

SECTION 03 47 13
TILT-UP CONCRETE
ADDED ADDENDUM 1

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.
- B. Requirements of specification section "Cast-in-Place Concrete" apply to the work of this section.

1.2. SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, and equipment necessary to place reinforcing steel, inserts and embedded items, and to cast and erect all tilt-up panels at the locations shown on the drawings.

1.3. CODES AND SPECIFICATIONS

The design, detailing, and erection of all concrete panels shall additionally be based on the following:

- A. "Building Code Requirements for Reinforced Concrete" (ACI 318), "Specifications for Structural Concrete for Buildings" (ACI 301) and all other Committee Reports and Specifications as published by the American Concrete Institute that are in force at the date of these documents.
- B. Manual of Standard Practice, as published by the Concrete Reinforcing Steel Institute (CRSI) that is in force at the date of these documents.
- C. "Structural Welding Code - Reinforcing Steel", AWS D1.4, American Welding Society that is in force at the date of these documents.
- D. PCI Design Handbook, as published by the Prestressed Concrete Institute that is in force at the date of these documents.

1.4. QUALIFICATIONS

- A. The fabrication and erection of the tilt-up panels shall be performed by a subcontractor with a minimum of two years of successful experience with panels of a similar size and number as required for this project. Evidence of compliance with this section shall be submitted to the Architect/Engineer.

1.5. SUBMITTALS

- A. Shop Drawings:
 - 1. Panels: Submit shop drawings showing size and thickness of panel,

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- finishes, reveals, chamfers, pockets and blockouts, reglets, complete reinforcing steel and all accessories, cast-in dowels, plates and bolts, lifting inserts, and all MEP cast-in items, such as conduit, electrical boxes, and sleeves. Shop drawings not showing all items cast into panels will not be reviewed. Panels shall not be cast until all shop drawings are reviewed and approved.
2. Casting Slab: Submit shop drawing showing size, type, and location of all casting slabs.
 3. Forms: Submit shop drawing showing edge forms for panels.
 4. Lifting Method: Submit complete shop drawings, for Owner's record only, showing method of lifting panels, type of lifting harness, type and placement of lifting and brace inserts, and method and details of bracing panels after lifting. Indicate sequence of erection for the entire job.
- B. Product Data: Submit manufacturer's product data with application and installation instructions for all panel products including concrete admixtures, bond breaker, patching products, epoxy products, grouts, curing compounds, water repellant coating, dowel bar replacement, reveal strips, form liners, reinforcement accessories, form ties, and lifting inserts.
- C. Laboratory Test Reports and Mix Designs: Submit laboratory test reports and mix designs for concrete.
- D. Material and Mill Certificates: Submit material and mill certificates for cement, aggregates, and reinforcing steel.
- E. Calculations of Lifting Method: Submit complete engineering calculations, for Owner's record only, with diagrams of lift points and center of gravity of panel. Show concrete stresses produced by lifting. For calculations prepared using a computer program, submit complete program documentation outlining analysis and design method along with input and output data for each panel. Submit hand calculations for one typical panel prepared by the same method as used by the computer program for comparison and confirmation of the program. Calculations shall be prepared under the supervision and signed by a registered professional engineer in the state where the project is located. Tension stresses in the concrete caused by lifting shall not exceed $4.5(f'_c)^{0.5}$.
- F. Sample Panels: Prepare for approval of Architect/Engineer a minimum of one sample panel for each type of finish specified. Sample panel shall

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be 2 feet by 2 feet by 2 inches minimum thickness cast from a minimum 3 cubic yard truck load. Approved panels shall remain on the job site until the Architect gives instructions for removal and disposal. Rejected panels shall be disposed of off site.

- G. Job Mock-Up: After acceptance of material samples construct one full size panel to include representative items to be encountered in the work. Submit shop drawings for mock-up panel. Cast, finish, cure and erect mock-up panel in the same manner as will be employed in the work. Job mock-up panel may be incorporated in the structure when acceptable to the Architect.

2.1. CONCRETE MATERIALS

Use selected cement and aggregates to match Architect's sample. Refer to drawings for classes and strengths of concrete.

