

SECTION 03 30 00

CAST-IN-PLACE CONCRETE
02/19

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE (ACI)

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| ACI 117 | (2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary |
| ACI 301 | (2016) Specifications for Structural Concrete |
| ACI 302.1R | (2015) Guide for Concrete Floor and Slab Construction |
| ACI 305R | (2010) Guide to Hot Weather Concreting |
| ACI SP-2 | (2007; Abstract: 10th Edition) ACI Manual of Concrete Inspection |

ASTM INTERNATIONAL (ASTM)

| | |
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| ASTM A970/A970M | (2018) Standard Specification for Headed Steel Bars for Concrete Reinforcement |
| ASTM C1012/C1012M | (2018b) Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution |
| ASTM E1155 | (2014) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers |

ARCHITECTURAL INSTITUTE OF JAPAN (AIJ)

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| JASS 5 | (2015) Reinforced Concrete Work |
| JASS 6 | (2015) Structural Steelwork Specification for Building Construction |

JAPANESE STANDARDS ASSOCIATION (JSA)

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| JIS A 1101 | (2014) Method of Test for Slump of Concrete |
| JIS A 1107 | (2014) Method of Sampling and Testing for Compressive Strength of Drilled Cores of Concrete |

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| JIS A 1108 | (2018) Method of Test for Compressive Strength of Concrete |
| JIS A 1115 | (2014) Method of Sampling Fresh Concrete |
| JIS A 1116 | (2005) Method of Test for Unit Mass and Air Content of Fresh Concrete by Mass Method |
| JIS A 1118 | (2017) Method of Test for Air Content of Fresh Concrete by Volumetric Method |
| JIS A 1128 | (2014) Method of Test for Air Content of Fresh Concrete by Pressure Method |
| JIS A 1132 | (2014) Method of Making and Curing Concrete Specimens |
| JIS A 1146 | (2017) Method of Test for Alkali-Silica Reactivity of Aggregates by Mortar-bar Method |
| JIS A 1154 | (2012) Method of Test for Chloride Ion Content in Hardened Concrete |
| JIS A 1804 | (2009) Methods of Test for Production Control of Concrete - Method of Rapid Test for Identification of Alkali-Silica Reactivity of Aggregate |
| JIS A 5005 | (2009) Crushed Stone and Manufactured Sand for Concrete |
| JIS A 5011 | (2013) Slag Aggregate for Concrete |
| JIS A 5308 | (2014) Ready-Mixed Concrete |
| JIS A 5758 | (2022) Sealants for Sealing and Glazing in Buildings |
| JIS A 6201 | (2015) Fly Ash for Use in Concrete |
| JIS A 6204 | (2011) Chemical Admixtures for Concrete |
| JIS A 8652 | (1995) Metal Panels for Concrete Form |
| JIS A 9521 | (2017) Thermal Insulation Materials for Buildings |
| JIS G 3101 | (2020) Rolled Steels for General Structure |
| JIS G 3112 | (2010) Steel Bars for Concrete Reinforcement |
| JIS G 3444 | (2021) Carbon Steel Tubes for General Structure |
| JIS G 3551 | (2005) Welded Wire Mesh and Rebar Grid |

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|-------------------------------|---|
| JIS H 8641 | (2021) Hot Dip Galvanized Coatings |
| JIS K 6251 | (2017) Rubber, Vulcanized or Thermoplastic-Determination of Tensile Stress-Strain Properties |
| JIS K 6253 | (2012) Rubber, Vulcanized or Thermoplastic - Determination of Hardness |
| JIS K 6258 | (2016) Rubber, Vulcanized or Thermoplastic - Determination of the Effect of Liquids |
| JIS K 6773 | (1999) Polyvinylchloride Waterstop |
| JIS K 7124-1 | (1999) Plastics Film and Sheeting - Determination of Impact Resistance by the Free-falling Dart Method - Part 1: Staircase Methods |
| JIS K 7127 | (1999) Plastics - Determination of Tensile Properties - Part 3: Test Conditions for Films and Sheets |
| JIS K 7129-2 | (2019) Plastics Film and Sheeting - Determination of Water Vapor Transmission Rate - Part 2: Infrared Detection Sensor Method |
| JIS Q 1011 | (2009) Conformity Assessment - Conformity Assessment for Japanese Industrial Standards - Guidance on Third-party Certification System for Ready-mixed Concrete Products |
| JIS Q 17011 | (2005) Conformity Assessment - General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies |
| JIS Q 17025 | (2005) General Requirements for the Competence of Testing and Calibration Laboratories |
| JIS R 5210 | (2009) Portland Cement |
| JIS R 5211 | (2019) Portland Blast-Furnace Slag Cement |
| JIS R 5212 | (2019) Portland Pozzolan Cement |
| JIS R 5213 | (2019) Portland Fly Ash Cement |
| JIS Z 3881 | (2014) Standard Qualification Procedure for Gas Pressure Welding Technique of Steel Bars for Concrete Reinforcement |
| JAPAN ROAD ASSOCIATION (JARA) | |
| JRA PDCG | (2019) Pavement Design and Construction Guidelines |

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM (MLIT)

MLIT-SS Chapter 6

MLIT Architectural Standard
Specifications, Chapter 6 Concrete

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC

(2009) Leadership in Energy and
Environmental Design(tm) New Construction
Rating System

1.2 DEFINITIONS

- a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, and slag cement.
- b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.
- c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.
- d. "Supplementary cementing materials" (SCM) include coal fly ash, slag cement, natural or calcined pozzolans, and ultra-fine coal ash when used in such proportions to replace the portland cement that result in improvement to sustainability and durability and reduced cost.
- e. "Design strength" ($f'c$) is the specified compressive strength of concrete at time(s) specified in this section to meet structural design criteria.
- f. "Mass Concrete" is any concrete system that approaches a maximum temperature of 70 degrees C within the first 72 hours of placement. In addition, it includes all concrete elements with a section thickness of 1 meter or more regardless of temperature.
- g. "Mixture proportioning" is the process of designing concrete mixture proportions to enable it to meet the strength, service life and constructability requirements of the project while minimizing the initial and life-cycle cost.
- h. "Mixture proportions" are the masses or volumes of individual ingredients used to make a unit measure (cubic meter or cubic yard) of concrete.
- i. "Pozzolan" is a siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.
- j. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

- [Concrete Curing Plan
-] Quality Control Plan; G[, [_____]]
Laboratory Accreditation; G[, [_____]]

SD-02 Shop Drawings

- [Formwork
-] Reinforcing Steel; G[, [_____]]

SD-03 Product Data

- Formwork Materials
- Reinforcement; (LEED NC)
- Liquid Chemical Floor Hardeners and Sealers
- Mechanical Reinforcing Bar Connectors

- [Pumping Concrete
-][Finishing Plan

-] SD-04 Samples
- [Slab Finish Sample
-][Surface Finish Samples

-] SD-05 Design Data
- Concrete Mix Design; G[, [_____]]

SD-06 Test Reports

- Concrete Mix Design; G[, [_____]]
- Fly Ash
- Pozzolan
- Slag Cement
- Aggregates

- [Tolerance Report
-] Compressive Strength Tests; G[, [_____]]
- [Unit Weight of Structural Concrete
-][Chloride Ion Concentration
-]
- [Air Content
-]
- Slump Tests
- Water
- SD-07 Certificates
 - Reinforcing Bars
 - Welder Qualifications
- [VOC Content for Form Release Agents, Curing Compounds, and Concrete Penetrating Sealers
-]
- Safety Data Sheets
- Field Testing Technician and Testing Agency
- SD-08 Manufacturer's Instructions
 - Liquid Chemical Floor Hardeners and Sealers
 - Joint Sealants; (LEED NC)
- [Curing Compound

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with JASS 5 and MLIT-SS Chapter 6 or ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Follow JASS 5 and MLIT-SS Chapter 6, requirements and recommendations. Do not deliver concrete until vapor retarder, [vapor barrier,] forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions, including [_____.] Do not store concrete curing compounds or sealers in occupied spaces.

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be

accurately identified after bundles are broken and tags removed.

1.6 QUALITY ASSURANCE

1.6.1 Design Data

1.6.1.1 Concrete Mix Design

Sixty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, supplementary cementitious materials, [fibers], and admixtures; and applicable reference specifications. Submit mill test and all other test for cement, supplementary cementitious materials, aggregates, and admixtures. Provide documentation of maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained versus sieve size. Provide mix proportion data using at least three different water-cementitious material ratios for each type of mixture, which produce a range of strength encompassing those required for each type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Resubmit data on concrete components if the qualities or source of components changes. For previously approved concrete mix designs used within the past twelve months, the previous mix design may be re-submitted without further trial batch testing if accompanied by material test data conducted within the last six months. Obtain mix design approval from the contracting officer prior to concrete placement.

1.6.2 Shop Drawings

1.6.2.1 Reinforcing Steel

Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars. Reproductions of contract drawings are unacceptable.

1.6.3 Control Submittals

[1.6.3.1 Concrete Curing Plan

Submit proposed materials, methods and duration for curing concrete elements in accordance with JASS 5 and MLIT-SS Chapter 6.

] [1.6.3.2 Pumping Concrete

Submit proposed materials and methods for pumping concrete. Submittal must include mix designs, pumping equipment including type of pump and size and material for pipe, and maximum length and height concrete is to be pumped.

] [1.6.3.3 Finishing Plan

Submit proposed material and procedures to be used in obtaining the finish

for the [_____] floors. Include qualification of person to be used for obtaining floor tolerance measurement, description of measuring equipment to be used, and a sketch showing lines and locations the measuring equipment will follow.

][1.6.3.4 VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Submit certification for the form release agent, curing compounds, and concrete penetrating sealers that indicate the VOC content of each product.

