

CITY OF LOS ANGELES
CALIFORNIA

BOARD OF
BUILDING AND SAFETY
COMMISSIONERS

VAN AMBATIELOS
PRESIDENT

E. FELICIA BRANNON
VICE PRESIDENT

JOSELYN GEAGA-ROSENTHAL
GEORGE HOVAGUIMIAN
JAVIER NUNEZ



ERIC GARCETTI
MAYOR

DEPARTMENT OF
BUILDING AND SAFETY
201 NORTH FIGUEROA STREET
LOS ANGELES, CA 90012

FRANK M. BUSH
GENERAL MANAGER
SUPERINTENDENT OF BUILDING

OSAMA YOUNAN, P.E.
EXECUTIVE OFFICER

Siplast
1111 HWY 67 South.
Arkadelphia, AR 71923

RESEARCH REPORT: RR 24389
(CSI #07220)

Attn: Todd Corley
(870) 246-8094

Expires: March 1, 2021
Issued Date: February 1, 2019
Code: 2017 LABC

GENERAL APPROVAL – Renewal - **I.** Zonolite roof deck insulation system for use as diaphragm, and one and two-hour fire resistance rating. **II.** Insulcel roof deck insulation system for use as two-hour fire resistance rating.

DETAILS

I. Zonolite roof deck insulation system:

1.1 Roof Diaphragms:

The roof deck system consists of nominal 7/8-, 1 5/16-, 1 1/2-, 2- or 3-inch-deep, high-strength steel decking welded to supporting framing and covered with a Zonolite concrete slurry, leveled to a 1/8-inch minimum thickness over the flutes. Zonolite Insulperm board is firmly seated and leveled on the slurry surface before initial set occurs, with board slots at right angle to the deck span, end joints staggered, and all joints butted snugly. A 2-inch minimum thickness of Zonolite concrete is laid immediately and screeded to a level, even surface to receive built-up roofing. A maximum of two hours is permitted for each construction sequence. The 2-inch-thick slab is considered a protective slab and is not mechanically attached to the supporting or perimeter framing to resist lateral loading. The minimum 2-inch-thick fill of Zonolite concrete may be poured in one operation directly over the deck, without insulperm insulation.

RR 24389
Page 1 of 7

Siplast, Inc.

RE: **I.** Zonolite roof deck insulation system for use as diaphragm, and one and two-hour fire resistance rating. **II.** Insulcel roof deck insulation system for use as two-hour fire resistance rating.

1.2 Steel Decking:

The decking is minimum No.26 gage, cold-rolled, single-fluted, nominal 7/8-, 1 5/16-, 1 1/2-, 2- or 3-inch-deep, 24- to 36-inch-wide steel decking having a 4-inch to a 12-inch pitch. The 7/8- and 1 5/16-inch-deep decks must conform to ASTM A 446 Grade E requirements, with a minimum yield strength of 80 ksi for thicknesses of 0.04 inch or less, and must conform to ASTM A 446, Grade C, requirements, with a minimum, yield strength of 40 ksi for thicknesses greater than 0.04 inch, Minimum No. 26 gage 1 1/2-, 2- and 3-inch-deep decks must conform to ASTM A 446 Grade A requirements with a minimum yield strength of 33 ksi. Decking must be galvanized to conform with ASTM A 525 requirements, with a minimum of G-60 coating.

1.3 Welding Electrodes:

Filler metal is 70-ksi-tensile-strength filler metal complying with the applicable AWS standards for the welding process.

1.4 Fastening Accessories:

Fastening accessories consist of weld washers, which are 15/16-inch square No. 14 gage steel washers, with bent-up edges on two opposite sides and a 3/8-inch-diameter hole at the center to receive a puddle weld.

1.5 Zonolite Concrete:

Zono concrete consists of a 1:6 mix by volume of portland cement to Zonolite vermiculite concrete aggregate and sufficient water to provide a wet density of 44 to 60 pcf. The concrete must have a minimum oven-dry weight of 22 pcf, and a minimum unit compressive strength of 140 psi when tested in accordance with ASTM C 495.

1.6 Insulperm Insulation Board:

Insulperm insulation board is a polystyrene foam board manufactured by Premier Industries. Each board is 2 feet wide by 4 feet long, with thicknesses from 3/4 to 8 inches in 1/4-inch increments. Board density must be 1.1 pcf maximum. Each board contains 30 slotted holes, 1/8 inch wide by 2 1/4 inches long and 1-inch diameter 30 keying holes, or 10 hole combination slot openings or 14-1 1/2" and 4-1 1/4" diameter holes. Holes and/or slots are on a regular pattern, for mechanical bonding of Zonolite concrete to the board. See Figure 1, Figure 2 and Figure 3.

Siplast, Inc.

RE: **I.** Zonolite roof deck insulation system for use as diaphragm, and one and two-hour fire resistance rating. **II.** Insulcel roof deck insulation system for use as two-hour fire resistance rating.

1.7 Deck Welding:

All deck welding must be accomplished under special inspection as required by Section 1704.3. Welding must comply with ANSI/AWS D1.3. Weld patterns at supporting framing must be one of the following:

Type-2: One weld washer fastener at each lap, and at two intermediate flutes.

