DSA IR 19-2

GLASS FIBER REINFORCED CONCRETE (GFRC) PANELS: 2022 CBC

Disciplines: Structural

History: Revised 09/12/23 Under 2022 CBC
Last Revised 09/09/21 Under 2019 CBC
Original Issue 09/01/99

Division of the State Architect (DSA) documents referenced within this publication are available on the DSA Forms or DSA Publications webpages.

PURPOSE

This Interpretation of Regulations (IR) clarifies requirements relating to glass fiber reinforced concrete (GFRC) panels used on construction projects under DSA jurisdiction.

SCOPE

This IR is applicable to GFRC panels fabricated by the spray-up or premix processes and covers design, quality control, and inspection requirements. This IR is not applicable to polymer modified E-glass fiber reinforced concrete. ←

BACKGROUND

Glass fiber reinforced concrete is the term applied to products manufactured using cement/ aggregate slurry thoroughly mixed with alkali-resistant glass fiber reinforcement. GFRC is typically used in thin-walled architectural cladding panels. The Precast/Prestressed Concrete Institute (PCI) provides guidance for GFRC design and construction through various publications. California Building Code (CBC), Section 1903A.3 requires GFRC to comply with the PCI publication Recommended Practice for Glass Fiber Reinforced Concrete Panels (MNL-128).

GFRC is traditionally fabricated by the spray-up or premix process. MNL-128 generally focuses on the spray-up process, which is the most common method of GFRC fabrication. The provisions specific to the premix process are presented in Appendix J of MNL-128. GFRC panels are fabricated with a minimum thickness of ½ inches and are typically supported by a steel panel frame.

1. APPROVAL PROCESS ←

The approval of GFRC for use on a specific project can be achieved by the deferred submittal process in compliance with the California Administrative Code (CAC), Section 4-317(g) when permitted by the DSA regional office performing plan review and construction oversight for the project. The deferred submittal process is described in Section 1.3 below.

As an alternate to the deferred submittal process, when elected by the project applicant or required by DSA, the GFRC panels may be incorporated into the construction documents. In this option, the review and approval of the GFRC panel drawings will be combined review and approval of construction documents.

1.1 GFRC Engineer

The design of GFRC panels is commonly delegated to an engineer retained by the manufacturer as defined in the Glossary below.

1.1.1 The GFRC engineer shall stamp and sign all GFRC drawings in accordance with *IR A-19: Design Professional's Signature and Seal (Stamp) on Construction Documents*.

1.1.2 The GFRC engineer shall provide complete calculations demonstrating the structural adequacy of the panels, including but not limited to the following:

1.1.2.1 Skin anchors with consideration of buckling limit states.

1.1.2.2 Structural members in the panel frame.

1.1.2.3 Sub-frame to support the panels.

1.2 Project Design Professionals

As defined in the Glossary below, the project design professionals are responsible for the design of the building upon which the GFRC panels will be installed.

1.2.1 The project design professionals shall affix to the GFRC drawings a signed Statement of General Conformance in accordance with *IR A-18: Use of Construction Documents Prepared by Other Professionals*.

1.2.2 The structural engineer of record listed on line 24a of form *DSA 1: Application for Approval of Plans and Specifications* shall verify the following:

1.2.2.1 Adequacy of the building structural members and their connections to resist the applied torsional, vertical, and lateral loads imposed by GFRC panels as prescribed in Section 2.1 below.

1.2.2.2 Compatibility of the panel anchor connections designed by the GFRC engineer with the building structure to which it attaches, including all parameters upon which the calculated capacity of the connection depends.

1.2.2.3 Spacing and size of joints between panels and between structural members and panels. The joints shall be sufficient to accommodate the in-plane and out-of-plane movements of panels and provide the deformation compatibility described in Section 2.1 below.

1.3 Deferred Submittal Review and Approval

When the deferred submittal process is used, the approval of the GFRC system is approved by DSA as described in this section. There are specific requirements and responsibilities for the GFRC manufacturer, GFRC engineer, project design professionals, and DSA in each phase. The review and approval of the GFRC system is performed after the construction contract has been awarded and a qualified GFRC manufacturer selected. The sequence of events is as follows:

1.3.1 The project design professionals work with DSA to submit and obtain approval of the construction documents. The DSA-approved construction documents shall define the complete design criteria of the GFRC system, including material properties, dimensions, applied loads, deformation compatibility demands, support conditions, and all non-structural performance requirements.