]1.6.3.5 Safety Data Sheets

Submit Safety Data Sheets (SDS) for all materials that are regulated for hazardous health effects. SDS must be readily accessible during each work shift to employees when they are at the construction site.

1.6.4 Test Reports

1.6.4.1 Fly Ash and Pozzolan

Submit test results in accordance with JIS A 6201 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date.

1.6.4.2 Slag Cement

Submit test results in accordance with JIS R 5211 for slag cement. Submit test results performed within 6 months of submittal date.

1.6.4.3 Aggregates

Submit test results in accordance with JIS A 5005, JIS A 1146 and JIS A 1804 as required in the paragraph titled ALKALI-AGGREGATE REACTION.

1.6.5 Field Samples

[1.6.5.1 Slab Finish Sample

Install minimum of 3000 mm by 3000 mm slab. Slab finish sample must not be part of the final project. Finish as required by specification.

][1.6.5.2 Surface Finish Samples

Provide a minimum of three sample concrete panels for each finish for each mix design, 1000 mm by 1000 mm, 75 mm thick. Use the approved concrete mix design(s). Provide sample panels on-site at locations directed. Once approved, each set of panels must be representative of each of the finishes specified and of the workmanship and finish(es) required. Do not remove or destroy samples until directed by the Contracting Officer.

]1.6.6 Quality Control Plan

Develop and submit for approval a concrete quality control program in accordance with the guidelines of JASS 5 and MLIT-SS Chapter 6 and as specified herein. The plan must include approved laboratories. Provide direct oversight for the concrete qualification program inclusive of associated sampling and testing. All quality control reports must be provided to the Contracting Officer, Quality Manager and Concrete Supplier.

1.6.7 Quality Control Personnel Certifications

The Contractor must submit for approval the responsibilities of the various quality control personnel, including the names and qualifications of the individuals in those positions and a quality control organizational chart defining the quality control hierarchy and the responsibility of the various positions. Quality control personnel must be employed by the Contractor.

Submit Japan Concrete Institute (JCI) or American Concrete Institute (ACI) certification for the following:

- a. CQC personnel responsible for inspection of concrete operations.
- b. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews.
- c. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I or equivalent Japan Concrete Institute (JCI) Concrete Field Testing Technician.

1.6.7.1 Quality Manager Qualifications

The quality manager must hold a current license as a First Class Kenchikushi architect registered under standard law of Japan with experience on at least five similar projects. Evidence of extraordinary proven experience may be considered by the Contracting Officer as sufficient to act as the Quality Manager.

1.6.7.2 Field Testing Technician and Testing Agency

Submit data on qualifications of proposed testing agency and technicians for approval by the Contracting Officer prior to performing testing on concrete.

- a. Work on concrete under this contract must be performed by an ACI Concrete Field Testing Technician Grade 1 qualified in accordance with ACI SP-2 or equivalent JCI Concrete Field Testing Technician. Equivalent certification programs must include requirements for written and performance examinations as stipulated in ACI SP-2.
- b. Testing agencies that perform testing services on concrete materials including reinforcing steel must meet the requirements of JASS 5, JIS Q 1011, JIS Q 17011 and JIS Q 17025.

1.6.8 Laboratory Qualifications for Concrete Qualification Testing

The concrete testing laboratory must have the necessary equipment and experience to accomplish required testing. The laboratory must meet the requirements of JASS 5, JIS Q 1011, JIS Q 17011 and JIS Q 17025.

1.6.9 Laboratory Accreditation

Laboratory and testing facilities must be provided by and at the expense of the Contractor. The laboratories performing the tests must be accredited in accordance with JIS Q 17011 and JIS Q 17025. The accreditation must be current and must include the required test methods, as specified. Furthermore, the testing must comply with the following requirements:

- a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies must be performed by an accredited laboratory and under the direction of a Chief Concrete Engineer or Concrete Engineer authorized by the Japan Concrete Institute or First Class Kenchikushi who is competent in concrete materials and must sign all reports and designs.
- b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by JIS A 1132.
- c. Contractor Quality Control: All sampling and testing must be performed by an approved, onsite, independent, accredited laboratory.

1.7 ENVIRONMENTAL REQUIREMENTS

Provide space ventilation according to material manufacturer recommendations, at a minimum, during and following installation of concrete curing compound and sealer. Maintain one of the following ventilation conditions during the curing period or for 72 hours after installation:

- a. Supply 100 percent outside air 24 hours a day.
- b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 13 degrees C and 29 degrees C and humidity is between 30 percent and 60 percent.
- c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.7.1 Submittals for Environmental Performance

- a. Provide SDS product information data showing that form release agents meet any environmental performance goals such as using vegetable and soy based products.
- b. Provide SDS product information data showing that concrete adhesives meet any environmental performance goals including low emitting, low volatile organic compound products.

1.8 QUALIFICATIONS FOR WELDING WORK

Welding procedures must be in accordance with JASS 6.

Verify that Welder qualifications are in accordance with JIS Z 3881 for welding of reinforcement or under an equivalent qualification test approved in advance. Welders are permitted to do only the type of welding for which each is specifically qualified.

PART 2 PRODUCTS

2.1 FORMWORK MATERIALS

- a. Form-facing material in contact with concrete must be [lumber,]

[plywood,] [tempered concrete-form-grade hardboard,] [metal,]
[plastic,] or [treated paper that creates specified appearance and
texture of concrete surface]. Submit product information on proposed
form-facing materials if different from that specified herein.

- b. Design formwork, shores, reshores, and backshores to support all vertical and lateral loads transmitted to them and to comply with applicable building code requirements.
- c. Design formwork and shoring for load redistribution resulting from stressing of post-tensioned reinforcement. Ensure that formwork allows movement resulting from application of prestressing force.
- d. Design formwork to withstand pressure resulting from placement and vibration of concrete and to maintain specified tolerances.
- e. Design formwork to accommodate waterstop materials in joints at locations indicated in Contract Documents.
- f. Provide temporary openings in formwork if needed to facilitate cleaning and inspection.
- g. Design formwork joints to inhibit leakage of mortar.
- h. Limit deflection of facing materials for concrete surfaces exposed to view to [1/240][1/400][_____] of center-to-center spacing of facing supports.
 - i. Do not use earth cuts as forms for vertical or sloping surfaces.
 - j. Submit product information on proposed form-facing materials if different from that specified herein.
 - k. Submit shop drawings for formwork, shoring, reshoring, and backshoring. Shop drawings must be signed and sealed by a licensed design engineer or First Class Kenchikushi.
 - l. Submit procedure for reshoring and backshoring, including drawings signed and sealed by a First Class Kenchikushi. Include on shop drawings the formwork removal procedure and magnitude of construction loads used for design of reshoring or backshoring system. Indicate in procedure the magnitude of live and dead loads assumed for required capacity of the structure at time of reshoring or backshoring.
 - m. Submit manufacturer's product data on form liner proposed for use with each formed surface.

2.1.1 Wood Forms

Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with Japan Agricultural Standard concrete form panels or better or hardboard for smooth form lining.[Submit data verifying that composite wood products contain no urea formaldehyde resins.]

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to Japan Agricultural Standard concrete form, not less than 12 mm thick.

2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to Japan Agricultural Standard high density form overlay, not less than 12 mm thick.

2.1.2 Steel Forms

Provide JIS A 8652 steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORMWORK ACCESSORIES

- a. Use commercially manufactured formwork accessories, including ties and hangers.
- b. Form ties and accessories must not reduce the effective cover of the reinforcement.

2.2.1 Form Ties

- a. Use form ties with ends or end fasteners that can be removed without damage to concrete.
- b. Where indicated in Contract Documents, use form ties with integral water barrier plates or other acceptable positive water barriers in walls.
- c. The breakback distance for ferrous ties must be at least [50 mm] [19 mm] [_____] for Surface Finish-2.0 or Surface Finish-3.0, as defined in ACI 301.
- [d. If the breakback distance is less than 19 mm, use coated or corrosion-resistant ties.
-] e. Submit manufacturer's data sheet on form ties.

2.2.2 Waterstops

Submit manufacturer's data sheet on waterstop materials and splices.

2.2.2.1 PVC Waterstop

Polyvinylchloride waterstops must conform to JIS K 6773.

2.2.2.2 Rubber Waterstop

Rubber waterstops must conform to JIS K 6773.

2.2.2.3 Thermoplastic Elastomeric Rubber Waterstop

Thermoplastic elastomeric rubber waterstops must conform to JIS K 6258.

2.2.2.4 Hydrophilic Waterstop

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water must conform to the following requirements when tested in accordance to JIS K 6251: Tensile strength 2.9 MPa minimum; ultimate elongation 600 percent minimum. Hardness must be

50:[40] minimum on the type A durometer when tested in accordance with JIS K 6253 and the volumetric expansion ratio in distilled water at 20 degrees C must be 3 to 1 minimum.

2.2.3 Biodegradable Form Release Agent

- a. Provide form release agent that is colorless, biodegradable, and [rapeseed oil-based] [soy oil-based] [water-based], with a [low maximum of 55 grams/liter (g/l)] [zero] VOC content.[A minimum of [85][_____] percent of the total product must be biobased material.]
- b. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
- c. Provide form release agent that reduces formwork moisture absorption, and does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene. Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.
- d. Submit manufacturer's product data on formwork release agent for use on each form-facing material.

2.2.4 Chamfer Materials

Use lumber materials with dimensions of 20 x 20 mm.

