Technical Evaluation Report

TO ASSIST WITH CODE COMPLIANCE

UL U356 Summary One-Hour Fire-Resistance Rated, Limited Load Bearing Wall Assemblies for Thermo-Ply® Red & Blue Protective Sheathing Using *IBC* Section 722 Calculation Method (Exposed to Fire on Interior Face Only)

TER No. 1210-01Summary

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Ox Paperboard Michigan, LLC

Manufacturing Locations:

228 Broadway, Suite 2 Hanover PA, 17331 269-435-2425	164 Eyster Rd. Halltown, WV 25423 269-435-2425	700 Centreville Rd. Constantine, MI 49042 269-435-2425

oxpaperboard.com/thermo-ply.html
paullautrup@oxpaperboard.com

DIVISION: 06 00 00 – WOOD, PLASTICS AND COMPOSITES
Section: 06 02 00 – Design Information
Section: 06 11 00 – Wood Framing
Section: 06 12 00 – Structural Panels
Section: 06 12 19 – Shear Wall Panels

DIVISION: 07 00 00 – THERMAL AND MOISTURE PROTECTION
Section: 07 21 00 – Thermal Insulation
Section: 07 25 00 – Water-Resistive Barriers/Weather Barriers
Section: 07 27 00 – Air Barriers

1. Products Evaluated:

1.1. Thermo-Ply® Protective Sheathing:

1.1.1. Thermo-Ply® (Red) Protective Sheathing (structural)

1.1.2. Thermo-Ply® (Blue) Protective Sheathing (structural)

1.2. For the most recent version of this report, visit drjengineering.org.

2. Applicable Codes and Standards:[1]

2.1. *2006, 2009* and *2012 International Building Code* (*IBC*)

2.2. *2006, 2009* and *2012 International Residential Code* (*IRC*)

[1] Unless otherwise noted, code references are from the 2012 versions of the codes. This product is also approved for use with the 2000 and 2003 versions of the *IBC* and *IRC* and the standards referenced therein.

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The *IBC* defines:

- **APPROVED SOURCE** – "An independent person, firm or corporation, *approved* by the *building official*, who is competent and experienced in the application of engineering principles to materials, methods or systems analyses."

DrJ's building construction professionals meet the competency requirements as defined in the *IBC* and can seal their work. DrJ is regularly engaged in conducting and providing engineering evaluations of single-element and full-scale building systems tests. This TER is developed from test reports complying with *IBC* Section 104.11.1 Research reports, which states, "Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from *approved* sources."

3. Performance Evaluation:

3.1. Performance as a component element of limited load bearing one-hour rated wall assemblies.

3.2. For other sheathing performance characteristics that may be used in an exterior wall assembly, see TER No. 1004-01: *Thermo-Ply® Protective Sheathing.*

4. Product Description and Materials:

4.1. See TER No. 1004-01: *Thermo-Ply® Protective Sheathing.*

5. Applications:

5.1. Fire Endurance Assemblies

5.1.1. Two full-scale ASTM E119 fire endurance tests and fire and hose stream tests of a limited load bearing unsymmetrical exterior wall assembly were conducted by the Building Research Laboratory at Ohio State University by Dr. Richard Bletzacker of Bletzacker and Associates.[2]

5.1.1.1. OSU Test project number 7187 had a fire endurance performance of 65 minutes and had a finish rating for the $^{5}/_{8}$" Type X gypsum wallboard (GWB) membrane of 19.9 minutes.

5.1.1.2. OSU Test project number 3518 had a fire endurance performance of 60 minutes and had a finish rating for the $^{5}/_{8}$" Type X GWB membrane of 20.4 minutes.

5.1.2. The key structural sheathing component for the wall assembly's exterior sheathing was Thermo-Ply® (Red) Protective Sheathing.

5.1.3. The finish rating for the $^{5}/_{8}$" Type X gypsum wallboard (GWB) membrane of this assembly was 20.4 minutes.

5.1.3.1. This is the GWB membrane finish rating used for the *2006* and *2009 IBC* Section 721 and *2012 IBC* Section 722 calculations.

5.1.3.2. GWB membrane comparisons will be made for the application of this tested finish rating to other fire rated assemblies having GWB membrane finish ratings of 20.4 minutes or greater.

