



**STRONGWELL®**

## **FRP Specifications**

**Section 06 71 00**  
**Fiberglass Reinforced Polymer (FRP)**  
**Structural Shapes/Plate and Fabrications**

**REVISED 03.2020**

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## **SECTION 06 71 00**

### **FIBERGLASS REINFORCED POLYMER (FRP) PRODUCTS AND FABRICATIONS**

#### **PART 1 – GENERAL**

##### **1.01 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.

##### **1.02 SUMMARY:**

- A. This section includes FRP Products & Fabrications for Structural Shapes and Plate.

##### **1.03 SCOPE OF WORK:**

- A. Furnish all labor, materials, equipment, and incidentals governed by this section necessary to install the fiberglass reinforced polymer (FRP) products as specified herein.

##### **1.04 QUALITY ASSURANCE:**

- A. The material covered by these specifications shall be furnished by an ISO 9001 certified manufacturer of proven ability who is regularly engaged in the manufacture, fabrication, and installation of FRP systems.
- B. Substitution of any component or modification of system shall be made only when approved by the Architect or Design Engineer.
- C. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.
- D. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

##### **1.05 DESIGN CRITERIA:**

- A. The design of EXTREN® structural shapes and plate, including connections, shall be in accordance with governing building codes and standards as applicable.
- B. Structural members shall be designed to support all applied loads. Deflection in any direction shall not be more than L/180 of span for structural members unless specifically stated otherwise in drawings and/or supplementary conditions. Connections shall be designed to transfer the loads.

## 1.06 SUBMITTALS:

- A. Shop drawings of all structural shapes and plate shall be submitted to the Design Engineer for approval in accordance with the requirements of Section \_\_\_\_\_. Fabrication shall not start until receipt of Design Engineer's approval marked "Approved As Submitted" or "Approved As Noted".
- B. Detail shop drawings showing:
  - 1. Dimensions
  - 2. Sectional assembly
  - 3. Location and identification mark
  - 4. Size and type of supporting frames required
- C. Samples of each type of product shall be submitted for approval in accordance with the requirements of Section \_\_\_\_\_.

## 1.07 SHIPPING AND STORAGE INSTRUCTIONS:

- A. All systems, sub-systems, and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.
- B. All materials and equipment necessary for the fabrication and installation of structural shapes and plate and appurtenances shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping, or damage of any kind to the materials or equipment, including damage due to over exposure to the sun. Any material which, in the opinion of the Design Engineer, has become damaged as to be unfit for use, shall be promptly removed from the site of work, and the Contractor shall receive no compensation for the damaged material or its removal.
- C. Identify and match-mark all materials, items, and fabrications for installation and field assembly.

## **PART 2 – PRODUCTS**

### **2.01 GENERAL:**

- A. Materials used in the manufacture of the FRP products shall be raw materials in conformance with the specification and certified as meeting the manufacturer's approved list of raw materials.
- B. All raw materials shall be as specified by the contract.
- C. The visual quality of the pultruded shapes shall conform to ASTM D4385.
- D. All FRP products noted in 1.02 shall be manufactured using a pultruded process utilizing \_\_\_\_\_ (select premium polyester or vinyl ester) resin (select with or without additional flame retardant additives). A synthetic surface veil fabric with embedded EXTREN® logo shall encase the glass reinforcement. FRP shapes shall achieve a flame spread rating of 25 or less in accordance with ASTM test method E-84, the flammability characteristics of UL 94 V-0 and the self-extinguishing requirements of ASTM D635. All structural shapes shall contain a UV inhibitor.
- E. If specified, after fabrication, all cut ends, holes, and abrasions of FRP shapes shall be sealed with a compatible resin coating.
- F. FRP products exposed to weather shall contain an ultraviolet inhibitor. Should additional ultraviolet protection be required, a one mil minimum UV coating can be applied.
- G. All exposed surfaces shall be smooth and true to form, consistent with ASTM D4385.
- H. Manufacturers:
  - 1. Strongwell
- I. Pultruded FRP products shall be manufactured and fabricated in the USA. Manufacturer shall provide a written Certificate of Compliance.
- J. The materials covered by these specifications shall be furnished by an ISO 9001 certified manufacturer.