2.2.5 Construction and movement joints

- a. Submit details and locations of construction joints in accordance with the requirements herein.
- b. Locate construction joints within middle one-third of spans of slabs, beams, and girders. If a beam intersects a girder within the middle one-third of girder span, the distance between the construction joint in the girder and the edge of the beam must be at least twice the width of the larger member.
- c. For members with post-tensioning tendons, locate construction joints where tendons pass through centroid of concrete section.
- d. Locate construction joints in walls and columns at underside of slabs, beams, or girders and at tops of footings or slabs.
- e. Make construction joints perpendicular to main reinforcement.
- f. Provide movement joints where indicated in Contract Documents or in accepted alternate locations.
- g. Submit location and detail of movement joints if different from those indicated in Contract Documents.
- h. Submit manufacturer's data sheet on expansion joint materials.
- i. Provide keyways where indicated in Contract Documents.[Longitudinal keyways indicated in Contract Documents must be at least 40 mm deep, measured perpendicular to the plane of the joint.]

2.2.6 Perimeter Insulation

Perimeter insulation must be expanded polystyrene conforming to JIS A 9521 meeting the following performance requirements:

- a. Density: 300 kg/m³ minimum.
- b. Compressive Strength at yield or 10 percent deformation: 104 kPa, min.
- c. Thermal Resistance of 25 mm thickness: 0.70 K·m²/W
- d. Flexural Strength: 240 kPa, min.
- e. Water Absorption by total immersion, volume percent: 3 percent maximum.
- f. Dimensional Stability (change in dimensions): 2 percent maximum.
- g. Water Vapor Permeance of 25 mm thickness: 200 ng/Pa·s·m², maximum.

Comply with EPA requirements in accordance with Section 01 33 29
SUSTAINABILITY REPORTING

2.2.7 Other Embedded items

Use sleeves, inserts, anchors, and other embedded items of material and design indicated in Contract Documents.

2.3 CONCRETE MATERIALS

2.3.1 Cementitious Materials

2.3.1.1 Portland Cement

- a. Unless otherwise specified, provide cement that conforms to JIS R 5210, Ordinary Portland Cement [and meets [low alkali content requirements][_____].]
- b. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.
- c. Submit information along with evidence demonstrating compliance with referenced standards. Submittals must include types of cementitious materials, manufacturing locations, shipping locations, and certificates showing compliance.
- d. Cementitious materials must be stored and kept dry and free from contaminants.

[2.3.1.2 Blended Cements

Blended cements must conform to [JIS R 5211, Type [A] [B] [C]], [JIS R 5212, Type [A] [B] [C]], [JIS R 5213, Type [A] [B] [C]].

]2.3.2 Water

- a. Water or ice must comply with the requirements of JIS A 5308, Annex C.

- b. Minimize the amount of water in the mix. Improve workability by adjusting the grading of the aggregate and using admixture rather than by adding water.
- c. Water must be [potable] [from rainwater collection] [from graywater] [from recycled water]; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.
- d. Protect mixing water and ice from contamination during storage and delivery.
- e. Submit test report showing water complies with JIS A 5308, Annex C.
- [f. When nonpotable source is proposed for use, submit documentation on effects of water on strength and setting time in compliance with JIS A 5308, Annex C.

]2.3.3 Aggregate

2.3.3.1 Normal-Weight Aggregate

- a. Aggregates must conform to JIS A 5005 [unless otherwise specified in the Contract Documents or approved by the contracting officer][____].
- b. Aggregates used in concrete must be obtained from the same sources and have the same size range as aggregates used in concrete represented by submitted field test records or used in trial mixtures.
- c. Store and handle aggregate in a manner that will avoid segregation and prevents contamination by other materials or other sizes of aggregates. Store aggregates in locations that will permit them to drain freely. Do not use aggregates that contain frozen lumps.
- d. Submit types, pit or quarry locations, producers' names, aggregate supplier statement of compliance with JIS A 5005 and JIS A 1804 expansion data not more than 18 months old.

2.3.4 Admixtures

- a. Chemical admixtures must conform to JIS A 6204.
- b. Air-entraining admixtures must conform to JIS A 6204.
- c. Chemical admixtures for use in producing flowing concrete must conform to JIS A 6204.
- d. Do not use calcium chloride admixtures[.][unless approved by the contracting officer.]
- e. Admixtures used in concrete must be the same as those used in the concrete represented by submitted field test records or used in trial mixtures.
- f. Protect stored admixtures against contamination, evaporation, or damage.
- g. To ensure uniform distribution of constituents, provide agitating equipment for admixtures used in the form of suspensions or unstable

solutions. Protect liquid admixtures from freezing and from temperature changes that would adversely affect their characteristics.

- h. Submit types, brand names, producers' names, manufacturer's technical data sheets, and certificates showing compliance with standards required herein.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Concrete Curing Materials

Provide concrete curing material in accordance with JASS 5 and MLIT-SS Chapter 6. Submit product data for concrete curing compounds. Submit manufactures instructions for placement of curing compound.

2.4.2 Nonshrink Grout

Packaged dry, hydraulic cement non-shrink grout, that is non-metallic, non-corrosive, non-bleed, with the following performance requirements when prepared using the highest water-to-solids ratio, maximum flow, or most fluid consistency at 23.0 plus or minus 2.0 degrees C:

- a. Minimum compressive strengths: 7.0 MPa at 1 day; 17.0 MPa at 3 day; 24.0 MPa at 7 day; and 34.0 MPa at 28 day.
- b. Early height change (maximum percent at time of final setting): plus 4.0 percent.
- c. Height change of moist cured hardened grout: 0.0 to plus or minus 0.3 percent at 1-day, 3-day, 14-day and 28-day.

2.4.3 Floor Finish Materials

2.4.3.1 Liquid Chemical Floor Hardeners and Sealers

- a. Hardener must be a colorless aqueous solution containing a blend of inorganic silicate or silicate material and proprietary components combined with a wetting agent; that penetrates, hardens, and densifies concrete surfaces. Submit manufactures instructions for placement of liquid chemical floor hardener.
- b. Use concrete penetrating sealers with a low (maximum 100 grams/liter, less water and less exempt compounds) VOC content. Submit manufactures instructions for placement of sealers.

2.4.4 Expansion/Contraction Joint Filler

Preformed, bituminous joint fiber filler for concrete paving and structural concrete construction. Provide joint filler meeting the following performance requirements:

- a. Density: 300 kg/m³ minimum.
- b. Compression: The load required to compress the test specimen to 50 percent of its thickness before test shall not be less than 690 kPa and not more than 5100 kPa. If the nominal thickness of the specimen is less than 13 mm a maximum load of 8600 kPa is permitted.
- c. Extrusion/Protrusion: Test specimen shall be compressed to 50 percent

of its thickness before test with three edges restrained. The amount of extrusion/protrusion of the free edge shall not exceed 6 mm.

- d. Recovery: The test specimen shall be compressed to 50 percent of its thickness before test. The load shall be released immediately after application. At the end of 10 minutes after release of the applied load, the specimen shall have recovered to at least 70 percent of its thickness before test.
- e. Water Absorption: The test specimen when submerged under 25 mm of water shall absorb not more than 15 percent by volume in 24 hours for 10 mm thickness and over.

Material must be 13 mm thick[, unless otherwise indicated]. [and of a width applicable for the joint formed]. [Backer material shall be closed cell, polyethylene foam material with a density between 20-45 kg/m³; Greater than 95 percent compression recovery; compression deflection 38 kPa; Greater than 160kPa tensile strength; and 200 degrees C heat resistance for hot applied sealants].

2.4.5 Joint Sealants and Seals

[Submit manufacturer's product data, indicating VOC content.] [Joint sealants conforming to the requirements of Section 07 92 00 JOINT SEALANTS].

2.4.5.1 Horizontal Surfaces, 3 Percent Slope, Maximum

JIS A 5758, multi-component sealant, Class 25, traffic [non-traffic]. [Hot-applied joint sealant for sealing cracks in concrete and asphalt pavements shall be in conformance with the applicable requirements of the JRA PDCG - Pavement Design and Construction Guidelines.]

2.4.5.2 Vertical Surfaces Greater Than 3 Percent Slope

JIS A 5758, multi-component sealant, non-sag, Class 25, traffic [non-traffic].

2.4.6 Vapor Retarder [and Vapor Barrier]

Preformed, flexible polyethylene sheeting to be used as vapor retarder in contact with soil or granular fill under concrete slabs, minimum 0.25 mm [0.38 mm] thickness or other equivalent material meeting the following performance requirements:

- a. Water Vapor Permeance, JIS K 7129-2 or equivalent test procedure: 2.28 ng/(m² · s · Pa), max.
- b. Water Vapor Permeance after wetting, drying and soaking [, after heat conditioning] [, after low temperature conditioning] [, after soil organism conditioning], JIS K 7129-2 or equivalent test procedure: 2.28 ng/(m² · s · Pa), max.
- c. Tensile Strength, JIS K 7127: 2.4 kN/m [5.3 kN/m] [7.9 kN/m], min.
- d. Puncture Resistance, JIS K 7124-1: 475 g [1700 g] [2200 g], min.

[Preformed, flexible polyethylene sheeting to be used as vapor barrier in

contact with soil or granular fill under concrete slabs, minimum 0.38 mm thickness or other equivalent material with the following performance requirements:

- a. Water Vapor Permeance, JIS K 7129-2 or equivalent test procedure: 0.57 ng/(m²·s ·Pa), max.
- b. Water Vapor Permeance after wetting, drying and soaking [, after heat conditioning] [, after low temperature conditioning] [, after soil organism conditioning], JIS K 7129-2 or equivalent test procedure: 0.57 ng/(m²·s ·Pa), max.
- c. Tensile Strength, JIS K 7127: 7.9 kN/m, min.
- d. Puncture Resistance, JIS K 7124-1: 2200 g, min.]

