PROJECT: ZIMBABWE (MUTARE) MEDICAL WAREHOUSE

Technical Structural Specifications

Z2016-000-SSA-001-0

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DIVISION 5 STEEL

SECTION 05 12 00 STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes structural steel.

B. This Section includes architecturally exposed structural steel.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Quality Assurance/Quality Control" for independent testing agency procedures and administrative requirements.
2. Division 3 Section "Cast-in-Place Concrete" for canopies foundations.
3. Division 7 Section "Sprayed Fire-Resistive materials."
4. Division 7 Section "App-Modified Bituminous Sheet Waterproofing" for canopies foundations and "Applied Fireproofing".
5. Division 9 Section "Exterior Painting" and "Interior Painting."

1.2 DEFINITIONS

A. Structural Steel: Elements of structural-steel (roller sections, built up sections, bolts, …etc) as classified by specification BS5950 or BS EN 1993 or equivalent code.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance:

1. Engineer all secondary steel elements required by the contract documents by the steel fabricator to withstand design loadings indicated. Secondary steel elements includes but not limited to: catwalks, handrails, ladders, and all substructures for cladding.
2. All connections details should be designed and detailed by the steel fabricator based on straining actions approved by the engineer.
3. For port cabinets, kiosks and steel canopies shown on the Architectural/Landscape drawings and not shown on Structural drawings: Engineer structural steel and its concrete foundations required by the Contract Documents to be completed by the fabricator to withstand design loadings indicated.

B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

C. Design Calculations: For port cabinets, kiosks and steel canopies shown on the Architectural/Landscape drawings and not shown on Structural drawings, the contractor is to submit design criteria, reference codes and loads used, fully detailed computer analysis and design including input data file, analysis model, end restraints and the associated output diagrams of all straining actions, support reactions, stresses and code checking in addition to design calculations for bolted and welded steel connections and concrete foundations.

1. Loads

Dead Load	- Self weight of all components - Weight of roof cladding and side walls - Any additional permanent loads
Live Load	- BS 6399
Wind Loads	- UBC1997.
Seismic Loads	- UBC1997.
Température Variation	- Uniform -30 ^{o}C or +30 ^{o}C.
Installation Loads	- Electro-mechanical installation load value is to be checked by the contractor prior to design (if any).

2. Load Combinations: The load combinations are to be accordance to UBC 1997.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Structural Design Deliverables (For port cabinets and steel canopies shown on the Architectural/Landscape drawings and not shown on Structural drawings): The contractor's design deliverables shall include, but are not limited to, the following:

1. Submit co-ordination, design, and other information showing such details of the work as required by Engineer.

- Drawings and information are to be prepared by an approved engineer and are to include, but are not limited to, the following: Structural framing plans, Sections and elevations, Connections details, Concrete Foundation details , All design and details information.
- During the design phase, the contractor is to ensure that a close coordination with all the other trades is finalized before proceeding with the construction phase.

2. Detailed structural calculations showing the static system used with clear graphical illustrations of the straining actions on structural elements, structure deformations, and detailed design calculations of the structural elements.

C. Product Data for each type of product specified.

D. Shop Drawings detailing fabrication of structural steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard BS or equivalent AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
   Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.
5. Include Shop Drawings signed and sealed by a qualified professional engineer responsible for their preparation.
6. Identify methods of erection and calculations of erection stresses.
7. Identify methods of bracing and temporary guys.
8. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard BS 7668 or equivalent AWS A2.1 and A2.4 symbols, and show size, length, and type of each weld.
9. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorage to be installed as work of others sections.
10. Identify members and connections of the seismic-load-resisting system.
11. Indicate locations and dimensions of protected zones.
12. Identify demand critical welds.
13. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to BS 7668 or equivalent AWS D1.1, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

F. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects/engineers and owners, and other information specified.

G. Product Data: Submit producer's or manufacturer's specifications and installation instructions. Include mill test reports in accordance with BS EN 10024, 10025, 10029, 10034,…etc or

equivalent ASTM A 6, laboratory test reports and other data to show compliance with specifications (including specified standards) for the following products:

1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.
2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
3. Tension-control, high strength bolt-nut-washer assemblies.
4. Direct-tension indicators.
5. Shear stud connectors.
6. Non shrink grout.
7. Welding electrodes.
8. Anchor bolts.
9. Stainless steel plates and Teflon bearings.

H. Test Reports: Submit copies of reports of tests conducted on shop and field bolted and welded connections. Include data on type(s) of tests conducted and test results. State compliance or non-compliance with specifications.

I. Fabricator and Erector: Submit the name of the proposed fabricator and erector with reference of work of a similar nature carried out by him on other projects, with relevant dates.

J. Surveys: Submit for information certified copies of each survey conducted by an approved engineer, showing elevations and locations of base plates and anchor bolts to receive structural steel, and final elevations and locations for major members. Indicate discrepancies between actual installation and contract documents.

K. Method Statement: Submit for approval, Quality Control method statement in accordance with quality assurance procedures, and Erection method statement.

L. No fabrication work is to commence before approval of test reports and submittals.

M. As-Built Drawings: At project closeout, submit Record “As-Built” Drawings of completed work products, in accordance with requirements of the Specification as indicated in the Division 1.

N. Source quality-control reports.

1.5 QUALITY ASSURANCE

A. Quality System: Comply with ISO 9001/9002 Quality System as a minimum. Incorporate all the standard procedures supplied by the Engineer and the Employer.

B. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

C. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

1. Fabricator must participate in the BS or equivalent AISC Quality Certification Program and be designated an BS or equivalent AISC -Certified Plant as follows:

- Category: Category II, complex steel building structures.
- Fabricator shall be registered with and approved by authorities having jurisdiction.

D. Comply with applicable provisions of the following specifications and documents:

1. BS 5950-1 Code of practice for design — Rolled and welded sections
2. BS 5950-2 Specification for materials, fabrication and erection — Rolled and welded sections.
3. BS 5950-3 Design in composite construction — Section 3.1: Code of practice for design of simple and continuous composite beams.
4. BS 5950-4 Design of composite slabs with profiled steel sheeting.
5. BS 5950-5 Design of cold formed thin gauge sections.
6. BS 5950-6 Design of light gauge profiled steel sheeting.
7. BS 5950-7 Specification for materials, fabrication and erection — Cold formed sections and sheeting.
8. BS 5950-8 Code of practice for fire resistant design.
9. BS 5950-9 Code of practice for stressed skin design.
10. BS 7419, Specification for holding down bolts.
11. BS 7608, Code of practice for fatigue design and assessment of steel structures.
12. BS 7644-1, Direct tension indicators — Part 1: Specification for compressible washers.
13. BS 7644-2, Direct tension indicators — Part 2: Specification for nut face and bolt face washers.
14. BS 7668, Specification for weldable structural steels — Hot finished structural hollow sections in weather resistant steels.
15. BS EN 10025, Hot rolled products of non-alloy structural steels — Technical delivery conditions.
16. BS EN 10113-2, Hot-rolled products in weldable fine grain structural steels — Part 2: Delivery conditions for normalized/normalized rolled steels.
17. BS EN 10113-3, Hot-rolled products in weldable fine grain structural steels — Part 3: Delivery conditions for thermomechanical rolled steels.
18. BS EN 10137-2, Plates and wide flats made of high yield strength structural steels in the quenched and tempered or precipitation hardened conditions — Part 2: Delivery conditions for quenched and tempered steels.
19. BS EN 10155, Structural steels with improved atmospheric corrosion resistance — Technical delivery conditions.
20. BS EN 10210-1, Hot finished structural hollow sections of non-alloy and fine grain structural steels — Part 1: Technical delivery requirements.
21. BS EN 10219-1, Cold formed welded structural hollow sections of non-alloy and fine grain steels — Part 1: Technical delivery requirements.
22. BS EN 10250-2, Open die steel forgings for general engineering purposes — Part 2: Non-alloy quality and special steels.
23. BS EN 22553, Welded, brazed and soldered joints — Symbolic representation on drawings.

24. CP3:Ch V:Part 2, Code of basic data for the design of buildings — Chapter V: Loading — Part 2: Wind loads. London: BSI, 1972.
25. Steel Structure Painting Manual Steel Structures Painting Council Latest edition.
26. BS EN ISO 12944 parts 1 to 8 : Corrosion protection of steel structures by protective paint systems.

E. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.

F. Shop-Painting Applicators: Qualified according to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

G. Welding Qualifications: Qualify procedures and personnel according to BS 7668, BS EN 287, BS EN 288.

1. Present evidence that each welder has satisfactorily passed BS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
2. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by BS standard or equivalent AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Management and Coordination."

I. Quality Control: Submit for approval a method statement of the system of quality control to be used in fabrication and erection, complying with BS including proposed welding procedure. An approved quality control engineer is to be assigned for the complete duration of the work to ensure proper performance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

C. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and re lubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating as per BS standard or equivalent ASTM F 1852 fasteners and for retesting fasteners after lubrication.

D. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time not to delay work.

E. Manufactured items are to be delivered in original packages, containers etc. bearing name of manufacturer and brand. Each piece of material is to bear the official grade and trade mark of the association under whose rules it is graded or is to be accompanied by a certificate of inspection issued by that association.

F. Protect structural steel works by approved adequate measures from constructional hazards during and after erection.

1.7 SEQUENCING

A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Surfaces, General: For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.

B. Structural Steel Shapes, Plates, and Bars are to conform BS EN 10025, Grade S355, having a minimum yield stress of 355 MPa; or equal.

C. Structural Steel for Square and Rectangular cross sections are to conform BS EN 10210, Grade S355 J2H, having a minimum yield stress of 355 MPa; or equal.

D. Structural Steel for Hollow Circular sections are to BS EN 10210, Grade S355 J2H, having a minimum yield stress of 355 MPa; or equal.

E. PURLINS AND GIRTS shall be cold formed, pre-hot dipped galvanized steel Z35 to BS EN 10143, to satisfy the specified first life to maintenance, and having a minimum yield stress of 350 MPa; or equal..

F. Stainless steel plates for Teflon bearings to conform to AISI TP BS 970, grade 316 S16.

G. Polytetra fluoroethylene (PTFE) sheets are to conform to ASTM D 4894 and ASTM D 4895.

H. Headed Stud-Type Shear Connectors: to BS standard or equivalent AWS D1.1, Type B, minimum proof strength 51000 PSI at 0.2% offset and minimum ultimate strength of 65000 PSI, made from steel to ASTM A 108, with mechanical properties to ASTM A 370, and applied in accordance with Recommended Practices for Stud Welding.

I. Anchor Rods, Bolts, Nuts, and Washers: As follows:

1. Unheaded anchor bolts: BS 4190 or equivalent ASTM F 1554, Grade 55 with minimum yield strength of 380 N/mm^2 typically used.
2. Headed Bolts: BS EN 14399 or equivalent ASTM A 490M, Type 1, or DIN 6914 grade 10.9 heavy hex steel structural bolts and heavy hex carbon-steel nuts.
3. Configuration: Straight.

- Nuts: BS 4190 or equivalent ASTM A 563M heavy-hex carbon steel.
- Plate Washers: BS EN 10025, Grade S355 or equivalent ASTM A 572M carbon steel.
- Washers: BS 4320 or equivalent ASTM F 436M, Type 1, hardened carbon steel.
- Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

J. Non-high-Strength Bolts, Nuts, and Washers: BS 4190 or equivalent ASTM A 307, Grade A or DIN 7990 Grade 4.6, regular low-carbon hexagonal head steel bolts and nuts and washers, to be used only when specified.

K. High-Strength Bolts, Nuts, and Washers: BS EN 14399 or equivalent ASTM A 490M, Type 1, or DIN 6914 grade 10.9 heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers, uncoated. Typically used unless otherwise noted.

1. Direct-Tension Indicators: BS standard or equivalent ASTM F 959, Type 490, uncoated are to be used at all friction bolts / slip critical bolts.

L. Welding Materials: Conform to BS standard or equivalent AWS Code and AWS Filler Metal Specifications. Select materials which are suitable for use with types of steel to be joined. Unless otherwise indicated, connections are designed for:

1. Metal-Arc Welding Electrodes: to E70XX series of the Specification for Mild Steel Covered Arc-Welding Electrodes, AWS A5.1, or the Specification for Low-Alloy Steel Covered Arc-Welding Electrodes, AWS A5.5.
2. Bare Electrodes and Granular Flux used in the submerged-arc process are to conform to F7 X-EXXX AWS flux classifications of the Specification for Base Mild Steel Electrodes and Fluxes for Submerged Arc Welding, AWS A5.17, or A 5.23 or the of AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings."

M. Threaded Rods: S 4190 or equivalent A 36M or ASTM A 193/A 193M, Grade B7 or ASTM A 449 or A 572/A 572M, Grade 50.

1. Nuts: BS 4190 or equivalent ASTM A 563M heavy-hex carbon steel.
2. Washers: BS 4320 or equivalent ASTM F 436M**,** Type 1, hardened carbon steel.
3. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C

N. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, BS standard or equivalent ASTM A 108, Grade 1035.

O. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, BS standard or equivalent ASTM A 108, Grade 1030.

P. Sleeve Nuts: Made from cold-finished carbon steel bars, BS standard or equivalent ASTM A 108, Grade 1018.

Q. Mill test reports: provide triplicate copies of certified mill test reports or certified reports of tests for steel elements, bolts, washer, nuts, electrodes made by the fabricator in accordance with BS standard or equivalent ASTM.

2.2 CORROSION AND FIRE PROTECTION SYSTEMS

A. Paints and coatings systems shall comply with Division 09 painting Sections and in accordance with SSPC requirements.

B. Fire protection systems shall comply with Division 07.

2.3 GROUT

A. Metallic, Shrinkage-Resistant Grout: BS standard or equivalent ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: BS standard or equivalent ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 FABRICATION

A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to BS 5950 or equivalent AISC specifications referenced in this Section and in Shop Drawings.

1. Camber structural steel members where indicated.
2. Identify high-strength structural steel according to BS standard or equivalent ASTM A 6M and maintain markings until steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
6. Comply with fabrication tolerance limits of BS standard or equivalent AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

B. Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.

1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
2. Comply with fabrication requirements, including tolerance limits, of BS standard or equivalent AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.

C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in BS standard or equivalent AWS D1.1/D1.1M.

D. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

E. Bolt Holes: cut, drill, or punch standard bolt holes perpendicular to metal surface.

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Shop weld shear connectors, spaced as shown, to beams and girders in composite construction. Use automatic end welding of headed-stud shear connectors according to BS standard or equivalent AWS D1.1 and manufacturer's printed instructions.

G. Steel Wall Framing: Select true and straight members for fabricating steel wall framing to be attached to structural steel framing. Straighten as required to provide uniform, square, and true members in completed wall framing.

H. Welded Door Frames: Build up welded door frames attached to structural steel framing. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 250 mm o.c., unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.

1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

J. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

K. Materials and workmanship are subject to inspection and test by the Engineer, who is to have access at all times to all parts of the workshop where steelworks is being fabricated and is to be provided with reasonable inspection facilities.

L. Obtain permission of the Engineer before starting fabrication.

M. Connections: Weld or bolt shop connections.

N. Bolt field connections, except where welded connections or other connections are indicated.

1. do not distort or enlarge holes when using drifts,
2. do not use drifts of large diameter than holes,
3. report any misalignment of holes,
4. reaming of holes will not be allowed except for minor connections, and subject to written approval from the Engineer.

O. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with BS standard or equivalent AISC "Specifications for Structural Joints using High Strength Bolts" (RCSC).

P. Welded Construction: Comply with BS standard or equivalent AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Unless shown on the drawings site welding will only be permitted for minor connections subject to written approval from the Engineer.

2. Do not place any welds, except those shown on the drawings, without approval even for temporary attachment and repair of faulty plates.
3. Use run on and run off plates to ensure full throat thickness at ends of butt welds as follows:

   - material for plates is to be identical to material being welded,
   - prepare plates in same manner as parts being joined,
   - size of run on and run off plates to be 75 mm x 75 mm,
   - after completion of welding remove plates and grind surfaces of joined parts where plates are attached to make smooth,
   - retain and identify plates for inspection when requested.

4. Provide evidence of welder's competence to undertake specified work. Welders must have been tested to the Standard Code for Welding in Building Construction of the American Welding Society using same electrodes class and welding positions which will be used in the work.
5. Test Welders to the Standard Code of Welding in Building Construction of the American Welding Society when instructed using:

   a. thickest plate specified and/or,
   b. material with highest carbon content,
   c. electrodes of appropriate class,
   d. welding positions which will be used in the work.

6. Test Welder's competence to undertake special welding procedures when instructed.

2.5 SHOP CONNECTIONS

A. Shop install and tighten high-strength bolts according to BS 5950, S EN 1993, BS 4190, BS 3692 and BS EN 14399-1 to BS EN 14399-10BS 4190standard or equivalent RCSC's "Specification for Structural Joints Using High Strength Bolts".

