

## **SECTION 03470**

### **SITE CAST TILT-UP CONCRETE**

#### **1. PART GENERAL**

##### **1.1. GENERAL REQUIREMENTS**

1.1.1. Conform to Division 01, General Requirements

##### **1.2. DESCRIPTION**

###### **1.2.1. Work Included**

- a. Site cast Tilt-Up concrete panels.
- b. Site cast Tilt-Up concrete units other than panels.
- c. The Project Architect/Engineer has not been retained to design the wall panels to resist the stresses caused by erection of the wall panels, nor to determine the means and methods to be used for erection and bracing until permanent bracing is in place.
- d. It shall be the Contractor's responsibility to erect the panel in a manner that will be both safe for personnel and property, and to brace and otherwise protect the panels against wind and other forces that may occur during construction and until connections to the permanent structural system are completed.
- e. It shall be the Contractor's responsibility to ensure that a suitable slab has been prepared to provide for the level of finish that has been established within this specification.
- f. It shall be the Contractor's responsibility to coordinate the slab finishing including saw cutting of all joints with the panel forming to minimize the impact to the architectural finish of the panels.

###### **1.3. RELATED SECTIONS**

- a. Section 03100 – Concrete Formwork: Formwork Requirements.
- b. Section 03200 – Reinforcing Steel:
- c. Section 03300 – Cast-in-Place Concrete:
- d. Section 05500 – Miscellaneous Metals.
- e. Section 07900 – Sealants and Caulking
- f. Section 09900 – Painting: Finishing of Panels.

###### **1.5. SUBMITTALS**

1.5.1. Submit under provisions of Section 01300.

1.5.2. Shop Drawings: Submit Panel Shop Drawings and Erection Drawings detailing all work of this section including temporary bracing. Reinforcing bars shown on the project drawings do not allow for lifting and erection stresses.

1.5.3. Quality Control Submittals:

a. Test Reports: When, and as directed by the Contract Documents, submit certified laboratory test reports confirming physical characteristics of materials used in the performance of the Work of this Section.

b. Manufacturer's Instructions: For manufactured items used, submit the manufacturer's current recommended methods of installation, including relevant limitations and safety precautions.

1.5.4. Material Submittals:

- a. Concrete mix designs for each mix specified.
- b. Sample of Interior and/or Exterior Surface Treatment.
- c. Manufacturer's literature for bondbreakers.
- d. Mix design for structural grout for panel support.

###### **1.6. QUALITY ASSURANCE**

1.6.1. Regulatory Requirements: Comply with applicable codes and regulations of governmental agencies having jurisdiction. Where those requirements conflict with this Specification, comply with the more stringent provisions.

1.6.2. Qualifications for Field Personnel: Contractor shall show evidence of competence in site cast tilt-up concrete construction. Workers shall be proficient in production and erection operations and shall be under the direct supervision of qualified personnel. Provide certification that supervisor to be employed in the Work has been ACI certified through the Tilt-Up Supervisor Certification Program.

1.6.3. Qualifications for Welding: Qualify welding processes and welding operators in accordance with CSA W59. Provide certification that welders to be employed in the Work have satisfactorily passed AWS qualification tests within the previous 12 months.

#### 1.6.4. Job Mock-up Panel for Architectural Finishes

- a. Prepare minimum 3-feet by 3-feet panel using forming system and construction methods to be used on project. Prepare one panel for each level of finish shown on the drawings.
- b. Incorporate edge and reveal conditions as detailed on the project drawings.
- c. Painted and Textured Concrete Finishes
  1. Utilize full range of color as specified
  2. Utilize full range of textures variation as specified.
- d. Sandblast or Colored Concrete Finishes
  1. Utilize full range size and colors in aggregate.
  2. Utilize full range of color in grout.
  3. If sand blasting is specified, it shall match degree specified.
- e. Architectural Liner or Cast-In Brick Finishes
  1. Utilize full range of color sampling for brick specified.
  2. If liners are to be used, sample shall consist of section showing integration of both horizontal and vertical liner joints.
- f. Maintain approved mock-up for comparison with finish work.
- g. Dispose of mock-up when project is completed or when directed by Project Architect/Engineer.
- h. Cast mock-up over slab joint or column joint if actual panels will be affected by these conditions.