Consider plastic vapor retarders and vapor barriers and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

2.5 CONCRETE MIX DESIGN

2.5.1 Properties and Requirements

- a. Use materials and material combinations listed in this section and the contract documents.
- b. Cementitious material content must be adequate for concrete to satisfy the specified requirements for strength, w/cm, durability, and finishability described in this section and the contract documents.

[The minimum cementitious material content for concrete used in floors must meet the following requirements:

| Nominal maximum size of aggregate, mm | Minimum cementitious material content, kg per cubic meter |
|---------------------------------------|---|
| 37.5 | 280 |
| 25 | 310 |
| 19 | 320 |
| 9.5 | 360 |

-]
- c. Selected target slump must meet the requirements this section, the contract documents, and must not exceed 230 mm. Concrete must not show visible signs of segregation.
 - d. The target slump must be enforced for the duration of the project. Determine the slump by JIS A 1101. Slump tolerances must meet the requirements of JASS 5 and MLIT-SS Chapter 6.
 - e. The nominal maximum size of coarse aggregate for a mixture must not exceed three-fourths of the minimum clear spacing between reinforcement, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

- f. Concrete must be air entrained for members assigned to Exposure Class F1, F2, or F3. The total air content must be in accordance with the requirements of the paragraph titled DURABILITY.
- g. Measure air content at the point of delivery in accordance with JIS A 1118 or JIS A 1128.
- h. Concrete for slabs to receive a hard-troweled finish must not contain an air-entraining admixture or have a total air content greater than 3 percent.
- i. Concrete properties and requirements for each portion of the structure are specified in the table below. Refer to the paragraph titled DURABILITY for more details on exposure categories and their requirements.

| | Minimum $f'c$ MPa | Exposure Categories[^] | Miscellaneous Requirements |
|---------------------------------|--------------------------------------|---|---|
| Footings | [36] [21] [____] at 28 days | [S0] [S1] [S2] [S3]; [C0] [C1] [C2]; [W0] [W1]; [F0] [F1] [F2] [F3] | [Max. slump: [15 cm] [____]] [Nominal maximum aggregate size must be [12.5 mm][19 mm][25 mm] [____]] |
| Columns and walls | [36] [21] [____] at 28 days | [S0] [S1] [S2] [S3]; [C0] [C1] [C2]; [W0] [W1]; [F0] [F1] [F2] [F3] | [Nominal maximum aggregate size must be [12.5 mm][19 mm][25 mm] [____]] |
| Beams and elevated slabs | [36] [21] [____] at 28 days | [S0] [S1] [S2] [S3]; [C0] [C1] [C2]; [W0] [W1]; [F0] [F1] [F2] [F3] | [Nominal maximum aggregate size must be [12.5 mm][19 mm][25 mm] [____]] |
| Slabs-on-ground | [36] [21] [____] at 28 days | [S0] [S1] [S2] [S3]; [C0] [C1] [C2]; [W0] [W1]; [F0] [F1] [F2] [F3] | |

| | Minimum $f'c$ MPa | Exposure Categories ^A | Miscellaneous Requirements |
|--------------------------|------------------------------------|---|--------------------------------|
| Concrete Toppings | [36] [21] [_____] at 28 days | [S0] [S1] [S2] [S3]; [C0] [C1] [C2]; [W0] [W1]; [F0] [F1] [F2] [F3] | [Max. slump: [15 cm] [_____]] |

2.5.2 Durability

2.5.2.1 Alkali-Aggregate Reaction

Do not use any aggregate susceptible to alkali-carbonate reaction (ACR) to reduce the potential of alkali-silica reaction (ASR). For each aggregate used in qualifying concrete mixtures, the expansion result of the aggregate and cementitious materials combination determined in accordance with JIS A 1146 must not exceed 0.10 percent at an age of 16 days.

2.5.2.2 Freezing and Thawing Resistance

- a. Provide concrete meeting the following requirements based on exposure class assigned to members for freezing-and-thawing exposure in Contract Documents:

| Exposure class | Maximum w/cm^* | Minimum $f'c$, MPa | Air content | Additional Requirements |
|-------------------|------------------|---------------------|---------------------------|---|
| F0 | N/A | 18 | | N/A |
| F1 | 0.55 | 24 | Depends on aggregate size | N/A |
| F2 | 0.45 | 30 | Depends on aggregate size | See limits on maximum cementitious material by mass |
| F3 | 0.40 | 36 | Depends on aggregate size | See limits on maximum cementitious material by mass |
| F3 plain concrete | 0.45 | 30 | Depends on aggregate size | See limits on maximum cementitious material by mass |

*The maximum w/cm limits do not apply to lightweight concrete.

- b. Concrete must be air entrained for members assigned to Exposure Class

F1, F2, or F3. The total air content must meet the requirements of the following table:

| Nominal maximum aggregate size, mm | Total air content, percent*^ | |
|------------------------------------|------------------------------|-------------------|
| | Exposure Class F2 and F3 | Exposure Class F1 |
| 9.5 | 7.5 | 6.0 |
| 12.5 | 7.0 | 5.5 |
| 19.0 | 6.0 | 5.0 |
| 25.0 | 6.0 | 4.5 |
| 37.5 | 5.5 | 4.5 |
| 50 | 5.0 | 4.0 |
| 75 | 5.5 | 3.5 |

*Tolerance on air content as delivered must be plus/minus 1.5 percent.

^For f'_c greater than 36 MPa psi, reducing air content by 1.0 percentage point is acceptable.

- c. Submit documentation verifying compliance with specified requirements.
- d. For sections of the structure that are assigned Exposure Class F3, submit certification on cement composition verifying that concrete mixture meets the requirements of the following table:

| Cementitious material | Maximum percent of total cementitious material by mass* |
|---|---|
| Fly ash or other pozzolans conforming to JIS A 6201 | 25 |
| Slag cement conforming to JIS A 5011 | 50 |

*Total cementitious material also includes JIS R 5210, fly ash, other pozzolans, and slag cement. The maximum percentages above must include:

- i. Fly ash or other pozzolans present in Type IP JIS R 5212 blended cement.
- ii. Slag cement present in Type IS JIS R 5211 blended cement.

^Fly ash or other pozzolans must constitute no more than 25 percent of the total mass of the cementitious materials.

2.5.2.3 Corrosion and Chloride Content

- a. Provide concrete meeting the requirements of the following table based on the exposure class assigned to members requiring protection against reinforcement corrosion in Contract Documents.
- b. Submit documentation verifying compliance with specified requirements.
- c. Water-soluble chloride ion content contributed from constituents including water, aggregates, cementitious materials, and admixtures must be determined for the concrete mixture by JIS A 1154 at age between 28 and 42 days.
- d. The maximum water-soluble chloride ion (Cl^-) content in concrete, percent by mass of cement is as follows:

| Exposure class | Maximum w/cm* | Minimum f'c, MPa | Maximum water-soluble chloride ion (Cl^-) content in concrete, percent by mass of cement |
|-----------------------|----------------------|-------------------------|---|
| Reinforced concrete | | | |
| C0 | N/A | 18 | 1.00 |
| C1 | N/A | 18 | 0.30 |
| C2 | 0.4 | 36 | 0.15 |
| Prestressed concrete | | | |
| C0 | N/A | 18 | 0.06 |
| C1 | N/A | 18 | 0.06 |
| C2 | 0.4 | 36 | 0.06 |

*The maximum w/cm limits do not apply to lightweight concrete.

2.5.2.4 Sulfate Resistance

- a. Provide concrete meeting the requirements of the following table based on the exposure class assigned to members for sulfate exposure.

| Exposure class | Maximum w/cm* | Minimum f'c MPa | Required cementitious materials-types | | Calcium chloride admixture |
|-----------------------|----------------------|------------------------|--|---------------------------|-----------------------------------|
| | | | JIS R 5210 | JIS R 5211, JIS R 5212 | |
| S0 | N/A | 17 | N/A | N/A | No restrictions |

| Exposure class | Maximum w/cm* | Minimum f'c MPa | Required cementitious materials-types | | Calcium chloride admixture |
|----------------|---------------|-----------------|---|---|----------------------------|
| | | | JIS R 5210 | JIS R 5211, JIS R 5212 | |
| S1 | 0.50 | 28 | II (moderate sulfate resistant)*^ | IP, portland pozzolan cement (moderate sulfate resistant); IS, portland blast furnace slag cement (<70) (moderate sulfate resistant) | No restrictions |
| S2 | 0.45 | 31 | IV (low heat of hydration)*^ | IP, portland pozzolan cement (high sulfate resistant); IS, portland blast furnace slag cement (<70) (high sulfate resistant) | Not permitted |
| S3 | 0.45 | 31 | V (high sulfate resistant) + pozzolan or slag cement ** | IP, portland pozzolan cement (high sulfate resistant) + pozzolan or slag cement^; IS, portland blast furnace slag cement (<70) (high sulfate resistant) + pozzolan or slag cement * | Not permitted |

* For seawater exposure, other types of portland cements with tricalcium aluminate (C3A) contents up to 10 percent are acceptable if the w/cm does not exceed 0.40.

** The amount of the specific source of the pozzolan or slag cement to be used shall be at least the amount determined by test or service record to improve sulfate resistance when used in concrete containing Type V cement. Alternatively, the amount of the specific source of the pozzolan or slag used shall not be less than the amount tested in accordance with ASTM C1012/C1012M and meeting the requirements maximum expansion requirements listed herein.

^ Other available types of cement, such as Type III or Type I, are acceptable in exposure classes S1 or S2 if the C3A contents are less than 8 or 5 percent, respectively.

b. The maximum w/cm limits for sulfate exposure do not apply to

lightweight concrete.