1. Bolts: BS EN 14399 or equivalent ASTM A 490M high-st rength bolts, unless otherwise indicated.
2. Connection Type: Friction type / Slip-critical, direct-tension, or tensioned shear/bearing connections as indicated.

B. Weld Connections: Comply with BS standard or equivalent AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 13 mm and larger. Grind flush butt welds. Dress exposed welds.

2.6 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 50 mm.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Galvanized surfaces.

2.7 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

2.8 SOURCE QUALITY CONTROL

A. Contractor will engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports, subject to the engineer approval, on contractor expense.

1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
2. Provide the testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Shop-bolted connections will be tested and inspected according to BS standard or equivalent AISC specifications and RCSC's "Specification for Structural Joints Using High Strength Bolts ".

1. Direct- tension indicator gaps will be verified to comply with BS standard or equivalent ASTM F 959, Table 2.

E. Testing agency may inspect structural steel at plant before shipment; however. Engineer reserves right, at any time before final acceptance, to reject material not complying with specified requirements.

F. Shop Welding: Inspect and test during fabrication of structural steel assemblies, as follows:

1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
2. Perform visual inspection of all welds.

3. Perform nondestructive tests of welds on 10% of all fillet weld lengths as a first testing round, depending on its results, the Engineer might instruct the Contractor to extend the testing process and/or to replace welder at no extra cost. Selection of tested samples to be approved by the Engineer. Non-destructive tests of butt welds to be done on 100% of the welded lengths.
   3.1 Fillet Welds
      - Liquid Penetrant Inspection: BS standard or equivalent ASTM E 165, or,
      - Magnetic Particle Inspection: BS standard or equivalent ASTM E 709; performed on root pass and on finished weld of fillet welds at random. Cracks or zones of incomplete fusion or penetration not acceptable.
   3.2 Butt Welds
      - Radiographic Inspection: BS standard or equivalent ASTM E 94 and ASTM E 142; minimum quality level "2-2T", or,
      - Ultrasonic Inspection: BS standard or equivalent ASTM E 164 for 100% of full penetration and partial welds.

G. In addition to visual inspection, shop-welded shear connectors will be inspected and tested according to requirements of BS standard or equivalent AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.

2. At locations agreed with the Engineer a minimum of 5% of studs which have satisfied the visual inspection shall have a bend test. The bend test shall be made by striking the head of the stud with a 6kg hammer until it is displaced laterally a distance of about one quarter of the height of the stud. The stud weld shall not show any signs of cracking or lack of fusion.

3. Studs subjected to the bend test shall not be straightened.

4. Studs with defective welding shall be removed and replaced and re-tested as per the requirements of the BS standard or equivalent AWS D1.1.
5. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of BS standard or equivalent AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to BS standard or equivalent AISC specifications referenced in this Section.

B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow curing.
4. Comply with manufacturer's instructions for proprietary grout materials.

C. Maintain erection tolerances of structural steel within BS standard or equivalent AISC's "Code of Standard Practice for Steel Buildings and Bridges."

1. Maintain erection tolerances of architecturally exposed structural steel within BS standard or equivalent AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

E. Splice members only where indicated.

F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

G. Do not use thermal cutting during erection.

H. Finish sections thermally cut during erection equal to a sheared appearance.

I. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

J. Do not use welding equipment on site without approval.

K. Ensure bolts are in center of slotted holes after erection of structure.

L. Treat sliding surfaces of proprietary joints in accordance with manufacture's recommendations before connecting.

M. Raise or lower to correct level using sawn steel packs not larger than necessary for the purpose.

N. Notify the Engineer when space beneath any column base is less than 10 mm or more than 50 mm.

O. Comply with BS standard or equivalent AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

P. Ensure that the capacity of plant and equipment used for erection are suitable and are in first class working order.

Q. Obtain permission before starting erection of steel work.

R. Inspect foundations before starting erection for line and level, anchor bolts for position, protruding length, condition and slackness.

3.4 FIELD CONNECTIONS

A. Install and tighten high-strength bolts according to BS standard or equivalent RCSC's "Specification for Structural Joints Using High Strength Bolts".

1. Bolts: BS EN 14399 or equivalent ASTM A 490M high-strength bolts, unless otherwise indicated.
2. Connection Type: Friction type / Slip-critical, direct-tension, or tensioned shear/bearing connections as indicated.

B. Weld Connections: Comply with BS standard or equivalent AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Comply with BS standard or equivalent AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 13 mm and larger. Grind flush butt welds. Dress exposed welds.

3.5 FIELD QUALITY CONTROL

A. Employer will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Field-bolted connections will be tested and inspected according to BS standard or equivalent RCSC's "Specification for Structural Joints Using High Strength Bolts".

1. Direct-tension indicator gaps will be verified to comply with BS standard or equivalent ASTM F 959, Table 2.

E. Field Welding: Inspect and test during erection of structural steel as follows:

1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
2. Perform visual inspection of all welds.
3. Perform nondestructive tests of welds on 10% of all fillet weld lengths as a first testing round, depending on its results, the Engineer might instruct the Contractor to extend the testing process and/or to replace welder at no extra cost. Selection of tested samples to be approved by the Engineer. Non-destructive tests of butt welds to be done on 100% of the welded lengths.
   3.1 Fillet Welds
   - Liquid Penetrant Inspection: BS standard or equivalent ASTM E 165, or,
   - Magnetic Particle Inspection: BS standard or equivalent ASTM E 709; performed on root pass and on finished weld of fillet welds at random. Cracks or zones of incomplete fusion or penetration not acceptable

3.2 Butt Welds

- Radiographic Inspection: BS standard or equivalent ASTM E 94 and ASTM E 142; minimum quality level "2-2T", or,
- Ultrasonic Inspection: BS standard or equivalent ASTM E 164 for 100% of full penetration and partial welds.

F. Weld defects: cracks, overlaps, lack of penetration or incomplete fusion shall not be allowed.

G. Lamination tests: carry out ultrasonic testing for lamination on all head plates for moment connections (15 mm thick or above) in accordance with BS standard or equivalent DIN 54120 or ASTM A 577/577 M.

H. Non-shrink grout: prepare 50 mm cubes and test for compressive strength in accordance with ASTM C 109.

I. In addition to visual inspection, field-welded shear connectors will be inspected and tested according to requirements of BS standard or equivalent AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.
2. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of BS standard or equivalent AWS D1.1.

J. Tolerances: The permissible deviation of fabricated and erected structures is to be in accordance with the limitations of the BS standard or equivalent AISC.

K. Equipment: provide necessary facilities and equipment for specified tests in the fabrication shop and on site. Calibrate load measuring equipment at regular intervals agreed with Engineer.

L. Results: submit three copies of test and examination results to Engineer immediately they are available.

3.6 CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION 05 12 00

SECTION 05 31 00 STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof Deck.
2. Composite floor deck.
3. Non-composite Deck.

B. Related Requirements:

1. Division 03 Section "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Division 03 Section "Lightweight Insulating Concrete" for lightweight insulating concrete fill over steel deck.
3. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
4. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
5. Division 09 painting Sections for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.
2. Acoustical roof deck.

D. Evaluation Reports: For steel deck.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to BS standard or equivalent ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to VAWS D1.3, "Structural Welding Code - Sheet Steel."

C. Electrical Raceway Units: Provide UL-labeled cellular floor-deck units complying with UL 209 and listed in UL's "Electrical Construction Equipment Directory" for use with standard header ducts and outlets for electrical distribution systems.

D. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect steel deck and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. BS standard or equivalent AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with BS standard or equivalent ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25percent.

D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS) Grade 50, G90 Z275 zinc coating or approved equal.
2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Structural Steel (SS) Grade 50, G90 Z275 80zinc coating or approved equal; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

2.3 COMPOSITE FLOOR DECK

A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS) Grade 50, G90 Z275 zinc coating or approved equal.

2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Structural Steel (SS) Grade 50, G60 Z180 zinc coating or approved equal; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard baked-on, rust-inhibitive primer.

2.4 NONCOMPOSITE FORM DECK

A. Non-composite Form Deck: Fabricate ribbed-steel sheet non-composite form-deck panels to comply with "SDI Specifications and Commentary for Non-composite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS) Grade 50, G90 Z275 zinc coating or approved equal.
2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Structural Steel (SS), Grade Grade 50, G90 Z275 zinc coating or approved equal; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

2.5 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 230 MPa, not less than 0.91-mm design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 230 MPa, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 1.90 mm thick, with factory-punched hole of 9.5-mm minimum diameter.

J. Flat Sump Plates: Single-piece steel sheet, 1.90 mm thick, of same material and finish as deck. For drains, cut holes in the field.

K. Recessed Sump Pans: Single-piece steel sheet, 1.90 mm thick, of same material and finish as deck, with 76-mm- wide flanges and level recessed pans of 38-mm minimum depth. For drains, cut holes in the field.

L. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

N. Shear Connectors: Comply with BS standard or equivalent AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

J. Shear Connectors: Weld shear connectors through deck to supporting frame according to BS standard or equivalent AWS D1.1.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 38 mm long, and as follows:

1. Weld Diameter: nominal.

2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 457 mm, and as follows:

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 38 mm, with end joints as follows:

1. End Joints: Lapped 51 mm minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 305 mm apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

G. Sound-Absorbing Insulation: Installation into topside ribs of deck as specified in Division 07

3.4 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: nominal.
2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 305 mm apart, but not more than 457 mm apart.
3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 914 mm, and as follows:

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 38 mm, with end joints as follows:

1. End Joints: Lapped 51 mm minimum..

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

F. Electrified Cellular Floor Deck: Install cellular floor system with deck.

1. Coordinate layout and installation of trench headers, preset inserts, duct fittings, and other components specified in Division 26 Section "Under floor Raceways for Electrical Systems" with installation of electrified cellular metal floor deck.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect / Engineer.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas of prime-painted deck immediately after installation, and apply repair paint as per painting application requirement of section 051200.

1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Division 09.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 50 00 METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section covers general requirements for materials and workmanship as necessary for providing custom architectural (non-structural and non-decorative) metal (ferrous and non-ferrous) fabrications work items as indicated on Drawings or as specified in other Specification Sections by reference to this Section. Section includes, but shall not be limited to, the following:

1. Metal framing and supports for vanities and countertops.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Steel framing and supports for countertops.
4. Metal ladders.
5. Ladder safety cages.
6. Miscellaneous steel trim.
7. Abrasive metal nosings.
8. Trench cover.
9. Shelf angles.
10. Sump pit cover.
11. Metal bollards.

B. Related Sections include, but shall not be limited to, the following:

1. Division 3 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts and other items cast into concrete.
2. Division 5 Section "Pipe and Tube Railings."
3. Division 5 Section "Metal Gratings."
4. Division 6 Sections for metal framing anchors and timber connectors.
5. Division 9 Section "Interior Painting."
6. Division 9 Section "Exterior Painting."

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Metal fabrications, including anchors and connections, shall withstand the effects of gravity loads and the following loads and stresses without exceeding the allowable design working stress of materials involved and without exhibiting permanent deformation in any components:

1. Wind loads as per UBC 1997.
2. Seismic loads as per UBC 1997.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: ± 25 deg C, ambient; 100 deg C, material surfaces.

C. Where sump pit, trenches, access covers may be subject to vehicular traffic, design loads shall consider the highest wheel load of the heaviest vehicular that may pass over sump pit cover as determined by Engineer and verified by Contractor.

1. Any deflection that takes place in cover under the maximum wheel load shall return to zero value after removal of the wheel load.

1.3 SUBMITTALS

A. Product Data: Detailed material and assembly descriptions. Show also fabrication and installation details for metal fabrications. Include product data for materials used in finishing and installation of metal fabrications similar to paints and grout.

B. Shop Drawings:

1. Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Engineering Calculations:

1. Include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by manufacturer.
2. Calculation and shop drawings are to be submitted simultaneously.

D. Samples for Verification: For each type and finish of metal nosing.

E. Qualification Data: For manufacturer of fabrications under this Section and for the consulting structural engineer responsible for the structural design of any fabrication.

F. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.

G. Welding Certificates signed by the Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

H. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

I. Warranty: Sample copy of manufacturer's proposed warranty complying with specified requirements, and stating obligations, remedies, limitations, and exclusions of warranty.

1.4 ENVIRONMENT, HEALTH AND SAFETY (EHS) SUBMITTALS

A. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

1.5 QUALITY ASSURANCE

A. Local Regulations and Codes: Comply with applicable requirements of the laws, codes, and regulations of authorities having jurisdiction.

1. Obtain necessary approvals from authorities having jurisdiction.
2. Comply with ZIMBABWE Fire& Life Safety Code of Practice including Annexures.
3. Comply with ZIMBABWE Civil Defense and the Municipality requirements and circulars.
4. Materials used on the façades shall be non-combustible and tested and approved as per the Civil Defense requirements.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. BS standard or equivalent AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

C. Corrosion Control: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

D. Surface-Burning Characteristics of Ancillary Materials: As tested according to BS standard or equivalent ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

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

1. Erect mockup for each item covered or erected under this Section.
2. Final approval to the manufacturer/fabricator/installer of any item shall be warranted only after approval of the mockup by Engineer.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specially approves such deviations in writing.

4. Approved mockups constructed on locations of Permanent Works may become part of the completed Work if undisturbed at time of Substantial Completion.
5. Demolish and remove mockups when directed unless otherwise indicated.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: BS EN 10025, Grade S355, having a minimum yield stress of 355 MPa; or equal.

B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304 and Type 316.

C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304 and Type 316.

D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with BS standard or equivalent ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

E. Rolled-Stainless-Steel Floor Plate: ASTM A 793.

F. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel.

G. Steel Tubing: BS standard or equivalent ASTM A 500, cold-formed steel tubing.

H. Steel Pipe: BS standard or equivalent ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

I. Cast Iron: Either gray iron, BS standard or equivalent ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B 209M, Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B 221M, Alloy 6063-T6.

C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 FASTENERS

A. General:

1. Provide Type 316 stainless-steel fasteners for exterior installations.
2. Provide Type 304 stainless-steel fasteners for the following interior installations:

   a. For fastening aluminum.
   b. For fastening stainless steel.
   c. For fastening nickel-plated finished items.

3. Provide bronze fasteners for fastening bronze.
4. Provide zinc-plated fasteners with coating complying with BS standard or equivalent ASTM B 633 or ASTM F 1941M, Class Fe/Zn 5, for other interior concealed installations.
5. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, BS EN 14399 or equivalent ASTM F 568M, Property Class 4.6; with hex nuts, BS 4190 or equivalent ASTM A 563M; and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, BS EN 14399 or equivalent ASTM A 325M, Type 3; with hex nuts, BS 4190 or equivalent ASTM A 563M, Class 8S3; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 738M; with hex nuts, ASTM F 836M; and, where indicated, flat washers; Alloy Group A4.

E. Anchor Bolts: BS 4190 or equivalent ASTM F 1554, Grade 36, of dimensions indicated; with nuts, BS 4190 or equivalent ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Eyebolts: BS standard or equivalent ASTM A 489.

G. Machine Screws: BS standard or equivalent ASME B18.6.7M.

H. Lag Screws: BS standard or equivalent ASME B18.2.3.8M.

I. Wood Screws: BS standard or equivalent Flat head, ASME B18.6.1.

J. Plain Washers: BS standard or equivalent Round, ASME B18.22M.

K. Lock Washers: Helical, spring type, BS standard or equivalent ASME B18.21.2M.

L. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to BS standard or equivalent ASTM E 488, conducted by a qualified independent testing agency.

M. Post-Installed Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per BS standard or equivalent ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with BS standard or equivalent ASTM B 633 or ASTM F 1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Interior Locations Where Stainless Steel Is Indicated: Alloy Group A1 stainless-steel bolts, ASTM F 738M, and nuts, ASTM F 836M.
3. Material for Exterior Locations is Indicated: Alloy Group A4 stainless-steel bolts, (ASTM F 738M), and nuts, (ASTM F 836M).

N. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

O. Post-Installed Chemical Anchors:

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group A4 stainless-steel bolts, ASTM F 738M, and nuts, ASTM F 836M.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to BS standard or equivalent AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Division 9 section "Interior Painting" and Division 9 Section "Exterior Painting."

C. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20.

D. Field Paint: Acrylic/Aliphatic polyurethane coating system as specified in Division 9, Section “Interior Painting” and Division 9, Section “Exterior Painting”.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with BS standard or equivalent ASTM D 1187.

F. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Concrete: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 20 MPa.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1 mm unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

J. Remove sharp or rough areas on exposed traffic surfaces.

K. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

L. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 3.2 by 38 mm, with a minimum 150-mm embedment and 50-mm hook, not less than 200 mm from ends and corners of units and 600 mm o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports unless otherwise indicated.

D. Finish miscellaneous framing and supports with Acrylic Aliphatic-Polyurethane Enamel specified in Division 9, Section "Interior Painting" and Division 9, Section "Exterior Painting."