Type 3: One weld washer fastener at each lap, and in all other flutes.

Weld patterns are identified by two numbers, the first referring to end support framing locations, and the second referring to interior support framing locations.

2.1 Diaphragm Shear and Flexibility:

a. Zonolite ZIC:

The maximum allowable diaphragm shear and flexibility for the No. 26 and No. 24 gage steel decking are subject to the following conditions:

- 1) Allowable diaphragm shear values (q) are shown in Table 1.
- 2) The flexibility factor (F) for both weld patterns is shown in Table 1.
- 3) Weld washer spacing to chords, struts or other shear transfer framing members parallel to the deck flutes is based on a maximum shear transfer of 600 pounds per washer.
- 4) The shear transfer between the diaphragm and an interior tie or strut line perpendicular to deck corrugations must not exceed the shear values, q_{max} , per Table 1. Two lines of weld patterns may be used to develop the total shear transfer.
- 5) Where individual panels are cut longitudinally, the partial panel must be connected in a manner to fully transfer the shear at that point to adjacent full panels.
- 6) The diaphragm flexibility limitations are set forth in Table 2.
- 7) Values as set forth above are not subject to increase for duration of load.

b. Zonolite Restrained B-Deck:

The Zonolite restrained B-deck system consist of No. 18 to No. 22 gage Type B deck with a No. 16 or No. 18 gage restraining element at diaphragm perimeters. The steel deck is 1 ½ inches deep with a 6-inch flute pitch and 36 inch-wide panels. Zonolite concrete is prepared in accordance with Section 1.5 of this report. The deck must be welded to the supports. Panels seams must be connected using top seam arc welds or

Siplast, Inc.

RE: **I.** Zonolite roof deck insulation system for use as diaphragm, and one and two-hour fire resistance rating. **II.** Insulcel roof deck insulation system for use as two-hour fire resistance rating.

button punches. The Zonolite concrete slurry is placed and followed by the Insulperm Insulation board, and a top layer of Zonolite concrete in accordance with Section 1.1 of this report, with Insulperm insulation from 3/4 to 4 inches thick. For deck assemblies where the Insulperm insulation is from 4 to 8 inches thick, diaphragm shears must be reduced to 85 percent and flexibility factors are doubled. See Figure 3.

3.1 Fire-resistive Roof Construction:

The fire-resistive assemblies described in this section must be constructed with Zonolite concrete in this report, except the concrete must have a minimum compressive strength of 125 psi. Additionally, for assemblies that are required to have welded-wire mesh, the reinforcing mesh must be minimum 2-inch hexagonal mesh woven from No. 19 gage (0.041 inch) galvanized wire with an additional No. 16 gage (0.062 inch) galvanized wire spaced 3 1/2 inches apart. When the fire-rated assembly is a roof-ceiling assembly, the roof covering material must be a compatible, fire-retardant, built-up roofing complying with the code. Where the insulated board thickness is from 4 to 8 inches, the built-up roof covering must be Class A, B, or C. All fire-rated assemblies described in this report must have a minimum weld pattern at the supporting frame consisting of 3/8-inch arc-spot (puddle) welds with weld washers spaced a maximum of 13 inches on center.

3.2 Zonolite ZIC Two-Hour Unrestrained:

The roof diaphragm construction consists of nominal 7/8-, 1 5/16-, 1 1/2-, 2- or 3-inch-deep, high strength steel decking welded to the supporting framing and covered with a Zonolite concrete slurry, leveled to a 1/8-inch minimum thickness over the flutes. Zonolite Insulperm board is firmly seated and leveled on the slurry surface before initial set occurs, with board slots at right angles to the deck span, end joints staggered and all joints butted snugly. A 2-inch minimum thickness of Zonolite concrete must be laid immediately and screeded to a level, even surface to receive built-up roofing. A maximum of four hours is permitted for each construction sequence with all slurry and Insulperm board covered the same day. The 2-inch-thick slab is considered a protective slab and is not mechanically attached to the supporting or perimeter framing to resist lateral loading. Beams or open web steel joists must be of two-hour fire-resistive construction. The roof deck unit loadings are limited to non-composite design, governed by allowable steel deck unit stresses and deflection limitations. Allowable spans are set forth in Table 3.

3.3 Zonolite ZIC Two-hour Restrained:

The roof construction consists of Zonolite concrete recognized in this evaluation, poured to a minimum thickness of 2 1/4 inches above the top flutes of the galvanized steel decking, which is supported by independently fire-protected steel framing. The underside of the steel deck is permitted to be unprotected. The vermiculite slab must be reinforced with mesh placed over the top of the metal deck prior to concrete placement.

Siplast, Inc.

RE: **I.** Zonolite roof deck insulation system for use as diaphragm, and one and two-hour fire resistance rating. **II.** Insulcel roof deck insulation system for use as two-hour fire resistance rating.

3.4 Zonolite ZIC One-hour Unrestrained:

The assembly is constructed in the same manner as the two-hour restrained roof construction described in Section 3.2.