5.1.4. The following table provides an *IBC* Section 703.3 "Alternative methods for determining fire resistance" based fire endurance assembly.

5.1.4.1. This section allows for substitutions of Thermo-Ply® (Red and Blue) Protective Sheathing as the exterior sheathing in the above mentioned one-hour rated fire tests conducted by the Building Research Laboratory at Ohio State University using code complying calculation procedures that incorporate specific thermal protection performance data taken directly from the fire testing performed.

5.1.4.2. This assembly is solely for fire endurance performance where the assembly is exposed to fire on the interior face only and where interior GWB is the protective membrane.

5.1.4.3. This is defined as an unsymmetrical fire endurance assembly where performance is from the interior side only.

5.1.5. Loading Requirements

5.1.5.1. The original wall assembly was loaded to 55% of the allowable load.

5.1.5.2. A superimposed load of 1,800 lbs per stud was applied to the assembly at the start of the test and was maintained throughout the test. This superimposed load imposed a stress of 342.9 psi, compression parallel to grain.

5.1.5.3. This results in a wall assembly permitted to be built as follows:

5.1.5.3.1. 8' wall heights can be loaded to a maximum of 1,800 lbs per stud (1,350 plf).

5.1.5.3.2. 9' wall heights can be loaded to a maximum of 1,180 lbs per stud (885 plf).

[2] Testing conducted by the Engineering Experiment Station at Ohio State University in Columbus, Ohio, 43212. The test is *Standard ASTM Fire Endurance Test and a Fire and Hose Stream Test on Duplicate Limited Load Bearing Unsymmetrical Exterior Wall Assemblies*, which was conducted by the Building Research Laboratory, Larry L. Whitaker, Supervisor, Test Operations.

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Fire Endurance Assembly Type or Designation	Hourly Rating Per UL Directory & *IBC* Section 721.6 or 722.6	GWB Manufacturer	GWB Fastener & Fastener Spacing	Exterior Side of Assembly Only Thermo-Ply® Red or Blue Item #5 Substitute	Wood Studs	Maximum Applied Compression Load (plf)	Finish Rating Must be Greater than 20.4 Minutes	Wall Performance after Finish Rating is Achieved, in Minutes	Total Fire Endurance Performance of UL U356 Assembly as Defined, in Minutes
UL U356 Exterior Side Thermo-Ply® Red or Blue attached to studs then assembly siding types applied	One-hour rated assembly fire endurance from interior side only	See UL U356 for a listing of manufacturers of 5/8" Fire Rated GWB that can be applied to achieve a Finish Rating of 20.4 minutes or greater as designated	Per UL U356 or max of 2"-long GWB nails spaced 6" o.c. around the perimeter and 12" o.c. on intermediate studs	Attached Directly to Studs Attached using 1 1/4" long roofing nails spaced 3" o.c. around the perimeter of each sheet and 6" o.c. on the intermediate studs or staples 16 gauge min, 7/16" crown penetrating a min of 1" into the stud or 0.113" nail min penetrating a min of 1" into stud per SBCRI testing.	Min SPF studs spaced at a maximum of 16" o.c.	1,350 plf @ a maximum 8' wall height 885 plf @ a maximum 9' wall height	Base finish rating for UL U356 assembly ranges from 23 to 25 minutes	39.6	62.6 to 64.6

Table 1: UL U356 with Thermo-Ply Red or Blue Applied as Exterior Structural Sheathing in One-Hour Rated Fire Endurance Wall Assemblies (Exposed to Fire on Interior Face Only) for GWB Manufacturers with Finish Ratings over 21 Minutes

Design No. U356

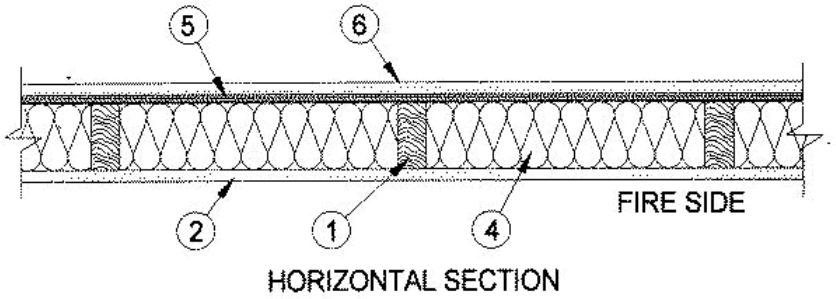
July 13, 2011

(Exposed to Fire on Interior Face Only)