2.8 METAL LADDERS

A. General:

1. Comply with BS standard or equivalent ANSI A14.3 or other equivalent standard approved by Engineer.
2. For elevator pit ladders, comply with BS standard or equivalent ASME A17.1.

B. Steel Ladders: Comply with the following unless otherwise indicated on Typical Details submitted by Contractor and approved by Engineer:

1. Space siderails 400 mm apart unless otherwise indicated.
2. Space siderails of elevator pit ladders 300 mm apart.
3. Siderails: Continuous, 10-by-64-mm steel flat bars, with eased edges.
4. Rungs: 20-mm- diameter steel bars.
5. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
7. Support each ladder at top and bottom and not more than 1500 mm o.c. with welded or bolted steel brackets.
8. Galvanize ladders, including brackets and fasteners.
9. Finish Ladders, including brackets and fasteners, with Acrylic Aliphatic-Polyurethane Enamel specified in Division 9, Section "Interior Painting" and Division 9, Section "Exterior Painting."

2.9 LADDER SAFETY CAGES

A. General:

1. Fabricate ladder safety cages to comply with BS standard or equivalent ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
2. Provide primary hoops at tops and bottoms of cages and spaced not more than 6 m o.c. Provide secondary intermediate hoops spaced not more than 1200 mm o.c. between primary hoops.
3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless-steel fasteners unless otherwise indicated.

B. Steel Ladder Safety Cages: Comply with details indicated on Drawings and as follows:

1. Primary Hoops: 6.4-by-100-mm flat bar hoops.
2. Secondary Intermediate Hoops: 6.4-by-50-mm flat bar hoops.
3. Vertical Bars: 4.8-by-38-mm flat bars secured to each hoop.
4. Galvanize ladder safety cages, including brackets and fasteners.
5. Finish ladder safety cages, including brackets and fasteners, as specified in Division 9 Section "Interior Painting" and Division 9 Section "Exterior Painting."

2.10 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize miscellaneous steel trim.

D. Finish miscellaneous steel trim as specified in Division 9, Section "Interior Painting" and Division 9, Section "Exterior Painting."

2.11 ABRASIVE METAL NOSINGS

A. Cast-Metal Units: Cast iron, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.

1. Nosings: Cross-hatched units, (75 mm) wide with (30-mm) lip, for casting into concrete steps.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Apply bituminous paint to concealed surfaces of cast-metal units.

D. Apply clear lacquer to concealed surfaces of extruded units.

2.12 TRENCH COVER

A. Fabricated from 8 mm thick galvanized checkered steel plate with steel angle framing hot dip galvanized. Provide with neoprene sealing strips on underside of cover, stainless steel locking screws and keyholes, removable cover supports and lugs on frame for building in. Provide covers with lifting handles. Framing shall be galvanized steel fabricated.

2.13 SUMP PIT COVER

A. Fabricated from minimum 6.00 mm thick structural steel checkered plate with steel stiffeners and steel angle frame as required to support imposed loads filled with concrete where indicated or needed for complete functional installation. Provide continuous neoprene seals and gaskets and equip with recessed steel lifting handles. Compressive strength of concrete infill shall not be less than 300 kg/cm^2 after 28 days.

B. Steel surfaces shall be galvanized and finished with aliphatic-acrylic polyurethane coating system as specified in Division 9, Section “Interior Painting”.

2.14 SHELF ANGLES

A. Fabricate shelf angles from structural quality stainless steel angles type 304 of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 19-mm bolts, spaced not more than 150 mm from ends and 600 mm o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 50 mm larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.15 METAL BOLLARDS

A. General: Comply with details indicated on Drawings.

B. Fixed Steel Bollards: Fabricate pipe bollards from Schedule 40 steel pipe.

1. Fabricate bollards with 20-mm- thick steel base plates for bolting to concrete slab. Drill base plates at all four corners for 19-mm anchor bolts. Chamfer corners of base plates to details indicated.
2. Finish bollards with Acrylic/Aliphatic-Polyurethane Enamel specified in Division 9 Section "Interior Painting" and Division 9, Section "Exterior Painting."

2.16 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.17 STEEL AND IRON FINISHES

A. Generally:

1. No concealed ferrous metal surface shall be left without priming coat as specified.
2. No exposed ferrous or galvanized steel surface shall be left without decorative colored finish paint system as specified.

B. Galvanizing: For those items indicated for galvanizing, apply zinc coating by the hot-dip process complying with the following requirements:

1. ASTM A 153 for galvanizing iron and steel hardware.
2. ASTM A 123 for galvanizing both fabricated and un-fabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.76 mm thick or thicker.

C. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean metal fabrications of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

D. Shop Priming:

1. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:

a. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Application of Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, under sprayed-on fireproofing where primer will be provided by the sprayed fire proofing applicator, or in masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

a. Stripe paint corners, crevices, bolts, welds, and sharp edges.
b. Minimum Dry Film Thickness is 75 microns, resulting from applying the number of coats recommended by manufacturer.

E. Field-Applied Finishes: Exposed metal fabrications shall receive finish protective colored coating system as specified in Division 9, Section “Interior Painting” and Division 9, Section “Exterior Painting”.

2.18 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Brushed Finish: Use a fine abrasive action on the surface of the stainless steel. It is modified by the action of bristles or a nylon fabric medium that may have some fine abrasive or lubricant included.

C. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Mirrorlike Reflective, Nondirectional Polish: No. 8.

2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

D. Bright, Directional Satin: No. 4 finish.

2.19 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Super Durable Polyester Powder Coating for aluminum alloy components is to be approved type to meet the requirements of AAMA 2604. Coating shall be based on specially-formulated polyester resin of enhanced performance and shall pass Qualicoat class 2 standard and Florida test specified in AAMA 2604 as demonstrated by test certificate available with manufacturer. The coating is to be electrostatically sprayed on the object to produce a hard, durable coating:

1.	Surface Finish:	Satin.
2.	Dry Film Thickness:	90 microns except 60 microns for internal corners.
3.	Color:	As selected by Engineer from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Typical Details.

3.3 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

A. Center nosings on tread widths unless otherwise indicated.

B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

3.4 INSTALLING METAL BOLLARDS

A. Anchor bollards to existing construction with expansion anchors. Provide four 19-mm bolts at each bollard unless otherwise indicated.

1. Embed anchor bolts at least 100 mm in concrete.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 05 52 13 PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and tube railings:

a. Pipe and Tube Railings in Emergency Staircases: Provide railings detailed to fully comply with requirements of NFPA 101.
b. Other applications as indicated on Drawings.
c. All steel pipe and tube railings including, but not limited to, the galvanized railings shall have factory or field applied colored decorative paint system finish as specified in this Section.

2. Stainless-steel pipe and tube railings.
3. Wall-mounted handrails.
4. Guard rails.

B. Related Sections include, but shall not be limited to, the following:

1. Division 9 Section "Interior Painting".
2. Division 9 Section "Exterior Painting".

1.2 PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.
2. Stainless Steel: 60 percent of minimum yield strength.

B. Structural Performance: Railings assembly shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Single concentrated load of 0.89 kN, applied in any direction at any point.
2. Uniform load of 0.73 kN/m applied in any direction.
3. Uniform and concentrated loads need not be assumed to act concurrently.

C. Structural Balustrade Panels shall meet the following requirements:

1. The panels and their support system shall be designed to withstand the loads specified in BS standard or equivalent ASCE (American Society of Civil Engineers).

2. A safety factor of 4 shall be used.
3. Guards are required for any space, walking or standing which is elevated 760mm above the finished grade level.
4. From the finished floor level, Height of the balcony, terrace railings, elevated space railings, shall not be less than 1200mm.
5. Balusters openings, the separation distance between vertical posts or members, of balcony, guardrail or handrail shall not be more than 100 mm.
6. Any opening formed by either vertical posts, curved frames or design features in the balcony or railings shall not be more than 100 mm.
7. Horizontal elements, bars, climbable features shall not be installed between 150mm and 760mm.
8. If the design demands any gap between finished floor surface and the bottom most horizontal component of the railing, such gap shall not be more than 100mm.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Railing system.
2. Railing brackets.
3. Finishing materials.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For products involving selection of color, texture, or design.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

a. Show method of finishing and connecting members at intersections.

E. Qualification Data: For qualified testing agency.

F. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

G. Welding certificates.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to BS standard or equivalent ASTM E 894 and ASTM E 935.

I. Maintenance Data: Include in Project's operation and maintenance manual.

1.4 ENVIRONMENT, HEALTH AND SAFETY (EHS) SUBMITTALS

A. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

1.5 QUALITY ASSURANCE

A. Local Regulations and Codes: Comply with applicable requirements of the laws, codes, and regulations of authorities having jurisdiction.

1. Obtain necessary approvals from authorities having jurisdiction.
2. Comply with ZIMBABWE Fire & Life Safety Code of Practice including Annexures.
3. Comply with ZIMBABWE Civil Defense and the Municipality requirements and circulars.
4. Materials used on the façades shall be non-combustible and tested and approved as per the Civil Defense requirements.

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

1. Erect mockup for each item covered or erected under this Section.
2. Final approval to the manufacturer/fabricator/installer of any item shall be warranted only after approval of the mockup by Engineer.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specially approves such deviations in writing.
4. Approved mockups constructed on locations of Permanent Works may become part of the completed Work if undisturbed at time of Substantial Completion.
5. Demolish and remove mockups when directed unless otherwise indicated.

C. Source Limitations: Obtain each type of railing from single source from single manufacturer.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. BS standard or equivalent AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. BS standard or equivalent AWS D1.6, "Structural Welding Code - Stainless Steel."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.7 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.2 STEEL AND IRON

A. Tubing: BS EN 10210, Grade S355 J2H, having a minimum yield stress of 355 MPa; or equal ASTM A 500 (cold formed) or ASTM A 513.

B. Pipe: BS EN 10210, Grade S355 J2H, having a minimum yield stress of 355 MPa; or equal.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: BS EN 10025, Grade S355, having a minimum yield stress of 355 MPa; or equal.

D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 STAINLESS STEEL

A. Tubing: ASTM A 554, Grade MT 304 for internal applications and Grade MT 316 for external applications.

B. Pipe: ASTM A 312/A 312M, Grade TP 304 for internal applications and Grade TP 316 for external applications.

C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20 for internal applications and Grade CF 8M or CF 3M for external applications.

D. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304 for internal applications and Grade Type 316 for external applications.

E. Bars and Shapes: ASTM A 276, Type 304 for internal applications and Grade Type 316 for external applications.

2.4 FASTENERS

A. General: Provide the following:

1. Hot-Dip Galvanized Railings: Hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
2. Stainless-Steel Components: Type 304 for internal applications and type 316 for external applications stainless-steel fasteners.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
2. Provide square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with BS standard or equivalent ASTM B 633 or ASTM F 1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material Where Stainless Steel Is Indicated: Alloy Group A1 stainless-steel bolts, BS standard or equivalent ASTM F 738M, and nuts, ASTM F 836M.
3. Material for Exterior Locations is Indicated: Alloy Group A4 stainless-steel bolts, BS standard or equivalent (ASTM F 738M), and nuts, (ASTM F 836M).

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to BS standard or equivalent AWS specifications for metal alloy welded.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Shop Primers: Provide primers that comply with Division 9 Section "Interior Painting" for interior railing and Division 9 Section "Exterior Painting" For exterior railing.

D. Intermediate Coats and Topcoats: Acrylic Aliphatic-Polyurethane Enamel that comply with Division 9 Section "Interior Painting" for interior railing and Division 9 Section "Exterior Painting" For exterior railing.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1 mm unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form changes in direction as follows:

1. By bending or by inserting prefabricated elbow fittings.

J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 6 mm or less.

M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

1. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.

a. At brackets and fittings fastened to plaster or gypsum board partitions, provide fillers made from crush-resistant material, or other means to transfer wall loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

N. Toe Boards and Escutcheon Plates: Where indicated, provide toe boards and escutcheon plates at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

O. For railing posts set in concrete, provide steel sleeves not less than 150 mm long with inside dimensions not less than 13 mm greater than outside dimensions of post, with steel plate forming bottom closure.

P. For removable railing posts, fabricate slip-fit sockets from matching-steel-alloy tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

Q. Where railings are indicated to be swinging, furnish all necessary hardware as specified for securing smooth operation and stopping of swinging segments.

2.7 FINISHES, GENERAL

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize steel and iron railings, including hardware, after fabrication.

   a. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
   b. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
   c. Coating: G90 (Z275 g/m^2).

2. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
3. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Items for Shop Priming: After galvanizing, thoroughly clean metal of grease, dirt, oil, flux, and other foreign matter, and treat with approved washing primer recommended for the purpose.

D. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

E. Colored-Painted Finish: Acrylic/Aliphatic-Polyurethane Enamel Complying with Division 9 Section "Interior Painting" For interior railing and Division 9 Section "Exterior Painting" For exterior railing

1. Color: As selected by Engineer from manufacturer's full range.

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

D. Satin, Reflective, Directional Polish: No. 7.

E. Mirrorlike Reflective, Non-directional Polish: No. 8.

F. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 2 mm in 1 m.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 5 mm in 3 m.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 50 mm beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 150 mm of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt or weld to metal supporting surfaces.

3.5 ATTACHING HANDRAILS TO WALLS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

B. Attach handrails to wall with wall brackets. Provide brackets with 38-mm clearance from inside face of handrail and finished wall surface.

C. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
4. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 Section "Interior Painting" For interior railing and Division 9 Section "Exterior Painting" For exterior railing.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

C. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by Engineer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 52 13

SECTION 05 53 00 METAL GRATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Stainless steel grating in ablution areas.
2. Heavy-duty cast iron gratings.
3. Galvanized steel gratings and catwalks.
4. Aluminum catwalk gratings.
5. Metal frames and supports for gratings.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide gratings capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections:

1. Floors: Capable of withstanding a uniform load of 11.97 kN/sq. m or a concentrated load of 13.40 kN, whichever produces the greater stress.
2. Walkways and Elevated Platforms: Uniform load of 4.79 kN/sq. m.
3. Sidewalks and Vehicular Driveways, Subject to Trucking: uniform load of 11.97 kN/sq. m or concentrated load of 35.60 kN, whichever produces the greater stress.
4. Limit deflection to L/360 or 6.4 mm, whichever is less.

1.3 SUBMITTALS

A. Product Data: Detailed descriptions of materials and gratings systems. Show fabrication and installation details for gratings:

1. Clips and anchorage devices for gratings.

B. Shop Drawings: Show fabrication and installation details for gratings. Include plans, elevations, sections, and details of connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Structural Calculations: For installed products indicated to comply with design loads, include structural analysis data signed and sealed by manufacturer.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects/ engineers and employers, and any other information specified or required by Engineer.

1.4 ENVIRONMENT, HEALTH AND SAFETY (EHS) SUBMITTALS

A. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

1.5 QUALITY ASSURANCE

A. Local Regulations and Codes: Comply with applicable requirements of the laws, codes, and regulations of authorities having jurisdiction.

1. Obtain necessary approvals from authorities having jurisdiction.
2. Comply with ZIMBABWE Fire& Life Safety Code of Practice including Annexures

B. Manufacturer Qualifications: A firm experienced in producing gratings similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. Manufacturer shall also be capable of providing engineering services for this project.

1. Engineering services are defined as those performed for installations of gratings that are similar to those indicated for this Project in material, design, and extent.

C. Metal Bar Grating Standards: Comply with applicable requirements of the following:

1. Heavy-Duty Metal Bar Gratings: Comply with NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."

D. Welding: Qualify procedures and personnel according to the following:

1. BS standard or equivalent AWS D1.1, "Structural Welding Code-Steel."
2. BS standard or equivalent AWS D1.6, "Structural Welding Code-Stainless Steel."
3. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
4. Certify that each welder has satisfactorily passed BS standard or equivalent AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

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

1. Erect mockup for each item covered or erected under this Section.
2. Final approval to the manufacturer/fabricator/installer of any item shall be warranted only after approval of the mockup by Engineer.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specially approves such deviations in writing.
4. Approved mockups constructed on locations of Permanent Works may become part of the completed Work if undisturbed at time of Substantial Completion.
5. Demolish and remove mockups when directed unless otherwise indicated.

1.6 PROJECT CONDITIONS

A. Field Measurements: Where gratings are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Typical Details. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating gratings without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.7 COORDINATION

A. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.8 WARRANTY

A. Gratings Warranty: Provide manufacturer’s standard warranty in which Manufacturer agrees to repair or replace without limitations, all or any part of the gratings specified in this section which fails or becomes defective in materials or workmanship within specified warranty period.

1. All gratings are guaranteed to be of good material and workmanship and free from defects that render it unserviceable for the use for which it is intended.
2. Warranty shall also include:

    a. Installation and finishing that may be required due to repair or replacement of defective gratings.

3. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Steel Plates, Shapes, and Bars: BS EN 10025, Grade S355, having a minimum yield stress of 355 MPa; or equal.