1.3.2 The manufacturer, working in a coordinated effort with the project design professionals, prepares the GFRC submittal package in accordance with the requirements of the DSA-approved construction documents.

1.3.2.1 If changes to the DSA-approved construction documents are required during the preparation of the GFRC submittal package, the project design professional shall prepare and submit a construction change document (CCD) to DSA for review and approval in accordance with *IR A-6: Construction Change Document Submittal and Approval Process*. Depending on the nature and extent of changes, DSA may require the revised documents be submitted and processed as a Revision. When a CCD or Revision is required, it must be approved prior to or concurrent with approval of the GFRC submittal package.

1.3.2.2 In accordance with Procedure (*PR) 18-04: Electronic Plan Review for Design Professionals of Record*, Section 5, the GFRC submittal package shall be organized into two separate electronic files. The approval document file contains the GFRC drawings. The supporting document file contains information that is not directly approved by DSA but is necessary to substantiate approval of the GFRC design, including the structural calculations, evaluations reports, proprietary product data, etc.

1.3.3 The manufacturer submits the GFRC submittal package to the project design professionals for review and approval. This step may take multiple exchanges between the project design professionals and the manufacturer to finalize the package for submission to DSA.

1.3.4 The design professional submits the GFRC submittal package to DSA for review, which may result in plan review comments that require action by the manufacturer, the project design professional, or both. The GFRC submittal shall be revised, and additional information provided as required to resolve all plan review comments. The project design professional shall coordinate with the manufacturer and DSA as necessary to resolve plan review comments, submit a revised submittal package, and obtain DSA approval.

1.3.5 When the GFRC drawings are complete and code compliant, DSA will affix its approval stamp. Manufacture of panels is not permitted until the GFRC drawings are approve by DSA.

2. DESIGN

GFRC panels shall be designed in accordance with the California Building Code (CBC), American Society of Civil Engineers Standard 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7), and MNL-128 for in-plane and out-of-plane loads and effects.

2.1 Design Criteria

The GFRC engineer shall consider each of the following in the design of GFRC panels. Structural calculations shall demonstrate adequacy for strength, stiffness, and deformation compatibility.

2.1.1 Panels shall be adequate to resist all loads and environmental conditions required by the CBC and standards identified above.

2.1.2 Anchors and connections of exterior panels shall also comply with the earthquake induced drift and force requirements of ASCE 7 Section 13.5.3.

2.1.3 Exterior wall systems shall be designed with adequate deformation compatibility as required by ASCE 7 Sections 13.5.3 and 13.3.2. The drift demand of the building shall be defined by the project design professional on the DSA-approved construction drawings.

2.2 Project Specifications

MNL-128 provides useful guidelines for writing GFRC panel specifications (refer to the Guide Specification section). In addition to requiring compliance with the requirements and recommendations of MNL-128, the project specifications prepared by the design professional shall include the following provisions:

2.2.1 Require panel design and fabrication in accordance with MNL-128.

2.2.2 Require the manufacturer have an established quality control program that complies with MNL-128 Chapter 8 and the Manual for Quality Control for Plants and Production of Glass Fiber Reinforced Concrete Products (MNL-130) published by PCI.

2.2.3 Specify mix design requirements for the backing material.

2.2.3.1 Require a cement/sand ratio in the following range: 1:1 to 1:2.

2.2.3.2 Require a minimum five percent nominal fiber content by weight.

2.2.3.3 Specify minimum strength and shrinkage requirements.

2.2.4 Require glass fibers comply with American Society for Testing and Materials (ASTM) C1666: Standard Specification for Alkali Resistant (AR) Glass Fiber for GFRC and Fiber-Reinforced Concrete and Cement.

2.3 GFRC Drawings

Whether processed as a deferred submittal or incorporated into the project construction documents, drawings for GFRC panels shall include the information required by this section.

2.3.1 Details for skin and panel anchors including the following:

2.3.1.1 Dimensions and thickness of bonding material.

2.3.1.2 Embedment dimension of skin anchors in bonding material.

2.3.1.3 Dimension for weld sizes and lengths in connections to panel frame or building structure.

2.3.2 Details showing and dimensioning the joints between GFRC cladding elements. Joint width shall be adequate for panel size, structural tolerance, anticipated movement, story drift, joint materials, and adjacent surface types.

2.3.3 Details of connections (as defined in Glossary below) shall indicate the size of oversized or slotted holes and the required clearance between connectors and the sides of holes for erection tolerance and to accommodate the drift compatibility requirements of ASCE 7 Section 13.5.3.