## 2.02 FRP STRUCTURAL SHAPES AND PLATE:

### A. Material

1. Structural shapes and plate shall be made from \_\_\_\_\_ (select premium polyester or vinyl ester) resin (select with or without additional flame retardant additives). A synthetic surface veil fabric with embedded EXTREN® logo shall encase the glass reinforcement. FRP shapes shall achieve a flame spread rating of 25 or less in accordance with ASTM test method E-84, the flammability characteristics of UL 94 V-0 and the self-extinguishing requirements of ASTM D635. All structural shapes shall contain a UV inhibitor.
2. Pultruded profiles shall satisfy the visual requirements of ASTM D4385.
3. Structural shapes and plate shall be EXTREN® as manufactured by Strongwell.

### B. Process

1. Manufactured by the pultrusion process.

2.03 Structural FRP members' composition shall consist of a glass fiber reinforced premium polyester or vinyl ester resin matrix and glass reinforcements. A synthetic surface veil fabric with embedded EXTREN® logo shall encase the glass reinforcement. All members shall meet or exceed the minimum published mechanical, physical, electrical, flammability, and corrosive properties published in the Strongwell Design Manual.

**Table 1 – Fiberglass Pultruded Material Properties  
Minimum Ultimate Coupon Properties**

PROPERTIES	ASTM TEST METHOD	UNITS/VALUE	SERIES 500/525 SHAPES	SERIES 600/625 SHAPES	SERIES 500/525 PLATE ④			SERIES 600/625 PLATE ④		
					1/8" 3.175 mm	3/16" -3/8" 4.76-6.35 mm	1/2"-1" 9.5-25.4 mm	1/8" 3.175 mm	3/16"-1/4" 4.76-6.35 mm	3/8"-1" 9.5-25.4 mm
<b>MECHANICAL</b>										
Tensile Stress, LW	D638	psi N/mm <sup>2</sup>	30,000 207	30,000 207	20,000 138	20,000 138	20,000 138	20,000 138	20,000 138	20,000 138
Tensile Stress, CW	D638	psi N/mm <sup>2</sup>	7,000 48.3	7,000 48.3	7,500 51.7	10,000 68.9	10,000 68.9	7,500 51.7	10,000 68.9	10,000 68.9
Tensile Modulus, LW	D638	10 <sup>6</sup> psi 10 <sup>3</sup> N/mm <sup>2</sup>	2.5 17.2	2.6 17.9	1.8 12.4	1.8 12.4	1.8 12.4	1.8 12.4	1.8 12.4	1.8 12.4
Tensile Modulus, CW	D638	10 <sup>6</sup> psi 10 <sup>3</sup> N/mm <sup>2</sup>	0.8 5.52	0.8 5.52	0.7 4.83	0.9 6.21	1.0 6.89	1.0 6.89	1.0 6.89	1.0 6.89