3.5 Zonolite ZIC One-hour Restrained:

The assembly is constructed in the same manner as the two-hour restrained roof construction described in Section 3.3.

II. Insulcel roof deck insulation system:

1.1 Roof Deck System:

The roof deck system consists of nominal 7/8-, 1 5/6-, 1 1/2-, 2- or 3-inch-deep, high strength steel decking welded to supporting framing and covered with an Insulcel concrete slurry, leveled to a 1/8-inch minimum thickness over the flutes. Insulperm board is firmly seated and leveled on the slurry surface before initial set occurs, with board slots at right angle to the deck span, end joints staggered, and all joints butted snugly. A 2-inch minimum thickness of Insulcel concrete is laid immediately and screeded to a level, even surface to receive built-up roofing. A maximum of two hours is permitted for each construction sequence. The 2-inch thick slab is considered a protective slab and is not mechanically attached to the supporting or perimeter framing to resist lateral loading. The minimum 2-inch-thick fill of Insulcel concrete may be poured in one operation directly over the deck, without insulperm insulation.

1.2 Steel Decking:

The decking is minimum No. 26 gage, cold-rolled, single-fluted, nominal 7/8-, 1 5/16-, 1 1/2-, 2- or 3-inch-deep, 24- to 36- inch-wide steel decking having a 4-inch to a 12-inch pitch. The 7/8- and 1 5/16-inch deep decks must conform to ASTM A 446 Grade E requirements with a minimum yield strength of 80 ksi for thicknesses of 0.04 inch or less, and must conform to ASTM A 446, Grade C requirements, with a minimum yield strength of 40 ksi for thicknesses greater than 0.04 inch. Minimum No. 26 gage, 1 1/2-, 2- and 3-inch-deep decks must conform to ASTM A 446 Grade A requirements with a minimum yield strength of 33 ksi. Decking must be galvanized to conform to ASTM A 525 requirements, with a minimum of G-60 coating.

1.3 Insulcel Concrete:

Insulcel concrete is a mixture of Portland cement, water, and pre-generated foam produced from Insucel Liquid concentrate. This mixture is typically placed with a cast density of 38 to 48 pcf and shall obtain a dry density range of 30 to 36 pcf and minimum compressive strength of 200 psi when tested in accordance with ASTM C 495.

Siplast, Inc.

RE: **I.** Zonolite roof deck insulation system for use as diaphragm, and one and two-hour fire resistance rating. **II.** Insulcel roof deck insulation system for use as two-hour fire resistance rating.

2.1 Insulcel Two-Hour fire-resistive construction:

The following is the two-hour fire-resistive assembly from top to down:

- 2" Insulcel concrete topping
- 3/4" to 8" Insulperm board
- 1/8" Insulcel concrete slurry
- metal deck.

The report is subject to the following conditions:

1. For use of deck as a roof diaphragm:

- a. Tests of vermiculite concrete shall be performed by a Los Angeles City approved testing agency.

Continuous inspection by a Los Angeles City Registered Deputy Inspector for light gage welding shall be provided during the deck welding. Deck welding shall be done by Los Angeles City certified light gage welders. Prior to proceeding with the welding, the welders shall demonstrate to the Los Angeles City Registered Deputy Inspector their ability to produce the prescribed weld satisfactorily. Samples of the deck material shall be welded to steel simulating the framing and then tested in accordance with AWS D1.3-08.

- b. The decking is limited to a maximum span of 8-feet when used as diaphragms resisting lateral loads.

2. For use of deck for fire resistive rating:

- a. Continuous inspection by a Los Angeles City Registered Deputy Inspector shall be provided during the mixing and placing of the concrete.
- b. Minimum depth of deck shall be no less than 1-5/16 inches.
- c. Maximum thickness of insulation shall not exceed 8 inches.
- d. The loading of the roof deck units shall be limited to a maximum 75-percent of their allowable loads when the construction is used to provide a two hour fire-resistive rating.

3. The insulperm insulation board is up to 8" thick for the 1½, 2 and 3 inch deep decks.

Siplast, Inc.

RE: **I.** Zonolite roof deck insulation system for use as diaphragm, and one and two-hour fire resistance rating. **II.** Insulcel roof deck insulation system for use as two-hour fire resistance rating.

DISCUSSION

This report is in compliance with the 2017 Los Angeles City Building Code.

The fire rating is based on tests per ASTM E119. UL Design No. P921.

The diaphragm design criteria are based on tests and analyses.

This general approval of an equivalent alternate to the Code is only valid where an engineer and/or inspector of this Department has determined that all conditions of this approval have been met in the project in which it is to be used.

Addressee to whom this Research Report is issued is responsible for providing copies of it, complete with any attachments indicated, to architects, engineers and builders using items approved herein in design or construction which must be approved by Department of Building and Safety Engineers and Inspectors.

DAVID CHANG, Chief
Engineering Research Section
201 N. Figueroa St., Room 880
Los Angeles, CA 90012
Phone- 213-202-9816
Fax- 213-202-9943

DE
RR 24389
R02/10/19
TLB1900035
2603.4.1.5/703/712

Attachment: Diaphragm Tables and Deck Details (5 sheets)