

SECTION 01 83 00 — FACILITY SHELL PERFORMANCE REQUIREMENTS

^{A16}1.01 SUMMARY:

- A. Provide permanently enclosed spaces for all **functional** areas, in accordance with Section 01 81 36 (*O & M Buildings and Facilities — Program*) unless otherwise indicated. Provide a physical enclosure that keeps out weather, unauthorized personnel, animals, and insects without requiring specific action by occupants, while providing convenient movement of occupants between inside and outside, desirable natural light, and views from inside to outside. Provide level floor areas, comfortable ceiling heights, and essentially vertical walls.
- B. The elements forming usable enclosed space and separating that space from the external environment comprise the shell and consist of:
 - 1. **Superstructure:** All elements forming floors and roofs above grade and the elements required for their support, insulation, fireproofing, and firestopping.
 - 2. **Exterior Enclosure:** All essentially vertical elements forming the separation between exterior and interior conditioned space, including exterior skin, components supporting weather barriers, and jointing and interfacing components; **but** not including the interior skin, unless an integral part of the enclosure, **which keep** out weather, unauthorized personnel, animals, and insects, without unusual action by occupants, while providing convenient movement of occupants between inside and outside, desirable natural light, and views from inside and outside.
 - 3. **Roofing:** All elements forming weather and thermal barriers at horizontal and sloped roofs and decks, and roof fixtures.
- C. **Exterior Surfaces Exposed to View:** The **shell** comprises surfaces visible from the **Canal** channel, street, or ground level, plus surfaces visible from windows of **the** same and adjacent buildings within the lock complex.
- D. Where shell elements also function as elements defined within another element group, meet requirements of both groups.
- E. In addition to the requirements of this **section**, comply with all applicable requirements of Section 01 10 00 (*General Project Requirements*).

1.02 REFERENCES:

- A. **Air Movement and Control Association Inc. (AMCA) Publication:**
 - 511-2007 Certified Ratings Program for Air Control Devices
- B. **American Architectural Manufacturer's Association (AAMA) Publications:**
 - 1503-1998 Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
 - 2605-2005 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings and Aluminum Extrusions and Panels

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| | GDSG-1-1987 | Glass Design for Sloped Glazing |
| | TSGG-1991 | Two-Sided Structural Glazing Guidelines for Aluminum Framed Skylights |
| C. | American Concrete Institute (ACI) Standards: | |
| | 301-2005 | Structural Concrete |
| | 315-2004 | Detailing Manual |
| | 318/318R-2005 | Building Code Requirements for Structural Concrete (ACI318-05) and Commentary (ACI318R-05) |
| | 530-2005 | Building Code Requirements for Masonry Structures and Related Commentaries |
| | 530.1-2005 | Masonry Structures |
| D. | American Institute of Steel Construction (AISC) Inc. Standard: | |
| | 325-2005 | Steel Construction Manual |
| | 360-2005 | Specification for Structural Steel Buildings |
| | 303-2005 | Code of Standard Practice for Steel Buildings and Bridges |
| E. | American National Standards Institute (ANSI) Standards: | |
| | A14.35-2002 | Safety Code for Construction, care and use of Ladders |
| | A250.4-2004 | Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcings |
| F. | American Society of Civil Engineers (ASCE) Code: | |
| | 7-2005 | Minimum Design Loads for Buildings and other Structures |
| G. | American Society for Testing and Materials (ASTM) International Standards: | |
| | A 36/A36M-2005 | Carbon Structural Steel |
| | A 53/A 53M-2007 | Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| | A 123Rev89A-1990 | Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products |
| | A 167-1999 | Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| | A 176-1999 | Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip |

A 554-2003	Welded Stainless Steel Mechanical Tubing
A 615/A 615M-2007	Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
A 653/A 653 M-2006(A)	Steel Sheet, Zinc-coated (Galvanized) or Zinc-iron Alloy-coated (Galvannealed) by the Hot-dip Process
A 792/A792M-2006a	Steel Sheet, 55% Aluminum-Zinc Alloy Coated by the Hot Dip Process
B 117-2007	Standard Practice for Operating Salt-Spray (Fog) Apparatus
B 209M-2006	Aluminum and Aluminum-alloy Sheet and Plate
B 221-2006	Aluminum and Aluminum-alloy Extruded Bars, Rods, Wire, Profiles and Tubes
B 241/B 241M-2002	Aluminum-alloy Seamless Pipe and Seamless Extruded Tube
B 308/B308M-2002	Aluminum and Aluminum-alloy 6061-T6 Standard Structural Profiles
B 429/B 429M-2006	Aluminum-alloy Extruded Structural Pipe and Tube
C 90-2006(b)	Load-bearing Concrete Masonry Units
C 129-2006	Non-load bearing Concrete Masonry Units
C 150-2005	Portland Cement
C 615-2003	Standard Specification for Granite Dimension Stone
C 920-2005	Elastomeric Joint Sealants
C 1036-2006	Flat Glass
C 1184-2005	Structural Silicone Sealants
D 1003-2000	Haze and Luminous Transmittance of Transparent Plastics
D 4397-2002	Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
E 84-2006	Surface Burning Characteristics of Building Materials
E 108-2007a	Fire Tests of Roof Coverings
E 119-2007	Fire Tests of Building Construction and Materials

E 283-2004	Determining Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen
E 330-2002(3)	Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Pressure Difference
E 331-2000	Water Penetration of External Walls, Doors by Uniform Static Air Pressure Difference
E 336-2005	Measurement of Airborne Sound Attenuation between Rooms in Buildings
E 547-2000	Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Cyclic Static Air
E 695-2003	Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
E 814-2006	Fire Tests of Through-penetration Fire Stops
E 1007-2004e1	Field Measurement of Tapping Machine Impact Sound Transmission through Floor-Ceiling Assemblies and Associated Support Structures.
E 1300-2004e1	Determining Load Resistance of Glass in Buildings
F 476-2002	Security of Swinging Door Assemblies
F 588-2007	Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact
F 842-2004	Measuring the Forced Entry Resistance of Sliding Door
F 1233-1998(04)	Security Glazing Materials and Systems

H. Autoridad del Canal de Panamá (ACP) Regulations:

Manual de Seguridad y Salud Ocupacional (2000)

I. American Welding Society (AWS) Codes:

D1.1/D1.1M-2006	Structural Welding Code
D10.7M/D10.7-2000	Gas Shielded-arc Welding of Aluminum and Aluminum-alloy Pipe

J. Builders Hardware Manufacturers Association (BHMA) Standards:

A156.1-2006	Butts and Hinges
A156.2-2003	Bored and Preassembled Locks and Latches