#### 1.7. TOLERANCES

1.7.1. Dimensions of the finished panels, at the time of erection in the structure, shall conform to the casting tolerances stated below unless otherwise specified or approved by the Project Architect/Engineer.

##### a. Height & Width of Basic Panel

1. Up to 20 feet 1/4 inch
2. 20 feet to 30 feet 3/8 inch
3. Each additional 10-foot increment in excess of 30 feet 1/8 inch

b. Note: Tolerances referenced here may be further restricted by joint width tolerances listed in section 1.5.2a.

##### c. Thickness 3/16 inch

d. Note: The tolerance listed is for the average variation of panel thickness through any horizontal or vertical cross-section of the panel.

##### e. Skew of Panel or Opening

1. Per 6 feet of dimension 1/8 inch
2. Maximum difference 1/2 inch

f. Note: The tolerance listed is the measured difference in length of the two diagonals.

##### g. Openings Cast Into Panel

1. Size of Opening 1/4 inch
2. Location of Centerline of Opening 1/4 inch

##### h. Location/Placement of Embedded Items

1. Inserts, Bolts, Pipe Sleeves 3/8 inch
2. Lifting and Bracing Inserts Per Manufacturer's Specs
3. Weld Plate Embeds (Lateral Placement) 1 inch
4. Weld Plate Embeds (Tipping & Flushness) 1/4 inch

i. Deviation of Concrete Reinforcing Steel Cover: Shall be in accordance with ACI 318 and in no case less than specified elsewhere.

1.7.2. Dimensions of the erected panels shall conform to the erection tolerances stated below unless otherwise specified or approved by the Project Architect/Engineer.

##### a. Joint Width Variation

1. Panels up to 20 feet tall 1/4 inch
2. For Each 10-foot Increment in Excess of 20 feet Tall 1/8 inch
3. In no case should the variation in joint width be increased or decreased more than 50% from the specified joint width.

b. Note: The tolerance listed is measured between the panels at the exterior face of the panels at the joint.

c. Joint Taper

1. Panels up to 20 feet tall 1/4 inch

2. For Each 10-foot Increment in Excess of 20 feet Tall 1/8 inch

3. Maximum for Entire Length 3/8 inch

d. Note: The tolerance listed is the measured difference in joint width indicating the panel edges are not parallel.

e. Panel Alignment

1. Alignment of Horizontal and Vertical Joints 1/4 inch

2. Offset in Exterior Face of Adjacent Panels 1/4 inch

### 1.8. PROJECT CONDITIONS

1.8.1. Do not construct formwork, place reinforcing steel or concrete, or erect panels during adverse weather unless approved measures are taken to prevent damage. During period of dry winds, low humidity and other conditions causing rapid drying, protect fresh concrete with an evaporation retardant (monomolecular film) or fine fog spray of water applied immediately after screeding and bull floating. Maintain protection until final finishing and curing compounds are applied.

1.8.2. For cold weather conditions, adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather. Concrete materials and reinforcing steel, forms, fillers and ground with which concrete is to come in contact shall be free from frost. If shelters are used, the type of fuel used for heating shall not weaken the concrete surface. Frozen materials or materials containing ice shall not be used. Also refer to CSA A23.1 - Specification for Cold Weather Concreting.

1.8.3. For hot weather conditions proper attention shall be given to concrete materials, production methods, handling, placing, protection and curing to prevent excessive concrete temperatures or water evaporation that may increase shrinkage and impair required strength or serviceability of the member or structure. Also refer to CSA A23.1 - Specification for Hot Weather Concreting.

## 2. PRODUCTS

### 2.1. MANUFACTURED ITEMS

2.1.1. Lifting hardware, inserts, braces, and related embedded and attached items shall be manufactured specifically for site cast tilt-up construction.