Compressive Stress, LW	D695	psi N/mm <sup>2</sup>	30,000 207	30,000 207	24,000 165	24,000 165	24,000 165	24,000 165	24,000 165	24,000 165
Compressive Stress, CW	D695	psi N/mm <sup>2</sup>	15,000 103	16,000 110	15,500 107	16,500 114	20,000 138	16,500 114	17,500 121	17,500 121
Compressive Modulus, LW	D695	10 <sup>6</sup> psi 10 <sup>3</sup> N/mm <sup>2</sup>	2.5 17.2	2.6 17.9	1.8 12.4	1.8 12.4	1.8 12.4	1.8 12.4	1.8 12.4	1.8 12.4
Compressive Modulus, CW	D695	10 <sup>6</sup> psi N/mm <sup>2</sup>	0.8 5.52	0.8 5.52	0.7 4.83	0.9 6.21	1.0 6.89	1.0 6.89	1.0 6.89	1.0 6.89
Flexural Stress, LW	D790	psi N/mm <sup>2</sup>	30,000 207	30,000 207	24,000 165	24,000 165	24,000 165	24,000 165	24,000 165	24,000 165
Flexural Stress, CW	D790	psi N/mm <sup>2</sup>	10,000 68.9	10,000 68.9	10,000 68.9	13,000 89.6	17,000 117	10,000 68.9	13,000 89.6	17,000 117
Flexural Modulus, LW	D790	10 <sup>6</sup> psi 10 <sup>3</sup> N/mm <sup>2</sup>	1.6 11.0	1.6 11.0	1.1 7.58	1.1 7.58	1.4 9.65	1.1 7.58	1.1 7.58	1.4 9.65
Flexural Modulus, CW	D790	10 <sup>6</sup> psi 10 <sup>3</sup> N/mm <sup>2</sup>	0.8 5.52	0.8 5.52	0.8 5.51	0.8 5.51	1.3 8.96	0.8 5.51	0.9 6.21	1.3 8.96
Modulus of Elasticity①	full section	10 <sup>6</sup> psi	2.6	2.8	LW: 2.0 CW: 0.8	2.0 0.8	2.0 1.3	2.0 0.8	2.0 0.9	2.0 1.3
		10 <sup>3</sup> N/mm <sup>2</sup>	17.9	19.3	LW: 13.7 CW: 5.51	13.7 5.51	13.7 8.96	13.7 5.51	13.7 6.21	13.7 8.95
Modulus of Elasticity >4" ① >102 mm	full section	10 <sup>6</sup> psi 10 <sup>3</sup> N/mm <sup>2</sup>	2.5 17.2	2.5 17.2	- -	- -	- -	- -	- -	- -
Shear Modulus, LW ②⑦	D5379	10 <sup>6</sup> psi 10 <sup>3</sup> N/mm <sup>2</sup>	0.425 2.93	0.425 2.93	- -	- -	- -	- -	- -	- -
Short Beam Shear, LW ⑥⑦	D2344	psi N/mm <sup>2</sup>	4,500 31.0	4,500 31.0	- -	- -	- -	- -	- -	- -
Ultimate Bearing Stress, LW	D953	psi N/mm <sup>2</sup>	30,000 207	30,000 207	32,000 221	32,000 221	32,000 221	32,000 221	32,000 221	32,000 221
Poisson's Ratio, LW ⑦	D3039	in/in mm/mm	0.33 0.33	0.33 0.33	0.31 0.31	0.31 0.31	0.31 0.31	0.32 0.32	0.32 0.32	0.32 0.32
Notched Izod Impact, LW	D256	ft-lbs/in J/mm	25 1.33	25 1.33	15 0.801	10 0.533	10 0.533	15 0.801	10 0.533	10 0.533
Notched Izod Impact, CW	D256	ft-lbs/in J/mm	4 0.214	4 0.214	5 0.267	5 0.267	5 0.267	5 0.267	5 0.267	5 0.267