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| | A156.3-2001 | Exit Devices |
| | A156.4-2000 | Door Controls — Closers |
| | A156.5-2001 | Auxiliary Locks and Associated Products |
| | A156.12-2005 | Interconnected Locks and Latches |
| | A156.13-2005 | Mortise Locks and Latches |
| K. | Federal Specification (FED): | |
| | TT-S-00227E | Sealing Compound: Elastomeric Type. Multi-component for Calking, Sealing and Glazing in Building and other Structures |
| | TT-S-001543 | Sealing Compound, Silicone Rubber Base (for Calking, Sealing and Glazing in Building and Other Structures) |
| L. | International Code Council (ICC) Code: | |
| | IBC 2006 | ICC International Building Code |
| M. | International Organization for Standardization (ISO) Standards: | |
| | 2631 - 1978 | Guide for the Evaluation of Human Exposure to Whole-body Vibration |
| | 2631-2:2003 | Mechanical Vibration and Shock: Evaluation of human exposure to whole-body vibration — Part 2: Vibration in buildings |
| | 2631-5:2004 | Mechanical Vibration and Shock: Evaluation of human exposure to whole-body vibration — Part 5: Method for evaluation of vibration containing multiple shocks |
| | 4866:1990 | Mechanical Vibration and Shock: Vibration of buildings — Guidelines for the measurement of vibrations and evaluation of their effects on buildings. |
| N. | Junta Técnica de Ingeniería y Arquitectura, (JTIA) Norm: | |
| | REP 2004 | Reglamento Estructural de la República de Panamá |
| O. | National Association of Architectural Metal Manufacturers (NAAMM) Publications: | |
| | 862-2003 | HMMA Guide Specification for Commercial Security Hollow Metal Doors and Frames |
| | | Metal Finishes Manual |
| P. | National Fenestration Rating Council (NFRC) | |

Q. National Fire Protection Association (NFPA) Publications:

80-2007	Standard for Fire Doors and Other Opening Protection
101-2006	Life Safety Code
204-2007	Standard for Smoke and Heat Venting

R. Underwriters' Laboratories, Inc. (UL) Standards:

305-2007	Panic Hardware
752-2005	Bullet-Resisting Equipment
UL Building Materials-2007	Building Material Directory

1.03 REQUIREMENTS:

A. Superstructure: Provide structural elements capable of supporting all required and anticipated loads without failure or damage. The superstructure comprises:

- Floors:** Floor construction above grade including balcony, mezzanine, and ramp floors, floors elevated for access, stair construction if part of the structure, and roof decks intended for occupant live load and equipment dead load; and the elements required for their support, insulation, fireproofing, and firestopping.
- Roofs:** Provide all roof construction, including canopies, and elements required for their support, insulation, fireproofing, and firestopping.

B. Exterior Enclosure: Provide an essentially vertical separation between exterior and interior conditioned space, that keeps out weather, unauthorized personnel, animals, and insects, without action by occupants, while providing convenient movement of occupants between inside and outside, and, where required, desirable natural light, natural ventilation, and views from inside to outside. The elements forming the vertical separation comprise the exterior enclosure and consist of:

- Exterior Walls:** Provide physical separation between exterior and interior conditioned space. The elements forming the physical separation comprise the exterior walls and consist of the supporting structure, the exterior skin, vapor retardants, air barriers, and insulation, the interior skin if an integral part of the wall, exterior screens and railings, balcony walls, exterior soffits unless they do not form a weather barrier, firestopping and draft-stopping within wall and between wall and floors, and other exterior wall elements.
- Exterior Windows and Other Openings:** Fill, cover, close, or otherwise protect all openings in the exterior walls (other than doors) so that the entire exterior enclosure functions as specified. The elements comprising exterior windows and other openings include windows, fixed glazing other than glazed walls, ventilation openings and protection devices for openings, and elements that form or complete the openings, unless an integral part of another element.
- Exterior Doors:** Secure all openings in the exterior wall that function to allow the entrance and exit of people, vehicles, and materials, so that the entire exterior enclosure functions as specified, using doors as specified. The elements

comprising exterior doors include doors of all sizes and uses, gates, and elements that form or complete the openings, unless an integral part of another element. Exterior doors controlled by the access control system as described in Section 28 13 00 (*Access Control Systems*) shall have hold-closed magnets and electric door strikes.

4. **Exterior Wall Fixtures:** Include all elements attached to the outside of the exterior walls, unless consisting of equipment or services fixtures. Fixtures required are those made necessary by the design such as signs. For signs, include the following:

- a. **Lock Complex Identification Sign:** Mounted as high as possible, for visibility from a great distance; provide one for each complex.
- b. **Main Entrance Identification Sign:** Mounted on poles for visibility from vehicles approaching the complex main entrance; provide one for each complex.
- c. **Building Identification Signs:** Mounted on two wall sides of each building, for visibility from the Canal and from the access road. Provide two for each building.

- C. **Roofing:** Provide a weather-proof enclosure over the entire "top-side" of building that also excludes unwelcome people, animals, and insects without requiring specific action by occupants, while shedding water and preventing uncontrolled water infiltration, withstanding anticipated loading conditions, providing required access, and permitting the entry of desirable natural light. Roofing comprises the following elements:

1. **Roof Coverings:** Weather barriers, insulation, wearing surfaces, water collectors, and conductors; including coverings over decks, balconies, and other exposed floors.
2. **Roof Openings:** Skylights, ventilation openings, access openings, and other roof opening elements.
3. **Roof Fixtures:** All elements attached to the roof, unless equipment or services.
4. **Roof Eaves:** Roof eaves are desirable. Extend roofing to project beyond exterior walls for roof eaves that will protect the exterior enclosure from weather.

1.04 DESIGN CRITERIA/SYSTEM DESCRIPTION:

A. Design Criteria for Superstructure:

1. **Fire Resistance:** Design and select materials to provide fire resistance in accordance with NFPA 101 and IBC.
 - a. For all elements required to have a fire resistive rating and which are not made of proven fire resistive materials.
 - b. For proven by mock up construction, acceptable testing agency shall be Underwriters Laboratories Inc.
 - c. Provide members with combustibility, flame spread, and smoke generation characteristics not greater than allowed by NFPA 101 and IBC.

- d. Design and select materials to provide fire resistance in accordance with NFPA 101 and IBC and the following:
 - 1) For fire resistance of column-beam, supporting roofs and canopies, load-bearing walls, roof-ceiling and other members as wind bracing, roof bracing, and sag and tension rods, comply with NFPA 101 and IBC.
 - 2) Determine fire resistance rating by testing in accordance with ASTM E 119.
 - 3) Determine flame spread index by testing in accordance with ASTM E 84.
 - 4) Determine smoke developed index by testing in accordance with ASTM E 84.
 - 5) Where fire resistance integrity of superstructure assemblies is impaired by subsequent installation of other construction elements, restore fire resistance using identical materials or other materials tested under ASTM E 814.
 - 6) At openings in fire-rated superstructure elements, provide firestopping that is rated at not less than the required fire resistance of the penetrated element.
2. **Explosion:** Design for and provide resistance to forces generated by explosion hazards. Design and construct shell to provide relief from explosion hazards so as to minimize effect on occupants, contents, and structural members.
3. **Grounding and Lightning Protection:** To prevent electric shock to building occupants, building metallic structural elements shall be bonded to the electrical grounding system, in accordance with Section 26 05 26 (*Grounding and Bonding for Electrical Systems*). To protect buildings, equipment, and occupants from a lightning strike, a lightning-arrester system shall be installed at each building, in accordance with Section 26 41 16 (*Lightning Protection and Dissipation Systems*) and Section 26 05 26 (*Grounding and Bonding for Electrical Systems*).
4. **Accidental Injury:** Protect pedestrians, building occupants, vehicles, and fixed equipment from rainwater and objects accidentally dropped from elevated observation decks, balconies, stairs, or ramps. Design and select materials to protect pedestrians and building occupants.
5. **Physical Security:** Design and construct to provide protection as follows:
 - a. **Opaque Elements at Ground Level:** Use materials that give the impression of strength, for discouragement of opportunistic attempts at intrusion.
 - b. **Exterior Doors:** Provide hollow metal doors and frames and roll up metal doors and frames with key locks.
 - c. **Exterior Windows:** Provide different levels of protection for different locations.