### 2.2. PANEL MATERIALS

#### 2.2.1. Forms:

a. Forms shall contain blockouts required to provide openings detailed on Drawings. Coordinate all openings with other trades.

b. Panel boundary forms shall be rigidly constructed and well braced steel or wood forms, straight and with precise corners. Design to withstand stresses resulting from the casting process. Consideration should be given to exposed formed surfaces. All forming surfaces shall be smooth and clean prior to pouring of concrete.

c. Panels may be stacked for ease of casting, in forms as specified above.

d. When panels are stack cast, maintain a continuous sound and smooth surface with forming and plaster at all openings.

e. Bondbreaker must be compatible with curing compound and other finishes, including paint, and floor finish.

2.2.2. **Reveal Materials:** All material used for creating reveals or relief in the exterior face of the panel must be of adequate strength to withstand construction traffic/loads without damage.

#### 2.2.3. Concrete Materials:

a. Cement: Portland cement, conforming to CAN/CSA-A5

b. Fine and coarse aggregates shall consist of clean, hard strong, and durable inert material, free of injurious amounts of deleterious substances, conforming to CSA A23.1

c. Concrete shall be a design mix approved by Project Architect/Engineer.

d. Mixing water shall be free of any acid, alkali, oil or organic material that may interfere with the setting of the cement.

- e. Admixtures shall be approved by Project Architect/Engineer.
- f. All concrete shall be produced and delivered in accordance with CSA A23.1

#### **2.2.4. Quality of Concrete**

- a. Ready-mixed concrete shall conform to CSA A23.1
- b. Concrete shall have a minimum compressive strength at 28 days as indicated on the project drawings and as required for panel erection

#### **2.2.5. Steel Reinforcement:**

- a. Reinforcing bars shall conform to SCA G30.1
- b. Welded wire reinforcement shall conform to CSA G30.5 and shall be of the style shown on the project drawings. Welded wire reinforcement shall be supplied in flat sheets.

#### **2.2.6. Miscellaneous Metals:**

- a. Conform to requirements of Section 05500 – Metal Fabrications.
- b. Provide all inserts, dowels, and other items to be cast in panels, including items required for erection and bracing.
- c. Steel that will be exposed to the exterior or damp environments in finished panels shall be plastic-tipped, hot-dipped galvanized or protected by other means to prevent corrosion or oxidation of the metal after fabrication

1. Selection of plastic-tipped treatments: Ensure that the plastic will not create stress concentrations within the thin sections of concrete when located near a surface from differential thermal expansion and contraction ultimately resulting in local shear failure of the concrete surface producing surface blemishes.

#### **2.2.7. Supports for Reinforcing Steel:**

- a. Supports may consist of metal, all-plastic and concrete materials.
- b. Metal supports shall be either galvanized after fabrication or plastic-tipped. No galvanized or plastic tip metal support shall be used on panels to receive exposed or sandblasted finish.
- c. All-plastic supports should be of such design as to adequately support reinforcement, provide minimal surface contact and be of such coloring as to not be distinguishable on any surfaces. Minimal surface contact is defined as having a total contact surface area not to exceed 0.10 square inches (64.5 mm<sup>2</sup>) per contact point. Refer to CRSI Manual of Standard Practice.
- d. Concrete supports may only be used in situations where surface contact is not visible.

### **2.3. CONCRETE CURING MATERIALS**

#### **2.3.1. Liquid Membrane-Forming Curing Compound:**

- a. Liquid-type membrane-forming curing compound complying with ASTM C309-98a, Type I and I D, Class B.
- b. It is preferred that the curing compound/bondbreaker be the same product or compatible, and that only one manufacturer's product is used.
- c. Concrete Curing of Casting Beds: All concrete in and around those areas to be used for casting shall be cured after finishing and as soon as the free water on the surface has disappeared and no water sheen is visible, but not so late that the liquid curing compound will be absorbed into the concrete. The cure and/or bondbreaking compound should be applied at the manufacturer's recommended coverage to achieve minimum moisture loss.