- A. Portland Cement: ASTM C 150, Type I or Type III, unless otherwise approved by the Architect/Engineer. Cement has the additional requirement that equivalent alkalies ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) do not exceed 0.60% according to ASTM C150-00, Table 2.
1. Use one brand of cement, for each class of concrete, throughout the project, unless approved otherwise by the Architect/Engineer and the Owner's Testing Laboratory.
 2. Testing of cement in lieu of mill certificate submittal will be required if:
 - a. The cement has been in storage at the mixing site for over 30 days
 - b. It is suspected by the Owner, Architect, Engineer or Testing Laboratory that the cement has been damaged in storage or in transit or is in any way defective.
- B. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete. Submit material certificates from aggregate supplier or test results from an independent testing agency certifying conformance to this specification for each source of aggregate.
- C. Water: Comply with the requirements of ASTM C1602.
- D. Air-Entraining Admixture: ASTM C 260. Provide air entrainment in all tilt-up panels as specified in Table 4.2.1 of ACI 318 Exposure in Table 4.2.1 shall be taken as moderate. Subject to compliance with requirements, provide one of the following products and manufacturers, or equal:

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"Darex" or "Daravair" series; W. R. Grace & Co.

"MBAE90" or "Micro-Air"; BASF Admixtures, Inc

"Sika AER"; Sika Corporation

"Air Mix" or "AEA-92"; The Euclid Chemical Company, Inc.

"Eucon Air 30" or "Eucon Air 40", The Euclid Chemical Co., Inc.

Submit manufacturer's certification that product conforms to the requirements specified.

- E. Water-Reducing Admixture: ASTM C 494, Type A. See maximum permissible chloride ion content in concrete specified below.

Subject to compliance with requirements, provide one of the following products and manufacturers, or equal:

"Pozzolith 322N" or "Polyheed 997"; BASF Admixtures, Inc.

"Plastocrete 161"; Sika Chemical Corp.

"Eucon WR-75 or WR-91"; The Euclid Chemical Company, Inc.

"WRDA "; series W.R. Grace & Co.

"Eucon NW" or "Eucon LW", The Euclid Chemical Company, Inc.

Submit manufacturer's certification that product conforms to the requirements specified.

- F. Mid-Range Water-Reducing Admixture: ASTM C494, Type A and Type F. See maximum permissible chloride ion content in concrete specified below.

Subject to compliance with requirements, provide one of the following products and manufacturers, or equal:

"Polyheed 997", BASF Admixtures, Inc.

"Eucon MR", The Euclid Chemical Company, Inc.

"Sikament HP", Sika Chemical Corp.

"Daracem" or "Mira" series, W.R. Grace & Co.

"Eucon X15" or "Eucon X20", The Euclid Chemical Company, Inc.

Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.

- G. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C494, Type F or Type G. See maximum permissible chloride ion content in concrete specified below.

Subject to compliance with requirements, provide one of the following products and manufacturers, or equal:

"ADVA" or "Daracem" Series; W.R. Grace & Co.

"Rheobuild 1000" or "Glenium 30/30"; BASF Admixtures, Inc.

"Sikament"; Sika Chemical Corp.

"Eucon 37/1037" or "Plastol" series; The Euclid Chemical Company, Inc.

"Euconl SP" or "Eucon RD", The Euclid Chemical Company, Inc.

Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures to be used.

- H. Water-Reducing, Accelerator Admixture (Non-Corrosive, Non-Chloride): ASTM C 494, Type C or E. See maximum permissible chloride ion content in concrete specified below.
Subject to compliance with requirements, provide one of the following products and manufacturers, or equal:

"Polarset"; "Gilco", "Lubricon NCA" or "DCI", W.R. Grace & Co.

"Pozzutec 20+"; BASF Admixtures, Inc.

"Accelguard 80/90"; "NCA", or "AcN", The Euclid Chemical Company, Inc.

"Plastocrete 161FL", Sika Chemical Co.

"Eucon AcN", The Euclid Chemical Company, Inc.

Submit manufacturer's certification that product conforms to the requirements specified.