B. Wire Rod for Grating Crossbars: BS standard or equivalent ASTM A 510M.

C. Uncoated Steel Sheet: BS standard or equivalent ASTM A 570/A 570M, Grade 33.

D. Galvanized Steel Sheet: BS standard or equivalent ASTM A 653/A 653M, structural quality, Grade 230, with Z275 coating.

E. Cast Iron: Either gray iron, BS standard or equivalent ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

F. Welding Rods and Bare Electrodes: Select according to BS standard or equivalent AWS specifications for metal alloy to be welded.

2.3 STAINLESS STEEL

A. Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 316.

B. Bars and Shapes: ASTM A 276, Type 316.

2.4 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer for type of use indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Shapes: ASTM B 221M, alloys as follows:

1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
2. 6061-T1, for grating crossbars.

2.5 FASTENERS

A. General: Provide Type 316 stainless-steel fasteners for stainless steel gratings and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5 for galvanized steel gratings.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, BS EN 14399 or equivalent ASTM F 568M, Property Class 4.6; with hex nuts, BS 4190 or equivalent ASTM A 563M; and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 738M for bolts and ASTM F 836M for nuts, Alloy Group 2 (A4).

D. Anchor Bolts: BS 4190 or equivalent ASTM F 1554, Grade 36, of dimensions indicated; with nuts, BS 4190 or equivalent ASTM A 563M, and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Plain Washers: Round, carbon steel, BS standard or equivalent ASME B18.22M.

F. Lock Washers: Helical, spring type, carbon steel, BS standard or equivalent ASME B18.21.2M.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Alloy Group 2 stainless-steel bolts complying with ASTM F 738M and nuts complying with ASTM F 836M.

2.6 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

C. Shear and punch metals cleanly and accurately. Remove burrs.

D. Ease exposed edges to a radius of approximately 1 mm, unless otherwise indicated.

E. Fit exposed connections accurately together to form hairline joints.

F. Welding: Comply with BS standard or equivalent AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

G. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop, unless otherwise indicated.
2. Toeplate Height: 100 mm, unless otherwise indicated.

2.7 METAL BAR GRATINGS AND CATWALKS

A. Heavy duty gratings manufactured from stainless steel grade 316 or galvanized steel as indicated on Drawings for each application area. Bearing bars and cross bars are to be of rectangular section with size and spacing as per manufacturer's written recommendation for the span and type of loading indicated. Cross bars are to be locked at right angles to and in the same plane as, the top surface of bearing bars. Properties shall be as follows:

1. Grating Mark: As indicated, but with bearing bar size not less than that required complying with structural performance requirements.
2. Type: Pressure locked.
3. Traffic Surface for Bar Gratings: Plain.
4. Cut Outs: Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
5. Fabricate removable grating sections with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports:

    a. Provide not less than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
    b. Furnish threaded bolts with nuts and washers for securing grating to supports.

2.8 ALUMINUM CATWALK GRATINGS

A. Heavy-duty gratings manufactured from aluminum alloy 6063 to ASTM B 221 temper T6 for bearing bars. Bearing bars and cross bars are to be of rectangular section with size and spacing as per manufacturer's written recommendation for the span and type of loading indicated on the Drawings and complying with performance requirements specified in this Section. Cross bars are to be locked at right angles to and in the same plane as, the top surface of bearing bars. Properties shall be as follows:

1. Grating Mark: As indicated, but with bearing bar size not less than that required complying with structural performance requirements.
2. Type: Welded.
3. Traffic Surface for Aluminum Bar Gratings: Plain.
4. Aluminum Finish: Applied abrasive finish.
5. Cut outs: Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

    a. Edge band openings in grating that interrupt 4 or more bearing bars with bars of same size and material as bearing bars.
    b. Do not notch bearing bars at supports to maintain elevation.

6. Fixation: Fix aluminum grating directly to under laying structural steel framing to details indicated on Drawings and approved shop drawings. Do not fix to cladding or other finishes.

2.9 CAST IRON GRATING

A. Ductile Cast Iron Grating: Heavy-duty gratings non-rock type, manufactured from ductile cast iron to BS standard or equivalent ASTM A 536, grade 80-55-06 for heavy duty. All castings shall be free from blow holes, shrinkage defects, swells, cracks and other defects. Heavy duty gratings are to be capable of supporting axle loads specified under Article “Performance Requirements” in this Section.

2.10 GRATING FRAMES AND SUPPORTS

A. Steel Frames and Supports: Fabricate from structural-steel shapes, plates, and bars of welded construction or cast iron to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Galvanize frames and supports for all exterior and interior applications of steel frames.

B. Stainless Steel Frames and Supports: Provide Type 316 stainless steel frames with stainless steel grating. Provide frames of welded stainless steel lugs for building in adjoining concrete.

C. Aluminum Frames and Supports: Provide structural extruded aluminum profiles and Sections. Provide factory opened for fixing and attaching to mounting surfaces.

D. Equip units with integrally welded anchors for casting into concrete or building into masonry.

1. Unless otherwise indicated, space anchors 900 mm o.c. and provide minimum anchor units in the form of steel straps 32 mm wide by 6 mm thick by 200 mm long.

2.11 FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Stainless-Steel Finish: Mill finish, as fabricated.

C. Aluminum Finishes:

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating but 0.025 mm or thicker) complying with AAMA 611.

D. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Fitting and Placement: Perform drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Gratings: Install grating in accordance with requirements of BS standard or equivalent ANSI/NAAMM MBG Technical Literature including installation clearances and standard anchoring details. Weld gratings to supporting steel, except for sections which are hinged or required to be removable. Secure removable units to supporting members with type and size of clips and fasteners as recommended by grating manufacturer for type of installation conditions shown. Do not notch bearing bars at supports to maintain elevation. Secure toe plates to gratings by welding.

3.2 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach non-removable units to supporting members by welding where both materials are the same; otherwise, fasten by bolting as indicated above.

3.3 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 53 00

DIVISION 07 THERMAL AND MOISTURE PROTECTION

SECTION 07 4100 ROOF PANELS

SECTION 07 4200 WALLPANELS

PART 1 - SUMMARY

A. This Section includes pre-fabricated factory-finished metal composite non-insulating panels used as external cladding system in building elevations or as interior finish systems. Applications include, but shall not be limited to:

1. Roof and Wall are made of sandwich panels that are ready fabricated of two Galvanized-Steel Sheets with polyurethane infill layer in between. The galvanized-steel sheet is of 0.5 mm thickness as per ASTM A653, G60 Z180 zinc coating or approved equal. The polyurethane layer thickness and density (not less than 40 kg/m3) should be calculated and submitted by the supplier / contractor to satisfy the required UV of each building.

2. Translucent Polycarbonate sheet thickness should be submitted by the supplier / contractor to satisfy the required UV of each building. Polycarbonate sheet to maintain the same corrugation and thermal conductivity properties as of the attached Sandwich Panel cladding.

3. Panel cladding to soffits.

B. Related Sections includes, but shall not be limited to, the following:

1. Division 3 Section "Cast-in-place Concrete" for properties of reinforced concrete elements that will receive fasteners of the aluminum composite panel assemblies.
2. Division 4 Section "Unit Masonry" for properties of concrete masonry units that will receive fasteners of the aluminum composite panel assemblies.
3. Division 5 Section "Structural Steel Framing" for any structural steel framing to be finished with aluminum composite panels.
4. Division 5 Section "Metal Fabrications" for any steel or aluminum supporting sub-framing used to construct formations to be cladded with aluminum composite panels and for any furring or supporting metal item auxiliary component.
5. Division 7 Section "Cold Fluid-Applied Waterproofing" for vapor barrier back to cladding panels and thermal insulation where panels are installed to masonry or concrete substrates.
6. Division 7 Section "Thermal Insulation" for insulation back to cladding panels.
7. Division 7 Section "Joint Sealants".

1.2 PERFORMANCE REQUIREMENTS

A. General: Design cladding system to satisfy performance requirements specified in this Article.

B. Structural Performance: Provide metal panel cladding system capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Wind Loads: Determine loads based on the following minimum design wind pressures:

   a. Wind Loads: UBC 1997.

2. Equipment Loads: Allow for loads due to cleaning and maintenance equipment.
3. Seismic Loads: UBC 1997.

C. Thermal Movements: Provide metal panel cladding system that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing displacement of stone, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): ± 30 deg C, ambient; 100 deg C, material surfaces.

D. Fire Retardant Core (FR): Noncombustible; shall have a Class “A” building material rating when tested in accordance with ASTM E84 (Steiner Tunnel Test) as specified in this Section.

E. Cladding to External Soffits: Detail system to withstand uplift forces resulting from the wind speed specified here before with a minimum factor of safety of 2.

1.3 SUBMITTALS

A. Product Data: Include manufacturer's product specifications, standard details, and general recommendations, as applicable to materials and finishes for each component and for total panel assemblies.

B. Product Test Reports: To demonstrate physical and performance properties of metal panels as included in submitted data sheets.

C. Shop Drawings: Show layout and arrangement of panels for each building elevation or cladded area, details of corner conditions, joints, panel profiles, supports, anchorages, trim, flashings, closures and relations with adjoining materials, and special details. Include special shop drawings for each application.

1. Include structural calculations to demonstrate compliance of each panel application design with specified performances.

D. Samples for Initial Selection: Manufacturer's color charts or chips showing the full range of colors, textures, and patterns available for panels.

E. Samples for Verification: Provide sample panels 300 mm long by actual panel width, in the profile, style, color, and texture indicated. Include clips, caps, battens, fasteners, closures, and other panel accessories.

F. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Engineers, owners and Employers, and other information specified.

G. Product Certificates: For each type of metal cladding panels specified, signed by product manufacturer and attesting that proposed panels comply with specifications requirements.

H. Research/Evaluation Reports: For specified panel type.

I. Cleaning and maintenance data for inclusion in Project's Operation and Maintenance Manual.

1.4 QUALITY ASSURANCE

A. Source Limitations for Metal Panels: Obtain composite non-insulating metal cladding panels, including related accessories, through one source from a single manufacturer.

1. Obtain panels for cladding for each building from single production patch.

B. Installer Qualifications: Engage an experienced installer who is approved in writing by manufacturer of panels and who has completed metal wall panel projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

C. Mockups: Before installing wall panels, construct mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using concealed materials indicated for the completed Work.

1. Locate mockups in the location and of the size, as directed by Engineer.
2. Mockup shall include different modes of installation indicated on Drawings (wall cladding, soffit, fascia, column covers) and shall not be less than 6 x 3 m.
3. Notify Engineer 7 days in advance of the dates and times when mockups will be constructed.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Engineer's approval of mockups before proceeding with construction of cladding panels.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

D. Preinstallation Conference:

1. Coordinate installation with window cleaning system, flashings and other adjoining construction to ensure proper sequencing.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver panels and other components so they will not be damaged or deformed. Package panels for protection against damage during transportation or handling.

B. Handling: Exercise care in unloading, storing, and erecting wall panels to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weather tight and ventilated covering. Store panels to ensure dryness. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal composite material panels during installation.

1.6 COORDINATION

A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leak-proof, secure, and noncorrosive installation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify location of structural members and openings in substrates by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish opening dimensions and proceed with fabricating panels without field measurements or allow for trimming panel units. Coordinate construction to ensure actual locations of structural members and to ensure opening dimensions correspond to established dimensions.

B. Weather Limitations: Proceed with panels installation to concrete or masonry substrates only after completion of applying pitch modified polyurethane waterproofing specified in Division 7, Section "Cold Fluid-Applied Waterproofing" and only if substrate is completely dry and if existing and forecasted weather conditions permit cladding to be installed according to manufacturer's written instructions.

1.8 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive the Employer of other rights the Employer may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Panel Warranty: Submit a written warranty, signed by manufacturer, covering failure of aluminum composite panels within the specified warranty period and agreeing to repair or replace panels that fail in material (except finish that has special warranty below) or workmanship.

1. Failures include, but are not limited to, the following:

a. Structural failures, including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Special Panel Warranty Period: Two years from date of Substantial Completion.

C. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on aluminum composite panels within the specified warranty period and agreeing to repair finish or replace wall panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering metal panels that may be incorporated into the Work include, but are not limited to, the following:

1. Alcan Composites.

a. Ref: Alucobond.

2. Mitsubishi.

a. Ref: Aloplic$^{(FR)}$.

3. Alcoa Inc.

a. Ref: Reynobond.

2.2 METALS AND METAL FINISHES

A. Aluminum Sheet Prepainted with Coil Coating: Aluminum sheet complying with ASTM B 209 (ASTM B 209M) for alclad alloy 3105-H14, 3003 or 3004 or 3005 with temper as required to suit forming operations, prepainted by the coil-coating process and complying with the following requirements:

1. Sheet Surface before Coating: Smooth, flat, mill finish.
2. Alternative alloys include 1100; alclad 3003, 3004, 3005, 3105, 5005, and 5050; in A14, H14, H22, H24, H32, or H34 temper.
3. Modulus of Elasticity E: 70,000 N/mm^2.
4. Coil Coating System: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions:

    a. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

        1) Humidity Resistance: 2000 hours.
        2) Salt-Spray Resistance: 2000 hours.
        3) Color: If not indicated on Drawings, as selected by Engineer from manufacturer’s full range.

2.3 ALUMINUM CLADDING PANELS

A. General: Pre-fabricated, pre-finished panels consisting of mineral core laminated in between two 0.50 mm thick aluminum skins in continuous co-extrusion process.

B. Core Material: Non-combustible, anti-toxic rigid mineral core.

C. Physical Properties: Comply with the following:

1. Total thickness: 6.00 mm.

    a. For exterior panels, provide back stiffeners where size of used panel exceeds limits recommended by manufacturer based on wind loads specified in this Section so as finished assemblies are free from denting or any sign of imperfections.

2. Weight: 10.9 kg/m^2 for 6.00 mm thick panels and 7.50 kg/m^2 for 4.00 mm thick panels to ASTM D 792.
3. Dimensions: As indicated on Drawings or shop drawings approved by Engineer.
4. Maximum Tolerances:

a. Width: ±2.0 mm.
b. Length: ±4.0 mm.
c. Thickness: ± 0.2 mm.
d. Bow: Maximum 5% of the length and/or width.
e. Squarness: Maximum 2.0 mm.
f. Surface Defects: The surface shall not have any irregularities such as roughness, buckling and other visual imperfections.

5. Individual panel width shall not exceed 1000 mm between joints. Long dimensions shall be as per building elevations design Drawings.

D. Mechanical Properties Of Aluminum Alloy (3105-H14):

1. 0.2% proof stress (ASTM E8): 152 MPa.
2. Flexural elasticity (ASTM E8): 70 kN/mm^2

E. Performance: Properties: Comply with the following:

1.	Tensile Strength:29 MpaASTM E 8, min.			
2.	0.2% proof stress 26 MpaASTM E 8			
3.	Elongation:2% ASTM E 8, max.			
4.	Flexural elasticity E29.1 kN/mm^2		ASTM C 393	
5.	Flexural rigidity, E×I	347kNmm^2/mm	ASTM C 393	
6.	Formability (T-bend)	2T, no cracking	ASTM D1737-62	
7.	Reverse impact-crosshatch	No pick off	NCCA 11-5	
8.	Hardness-pencil	H	ASTM D 3363-92a	
9.	Adhesion (Dry)	No pick off	ASTMD3359, method 8	
10.	Abrasive resistance	40 liters/mil	ASTM D968-93	
11.	Chemical resistance, Mortar, pat test, 24hrs	No change	AAMA	
12.	Deflection Temperature:	109 °C	ASTM D 648	
13.	Coefficient of Linear Thermal Expansion:	24×10-6 / °C		
14.	STC (Standard Transmission Class)	26	ASTM E 413	
15.	British Thermal Unit	Passed	NFPA 259-93	
16.	Climbing Drum Peel Test	Passed	ASTM D1781-76	
17.	Steiner Tunnel Test	Class A / Class 1	ASTM E84	
18.	ASTM E-108, Modified	Passed	ISMA Test	
		Passed	UBC 26-9 & NFPA 285	
19.	Gloss (60°)	15 to 80%	ASTM D523-89	
20.	Weather-o-meter test			
	a. Color retention: Maximum 5 units after 4000 hrs		ASTM D2244-93	
	b. Gloss retention: 70% after 4000 hrs		ASTM D523-89	
	c. Chalk resistance: Maximum 8 units after 4000 hrs		ASTM D4214-89	
21.	Salt spray resistance: Blister-10, scribe-8, after 3000 hrs, 35 °C salt fog, ASTM B117-90			

22. Humidity-thermal: No blister, no cracking After 15 cycles of 38 ºC 100%RH for 24hrs and -23 ºC for 20hrs, ASTM D2246-87
23. Humidity resistance: No change After 3000 hrs, 100%RH, 35°C, ASTM D2247-94

F. Panels Finish:

1. Panel's Face Finish (Exposed to View): 3-coat PVDF coil coating system as specified.
2. Panel's Back Finish (Concealed from view at Backup Wall Side): Chromate treated and epoxy resin primer or 13-micron thick polyester powder coating.
3. Reverse Face of Sheets Used in Manufacture of Panels: Manufacturer's standard treatment.