- c. Alternative combinations of cementitious materials of those listed in this paragraph are acceptable if they meet the maximum expansion requirements listed in the following table:

| Exposure class | Maximum expansion when tested using ASTM C1012/C1012M | | |
|----------------|---|---------------------------|--------------|
| | At 6 months | At 6 months | At 18 months |
| S1 | 0.10 percent | N/A | N/A |
| S2 | 0.05 percent | 0.10 percent [^] | N/A |
| S3 | N/A | N/A | 0.10 percent |

[^]The 12-month expansion limit applies only when the measured expansion exceeds the 6-month maximum expansion limit.

2.5.2.5 Concrete Temperature

The temperature of concrete as delivered must not exceed [35 degrees C] [_____].

2.5.2.6 Concrete Permeability

- a. Provide concrete meeting the requirements of the following table based on exposure class assigned to members requiring low permeability in the Contract Documents.

| Exposure class | Maximum w/cm* | Minimum f'c, MPa | Additional minimum requirements |
|----------------|---------------|------------------|---------------------------------|
| W0 | N/A | 18 | None |
| W1 | 0.5 | 27 | None |

*The maximum w/cm limits do not apply to lightweight concrete.

- b. Submit documentation verifying compliance with specified requirements.

2.5.3 Trial Mixtures

Trial mixtures must be in accordance to JASS 5 and MLIT-SS Chapter 6.

2.5.4 Ready-Mix Concrete

Provide concrete that meets the requirements of JIS A 5308.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by JIS A 5308:

- a. Type and brand cement

b. Cement and supplementary cementitious materials content in 43-kilogram bags per cubic meter of concrete

c. Maximum size of aggregate

d. Amount and brand name of admixtures

e. Total water content expressed by water cementitious material ratio

2.6 REINFORCEMENT

a. Bend reinforcement cold. Fabricate reinforcement in accordance with fabricating tolerances of JASS 5 and MLIT-SS Chapter 6.

b. When handling and storing coated reinforcement, use equipment and methods that do not damage the coating. If stored outdoors for more than 2 months, cover coated reinforcement with opaque protective material.

c. Submit manufacturer's certified test report for reinforcement.

d. Submit placing drawings showing fabrication dimensions and placement locations of reinforcement and reinforcement supports. Placing drawings must indicate locations of splices, lengths of lap splices, and details of mechanical and welded splices.

e. Submit request with locations and details of splices not indicated in Contract Documents.

f. Submit request to place column dowels without using templates.

[g. Submit request and procedure to field-bend or straighten reinforcing bars partially embedded in concrete at locations not indicated in Contract Documents. Field bending or straightening of reinforcing bars is permitted [where indicated in the Contract Documents][in the following locations: [_____]]

] h. Submit request for field cutting, including location and type of bar to be cut and reason field cutting is required.

2.6.1 Reinforcing Bars

a. Reinforcing bars must be deformed, except spirals, load-transfer dowels, and welded wire reinforcement, which may be plain.

b. JIS G 3112, grades and sizes as indicated. [Cold drawn wire used for spiral reinforcement must conform to JIS G 3551.]

[Provide reinforcing bars that contain a minimum of [100][_____] percent recycled content.][See Section 01 33 29 SUSTAINABILITY REPORTING for cumulative total recycled content requirements.]

c. [Reinforcing bars may contain post-consumer or post-industrial recycled content.][Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.]

d. Submit mill certificates for reinforcing bars.

2.6.1.1 Headed Reinforcing Bars

Headed reinforcing bars must conform to ASTM A970/A970M including Annex A1, and other specified requirements.

2.6.1.2 Bar Mats

- a. Bar mats must conform to JIS G 3551.

2.6.2 Mechanical Reinforcing Bar Connectors

- a. Provide 125 percent minimum yield strength of the reinforcement bar.
- b. Mechanical splices for galvanized reinforcing bars must be galvanized or coated with dielectric material.
- c. Mechanical splices used with epoxy-coated or dual-coated reinforcing bars must be coated with dielectric material.
- d. Submit data on mechanical splices demonstrating compliance with this paragraph.

2.6.3 Wire

- a. [Provide wire reinforcement that contains a minimum of [100] [_____] percent recycled content.][See Section 01 33 29 SUSTAINABILITY REPORTING for cumulative total recycled content requirements. Wire reinforcement may contain post-consumer or post-industrial recycled content.]Provide flat sheets of welded wire reinforcement for slabs and toppings.
- b. Plain or deformed steel wire must conform to JIS G 3551.

2.6.4 Welded Wire Reinforcement

- a. Use welded wire reinforcement specified in Contract Documents and conforming to one or more of the specifications given herein.
- b. Plain welded wire reinforcement must conform to JIS G 3551, with welded intersections spaced no greater than 300 mm apart in direction of principal reinforcement.
- c. Deformed welded wire reinforcement must conform to JIS G 3551, with welded intersections spaced no greater than 400 mm apart in direction of principal reinforcement.
- d. Zinc-coated (galvanized) welded wire reinforcement must conform to JIS H 8641. Coating damage incurred during shipment, storage, handling, and placing of zinc-coated (galvanized) welded wire reinforcement must be repaired in accordance with JASS 6. If damaged area exceeds 2 percent of surface area in each linear foot of each wire or welded wire reinforcement, the sheet containing the damaged area must not be used. The 2 percent limit on damaged coating area shall include repaired areas damaged before shipment.

2.6.5 Reinforcing Bar Supports

- a. Provide reinforcement support types within structure as required by

Contract Documents. Reinforcement supports must conform to JASS 5 and MLIT-SS Chapter 6.

- b. Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.
- c. [Minimum [5][10][_____] percent post-consumer recycled content, or minimum [20][40][_____] percent post-industrial recycled content.] [See Section 01 33 29 SUSTAINABILITY REPORTING for cumulative total recycled content requirements. Plastic and steel may contain post-consumer or post-industrial recycled content.]

2.6.6 Dowels for Load Transfer in Floors

Provide greased dowels for load transfer in floors of the type, design, weight, and dimensions indicated. Provide dowel bars that are plain-billet steel conforming to JIS G 3112, Grade SD295. Provide dowel pipe that is steel conforming to JIS G 3444 STK400.

[Plate dowels must conform to JIS G 3101 SS400, and must be of size and spacing indicated. Plate dowel system must minimize shrinkage restraint by [using a tapered shape] [or] [formed void] [or] [by having compressible material on the vertical faces with a thin bond breaker on the top and bottom dowel surfaces.]

2.6.7 Welding

- a. Provide weldable reinforcing bars that conform to JIS G 3112, grades and sizes as indicated. The maximum carbon content shall not exceed 0.55 percent with carbon not exceeding 0.30 percent and manganese not exceeding 1.5 percent.
- b. Comply with JIS Z 3881 unless otherwise specified. Do not tack weld reinforcing bars.
- c. Welded assemblies of steel reinforcement produced under factory conditions, such as welded wire reinforcement, bar mats, and deformed bar anchors, are allowed.

PART 3 EXECUTION

3.1 EXAMINATION

- a. Do not begin installation until substrates have been properly constructed; verify that substrates are level.
- b. If substrate preparation is the responsibility of another installer, notify Contracting Officer of unsatisfactory preparation before processing.
- c. Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Contracting Officer and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete

before the concrete is poured.

3.2.1 General

- a. Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.
- b. Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

- a. When subgrade material is semi-porous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited, or seal subgrade surface by covering surface with specified vapor retarder.
- b. When subgrade material is porous, seal subgrade surface by covering surface with specified vapor retarder.

3.2.3 Subgrade Under Slabs on Ground

- a. Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.
- b. Previously constructed subgrade or fill must be cleaned of foreign materials
- c. Finish surface of capillary water barrier under interior slabs on ground must not show deviation in excess of 6 mm when tested with a 3000 mm straightedge parallel with and at right angles to building lines.
- d. Finished surface of subgrade or fill under exterior slabs on ground must not be more than 6 mm above or 30 mm below elevation indicated.

3.2.4 Edge Forms and Screed Strips for Slabs

- a. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment.
- b. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.5 Reinforcement and Other Embedded Items

- a. Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.
- b. When concrete is placed, reinforcement must be free of materials deleterious to bond. Reinforcement with rust, mill scale, or a combination of both will be considered satisfactory, provided minimum nominal dimensions, nominal weight, and minimum average height of deformations of a hand-wire-brushed test specimen are not less than applicable ASTM specification requirements.

3.3 FORMS

- a. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade.
- b. Chamfer above grade exposed joints, edges, and external corners of concrete [20 mm]. Place chamfer strips in corners of formwork to produce beveled edges on permanently exposed surfaces.[Do not bevel reentrant corners or edges of formed joints of concrete.]
- c. Provide formwork with clean-out openings to permit inspection and removal of debris.
- d. Inspect formwork and remove foreign material before concrete is placed.
- e. At construction joints, lap form-facing materials over the concrete of previous placement. Ensure formwork is placed against hardened concrete so offsets at construction joints conform to specified tolerances.
- f. Provide positive means of adjustment (such as wedges or jacks) of shores and struts. Do not make adjustments in formwork after concrete has reached initial setting. Brace formwork to resist lateral deflection and lateral instability.
- g. Fasten form wedges in place after final adjustment of forms and before concrete placement.
- h. Provide anchoring and bracing to control upward and lateral movement of formwork system.
- i. Construct formwork for openings to facilitate removal and to produce opening dimensions as specified and within tolerances.
- j. Provide runways for moving equipment. Support runways directly on formwork or structural members. Do not support runways on reinforcement. Loading applied by runways must not exceed capacity of formwork or structural members.
- k. Position and support expansion joint materials, waterstops, and other embedded items to prevent displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with removable material to prevent concrete entry into voids.
- l. Clean surfaces of formwork and embedded materials of mortar, grout, and foreign materials before concrete placement.