- I. Water-Reducing, Retarding Admixture: ASTM C 494, Type D. See maximum permissible chloride ion content in concrete specified below.
Subject to compliance with requirements, provide one of the following products and manufacturers, or equal:

"Daratard" series, W.R. Grace & Co.

"Pozzololith 100XR" or "Pozzololith 300R; BASF Admixtures, Inc.

"Plastiment"; Sika Chemical Co.

"Eucon Retarder", Series, The Euclid Chemical Company, Inc.

Submit manufacturer's certification that product conforms to the requirements specified.

- J. Pozzolan Admixtures: Fly ash or other pozzolan admixtures shall not be used in tilt-up panels.

- K. Admixtures Containing Chloride Ions: Admixtures containing chloride ions shall not be used in tilt-up panels. The maximum chloride ion content in panel concrete shall be 0.30 (maximum water soluble chloride ion in concrete at 28 days, % by weight of cement). The Contractor shall have a Testing Laboratory verify in a written submittal that the chloride ion content does not exceed limits stated above.

- L. Concrete Reinforcement:

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1. Reinforcing Steel: All reinforcing steel shall conform to the "Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement," ASTM A615 Grade 60 unless noted otherwise on the drawings. All reinforcing steel required to be welded shall conform to ASTM A 706 "Standard Specification for Low Alloy Steel Deformed Bars for Concrete Reinforcement".
2. Deformed Bar Anchors: Deformed Bar Anchors shall conform to "Standard Specification for Deformed Steel Wire for Concrete Reinforcement", ASTM A 496 with a minimum yield strength of 75,000 PSI. Standard ASTM A 615 Grade 60 reinforcing bars may not be substituted for deformed bar anchors.
3. Welded Wire Fabric: Welded smooth wire fabric for concrete reinforcement shall conform to the "Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement," ASTM A 185 with a yield strength of 65,000 PSI. Welded deformed wire fabric for concrete reinforcement shall conform to the "Standard Specification for Welded Deformed Wire Fabric for Concrete Reinforcement," ASTM A 497 with a yield strength of 70,000 PSI. All welded wire fabric shall be furnished in flat sheets only.
4. Tie Wire: Tie wire shall be annealed steel tie wire, minimum 16 gauge.
5. Dowel Bar Replacement: All reinforcing steel dowel bars shown on the drawings crossing concrete construction joint surfaces with inserts cast flush against the form and having reinforcing bars connected to the insert in a subsequent concrete pour shall conform to the following:
 - a. Splice connection at insert shall develop the full tensile strength of the reinforcing steel conforming to a Type 2 splice in accordance with ACI 318-05, ch. 21.
 - b. Splices shall be approved by the ICC Evaluation Service, Inc. and shall have an Evaluation Report submitted for Engineer review.
 - c. The following are acceptable products:
 - "Lenton Form Saver", Erico Products, Inc.
 - "DB-SAE Dowel Bar Splicer", Dayton/Richmond, Inc.
 - or other Engineer-approved product.
6. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing,

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supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications. Provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

Where possible, reinforcing steel shall be supported from above and chairs shall be avoided.

7. Form Ties: Provide form ties of adjustable length and type which will not leave holes larger than 1" in diameter in face of concrete. Ties shall be such that when forms are removed no metal will be within 1" of the finished concrete surface. All holes must be patched and rubbed to Architect's approval.

2.2. RELATED MATERIALS

- A. Release Agent (Curing Compound-Bond Breaker): Solution of organic esters and silicones containing no oils, waxes, paraffins or other material which could affect bond of subsequent finishes or the natural appearance of the exposed concrete surface. Material shall be the highest quality non-staining type and manufactured for the intended use.
- B. Forms: Provide wood, metal, or other substantial material to maintain forms in good alignment and produce required finish. Provide external bracing to prevent form displacement during casting operations.
- C. Reveal Strips and Form Liners: Provide products as required to conform to panel finish matching Architect's control sample.
- D. Structural Steel: All structural steel shapes and plates shall conform to ASTM A 36 unless noted otherwise on the drawings.
- E. Castings:
 1. Malleable Iron: ASTM A 47, Grade 32510.
 2. Carbon Steel: ASTM A 27, Grade 60-30.
 3. Ductile Iron: ASTM A 536, Grade 60-40-18.
- F. Flashing Reglets: Provide open type having continuous groove not less than 1 1/8" deep by 3/16" wide at opening and sloped upwards at 45 degrees, unless otherwise indicated. Furnish with easily removed filler strip.
 1. Stainless Steel: ASTM A 167, Type 302, soft temper, minimum 0.011" thick.
 2. Copper Strip: ASTM B 370, cold rolled temper, minimum 16 oz. per square foot.

