un removable. Provide three hinges for doors 2200 mm or less in height; one additional hinge for each additional 800 mm of door height.

2.2.2 Locks and Latches

2.2.2.1 Lock Function Definitions

Passage Function: Latch bolt by levers at all times.

Privacy Function: Latch bolt by knobs/levers, dead bolt by turn inside or emergency key.

Office Function: Deadlocking latch bolt by knobs/levers except where outside knob/lever locked by buttons in face, then by key outside.

Storeroom Function: Deadlocking latch bolt by inside knob/lever or key outside. Outside knob/lever rigid.

2.2.2.2 Lock with Cylinder (Wide Type)

Case: Steel, electrostatic black powder painted.

Forend plate: Steel and yellow-nickel plated.

Deadbolt: MS 58 brass.

Latch: MS 58 brass.

2.2.2.3 Interior Mortise Lock with Ball Bearing

Steel case electrostatic powder painted.

Forend plate: Steel and chromium plated.

Deadbolt: Zinc alloy and chromium plated.

Latch: Zinc alloy and yellow-nickel plated.

2.2.2.4 Security Mortise Lock with Cylinder

Case: Steel, electrostatic black powder painted.

Forend plate: Brass and chromium plated.

Deadbolt: Steel, 3 bars, silver-nickel plated.

2.2.3 Exit Devices

BHMA A156.3, Grade 1 standards. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices.

Touch bars may be provided in lieu of conventional crossbars and arms.

Provide escutcheons, not less than 178 by 57 mm.

2.2.4 Cylinders

Cylinders shall be products of one manufacturer.

Body: MS 58 brass and chromium plated, standard size, special profile.

Key: Multiwave (Standard).

Cam: Sintered steel.

Key Combinations: Digital technology.

Springs: Phosphorus bronze (Cu37 Sn8).

Pins: Profile formed MS 58 brass.

2.2.5 Keying System

Provide a master keying system.

Master keying system shall be provided for each building. Three change keys shall be provided for each door and each master.

2.2.6 Lock Trim

Commercial design with satin finish escutcheons and levers or knobs.

2.2.6.1 Lever Handles

Acceptable Manufacturer

2.2.6.2 Building Entrance Handles and Pulls

Acceptable Manufacturer.

2.2.6.3 Other Handles and Pulls

Acceptable Manufacturer:

2.2.7 Keys

Furnish three keys for each key change and for each master keying system. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys.

2.2.8 Door Bolts

BHMA A156.16 or equivalent DIN, BS, or EN standards. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds.

Automatic latching flush bolts: BHMA A156.3 standards, Type 25. Acceptable Manufacturer.

2.2.9 Closers

BHMA A156.4, Series C02000, Grade 1, with PT 4C standards. Provide with brackets, arms, mounting devices, fasteners, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers.

2.2.9.1 Interior Doors:

Acceptable Manufacturer.

2.2.9.2 Exterior Doors:

Acceptable Manufacturer: Provide without stop.

2.2.10 Door Protection Plates

2.2.10.1 Sizes of Armor, Kick, and Push Plates

Width for single doors shall be 50 mm less than door width; width for pairs of doors shall be 25 mm less than door width. Height of kick plates shall be 200 mm for flush doors. Height of armor plates shall be not less than 900 mm for flush doors. Dimension of stainless steel push plates is 150 x 300 mm.

2.2.11 Door Stops

BHMA A156.16 standards Cylindrical type, 5 cm. Acceptable Manufacturer.

Thresholds

Provide thresholds of locally available marble in sizes and locations as indicated on Drawings.

2.2.13 Weather Stripping

BHMA A156.22 standards. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". A set shall include head and jamb seals, sweep strips, and, for pairs of doors, astragals.

2.2.13.1 Door Weather stripping

General: Provide continuous weather-strip casketing on exterior doors and provide smoke, light, or sound casketing on interior doors where indicated or scheduled. Provide uncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Perimeter Casketing: Apply to head and jamb, forming seal between door and frame.
2. Meeting Stile Casketing: Fasten to meeting stiles, forming seal when doors are closed.
3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

2.2.13.2 Door Sweeps

Door Sweeps: Gasket material held in place by flat metal housing or flange; surface mounted to face of door with screws.

