

ICC-ES Evaluation Report

ESR-4446

Reissued August 2024


This report also contains:

- CBC Supplement

Subject to renewal August 2025

ICC-ES Evaluation Reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, LLC, express or implied, as to any finding or other matter in this report, or as to any product covered by the report.

Copyright © 2024 ICC Evaluation Service, LLC. All rights reserved.

<p>DIVISION: 06 00 00— WOOD, PLASTICS AND COMPOSITES</p> <p>Section: 06 52 00— Plastic Structural Assemblies</p> <p>DIVISION: 33 00 00— UTILITIES</p> <p>Section: 33 16 00— Water Utility Storage Tanks</p>	<p>REPORT HOLDER:</p> <p>MITSUBISHI CHEMICAL INFRATEC CORP., LTD.</p>	<p>EVALUATION SUBJECT:</p> <p>FRP PANEL TANK (HISHITANK™)</p>	
---	---	---	---

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021 [International Building Code® \(IBC\)](#)

Properties evaluated:

- Structural
- Material Properties

2.0 USES

The Fiber Reinforced Plastic (FRP) Panel Tank (HISHITANK™) is an enclosed tank used to store and distribute water, limited to ground level tank applications under the IBC.

3.0 DESCRIPTION

3.1 General:

The FRP Panel Tank (HISHITANK™) consists of roof, wall, and floor fiberglass reinforced panels, mechanically interconnected by exterior and interior steel reinforcements to assemble a rectangularly shaped enclosed tank. The enclosed tank size can be 1m (3.28ft.), 2m (6.56ft.) or 3m (9.84ft.) in height, with the 3m height achieved by stacking the 2m (6.56ft.) side wall panel on top of the 1m (3.28ft.) side wall panel. Steel interior and exterior structural elements are used for the tank assembly.

The FRP Panel Tank (HISHITANK™) is supported on a steel footing, anchored to a concrete foundation.

The scope of this report is for the evaluation of the fiberglass reinforced panel design capacities. The design of the steel reinforcement and corresponding connections, as well as the steel footing and its support concrete foundation are outside the scope of this report. HISHITANK is a trademark of Mitsubishi Chemical Infratec Corp., Ltd.

3.2 Material:

3.2.1 FRP panels: The fiberglass reinforced panels are formed by pressing SMC (sheet molding compound), a combination of unsaturated polyester resin and alkali-free roving glass. Panels are manufactured in ivory color with a proprietary contour profile. Panel edges are manufactured with holes for bolt connections. See [Table 1](#) and [Figure 1](#) for additional information regarding physical properties and dimensions, respectively. The panel types are as follows:

3.2.1.1 Side Wall Panels: The side wall panels models are KSF30BX [1m x 1m (3.28ft x 3.28ft)] and KLF20BX [1m x 2m (3.28ft x 6.56ft)]. The KSF30BX side wall panel thickness is 5mm (0.196 in.) minimum. The KLF20BX side wall panel thickness ranges between 3mm (0.118 in.) to 8mm (0.315 in.) for the curved area and between 3mm (0.118 in.) to 10mm (0.393 in.) for the flat area.

3.2.1.2 Roof Panel: The roof panel model is KRF00 [1m x 1m (3.28ft. x 3.28ft.)]. The KRF00 roof panel thickness is 3.5mm (0.138 in.).

3.2.1.3 Floor Panel: The floor panel model is KBF30 [1m x 1m (3.28ft x 3.28ft)]. The KBF30 floor panel thickness is 7.25mm (0.285 in.) for the curved area and 12mm (0.472 in.) for the flat area.

3.2.2 Steel Reinforcement: The steel reinforcements, provided by Mitsubishi Chemical Infratec Corp., LTD, are comprised of exterior side members, interior roof members and interior roof supports, all of which are installed in the field. See [Figures 2, 3](#) and [4](#) for additional steel reinforcement information for 1m, 2m and 3m tanks. The steel reinforcement is approved under the FRP Panel Tank (HISHITANK™) quality documentation.