### **2.4. SANDWICH INSULATION SYSTEMS**

2.4.1. The insulated concrete sandwich panels must be constructed to maintain the effective acceptable material R- 20 of the panels with less than one (1) percent reduction due to penetrations and connection detailing.

### **2.5. SEALANT AND CAULKING MATERIALS**

2.5.1. **Sealants:** In accordance with Section 07920 – Sealants and Caulking.

### **2.6. BONDBREAKER**

2.6.1. Liquid Dissipating Membrane-Forming Curing Compound.

- a. The bondbreaking material shall also be a dissipating membrane forming material complying with ASTM C 309-98a, Type I and I D, Class B.
- b. The bondbreaking compound shall be applied with adequate time to dry prior to placement of reinforcing steel.
- c. The bondbreaking compound shall dry in 30-minutes or less at 100°F to reduce panel clean up.
- d. Material must be compatible with curing material.

- e. The bondbreaker used must be compatible with any coating specified for interior or exterior concrete panels and slab.
- 2.6.2. Refer to manufacturer's instructions as to proper procedures for post applying a liquid floor hardener or sealant to areas where bondbreaker is present.

### **3. EXECUTION**

#### **3.1. GENERAL**

- 3.1.1. Coordinate site cast tilt-up operations with Work of other trades in order that Work may be expedited and omissions and delays avoided.
- 3.1.2. Concrete shall be so handled as to prevent segregation. Mixers, chutes, conveyors, pump hoses, and other handling equipment shall be kept clean and free of foreign matter.

#### **3.2. CASTING SURFACES**

- 3.2.1. The information contained in this section consists of general recommendations for the design and construction of the Casting Slab.
- 3.2.2. Casting Slab Preparation:
  - a. Casting slab shall be cured. Saw cuts, cracks, joints or defects in the casting bed shall be filled so as to minimize transfer of the joint line to the panel face.
  - b. Waste slabs, if used, shall be of sufficient thickness and strength so as not to crack with the weight of the panels.
  - c. Contractor shall be responsible for compatibility of curing agents, sealants, and releasing agents utilized in the Work. If panels are to be stacked, the troweled surface shall be considered the casting bed and shall be treated as the same.
  - d. Isolation pockets shall be formed in such a manner as to minimize the transfer of the pocket to the finished appearance of the panel.
- 3.2.3. Bondbreaker to be applied in accordance with manufacturer's printed instructions for the applicable condition.
- 3.2.4. After placing reinforcing steel for panels, check casting slab surfaces for continuity of film. Touch-up or recoat worn or damaged areas, taking care to prevent application of coating on reinforcing steel and inserts.
- 3.2.5. Coordinate installation of inserts and anchorages required to be set into concrete slabs prior to casting of panels.
- 3.2.6. Where reveals are specified in panels, assure that forming strips are straight and securely fastened to prevent movement or floating during placing operations and that alignment between adjacent panels is correct. Reveal tolerances shall comply with the provisions of Section 3.7 of this document.

#### **3.3. FORMING PANELS**

- 3.3.1. The Contractor shall layout the panels for casting in a manner that minimizes the locations of floor joints, column isolation joints and other construction joints in the panel faces. The Contractor shall prevent the layout of the panels over temporarily poured casting surfaces such as pre-formed columns and pits unless deemed absolutely necessary.
- 3.3.2. Forms shall be designed to maintain the perimeter of the panel as shown on the project drawings within 1/4-inch maximum deflection during pouring.
- 3.3.3. All formed blockouts for openings in the panels shall be designed to limit the deflection during pouring to a maximum of 1/8 inch.

#### **3.4. PLACING CONCRETE**

- 3.4.1. Concrete shall be thoroughly worked around reinforcement, around the embedded items, and into corners of the forms.
- 3.4.2. Cold joints shall not be permitted in an individual site cast tilt-up panel.

#### **3.5. CURING AND PROTECTIONS**

- 3.5.1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.
- 3.5.2. Apply liquid membrane curing compound in accordance with manufacturer's recommendations.
- 3.5.3. Underlying panels in a stack cast arrangement shall be cured in the same manner as casting beds.