**Table 1 – Fiberglass Pultruded Material Properties  
Minimum Ultimate Coupon Properties – cont'd**

PROPERTIES	ASTM TEST METHOD	UNITS/VALUE	SERIES 500/525 SHAPES	SERIES 625 SHAPES	SERIES 500/525 PLATE ④			SERIES 625 PLATE ④		
					1/8" 3.175 mm	3/16 -3/8" 4.76-6.35 mm	1/2"-1" 9.5-25.4 mm	1/8" 3.175 mm	3/16"-1/4" 4.76-6.35 mm	3/8"-1" 9.5-25.4 mm
<b>PHYSICAL</b>										
Barcol Hardness ④	D2583	—	45	45	40	40	40	40	40	40
24 HR Water Absorption ⑤	D570	% Max by wt	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Density	D792	lbs/in <sup>3</sup>	0.062-0.070	0.062-0.070	0.060-0.068	0.060-0.068	0.060-0.068	0.060-0.068	0.060-0.068	0.060-0.068
		10 <sup>-3</sup> g/mm <sup>3</sup>	1.72-1.94	1.72-1.94	1.66-1.88	1.66-1.88	1.66-1.88	1.66-1.88	1.66-1.88	1.66-1.88
Coefficient of Thermal Expansion, LW ⑦	D696	10 <sup>-6</sup> in/in/°F	7	7	8	8	8	8	8	8
		10 <sup>-6</sup> mm/mm/°C	12	12	14.5	14.5	14.5	14.5	14.5	14.5
Coefficient of Thermal Expansion, CW ⑦	D696	10 <sup>-6</sup> in/in/°F	16	16	-	-	-	-	-	-
		10 <sup>-6</sup> mm/mm/°C	28.8	28.8	-	-	-	-	-	-
Thermal Conductivity ⑦	C177	BTU-in/ft <sup>2</sup> /hr/°F	4	4	-	-	-	-	-	-
		w(m * °K)	0.58	0.58	-	-	-	-	-	-
<b>ELECTRICAL</b>										
Arc Resistance, LW ⑦	D495	seconds	120	120						
Dielectric Strength, LW ⑦	D149	KV/in	35	35	35	35	35	35	35	35
		KV/mm	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38
Dielectric Strength, PF ⑧	D149	volts/mil	200	200	200	-	-	250	-	-
<b>FLAMMABILITY ④ (≥1/8" thickness)</b>										
Tunnel Test	E84	25 Max								
NBS Smoke Chamber	E662	650-700 (typical)								
Flammability	UL 94	V-0								
Flammability	D635	Self Extinguishing								
UL Thermal Index	Generic	266°F 130°C								
British Fire Test	BS 476-7	Class 1								

All values are minimum ultimate properties from coupon tests except as noted.

- ① This value is determined from full section simple beam bending of EXTREN® structural shapes.
- ② The Shear Modulus value has been determined from tests with full sections of EXTREN® structural shapes.  
(See the Strongwell *Design Manual* for further information.)
- ③ Plate compressive stress/modulus measured edgewise and flexural stress/modulus measured flatwise.
- ④ Values apply to Series 525 and 625.
- ⑤ Measured as a percentage maximum by weight.
- ⑥ Span to depth ratio of 3:1; EXTREN® angles will have a minimum value of 4,000 psi and the I/W shapes are tested in the web.
- ⑦ Typical values
- ⑧ This is a typical value which varies with composite thickness.

LW = Lengthwise

CW = Crosswise

PF = Perpendicular to laminate face

## **PART 3 – EXECUTION**

### **3.01 PREPARATION:**

- A. Coordinate and furnish setting drawings, diagrams, and templates for all FRP material. Provide instructions for installation of concrete inserts, sleeves, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.
- B. Coordinate delivery of such items to project site.

### **3.02 INSPECTION AND TESTING:**

- A. The Design Engineer shall have the right to inspect all materials to be furnished under these specifications prior to their shipment from the point of manufacture.
- B. All labor, power, materials, equipment, and appurtenances required for testing shall be furnished by the Contractor at no cost to the Owner.

### **3.03 INSTALLATION, GENERAL:**

- A. Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous FRP fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, and other connectors as determined by the Design Engineer of Record.
- B. Cutting, fitting, and placement: Perform cutting, drilling, and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; measured from established lines and levels.
- C. Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.

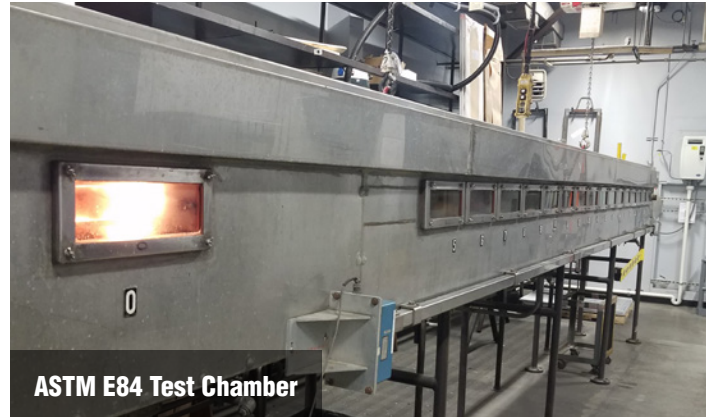
### **3.04 ALL FRP INSTALLATION:**

- A. If required, all field cut and drilled edges, holes, and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer.
- B. Install items specified as indicated and in accordance with manufacturer's instructions.