3.2.2.1 Side Members: Side members consist of hot dipped galvanized angles, plates and brackets with holes that connect with the FRP panels through bolting. Side members have a minimum yield and tensile strength of **235 MPa (34 ksi) and 400 Mpa (58 ksi), respectively.**

3.2.2.2 Interior Roof Members: Interior roof members consist of beams and corresponding brackets that serve as support for roof panels. The interior roof members and brackets are powder coated and have a minimum yield and tensile strength of 235 MPa (34 ksi) and 400 Mpa (58 ksi), respectively.

3.2.2.3 Interior Roof Supports: Interior roof supports consist of pipe columns and corresponding plates, that support interior roof members. Pipe columns are powder coated, with a minimum yield and tensile strength of 205 MPa (35 ksi) and 520 Mpa (75 ksi), respectively. Plates are connected to interior roof members with bolts.

3.2.3 Bolts, nuts and washers: M10 (0.39 in.) bolts, nuts and washers, provided by Mitsubishi Chemical Infratec Corp., LTD, used to connect panels and/or steel reinforcement are stainless steel, with a minimum yield and tensile strength of 210 MPa (30 ksi) and 500 Mpa (73 ksi), respectively or hot dipped galvanized, with a minimum yield and tensile strength of 340 Mpa (49 ksi) and 420 Mpa (61 ksi), respectively. The bolts, nuts and connectors are approved under the FRP Panel Tank (HISHITANK™) quality documentation.

3.2.4 Gaskets: EPDM gaskets, provided by Mitsubishi Chemical Infratec Corp., LTD, are used between panels, and are in compliance with ASTM D1171, ASTM D412 (Die A) and ASTM D1056.

3.3 Steel Footing and Concrete Foundation: Steel footing consists of primary and secondary pieces, providing support to the side wall and floor panels. Connection of the panels or side members to the steel footing consists of interior mounting brackets (1m tall tank) or exterior lower block angles (2m or 3m tall tank). Steel footing and connectors are hot dipped galvanized with a minimum yield and tensile strength of 235 MPa (34 ksi) and 400 Mpa (58 ksi), respectively. Bolts, nuts and washers used for steel footing to connectors are M12 (0.47 in.) for the 2m tank, or M16 (0.63 in.) for the 1m or 3m tank, and either stainless steel with a minimum yield and tensile strength of 210 MPa (30 ksi) and 500 Mpa (73 ksi), respectively or hot dipped galvanized with a minimum yield and tensile strength of 340 Mpa (49 ksi) and 420 Mpa (61 ksi), respectively. Steel footing is connected to concrete foundation with cast in or post installed anchor bolts. See [Figure 5](#) for additional information for connections. The steel footing and connectors are approved under the FRP Panel Tank (HISHITANK™) quality documentation.

4.0 DESIGN AND INSTALLATION

4.1 Design: The FRP Panel Tank (HISHITANK™) shall be designed in accordance with the load requirements of IBC Section 1604, ASCE 7-16 Chapter 15 and AWWA D121, as applicable.

The allowable stress design (ASD) capacities for FRP panels are noted in [Table 2](#) of this report and must be used in the tank design.

The steel reinforcement and connections supporting FRP panels, such as side members, interior roof members and interior roof supports must be designed in accordance with AISC 360-16, to resist the applied loads including in-plane lateral shear load, out-of-plane (transverse) load and axial load, as applicable.

The design of the steel footing and the concrete foundation with anchorage must comply with the requirements of AISC 360-16 and ACI 318-19, respectively.

4.2 Installation: The FRP Panel Tank (HISHITANK™) must be installed in accordance with Manufacturer's Published Installation Instructions (MPII), as indicated in the FRP Panel Tank Installation Manual. See [Figure 6](#) for installation stages.

4.3 Special Inspection: Special Inspections is required during the tank assembly in accordance with IBC Section 1705.1.1. Any anchorage to concrete foundation performed at the jobsite requires special inspection in accordance with IBC Section 1705.3.