G. Installation Mode: Cavity depth from back of panels to face of cladded vertical surfaces is to be to the details indicated on Drawings and to the manufacturer's recommendations, but not more than 70 mm if not indicated on Drawings.

H. Panels shall have protection film at least on exposed PVDF-coated surfaces. Protection film shall be type that cause no harm to PVDF coating upon removal.

2.4 MISCELLANEOUS MATERIALS

A. Panel Supports and Anchorage: Provide furring channels, angles, plates, bracing, and other manufacturer's standard anchorage and fixation system manufactured from aluminum.

1. Finish: Manufacturer's standard polyester finish in color approved by Engineer.
2. Where supporting furring or members will be shown in finished work, finish the exposed surface with the same finish as the exposed surfaces of the panels.

B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.

1. Use zinc-plated, predrilled, expansion or chemical type steel anchors for fixing supporting angles or brackets to backing walls and aluminum or stainless-steel fasteners for fixing aluminum composite panels to supporting framing.

C. Metal Sheet Accessories:

1. Provide components required for a complete cladding system including copings, fasciae, sills, corner units, clips, flashings, and similar items formed from aluminum sheets and of matching finishes as aluminum cladding panels specified in this Section on exposed and back surfaces. Minimum thickness is to be 1.50 mm. Comply with applicable requirements in Division 7, Section "Sheet Metal Flashing and Trim" for workmanship.
2. Trims: Where indicated, provide manufacturer's profiles.

D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

E. Joint Sealant: One-part MS, or silicone-rubber colored sealants. Comply with requirements of Division 7, Section "Joint Sealants".

F. Gaskets and Fillers: EPDM, weather resistant types as standard with manufacturers.

G. Backer Rods: Type compatible with sealant as Division 7, Section "Joint Sealants".

2.5 STRUCTURAL STEEL FRAMING

A. Comply with details indicated on Drawings where indicated to support soffits or cladding erected with aluminum composite panels.

B. Comply with requirements specified in Division 5, Section "Structural Steel Framing" or in Division 5, Section "Metal Fabrications".

C. Minimum Factor of safety for design is to be 2.

D. Finish as specified in Division 5, Section “Metal Fabrications”.

2.6 FABRICATION

A. General: Fabricate and finish panels, cladding, fascia, soffits and column covers components at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill architectural design indicated on Drawings.

1. Fabricate panels to be fixed to furring profiles in snap-on detail. Comply with details indicated on the shop drawings approved by Engineer.

B. Comply with indicated profiles and with dimensional and structural requirements.

C. Stiffeners at Back of Panels: Fabricate panels with panel stiffeners, as required to comply with deflection limits.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of panel cladding. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Ensure that pitch modified polyurethane waterproofing has fully cured.

3.2 PANEL INSTALLATION

A. General: Comply with panel manufacturer's written instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.

B. Field cutting of panels by torch is not permitted.

C. Install panels with concealed fastening system. Install panels in the direction indicated by manufacturer on the protective film. Install panels in the sequence provided by manufacturer.

D. Accessories: Install components required for a complete cladding assembly including trim, copings, fasciae, corner units, clips, flashings, sealants, and similar items.

E. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants".

F. Vertical Cladding: Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as necessary for waterproofing. Handle and apply sealant and back-up according to sealant manufacturer's written instructions.

G. Expansion Joints: Do not bridge expansion joints with metal cladding panels. Provide expansion joints in metal panel cladding where they occur in cladded substrates. Provide manufacturer standard concealed brackets for fixing at expansion joints.

H. Curved Cladding: Comply with details indicated on Drawings.

I. Do not allow direct contact between ferrous metal or cementitious construction and aluminum. Provide separation tapes recommended for the purpose and approved by Engineer.

J. Finished work shall be:

1. Neat,
2. To the panel indicated on Drawings, or approved shop drawings.
3. Level,
4. To approved curvatures and radii,
5. Plumb,
6. Without any dents, dimples or depressions,
7. Firm and reboust,
8. To lines,
9. Of matching joint width,
10. Of uniform joint,
11. Smooth without (lipping line difference between adjoining panels)
12. Of tight corners and joints, and
13. Of uniform lines.

3.3 CLEANING AND PROTECTING

A. Damaged Units: Replace panels and other components of the Work that have been damaged, that have dents, dimples or depressions due to wind pressure or installation work or that have been deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

B. Cleaning: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.

END OF SECTION 074100

END OF SECTION 074200

SECTION 07 62 00 SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sheet metal flashing and trim:

1. Formed wall flashing and trim.
2. Pipe penetration flashing.
3. Copings.
4. Settlement/ expansion flashing on roof.

B. Related Sections include, but shall not be limited to, the following:

1. Division 3 Section "Cast-in-Place Concrete" for installing reglets.
2. Division 6 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
3. Division 7 Section "Atactic-Polypropylene (APP) Modified Bituminous Membrane Roofing".
4. Division 7 Section "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Fabricate and install roof edge flashing capable of resisting uplift pressures calculated according to Wind loads as per UBC 1997.

1. Provide roof edge flashing that is demonstrated by structural calculation to resist uplift pressures calculated according to ASCE/SEI7 for corner uplift pressure, perimeter uplift pressure and field-of-roof uplift pressure based on wind speed specified before.

C. Metal flashing installed to maintain and cover roofing membrane on upstands and other vertical surfaces shall be detailed to be watertight and shed water away from membrane top edge.

D. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): ± 25 deg C, ambient; 100 deg C, material surfaces.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 300 mm long. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim: 300 mm long. Include fasteners and other exposed accessories.
3. Accessories: Full-size sample.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weather tight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.6 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leak-proof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. Aluminum Sheet: ASTM B 209M, Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14, finished as follows:

1. Concealed Back Side:

a. Mill Finish.

2. Exposed Front Side:

a. Super Durable Powder Coating finish:

1) Comply with requirements in Division 8, Sections where the coating is specified.
2) Color is to be selected by Engineer.

2.2 UNDERLAYMENT MATERIALS

A. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Fasteners to be stainless steel or Aluminum screws with pre drilled expansion type, hard nylon wall plugs at 500mm intervals.

C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

D. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 0.4-mm dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 FABRICATION, GENERAL

A. General: Custom fabricates sheet metal flashing and trim to comply with details indicated on Drawings. Shops fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

D. Expansion Provisions: Where lapped or bayonet-type expansion provisions.

E. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Fabricate sheet metal flashing and trim to form the shapes and dimension shown on Drawings and shop drawings approved by Engineer as necessary to close and seal the external facades and other applications shown on Drawings.

1. Material: Aluminum sheet, 0.90 mm thick.
2. Finish: Super Durable Powder Coating finish.
3. Color: As selected by Engineer from manufacturer's full range.

B. Roof-Penetration Flashing: Fabricate from the following material:

1. Aluminum: 0.8 mm thick.

C. Settlement/ Expansion Flashing on Roof: Not less than 1.00 mm thick aluminum flashing as specified in this Section formed to details indicated on Drawings, fixed from one side only and installed as specified in this Section and as indicated on Drawings.

2.6 COPINGS

A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 3.6 m, concealed anchorage; corner units, end cap units, and concealed splice plates with same finish as coping caps.

1. Coping-Cap Material: Formed aluminum, thickness as required to meet performance requirements.

a. Finish: Super Durable Powder coating finish.
b. Color: As selected by Engineer from manufacturer's full range.

2. Face Leg Cleats: Concealed, continuous galvanized-steel sheet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

1. Coat side of uncoated aluminum sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.

3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and butyl sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Space cleats not more than 300 mm apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 3 m with no joints allowed within 600 mm of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 25 mm deep, filled with butyl sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 32 mm for nails and not less than 19 mm for wood screws.

1. Aluminum: Use aluminum or stainless-steel fasteners.

H. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

C. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

SECTION 078100

APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes Sprayed Fire-Resistive Materials (SFRM). Applications include, but are not limited to the following:

1. Corrosion resistant protection priming coat that shall be applied to structural steel surfaces prior to application of the sprayed fire resistive material.
2. Fire resistance protection to any steel surfaces that are protected above or behind other finish work assemblies similar to furred ceilings, suspended ceilings, and partitions or lining.
3. Other applications as indicated on Drawings where the fire protection material will be concealed.
4. Topcoats or sealers.

B. Related Sections include, but shall not be limited to, the following:

1. Division 5 Section "Structural Steel Framing" for surface conditions required for structural steel receiving sprayed fire-resistive materials.
2. Division 9 Sections for Painting for interior and exterior acrylic paints.

1.3 PERFORMANCE REQUIREMENTS

A. Fire-resistive requirements for building systems and components shall be as shown in Fire Zoning Drawings and Fire Report.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include in product data the third part test reports and the loading tables that indicate the thickness of SFRM for each structural steel element, for each structural steel profile and for each case of exposure to fire.

B. Shop Drawings: Structural framing plans indicating the following:

1. Locations and types of surface preparations required before applying sprayed fire-resistive material.
2. Extent of sprayed fire-resistive material for each construction and fire-resistance rating, including the following:

a. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.
c. Designation of restrained and unrestrained conditions based on definitions in ASTM E 119, Appendix X3.

3. Treatment of sprayed fire-resistive material after application.

C. Product Certificates: For each type of sprayed fire-resistive material, signed by product manufacturer.

D. Qualification Data: For Installer, manufacturer and testing agency. Include list of completed projects with project names, addresses, names of Engineers and Employers, and other information specified.

E. Compatibility and Adhesion Test Reports: From sprayed fire-resistive material manufacturer indicating the following:

1. Materials have been tested for bond with substrates.
2. Materials have been verified by sprayed fire-resistive material manufacturer to be compatible with substrate primers and coatings.
3. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. Field quality-control test reports.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for proposed sprayed fire-resistive materials.

H. Research/Evaluation Reports: For sprayed fire-resistive materials.

I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Local Regulations and Codes: Comply with applicable requirements of the laws, codes, and regulations of authorities having jurisdiction.

1. Obtain necessary approvals from authorities having jurisdiction.
2. Comply with ZIMBABWE Fire & Life Safety Code of Practice including Annexures.
3. Comply with ZIMBABWE Civil Defense and the Municipality requirements and circulars.

B. Provide sprayed fire-resistive material system that is produced by a manufacturer accredited by Civil Defense in ZIMBABWE or by a manufacturer who has his system tested by UL or other independent testing and inspection agency acceptable to authorities having jurisdiction.

C. Source Limitations: Obtain sprayed fire-resistive material throughout the project or throughout each building in the project through one source from a single manufacturer.

D. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

1. Installer shall have valid authorization from authorities having jurisdiction in ZIMBABWE.
2. The Installer's responsibilities include providing engineering services needed to assume engineering responsibility for designation of restrained and unrestrained conditions.

E. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

F. Sprayed Fire-Resistive Materials Testing: By a qualified testing and inspecting agency engaged by the Contractor or manufacturer to test for compliance with specified requirements for performance and test methods.

1. Sprayed fire-resistive materials are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Testing is performed on specimens of sprayed fire-resistive materials that comply with laboratory testing requirements specified in Part 2 and are otherwise identical to installed fire-resistive materials, including application of accelerant, sealers, topcoats, tamping, troweling, rolling, and water overspray, if any of these are used in final application.
3. Testing is performed on specimens whose application the independent testing and inspecting agency witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.

G. Compatibility and Adhesion Testing: Engage a qualified testing and inspecting agency to test for compliance with requirements for specified performance and test methods.

1. Test for bond per ASTM E 736 and requirements in UL's "Fire Resistance Directory" for coating materials. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
2. Verify that manufacturer, through its own laboratory testing or field experience, has not found primers or coatings to be incompatible with sprayed fire-resistive material.

H. Fire-Test-Response Characteristics: Provide sprayed fire-resistive material with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify bags containing sprayed fire-resistive material with appropriate imprinted markings of applicable testing and inspecting agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency acceptable to authorities having jurisdiction, for sprayed fire-resistive material serving as direct-applied protection tested per ASTM E 119.
2. Surface-Burning Characteristics: ASTM E 84.

I. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

J. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate qualities of materials and execution and set quality standard measures for fabrication, installation and field quality control testing.

1. Locations of Mockups: To be agreed with Engineer.
2. Extent of Mockups: Approximately 9 sq. m of surface for each product indicated.
3. Approved mockups erected at locations of permanent works may become part of the completed Work if undisturbed at time of Substantial Completion.

K. Field Quality Control Testing Agency Pre-qualifications: The following pre-qualifications documents are still need to be included in the submittal for qualifying testing agency:

1. Legal constitution of the company and names of owners.
2. Approvals, licenses, accreditations by authorities in ZIMBABWE.
3. Qualifications of company according to ASTM E 699 “Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components”.
4. Copy of the valid ISO certification.
5. Copy of company manual and procedures.
6. Financial documents of the company including tax card number.
7. List of equipment that will be employed in the project and their catalogues.
8. Detailed list of activities and tests that will be conducted by the submitted testing third-party testing agency including the samples of test reports that will be produced in the project.

L. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to sprayed fire-resistive materials including, but not limited to, the following:

1. Coordinate the work of SFRM with the work of other trades.
2. Review products, exposure conditions, design ratings, restrained and unrestrained conditions, calculations, densities, thicknesses, bond strengths, and other performance requirements.
3. Review and finalize construction schedule and verify sequencing and coordination requirements.
4. Review weather predictions, ambient conditions, and proposed temporary protections for sprayed fire-resistive materials during and after installation.
5. Review surface conditions and preparations.
6. Review field quality-control testing procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life if applicable, and fire-resistance ratings applicable to Project.

B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.

C. Store materials inside, under cover, aboveground, and kept dry until ready for use. Remove from Project site and discard wet or deteriorated materials.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply sprayed fire-resistive material when ambient or substrate temperature is 4.4 deg. C (40 deg. F) or lower unless temporary protection and heat is provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of sprayed fire-resistive material. Use natural means or, if they are inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.8 COORDINATION

A. Sequence and coordinate application of sprayed fire-resistive materials with other related work specified in other Sections to comply with the following requirements:

1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
2. Provide temporary enclosures for applications to prevent deterioration of fire-resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
3. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
4. Do not apply fire-resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.
5. Do not apply fire-resistive material to metal floor deck substrates until concrete topping has been completed.
6. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
7. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.
8. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.9 WARRANTY

A. General: The warranty specified in this Article shall not deprive the Employer of other rights the Employer may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty for SFRM Fire Protection Performance: Manufacturer's standard form, signed by the Contractor and by the Installer, in which manufacturer agrees to repair or replace sprayed fire-resistive materials that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of sprayed fire-resistive materials from substrates.
2. Not covered under the warranty are failures due to damage by occupants and Employer's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.
3. Warranty Period: Ten years from date of Substantial Completion.

C. Special Warranty for Sprayed Fire-Resistive Materials Corrosion Protection Performance: Manufacturer's standard form signed by the Contractor and by the Installer, in which manufacturer agrees to repair or replace steel priming protection coat that fail to provide corrosion protection to structural steel of 20 years to first maintenance.

PART 2 - PRODUCTS

2.1 SPRAYED FIRE RESISTIVE SYSTEM

A. Comply with the following:

1. Surface preparation as specified in Division 5, Section “Structural Steel Framing”.
2. Epoxy-zinc-rich primer in number and thickness of coats to satisfy the warranty period to first maintenance as specified.
3. Adhesive for bonding fire-resistive material certified as compatible with the applied primer.
4. SFRM in thickness required to obtain the indicated fire resistance rating for each structural steel section based on the ratio Hp/A of the section and the loading tables (coating thickness tables) certified by the third party testing agency which accredited the fire rating of the SFRM product.
5. Two sealer coats where the SFRM is used within a ceiling air plenum.
6. Two acrylic coats where the SFRM is used within a ceiling maintenance plenum or shown on Drawings.

    a. Color: As selected by Engineer.

B. Features:

1. Cementitious, durable, remains in place during construction and beyond.
2. Film build-on all surfaces including columns, beams and decks.
3. Applicator friendly, high film build, no alum required for increased coverage and easy clean-up.
4. Asbestos-free, complies with EPA and OSHA regulations.
5. Mineral-wool free, no airborne fibers.
6. Alum and chloride free, no special priming required.
7. Styrene free, no toxic decomposition gasses.
8. Multiple UL designs, provides for design flexibility with over 40 UL designs.
9. Quality Manufactured, under strict quality standards.
10. UL inspection service, consistent quality in every bag.
11. Ready to use, no site additives required.

2.2 CONCEALED SFRM

A. Material Composition: Manufacturer's standard product, as follows:

1. Cementitious sprayed fire-resistive material consisting of factory-mixed, dry formulation of Portland cement binders and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.

B. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:

1. Dry Density: 250 kg/cu. m for average and individual densities regardless of density indicated in referenced fire-resistance design, or greater if required to attain fire-resistance ratings indicated, as per ASTM E 605.
2. Thickness: Provide minimum average thickness required for fire-resistance design indicated according to the following criteria, but not less than 9 mm, per ASTM E 605:

    a. Where the referenced fire-resistance design lists a thickness of 25 mm or greater, the minimum allowable individual thickness of sprayed fire-resistive material is the design thickness minus 6 mm.
    b. Where the referenced fire-resistance design lists a thickness of less than 25 mm but more than 9 mm, the minimum allowable individual thickness of sprayed fire-resistive material is the greater of 9 mm or 75 percent of the design thickness.
    c. No reduction in average thickness is permitted for those fire-resistance designs whose fire-resistance ratings were established at densities of less than 250 kg/cu. m.

3. Bond Strength: 24.66 kPa minimum per ASTM E 736 under the following conditions:

    a. Field test sprayed fire-resistive material that is applied to flanges of wide-flange, structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.
    b. If surfaces of structural steel receiving sprayed fire-resistive material are primed or otherwise painted for coating materials, perform series of bond tests specified in UL's "Fire Resistance Directory." Provide bond strength indicated in referenced UL fire-resistance criteria, but not less than 24.66 kPa minimum per ASTM E 736.
    c. Minimum thickness of sprayed fire-resistive material tested in laboratory shall be 19 mm.

4. Compressive Strength: 288.2 kPa as determined in the laboratory, per ASTM E 761. Minimum thickness of sprayed fire-resistive material tested shall be 19 mm and minimum dry density shall be as specified, but not less than 250 kg/cu. m.
5. Corrosion Resistance: No evidence of corrosion (0.00 gm/mm²) per ASTM E 937.
6. Deflection: No cracking, spalling, or delamination, per ASTM E 759.
7. Effect of Impact on Bonding: No cracking, spalling, or delamination, per ASTM E 760.
8. Air Erosion: Maximum weight loss of 0.000 g/sq. m in 24 hours, per ASTM E 859. For laboratory tests, minimum thickness of sprayed fire-resistive material is 19 mm, maximum dry density is 250 kg/cu. m, test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.
9. Fungi Resistance: Passes per ASTM G 21 and ASTM D 3273.
10. Insulation "K" Factor: 0.73 (BTU in/hr ft²-F at 75°F) per ASTM C 177.
11. Shrinkage: < 0.5%.
12. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products, per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

    a. Flame-Spread Index: 10 or less.
    b. Smoke-Developed Index: 0.

13. Fungal Resistance: No observed growth on specimens, per ASTM G 21.

2.3 FIELD APPLIED FINISH

A. Sealer for Sprayed-Fiber Fire-Resistive Material: Transparent-drying, water-dispersible protective coating recommended in writing by manufacturer of sprayed-fiber fire-resistive material.

B. Acrylic Top Coats: Finish surfaces coated with sprayed fire-resistive materials with acrylic paints.

2.4 AUXILIARY FIRE-RESISTIVE MATERIALS

A. General: Provide auxiliary fire-resistive materials that are compatible with sprayed fire-resistive materials and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Primer shall be warranted by manufacturer as providing corrosion protection to first maintenance of not less than 20 years.

C. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of sprayed fire-resistive material.

D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistance designs indicated and fire-resistive material manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.

E. Reinforcing Fabric: Glass-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated, approved by manufacturer of fire-resistive material.

F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance designs indicated, approved by manufacturer of fire-resistive material. Include pins and attachment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of work. A substrate is in satisfactory condition if it complies with the following:

1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
2. Substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.
5. Manufacturer’s recommendations as included in his written technical literature and approved method statement.

B. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of oil, rolling compounds, and other substances capable of interfering with bond.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application.

B. Clean substrates of substances that could impair bond of fire-resistive material, including dirt, oil, grease, release agents, rolling compounds, loose mill scale, and incompatible primers, paints, and encapsulants.

C. Prior to applying primer the steel surfaces shall be blast cleaned to Swedish Standard SA 3 (ISO 8501-1) or SSPC-SP6.

D. Prime substrates where recommended in writing by sprayed fire-resistive material manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive sprayed fire-resistive material.

E. For exposed applications, repair substrates to remove any surface imperfections that could affect uniformity of texture and thickness in finished surface of sprayed fire-resistive material. Remove minor projections and fill voids that would affect fire-resistive products after application.

3.3 INSTALLATION, GENERAL

A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire resistance ratings indicated.

B. Apply sprayed fire-resistive material that is identical to products tested as specified in Part 1 "Quality Assurance" Article and substantiated by test reports, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.

C. Install metal lath, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach lath to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer. Attach lathing accessories where indicated or required for secure attachment to substrate.

D. Coat substrates with adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by sprayed fire-resistive material manufacturer for material and application indicated.

E. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by sprayed fire-resistive material manufacturer, install body of fire-resistive covering in a single course.

F. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.

G. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply sprayed fire-resistive material that differs in color from that of encapsulant over which it is applied.

H. Where sealers are used, apply products that are tinted to differentiate them from sprayed fire-resistive material over which they are applied.

3.4 INSTALLATION, CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

A. Apply concealed sprayed fire-resistive material in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform field tests and inspections and to prepare test reports.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements under this Section.

B. Testing Services: Testing and inspecting of completed applications of sprayed fire-resistive material shall take place in successive stages, in areas of extent and using methods as

follows. Do not proceed with application of sprayed fire-resistive material for the next area until test results for previously completed applications of sprayed fire-resistive material show compliance with requirements. Tested values must equal or exceed values indicated and required for approved fire-resistance design.

1. Testing agency will test finished works according to Standards referenced in this Section at approved intervals for:

    a. Cohesion and adhesion bond strength.
    b. Density.
    c. Thickness.

2. Thickness for Floor, Roof, and Wall Assemblies: For each 93 sq. m area, or partial area, on each floor, from the average of 4 measurements from a 0.093 sq. m sample area, with sample width of not less than 152 mm, per ASTM E 605.
3. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns, per ASTM E 605.
4. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 605.
5. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: For each 929 sq. m area, or partial area, on each floor, cohesion and adhesion from one sample of size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 736.
6. If testing finds applications of sprayed fire-resistive material are not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.

C. Remove and replace applications of sprayed fire-resistive material where test results indicate that it does not comply with specified requirements for cohesion and adhesion, for density, or for both and retest as specified above.

D. Apply additional sprayed fire-resistive material, per manufacturer's written instructions, where test results indicate that thickness does not comply with specified requirements.

E. Additional testing and inspecting, at the Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING, PROTECTING AND REPAIR

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect sprayed fire-resistive material, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at time of Substantial Completion.

C. Coordinate application of sprayed fire-resistive material with other construction to minimize need to cut or remove fire protection. As installation of other construction proceeds, inspect sprayed fire-resistive material and patch any damaged or removed areas.

D. Repair or replace work that has not been successfully protected.

END OF SECTION 078100

SECTION 078124

INTUMESCENT FIREPROOFING (THIN-FILM)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and application of fire proofing and resisting intumescent coating system to structural steel.

1. Unless otherwise indicated on Drawings, applications of fireproof intumescent paint includes, but shall not be limited to, any structural steel surface indicated to be fire resistant rated and is exposed to view and not concealed beyond any other work item similar to cladding, suspended ceiling or lining.
2. Corrosion protection priming coat is to be provided as a coating layer of the intumescent paint system.

B. Related Sections include, but shall not be limited to, the following:

1. Division 5 Section ″Structural Steel Framing″ for coordinating surface preparation requirements.

1.3 SUBMITTALS

A. Product Data: For each type of product or coating material indicated.

1. Manufacturer's Information: Provide manufacturer's technical information, including, but not limited to, the following:

a. For each indicated fire protection period; valid third-party certified loading tables that indicate different thickness of the intumescent coating for each steel section or profile (I-beam, angles, channels, plates and hollow sections) in different applications (beam; column and bracing) for the loaded case. Indicate also the maximum temperature that can be withstood by the coating during the fire resistance period.
b. Third party test reports to indicate compliance of submitted materials with requirements specified for flame spread and smoke developed indices in this Section.
c. Third party test reports to indicate the properties of submitted materials as specified.
d. Evaluation of the expected lift time for the fire proofing performance of the submitted coating.

e. Instructions for handling, storing, and applying intumescent paint materials.

B. Detailed tables prepared based on the approved shop drawings of structural steel works that indicate type, application, properties, Hp/A ratio of each structural steel section, case of fire exposure and thickness of intumescent coating that will be applied to the steel sections. Tables shall be signed by the representative of the Intumescent coating Subcontractor and sealed by said Subcontractor and Contractor.

C. Samples for Verification: For each color of top finish coat to be applied, with texture to simulate actual conditions, on representative samples of actual substrate.

1. Provide stepped Samples, defining each separate coat, including primer, intumescent paint and finish coat. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture of finish coat are achieved.

D. Material Test Reports: For the intumescent paint.

E. Material Certificates: For each coating material of the intumescent paint system, signed by manufacturers.

F. Sample of product warranty.

G. Cleaning and maintenance instructions for inclusion in project`s operation and maintenance manual.

1.4 QUALITY ASSURANCE

A. Local Regulations and Codes: Comply with applicable requirements of the laws, codes, and regulations of authorities having jurisdiction.

1. Obtain necessary approvals from authorities having jurisdiction.
2. Comply with ZIMBABWE Fire & Life Safety Code of Practice including Annexures.
3. Comply with ZIMBABWE Civil Defense and the Municipality requirements and circulars.

B. Provide intumescent paint system that is produced by a manufacturer accredited by Civil Defense in ZIMBABWE or by a manufacturer who has his system tested by UL or other independent testing and inspection agency acceptable to authorities having jurisdiction.

C. Provide the products of a company holding valid ISO 9002 certificate.

D. Applicator Qualifications: Authorized by manufacturer.

E. Source Limitations: Provide Proprietary intumescent paint system including all system coats.

F. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required.

1. Engineer will select one surface to represent surfaces and conditions for application of each type of coating and substrate.

2. Final approval of colors of finish coat will be from benchmark samples.

G. Preinstallation Conference: Conduct conference at Project site to coordinate the work of intumescent paints with the work of other trades.

H. Fire-Test-Response Characteristics: Provide intumescent paints with the following surface-burning characteristics as determined by testing identical products per ASTM E 84, by UL, or by another testing and inspecting agency acceptable to Engineer.

1. Flame-Spread Index: 25.
2. Smoke-Developed Index: 450.

I. Fire-Resistance Characteristics: Provide intumescent paint system with the following fire resistance duration as determined by testing identical products per ASTM E 119 or BS 476 Part 21, by UL (USA), Warnock Hersey (USA), BRE or Certifire (UK) or by another testing and inspecting agency acceptable to Engineer.

1. Fire Resistance Rating: As indicated on Fire Zoning Drawings.

J. Field Quality Control Testing Agency Pre-qualifications: The following pre-qualifications documents are still need to be included in the submittal for qualifying testing agency:

1. Legal constitution of the company and names of owners.
2. Approvals, licenses, accreditations by authorities in ZIMBABWE.
3. Qualifications of company according to ASTM E 699 “Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components”.
4. Copy of the valid ISO certification.
5. Copy of company manual and procedures.
6. Financial documents of the company including tax card number.
7. List of equipment that will be employed in the project and their catalogues.
8. Detailed list of activities and tests that will be conducted by the submitted testing third-party testing agency including the samples of test reports that will be produced in the project.

1.5 PROJECT CONDITIONS

A. Do not apply intumescent paints in rain, fog, or mist; when relative humidity exceeds 85 percent; if temperature is less than 5 deg C above the dew point; or to damp or wet surfaces.

1.6 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Employer of other rights the Employer may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty for Intumescent Paint: Manufacturer`s special warranty in a form acceptable to Engineer in which manufacturer agrees to repair or replace intumescent paint system that fail within the specified warranty period.

1. Failure includes, but shall not be limited to, the following:

a. Peeling or blistering of paint.
b. Failure to protect against fire for the specified time.
c. Cracking of paint film.
d. Crazing of paint film.
e. Efflorescence.
f. Change in color of finish top coat.
g. Staining.

2. Warranty Period for Fire Performance: 20 years from date of Substantial Completion.

C. Warranty for Corrosion Resistance: The fire resistance paint system (primer + intumescent paint + top finish coat) shall provide corrosion protection to first maintenance for the warranty period specified here after.

1. Corrosion Resistance Warranty Period: 20 years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INTUMESCENT PAINT SYSTEM

A. Structural Steel: Provide the following intumescent paint system over new load-bearing structural construction. Intumescent paint system shall consist of the following coats:

1. Corrosion protection primer compatible with intumescent paint.
2. Intumescent coating in multiple-coat application according to required thickness.
3. Finish topcoat with high performance approved paint by intumescent paint manufacturer in the indicated or selected color.

B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

C. Intumescent Paint Layer: Thin-film intumescent fire resistive coating for load-bearing structural steel that is compatible with primer specified and accept wide range of decorative finish coatings and comply with following:

1. Solvent based for factory applied intumescent coatings.
2. One component.
3. Asbestos free.
4. Activation: Thermal.
5. Type: Self-destructive that expands to not less than 40 times film thickness.
6. Thickness: Shall be as necessary to provide fire resistance rating specified in Sub-Clause 1.4/I of this Section based on the ratio Hp/A for each structural steel section to be protected.

    a. Hp: The perimeter of the steel section.
    b. A: The cross section area of the steel section.

7. Number of coats: One or more coat based on required thickness and the recommended maximum thickness per coat.
8. Physical Properties:

    a. Solid content by weight: 67 %, minimum to ASTM D 2369.
    b. Abrasion Index to ASTM D 4060: 185 mg @ 1000 cycles or better.
    c. Bond Strength to ASTM D 4541: 2.40 MPa (minimum).
    d. Compressive Strength: 7.90 MPa to ASTM D 695.
    e. Shore D Hardness: Minimum 70 to ASTM D 2240.
    f. Density: 1360 kg/m^3 minimum.

9. Application: Designated for "interior general purpose" and "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.
10. Finish Texture and Color: As selected by Engineer from manufacturer's standard finishes.

D. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

2.2 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.

C. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and other conditions affecting performance of work.

1. Proceed with application only after unsatisfactory conditions have been corrected and surfaces to receive paint are thoroughly dry.
2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total intumescent paint system for various substrates. On Engineer's request, furnish information on characteristics of finish materials to ensure use of compatible primers.

3.2 PREPARATION

A. General: Surface preparation of structural steel shall comply with the specifications of The Society for Protective Coatings (SSPC) in USA as follows; or other equivalent standard; and as specified:

1. SSPC-SP 1 for solvent cleaning.
2. SSPC-SP 2 for Hand cleaning.
3. SSPC-SP 3 for Power tool cleaning.

B. Cleaning: Before applying coatings or other surface treatments, clean substrates of substances that could impair bond of intumescent paint systems.

1. Schedule cleaning and painting application so dust and other contaminants will not fall on wet, newly painted surfaces.
2. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified:

a. Prior to applying primer, the steel surfaces shall be blast cleaned to Swedish Standard SA 3 (ISO 8501-1) or SSPC-SP6.

C. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density, and as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

3.3 APPLICATION

A. General: Apply intumescent paints according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Do not apply coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions indicated as unacceptable in manufacturer's written instructions, or to surfaces that are otherwise detrimental to forming an acceptable coating.

B. Application of primer coat shall comply with requirements of SSPC specifications in addition to requirements in this Section.

C. Apply intumescent paints to exposed surfaces indicated according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

D. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required are the same regardless of the application method.
2. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer.
3. If intumescent coat show through the finish topcoat, apply additional coats until paint film is of uniform finish, color, and appearance.
4. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
5. Any damage to the factory-applied priming coat shall be repaired and touched-up in compliance with recommendations of priming coat manufacturer application of intumescent paint shall not commence without written approval of prime coat by the Engineer.

6. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where applying another coat of paint does not cause the undercoat to lose adhesion.

E. Application Procedures: Apply coatings by airless spray.

F. Minimum Coating Thickness: Apply materials at not less and not more than manufacturer's recommended spreading rate for the surface to be coated. Provide the total dry film thickness of the entire system as recommended by the manufacturer to provide surface-burning characteristics and fire resistance rating specified, but not less than thickness specified in this Section.

G. Quality Control: Wet and Dry Film Thickness (DFT) shall be checked regularly during applications at intervals as instructed by Engineer:

1. To ensure the correct thickness is being applied, frequent measurements shall be taken using a wet film thickness gauge.
2. Take a DFT reading as soon as the Intumescent Paint is fully cured.

a. Contractor shall provide Elecometer 211 permanent magnetic banana gauge or Elecometer 456 electromagnetic (electronic gauge) type to take DFT thickness. Ensure to deduct thickness of primer from measured thickness.