3.3.1 Coating

- a. Cover formwork surfaces with an acceptable material that inhibits bond with concrete.
- b. If formwork release agent is used, apply to formwork surfaces in accordance with manufacturer's recommendations before placing reinforcement. Remove excess release agent on formwork prior to concrete placement.
- c. Do not allow formwork release agent to contact reinforcement or

hardened concrete against which fresh concrete is to be placed.

3.3.2 Reshoring

- a. Do not allow structural members to be loaded with combined dead and construction loads in excess of loads indicated in the accepted procedure.
- b. Install and remove reshores or backshores in accordance with accepted procedure.
- c. For floors supporting shores under newly placed concrete, either leave original supporting shores in place, or install reshores or backshores. Shoring system and supporting slabs must resist anticipated loads. Locate reshores and backshores directly under a shore position or as indicated on formwork shop drawings.
- d. In multistory buildings, place reshoring or backshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms, and construction live loads.

3.3.3 Reuse

- a. Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.
- b. Wood forms must not be clogged with paste and must be capable of absorbing high water-cementitious material ratio paste.
- c. Remove leaked mortar from formwork joints before reuse.

3.3.4 Forms for Standard Rough Form Finish

Provide formwork in accordance with JASS 5 and MLIT-SS Chapter 6 with a surface finish, ACI 301 SF-1.0, for formed surfaces that are to be concealed by other construction.

3.3.5 Forms for Standard Smooth Form Finish

Provide formwork in accordance with JASS 5 and MLIT-SS Chapter 6 with a surface finish, ACI 301 SF-3.0, for formed surfaces that are exposed to view. [Do not provide mockup of concrete surface appearance and texture.]

3.3.6 Form Ties

- a. For post-tensioned structures, do not remove formwork supports until stressing records have been accepted by the Contracting Officer.
- b. After ends or end fasteners of form ties have been removed, repair tie holes in accordance with JASS 5 and MLIT-SS Chapter 6.

3.3.7 Tolerances for Form Construction

- a. Construct formwork so concrete surfaces conform to tolerances in JASS 5 and MLIT-SS Chapter 6.
- b. Position and secure sleeves, inserts, anchors, and other embedded items such that embedded items are positioned within JASS 5 and MLIT-SS Chapter 6 tolerances.

- c. To maintain specified elevation and thickness within tolerances, install formwork to compensate for deflection and anticipated settlement in formwork during concrete placement. Set formwork and intermediate screed strips for slabs to produce designated elevation, camber, and contour of finished surface before formwork removal. If specified finish requires use of vibrating screeds or roller pipe screeds, ensure that edge forms and screed strips are strong enough to support such equipment.

3.3.8 Removal of Forms and Supports

- a. If vertical formed surfaces require finishing, remove forms as soon as removal operations will not damage concrete.
- b. Remove top forms on sloping surfaces of concrete as soon as removal will not allow concrete to sag. Perform repairs and finishing operations required. If forms are removed before end of specified curing period, provide curing and protection.
- c. Do not damage concrete during removal of vertical formwork for columns, walls, and sides of beams. Perform needed repair and finishing operations required on vertical surfaces. If forms are removed before end of specified curing period, provide curing and protection.
- [d. Leave formwork and shoring in place to support construction loads and weight of concrete in beams, slabs, and other structural members until in-place required strength of concrete is reached.
-] e. Form-facing material and horizontal facing support members may be removed before in-place concrete reaches specified compressive strength if shores and other supports are designed to allow facing removal without deflection of supported slab or member.

3.3.9 Strength of Concrete Required for Removal of Formwork

If removal of formwork, reshoring, or backshoring is based on concrete reaching a specified in-place strength, mold and field-cure cylinders in accordance with JIS A 1132. Test cylinders in accordance with JIS A 1108.

3.4 WATERSTOP INSTALLATION AND SPLICES

- a. Provide waterstops in construction joints as indicated.
- b. Install formwork to accommodate waterstop materials. Locate waterstops in joints where indicated in Contract Documents. Minimize number of splices in waterstop. Splice waterstops in accordance with manufacturer's written instructions. Install factory-manufactured premolded mitered corners.
- c. Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Protect waterstops protruding from joints from damage.

3.4.1 PVC Waterstop

Make splices by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically

designed for waterstop welding. Reform waterstops at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled, must show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.4.2 Rubber Waterstop

Rubber waterstops must be spliced using cold bond adhesive as recommended by the manufacturer.

3.4.3 Thermoplastic Elastomeric Rubber Waterstop

Fittings must be shop made using a machine specifically designed to mechanically weld the waterstop. A portable power saw must be used to miter or straight cut the ends to be joined to ensure good alignment and contact between joined surfaces. Maintain continuity of the characteristic features of the cross section of the waterstop (for example ribs, tabular center axis, and protrusions) across the splice.

3.4.4 Hydrophilic Waterstop

Miter cut ends to be joined with sharp knife or shears. The ends must be adhered with adhesive.

3.5 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

- a. Unless otherwise specified, placing reinforcement and miscellaneous materials must be in accordance to JASS 5 and MLIT-SS Chapter 6. Provide bars, welded wire reinforcement, wire ties, supports, and other devices necessary to install and secure reinforcement.
- b. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.
- c. Nonprestressed cast-in-place concrete members must have concrete cover for reinforcement given in the following table:

| Concrete Exposure | Member | Reinforcement | Specified cover, mm |
|---|--------|---------------|---------------------|
| Cast against and permanently in contact with ground | All | All | 75 |

| Concrete Exposure | Member | Reinforcement | Specified cover, mm |
|--|---|--|---------------------|
| Exposed to weather or in contact with ground | All | D19 through D51 bars | 50 |
| | | D16, 16 mm diameter smooth, or 16 mm diameter deformed wire, and smaller | 40 |
| Not exposed to weather or in contact with ground | Slabs, joists, and walls | D38, D41 and D51 bars | 40 |
| | | D35 bar and smaller | 20 |
| | Beams, columns, pedestals, and tension ties | Primary reinforcement, stirrups, ties, spirals, and hoops | 40 |

- d. Cast-in-place prestressed concrete members must have concrete cover for reinforcement, ducts, and end fittings given in the following table:

| Concrete Exposure | Member | Reinforcement | Specified cover, mm |
|---|----------------------------------|------------------------------------|---------------------|
| Cast against and permanently in contact with ground | All | All | 75 |
| Exposed to weather or in contact with ground | Slabs, joists, and walls | All | 25 |
| | All other | All | 40 |
| Not exposed to weather or in contact with ground | Slabs, joists, and walls | All | 20 |
| | Beams, columns, and tension ties | Primary reinforcement | 40 |
| | | Stirrups, ties, spirals, and hoops | 25 |

- e. Precast nonprestressed or prestressed concrete members manufactured under plant conditions must have concrete cover for reinforcement, ducts, and end fittings given in the following table:

| Concrete Exposure | Member | Reinforcement | Specified cover, mm |
|--|-----------|--|---------------------|
| Exposed to weather or in contact with ground | Walls | D38, D41 and D51 bars; tendons larger than 40 mm diameter | 40 |
| | | D35 bars and smaller; 16 mm diameter smooth, or 16 mm diameter deformed wire, and smaller; tendons and strands 40 mm and smaller | 20 |
| | All other | D38, D41 and D51 bars; tendons and strands larger than 40 mm diameter | 50 |
| | | D19 through D35 bars; tendons and strands larger than 16 mm diameter through 40 mm | 40 |
| | | D16 bar, 16 mm diameter smooth, or 16 mm diameter deformed wire, and smaller; tendons and strands 16 mm diameter and smaller | 30 |

| Concrete Exposure | Member | Reinforcement | Specified cover, mm |
|--|---|--|---|
| Not exposed to weather or in contact with ground | Slabs, joists, and walls | D38, D41 and D51 bars; tendons larger than 40 mm diameter | 30 |
| | | Tendons and strands 40 mm diameter and smaller | 20 |
| | | D35, 16 mm diameter smooth, or 16 mm diameter deformed wire, and smaller | 16 |
| | Beams, columns, pedestals, and tension ties | Primary reinforcement | Greater of bar diameter and 16 and need not exceed 40 |
| | | Stirrups, ties, spirals, and hoops | 10 |

3.5.1 General

Provide details of reinforcement that are in accordance with the Contract Documents.

3.5.2 Vapor Retarder [and Vapor Barrier]

- a. Level and compact base material and install vapor retarder [vapor barrier] with the longest dimension parallel with the direction of concrete pour and face laps away from direction of pour whenever possible. Extend vapor retarder [vapor barrier] over footings, and seal to foundation wall, grade beam, or slab at an elevation consistent with the top of the slab or terminate at impediments such as dowels or water stops. Seal around all penetrations such as utilities and columns with vapor retarder [vapor barrier] material and seal tape. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 300 mm and tape. [Extend vapor retarder [vapor barrier] over the tops of pile caps and grade beams to a distance acceptable to the contracting officer and terminate as recommended by the manufacturer.]
- b. Protect vapor retarder [vapor barrier] from damage during installation of reinforcing steel, utilities and concrete. Provide reinforcing bar supports with base section that minimize the potential for puncture of vapor retarder [vapor barrier]. Avoid use of stakes driven through the vapor retarder [vapor barrier].
- c. Inspect installation of vapor retarder [vapor barrier] including sealing of joints and penetrations and mark all areas of damage and insufficient installation in advance of concrete placement such that

deficiencies are corrected before concrete is placed. Remove torn, punctured or damaged vapor retarder [vapor barrier] and repair damaged areas prior to concrete placement with vapor retarder [vapor barrier] material lapped and sealed a minimum of 150 mm beyond damaged area or as instructed by the manufacturer.