5.0 CONDITIONS OF USE:

The FRP Panel Tank (HISHITANK™) described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 Installation complies with this report, the approved plans and the MPII, a copy of which must be available on the jobsite during construction. In case of conflict, the most stringent requirement governs.
- 5.2 Installers shall be approved by the report holder and a quality assurance program for the installation of the system shall be documented.
- 5.3 A registered design professional shall prepare structural calculations and plans for the water tank design in accordance with the requirements of ASCE 7-16 as indicated in the International Building Code (IBC) and AWWA D121, as applicable, and submitted to the building official for each project.
- 5.4 The FRP panel ASD demand values must not exceed those ASD capacities found in [Table 2](#) of this report.
- 5.5 The structural analysis submitted to the building official for each project, must show that the FRP Panel Tank (HISHITANK™) (including FRP panels, steel reinforcement and connections) provides a complete load path from the point of origin to load-resisting elements.
- 5.6 The design of the steel reinforcement, steel footing and concrete foundation have not been evaluated and are outside the scope of this report.
- 5.7 The steel reinforcement and bolts are to be provided by the report holder. The steel footing pieces may be provided by the report holder.
- 5.8 The FRP Panel Tank (HISHITANK™) is manufactured under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

- 6.1 Transverse, racking shear and axial testing of the FRP panels in accordance with ASTM E72.
- 6.2 Plastic bearing strength testing in accordance with ASTM D953.
- 6.3 Shear strength testing in accordance with ASTM D732.
- 6.4 Surface hardness testing in accordance with ASTM D2583.
- 6.5 Accelerated weathering testing in conformance with ASTM G155.
- 6.6 Tensile, bending, and compressive strength testing in accordance with JIS K 6911.
- 6.7 Tensile Modulus testing in accordance with JIS K 7161.
- 6.8 Glass fiber content testing in accordance with JIS K 7052.

7.0 IDENTIFICATION

- 7.1 The ICC-ES mark of conformity, electronic labeling, or the evaluation report number (ICC-ES ESR-4446) along with the name, registered trademark, or registered logo of the report holder must be included in the product label.
- 7.2 In addition, the FRP Panel Tank (HISHITANK™) is identified with markings on the fiberglass panel indicating model and serial number and a tank serial label, that indicates completion of assembly and included parts.
- 7.3 The report holder's contact information is the following:

MITSUBISHI CHEMICAL INFRATEC CORP., LTD.

1-1-1 MARUNOUCHI, CHIYODA-KU

TOKYO 100-8251

JAPAN

+81-36629-1282

<https://www.hishitank.com>

info@hishitank.com

TABLE 1 – PHYSICAL PROPERTIES OF HISHITANK™ FIBERGLASS REINFORCED PANELS

PROPERTY	TESTED VALUE
Tensile Strength	16389 psi (113 MPa)
Tensile Modulus	2016 ksi (13.9 GPa)
Surface Hardness	54
Glass fiber content	37.7%
Flexural Strength	26107 psi (180 MPa)
Transverse Shear Strength	14870 psi (103 MPa)
Compressive Strength	49313 psi (340 MPa)
Bearing Strength	45414 psi (313 MPa)

TABLE 2 –HISHITANK™ FIBERGLASS REINFORCED PANELS ALLOWABLE CAPACITIES⁵

PANEL MODEL	DIMENSIONS (w x h)	APPLICATION	TYPE OF LOAD	ASD CAPACITIES ¹
KSF30BX	1m x 1m (3.28ft x 3.28ft) ²	Wall Panel	Transverse uniform	300 psf (14.4 kPa)
KLF20BX	1m x 2m (3.28ft x 6.56ft) ²	Wall Panel	Transverse uniform	83 psf (4.0 kPa)
KRF00	1m x 1m (3.28ft x 3.28ft) ²	Roof panel	Transverse uniform	136 psf (6.5 kPa)
KBF30	1m x 1m (3.28ft x 3.28ft) ²	Floor panel	Transverse uniform	362 psf (17.3 kPa)
KSF30BX	2m x 1m (6.56ft x 3.28ft) ³	Wall Panel	Racking shear	985 plf (14.4 kN/m)
KLF20BX	2m x 2m (6.56ft x 6.56ft) ³	Wall Panel	Racking shear	436 plf (6.4 kN/m)
KSF30BX + KLF20BX	2m x 3m (6.56ft x 9.84ft) ³	Wall Panel	Racking shear	436 plf (6.4 kN/m)
KSF30BX	1m x 1m (3.28ft x 3.28ft) ⁴	Wall Panel	Axial	3048 lbs (13.6 kN)
KLF20BX	1m x 2m (3.28ft x 6.56ft) ⁴	Wall Panel	Axial	5604 lbs (24.9 kN)
KSF30BX + KLF20BX	1m x 3m (3.28ft x 9.84ft) ⁴	Wall Panel	Axial	5604 lbs (24.9 kN)