**End of Section**

## INTRODUCTION

When a fire-retardant material is required for an application, ASTM E84 Class A fire rating has been used as a default in several specifications and applications. Making an informed decision in choosing the right type of material for an application is not only important from the fire safety aspect but also helps with finding alternate classifications when Class A fire retardant material is not required. In this article, we would like to discuss the overview of ASTM E84, the importance of fire rating classification, and the flame spread performance of various commonly known materials.



ASTM E84 Test Chamber

## WHAT IS ASTM E84?

ASTM E84, also popularly known as E84 or Tunnel Test is a standard test method for surface burning characteristics of building materials. This test method is intended to provide **only comparative measurements** of surface flame spread and smoke density measurements with that of select grade red oak and fiber cement board surfaces under specific fire exposure conditions.

A test sample that is 20" wide x 24' long is placed on the ledges of a horizontal rectangular tunnel with an opening measuring 17-3/4" wide x 12" tall x 25' long. This sample is exposed to a controlled airflow and flaming fire for a duration of 10 minutes. The distance traveled by the flame front along the surface of the sample and the rate at which the flame advances during the test will be recorded and used for Flame Spread Index calculations. The concentration of smoke the sample emits during the test will be measured using a photometer and a Smoke Developed Index will be calculated.

## CLASSIFICATION BASED ON FLAME SPREAD INDEX

ASTM E84 does not include classification criteria for the results obtained from testing. The International Building Code® (IBC), NFPA 101: Life Safety Code® (NFPA 101), and NFPA 5000: Building Construction and Safety Code® (NFPA 5000) all describe a set of classification criteria required for **Interior Wall and Ceiling Finish Materials** based on Flame Spread Index and Smoke Developed Index when tested in accordance with ASTM E84 or UL 723. Refer to IBC-2018 section 803.1.2 for more details.

CLASS	FLAME SPREAD INDEX (FSI)	SMOKE DEVELOPED INDEX (SDI)
A	0-25	0-450
B	26-75	0-450
C	76-200	0-450

FLAME SPREAD PERFORMANCE OF VARIOUS MATERIALS AS PER ASTM E84			
MATERIAL	PRODUCT	FSI	CLASS
Softwood Plywood	23/32" Douglas-fir Plywood	35	B
	15/32" Douglas-fir Plywood	40	B
	3/8" Douglas-fir Plywood	65	B
	1/4" Douglas-fir Plywood	85	C
Oriented Strand Board (OSB)	15/32" OSB	100	C
1" Nominal Solid Wood	1" Douglas-fir	70	B
Fiber Cement Board	1/4" Fiber Cement Board	0	A
STRONGWELL® EXTREN®	1/8" 500 Series	100	C
	1/4" and above 500 Series	50	B
	1/8" and above 525 Series	15	A
	1/8" and above 625 Series	10	A

*Note: The above noted classification is for Flame Spread Index (FSI) only and STRONGWELL® EXTREN® products are not rated for Smoke Developed Index (SDI).*

References:

1. ASTM E84-21a, "Standard Test Method for Surface Burning Characteristics of Building Materials". <https://www.astm.org/Standards/E84.htm>
2. 2017 American Wood Council, "Design for Code Acceptance". <https://www.awc.org/pdf/codes-standards/publications/dca/AWC-DCA1-FlameSpreadPerformance-1706.pdf>
3. 2018 International Building Code (IBC), Chapter 8: Interior Finishes. <https://codes.iccsafe.org/content/IBC2018/chapter-8-interior-finishes>