1. Gasket Material: Brush as standard with manufacturer.
2. Housing Material: Housing metal as standard with manufacturer.

2.2.14 Overhead Rain Drips

Approximately 38 mm high by 64 mm projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

2.2.15 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.2.16 Miscellaneous Hardware

Provide the following as required:

Swing Door Roller Lockset

2.3 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Provide fasteners of type necessary to accomplish a permanent installation.

2.4 FINISHES

BHMA A156.18 standards. Hardware shall have BHMA 630 finish. All hardware shall be one finish (satin chrome or stainless steel finish), unless specified otherwise. Provide items not manufactured in

stainless steel in BHMA 626 finish (satin chromium plated over brass or bronze finish, except surface door closers which shall have aluminum paint finish. Hinges for exterior doors shall be stainless steel or chromium plated brass or bronze finish. Exit devices may be provided in BHMA 626 aluminum color or bronze finish in lieu of BHMA 630 stainless steel finish. Exposed parts of concealed closers shall have finished matching lock and dooring trim. Hardware showing on interior of shower rooms, toilet rooms, laundry rooms, and kitchens shall have bright stainless steel or bright chromium plated finish.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed instructions. Provide machine screws set in expansion shields for fastening hardware to solid masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping so as to prevent damage. Provide full contact, weather-tight seals. Doors shall operate without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 225 mm o.c. after doors and frames have been finish painted.

3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 standards for fire doors, and NFPA 101 for exit doors.

3.3 HARDWARE LOCATIONS

As indicated on Drawings.

a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.

--- End of Section --

SECTION 09

RESINOUS TERRAZZO FLOORING

PART 1 GENERAL

SECTION INCLUDES

Cast In Place Concrete Substrate.

Epoxy Resin Terrazzo poured in place with joint, edge, and termination divider strips as indicated on drawing.

Crack suppression membrane with reinforcing mesh.

Moisture vapor transmission barrier placed on concrete slab.

1.1 REFERENCES

ACI 301 - Specifications for Structural Concrete for Buildings.

ACI 302.1 - Guide for Concrete Floor and Slab Construction.

ACI 318 - Building code requirements for Reinforced Concrete.

AASHTO T 277 - Standard Method of Test for Rapid Determination of the Chloride Permeability of Concrete.

ASTM C 33 - Standard Specification for Concrete.

ASTM C 94 - Standard Specification for Ready-Mixed Concrete.

ASTM C 150 - Standard Specification for Portland Cement.

ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.

ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.

ASTM C 171 - Standard Specification for Sheet Materials for Curing Concrete.

ASTM C 138 - Standard Test Method for Unit Weights, Yield, and Air Content (Gravimetric) of Concrete.

1.2 SUBMITTALS

Submit

Product Data: Manufacturer's data sheets on each product to be used, including:

Preparation instructions and recommendations.

Storage and handling requirements and recommendations.

Installation methods.

Shop Drawings: Submit shop drawings detailing the locations of all construction joints and the terrazzo pattern to be applied.

Selection Samples: For each finish product specified, three complete sets of color chips representing manufacturer's full range of available colors and patterns. Verification Samples: For each finish product specified, three samples, minimum size 6 inches (150 mm) square representing actual product, color, and patterns.

Concrete Certifications:

Concrete mix design and trial mix laboratory reports to include:

Water-Cement Ratio.

Slump.

Air Content per ASTM C 231 or ASTM C 173.

Aggregate gradation.

Rapid Permeability test results per AASHTO T 277.

Compressive Strength per ASTM C 39.

Mix Proportions of all ingredients.

Independent laboratory certification that aggregates to be used are non-reactive.

Schedule of placement sequence

Proposed curing schedule to include method and duration

Certification from the admixture manufacturer that admixture(s) provided contain no chlorides.

Certification that the concrete batch plant has been tested and that all equipment is within the tolerances as set forth in the National Bureau of Standards Handbook No. 44.

1.3 QUALITY ASSURANCE

Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten (10) years experience.

Installer Qualifications:

All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.

Installation contractor must be a current Contractor member of the NTMA and perform all work in accordance with the NTMA specifications and standards.

Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

Finish areas designated by Architect.

Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.

Refinish mock-up area as required to produce acceptable work.

1.4 DELIVERY, STORAGE, AND HANDLING

Store products in manufacturer's unopened packaging until ready for installation.

Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.5 PROJECT CONDITIONS

Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.6 WARRANTY

At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

Duration: One (1) Year from date of substantial completion.

PART 2 PRODUCTS

Submit color for approval

2.1 MANUFACTURERS

Acceptable Manufacturer by UNDP

2.2 EPOXY MATERIALS

Primer: Resin manufacturer's 100 percent solids epoxy primer.

Flexible Membrane: Resin Manufacturer's 100 percent solids epoxy crack suppression membrane.

Epoxy Resin: Epoxy matrix, 100 percent solids, 0 VOC epoxy resin. From NTMA associate member supplier.

2.3 AGGREGATE

Marble Chips: Standard color marble chips from NTMA associate member producer or Distributor. Maximum size #2 NTMA standard sizing.

Glass Chips: Standard color or approved custom color from sample.

2.4 ASSOCIATED MATERIALS

Divider Strip: Zinc, 1/8 inch (3mm) in thickness unless otherwise noted on drawing.

Terrazzo Cleaner: PH factor between 7 and 10, biodegradable and phosphate free as recommended by epoxy resin manufacturer.

Sealer: Tesco Crystal seal penetrating sealer.

Moisture Transmission Barrier: as supplied or recommended by epoxy resin manufacturer.

2.5 MIXES

Terrazzo Selection

Terrazzo type shall be 3/8 inch (8mm) epoxy resin matrix thin-set terrazzo.

Terrazzo color mixes shall be NTMA color plates or custom matrix as produced by NTMA contractor member. Sample(s) matrix designations #'s

Proportions

In accordance with resin system manufacturer's recommendations.

Mixes

2.6 COLOR

To be approved by UNDP Engineer

PART 3 EXECUTION

3.1 EXAMINATION

Do not begin installation until substrates have been properly prepared.

If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

3.2 PREPARATION

Clean surfaces thoroughly prior to installation.

Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

Sub-Floor Preparation

Prepare substrate to receive epoxy terrazzo by shot blasting to expose clean concrete substrate. If required due to moisture vapor transmission rate test results exceeding NTMA recommended levels, install moisture vapor transmission barrier to concrete slab per manufacturer's recommendations.

Where required, install crack isolation membrane as required at cold joints and cracks, over concrete substrate as per manufacturer's instructions. Install divider strips as indicated on approved layout. Place any expansion joint strips to match expansion joints where required.

3.3 INSTALLATION

Install in accordance with manufacturer's instructions.

3.3.1 Placing Terrazzo

With primer manufacturer's recommendations. Place terrazzo mixture in panels formed by divider strips and trowel mixture to top of strips.

3.3.2 Curing

After completing placement of terrazzo allow to cure until topping develops sufficient strength to prevent lifting or pulling of terrazzo strips during grinding.

3.3.3 Finishing

Rough Grinding: Grind with #24 grit or finer BRICKs or with comparable diamond plates. Glass should be ground with finer BRICKs.

Follow initial grind with #80 grit or finer BRICKs as required to meet the finish of approved project control samples.

3.3.4 Grouting

Cleanse floor with clean water and rinse.

Remove excess rinse water and machine or hand applies grout, taking care to fill voids.

Grout may be left on terrazzo topping until all heavy or messy work in project area is complete.

3.3.5 Fine Grinding

Grind with #80 grit or finer BRICKs until all grout is removed from surface. Finer grit finishes can be specified at an additional cost.

Upon completion, terrazzo must show a minimum of 70 percent glass or marble chips. Some minor variation in chip density is inherent in terrazzo.

3.3.4 Cleaning and Sealing

Wash all surfaces with a neutral cleaner.

Rinse with clean water and allow to dry.

Apply penetrating sealer in accordance with manufacturer's directions.

3.4 PROTECTION

Protect installed products until completion of project.

Touch-up, repair or replace damaged products before Substantial Completion.