#### **3.6. HANDLING AND ERECTION OF PANELS**

- 3.6.1. Design panels for erection stresses and selection of lifting system and hardware shall be by the Contractor.
- 3.6.2. Minimum strength of panels at time of erection shall be in accordance with the lifting design.
- 3.6.3. It is recommended that the Contractor take extra test specimens and field cure to verify concrete strength of panels.
- 3.6.4. Before starting erection operations, Contractor shall check relevant job site conditions insofar as they are ready for the erection of panels. Each element shall be properly marked to correspond with the designation indicated on the approved Shop Drawings.
- 3.6.5. Protect elements to prevent staining, warping or cracking.
- 3.6.6. Patch or repair defects in panels in a manner acceptable to the Project Architect/Engineer.
- 3.6.7. Use erection equipment that will prevent damage to existing construction, permanent floor slabs and panels. Damage to Work shall be repaired or replaced at the Contractor's expense and in a manner acceptable to the Project Architect/Engineer prior to painting or coating.
- 3.6.8. Set panels in the position assigned. Place panels evenly on prepared setting pads or proper capacity shims. Grout space under panels for full bearing or provide additional support until grouting takes place.
- 3.6.9. Panels not attached to the building frame at the time of erection shall be braced in position using a bracing system designed to resist wind and other loads that may reasonably be determined until all structural connections have been made. There shall be a minimum of two braces per panel. Design of bracing shall be the responsibility of the Contractor. Panel bracing connection shall be maintained daily by Contractor to assure tightness.
- 3.6.10. After panels are erected, Contractor shall check all connecting bolts at the floor and panels daily to ensure tightness.
- 3.6.11. Dry-pack grout installation and preparation for weld pockets and other panel block outs not cast in during pouring shall be performed as follows:
- Remove laitance down to sound concrete
  - Surface to receive grout shall be rough and reasonably level
  - Surface shall have been properly wet cured
  - Do not use curing compounds
  - Clean surface of oil, grease, dirt and loose particles.
  - Remove free water from concrete and bolt holes immediately before grouting.
- 3.6.12. Protection of the erected elements shall be the responsibility of the Contractor.
- 3.6.13. Temporary panel bracing shall not be removed until roof diaphragm is completely welded and installed.
- 3.6.14. After the panels are erected, dismantle panel erection devices and patch panels as required for a uniform appearance.
- 3.6.15. After panels are erected, patch holes or other blemishes in casting slab that were caused by the panel casting and erection processes in a manner acceptable to the Project Architect/Engineer.

### 3.7. **PANEL FINISH**

- 3.7.1. Exposed surfaces of panels shall be finished as indicated on the project drawings. This shall include both the front and back of the panels as well as any exposed edges as defined below.
- 3.7.2. Visible surfaces of the panels, when in place shall be free from surface defects for as defined below for a \_\_Grade A Smooth\_\_ finish. Refer to Section 1.4 (D) of this document for sample finish requirements.
- Grade A - Architectural: Projects designed for the circulation of people within a distance of 10 feet to 25 feet
    - All panel surfaces will be free of all voids, holes, pockets and other surface deformations greater than 1/8 inch
    - Surfaces of panels must not project reinforcing patterns, floor joints or other projections or voids from the casting surface.
    - Cracks are not permissible in excess of 1/32 inch
    - All surface repairs must be performed in such a way as to prevent the projection of repair strokes through the intended finish.
    - All holes shall be filled with patching material to present a smooth surface ready for painting unless the designed finish is to result in exposed aggregates whereby the

patching material shall match the intended color and texture.

6. Reveals must be maintained in their designed positions. Deviation from any horizontal or vertical line shall not exceed 1/8 inch over 10 feet

b. Grade B - Standard: Projects designed for the circulation of people within a distance greater than 25 feet while retaining an emphasis on quality finishes and aesthetic detail.