- [d. Place a 50 mm layer of clean concrete sand on vapor retarder [vapor barrier] before placing concrete.]

3.5.3 Perimeter Insulation

Install perimeter insulation at locations indicated. Adhesive must be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.5.4 Reinforcement Supports

Provide reinforcement support in accordance with JASS 5 and MLIT-SS Chapter 6. Supports for coated or galvanized bars must also be coated with electrically compatible material for a distance of at least 50 mm beyond the point of contact with the bars.

3.5.5 Splicing

Lap slice lengths and locations as indicated in the Contract Documents. For splice locations not indicated follow JASS 5 and MLIT-SS Chapter 6, at no additional cost to the Government and subject to approval. Splicing must be by lapping, by gas pressure welding, or by mechanical or welded connection, except that lap splices must not be used for bars larger than D35. Do not splice at points of maximum stress and stagger splices a minimum of [600][1200][____] mm or as otherwise indicated so no more than half of the bars are spliced at any one section.

Overlap welded wire reinforcement the spacing of the cross wires, plus 50 mm.

Approve welded splices prior to use.

3.5.6 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Provide bolt threads that match the connector. Countersink the connector in the concrete. Caulk the depression after the bolt is installed.

3.5.7 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement and support against displacement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.5.8 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

- a. Provide fabrication tolerances that are in accordance with JASS 5 and

MLIT-SS Chapter 6.

- b. Provide hooks and bends that are in accordance with the Contract Documents.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

- a. Bar lengths, depths, and bends beyond specified fabrication tolerances
- b. Bends or kinks not indicated on drawings or approved shop drawings
- c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

3.5.9 Placing Reinforcement

Place reinforcement in accordance with JASS 5 and MLIT-SS Chapter 6.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire reinforcement on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 25 mm from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 90 by 90 mm, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

- a. Provide supports for reinforcing bars that are sufficient in number and have sufficient strength to carry the reinforcement they support, and in accordance with JASS 5 and MLIT-SS Chapter 6. Do not use supports to support runways for concrete conveying equipment and similar construction loads.
- b. Equip supports on ground and similar surfaces with sand-plates.
- c. Support welded wire reinforcement as required for reinforcing bars.
- d. Secure reinforcements to supports by means of tie wire. Wire must be

black, soft iron wire, not less than 1.6 mm.

- e. Reinforcement must be accurately placed, securely tied at intersections, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to the Contract Documents.
- f. Bending of reinforcing bars partially embedded in concrete is permitted only as specified in the Contract Documents.

3.5.10 Spacing of Reinforcing Bars

- a. Spacing must be as indicated in the Contract Documents.
- b. Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to preapproval by the Contracting Officer.

3.5.11 Concrete Protection for Reinforcement

Additional concrete protection must be in accordance with the Contract Documents.

3.5.12 Welding

Welding must be in accordance with JASS 6. Welders shall be certified in accordance with JIS Z 3881 for gas pressure welding. Welded joint connections shall develop 125 percent of the specified yield strength of the reinforcing bar and 100 percent of the specified tensile strength of the reinforcing bar.

3.6 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

In accordance with JIS A 5308, JASS 5 and MLIT-SS Chapter 6, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.6.1 Measuring

Make measurements at intervals as specified in paragraphs SAMPLING and TESTING.

3.6.2 Mixing

- a. Mix concrete in accordance with JIS A 5308, JASS 5 and MLIT-SS Chapter 6.
- b. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 29 degrees C.

- c. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 29 degrees C except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and submitted water-cementitious material ratio are not exceeded and the required concrete strength is still met. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required.
- d. [If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits.]Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch. Do not reconstitute concrete that has begun to solidify.

3.6.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.7 PLACING CONCRETE

Place concrete in accordance with JASS 5 and MLIT-SS Chapter 6.

[3.7.1 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width must be a minimum of 100 mm greater than indicated.

][3.7.2 Pumping

JASS 5 and MLIT-SS Chapter 6. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 50 mm at discharge/placement. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of coarse aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well-rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

[3.7.3 Cold Weather

Cold weather concrete must meet the requirements of JASS 5 and MLIT-SS Chapter 6 unless otherwise specified. Do not allow concrete temperature to decrease below 10 degrees C. Obtain approval prior to placing concrete when the ambient temperature is below 4 degrees C or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 10 degrees C minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 3 degrees C in any 1 hour and 10 degrees C per 24 hours after heat application.

3.7.4 Hot Weather

[Hot weather concrete must meet the requirements of JASS 5 and

MLIT-SS Chapter 6 unless otherwise specified.]Maintain required concrete temperature using Figure 4.2 in ACI 305R to prevent the evaporation rate from exceeding 1 kg per square meter of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.7.5 Bonding

Surfaces of set concrete at joints, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

- a. At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.
- b. At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.
- c. Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 22.5 liters of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1.6 mm. Deposit fresh concrete before cement grout has attained its initial set.

3.8 WASTE MANAGEMENT

Provide as specified in the Waste Management Plan and as follows.

3.8.1 Mixing Equipment

Before concrete pours, designate[Contractor-owned site meeting environmental standards][on-site area to be paved later in project] for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.8.2 Hardened, Cured Waste Concrete

[Crush and reuse hardened, cured waste concrete as fill or as a base course for pavement.][Use hardened, cured waste concrete as aggregate in concrete mix if approved by Contracting Officer.]

3.8.3 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.8.4 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material.[Return excess cement to supplier.][Institute deconstruction and construction waste separation and recycling for use in manufacturer's programs. When such a program is not available, seek local recyclers to reclaim the materials.]

3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.9.1 Defects

Repair surface defects in accordance with JASS 5 and MLIT-SS Chapter 6.

3.9.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

3.9.3 Formed Surfaces

3.9.3.1 Tolerances

Tolerances in accordance with JASS 5 and MLIT-SS Chapter 6 and as indicated.

3.9.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view a surface finish SF-1.0. Patch holes and defects in accordance with ACI 301 or JASS 5 and MLIT-SS Chapter 6.

3.9.3.3 Standard Smooth Finish

Provide for surfaces exposed to public view a surface finish SF-3.0. Patch holes and defects in accordance with ACI 301 or JASS 5 and MLIT-SS Chapter 6.

3.9.4 [Smooth-Rubbed][Grout-Cleaned Rubbed][Cork-Floated][Exposed Aggregate] Finish

[Provide a smooth-rubbed finish per ACI 301 Section 5 in the locations indicated.][Provide a grout-cleaned rubbed finish per ACI 301 Section 5 in the locations indicated.][Provide a cork-floated finish per ACI 301 Section 5 in the locations indicated.][Provide an exposed aggregate finish per ACI 301 Section 5 in the locations indicated.]

3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

In accordance with JASS 5 and MLIT-SS Chapter 6, unless otherwise specified. Slope floors uniformly to drains where drains are provided.[Depress the concrete base slab where quarry tile, ceramic tile, [or] [_____] are indicated.][Steel trowel and fine-broom finish concrete

slabs that are to receive quarry tile, ceramic tile, or paver tile [_____.] Where straightedge measurements are specified, Contractor must provide straightedge.

3.10.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.10.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. Finish concrete in accordance with ACI 301 Section 5 for a scratched finish.

3.10.1.2 Floated

Use for [surfaces to receive [roofing,] [waterproofing membranes,] [sand bed terrazzo,]] [_____] [and] [exterior slabs where not otherwise specified.] Finish concrete in accordance with ACI 301 Section 5 for a floated finish.

3.10.1.3 Steel Troweled

Use for floors intended as walking surfaces[,] [and] for reception of floor coverings[, and] [_____.] Finish concrete in accordance with ACI 301 Section 5 for a steel troweled finish.

[3.10.1.4 Nonslip Finish

Use on surfaces of exterior platforms, steps, and landings; and on exterior and interior pedestrian ramps. Finish concrete in accordance with ACI 301 Section 5 for a dry-shake finish. After the selected material has been embedded by the two floatings, complete the operation with a [broomed] [floated] [troweled] finish.

]3.10.1.5 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Finish concrete in accordance with ACI 301 Section 5 for a broomed finish.

3.10.1.6 Pavement

Screeed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by [belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained.] [a burlap drag. Drag a strip of clean, wet burlap from 900 to 3000 mm wide and 600 mm longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks.] Round edges and joints with an edger having a radius of 3 mm.

3.10.1.7 Chemical-Hardener Treatment

[Apply liquid-chemical floor hardener where indicated after curing and drying concrete surface. Dilute liquid hardener with water and apply in three coats. First coat must be one-third strength, second coat one-half strength, and third coat two-thirds strength. Apply each coat evenly and allow to dry 24 hours between coats.

Approved proprietary chemical hardeners must be applied in accordance with manufacturer's printed directions.

3.10.2 Flat Floor Finishes

ACI 302.1R. Construct in accordance with one of the methods recommended in Table 7.15.3, "Typical Composite Ff/FL Values for Various Construction Methods." ACI 117 for tolerance tested by ASTM E1155.

a. Specified Conventional Value:

Floor Flatness (Ff) [20] [_____] [13] [_____] minimum
Floor Levelness (FL) [15] [_____] [10] [_____] minimum

b. Specified Industrial:

Floor Flatness (Ff) [30] [_____] [15] [_____] minimum
Floor Levelness (FL) [20] [_____] [10] [_____] minimum

3.10.2.1 Measurement of Floor Tolerances

Test slab within 24 hours of the final troweling. Provide tests to Contracting Officer within 12 hours after collecting the data. Floor flatness inspector is required to provide a tolerance report which must include:

- Key plan showing location of data collected.
- Results required by ASTM E1155.