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3. Hot-Dip Galvanized Sheet Metal: ASTM A 525, with ASTM A 525 G90 zinc coating, minimum 24 ga.

G. Bonding Compound: Polyvinyl acetate or acrylic base, for use in cosmetic nonstructural repairs.

Products: Subject to compliance with requirements, provide one of the following:

1. Acrylic or Styrene Butadiene

"Day-Chem Ad Bond (J-40)"; Dayton Superior

"SBR Latex"; Euclid Chemical Co.

"Daraweld C"; W. R. Grace.

"Acrylic Additive," BASF Building Systems, Inc.

"SikaLatex", Sika Chemical Co.

"Intralok", W. R. Meadows

"US Spec Acrylcoat", US Mix Co.

"Akkro 7-T", Tamms Industries

2. Polyvinyl Acetate (Interior Use Only)

"Euco Weld"; Euclid Chemical Co.

"Everweld"; L & M Construction Chemicals, Inc.

"Superior Concrete Bonder (J-41)," Dayton Superior

H. Epoxy Products: Two component material suitable for use on dry or damp surface, complying with ASTM C881, for use in all structural concrete repairs.

1. Products for Crack Repair, or equal:

"Sikadur 35 Hi Mod LV"; Sika Chemical Company - injection type

"Sikadur 52", Sika Chemical Company - injection type

"Sikadur 55 SLV", Sika Chemical Company - gravity feed

"Eucopoxy Injection Resin," Euclid Chemical Company

"Sure-Inject (J-56)," Dayton Superior

"Epofil SLV", BASF Building Systems

"ETI-LV" or "ETI-GV", Simpson Strong-Tie Co., Inc. - injection type

"Pro-Poxy 100 LV" or "Pro-Poxy 50", Unitex

"Crackbond", U.S. Anchor Corp.

"Rezi-Weld LV", W. R. Meadows

"US Spec Maxibond" US Mix Co. - injection or gravity feed

"US Spec Eposeal LVS", US Mix Co. - gravity feed

2. Products for Epoxy Mortar Patches, or equal:

"Sikadur Lo-Mod LV"; Sika Chemical Corporation.
"Euco 352 LV," Euclid Chemical Company
"Sure Grip Epoxy Grout (J-54)," Dayton-Superior
"Epofil", BASF Building Systems
"Pro-Poxy 2500", Unitex
"Rezi-Weld 1000", W. R. Meadows
"US Spec EPM 3000", US Mix Co.
"Duralcrete LV", Tamms Industries

3. Products for Epoxying Bolts or Reinforcing Steel into Concrete-Moderate Temperatures: Product that conforms to ASTM C881-02, Type IV, Grade 3, Class B, & C except gel times, and that is dispensed from a two-component cartridge system through a mixing nozzle that thoroughly mixes the two components as it is injected into the hole. Do not install these products when the surface temperature of the concrete substrate is less than 40° F, or equal.

"Sikadur 31 Hi-Mod Gel"; Sika Corporation
"Euclid 452 Gel", Euclid Chemical Company
"Sure Anchor I (J-51)", Dayton Superior
"Epo Gel" or "Rapid Gel", BASF Building Systems
"Power-Fast Injection Gel", Powers Rawl
"Epoxy-Tie ET" or "Epoxy-Tie SET", Simpson Strong-Tie Co., Inc.
"Pro-Poxy 300", Unitex
"Ultrabond 1300", U.S. Anchor Corp.
"Rezi-Weld 1000", W. R. Meadows
"US Spec Gelbond NS", US Mix Co.
"Duralcrete Gel", Tamms Industries

4. Products for Epoxying Bolts or Reinforcing Steel into Concrete-Low or Moderate Temperatures: Product that conforms to ASTM C881-02, Type IV, Grade 3, Class A, B, & C except gel times, and that is dispensed from a two-component cartridge system through a mixing nozzle that thoroughly mixes the two components as it is injected into the hole. Consult with the manufacturer for the minimum temperature of the concrete surface allowed, or equal.