1. All panel surfaces will be free of all voids, holes, pockets and other surface deformations greater than 1/4 inch

2. Surfaces of panels may be repaired sufficiently to prevent excessive projection of blemishes through intended finish.

3. Cracks are permissible as naturally resulting from curing. Cracks are not permissible as caused by erection forces.

4. Surface repairs shall improve the appearance of the panels within the descriptions above provided they do not result in additional blemishes that are visible within the distance set.

5. All holes shall be filled with patching material to present a smooth surface ready for painting unless the designed finish is to result in exposed aggregates whereby the patching material shall match the intended color and texture.

6. Reveals must be maintained in their designed positions. Deviations greater than 1/4 inch from any location will not be permissible.

c. Grade C - Utility: Projects designed for remote areas with little or no public interaction and/or projects designed specifically for interior use with little or no emphasis towards the exterior design.

1. The Contractor shall consult with the Project Architect/Engineer and the Owner prior to initiating the project to determine the expectations for the project appearance.

2. Panel surfaces showing voids, holes, pockets and other surface deformations are permissible provided they do not weaken the structural integrity of the panel or the finish of the panel and provided they do not exceed 1/2 inch

3. Cracked surfaces are permissible provided the cracks are not resulting from structural weakness or failure and provided they do not present the potential for failure of the finish over the life of the building.

3.7.3. Surfaces to be painted shall be prepared to receive paint finish as specified in Section 09900.

### **3.8. SEALING OF PANEL JOINTS**

3.8.1. Clean the panel joints of contaminants, including form release agents and concrete laitance. Dust and loose particles shall be blown out or otherwise cleaned to provide proper bond. Apply sealants in accordance with manufacturer's recommendations.

3.8.2. Install joint insulation where indicated to consist of a limited expansion polyurethane insulation or an approved equal as provided in accordance with Section 07200 – Insulation.

3.8.3. Install back-up rod, primer, paint and sealant in accordance with Section 07920 – Sealants and Caulking.

### **3.9. FIELD QUALITY CONTROL**

#### **3.9.1. Testing:**

a. Take not less than 4 cylinders for each class of concrete, for each 100 cubic meters or fraction thereof, for each day concrete is cast, or not less than once for each 5,000 sq.ft. (464.5 sq.m.) of panel area. The specimens shall be field cured.

b. Of each set of 4 cylinders, two shall be tested at 7 days and two at 28 days.

c. Casting and curing of test cylinders shall be in accordance with ASTM C31.

d. Test cylinders and test reports shall accurately indicate in which panel, by number and concrete delivery tag, the concrete represented by each test cylinder was placed.

e. Copies of test reports shall be distributed to Owner, Project Architect/Engineer, Building Official and Contractor. Reports shall indicate location of tests, dates, technician, and other pertinent information.

#### **3.9.2. Deficient Compressive Strength**

a. In the event that concrete tests indicate a 7-day or 28-day strength below that which was

specified, the Contractor with the agreement of the Project Architect/Engineer shall have the mix adjusted so that subsequent concrete will comply with the minimum strength requirements. The owner may require core specimens to be taken and tested, at the Contractor's expense. If core tests fall below minimum requirements, as determined by the Project Architect/Engineer, the concrete in place will be deemed to be defective. This concrete shall be removed and replaced or strengthened in a manner acceptable to the Owner and Project Architect/Engineer, at the Contractor's expense. Any demolition or repair of other materials or systems as a result of repair or replacement of defective concrete shall be at the Contractor's expense.

#### **3.10. CRACKED AND DAMAGED PANELS**

3.10.1. Panel damage that occurs during erection, cracks readily visible per the requirements specified in Section 03470.3.6.2, permanent bowing occurring from erection, and spalls, shall be repaired or replaced to the satisfaction of the Project Architect/Engineer, appropriate to the type and location on the building.

#### **3.11. CLEANING**

3.11.1. When Work of this Section has been completed, remove trash, debris, surplus materials, tools and equipment from site.

#### **3.12. PROTECTION**

3.12.1. During the period after this Work has been completed, the General Contractor shall protect site cast tilt-up concrete finished concrete surfaces from damage by subsequent construction operations.

**END OF SECTION**