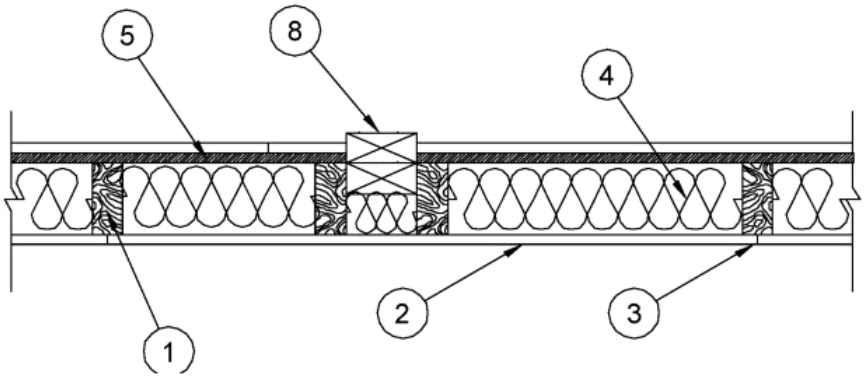
Bearing Wall Rating — 1 Hr

Finish Rating — 23 Min or 25 Min (See Item 2C)

Load Restricted for Canadian Applications — See Guide BXUV7



HORIZONTAL SECTION



1. Wood Studs — Nom 2 by 4 in. spaced 16 in. OC with two 2 by 4 in. top and one 2 by 4 in. bottom plates. Studs laterally-braced by wood structural panel sheathing (Item 5).

When Mineral and Fiber Boards* (Item 5A) are considered as bracing for the studs, the load is restricted to 76% of allowable axial load. Walls effectively fire stopped at top and bottom of wall.

2. Gypsum Board* — Nom 5/8 in. thick, 4 ft. wide, applied vertically and nailed to studs and bearing plates 7 in. OC with 6d cement-coated nails, 1-7/8 in. long with 1/4 in. diam head. **Finish Rating is 23 minutes.**

Any UL Classified Gypsum Board that is eligible for use in Design Nos. L501, G512 or U305. See **Gypsum Board** (CKNX) Category for names of Classified companies.

2A. Gypsum Board* — (As an alternate to Item 2, not shown) - Any 5/8 in. thick 4 ft. wide gypsum panels that are eligible for use in Design Nos. L501, G512 or U305, supplied by the Classified Companies listed below shown in the **Gypsum Board*** (CKNX) category. Applied vertically and attached to studs and bearing plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board. **Finish Rating is 23 minutes.**
CGC INC

UNITED STATES GYPSUM CO

USG MEXICO S A DE C V

2B. Gypsum Board* — (As an alternate to Item 2, not shown) - 5/8 in. thick 4 ft. wide gypsum panels applied vertically and attached to studs and bearing plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screw 1 in. from edge of board. **Finish Rating is 23 minutes.**

AMERICAN GYPSUM CO — Types AGX-1, M-Glass, AG-C

CERTAINTEED GYPSUM INC — ProRoc Type C or ProRoc Type X

CERTAINTEED GYPSUM CANADA INC — ProRoc Type C or ProRoc Type X

PABCO BUILDING PRODUCTS L L C, DBA

PABCO GYPSUM — Type PG-11

TEMPLE-INLAND — Types X, Veneer Plaster Base-Type X, Water Rated-Type X, Sheathing Type-X, Soffit-Type X, Type X ComfortGuard Sound Deadening Gypsum Board.