"HSE 2421 System", or "HIT RE 500", Hilti Fastening Systems
"Epcon C6 System", ITW Ramset/Red Head
"Euclid 620 Gel", Euclid Chemical Company
"Pro-Poxy 300 Fast", Unitex
"HS-200", U.S. Anchor Corp.

"US Spec Gelbond NS Fast", US Mix Co.

"Dural Fast Set Epoxy Gel", Tamms Industries

5. Products for Epoxying Steel Plates to Concrete: Conform to ASTM C881-90, Type IV, Grade 3, Class A, B, & C except gel times, or equal.

"Sikadur 31 Hi-Mod Gel"; Sika Corporation

"Euclid 452 Gel," Euclid Chemical Company

"Sure Anchor I (J-S1)," Dayton Superior

"Epo Gel" or "Rapid Gel", BASF Building Systems

"Pro-Poxy 200", Unitex

"US Spec Gelbond NS" US Mix Co.

"Duralcrete Gel", Tamms Industries

Substitutions may be considered provided complete technical information and job references are furnished to the Engineer for approval prior to commencement of work.

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I. Expansion Anchors in Concrete:

1. ICC Approval: Only anchors evaluated by the ICC Evaluation Service, Inc. (ICC-ES) with a published Evaluation Report shall be approved for use. Anchors that are to be installed in concrete that may become cracked under service loads as noted on the drawings shall be evaluated by ICC-ES according to Acceptance Criteria 193 and shall be specifically approved for use in cracked concrete. All anchors shall be approved for resisting seismic and wind loads.
2. Type: All expansion anchors in concrete shall be only wedge type expansion, sleeve-type expansion, or undercut type anchors.
3. Interior Use: All expansion anchors, nuts and washers for use in interior conditioned environments free of potential moisture shall be manufactured from carbon steel zinc plated in accordance with Federal Specification QQ-Z-325C, Type II, Class 3.
4. Exterior or Exposed Use: All expansion anchors, nuts and washers for use in exposed or potentially wet environments, or for attachment of exterior cladding materials shall be galvanized or stainless steel. Galvanized anchors, nuts and washers shall conform to ASTM A 153. Stainless steel anchors shall be manufactured from 300 series stainless steel and nuts and washers from 300 series or

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Type 18-8 stainless steel.

5. Nuts and Washers: Nuts and washers shall be furnished from the manufacturer and used with the anchors.
6. Acceptable Products and Manufacturers - Uncracked Concrete Only, or equal:

"Kwik-Bolt 3", HSL Heavy Duty Sleeve Anchor" and "HDA Undercut Anchor"; Hilti Fastening Systems
"Trubolt Wedge Anchors," ITW Ramset/Red Head
"Power Stud" or "Power Bolt," Powers Fasteners, Inc.
"Wedge-All", Simpson Strong-Tie Co., Inc.
"Ultrawedge", U.S. Anchor Corp.

Other products will be acceptable only if evaluated by ICC-ES with an Evaluation Report submitted for Engineer review.

7. Acceptable Products and Manufacturers - Cracked and Uncracked Concrete:

"Kwik Bolt TZ", "HDA Undercut Anchor" and "HSL-3 Heavy Duty Sleeve Anchor", Hilti Fastening Systems

Other products will be acceptable only if evaluated by ICC-ES according to Acceptance Criteria 193 with a published Evaluation Report that specifically allows the use of the anchor in cracked concrete.

J. Non-Shrink Grout: Provide grout type(s) as specified on the drawings:

1. Non-Metallic Non-Shrink Grout: Premixed, non-corrosive, non-staining product containing Portland cement, silica sands, shrinkage compensating agents, and fluidity improving compounds. Conform to ASTM C1107. Provide the minimum strength as shown below as determined by grout cube test at 28 days:
 - a. 6,000 PSI for supporting concrete 3000 psi and less.
 - b. 8,000 PSI for supporting concrete greater than 3000 psi and less than or equal to 4000 psi.
 - c. Unless noted otherwise on the drawings, grout strength on supporting concrete greater than 4000 psi shall be 8000 psi.