H. Apply nonintumescent topcoats using materials and application methods according to manufacturer's written instructions.

I. Completed Work: Match approved samples for color, texture, and coverage. Removed, refinish, or repaint work not complying with specified requirements.

3.4 CLEANING AND PROTECTION

A. Cleanup: At the end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting, remove temporary protective wrappings provided by others to protect their work.

END OF SECTION 078124

SECTION 099113

EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Coating System to Portland cement plaster substrates.
2. Coating System to cement board substrates.
3. Coating System to Concrete substrates.
4. Coating System to Structural Steel:

    a. Apply to structural steel works specified under Division 5, Section Structural Steel.
    b. Apply all coatings to structural steel prior to installing the weatherproof setting of the building and allow sufficient time for full setting of the coats.

5. Coating System to exterior architectural steel work items.
6. Coating System to exterior architectural galvanized steel work items.
7. Other substrates as indicated on Drawings.

B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Engineer will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:

    a. Finished mechanical and electrical equipment.
    b. Light fixtures.
    c. Any other item specified to have factory applied colored paint or coating system.

2. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include, but shall not be limited to, the following:

1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 9 Section "Cement Plastering".
3. Division 9 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

B. Abbreviations:

1. DFT: Dry Film Thickness.
2. MPI: Master Painters Institute.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 200 mm square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product Test Reports: For each submitted paint system. Test reports shall be prepared by a third party testing agency on samples selected from current production runs. Conduct and test reports for the following paint properties:

1. Chemical composition and solid percentage.
2. Specific gravity.
3. Viscosity.
4. Opacity.
5. Cleanability.
6. Scrub resistance, wet and dry.
7. Adhesion to substrate.
8. Yellowing resistance.

1.5 QUALITY ASSURANCE

A. Local Regulations and Codes: Comply with applicable requirements of the laws, codes, and regulations of authorities having jurisdiction.

1. Obtain necessary approvals from authorities having jurisdiction.
2. Comply with ZIMBABWE Civil Defense and the Municipality requirements and circulars.
3. Materials used on the façades shall be non-combustible and tested and approved as per the Civil Defense requirements.

B. Surface-Burning Characteristics of Exterior Paintings: As tested according to ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. Preparation and Workmanship: Comply with:

1. Requirements specified in this Section.
2. Requirements specified in MPI manual.
3. Requirements specified in BS 6150.
4. Manufacturer’s printed instructions and data sheets.

D. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Engineer will select one surface to represent surfaces and conditions for application of each paint system specified in Part 2.

a. Vertical and Horizontal Surfaces: Provide samples of at least 9 sq. m.
b. Other Items: Engineer will designate items or areas required.

2. Final approval of color selections will be based on benchmark samples.

a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Engineer at no added cost to Employer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.

7. Color name and number.

B. Store materials not in use in tightly covered containers in a well-ventilated area at an ambient temperature as recommended by manufacturer in technical datasheet Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.7 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 10 and 35 deg C.

B. Do not apply exterior paints in rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 3 deg C above the dew point; or to damp or wet surfaces.

1.8 EXTRA MATERIALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Exterior Paints: 5 percent, but not less than 3.8 L of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINTS AND COATINGS GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected by Engineer from manufacturer's full range.

2.2 PRIMERS/FILLERS FOR PORTLAND CEMENT SUBSTRATES

A. Exterior Portland Cement Plaster Primer: Factory-formulated alkali-resistant acrylic-latex exterior bonding primer for exterior application.

1. Apply to attain dry film thickness recommended by manufacturer but not less than 0.025mm.
2. Use acrylic based primer.

B. Exterior Portland Cement Plaster Filler: Factory-formulated filler specially produced for making good exterior surfaces to receive exterior acrylic emulsion paint finish.

1. Use acrylic based filler.

2.3 METAL PRIMERS

A. Primer for Galvanized Steel Substrates:

1. Washing Primer: Polyvinylbutaryl (PVB) etching primer or other primer as recommended by manufacturer of the coating system.
2. Factory-formulated quick-drying rust-inhibitive lead-and-chromate-free epoxy-based metal primer as recommended by paint system manufacturer.
3. Apply to attain dry film thickness recommended by manufacturer but not less than 0.030 mm.
4. Primer coat shall be in addition to priming coat specified to be workshop-applied.

B. Primer for Steel Substrates:

1. Factory-formulated quick-drying rust-inhibitive lead-and-chromate-free epoxy-based metal primer as recommended by paint system manufacturer.
2. Apply to attain dry film thickness recommended by manufacturer but not less than 0.030 mm.
3. Primer coat shall be in addition to priming coat specified to be workshop-applied.

2.4 TOUCH-UP MATERIALS

A. Provide touch-up materials recommended by manufacturer for making good and remedy of any scratch or defect noted in factory-applied corrosion resistant priming coat during transit of steel works from workshop to site.

2.5 EXTERIOR ACRYLIC-BASED PAINTS

A. Paint System over Exterior Portland Cement Plaster, Cement Board and Concrete: Smooth Acrylic Paint, 2 finish coat over one priming coat and making surface good.

1. Primer: Alkali-resistant, exterior, acrylic-latex bonding primer applied at spreading rate recommended by the manufacturer.
2. Smooth Acrylic Paint Finish: Alkali-resistant water based, environmentally friendly, exterior, flexible, 100% acrylic weather-resistant UV-resistant and color stable, washable and resistant to repeated scribing, water vapor permeable and of crack bridging capability up to 0.5 mm. the paint shall also provide protection to concrete against salts and carbon dioxide and has the advantage of reducing dust and dirt pick up

2.6 ANTI-CARBONATION PAINT MATERIALS, GENERAL

A. Anti-carbonation paint suitable for application on internal and external concrete, Portland cement plaster or masonry surfaces, water-based and nontoxic, allows substrate to breath, Protects substrates form Carbonation, of elastic nature with crack bridging properties.

1. Application: For exterior ramps and where indicated.

B. Anti-carbonation paint is to high performance single component elastomeric, self-cleaning by application of just sprayed water, highly durable, acrylic resin based coating which cures to form a tightly adherent, decorative weatherproof membrane guaranteed for up to 15 years. The formed coating membrane shall tolerate thermal movement in the substrate without splitting or cracking and will retain its elastomeric properties even after prolonged exposure to ultra-violet light. The finished surface shall be chemical and pollution-resistant surface that has been specially manufactured to shed dirt, ensuring that it retains a bright, attractive appearance throughout its life. Coating shall be vapor permeable and allows entrapped substrate moisture to escape without causing blistering or delamination and shall produce an effective barrier to carbon dioxide diffusion and provide reinforced concrete substrates with an excellent defense against the harmful effects of carbonation. Color and sheen shall be selected by the Engineer from manufacturer’s full range of products.

C. The protective coating system shall comprise the following elements:

1. Penetrating silane-siloxane primer.
2. Two coats of single component, elastomeric, aliphatic acrylic coating.

D. Anti-carbonation paint shall also comply with following properties:

1. Solids by Weight: 64%.

2. Volume Solids: 50%.
3. Carbon Dioxide Diffusion Resistance:

    a. Equivalent Thickness of 30 N Concrete: More than 500 mm.

4. Chloride Ion Diffusion Coefficient: No chloride ion diffusion after 60 days.
5. Static Crack Spanning Capability for 200-micron Dry Film Thickness at 23 ºC: Minimum 2.00 mm to ASTM C836.
6. Tear Resistance: 15 N/mm to ASTM D1004.
7. Tensile Strength: 5.00 N/mm^2 to ASTM D412.
8. Reduction in Water absorption: Not less than 82% to ASTM C642.
9. Reduction in Chloride Ions Penetration: Not less than 97% to AASHTO T277.
10. Adhesion: Not less than 1.00 N/mm^2 to BS 1881.

E. System Application: Two coats of anti-carbonation coating to achieve a total dry film thickness of not less than 200 microns in addition to primer coat.

2.7 EXTERIOR PAINTS FOR METALS

A. Ferrous Metals and Steel and Galvanized Steel: Provide the following finish system over interior ferrous metal

1. Aliphatic-Acrylic Polyurethane Enamel: High solids, high build, satin to semi-gloss finish applicable on steel surfaces, primed with same manufacturer's recommended primers and/or intermediate coats. Dry enamel film shall exhibit excellent gloss and color retention, durability, scratch and abrasion resistance, corrosion and chemical resistance. Comply with the following:

    a. Binder: Aliphatic acrylic polyurethane.
    b. Pigments: Rutile titanium dioxide and/or color pigments and functional extenders.
    c. Appearance: Semi-Gloss.
    d. % Solids, by Volume: 72% ± 2%, minimum.
    e. Color: As selected by Engineer from manufacturer's full range of colors.
    f. Application: Airless spray.
    g. Primer: Epoxy based primer as recommended by paint system manufacturer.
    h. Dry Film Thickness: Apply two coats at spreading rate recommended by manufacturer to achieve a dry film thickness of 75-125 microns per coat, minimum.

2.8 COATING SYSTEM FOR STRUCTURAL STEEL

A. General: Coating system for structural steel shall comply with ISO 12944-5:2007 (E) for Corrosivity Category C4, high durability.

B. Warranty: 20 years to first maintenance from date of Substantial Completion.

C. System Coats:

1. Corrosion-Resistant Priming Coat: Epoxy zinc rich primer at not less than 50 microns thickness.
2. Intermediate Coat: Epoxy based intermediate coating, two components, and high-build not less than 80% solids content at not less than 125 microns dry film thickness.
3. Top Coat: Acrylic/Aliphatic polyurethane finish coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations.

B. Remove hardware, covers, plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete and Portland Cement Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.

1. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze.
2. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
3. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

4. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
5. For concrete surfaces and external plaster apply a priming coat and fill blow holes, minor cracks and other surface defects with compatible stucco and rub down flush with surface.
6. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by methods recommended by manufacturer and paint applicator.

1. Apply one coat of wash primer to promote and enhance adhesion of paint system to the galvanized surface.

F. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of SSPC standards and the following:

1. Treat metal with a metal treatment wash coat before priming.
2. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

G. Structural Steel Substrates: Clean structural steel surfaces; remove oil, grease, dirt, loose mill scale, and other foreign substances.

1. Bare Structural Steel; Surfaces: Blast steel surfaces clean as recommended by paint system manufacturer and according to Swedish Standard SIS 05 59 00 – 1967, Sa 3: Blast cleaning to visually clean steel. Surface shall be completely free from oil, grease, mill scale and rust.
2. Coated Structural Steel (before applying undercoat or Finish coat): Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat or the touch up material recommended by manufacturer of the paint system.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Employer reserves the right to invoke the following test procedure at any time and as often as the Employer deems necessary during the period when paint is being applied.

B. Engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.

C. The testing agency will perform appropriate tests for the following characteristics as required by the Employer:

1. Quantitative material analysis.
2. Abrasion resistance.
3. Apparent reflectivity.
4. Flexibility.
5. Washability.
6. Absorption.
7. Accelerated weathering.
8. Dry opacity.
9. Accelerated yellowness.
10. Recoating.
11. Skinning.
12. Color retention.
13. Alkali and mildew resistance.

D. Employer may direct the Contractor to stop painting if test results show material being used does not comply with specified requirements.

E. Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

F. Dry Film Thickness Testing: Engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and

apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Engineer, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Coating System For Building Elevations:

1. Applicable for smooth-finished concrete surface and concrete and masonry surfaces finished with Portland cement plaster.

a. Smooth Acrylic Paint:

1) Surface preparation and making good as specified with acrylic based primer and putty. Primer DFT shall be not than 35 microns.
2) One coat smooth-textured 100% acrylic based emulsion paint to achieve a total dry film thickness of not less than 110 microns.
3) One coat smooth-textured 100% acrylic based emulsion pain to achieve a total dry film thickness of not less than 110 microns.

2. Anti-Carbonation Paint: As specified in this Section.

B. Coating System for Architectural Steel Work Items:

1. System Coats:

a. Primer: Epoxy polyamide or other epoxy resin as recommended by manufacturer.
b. Finish Coats: Aliphatic-Acrylic polyurethane coating as specified. Apply minimum two coats to obtain dry film thickness recommended by manufacturer but not less than DFT specified per coat.

C. Coating System for Architectural Galvanized Steel Work Items:

1. System Coats:

a. Surface Preparation: Wash primer to provide adhesion between zinc coated surface and coating system specified here after.
b. Primer: Epoxy polyamide or other epoxy resin as recommended by manufacturer.
c. Finish Coats: Aliphatic-Acrylic polyurethane coating as specified. Apply minimum two coats to obtain dry film thickness recommended by manufacturer but not less than DFT specified per coat.

D. Coating System For Structural Steel:

1. Warranty: 20 years to first maintenance from date of Substantial Completion.
2. System Coats:

a. Corrosion-Resistant Priming Coat: Epoxy zinc rich primer at not less than 50 microns thickness.
b. Intermediate Coat: Epoxy based intermediate coating, two components, high-build not less than 80 % solids content of DFT specified.
c. Top Coat: Aliphatic-Acrylic polyurethane finish coating of DFT specified.

3. Apply to exterior structural steel indicated on Drawings to have no fire protection treatment.

END OF SECTION 099113

SECTION 099123

INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and field painting of interior items and surfaces.

1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Engineer will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:

a. Finished mechanical and electrical equipment.
b. Light fixtures.
c. Any other item specified to have factory applied colored paint or coating system.

2. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include, but shall not be limited to, the following:

1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 6 Sections for shop priming carpentry with primers specified in this Section.
3. Division 8 Section "Flush Wood Doors" for doors indicated to have opaque finish.
4. Division 9 Section "Cement Plastering".
5. Division 9 Section "Non-Rated Gypsum Board Assemblies".
6. Division 9 Section "Gypsum Board Ceiling Assemblies".

7. Division 9 Section "Rated Gypsum Board Assemblies".
8. Division 9 Section "Cement Board Assemblies".
9. Division 9 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
10. Division 9 Section "Staining and Transparent Finishing" for stained and transparent finish of wood items.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

B. Abbreviations:

1. DFT: Dry Film Thickness.
2. UL: Underwriter Laboratories.
3. MPI: Master Painters Institute.

1.4 SUBMITTALS

A. General: Product data, samples and product test reports of each paint system shall be submitted under one submittal and reviewed collectively.

B. Product Data: For each type of product indicated.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

C. Manufacturer’s Color Chart for Initial Selection: For each type of topcoat product indicated.

D. Product Test Reports: For each submitted paint system. Test reports shall be prepared by a third party testing agency on samples selected from current production runs. Conduct and test reports for the following paint properties:

1. Chemical composition.
2. Specific gravity.
3. Viscosity.
4. Gloss degree.
5. Adhesion to substrates as used in the project.
6. Resistance to yellowing.
7. Scrub resistant using brush scrapers.
8. Opacity.

E. Test reports shall be fully descriptive and shall indicate the following information as a minimum:

1. No. of samples.
2. Samples preparation description, and thicknesses of layer.

3. Curing and setting of paint procedure.
4. Reference standard for test.
5. Testing procedure.

F. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
3. Submit three Samples on each substrate indicated for Engineer's review of color and texture only.

G. Cleaning and maintenance instructions for each paint system for inclusion in Project's Operation and Maintenance Manual.

1.5 ENVIRONMENT, HEALTH AND SAFETY (EHS) SUBMITTALS

A. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

B. Product Data for Credit IEQ 4.2, Low Emitting Materials: Submit manufacturer's data sheet including printed statement of VOC content.

1.6 QUALITY ASSURANCE

A. Local Regulations and Codes: Comply with applicable requirements of the laws, codes, and regulations of authorities having jurisdiction.

1. Obtain necessary approvals from authorities having jurisdiction.
2. Comply with the Civil Defense and the Municipality requirements and circulars.

B. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance. Paint applicators shall be identities that approved and accredited by Authorities Having Jurisdiction.

C. Source Limitations: Obtain fillers, putties, undercoats and primers for each coating system from the same manufacturer as the finish coats. Furnish paint materials as comprehensive integral paint system with all materials from same manufacturer or from sources recommended by top coat manufacturer in product's technical data sheet.

D. Surface-Burning Characteristics of Interior Paintings: As tested according to ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

E. Preparation and Workmanship: Comply with:

1. Requirements specified in this Section.
2. Requirements specified in MPI manual.
3. Requirements specified in BS 6150.
4. Manufacturer’s printed instructions and data sheets.

F. Mockups: Before painting, install mockups of at least 9 sq. m in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for each type, color and texture of paint indicated.
2. Install mockups for each composition of paint indicated.
3. Engineer will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

    a. Wall and Ceiling Surfaces: Provide samples on full wall or ceiling area of at least 9 sq. m.
    b. Other Items: Engineer will designate items or areas required.

4. Apply benchmark samples after permanent lighting and other environmental services have been activated.
5. Final approval of color selections will be based on benchmark samples.

    a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Engineer at no added cost to Employer.

