9 March 2021

John Beebe
Fireproofing Department Estimator/Project Manager
WPI
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Wilsonville, OR 97070
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Email: John.Beebe@wpibuilds.com

RE: Project: Block 216
Location: 970 Washington Street, Portland, OR
Contractor: WPI
Global Engineering Judgment: GFPG_BLOCK 216_BEAM_PORTLAND OR_001c
Rating: 2-hours

Dear Mr. Beebe:

We have received and reviewed the documentation provided via email regarding the protection of horizontal hollow tube steel beams on the above referenced project. Received were a copy of the Life Safey Checklist as prepared by the City of Portland – Bureau of Development Services, Recheck dated 2 February 2021, and a corresponding letter from GCP Applied Technologies dated 24 November 2020, prepared by John Dalton, GCP Applied Technologies. It is desired that the required 2-hour fire-resistive rating be achieved, in accordance with ASTM E119/UL 263, "Standard Test Methods for Fire Tests of Building Construction and Materials," as well as the 2014 Oregon Structural Specialty Code.

Briefly, per comment #2 of the Portand BDS Recheck, Sheet 007 of the project documents indicates the installation of HSS 8 x 4 x ¼" hollow tube steel beams that are to be protected utilizing Monokote 1000 HB Spray-Applied Fire Resistive Material (SFRM) as manufactured by GCP Applied Technologies, at a 1-3/4" thickness as determined by UL Design Y710. These thicknesses are based off the column design tested in UL Design Y710.

UL has not tested for this application. As a result, an Alternative Method per Section 703.3 of the 2014 Oregon Structural Specialty Code is required in the form of an Engineering Judgment to address the firestopping of this condition. Section 703.3 states, "The application of any of the alternative methods listed in this section shall be based on the fire exposure and acceptance criteria specified in ASTM E119 or UL 263. The required **fire resistance** of a building element, component or assembly shall be permitted to be established by any of the following methods or procedures: 1. Fire-resistance designs documented in sources; 2. Prescriptive designs of fire-resistance-rated building elements, components or assemblies as prescribed in Section 721; 3. Calculations in accordance with Section 722; 4. Engineering analysis based on a comparison of building element, component or assemblies designs having *fire-resistance ratings* as determined by the test procedures set forth in ASTM E119 or UL 263; 5. Alternative protection methods as allowed by Section 104.11."

It is standard industry practice to determine SFRM thicknesses based on calculated A/P and W/D rations. These ratios are determined by dividing the weight, W, of the steel section in lbs./ft. (or the cross-sectional area, A, of the steel member) by the heated perimeter, D (or P), of protection at the interface of the protection material through which heat is be transferred to the steel, in inches. A/P ratio equation for steel members is provided in the Underwriters Laboratories, Inc. (UL) Directory. It is also standard industry practice to treat beams utilizing a column design (X- or Y-Series UL designs) as a basis for determining thickness. Column designs are considered a 'worst-case' thickness, as these are more conservative due to the four-sided exposure, as opposed to a three-sided exposure for a beam. In addition, column tests do not account for the heat sink properties of a concrete floor.

Per ASTM E119, limiting temperatures for beam evaluations are for a limiting average steel temperature of 1100°F, or a limiting individual steel temperature of 1300°F at any single measured point. Based on alternative methods of testing in accordance with ASTM E119, item #26 Conditions of Acceptance, the column thicknesses will provide limiting average steel temperatures of 1000°F, or a limiting individual steel temperature of 1200°F at any single measured point. These temperatures are more stringent than those required for beam evaluations.

Pursuant to our review of the evaluation presented, and utilizing the thickness required as outlined in the UL Design for the appropriate condition, Global believes that substantial justification exists to support the conclusion that the required fire-resistance rating in accordance with ASTM E119 would be obtained for the beam, utilizing the 1-3/4" design thickness detailed in Y710, provided that the Monokote 1000 HB product is installed in accordance with manufacturer's written application installation instructions and methods.

This review is limited to those specific assemblies depicted and only for use as part of the above referenced project and cannot be extended to other assemblies or projects. The rating of the fireproofing system is dependent on the performance of the surrounding structure under fire exposure with a maximum possible rating of 2-hours based on the thicknesses provided. The contractor is responsible for the compliant installation of the referenced engineering judgment.

Prepared by: John D. Campbell, P.E.