- d. Provide glazing in accordance with UL 752 at security points ([GH] and [GBs]). Bullet-proof glazing shall pass ballistic resistance test of 9 mm/submachine gun, in accordance with ASTM F 1233, Security Glazing Materials and Systems.
- 6. **Flood Conditions:** ^{A17}The Works are located in a special flood-hazard area (A Zone). Design to resist loads from Gatun Lake water at its extreme elevation in accordance with ASCE 7 or REP 2004 whichever is more stringent. ^{A17}
- 7. **Structural Performance:**
 - a. **Capacity:** Design and select materials to support all loads without load-related damage, with adequate serviceability requirements, in accordance with REP 2004 and IBC.
 - 1) **Dead Loads:** Design to resist loads from weights of materials, construction, fixed service equipment, and storage.
 - 2) **Live Loads:**
 - a) **Floors:** Resist uniformly distributed, concentrated, impact, and dynamic loads. Where permitted by code, live load reductions shall be allowed.
 - b) **Roofs:** Resist uniformly distributed, concentrated, impact, and dynamic loads. Where permitted by code, live load reductions shall be allowed.
 - 3) **External Loads:** In accordance with REP 2004.
 - a) **Wind:** Basic wind speed 115 km/h for the Pacific locks and 140 km/h for the Atlantic locks (3 second gust), in accordance with REP-2004 and ASCE 7.
 - b) **Rain:** Resist loads from ponding rainwater when the primary drainage system is blocked.
 - c) **Earthquake:** In compliance with provisions of REP 2004 and Section 01 81 16.13 (*Seismic Design Criteria*).
 - 4) **Special Loads:** In addition to loads defined by code, design for loads from moving machinery, elevators, cranes, and vehicles where applicable.
 - a) **Storage Room Shelving Areas:** 14.4 kN/m² minimum uniform live load over 100% of floor area at spares storage building [SS] and 30% floor area at maintenance building [MB].
 - b) **Removable Access Floor:** 7.2 kN/m² minimum uniform live load and 136 kg concentrated load at center of each 600 mm span.
 - c) Structure's load and other identified loads.

- 5) **Special Components:** If design method is not specifically prescribed by code, design in accordance with the latest version of ASCE 7.
 - b. Design and provide shell elements to resist loosening or detachment in winds equivalent to the design wind speed.
 - c. Isolate structure from sources of vibration in accordance with ISO 2631 and ISO 4866.
 - d. Elements engineered by the manufacturer or fabricator shall require the signature of acceptance by the Contractor's engineer-of-record.
8. **Impact Resistance:** Design and select materials to resist damage due to impact in accordance with code and ASTM E 695 and the following:
 - a. Minimize damage from windborne debris propelled at up to 35 km/h.
 - b. Minimize damage due to potential vandalism.
9. **Wear Resistance:** Design and select materials to provide resistance to normal wear and tear in accordance with code and the following:
 - a. **Elements Within Reach of Pedestrians:** Minimize degradation from rubbing and scratching caused by pedestrians, movement of equipment and machinery.
 - b. Minimize degradation caused by rain, salt water, and windblown dust and debris.
10. **Natural Light:** Provide fenestrations in shell to meet requirements for natural light as specified in Section 01 84 00 (*Facility Interior Performance Requirements*) and in accordance with the code referenced in this section and the following:
 - a. **Exterior Glazing:** Minimum 10 percent of total floor area for each occupied room SP1, SP2 and SP3; required for SRs except for toilet and changing rooms.
 - b. Provide high fenestration for SR1, SR2, SR7, SR8, and SR15.
11. **Natural Ventilation:** Design and construct shell to provide natural ventilation in accordance with IBC code and the following:
 - a. **Minimum Ventilation Opening Area:** 8 percent of total floor area for each occupied room and 3 percent for SR1, SR2, SR7, SR8, and SR15.
 - b. **Ventilation Area:** Minimum of 10 percent of wall area
 - c. Design ventilation to provide cross ventilation where possible.
12. **Ventilation of Special Spaces:** Design and construct shell to provide outside air movement through enclosed shell volumes in accordance with IBC code.

Minimum ventilation opening area shall be net 1 percent of total enclosed area, distributed to encourage uniform outside air movement through enclosed space.

13. **Thermal Performance:** Provide construction that will have thermal resistance as necessary to maintain interior comfort levels and the following:
- a. **Energy Efficiency:** Design and provide shell components that will result in low energy consumption and reduced maintenance costs.
 - b. **Condensation:** None on surfaces under [the following mean temperatures, relative humidity, and rainfall conditions](#):
 - 1) **Pacific Side¹:** 89.3% mean humidity, a mean 24-hour shaded temperature of 26.7 °C, and a monthly mean rainfall of 158.3 mm. The maximum registered temperature has been 40.2 °C, the maximum humidity, 99%; and the maximum monthly rainfall, 566.42 mm.
 - 2) **Atlantic Side²:** 79.2 % mean humidity, a mean 24-hour shaded temperature of 26.9°C, with a monthly mean rainfall of 251.5 mm. The maximum registered temperature has been 33.3 °C, the maximum humidity, 99.7%; and the maximum monthly rainfall, 955.04 mm.
 - 3) [See Sub-Clause 5.1 of the Conditions of Contract and Volume VI \(Reference Documents\), Part 7 \(Hydrometeorological Report\).](#)
 - c. **Components That Have Surfaces Facing Both Interior and Exterior Environment:** Condensation Resistance Factor (CRF) to meet requirement above when tested in accordance with AAMA 1503.
14. **Air Infiltration:** Maximum of 0.0003 m³/s per square meter of exterior surface area, measured in accordance with ASTM E 283 at differential pressure of 299 Pa. Use method of sealing joints between elements that will be effective given available construction practices. For air intake and exhaust openings, see also Section 01 86 13 (*Plant — Mechanical Systems and Equipment*).
15. **Water Penetration:** Design and select materials to prevent water penetration into the interior of the building, under conditions of rain driven by 35 km/h wind. Where roof coverings are not used over roofs, provide supplementary waterproof construction providing equivalent protection.
16. **Weather Resistance:** Design and select materials to minimize deterioration due to precipitation, sunlight, ozone, normal temperature changes, salt air, and atmospheric pollutants.
- a. **Deterioration:** [Includes corrosion, shrinking, cracking, spalling, delamination, abnormal oxidation, decay, and rot.](#)

¹ Data collected by PCC and ACP [from](#) January 1985 to July 2006 at Balboa.

² Data collected by PCC and ACP [from](#) January 1985 to July 2006 at Coco Solo and Limón Bay on the Atlantic Side.