2.3.4 When rectangular hollow structural sections are used, drawings shall indicate the orientation of the section.

2.3.5 Drawings shall clearly identify the boundary and interface between GFRC panels and the supporting structural members designed by the project design professional and specified on the structural drawings of the construction documents.

3. QUALITY CONTROL, TESTING, AND INSPECTION

The requirements of this section shall apply to all GFRC panels regardless of the fabrication process (i.e., spray-up or premix). The form *DSA 103: Listing of Structural Tests and Special Inspections* for the project shall clearly indicate GFRC testing and inspections requirements in the “C6. Other Concrete” section.

3.1 Manufacturer’s Quality Control

GFRC panels shall be fabricated in accordance with MNL-128. The manufacturer shall have an established quality control program which meets the requirements of MNL-130, including the testing and inspection requirements of Division 5 and the test procedures of Appendix H.

3.1.1 When the manufacturing plant holds a current Group G certification issued by PCI, the manufacturer shall submit documentation of the PCI certification to the project design professional and DSA.

3.1.2 When the manufacturing plant does not hold a current Group G certification issued by PCI, the manufacturer shall submit its quality control manual to the project design professional for review and acceptance.

3.2 Testing Requirements

Any required structural material tests shall be performed by the project laboratory of record (LOR) who is employed by the school district and qualified by the DSA Lab Evaluation and Acceptance program. ←

3.2.1 Manufacturer shall provide quality control testing as required by MNL-130 Division 5, Section 5.2 and Appendix H. Test reports shall be submitted to the project inspector and the LOR.

3.2.2 Skin anchor pull-off and shear tests shall be conducted in accordance with ASTM C1230 and the acceptance criteria of MNL-130 Division 5, Section 5.2.5.

3.2.3 The testing program for GFRC fabricated by the premix process may be modified as it applies to specific panels.

3.3 Shop Special Inspection

The manufacturing of GFRC panels shall be subject to continuous special inspection by a special inspector meeting the criteria required by CAC Section 4-335(f).

Exception: Continuous special inspection is not required for GFRC manufacturing in plants holding a current Group G certification issued by PCI. However, any work identified in Section 3.4 below that is performed in the shop, rather than the field, is not exempt from special inspection. ←

3.3.1 The special inspector shall provide detailed daily special inspection reports in accordance with *IR 17-12: Special Inspection Reporting Requirements*.

3.3.2 All panels shall be marked with the approved special inspector's identification mark, and a list of approved panels shall be provided to the project inspector and DSA.

3.4 Field Special Inspection

Any required special inspection of field work (e.g., welding, bolt installations, etc.) shall be performed by a special inspector meeting the criteria required by CAC Section 4-335(f). The special inspector shall provide detailed daily special inspection reports in accordance with IR 17-12.

REFERENCES:

2022 California Code of Regulations (CCR) Title 24
Part 1: California Administrative Code (CAC), Section 4-316, 4-317, 4-343, 4-335.
Part 2: California Building Code (CBC), Section 1903A.3.

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GLOSSARY

Connection

Welding or bolting that attaches the skin to the panel frame or the panel frame to the building structure.

GFRC Engineer

A California registered professional engineer retained by the GFRC manufacturer who is responsible for the design of the panel, panel frame, anchors, and connections of the anchors to the panel in accordance with the design criteria in Section 2.1 above. The GFRC engineer stamps and signs the GFRC drawings.

Panel

The entire cladding component, including GFRC skin, support frame, anchors, and connection hardware.

Panel Anchor

Anchor that connects the panel frame to the building structure.

Panel Frame

Cold form or hot-rolled steel framing system supporting the skin.

Project Design Professional

The architect or structural engineer in general responsible charge of a project in accordance CAC Section 4-316(a) and the structural engineer with delegated responsibility in accordance with CAC Section 4-316(b). These individuals are sometimes referred to as the architect of record and structural engineer of record, and both are intended when this term is used in the plural form in this IR.

Skin

GFRC portion of the panel.

Skin Anchor

Anchor that is bonded to the skin by the bonding pad and connects the skin to the panel frame. There are three types of skin anchors: flex anchors, flat plate gravity anchors and truss rod gravity anchors. See Figures 24, 26, and 27 of MNL-128. The strength of skin anchors shall be determined in accordance with MNL-128, Section 5.7.2.3, and tested per Section 3.2.2 above.