3.10.2.2 Remedies for Out of Tolerance Work

Contractor is required to repair and retest any floors not meeting specified tolerances. Prior to repair, Contractor must submit and receive approval for the proposed repair, including product data from any materials proposed. Repairs must not result in damage to structural integrity of the floor. For floors exposed to public view, repairs must prevent any uneven or unusual coloring of the surface.

3.10.3 Concrete Walks

Provide 100 mm thick minimum unless otherwise indicated. Provide contraction joints spaced every 1500 lineal mm unless otherwise indicated. Cut contraction joints 25 mm deep, or one fourth the slab thickness whichever is deeper, with a jointing tool after the surface has been finished. Provide 13 mm thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 15 m maximum. Give walks a broomed finish. Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 6 mm in 1500 mm.

3.10.4 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.10.5 Curbs[and Gutters]

Provide contraction joints spaced every 3 m maximum unless otherwise indicated. Cut contraction joints 20 mm deep with a jointing tool after the surface has been finished. Provide expansion joints 13 mm thick and spaced every 30 m maximum unless otherwise indicated. Perform pavement finish.

[3.10.6 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, and must be 600 mm long, 300 mm wide and 100 mm thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building.

]3.11 JOINTS

3.11.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Joints must be perpendicular to main reinforcement. Reinforcement must be continued and developed across construction joints. Locate construction joints as follows:

3.11.1.1 Maximum Allowable Construction Joint Spacing

- a. In walls at not more than 18.0 meter in any horizontal direction.
- b. In slabs on ground, so as to divide slab into areas not in excess of 110 square meter.

3.11.1.2 Construction Joints for Constructability Purposes

- a. In walls, at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall.
- b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier.
- c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

Provide keyways at least 40 mm deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

3.11.2 Isolation Joints in Slabs on Ground

- a. Provide joints at points of contact between slabs on ground and

vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

- b. Fill joints with premolded joint filler strips 13 mm thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 20 mm in depth where joint is sealed with sealing compound and not less than 6 mm in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

3.11.3 Contraction Joints in Slabs on Ground

- a. Provide joints to form panels as indicated.
- b. Under and on exact line of each control joint, cut 50 percent of welded wire reinforcement before placing concrete.
- c. Sawcut contraction joints into slab on ground in accordance with ACI 301 Section 5.
- [d. Joints must be 4 mm wide by 1/5 to 1/4 of slab depth and formed by inserting hand-pressed fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. After concrete has cured for at least 7 days, the Contractor must remove inserts and clean groove of foreign matter and loose particles.
]
[e. Sawcutting will be limited to within 12 hours after set and at 1/4 slab depth.

3.11.4 Sealing Joints in Slabs on Ground

- a. Contraction and control joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.
- b. Sealed groove must be left ready to receive filling material that is provided as part of finish floor covering work.

3.12 CONCRETE FLOOR TOPPING

3.12.1 Standard Floor Topping

Provide topping for treads and platforms of metal steel stairs and elsewhere as indicated.

3.12.1.1 Preparations Prior to Placing

- a. When topping is placed on a green concrete base slab, screed surface of base slab to a level not more than 40 mm nor less than 25 mm below required finish surface. Remove water and laitance from surface of base slab before placing topping mixture. As soon as water ceases to rise to surface of base slab, place topping.
- b. When topping is placed on a hardened concrete base slab, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants

from base slab surface, leaving a clean surface. Prior to placing topping mixture, 64 mm minimum, slab surface must be dampened and left free of standing water. Immediately before topping mixture is placed, broom a coat of neat cement grout onto surface of slab. Do not allow cement grout to set or dry before topping is placed.

- c. When topping is placed on a metal surface, such as metal pans for steel stairs, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from metal surface.

3.12.1.2 Placing

Spread standard topping mixture evenly on previously prepared base slab or metal surface, brought to correct level with a straightedge, and struck off. Topping must be consolidated, floated, checked for trueness of surface, and refloated as specified for float finish.

3.12.1.3 Finishing

Give trowel finish standard floor topping surfaces.

Give other finishes standard floor topping surfaces as indicated.

3.13 CURING AND PROTECTION

Curing and protection in accordance with JASS 5 and MLIT-SS Chapter 6, unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer, hardener, or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs, including [____].

3.13.1 Curing Periods

JASS 5 and MLIT-SS Chapter 6, except 10 days for retaining walls, pavement or chimneys. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

3.13.2 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of

formed surfaces by any of the curing methods specified above, as applicable.

3.13.3 Curing Unformed Surfaces

- a. Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.
- [b. Accomplish final curing of unformed surfaces by any of curing methods specified, as applicable.
-] c. Accomplish final curing of concrete surfaces to receive liquid floor hardener or finish flooring by moisture-retaining cover curing.

3.13.4 Temperature of Concrete During Curing

When temperature of atmosphere is 5 degrees C and below, maintain temperature of concrete at not less than 13 degrees C throughout concrete curing period or 7 degrees C when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 27 degrees C and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 3 degrees C in any 1 hour nor 27 degrees C in any 24-hour period.

3.13.5 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.13.6 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.14 FIELD QUALITY CONTROL

3.14.1 Sampling

JIS A 1115. Collect samples of fresh concrete to perform tests specified.
JIS A 1132 for making test specimens.

3.14.2 Testing

3.14.2.1 Slump Tests

JIS A 1101. Take concrete samples during concrete placement/discharge. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cementitious material ratio is not exceeded. Perform tests at commencement of concrete placement, when

test cylinders are made, and for each batch (minimum) or every 16 cubic meters (maximum) of concrete.

3.14.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 10 degrees C and above 27 degrees C) for each batch (minimum) or every 16 cubic meters (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.14.2.3 Compressive Strength Tests

JIS A 1108. Make [six] [eight] 150 mm by 300 mm [100 mm by 200 mm] test cylinders for each set of tests in accordance with JIS A 1132, JIS A 1115 and applicable requirements of JASS 5 and MLIT-SS Chapter 6. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, [two cylinders at 56 days] [two cylinders at 90 days] [_____] and hold two cylinder in reserve. Take samples for strength tests of each [mix design of] [and for] [_____] concrete placed each day not less than once a day, nor less than once for each 75 cubic meters of concrete for the first 380 cubic meters, then every 380 cubic meters thereafter, nor less than once for each 500 square meters of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days[56 days] [90 days] [_____]. Concrete compressive tests must meet the requirements of this section, the Contract Document, and JASS 5 and MLIT-SS Chapter 6. Retest locations represented by erratic core strengths. Where retest does not meet concrete compressive strength requirements submit a mitigation or remediation plan for review and approval by the contracting officer. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

[3.14.2.4 Air Content

JIS A 1118 or JIS A 1128 for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

][3.14.2.5 Unit Weight of Structural Concrete

JIS A 1116. Determine unit weight of normal weight concrete. Perform test for every 15 cubic meters maximum.

][3.14.2.6 Chloride Ion Concentration

Chloride ion concentration must meet the requirements of the paragraph titled CORROSION AND CHLORIDE CONTENT. Determine water soluble ion concentration in accordance with JIS A 1154. Perform test once for each mix design.

]3.14.2.7 Strength of Concrete Structure

The strength of the concrete structure will be considered to be deficient if any of the following conditions are identified:

- a. Failure to meet compressive strength tests as evaluated.

- b. Reinforcement not conforming to requirements specified.
- c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.
- d. Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified.
- e. Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration.
- f. Poor workmanship likely to result in deficient strength.

Where the strength of the concrete structure is considered deficient submit a mitigation or remediation plan for review and approval by the contracting officer.

3.14.2.8 Non-Conforming Materials

Factors that indicate that there are non-conforming materials include (but not limited to) excessive compressive strength, inadequate compressive strength, excessive slump, excessive voids and honeycombing, concrete delivery records that indicate excessive time between mixing and placement, or excessive water was added to the mixture during delivery and placement. Any of these indicators alone are sufficient reason for the Contracting Officer to request additional sampling and testing.

Investigations into non-conforming materials must be conducted at the Contractor's expense. The Contractor must be responsible for the investigation and must make written recommendations to adequately mitigate or remediate the non-conforming material. The Contracting Officer may accept, accept with reduced payment, require mitigation, or require removal and replacement of non-conforming material at no additional cost to the Government.

3.14.2.9 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements or there are non-conforming materials, make cores drilled from hardened concrete for compressive strength determination in accordance with JIS A 1107, and as follows:

- a. Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.
- b. Test cores after moisture conditioning in accordance with JIS A 1107 if concrete they represent is more than superficially wet under service.
- c. Air dry cores, (16 to 27 degrees C with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.
- d. Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

[e. Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required must be borne by the Contractor.

]

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the Contracting Officer.

3.15 REPAIR, REHABILITATION AND REMOVAL

Before the Contracting Officer accepts the structure the Contractor must inspect the structure for cracks, damage and substandard concrete placements that may adversely affect the service life of the structure. A report documenting these defects must be prepared which includes recommendations for repair, removal or remediation must be submitted to the Contracting Officer for approval before any corrective work is accomplished.

[3.15.1 Crack Repair

Prior to final acceptance, all cracks in excess of 0.50 mm wide must be documented and repaired. The proposed method and materials to repair the cracks must be submitted to the Contracting Officer for approval. The proposal must address the amount of movement expected in the crack due to temperature changes and loading.

]3.15.2 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Concrete surfaces with weak surfaces less than 6 mm thick must be diamond ground to remove the weak surface. Surfaces containing weak surfaces greater than 6 mm thick must be removed and replaced or mitigated in a manner acceptable to the Contracting Officer.

3.15.3 Failure of Quality Assurance Test Results

Proposed mitigation efforts by the Contractor must be approved by the Contracting Officer prior to proceeding.

-- End of Section --