Subject to conformance with specified requirements, acceptable non-shrink grouts include, or equal:

"14k Hy Flow" and "SonogROUT 10k" as manufactured by Sonneborn-ChemRex, Inc.

"Crystex" and "DuragROUT" as manufactured by L&M Construction Chemicals, Inc.

"Sure Grip High Performance Grout," and "1107 Advantage Grout" as manufactured by Dayton-Superior Corporation.

"Masterflow 555", "Masterflow 928" and "Set Grout" as manufactured by ChemRex, Inc., MBT Protection and Repair Division.

"Five Star Grout" as manufactured by U.S. Grout Corp.

"NS Grout" and "Hi-Flow Grout" as manufactured by The Euclid Chemical Company.

- K. Corrosion Protection of Steel: Shop prime all items except those exposed to weather or in contact with earth which shall be hot-dipped galvanized in accordance with ASTM A153. Touch-up after field welding with zinc-rich coating as manufactured by Sherwin-Williams (Zinc-Clad 5 B69 A 45) or ZRC Cold Galvanizing Compound. Exposed surfaces of all plates embedded in concrete shall be painted with zinc-rich coating specified above after the field connection is complete.

2.3. PROPORTIONING AND DESIGN OF MIXES

- A. Refer to the "Cast-in-Place Concrete" section of the Specifications.

2.4. CONCRETE MIXES

- A. Ready Mix Concrete: Comply with all requirements of ASTM C94 and Testing Laboratory section of the Specifications.

2.5. PANEL FINISH

- A. Casting Bed: Panel outside finish shall reflect the finish of the approved casting bed. The casting bed shall be inspected and approved by the Owner's authorized inspector prior to casting.

- B. Inside Panel Finish: Apply smooth trowel finish to top of panel surface (inside surface).

- C. Finish Requirements:

1. Unacceptable blemishes shall include but not necessarily be limited to exposed aggregate, holes, honeycombs, cracks, fins, rough corners and edges, excessive or inconsistent surface texture out of plane more than 1/8" in a length of 10 feet.
2. All cracks, honeycombs and holes shall be patched using methods and materials approved by the Architect for the finish the particular panel is scheduled to receive.
3. All corners, edges and surface irregularities shall be rubbed smooth with a carborundum stone.

2.6. FABRICATION TOLERANCES

- A. Casting Bed Surface Tolerance: Casting beds shall be prepared to

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smoothness surface range of variation tolerance not to exceed 1/4" per 10 feet. This tolerance shall be measured by setting a 10 foot straightedge on 3/8" thick steel shims at each end. The surface tolerance shall be met if, for any point measured on the casting bed surface, a 1/4" diameter roller fits anywhere under the elevated straightedge and a 1/2" diameter roller does not fit anywhere under the elevated straightedge. Grinding and/or filling shall be undertaken on the casting bed surface until the specified tolerance is met.

B. Panel Casting Tolerances: Panel Casting tolerances shall be as specified below:

1. The following panel tolerances apply to the over-all height and width measured at the face adjacent to form when cast:
 - a. Panels 10 feet or under; $\pm 1/8"$
 - b. Panels 10 feet to 20 feet; $+ 1/8"$, $- 3/16"$
 - c. Panels 20 feet to 30 feet; $+ 1/8"$, $- 1/4"$
 - d. Each additional 10 feet; $\pm 1/16"$ per 10 feet
2. Panel Thickness: $+ 1/4"$, $- 1/8"$.
3. Size of Openings Within a Panel: $\pm 1/4"$.
4. Out of Square (Diagonal Measure): $1/8"$ per 6 feet but not more than $1/4"$ total.
5. Location Tolerances for Openings or Blockouts in Panels: $\pm 1/4"$.
6. Warping and Bowing: Warping and bowing tolerances shall be as specified in the "PCI Design Handbook as published by the Prestressed Concrete Institute.