- b. **Surfaces Exposed to View:** Deterioration adversely affecting aesthetic life span includes color fading, crazing, and delamination of applied coatings.
 - c. **Coating Performance:** AAMA 2605, minimum.
 - d. **Coating Salt Spray Resistance:** No deterioration when tested in accordance with ASTM B 117 for 1,000-hour exposure with 5 percent salt fog at 35 degrees C.
 - e. **Joint Components and Penetration Seals:** Shall be capable of resisting expected thermal expansion and contraction; use overlapping joints that shed water wherever possible.
 - f. **Transparent Elements (Glazing):** No haze, loss of light transmission, or color change during entire expected service life.
 - g. **Test Criteria:** Less than 1 percent change in haze, transmission, and color over 2-year exposure, when tested after natural exposure conditions or accelerated light and water conditions simulating natural exposure at Site, in accordance with ASTM D 1003; accelerated exposure documented with comparison to natural conditions.
 - h. **Service Temperature:** High temperature equal to that expected due to any combination of air temperature and heat gain from solar and other sources.
 - i. **Corrosion Resistance:** In locations exposed to the outdoor air or in potential contact with moisture inside shell assemblies, use only corrosion-resistant metals defined in paragraph 1.04 A.22.b. (*Corrosion Resistant Metals*) of this Section and that comply with Section 09 96 00 (*Corrosion Control Coatings*).
 - j. **Ozone Resistance:** Do not use materials that are adversely affected by ozone.
17. **Moisture Vapor Transmission:** Design shall prevent deterioration of materials due to condensation of moisture vapor inside assemblies.
- a. Use supplementary vapor retardant if necessary to meet requirements.
 - b. Use method of sealing joints between elements that will be effective given available construction practices.
18. **Acoustical Performance:** Design and construct the shell to limit sound transmission as follows:
- a. **Ambient Sound Level:** Maintain ambient sound levels in perimeter spaces within Noise Criteria (NC) ranges specified in Section 01 84 00 (*Facility Interior Performance Requirements*) during hours of occupancy.
 - b. **Exterior Noise Level:** Maintain maximum average daytime and nighttime noise level from interior sound sources in accordance with ACP “Manual de Seguridad y Salud Ocupacional”.

- c. **Vibration Control:** Use shell elements that will not resonate at frequencies that are characteristic of ambient exterior sound sources at the Site.
 - d. Provide minimum performance values for individual shell elements specified in ASTM and ISO standards designated as references of this section.
- 19. **Appearance:** Design and select materials to provide exterior appearance with characteristics as follows:
 - a. Compatible with adjacent buildings in same complex.
 - b. Conceal mechanical equipment, plumbing equipment, electrical equipment, piping, conduit, and ducts from transiting vessels.
- 20. **Cleanliness of Exterior Surfaces:** Design and select materials to:
 - a. Prevent attraction and adherence of dust and air-borne dirt and soot and minimize appearance of settled dust and dirt.
 - b. Be washed reasonably clean by normal precipitation.
 - c. ^{A17}Prevent dust and dirt that has been washed by normal precipitation ^{A17}, from settling over surfaces that are exposed to view.
 - d. Require minimum maintenance to keep clean.
- 21. **Operation and Maintenance:** For ease of maintenance and alteration, provide floors elevated for access, with removable panels, at operator station in the main control building [CB].
- 22. **Natural Hazards:** Design to resist damage from perching, nesting, and feeding birds.
- 23. **Products:**
 - a. **Structural Steel:** Conforming to ASTM A36, designed and detailed in accordance with AISC 325 and AWS D1.1.
 - b. **Corrosion-Resistant Metals:**
 - 1) Steel, hot-dipped galvanized per ASTM A 123.
 - 2) Stainless steel, American Iron and Steel Institute (AISI) Type 304 or 316 conforming to ASTM A 167 and ASTM A 176.
 - 3) (Reserved)
 - c. **Construct the Shell Using One of the Following:**
 - 1) Cast-in-place concrete designed in accordance with ACI 318. Portland cement shall comply with ASTM C 150 and reinforcement with ASTM C 615.
 - 2) Precast concrete designed in accordance with ACI 318.

- 3) Concrete masonry units conforming to ASTM C 90 or ASTM C 129.
- d. **For Exterior Floors:** Use pavement or concrete tiles as specified in Section 01 84 00 (*Facility Interior Performance Requirements*).
- e. **Do Not Use:**
 - 1) Wooden structural members.
 - 2) Wood joists, rafters, and deck.
 - 3) Load-bearing heavy timber wooden frames and decks.
 - 4) Glued-laminated wooden frames and decks.
 - 5) Load-bearing wooden stud walls; wooden joists, rafters, and decks; and minor structural steel.
 - 6) Non-reinforced load-bearing masonry.
- f. **For Structure-Supporting Roofs:**
 - 1) Use One or More of the Following:
 - a) Structural steel beams, columns, girders, joists, and wind-bracing conforming to ASTM A36, designed and detailed in accordance with AISC 325 and AWS D1.1. Purlins conforming to ASTM A 653.
 - b) Cast-in-place reinforced concrete beams, columns, walls, girders, and joists designed in accordance with ACI 318.
 - c) Precast concrete beams, columns, tees, and hollow slabs, designed in accordance with ACI 318.
 - d) Open-web steel joists or joist girders conforming to ASTM A36, designed and detailed in accordance with AISC 325 and AWS D1.1.
 - e) Load-bearing concrete masonry walls.
 - 2) Do not use wooden structural members.
- g. **Other Roof Elements:** Use one or more of the following, as required:
 - 1) Gutters.
 - 2) Downspouts.
 - 3) Flashing.
 - 4) Roof vent.
 - 5) Skylights.
 - 6) Reglets.
 - 7) Ridges.

24. **Methods of Construction:**

a. **Construct the Shell Using one or More of the Following Methods:**

- 1) Cast-in-place reinforced concrete.
- 2) Welded structural steel.
- 3) Bolted structural steel.
- 4) Precast concrete.
- 5) Pre-fabricated steel structure.
- 6) Insulated concrete form walls.
- 7) Reinforced masonry construction.

b. **Do Not Use:**

- 1) Geodesic domes.
- 2) Lift-slab construction.
- 3) Dead-flat roofs.

B. **Design Criteria for Exterior Enclosure:**

1. **Safety Glazing:** Do not use fully tempered glass more than 7.6 m above grade.

2. **Fire Resistance:**

- a. **All Materials of Exterior Enclosure:** Non-combustible, no exceptions.
- b. **Facades Enclosing Stairs:** Per NFPA 101 and IBC.
- c. **Facades Exposing Stairs or Stair Enclosures:** Per NFPA 101 and IBC.

3. **Structure:**

- a. **Structural Performance:** In accordance with ACI 530 requirements for concrete masonry unit walls and openings, including:
 - 1) **Tie Beams:** For wall over 2.5 m high and at each additional 2.5 m.
 - 2) Longitudinal ladder-type tie every second row of masonry block.
 - 3) A perimeter column as required by design and by REP 2004 or IBC.
- b. **Design Wind Loads:** In accordance with REP 2004.

4. **Products:**

- a. **Construct the Exterior Enclosure Using One or More of the Following:**
 - 1) Concrete masonry unit walls.
 - 2) Weatherproof concrete ventilation blocks.
 - 3) Cast-in-place concrete walls.