SECTION 10

PANEL BOARDS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

American standards are applicable to the greatest extent possible, based on voltages required for this project. References to American standards do not relieve the contractor from procuring and installing materials and equipment compatible with required voltages. Standard references indicate a minimum, acceptable level of quality or performance for the work to be judged by. When materials or equipment do not comply with referenced American standards, they must comply with equivalent European standards, such as DIN, BS, or EN. Submit copies of equivalent European standards for evaluation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 187 (1994) Copper Bar, Bus Bar, Rod and Shapes

ASME INTERNATIONAL (ASME)

ASME B1.1 (1989) Unified Inch Screw Threads (UN and UNR Thread Form)

ASME B1.20.1 (1983; R 2001) Pipe Threads, General Purpose (Inch)

BRITISH STANDARDS (BS)

BS EN 60439-3 (Jun 1991) Low-voltage switchgear and control gear assemblies; Part 3: Particular requirements for assemblies intended to be installed in places where unskilled persons have access to their use - Distribution boards

BS EN 60947-2 (2001, Ed. 2.2) Low-voltage switchgear and control gear; Part 2. Circuit breaker

INTERNATIONAL ELECTROTECHNICAL COMMISSION IEC)

IEC 60529 (2001-02, Ed. 2.1) Degrees of Protection Provided by Enclosures (IP Code)

IEC 60898-1 (2002, Ed. 1.0) Electrical accessories - Circuit Breakers for overcurrent protection for households and similar installations - Part 1: Circuit breakers for a.c. operation

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1 (1999) Molded Case Circuit Breakers and Molded Case Switches

NEMA PB 1 (1995) Panel boards

UNDERWRITERS LABORATORIES (UL)

UL 50 (1995; Rev thru Nov 1999) Enclosures for Electrical Equipment

UL 67 (1993; Rev thru Oct 1999) Panel boards

UL 489 (1996; Rev thru Mar 2000) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

1.2 COORDINATION OF REFERENCES

American standards are applicable to the greatest extent possible, based on voltages required for this project. References to American standards do not relieve the contractor from procuring and installing materials and equipment compatible with required voltages. Standard references indicate a minimum, acceptable level of quality or performance for the work to be judged by. When materials or equipment do not comply with referenced American standards, they must comply with equivalent European standards, such as DIN, BS, or EN. Submit copies of equivalent European standards for evaluation.

1.3 SYSTEM DESCRIPTION

These specifications include the design, fabrication, assembly, wiring, and delivery of the items of equipment and accessories and spare parts listed in the Schedule and shown on the drawings.

1.3.1 Coordination

The general arrangement of the panel boards is shown on the contract drawings. Any modifications of the equipment arrangement or device requirements as shown on the drawings shall be subject to the approval of the UNDP. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. All equipment shall be completely assembled at the factory.

1.3.2 Standard Products

Material and equipment shall be standard products of a manufacturer regularly engaged in their manufacture and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. All materials shall conform to the requirements of these specifications. Materials shall be of high quality, free from defects and imperfections, of recent manufacture, and of the classification and grades designated. All materials, supplies, and articles not manufactured by the Contractor shall be the products of other recognized reputable manufacturers. If the Contractor desires for any reason to deviate from the standards designated in these specifications, he shall, after award, submit a statement of the exact nature of the deviation, and shall submit, for the approval of the UNDP, complete specifications for the materials which he proposes to use.

1.3.3 Nameplates

Nameplates shall be made of laminated sheet plastic or of anodized aluminum to provide white letters on a black background. The nameplates shall be fastened to the panels in proper positions.

1.4 SUBMITTALS

The following shall be submitted:

Shop Drawings

Panel boards

The Contractor shall, within 30 calendar days after date of receipt by him of notice of award, submit for the approval of the UNDP six (6) copies of outline drawings of all equipment to be furnished under this contract, together with weights and overall dimensions. Drawings shall show the general arrangement and overall dimensions of the motor control centers, switchboards, and panel boards. These drawings shall show space requirements, details of any floor supports to be embedded in concrete and provisions for conduits for external cables.

The Contractor shall, within 30 calendar days after date of receipt by him of notice of award, submit for the approval of the UNDP six (6) copies of electrical equipment drawings. A single-line diagram, equipment list and nameplate schedule shall be provided for each switchboard and panel board.

Product Data

Panel boards

The Contractor shall within 30 calendar days after date of receipt by him of notice of award submit for approval six (6) copies of such descriptive cuts and information as are required to demonstrate fully that all parts of the equipment will conform to the requirements and intent of the specifications. Data shall include descriptive data showing typical construction of the types of equipment proposed, including the manufacturer's name, type of molded case circuit breakers or motor circuit protectors, performance capacities and other information pertaining to the equipment.