C. LOCATION TOLERANCES FOR CAST-IN ITEMS:

1. Inserts, pipe sleeves, bolts, plates; $\pm 3/8"$.
2. Flashing reglets at panel edge; $\pm 1/4"$.
3. Reglets for glazing gaskets; $\pm 1/8"$.
4. Groove width for glazing gaskets; $\pm 1/16"$.
5. Electrical outlets, hose bibs, etc.; $\pm 1/2"$.

3.1. PREPARATION OF CASTING BED

- A. Curing of Casting Bed Slab: Cure concrete surface upon which wall panels are to be cast by moist curing method using water ponding or water fog spray. Upon completion of curing, apply specified bond breaker/curing compound in accordance with manufacturer's instructions.
- B. Repairing Casting Bed Surface: In the event there are any cracks, pits, or other surface imperfections in the casting bed which could be transferred to the panel surface, take appropriate steps to correct the

casting bed surface.

C. Construction of Forms:

1. Construct forms to the shape, lines, and dimensions as specified on the shop drawings. Place form liners and reveal strips accurately and securely to assure they do not move during casting operations.
2. Brace and tie forms together so as to maintain position and shape. Prevent mortar leakage by maintaining forms sufficiently tight.
3. Take care to assure that formwork does not stain concrete surfaces.
4. After forms are in place, apply a second coat of bond breaker.

D. Reinforcing Steel and Insert Placement: Set and tie reinforcing steel specified on the drawings. Locate and secure all anchorages, plates, bolts, and other embedded items. Reinforcing steel shall be chaired and spaced to provide 3/4" cover unless specified otherwise on the drawings. After placing reinforcing steel for panels, check casting slab surfaces for continuity of bond breaker film. Touch up or recoat worn or damaged areas, taking particular care not to coat reinforcing steel and inserts.

3.2. CONCRETE PLACEMENT

A. Mixing:

1. Mix to a uniform distribution of materials, at least two minutes after all materials are in mixer, and discharge concrete completely before mixer is recharged.
2. Deliver and discharge concrete from the truck mixer within a maximum of 1-1/2 hours after the introduction of water to the cement and aggregate and before the concrete starts to set.
3. Mix each batch of concrete not less than 50 nor more than 100 revolutions of the drum at mixing speed. Additional mixing shall be at agitating speed.
4. Ready-mix concrete shall conform to the requirements of ASTM C94.

B. Conveying: Convey from the mixer to the place of final deposit by methods which will prevent the separation or loss of the materials.

C. Depositing:

1. Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Retempering is prohibited.
2. When concreting is once started, it shall be carried on as a continuous operation, until placing of panels in a section is completed. Whenever possible, pour panels from a single mixer load of concrete.

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3. Take ample precaution to prevent honeycombing. Use mechanical vibrator sparingly, and do not use it to flow concrete.
 4. Keep reinforcement in place while placing concrete.
- D. Installation of Embedded Items: Install anchor bolts, slots, boxes, sleeves and other required devices. Provide all such items not specified to be provided by other trades.
- E. Hot Weather Concreting:
1. The maximum acceptable concrete temperature at the truck discharge point shall be 95°F.
 2. See "Cast-in-Place Concrete" section of the Specifications for required hot weather concreting practices.
- F. Cold Weather Concreting:
1. Concrete shall not be placed on any day when the outside air temperature is 40°F or less unless cold weather concreting practices are followed.
 2. Cold weather concreting practices should also be followed whenever the following conditions exist for more than three successive days:
 - a. the average daily air temperature is less than 40°F, and
 - b. the air temperature is not greater than 50°F for more than one half of any 24 hour period.The average daily air temperature is the average of the highest and lowest temperature occurring during the period from midnight to midnight.
 3. See "Cast-in-Place Concrete" section of the Specifications for required cold weather concreting practices.
- G. Curing:
1. Curing shall commence as soon as possible after free water has disappeared from the concrete surface after placing and finishing and shall continue for as long as required to attain required lifting strengths.
 2. The curing period shall be 7 days or until the concrete attains a compressive strength of 3000 psi as determined by test cylinders, made and kept adjacent to the panels and cured by the same methods.
 3. Cure by moisture curing or moisture-cover curing as specified in the "Cast-in-Place Concrete" specification..
 4. Curing may also be accomplished using an approved chemical curing compound conforming to ASTM C1315 provided the compound in no way interferes with subsequent surface treatment and is applied in

strict accordance with manufacturer's instructions.