- 4) Sliding window in offices.
 - 5) Metal doors and rollup doors.
 - 6) Panic bars on exit doors.
 - 7) Heavy-duty hardware.
 - b. **Do Not Use:**
 - 1) Brick walls.
 - 2) Wood walls.
 - 3) Metal siding walls.
 - 4) Gypsum walls.
 - 5) Composite walls.
 - 6) PVC, medium-density fiberboard (MDFB), or wooden doors.
 - 7) PVC or wooden windows.
5. **Construction Methods and Techniques:**
 - a. **Construct the Exterior Enclosure Using the Following Methods:**
 - 1) Concrete unit masonry wall system or cast-in-place concrete in accordance with ACI 301, ACI 315, and ACI 318. Work shall conform to ACI 530 and ACI 530.1.
 - 2) Insulated concrete form walls
6. **Operation and Maintenance:**
 - a. Use roof, window, and door overhangs and roof drains to avoid wall stains and mold.
 - b. Connect roof drainage to the building drainage system to avoid water filtration and wall stains.
 - c. Use materials that sustain wash down/power wash operations.
 - d. Avoid openings where birds and bats can perch and nest.
 - e. Use sloped window sills and coved baseboards to avoid water filtration.
7. **Design Criteria for Walls:**
 - a. **Structure:**
 - 1) **Load Design:** Resistant to required forces in accordance with ASCE 7, REP 2004, and ACI 530.
 - 2) Provide field transmission loss (FTL) for façade in accordance with ASTM E 336.

- 3) **Railing Assemblies:** Resistant to required forces in accordance with ASCE 7 and REP 2004.

b. **Products:**

- 1) **Supporting Structure of Walls:** Use one or more of the following:
 - a) **Cast-in-Place Concrete:** Portland cement shall comply with ASTM C 150 and reinforcement with ASTM C 615.
 - b) Precast concrete in accordance with Section 03 30 00 (*Concrete*).
 - c) Load-bearing unit masonry assemblies conforming to ASTM C 90.
 - d) Non-load-bearing unit masonry assemblies conforming to ASTM C 129.
 - e) Secondary structural steel members conforming to ASTM A 36 and AISC 325.
 - f) Cold-formed metal framing conforming to AISC 325.
 - g) Glazed aluminum curtain wall conforming to ASTM B 221, ASTM B 308, and ASTM B 429.
 - h) Translucent wall panel assembly.
- 2) Do not use wood stud framing for the supporting structure of walls.
- 3) **Balcony Walls:** Same requirement as walls, except thermal performance is not required.
- 4) **Parapets:** Do not use parapets.
- 5) **Exterior Skin of Exterior Walls:** Do not use siding panels.
- 6) **Joint Sealers in Exterior Skin:** Use one of the following:
 - a) Silicone sealant conforming FED TT-S-001543.
 - b) Elastomeric joint sealant conforming ASTM C 920 or FED TT-S-00227E.
 - c) Polyurethane sealant.
 - d) Hollow neoprene gaskets.
- 7) **Air Barrier, if required:** Use one of the following:
 - a) Reinforced rubber.
 - b) Plastic sheet.
 - c) **Do Not Use:**
 - i. Board materials.
 - ii. Cement parging.

- 8) **Water Vapor Barrier:** Polyethylene sheeting conforming to ASTM D 4397.
 - 9) **Insulation:** Do not use:
 - a) Sprayed insulation.
 - b) Blown insulation.
 - 10) **Exterior Screens:** Use aluminum screens.
 - 11) **Exterior Railings:**
 - a) Aluminum railings shall conform to ASTM B 221, and ASTM B 241, ASTM B 429 and AWS D 10.7.
 - b) Galvanized steel railings shall use hot-dip galvanized pipe conforming to ASTM A 53 and AWS D1.1.
 - c) Stainless steel railings shall conform to ASTM A 554.
 - d) Do not use railings of wood, plastic, or non-galvanized carbon steel.
 - 12) **Exterior Ceilings and Soffits:** Use one of the following:
 - a) Portland cement plaster or stucco.
 - b) Gypsum exterior soffit board.
 - c) Linear aluminum ceiling.
 - 13) **Glazing:** For glass, use one of the following:
 - a) Heat-strengthened glass.
 - b) Fully tempered glass.
 - c) Tinted glass.
 - d) Low E glass.
 - e) Laminated glass.
 - f) Patterned glass.
 - g) Wired glass.
 - h) Double pane insulated glass units.
8. **Design Criteria for Windows:**
- a. **Fire Resistance:** Rating as required to maintain fire resistance rating of exterior walls that have windows.
 - b. **Emergency Escape:** Provide minimum opening size as required by code.
 - c. **Forced Entry Resistance:** Minimum of Class I in accordance with ASTM F 1233 and Grade 10 in accordance with ASTM F 588.
 - d. **Operable Openings and Ventilation Openings:** Equipped with means of keeping rain, insects, birds, and other animals out.

e. **Structure:**

- 1) **Lintels:** Constructed to span openings and support loads imposed by exterior wall; maximum deflection of 1/360 of span, vertically and horizontally.
- 2) **Wind Design:** No damage when tested in accordance with ASTM E 330 at 1.5 times positive and negative design wind loads using 10 second duration of maximum load.
 - a) **Members Not Supporting Glass:** Maximum deflection of 1/180 of span.
 - b) **Members Supporting Glass:** Maximum deflection of flexure limit of glass; with full recovery of glazing materials.

f. **Operation and Maintenance:**

- 1) **Cleanability:** Design glazed openings to permit the exterior surface to be cleaned from inside or outside without removing window sash. At the main control building [CB] apply transparent hydrophilic coating (silicon dioxide) on exterior surface of window glazing or similar product for self-cleaning purpose.
- 2) **Operating Components:** Remaining operable for 20 years under normal exposure conditions for the Site.
- 3) **Mechanical Ventilation Openings:** No moving parts on exterior of building or where accessible to occupants.

g. **Products:**

- 1) **Windows (Operable and Fixed):** Use one of the following:
 - a) Aluminum windows conforming to ASTM B 209, and ASTM B221, and AWS D 10.7. Finish shall conform to NAAMM Architectural Class 1, AA-A41.
 - b) Masonry unit ventilation blocks.
- 2) **Window Operation:** Use one of the following:
 - a) Double or single hung windows.
 - b) Horizontal sliding windows at office space.
 - c) Fixed non-operable windows at control display area of Main Control Building [CB].
- 3) **Glazing:** Double pane insulated units at main control building [CB]. Do not use:
 - a) Other metal windows.
 - b) Wooden windows.
 - c) Metal-clad wooden windows.
 - d) Plastic-clad wooden windows.