6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at an ambient temperature as recommended by manufacturer in technical datasheet Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Keep storage area neat and orderly. Remove oily rags and waste daily.

2. Store materials that have low flashing point in full accordance with manufacturer's printed instructions.
3. Provide fire extinguishers in types to suit types of materials stored and in numbers to proportion with quantities of materials stored.

    a. Comply with requirements in Division 1, Section "Temporary Facilities and Controls".

1.8 PROJECT CONDITIONS

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 10 and 32 deg C.

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 7 and 35 deg C.

C. Do not apply interior paints in rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 3 deg C above the dew point; or to damp or wet surfaces.

1.9 EXTRA MATERIALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Interior Paints: 5 percent, but not less than 3.8 L of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Material Compatibility: Provide primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

1. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate quality standards, colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: As selected by Engineer from manufacturer's full range.

D. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints and Coatings: VOC not more than 50 g/L.
2. Nonflat Paints and Coatings: VOC not more than 50 g/L.
3. Dry-Fog Coatings: VOC not more than 150 g/L.
4. Primers, Sealers, and Undercoaters: VOC not more than 100 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 100 g/L.
6. Zinc-Rich Industrial Maintenance Primers: VOC not more than 100 g/L.
7. Pretreatment Wash Primers: VOC not more than 420 g/L.
8. Clear Wood Finishes, Varnishes: VOC not more than 275 g/L.
9. Clear Wood Finishes, Lacquers: VOC not more than 275 g/L.
10. Floor Coatings: VOC not more than 50 g/L.
11. Shellacs, Clear: VOC not more than 730 g/L.
12. Shellacs, Pigmented: VOC not more than 550 g/L.
13. Stains: VOC not more than 250 g/L.

2.2 INTERIOR FILLERS AND PUTTIES

A. General: Obtain from same manufacturer of the paint system and to be compatible with other coats of the system.

B. Block Filler: Latex block filler suitable for interior and exterior applications.

C. Acrylic Paint Systems: Use acrylic-based materials.

2.3 INTERIOR PRIMERS

A. Interior Portland Cement Plaster Primer: Factory-formulated alkali-resistant acrylic-latex interior primer for interior application.

1. Apply to attain dry film thickness recommended by manufacturer but not less than 0.025 mm

B. Interior Portland Cement Plaster Primer: Factory-formulated 100%-acrylic sealing and priming stucco as standard with manufacturer for acrylic-based Earthtone paints.

C. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive lead-and-chromate-free epoxy-based metal primer.

1. Apply to attain dry film thickness recommended by manufacturer but not less than 0.030 mm.
2. Primer coat shall be in addition to priming coat specified to be workshop-applied.

D. Galvanized Steel Substrates Primer:

1. Washing Primer: Polyvinylbutaryl (PVB) etching primer or other primer as recommended by manufacturer of the coating system.
2. Factory-formulated quick-drying rust-inhibitive lead-and-chromate-free epoxy-based metal primer as recommended by paint system manufacturer.
3. Apply to attain dry film thickness recommended by manufacturer but not less than 0.030 mm.
4. Primer coat shall be in addition to priming coat specified to be workshop-applied.

2.4 INTERIOR FINISH COATS

A. Portland Cement Plaster, Gypsum Board, Cement Board and Concrete Surfaces:

1. General: Interior emulsion paints shall be:

a. Based on 100% acrylic, specially produced acrylic or resin approved by Engineer.
b. Scrub Resistance Test Result: Not less than 5000.
c. The used emulsion paint shall successfully pass tests for adhesion to substrate, non-yellowing, opacity and viscosity to the requirements of an International Standard acceptable Engineer.
d. Where indicated in finish schedule, apply the paint with stencil to provide the pattern indicated.

2. Acrylic Emulsion Paint: Factory-formulated flat acrylic-emulsion paint for interior application suitable for repeated washing. Paint shall be highly recognized as interior emulsion paint, of acrylic binder, of high leveling and hiding properties and excellent flow properties and washability properties. Crack bridging capability of paint shall be 1.00 mm minimum. Paint shall be of anti fungal and anti bacterial properties and shall be classified as Class 1Y or better surface spread of flame to BS 476: Part 7.

Solid content shall not be less than 36%, by volume when tested to ISO 3233: 1998 (E).

a. First and Second Coats: Acrylic -based, interior paint applied at spreading rate recommended by the manufacturer to achieve a Dry Film Thickness (DFT) of not less than 0.060 mm per coat, and a total paint DFT of 120 microns.

3. Acrylic Emulsion Paint (Matt and Silk): Interior 100% acrylic (pure) resin based emulsion to produce a highly durable, flexible and water-resistant coating suitable for repeated washing and scrubbing (not less than 3000 Cycles abrasion test), alkali resistant and excellent opacity and adhesion.

a. First and Second Coats: Acrylic -based, interior paint applied at spreading rate recommended by the manufacturer to achieve a Dry Film Thickness (DFT) of not less than 0.060 mm per coat, and a total paint DFT of 120 microns.

4. Epoxy Paint: A high performance, two-component chemically-cured waterborne gloss epoxy coating for use as a hard, durable high performance architectural coating (HIPAC):

a. Performance Requirements:

1) Film Properties:

a) Abrasion Resistance: Good.
b) Pencil Hardness: Good.
c) Flexibility: Excellent.
d) Impact Resistance: Excellent.
e) Water Resistance: Excellent.
f) Chemical/Stain: Resistance Excellent.

2) Product Data:

a) Pigment: Lightfast Non-Lead Pigments and Mineral Extenders
b) Binder: Polyamide Cured Epoxy.
c) Solvent: Aromatic Hydrocarbon and Alcohol.
d) Volume Solids: 43% +- 1% - varies with colour.
e) Flame Spread Rating: Class A (0-25) over non-combustible surfaces.

3) Application:

a) Film Thickness: Wet: 115 – 290 micro-meters, Dry: 50 – 125 micro-meters.

B. Gypsum Boards:

1. Same materials as specified for application onto Portland cement plaster substrates in Clause A of this Article.

C. Opaque Finish of Wood Surfaces:

1. Polyurethane Paint System: Top and under coats are to be spray-applied, aliphatic polyurethane based, non-toxic, air drying to a smooth, highly opaque surface to produce a durable, flexible and water-resistant coating with excellent adhesion and color retention. Undercoat is to be suitable to receive further coatings. Finish is to be highly gloss.

    a. Color shall be as selected by Engineer from manufacturer's full range.
    b. Primer and Fillers for surface preparation are to be as recommended by manufacturer.

D. Ferrous Surfaces:

1. Aliphatic-Acrylic Polyurethane Enamel: High solids, high build, satin to semi-gloss finish applicable on steel surfaces, primed with same manufacturer's recommended primers and/or intermediate coats. Dry enamel film shall exhibit excellent gloss and color retention, durability, scratch and abrasion resistance, corrosion and chemical resistance. Comply with the following:

    a. Binder: Aliphatic acrylic polyurethane.
    b. Pigments: Rutile titanium dioxide and/or color pigments and functional extenders.
    c. Appearance: Semi-Gloss.
    d. % Solids, by Volume: 72% ± 2%, minimum.
    e. Color: As selected by Engineer from manufacturer's full range of colors.
    f. Application: Airless spray.
    g. Primer: Epoxy based primer as recommended by paint system manufacturer.
    h. Dry Film Thickness: Apply two coats at spreading rate recommended by manufacturer to achieve a dry film thickness of 75-125 microns per coat, minimum.

2.5 DECORATIVE STUCCO FINISH

A. Provide ready mixed marble stucco paste that is trowel applied to create smooth or finely textured finishes which resemble polished stone in their appearance, hardness and feel to the touch.

B. Decorative stucco finish shall be made from a combination of ultra-fine lime putty and crushed white marble that has been carefully graded to impart outstanding workability and final trowel polish, and shall include entirely natural mineral material.

C. Decorative Stucco Finish Color: As selected by Engineer from manufacturer full range.

D. Properties:

1. Specific Density: 1.8 kg/L.
2. Dry Solids Content: 76%.
3. Shore D Hardness: 78.
4. Fire Performance:

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

2.6 DECORATIVE WALL COATINGS

A. Provide water based decorative wall coating specially formulated with pearlescent pigments to create an elegant finish with a subtle surface shimmer that provide wide range of colors for both modern and classical interiors

B. System shall include a preparative basecoat, BaseColor Matt and a protective top coat, Clearseal Gloss.

C. Properties:

1. Scrub Resistance: 1,925 cycles to ASTM D2486.
2. Stain Resistance: High resistance to ASTM D1308 “Standard Test Method for Effect of Household Chemicals”
3. Fire Performance:

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2.7 COATING SYSTEM FOR STRUCTURAL STEEL

A. Warranty: 20 years to first maintenance from date of Substantial Completion.

B. System Coats:

1. Corrosion-Resistant Priming Coat: Epoxy zinc rich primer at not less than 75 microns thickness.
2. Intermediate Coat: Epoxy based intermediate coating, two components, high-build not less than 80% solids content.
3. Top Coat: Acrylic/Aliphatic polyurethane finish coating.

2.8 COATING SYSTEM FOR STRUCTURAL STEEL

A. General: Coating system for structural steel shall comply with ISO 12944-5:2007 (E) for Corrosivity Category C4, high durability.

B. Warranty: 20 years to first maintenance from date of Substantial Completion.

C. System Coats:

1. Corrosion-Resistant Priming Coat: Epoxy zinc rich primer at not less than 75 microns thickness.
2. Intermediate Coat: Epoxy based intermediate coating, two components, and high-build not less than 80% solids content at not less than 130 microns dry film thickness.
3. Top Coat: Acrylic/Aliphatic polyurethane finish coating at not less than 75 microns dry film thickness.

D. Apply to interior structural steel indicated on Drawings or approved shop drawings to have no fire protection treatment, if any.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 %.
2. Wood: 15 %.
3. Gypsum Board: 12 %.
4. Plaster: 12 %.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify Engineer about anticipated problems when using the materials specified over substrates primed by others.

E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to requirements of BS 6150:1991 and manufacturer's written instructions for each particular substrate condition and as specified.

1. Remove and reprime incompatible primers.
2. Cementitious Materials: Prepare cement plaster, and mineral surfaces to be painted as follows:

    a. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
    b. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
    c. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
    d. Prepare surfaces with two coats of filler or putty that is compatible with under coats and finish coats and obtained from same manufacturer of paint coats:

        1) Use compatible acrylic-based filler under acrylic emulsion paints.
        2) Sand after setting of filler and patch remaining spots or irregularities and lightly sand to obtain perfect smooth uniform surface suitable for receiving paint coats.

3. Gypsum Boards: Comply with requirements specified in Division 9, Sections for Gypsum Board.
4. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by methods recommended by manufacturer and paint applicator.

    a. Apply one coat of wash primer to promote and enhance adhesion of paint system to the galvanized surface.

5. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of SSPC standards and the following:

    a. Treat metal with a metal treatment wash coat before priming.
    b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

6. Structural Steel Substrates: Clean structural steel surfaces; remove oil, grease, dirt, loose mill scale, and other foreign substances.

    a. Bare Structural Steel; Surfaces: Blast steel surfaces clean as recommended by paint system manufacturer and according to Swedish Standard SIS 05 59 00 – 1967, Sa 3: Blast cleaning to visually clean steel. Surface shall be completely free from oil, grease, mill scale and rust.
    b. Coated Structural Steel (before applying undercoat or Finish coat): Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat or the touch up material recommended by manufacturer of the paint system.

7. Wood Substrates:

    a. Scrape and clean knots, and apply coat of knot sealer before applying primer.
    b. Sand surfaces that will be exposed to view, and dust off. Sand bare wood with 80 – 120 grit sand paper or as per manufacturer’s recommendations to obtain a uniform and flawless surface. Remove all sanding residue with a vacuum or tack cloth.
    c. Prime edges, ends, faces, undersides, and backsides of wood.
    d. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, louvers and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
3. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated, unless higher thickness is recommended by manufacturer. Provide total dry film thickness of the entire system as recommended by manufacturer but not less dry film thickness specified.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

F. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

G. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

H. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

3.4 FIELD QUALITY CONTROL

A. Employer reserves the right to invoke the following test procedure at any time and as often as the Employer deems necessary during the period when paint is being applied.

B. Engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.

C. The testing agency will perform appropriate tests for the following characteristics as required by the Employer:

1. Quantitative material analysis.
2. Abrasion resistance.
3. Apparent reflectivity.
4. Flexibility.
5. Washability.
6. Absorption.
7. Accelerated weathering.
8. Dry opacity.
9. Accelerated yellowness.
10. Recoating.
11. Skinning.
12. Color retention.
13. Alkali and mildew resistance.

D. Employer may direct the Contractor to stop painting if test results show material being used does not comply with specified requirements.

E. Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

F. Dry Film Thickness Testing: Engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by

Engineer, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

E. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Coordinate the following paint coats with surface preparation steps as specified.

B. Special Paint System: Apply in compliance with recommendations in manufacturer's technical data and literature.

C. Concrete: Provide the following paint systems over interior concrete and brick masonry surfaces:

1. Acrylic Finish: 2 finish coats over a primer.

a. Primer: Alkali-resistant, acrylic-latex, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.036 mm.
b. Undercoat: same material for finish coats specified hereafter diluted to the manufacturer's recommendations.
c. First and Second Finish Coats: Acrylic, interior paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.06 mm per coat, and a total paint DFT of 120 microns.
d. Sheen level: As selected by Engineer.

D. Gypsum and Cement Boards: Provide the following finish system over interior gypsum board surfaces:

1. Acrylic Finish: 2 finish coats over a primer.

a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.031 mm.
b. First and Second Coats: Acrylic -based, interior paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.060 mm.
c. Sheen level: As selected by Engineer.

E. Portland Cement Plaster: Provide the following finish systems over new, interior Portland cement plaster surfaces:

1. Acrylic Finish: 2 finish coats over a primer.

a. Primer: Alkali-resistant, acrylic-latex, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.036 mm.
b. Undercoat: same material for finish coats specified hereafter diluted to the manufacturer's recommendations.
c. First and Second Finish Coats: Acrylic, interior paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.06 mm per coat, and a total paint DFT of 120 microns.
d. Sheen level: As selected by Engineer.

2. Decorative Stucco Finish: Manufacturer's proprietary system as follows:

a. Primer: 1 coat of manufacturer's standard primer.
b. First and Second Finish Coats: 2 coats of decorative stucco finish as specified, to achieve a total dry film thickness recommended by manufacturer to provide the required texture and patterns.

3. Decorative Wall Coatings: Manufacturer's proprietary system as follows:

a. Apply Base Color Matt coat in one or two coats.
b. Apply the first coat of decorative paint to the surface.
c. Apply final coat of decorative paint and pattern.
d. For improved abrasion resistance apply single coat of Clear seal Gloss.

4. Epoxy Paint Finish: 2 finish coats over primer.

a. Primer: 1 coat of manufacturer's standard water based epoxy primer.
b. First and Second Finish Coats: 2 coats of Epoxy Paint finish as specified, to achieve a total dry film thickness of 125 microns, minimum.

F. Woodwork and Hardboard: Provide the following paint finish system over new, interior wood surfaces:

1. Polyurethane Paint System: 1 finish coats over a wood undercoater.

a. Undercoat: Polyurethane-based, interior enamel undercoater applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.075 mm.
b. Finish Coat: Full-gloss, acrylic/aliphatic polyurethane-based, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 0.075 mm.

G. Zinc-Coated Metal: Provide the following finish systems over zinc-coated metal:

1. Aliphatic-Acrylic Polyurethane Enamel: 2 finish coats over primer:

a. Primer: Primer for Galvanized Steel:

1) Washing Primer: Polyvinylbutaryl (PVB) etching primer.
2) Primer: Polyamide epoxy primer or other epoxy resin as recommended by manufacture.

b. Finish Coats: Aliphatic-Acrylic polyurethane coating as specified. Apply minimum two coats to obtain dry film thickness recommended by manufacturer but not less than DFT specified per coat.

H. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Aliphatic-Acrylic Polyurethane Enamel: 2 finish coats over primer:

a. Primer: Epoxy polyamide or other epoxy resin as recommended by manufacture.
b. Finish Coats: Aliphatic-Acrylic polyurethane coating as specified. Apply minimum two coats to obtain dry film thickness recommended by manufacturer but not less than DFT specified per coat.

I. Coating System For Structural Steel: Provide the following finish over interior structural steel:

1. Corrosion-Resistant Priming Coat: Epoxy zinc rich primer at not less than 75 microns thickness.
2. Intermediate Coat: Epoxy based intermediate coating, two components, high-build not less than 80% solids content of DFT specified.
3. Top Coat: Acrylic/Aliphatic polyurethane finish coating of DFT specified.
4. Warranty for the overall finish system shall be 20 years to first maintenance from date of substantial completion.

END OF SECTION 099123