REGISTERED PROFESSIONAL ENGINEER
74880PE
OREGON
MAY 11, 2004
JOHN D. CAMPBELL
EXPIRES: Dec 31, 2021

John Campbell
Digitally signed by John Campbell
Date: 2021.03.09 23:24:41 -06'00'

UL Product iQ™

BXUV.Y710 - Fire-resistance Ratings - ANSI/UL 263

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263 Certified for United States

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263 Certified for United States
Design Criteria and Allowable Variances

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada
Design Criteria and Allowable Variances

Design No. Y710

February 05, 2014

Ratings — 1, 1-1/2, 2, 3 and 4 Hr

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

1. **Steel Pipe or Tube Column —** Steel circular pipe (SP) or steel square or rectangular tube (ST). The A/P ratio of the steel pipe or tube (see Item 2) shall range from 0.18 to 2.0.

2. **Spray-Applied Fire Resistive Materials* —** Prepared by mixing with water according to instructions and applying in one or more coats to the thicknesses shown below, to steel surfaces which are clean and free of dirt, loose scale, and oil. Min avg and min ind density for Types MK-6/CBF, MK-6/ED, MK-6/HY, MK-6/HB, MK-6s, MK-6 GF, MK-6 GF Extended Set, MK-10 HB, MK-10 HB Extended Set, MK-1000/HB, MK-1000/HB Extended Set and RG of 15/14 pcf, respectively. Min avg and min ind density for Types Z-106, Z-106/G, Z-106/HY of 22/19 pcf, respectively.

Column Size In.	A/P	Min Thkns In. 1 Hr	1-1/2 Hr	2 Hr	3 Hr	4 Hr
ST 3x3x3/16	.18	1	1-11/16	2-5/16	3-9/16	NA

ST 3x3x5/16	.28	11/16	1-1/8	1-1/2	2-5/16	3-1/16
ST 3x3x1/2	.42	7/16	3/4	1	1-1/2	2-1/16
ST 8x8x5/8	.58	3/8	5/8	3/4	1-1/8	1-1/2
ST 20x20x3/4	.72	1/4	3/8	9/16	7/8	1-3/16
ST 20x20x1	.95	1/4	5/16	7/16	11/16	15/16
ST 32x32x1-1/4	1.20	1/4	1/4	3/8	9/16	3/4
ST 32x32x1-1/2	1.43	1/4	1/4	5/16	1/2	5/8
ST 32x32x1-3/4	1.65	1/4	1/4	1/4	7/16	9/16
ST 32x32x2	1.88	1/4	1/4	1/4	3/8	1/2
SP 3x.216	.20	15/16	1-1/2	2-1/16	3-1/8	NA
SP 8x.322	.31	5/8	1	1-5/16	2-1/16	2-13/16
SP 6x.432	.40	1/2	3/4	1	1-9/16	2-1/8
SP 10x.50	.48	3/8	5/8	7/8	1-3/8	1-13/16
SP 6x.864	.74	1/4	3/8	9/16	7/8	1-3/16

The hourly rating of the structural member is dependent upon the ratio of A/P and the thickness of Spray-Applied Fire Resistive Materials, where A is the cross sectional area of the pipe or tube and P is the heated perimeter.

The A/P ratio of a circular pipe is determined by:

$$\text{A/P pipe} = \frac{t\,(d-t)}{d}$$

Where:

d = the outer diam of the pipe (in.)

t = the wall thickness of the pipe (in.)

The A/P ratio of a rectangular or square tube is determined by:

$$\text{A/P tube} = \frac{t\,(a+b-2t)}{a+b}$$

Where:

a = the outer width of the tube (in.)

b = the outer length of the tube (in.)

t = the wall thickness of the tube (in.)

The thickness of Spray-Applied Fire Resistive Materials for rating of 3/4, 1, 1-1/2, 2, 3 and 4 h of a steel pipe or tube can be determined by the equation:

$$R-0.20$$

$$h = \frac{R}{4.43\ (A/P)}$$

Where:

R = the hourly rating (hrs)

h = the thickness of Spray-Applied Fire Resistive Materials, minimum 1/4 in., maximum 3-7/8 in.

ARABIAN VERMICULITE INDUSTRIES — Type MK-6GF, MK-6 GF Extended Set, MK-10 HB, MK-10 HB Extended Set, MK-1000/HB, MK-1000/HB Extended Set.

GCP KOREA INC — Types MK-6/CBF, MK-6/ED, MK-6/HY, MK-10 HB, MK-10 HB Extended Set, MK-6/HB, MK-6s, MK-6GF, MK-6 GF Extended Set, MK-1000/HB, MK-1000/HB Extended Set, Monokote Acoustic 1, Monokote Acoustic 5, Z-106, Z-106/G, Z-106/HY.