- e) Tubular plastic windows.
- f) Composite windows.
- 4) **Fixed Glazing:**
 - a) Glazing: Single pane except for main control building [CB], which requires double pane insulated units.
 - b) Use perimeter aluminum frame.
- 5) **Glazing:** Use one or more of the following:
 - a) Fully tempered, bullet-proof, laminated glass at front windows of [GH].
 - b) Flat glass conforming to ASTM C 1036.
 - c) Low E glass.
 - d) Laminated glass at ground floor windows.
 - e) Wired glass at lights in fire-rated openings for light introduction.
- 6) **Ventilation Openings:** Cover all natural and mechanical ventilation openings.
 - a) Use one of the following:
 - i. Aluminum stationary blade vents or louvers.
 - ii. Operable aluminum vents or louvers.
 - iii. Ventilation blocks (masonry units) for natural ventilation openings.
 - b) Do not use grilles.
- 7) **Protection Devices for Openings:** Provide all protection devices necessary to comply with performance requirements. Use one of the following:
 - a) Sun and rain control devices.
 - b) Insulation panels at control display area of the main control Building [CB].
 - c) Security window screens at the [GBs].
 - d) Do not use:
 - i. Shutters.
 - ii. Storm panels.
 - iii. Awnings.
- 8) **Other Exterior Opening Elements:** All components required to complete the opening.
- 9) **Lintels:** Use one of the following:

- a) Cast-in-place reinforced concrete.
 - b) Unit masonry with reinforcement.
 - c) Precast concrete.
 - d) Steel (for metal buildings).
- 10) **Sills:** Use one of the following:
- a) Cast-in-place reinforced concrete.
 - b) Precast concrete.
 - c) Unit masonry with reinforcement.
- 11) **Concealed Flashings:** Use aluminum flashing.
- 12) **Joint Sealers:** As specified herein.

9. **Design Criteria for Doors**

- a. **Emergency Egress:** Provide exit doors that are at least 915 mm wide, comply with NFPA 80, and are listed in UL Building Material Directory.
- b. **Fire Resistance:**
 - 1) **Doors Required by Code to be Fire Resistive:** Provide fire resistance rating as required by code, for fire resistance rating of exterior walls with doors.
 - 2) **Doors into Stairs:** Provide maximum 232-degree C temperature rise rating at 30 minutes standard fire test exposure.
- c. **Physical Security:**
 - 1) Doors that are not removable from outside without use of key.
 - 2) No glazing at locations not facing a street.
 - 3) Secure each exterior door using a "fail-secure" method that allows entrance plus exit from inside using only one motion.
 - 4) **Exit-Only Function:** The following must not allow entrance:
 - a) Exit doors opening from exit stairways directly to exterior.
 - b) Emergency exit doors that are not used for entrance.
 - 5) **Keys:** Type as required to minimize unauthorized entry.
 - a) New master keying system, with exterior doors on a separate "maintenance" master key.
 - b) **Key Changing:** All locks changeable without disassembly of lock cylinders; acceptable methods include use of standard mortise cylinders and interchangeable removable core cylinders.
 - c) **Keymaking Restrictions:** Key blanks and keymaking restricted to Employer.

- 6) **Lock Functions:** Appropriate to the location and function and as follows:
 - a) **Entrance Doors:** Public entry/exit ("nightlatch") (X02).
 - b) **Service Entry Doors:** Always locked, deadbolt (F98)
 - c) **Exit Doors from Stairwells and Fire Exits:** Exit only (F89) (with panic bar).
- 7) **Lock Function Definitions:** As described in BHMA A156.2 (F36-F48, F75-F94, F107-F109), A156.3 ("X" prefix), A156.5-("E" prefix), A156.12 (F95-F106), and A156.13 (F01-F25); type of lock required may also be governed by other criteria.
- 8) **Forced Entry:** Provide entrance doors capable of resisting forced entry equivalent to:
 - a) **Sliding Doors:** ASTM F 842 Grade 10. Minimum forced entry resistance of Class I in accordance with ASTM F 1233.
 - b) **Locks and Lock Cylinders:** BHMA A156.5 Security Grade 1.
 - c) **Exception for Automatic Sliding Doors:** Provide means of securing while allowing controlled entry and unlimited emergency exit.
- d. **Physical Endurance for Doors:**
 - 1) **Doors, Frames, and Hardware:** Shall comply with ANSI A 250.4 Level A, using hardware specified.
 - 2) **Doors, Frames, and Anchors:** Shall comply with NAAMM 862 endurance test requirements.
- e. **Glazing in Doors:** Where applicable, comply with requirements for safety glazing, security, and forced entry specified herein.
- f. **Structure:**
 - 1) **Lintels:** Constructed to span door openings and support loads imposed by exterior wall with maximum deflection vertically and horizontally of 1/360 of span.
 - 2) **Door Frames:** Constructed to span door opening with maximum deflection vertically and horizontally of 1/360 of span.
- g. **Operation and Maintenance:**
 - 1) **Service Life Span of Operating Components:** Remaining operable for 20 years under normal exposure conditions for the Site.
 - 2) **Ease of Use and Repair:** Provide doors that will be easy to use by occupants, easy to repair or service, and with operating components easy to replace.

h. **Products:**

- 1) **Main Entrance Doors:** Use one of the following for complex entrance at guardhouse [GH], except that turnstile stainless steel doors are required at pedestrian access in accordance with Section 01 87 00 (*Equipment and Furnishings*):
 - a) Forged iron.
 - b) Turnstile stainless steel doors at pedestrian access in accordance with Section 01 87 00 (*Equipment and Furnishings*) at [GH] and [GBs].
 - c) Automatic swinging or sliding doors for vehicular access in accordance with Section 01 86 13 (*Plant — Mechanical Systems and Equipment*).
- 2) **Use One of the Following for the Main Entrances to Buildings:**
 - a) Glazed hollow metal door at main control building [CB].
 - b) Hollow metal doors.
 - c) Galvanized steel coiling doors for access of equipment and work vehicles according to Section 01 86 13 (*Plant — Mechanical Systems and Equipment*).
- 3) **Door Accessories:**
 - a) Provide weather stripping, thresholds, and gaskets.
 - b) Provide removable or fixed mullions at double doors.
 - c) Provide heavy-duty stainless steel locks, door knobs, hinges, and other hardware.
- 4) **Chain Link Fence and Gates:** In accordance with Section 01 89 16 (*Site Construction*). Use one of the following types of gates:
 - a) ^{A4} (Reserved). ^{A4}
 - b) Sliding or swinging gates at [GBs] vehicular entrances and exits.
 - c) Swinging gates at secondary access points in perimeter fence.
 - d) Barrier at entrance and exit to employee parking lots [PLEs] located outside the complex fence. Include traffic barrier as per Section 28 16 46 (*Vehicular Control Systems*).
- 5) **Other Exterior Opening Elements:** Provide all components required to complete door openings: Lintels, sills, flashing, joint sealers, mullions, gaskets, jambs, frames, door controls, weather stripping, and thresholds.

- a) **Lintels:** Use one of the following:
 - i. Cast-in-place reinforced concrete for large doors or double doors.
 - ii. Precast concrete.
 - iii. Unit masonry with reinforcement for single doors.
 - iv. Steel (for metal buildings).
 - b) **Sills:** Use one of the following:
 - i. Cast-in-place reinforced concrete for large doors or double doors.
 - ii. Unit masonry with reinforcement for single doors.
 - iii. Steel (for metal buildings).
 - iv. Precast concrete.
 - c) **Overhangs and Concealed Flashings:** Use one of the following:
 - i. Cast-in-place reinforced concrete.
 - ii. Corrugated aluminum sheet over galvanized steel structure.
 - iii. Aluminum flashing.
 - d) **Joint Sealers:** Same as specified for exterior walls in this section.
- 6) **Glazing in Doors:**
- a) Single and double pane insulated glass units.
 - b) Use the following:
 - i. Laminated glass.
 - ii. Laminated tempered glass at [GH] doors.
- 7) **Hardware for Sliding or Swinging Doors:** Use one of the following:
- a) Forged iron.
 - b) Galvanized steel.
 - c) Use fire rated hardware on fire rated doors.
 - d) **Hinges:** Ball-bearing, heavy-weight hinges meeting the requirements in BHMA A156.1.