¹ ASD capacities are based on a Factor of Safety of 5 applied to the average ultimate load at failure of the panels. No further increases are allowed.

² Capacity for a single panel.

³ Capacity based on a minimum of 2 wall panel elevations side by side.

⁴ Capacity for a single wall panel elevation.

⁵ Capacity of panels consider the installation of steel reinforcement, steel footing and corresponding bolts, as applicable, in accordance with the installation manual. See Sections 3.2.2, 3.2.3 and 3.3 for minimum material specifications.

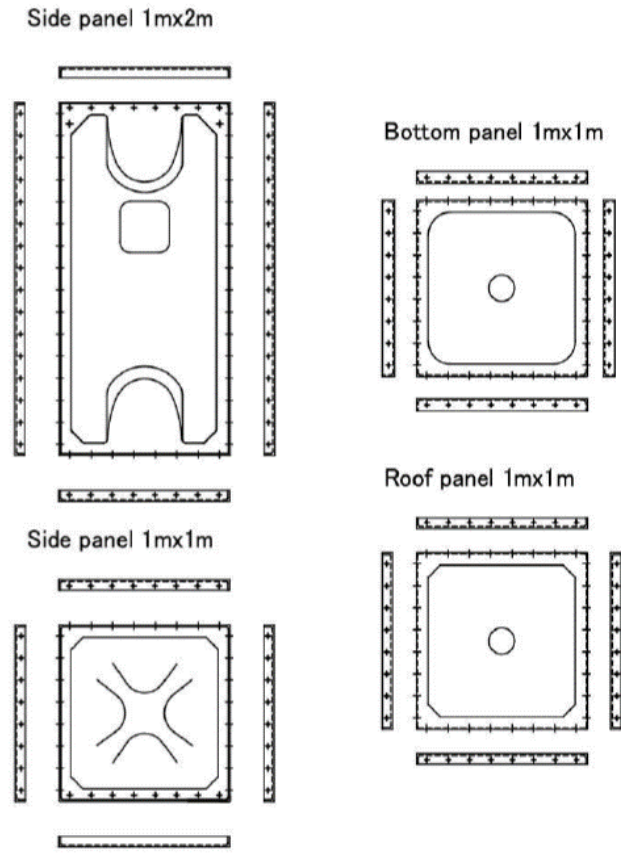
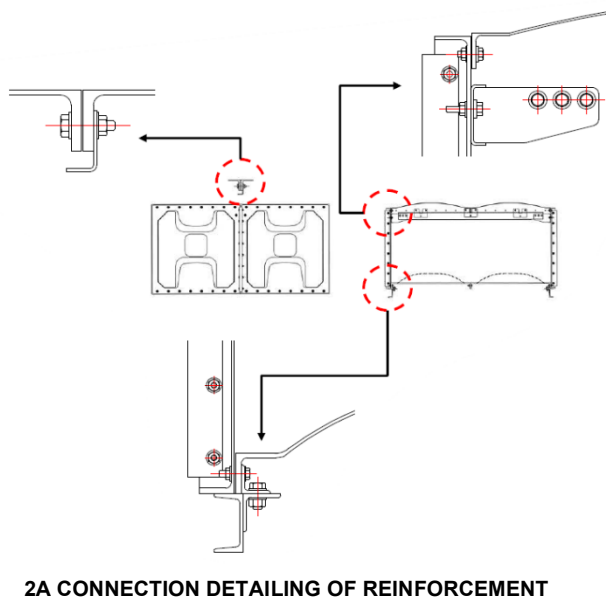