GCP APPLIED TECHNOLOGIES INC — Types MK-4, MK-5, MK-6/HY, MK-10 HB, MK-10 HB Extended Set, MK-6/HB, MK-6s, MK-6 GF, MK-6 GF Extended Set, MK-1000/HB, MK-1000/HB Extended Set, Monokote Acoustic 1, Monokote Acoustic 5, RG, Z-106, Z-106/G, Z-106/HY.

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Last Updated on 2014-02-05

MONOKOTE® MK-1000 HB

Product data and application instructions

Product Description

MONOKOTE®MK-1000 HB is a single component, spray applied, mill-mixed fire resistive plaster. It has approval for use on structural steel members and fluted decking to provide up to four hours of fire protection, and on flat plate cellular decking for up to three hours with SPATTERKOTE®SK-3.

The product has been designed to obtain bond strengths in excess of 1,000 psf making it an attractive material for meeting the 2009 IBC building requirements for bond strength for buildings in excess of 420 feet tall. The capability of meeting the bond strength requirements with a high yielding spray applied fire resistant material makes MONOKOTE® MK- 1000 HB fire resistive plasters a cost effective option.

Features & Benefits

MONOKOTE®cementitious fireproofing offers many significant advantages to the architect, owner, applicator and building occupant. These include:

- Proven in-place performance
- Low in-place cost
- Fast, efficient application
- UL fire tested and factory inspected
- Building Code compliant

Delivery & Storage

- All material to be used for fireproofing shall be delivered in original unopened packages bearing the name of the manufacturer, the brand and proper UL labels for fire hazard and fire resistance classifications.
- The material shall be kept dry until ready for use. Packages of material shall be kept off of the ground, under cover and away from sweating walls and other damp surfaces. All bags that have been exposed to water before use shall be discarded. Stock of material is to be rotated and used before its expiration date.

Steel & Concrete Surfaces

- Prior to the application of MONOKOTE® MK-1000 HB fire resistive plasters, an inspection shall be made to determine that all steel surfaces are acceptable to receive fireproofing. The steel shall be free of oil, grease, rolling compounds or lubricants, loose mill scale, excess rust, noncompatible primer, lock down agent or any other substance that will impair proper adhesion. Where necessary, the cleaning of steel surfaces to receive fireproofing shall be the responsibility of the general contractor.
- The project architect shall determine if the painted/primed structural steel to receive fireproofing has been tested in accordance with ASTM E119, to provide the required fire resistance rating.
- Many Fire Resistance Designs allow the use of painted metal floor or roof-deck in place of galvanized decking. Painted decking must be UL listed in the specific fire resistance designs and must carry the UL classification marking. Consult your local GCP sales representative for details.
- Prior to application of MONOKOTE® MK-1000 HB fire resistive plasters, a bonding agent, approved by the fireproofing manufacturer, shall be applied to all concrete substrates to receive MONOKOTE® MK-1000 HB.
- Fireproofing to the underside of roof deck assemblies shall be done only after roofing application is complete and roof traffic has ceased.
- No fireproofing shall be applied prior to completion of concrete work on steel decking.
- Other trades shall not install ducts, piping, equipment, or other suspended items until the fireproofing is completed and inspected.
- Other trades shall install clips, hangers, support sleeves, and other attachments that penetrate the fireproofing, prior to application of the fireproofing.

Performance Characteristics

PHYSICAL PROPERTIES	RECOMMENDED SPECIFICATION	TYPICAL VALUES	TEST METHOD
Dry density, minimum average	18 pcf (288 kg/m^3)	18 pcf (288 kg/m^3)	ASTM E605
Bond strength	1,000 psf (28.7 KPa)	1,528 psf (46.3 KPa)	ASTM E736
Compression, 10% deformation	50 psi (344 KPa)	53 psi (385.0 KPa)	ASTM E761
Air erosion	Max 0.000 g/ft^2 (0.00 g/m^2)	0.000 g/ft^2 (0.00 g/m^2)	ASTM E859
Corrosion	Does not contribute to corrosion	Does not contribute to corrosion	ASTM E937
Bond impact	No cracking, spalling or delamination	No cracking, spalling or delamination	ASTM E760
Deflection	No cracking, spalling or delamination	No cracking, spalling or delamination	ASTM E759
Resistance to mold growth	No growth after 28 days	No growth after 28 days	ASTM G21
Surface burning characteristics	Flame spread = 0 Smoke developed = 0	Flame spread = 0 Smoke developed = 0	ASTM E84
Combustibility	Less than 5 MJ/m^2 total, 20 kw/m^2 peak heat release	Less than 5 MJ/m^2 total, 20 kw/m^2 peak heat release	ASTM E1354

*Actual laboratory tested values meet or exceed GCP's recommended value. Test reports are available on request from your GCP sales representative.