2C. Gypsum Board* — (As an alternate to Item 2, not shown) - For Use with Item 5A only - 5/8 in. thick 4 ft. wide gypsum panels applied horizontally and attached to studs and bearing plates with 1-1/4 in. long Type W coarse thread gypsum panel steel screws spaced a max 8 in. OC, with last screws 1 in. and 4 in. from edges of board. **Finish Rating is 25 min.**

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type PG-11

TEMPLE-INLAND — Type X, Veneer Plaster Base-Type X, Water Rated-Type X, Sheathing Type-X Soffit-Type X

2D. Gypsum Board* — (As an alternate to Item 2) - Not to be used with item 7. 5/8 in. thick, 4 ft. wide, paper surfaced, applied vertically only and fastened to the studs and plates with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 1/4 in. diam heads, 7 in. OC. **Finish Rating is 23 minutes.**

NATIONAL GYPSUM CO — SoundBreak XP Type X Gypsum Board

2E. Wall and Partition Facings and Accessories* — (As an alternate to Items 2 through 2D) — Nominal 5/8 in. thick, 4 ft. wide panels, secured as described in Item 2. **Finish Rating is 23 minutes.**

SERIOUS ENERGY INC — Type QuietRock ES, Type QuietRock QR-527.

2F. Gypsum Board* — (As an alternate to Item 2) - Not to be used with item 7. 5/8 in. thick, 4 ft. wide, paper surfaced, applied vertically only and fastened to the studs and plates with 6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam and 1/4 in. diam heads, 7 in. OC. **Finish Rating is 23 minutes.**

CERTAINTEED GYPSUM INC — Type SilentFX

3. Joints and Nailheads — (Not Shown) — Wallboard joints covered with tape and joint compound. Nail heads covered with joint compound.

4. Batts and Blankets* — Mineral fiber or glass fiber insulation, 3-1/2 in. thick, pressure fit to fill wall cavities between studs and plates. Mineral fiber insulation to be unfaced and to have a min density of 3 pcf. Glass fiber insulation to be faced with aluminum foil or kraft paper and to have a min density of 0.9 pcf (min R-13 thermal insulation rating).

See **Batts and Blankets*** (BKNV) Category in the Building Materials Directory and **Batts and Blankets***(BZJZ) Category in the Fire Resistance Directory for names of Classified Companies.

4A. Fiber, Sprayed* — As an alternate to Batts and Blankets (Item 4) — Spray applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. Nominal dry density of 3.0 lb/ft^3. Alternate application method: The fiber is applied with U.S. Greenfiber LLC Type AD100 hot melt adhesive at a nominal ratio of one part adhesive to 6.6 parts fiber to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. Nominal dry density of 2.5 lb/ft^3.

U S GREENFIBER L L C — Cocoon2 Stabilized or Cocoon-FRM (Fire Rated Material)

4B. Fiber, Sprayed* — As an alternate to Item 4 and 4A — Spray applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. Nominal dry density of 4.58 lb/ft^3.

NU-WOOL CO INC — Cellulose Insulation

4C. Fiber, Sprayed* — As an alternate to Batts and Blankets (Item 4) - Spray applied cellulose fiber. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. The minimum dry density shall be 4.30 lbs/ft^3.

INTERNATIONAL CELLULOSE CORP — Celbar-RL

5. Wood Structural Panel Sheathing — Min 7/16 in. thick, 4 ft wide wood structural panels, min grade "C-D" or "Sheathing". Installed with long dimension of sheet (strength axis) or face grain of plywood parallel with or perpendicular to studs. Vertical joints centered on studs. Horizontal joints backed with nom 2 by 4 in. wood blocking. Attached to studs on exterior side of wall with 6d cement coated box nails spaced 6 in. OC at perimeter of panels and 12 in. OC along interior studs.

5A. Mineral and Fiber Boards* — As an alternate to Item 5 - Min 1/2 in. thick, 4 ft wide sheathing, installed vertically to studs. Vertical joints centered on studs. Horizontal joints backed with nom 2 by 4 in. wood blocking. Attached to studs on exterior side of wall with 1-1/2 in. long galvanized roofing nails spaced 6 in. OC at perimeter of panels and 12 in. OC along interior studs. As an option a weather resistive barrier may be applied over the Mineral and Fiber Boards.