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RESEARCH REPORT: RR 25698

Expires: June 1, 2024  
Issued Date: September 1, 2022  
Code: 2020 LABC

Local Representative:  
Bill Faust  
(276) 645-8155

**GENERAL APPROVAL** – Renewal - Strongwell FRP RF Panel Enclosure System for rooftop communication antenna screening.

## DETAILS

The Strongwell enclosure system consists of Extren® pultruded fiberglass reinforced structural shapes, Durashield® and Safplank® pultruded with spans between structural supports. Connections between the pultruded structural shapes and cladding members are accomplished by means of FRP threaded rod and fiberglass thermoplastic nuts. The material specifications are as follows:

1. Extren® Pultruded Structural Shapes: Fiberglass reinforced plastic shapes formed by the pultrusion method. The minimum properties for the pultruded shapes are listed in Table 1.
2. Durashield® , Extren® flatplate and Safeplank® which are also made by the pultrusion process with bi-directional strength.
3. ½" FRP threaded rods.
4. Fiberglass reinforced thermoplastic nuts.

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**The approval is subject to the following conditions:**

1. Extren® 1/4" flate plates, Durashield® and/or Safplank® cladding members are connected to the frame by means of 1/2" FRP threaded rods and fiberglass reinforced thermoplastic nuts. When supported as described the allowable load for a 6-ft by 8-ft framed panel is 40 psf (pounds per square foot).
2. Extren® Structural Shapes applied as beams: The design values are in Table 1.

**TABLE 1 - Design values for FRP**

Property	Direction	Specification
Tensile	Lengthwise Crosswise	5881 psi 1606 psi
Tensile Modulus	Lengthwise Crosswise	3.62 x 10 <sup>6</sup> psi 0.97 x 10 <sup>6</sup> psi
Flexural	Lengthwise Crosswise	6588 psi 2612 psi
Flexural Modulus	Lengthwise Crosswise	1.88 x 10 <sup>6</sup> psi 1.18 x 10 <sup>6</sup> psi
Shear	Horizontal	904 psi
½" bolt bearing	Lengthwise Crosswise	5475 psi 2105 psi
Minimum edge distance		1.5 - inch

Note: Design value is based on a factor of safety of 8

3. Complete plans and structural calculations prepared by a California licensed architect or civil or structural engineer and shall be submitted to the department for approval prior to permit issuance.
4. The Fire Department shall approve all plans for plastic screening on Title 19 buildings.
5. Antennas and screening must not obstruct access to the roof by the Fire Department as required by Sec 57.12.04 of the Los Angeles Municipal Code which states: No person shall obstruct required access passageways on the roof surface. An unobstructed passageway for use by the Fire Department shall be provided through or around any approved structures or equipment installations on the roof surface. One access passageway shall be provided for every 50-foot length or fraction thereof of roof surface. Passageways shall be at least three feet wide and have at least seven feet of overhead clearance.

## STRONGWELL

RE: Strongwell Panel Enclosure System

6. The individual rooftop screening panel area in any one plane or approximately the same plane shall be limited to 250 square feet and the total maximum aggregate area of all panels shall not exceed the larger of 3 square feet per foot of building frontage or 5 percent of the area of the roof, with a maximum allowable height of 18 feet above the roof level.
7. Screening material shall be located at least 20 ft from interior property lines for Type I, II, III, and IV buildings per 2020 LABC section 1510.6.2, Item 2.
8. Screening material shall be located at least 5 ft from interior property lines for Type V buildings per 2020 LABC section 1510.6.3, Item 3.
9. Screening shall not be illuminated or electrified.
10. Each panel shall be identified with LARR #25698 and Strongwell Label.
11. The fabrication will be in accordance with manufacturer's quality control manual. A copy of the quality control manual is on file with Engineering Research Section.

## DISCUSSION

The report is in compliance with the 2020 Los Angeles City Building Code.

The approval is based on LADBS Acceptance Criteria L182

The approval is based on tests per section 1510.6.2 and 2303.2 of the 2020 LABC, which show that the approved materials exhibit performance that is equivalent to fire-retardant treated wood.

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.

STRONGWELL

RE: Strongwell Panel Enclosure System

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.

---

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