Mixing

- MONOKOTE® fireproofing shall be mixed by machine in a conventional, plaster-type mixer or a continuous mixer specifically modified for cementitious fireproofing. The mixer shall be kept clean and free of all previously mixed material. The mixer speed in a conventional mixer shall be adjusted to the lowest speed which gives adequate blending of the material and a mixer density of 43–53 pcf (690–850 kg/m^3) of material.
- Using a suitable metering device and a conventional mixer, all water shall be first added to the mixer as the blades turn. Mixing shall continue until the mix is lump-free, with a creamy texture. All material is to be thoroughly wet. Target density of 48 ± 1 pcf (770 ± 16 kg/m^3) is most desirable. Overmixing MONOKOTE® will reduce pumping rate.

Application

- Application of MONOKOTE® Fireproofing can be made in the following sequence:
  1. For thicknesses of approximately 1⁄2 in. (13 mm) or less, apply in one pass.
  2. For thicknesses of 5⁄8 in. (16 mm) or greater, apply subsequent passes after the first coat has set.
- SPATTERKOTE® SK-3 shall be applied to all cellular steel floor units with flat plate on the bottom and to roof decking where required prior to application of MONOKOTE® . SPATTERKOTE® shall be applied in accordance with manufacturer's application instructions.
- MONOKOTE® Fireproofing material shall not be used if it contains partially set, frozen or caked material.
- The minimum average density shall be that required by the manufacturer, listed in the UL Fire Resistance Directory for each rating indicated, ICBO Evaluation Report, as required by the authority having jurisdiction, or minimum average 18 lbs/ft3 (288 kg/m3), whichever is greater.
- MONOKOTE® shall be mixed with water at the job site.
- MONOKOTE® Accelerator is to be used with MONOKOTE® Fireproofing to enhance set characteristics and product yield. The MONOKOTE® Accelerator is injected into the MONOKOTE® Fireproofing at the spray gun. MONOKOTE® Accelerator shall be mixed and used according to manufacturers recommendations.
- MONOKOTE® is applied directly to the steel, at various rates of application which will be job dependent, using standard plastering type equipment or continuous mixer/pump units. A spray gun, with a properly sized orifice and spray shield and air pressure at the nozzle of approximately 20 psi (38 KPa), will provide the correct hangability, density and appearance. NOTE: If freshly sprayed MONOKOTE® does not adhere properly, it is probably due to a too wet mix, poor thickness control, or an improperly cleaned substrate.

Temperature & Ventilation

- The substrate temperature shall be a minimum of 40 °F (4.5 °C) for at least 1-hour prior to the application of the MONOKOTE® . Additionally, the air and substrate temperature during application and for a minimum or 24 hours after application shall be no less than 40 °F (4.5 °C).
- Provisions shall be made for ventilation to properly dry the fireproofing after application. In enclosed areas lacking natural ventilation, air circulation and ventilation must be provided to achieve a minimum total fresh air exchange rate of 4 times per hour until the material is substantially dry.

Field Tests

- The architect will select an independent testing laboratory (for which the owner will pay) to sample and verify the thickness and density of the fireproofing in accordance with the the applicable building code.
- The architect will select an independent testing laboratory (for which the owner will pay) to randomly sample and verify the bond strength of the fireproofing in accordance with the provisions of ASTM E736.
- Results of the above tests will be made available to all parties at the completion of pre-designated areas which shall have been determined at a pre-job conference.

Safety

- MONOKOTE® is slippery when wet. The general contractor and applicator shall be responsible for posting appropriate cautionary "SLIPPERY WHEN WET" signs. Signs should be posted in all areas in contact with wet fireproofing material. Anti-slip surfaces should be used on all working surfaces.
- Safety Data Sheets (SDS) for MONOKOTE® MK-1000 HB fire resistive plasters are available on our web site or by calling 866-333-3SBM.

Last Updated: 2021-02-05
gcpat.com/solutions/products/monokote-fireproofing/monokote-mk-1000-hb