3.3. ERECTION OF PANELS

A. Precast Panel Review: Prior to lifting, the Contractor shall verify the proper dimensions, openings, blockouts, and inserts of all panels to be erected and shall correct or replace those panels not in accordance with the approved shop drawings.

B. Lifting:

1. Panels shall be lifted according to the engineering calculations and shop drawings. Panels shall not be lifted until the concrete achieves the required compressive strength specified in the analysis but not less than 3000 psi.
2. Coordinate panel erection sequence and adhere to special lifting techniques and sequences as specified on the erection shop drawings.
3. Carefully tilt and lift panels from the casting slab and erect plumb in accurate location and alignment. Use wedges where required to correctly position panels. Anchor and grout panels to foundation and to each other as specified.

C. Bracing: After placing, provide temporary braces and supports to securely hold panels in position according to the approved shop drawings. Maintain braces in place until final framing and connections to panels are completed.

D. Erection Tolerances: Tilt-up panels shall be erected to the tolerances specified below and in the PCI Design Manual, "Erection Tolerances - Architectural Wall Panels".

1. Plan Location; $\pm 1/2"$.
2. Top Elevation; $\pm 1/4"$.
3. Elevation of Supports for Members Framing into Panels; $+1/4"$, $-1/2"$.
4. Plumbness:
 - a. In any 10 feet of height; $1/4"$
 - b. Maximum over height of panel; 1"
5. Joint Width; $\pm 1/4"$.
6. Joint Taper:
 - a. Over 10 feet of length; $1/4"$
 - b. Maximum; $3/8"$
7. Maximum Jog in Alignment of Matching Faces; $1/4"$.

E. Welding:

1. All welding to panels at connections shall be performed by AWS certified welders.
2. Precautions shall be taken to insulate concrete from thermal

stresses caused by welding.

F. Unauthorized Connections: All connections between panels and between framing members and panels shall be made in strict accordance with approved shop drawings. Any connections that can not be made as shown on the drawings because of mis-casting or out-of-tolerances must be submitted to the Engineer for redesign for each specific occurrence. Erection shall proceed only with revised drawings submitted through the Architect to the field. Unauthorized connections shall not be allowed. Expansion bolts to tilt-up panels shall not be used without Engineer approval for each case.

G. Crane Load on Slab-on-Grade: The slab thickness and reinforcement shown on the drawings has not been designed for crane loads. The Contractor shall be responsible for distributing crane loads over the slab to prevent overstress and cracking of the slab or shall increase slab thickness and reinforcement as required.

3.4. DAMAGED OR MIS-CAST PANELS

A. Any panels that are noticeably cracked from the process of lifting, handling, or any other reason shall be replaced by the Contractor at no additional cost to the Owner.

B. Concrete panels which are not formed as shown on the drawings or are out-of-tolerance or show a defective finish shall be considered as not conforming with the intent of this specification and shall be removed from the job and replaced by the Contractor at no additional cost to the Owner.

3.5. CONCRETE SURFACE REPAIRS

A. Classification:

1. Structural Repair: Major defective areas including cracks, spalls, or honeycombs that affect the structural integrity of the panel shall require a structural repair using a two part epoxy bonder and/or epoxy mortar. Location of structural repairs shall be at the discretion of the Engineer.

2. Cosmetic Repair: Minor defective areas in panels that do not affect the structural integrity of the panel shall require a cosmetic repair using a non-shrink patching mortar and bonding agent. Location of cosmetic repairs shall be at the discretion of the Architect and Engineer.

B. Method: The method of repair shall be approved by the Architect/Engineer after samples are submitted for review by the

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- C. Waiver: Permission to patch or repair any area shall not be considered as a waiver of the Architect's right to require complete removal of the defective work if the repair does not, in the opinion of the Architect, satisfactorily restore the quality and appearance of the work.

- - - END OF SECTION - - -