8) **Hardware for Building Entry/Exit Doors:**

- a) Use heavy-duty stainless steel hardware.
- b) Use fire rated hardware on fire rated doors conforming to UL 305.
- c) **Hinges:** Heavy-duty stainless steel ball bearings.
- d) **Exit Devices:** Unless specifically indicated as another type, concealed vertical rod type.
- e) **Locksets:** Unless specifically indicated as another type, heavy-duty stainless steel, bored (cylindrical) or interconnected lockset and deadbolt. Do not use rim type auxiliary locks or lock combinations requiring two hands for operation. Door locks and latches shall conform to BHMA A156.2 and ANSI/BHMA A156.13.
- f) **Door Closers for Air-Conditioned Spaces:** Unless specifically indicated as one type, surface overhead frame-mounted type, surface overhead door-mounted type. Do not use concealed overhead type, floor mounted type, spring hinges. Door controls and closers shall conform to BHMA A 156.4
- g) **Door Stops:** Unless specifically indicated as another type, floor- or wall-mounted type. Do not use overhead-mounted type.
- h) **Door Hold-Opens:** Unless specifically indicated as another type, floor-, wall-, or overhead door/frame-mounted type. Do not use hold-open feature in closer alone without a separate stop or magnetic hold-open.
- i) **Weatherstrip:** For head and side jamb, sills, and astragals.
- j) **Do Not Use:**
 - i. Different metals subject to galvanic action in direct contact with each other.
 - ii. Aluminum in direct contact with concrete or cementitious materials.

10. **Design Criteria for Exterior Wall Fixtures:**

- a. **Anchorage:** Design wall fixtures to be supported from building structural frame rather than from exterior wall.
- b. **Operation and Maintenance of Sign Lamps:** Minimum rated service life of 20,000 hours.
- c. **Signs:** May be aluminum extruded letters and numbers at all buildings.
- d. **Other Exterior Wall Fixtures:** Use the following where required:

- 1) CCVS cameras as per Section 28 23 00 (*Closed Circuit Video Systems*).
- 2) Exterior lights as per Section 26 50 00 (*Lighting Systems*).
- 3) Public Address Systems as per Section 27 51 16 (*Public Address Systems*).
- 4) **Do Not Use:** service fixtures or equipment supported on walls other than those previously mentioned.

C. **Design Criteria for Roofing:**

1. **Roof Worker Safety:** Design to provide safe design and safety measures as required by code and the following:
 - a. **Ladder Safety:** Comply with ANSI A14.3.
2. **Fire Resistance:** In addition to fire resistance specified in this section, provide materials that will prevent:
 - a. Roof surface catching fire due to external fire sources.
 - b. Roof coverings catching fire due to internal fire sources without the use of fire retardant treatment, unless treatment is permanent. Refer to ASTM E 108 Class A roof covering.
 - c. External fire sources from breaking through roof openings.
3. **Physical Security:** Consider the roof area and all roof openings unsupervised.
 - a. **Fixed Homogeneous Elements:** Minimum forced-entry resistance of Class I in accordance with ASTM F 1233.
 - b. **Roof Openings and Assemblies:** Minimum forced-entry resistance of Class I in accordance with ASTM F 1233 and of Grade 10 in accordance with ASTM F 476 and adapted to suit assembly.
 - c. **Operable Openings (if Required):** No unlocking devices accessible from outside.
 - d. **Skylights:** Minimum forced-entry resistance of Class I in accordance with ASTM F 1233.
4. **Fire/Smoke Ventilation:** As required by code.
 - a. **Heat and Smoke Vents in Roof:** Comply with the code.
 - 1) **Areas Required to be Vented:** Undivided floor areas over 186 square meters.
 - 2) **Design Fire Type:** Limited-growth (steady fire).
 - 3) **Vent Design:** NFPA 204, including curtain boards and ancillary elements.
 - 4) **Releasing Device:** Any type allowed by code.
 - 5) **Releasing Device Rating:** 55 degrees C above normal highest ambient temperature of space.

- 6) **Operation:** Open despite external design wind load; prevent inadvertent opening under design wind uplift.
 - 7) **Curtain Boards:** **Non-combustible material** and construction that resists passage of smoke.
5. **Structure:**
 - a. **Rainwater Load:** As required by REP 2004.
 - b. **Roof Component Wind Resistance:** As required by REP 2004.
 - c. **Roof Covering Substrate:** Sufficiently rigid or dense to support water barrier in a manner that prevents puncture due to traffic on roof.
 - d. **Wind Uplift:** Where roof covering has a lower air transmission rate than the roof superstructure, provide means of preventing blow-off or ballooning due to low negative pressure over roof.
 - e. **Self-Supporting Elements:** Same requirements as for superstructure.
 - f. **Glass Design:** Type, size, and thickness as required to comply with ASTM E 1300 and AAMA GDSG-1, as applicable.
 - g. **Structural Sealant Glazing Systems:** Comply with ASTM C 1184, including non-mandatory appendix, and AAMA TSGG.
6. **Heat and Acoustical Insulation:**
 - a. **R-Value:** Minimum 0.284 SI.
 - b. Acoustical values shall be in accordance with ASTM E 1007.
7. **Operation and Maintenance:**
 - a. **Ease of Service:**
 - 1) All components of roofing (not just roof covering) easily accessible by maintenance persons.
 - 2) Rooftop fixtures serviceable by simple replacement of parts, minimizing time required on roof and eliminating need for repair work in weather.
 - b. **Water Conductor Capacity:** As required by code, based on 10 year, 5 minute intensity.
 - c. **Cleaning:** If applicable, design and install skylights to allow cleaning without the need for climbing or walking on either the structural members or the glazing, using cleaning tools with handles not longer than 3 m.
 - d. **Replacement:** Design and install glazed elements so that glazing can be replaced from outside without need for scaffolding or other temporary supports inside the building.
8. **Products:**
 - a. **Roof Covering:** Use one of the following:
 - 1) Corrugated aluminum zinc alloy on steel sheet, conforming to ASTM B 209.