TEMPLE-INLAND FOREST PRODUCTS CORP — Types FiberBrace or QuietBrace

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5B. Thermo Ply Red and Blue *— As an alternate to Item 5 per the IBC Section 703.3, gypsum wallboard finish rating from ASTM E119 testing and the IBC Chapter 721.6/722.6 calculations.*

6. Exterior Facings — Installed in accordance with the manufacturer's installation instructions. One of the following exterior facings is to be applied over the sheathing:

A. Vinyl Siding — Molded Plastic* — Contoured rigid vinyl siding having a flame spread value of 20 or less.

See Molded Plastic (BTAT) category in the Building Materials Directory for names of manufacturers.

B. Particle Board Siding — Hardboard exterior sidings including patterned panel or lap siding.

C. Wood Structural Panel or Lap Siding — APA Rated Siding, Exterior, plywood, OSB or composite panels with veneer faces and structural wood core, per PS 1 or APA Standard PRP-108, including textured, rough sawn, medium density overlay, brushed, grooved and lap siding.

D. Cementitious Stucco — Portland cement or synthetic stucco systems with self-furring metal lath or adhesive base coat. Thickness from 3/8 to 3/4 in., depending on system.

E. Brick Veneer — Any type on nom 4 in. wide brick veneer. When brick veneer is used, the rating is applicable with exposure on either face. Brick veneer fastened with corrugated metal wall ties attached over sheathing to wood studs with 8d nail per tie: ties spaced not more than each sixth course of brick and max 32 in. OC horizontally. One in. air space provided between brick veneer and sheathing.

F. Exterior Insulation and Finish System (EIFS) — Nom 1 in. Foamed Plastic* insulation bearing the UL Classification Marking, attached over sheathing and finished with coating system, or Portland cement or synthetic stucco systems, in accordance with manufacturer's instructions. See **Foamed Plastic** (BRYX and CCVW) categories for names of Classified companies.

G. Siding — Aluminum or steel siding attached over sheathing to studs.

H. Fiber-Cement Siding — Fiber-cement exterior sidings including smooth and patterned panel or lap siding.

6. Findings:

6.1. *IBC* Section 104.11 and *IRC* Section R104.11 specifically state that:

> The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code.

6.2. The use of vinyl siding will not affect the one-hour fire resistance rating of the Thermo-Ply® (Red and Blue) wall assembly.

6.3. The assembly as described in Table 1 is an accurate assessment of fire endurance performance for the Thermo-Ply® (Red and Blue) wall assembly.

7. Identification:

7.1. Each Thermo-Ply® Protective Sheathing panel described in this TER is identified by a label on the board or packaging material bearing the manufacturer's name, product name, label of the third-party inspection agency, and other information to confirm code compliance.

7.2. Additional technical information can be found at oxpaperboard.com/thermo-ply.html.

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8. Review Schedule:

8.1. This TER is subject to periodic review and revision. For the most recent version of this report, visit drjengineering.org.

8.2. For information on the current status of this report, contact DrJ.

Responsibility Statement

The information contained herein is a product, engineering or building code compliance research report performed in accordance with the referenced building codes, testing and/or analysis through the use of accepted engineering procedures, experience and good technical judgment. Product, design and code compliance quality control is the responsibility of the referenced company. Consult the referenced company for the proper detailing and application for the intended purpose. Consult your local jurisdiction or design professional to assure compliance with the local building code. DrJ (drjengineering.org) research 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 DrJ, express or implied, as to any finding or other matter in this report or as to any product covered by this report.

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Appendix A:
TERs Are Comparable to, Compatible with, and Equivalent to the Purpose of an ICC-ES ESR

1. Technical Evaluation Reports (TERs), drafted and maintained by DrJ (professional engineering firm and ISO/IEC 17065 applicant through ANSI/ACLASS), assess how specific products comply with the provisions of the building code. DrJ is a code-defined "approved source," and DrJ employs professional engineers and follows state professional engineering rules and regulations.

2. TERs are comparable to, compatible with, and equivalent to the purpose of an ICC Evaluation Service (ICC-ES) Evaluation Service Reports (ESRs).[3]

2.1. ICC Evaluation Service does not provide an engineer's seal on any of its ESRs.

2.2. Furthermore, the ICC-ES Evaluation Report Purpose is defined as follows[4]:

ICC EVALUATION SERVICE

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

ICC EVALUATION SERVICE, LLC,
RULES OF PROCEDURE FOR EVALUATION REPORTS

1.0 PURPOSE

These rules set forth procedures governing ICC Evaluation Service, LLC (ICC-ES), issuance and maintenance of evaluation reports on building materials and products, methods of construction, prefabricated building components, and prefabricated buildings.