FIGURE 1 – HISHITANK™ FIBERGLASS REINFORCED PANELS



2A CONNECTION DETAILING OF REINFORCEMENT



2B INTERIOR ROOF MEMBER



2C SIDE MEMBER TOP



2D SIDE MEMBER BOTTOM

FIGURE 2—STEEL REINFORCEMENT FOR 1M TANK CONFIGURATION

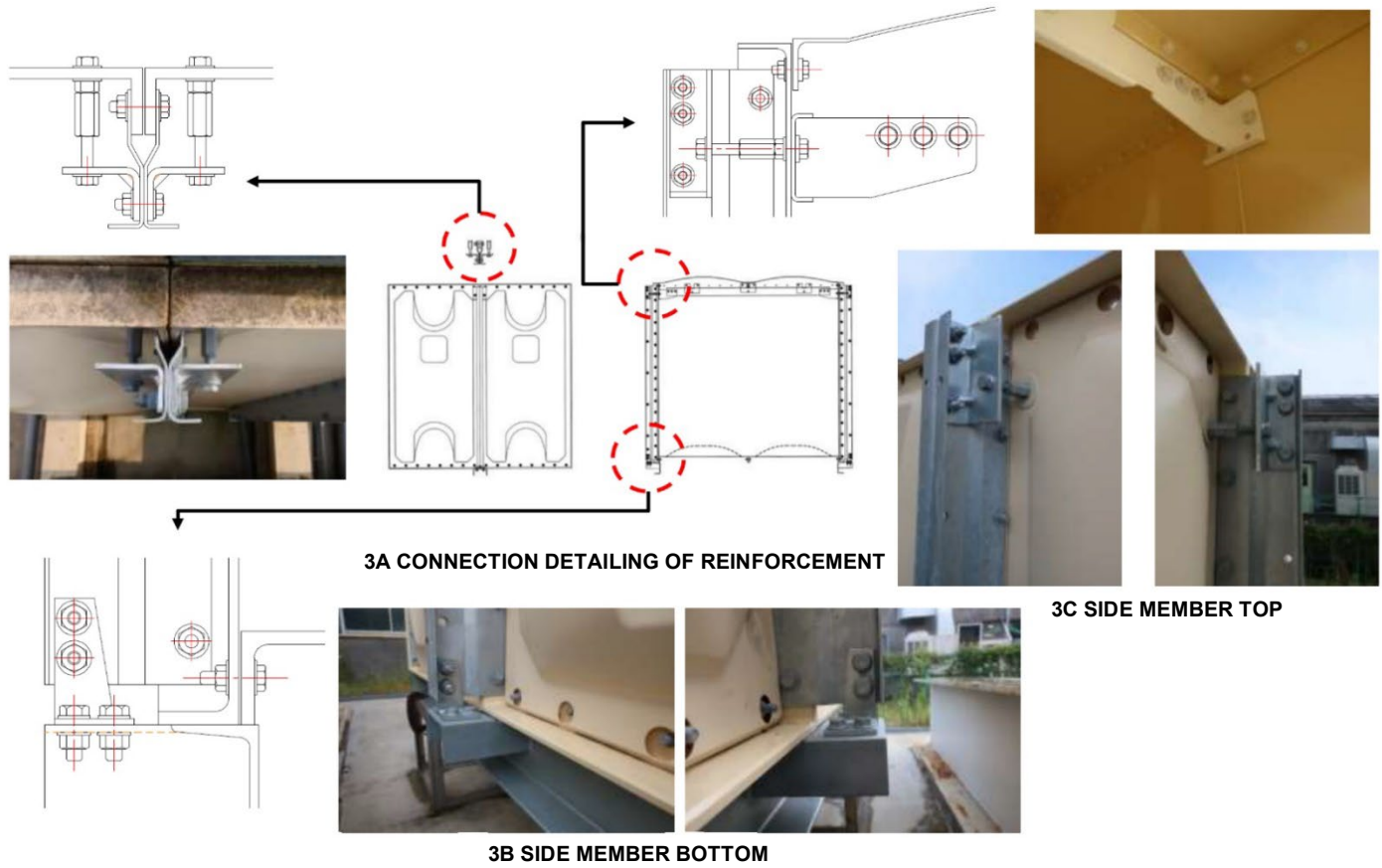


FIGURE 3—STEEL REINFORCEMENT FOR 2M TANK CONFIGURATION

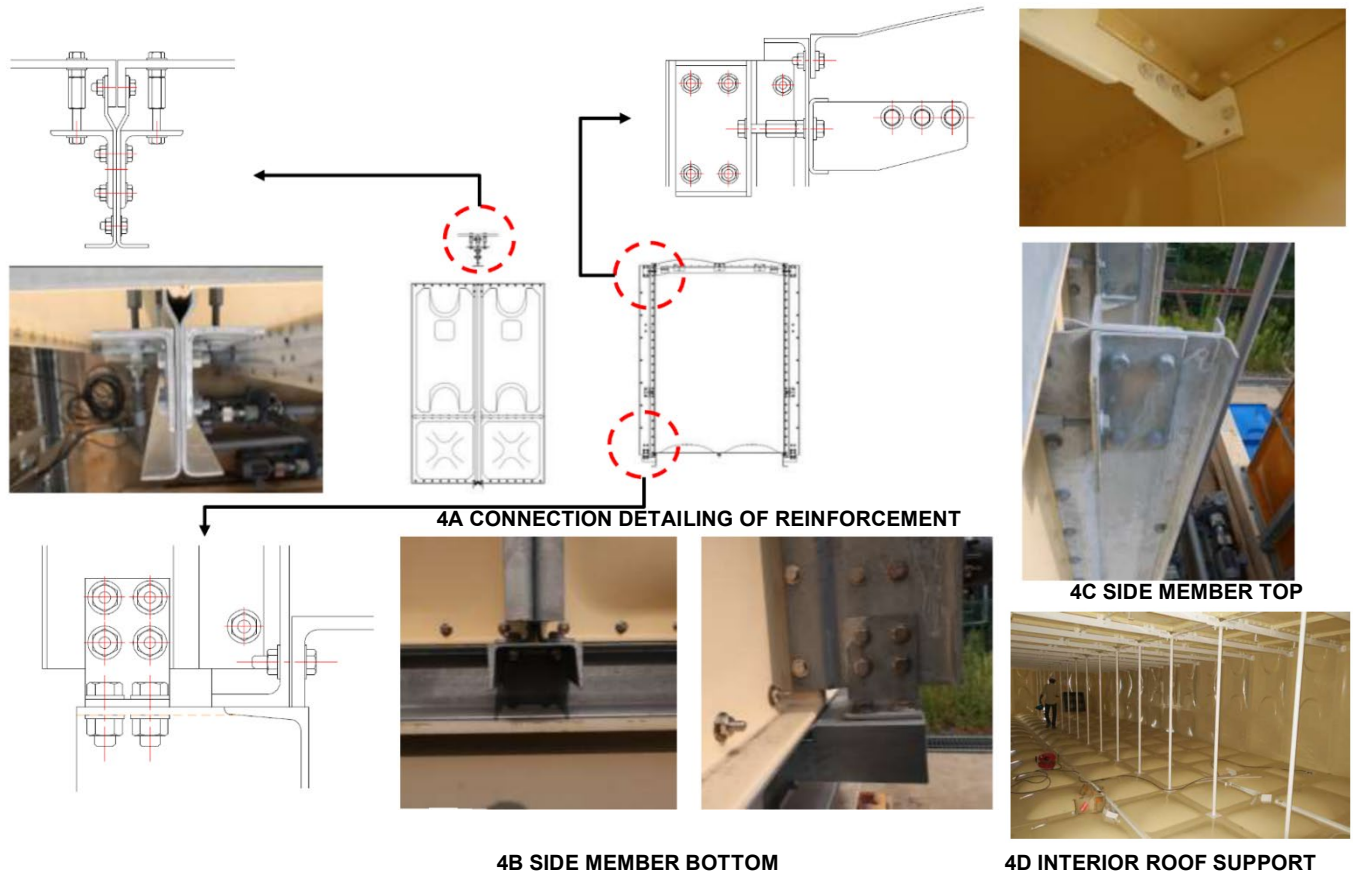


FIGURE 4—STEEL REINFORCEMENT FOR 3M TANK CONFIGURATION



5A MOUNTING BRACKETS (1M TANK)