- 2) Aluminum alloy 3003, H16 temper, ASTM B 209.
 - 3) Aluminum zinc alloy on steel sheet (Galvalume), ASTM A 792/A 792M structural grade 37, coating AZ-50.
 - 4) Corrugated sheet metal steel roofing, factory coated.
 - 5) Metal roof panels or tiles, factory coated.
 - 6) Sloped concrete roof.
 - 7) Translucent roof panels.
- b. **Finishes for Metal Roofing:** Use one of the following:
- 1) Fluoropolymer coating (70 percent Kynar 500 (tm) or Hylar 5000(tm)), minimum two coats.
 - 2) Siliconized polyester coating.
- c. **Water Collectors and Conductors:** Use one of the following:
- 1) Metal piping.
 - 2) Aluminum sheet metal.
 - 3) Factory-finished galvanized steel sheet metal.
 - 4) Galvanized steel sheet metal.
 - 5) Molded or extruded polyvinyl chloride plastic.
 - 6) Copper sheet metal.
 - 7) Stainless steel sheet metal.
- d. **Flashing, Trim, and Accessories:** Use one of the following:
- 1) Aluminum sheet metal, conforming to ASTM B 209.
 - 2) Factory-finished galvanized sheet metal.
 - 3) Galvanized steel sheet metal.
 - 4) Copper sheet metal.
 - 5) Stainless steel sheet metal.
- e. **Roof Openings:** Use one of the following:
- 1) Gravity ventilators at ridge.
 - 2) Ridge vents.
- f. **Ventilation Openings over Plane of Roof:** Use one of the following:
- 1) Ridge vents.
 - 2) Fixed gravity ventilators.

- 3) Wind-assisted gravity ventilators.

1.05 SUBMITTALS:

A. ^{A17}Intermediate Design: ^{A17}

1. Concept drawings of proposed solution indicating overall building configuration, scale, and relationship between buildings.
2. Identification of proposed methods of meeting security requirements.
3. Identification of major structural materials and systems.
4. Detailed listing of design criteria and preliminary analysis, prepared by licensed professionals.
5. Description of flood design approach to be used.
6. Name, qualifications, and license number of the following professional staff responsible for the design of the facilities:
 - a. Architect.
 - b. Structural engineer.
 - c. Mechanical engineer for building heating ventilating and cooling (HVAC) systems.
 - d. Mechanical engineer for building plumbing systems.
 - e. Acoustical engineer.
 - f. Electrical engineer.

B. ^{A17}Final Design: ^{A17}

1. For Shell:

- a. Architectural drawings and rendering showing all building elements that are part of the shell with sizes and locations to scale.
- b. Identification of assemblies and methods for fire resistance.
- c. Drawings showing openings, enclosure elements, floor areas, and ventilation solutions to achieve required amenity and comfort for buildings.
- d. Acoustical analysis for occupied building, prepared by an acoustical engineer.
- e. Engineering design calculations and drawings prepared by licensed engineer.
- f. For structures engineered by manufacturers or fabricators other than the Contractor, detailed design analysis prepared by a licensed structural engineer, with approval of engineer-of-record recorded, including stamped shop drawings.

2. **For Superstructure:**

- a. Certifications of laboratory tested fire resistive materials to be used.
- b. Design calculations, for future reference.
- c. Construction procedures and methods to be used.
- d. Drawings, showing construction and assembly details.
- e. **Welding Procedures:** Certified Welding Procedures Specifications (WPS) and Certified Procedure Qualification Records (PQR).
- f. Certification of products to be used.

3. **For Exterior Enclosure:**

a. **For Walls.**

- 1) Product data of materials to be used.
- 2) Identification of materials and their proposed use and location.
- 3) Certifications of products.

b. **For Exterior Windows:**

- 1) For standard manufactured products, certification of specified properties by the National Fenestration Rating Council (NFRC) or other testing agency acceptable to the Employer's Representative; for custom-fabricated elements, test reports.
- 2) For standard manufactured fenestration products, certification of specified properties by NFRC or other testing agency acceptable to the Employer's Representative; for other elements, test reports.
- 3) Identify air velocity; show AMCA 511 certified water penetration ratings.
- 4) Details of method of weather sealing; test reports on window/frame assemblies.
- 5) Shop drawings details; specifications; technical data; and location of windows, accessories, and hardware.
- 6) Certification of compliance with code or standards.

c. **For Exterior Doors:**

- 1) Details of method of weather sealing; test reports on door/frame assemblies.
- 2) Shop drawings; specifications; technical data; and location of doors, accessories, and hardware.
- 3) Certification of compliance with code or standards.

- d. **For Exterior Wall Fixtures:**
 - 1) Details of letter and number signs and support system.
 - 2) Shop drawings, specifications, and technical data.
- 4. **For Roofing:**
 - a. Evidence of product compliance.
 - b. Identification of proven-in-use products and assemblies; in addition to substantiation items specified in Section 01 10 00 (*General Project Requirements*), provide, for minimum material thickness or gage, impermeability, overlaps, and shop drawings of details for flashing and accessories.
 - c. As specified for service life span in Section 01 10 00 (*General Project Requirements*), including service life analysis and life cycle cost analysis.
 - d. Calculations of capacity.
 - e. Fire rating identification numbers recognized by code authorities, on the construction drawings.
 - f. Water flood tests of roof areas that can accumulate rainwater if primary drains are blocked, up to depth for which structure is designed.
 - g. Quality assurance program to be implemented to ensure complete and correct installation of weather-barrier elements.
- C. **Before Taking-Over Documentation:**
 - 1. As built drawings, manuals, reports, and supporting documentation.
 - 2. Field tests to verify compliance with performance requirements.
 - 3. Certification of service life for building components.
 - 4. **Roofing**
 - a. Reports of first 3 significant rainfalls after completion of each roofing element, including rainfall amount and intensity, wind speed and direction, and results of inspection of roof and underside.
 - b. Provide manufacturer and installer warranty.
 - c. **Water Tests:**
 - 1) Comply with requirements of static pressure test in accordance with ASTM E 331.
 - 2) Comply with requirements of cyclic pressure test in accordance with ASTM E 547.
 - 5. **Life Cycle Cost Analysis:** Service life span for shell is the same as building service life, except as follows:
 - a. **Load-Bearing Structural Members:** Minimum of 50 years. No anticipated deterioration when protected as required.

- b. **Protective Elements:** Minimum 25 years.
- c. **Wall Primary Weather-Barrier Elements:** Minimum 50 years functional and aesthetic service life, excluding joint sealers.
- d. **Transparent Elements (Glazing):** Same as other wall primary weather-barrier elements, except accidental breakage is considered normal wear-and-tear.
- e. **Joint Sealers:** Minimum 20 years before replacement.
- f. **Surfaces Exposed to View:** Minimum 10 years aesthetic service life; deterioration includes color fading, crazing, and delamination of applied coatings.
- g. **Roof Covering Weather-Barriers:** Minimum 20 years, fully functional.

1.06 QUALITY ASSURANCE:

- A. Provide certification that the buildings meet requirements included in paragraph 1.03 (*Requirements*). Materials, products, and workmanship shall conform to minimum codes, regulations, and standards included in this section.
 - 1. Water penetration for superstructure, exterior enclosure, and roofing.
 - 2. Weather resistance for superstructure, exterior enclosure, and roofing.
 - 3. Impact resistance for shell, superstructure, exterior enclosure, and roofing.
 - 4. Moisture vapor transmission for superstructure, exterior enclosure, and roofing.
 - 5. Wear resistance for superstructure, exterior enclosure, and roofing.
 - 6. Joint components and penetration seals.
 - 7. Glazing reflection from roof or windows.
 - 8. Service temperature.
 - 9. Corrosion resistance.
 - 10. Fireproofing.
 - 11. Finishes.
- B. Provide coverage for roofing materials, installation, and workmanship during the Defects Notification Period.
- C. Safety, security, environmental, and functional space requirements shall be inspected in the presence of the Employer's Representative.^{A16}

END OF SECTION