ICC-ES evaluation reports assist those enforcing model codes in determining whether a given subject complies with those codes. An evaluation report is not to be construed as representing a judgment about aesthetics or any other attributes not specifically addressed in the report, nor as an endorsement or recommendation for use of the subject of the report. Approval for use is the prerogative and responsibility of the Code Official; ICC-ES does not intend to assume, nor can ICC-ES assume, that prerogative and responsibility.

2.3. ICC ESR Disclaimer[5]:

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.

[3] ICC Evaluation Service, LLC and the ICC-ES Evaluation Reports logo are registered trademarks of ICC-ES.
[4] See the "ICC-ES Rules of Procedure" at www.icc-es.org/pdf/rules_evalrpts.pdf.
[5] Page 1 footer of each ICC-ES report that can be found at www.icc-es.org/reports/index.cfm.

3. DrJ Sealed Engineering

3.1. DrJ engineers have undertaken the rigorous engineering and analysis work to determine the subject of this report's compliance with the codes and standards referenced in Section 2.

3.2. DrJ work:

3.2.1. Complies with accepted engineering procedures, experience and good technical judgment.

3.2.2. Is the work of an independent person, firm or corporation who is competent and experienced in the application of engineering principles to materials, methods or systems analyses.

3.3. A Technical Evaluation Report generated by DrJ is in all "code-compliance-evaluation-processing" respects equivalent to an ICC-ES ESR, as ICC-ES defines its approach, with one material difference.

3.3.1. DrJ will seal all TERs, as needed, so that responsibility for the work is well-defined.

3.3.2. The DrJ responsibility statement is identical to that provided in ICC-ES ESRs.

> DrJ (drjengineering.org) research 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 DrJ express or implied as to any finding or other matter in this report or as to any product covered by this report.

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Appendix B:
Legal Aspects of Product Approval

1. Product Approval

1.1. In general, the model and local codes provide for the use of alternative materials, designs and methods of construction by having a legal provision that states something similar to:

> The provisions of this code/law are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code/law, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the compliance official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code/law, and that the material, design, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code/law.

1.2. In concert with preserving "free and unfettered competition as the rule of trade", should this alternative material, design or method of construction not be approved, the building official shall respond in writing, stating the specific reasons for non-code-compliance and/or for non-professional engineering regulation compliance.

> Congress passed the first antitrust law, the Sherman Act, in 1890 as a "comprehensive charter of economic liberty aimed at preserving free and unfettered competition as the rule of trade." In 1914, Congress passed two additional antitrust laws: the Federal Trade Commission Act, which created the FTC, and the Clayton Act. With some revisions, these are the three core federal antitrust laws still in effect today.
>
> …Yet for over 100 years, the antitrust laws have had the same basic objective: to protect the process of competition for the benefit of consumers, making sure there are strong incentives for businesses to operate efficiently, keep prices down, and keep quality up….
>
> The Sherman Act outlaws "every contract, combination, or conspiracy in restraint of trade," and any "monopolization, attempted monopolization, or conspiracy or combination to monopolize." For instance, in some sense, an agreement between two individuals to form a partnership restrains trade, but may not do so unreasonably, and thus may be lawful under the antitrust laws. On the other hand, certain acts are considered so harmful to competition that they are almost always illegal.
>
> The penalties for violating the Sherman Act can be severe. Although most enforcement actions are civil, the Sherman Act is also a criminal law, and individuals and businesses that violate it may be prosecuted by the Department of Justice.[6]

2. Legal Validity of this TER

2.1. This TER is a code-defined (e.g., *2009 IBC* and *IRC* Section 104.11.1 and *2009 IBC* Section 1703.4.2) "research report" that provides supporting data to assist in the approval of materials, designs or assemblies not specifically provided for in this code.

2.2. Therefore, this TER is a valid research report from a professional engineering company that complies with the code definition of "approved source." If required by the authority having jurisdiction, this TER can also be sealed to comply with professional engineering laws and regulations.

[6] http://www.ftc.gov/bc/antitrust/antitrust_laws.shtm