5B LOWER BLOCK ANGLE CONNECTION (3M TANK)



5C LOWER BLOCK ANGLE CONNECTION (2M TANK)

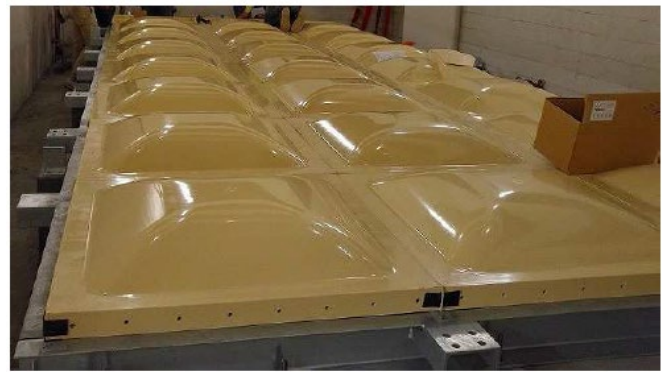


5D STEEL FOOTING ANCHORAGE

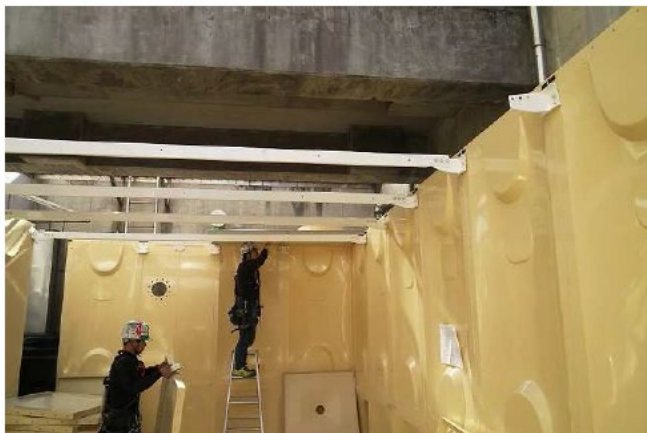
FIGURE 5 – STEEL FOOTING AND CONCRETE FOUNDATION



6A STEEL FOOTING ASSEMBLY



6B BOTTOM PANEL ASSEMBLY



6C SIDE WALL ASSEMBLY



6D ROOF ASSEMBLY

FIGURE 6 – TYPICAL INSTALLATION ASSEMBLIES OF HISHITANK™ PANELS

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 52 00—Plastic Structural Assemblies

DIVISION: 33 00 00—UTILITIES
Section: 33 16 00—Water Utility Storage Tanks

REPORT HOLDER:

MITSUBISHI CHEMICAL INFRATEC CORP., LTD.

EVALUATION SUBJECT:

FRP PANEL TANK (HISHITANK™)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Fiber Reinforced Plastic (FRP) Panel Tank (HISHITANK™), described in ICC-ES evaluation report ESR-4446, has also been evaluated for compliance with the codes noted below.

Applicable code edition(s):

- 2022 California Building Code (CBC)

For evaluation of applicable Chapters adopted by the California Office of Statewide Health Planning and Development (OSHPD) AKA: California Department of Health Care Access and Information (HCAI) and the Division of State Architect (DSA), see Sections 2.1.1 and 2.1.2 below.

2.0 CONCLUSIONS

2.1 CBC:

The Fiber Reinforced Plastic (FRP) Panel Tank (HISHITANK™), described in Sections 2.0 through 7.0 of the evaluation report ESR-4446, complies with CBC Section 1604, provided the design and installation are in accordance with the 2021 *International Building Code*® (IBC) provisions noted in the evaluation report and the additional requirements of CBC Section 1604, as applicable.

2.1.1 OSHPD:

The applicable OSHPD Sections and Chapters of the CBC are beyond the scope of this supplement.

2.1.2 DSA:

The applicable DSA Sections and Chapters of the CBC are beyond the scope of this supplement.

This supplement expires concurrently with the evaluation report, reissued August 2024.