Pultrusion Conference 2021

Building Pultrusion Product Opportunities in Structural Engineering

Emily Guglielmo, SE, PE, F.SEI

Martin/Martin, Inc.

Building Pultrusion Product Opportunities in Structural Engineering

- Successes with Composites
- Success with Pultrusion
- Challenges for Pultrusion in Structural Engineering
- Opportunities for Pultrusion in Structural Engineering

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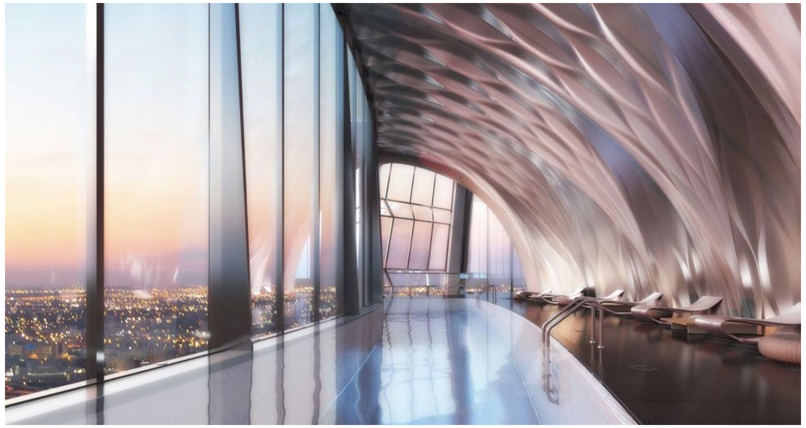
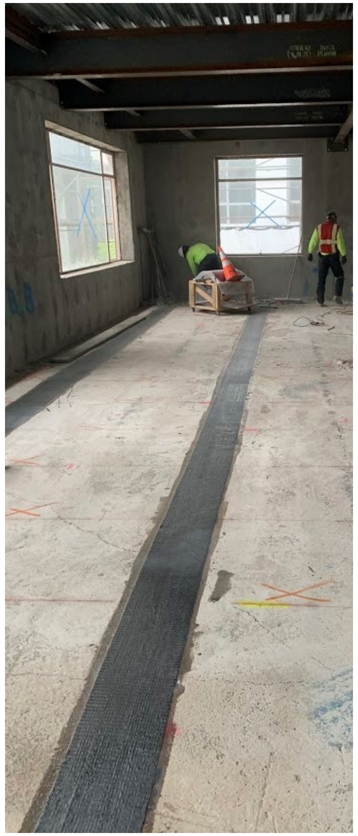
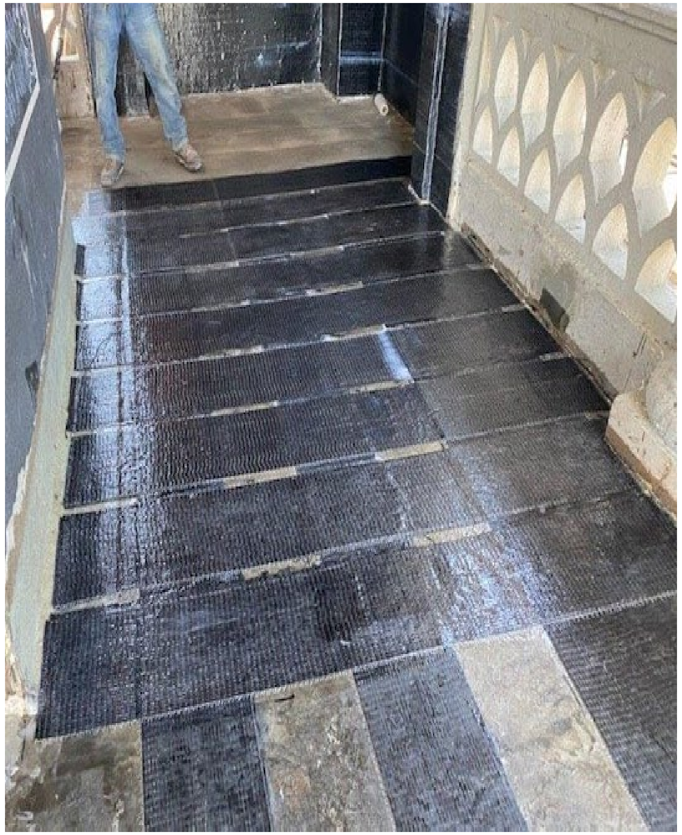
Successes with Composites: Sculpture

Successes with Composites: Canopies



Successes with Composites: Building Facades





Successes with Composites: Repair and Retrofit

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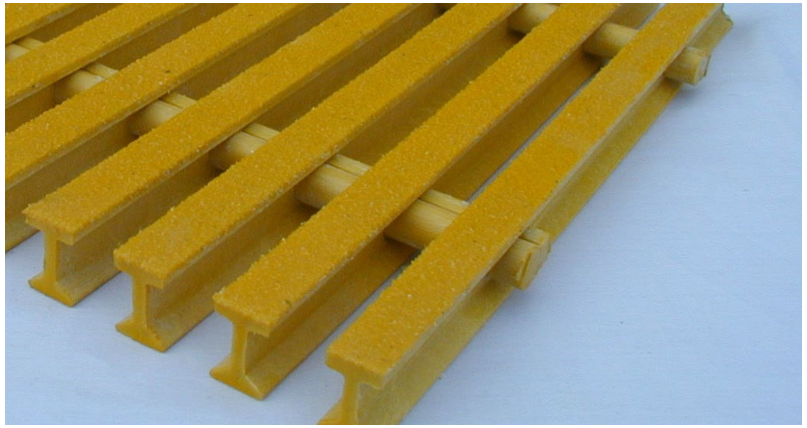

Successes with Composite Pultrusion: Non-Building

Photo Credits: Defifiberglass, Southern Cooling Towers, Bedford & Pearson Pilings, E.T. Techtonics, Creative Pultrusions Inc., Structural Fiberglass Inc., Strongwell

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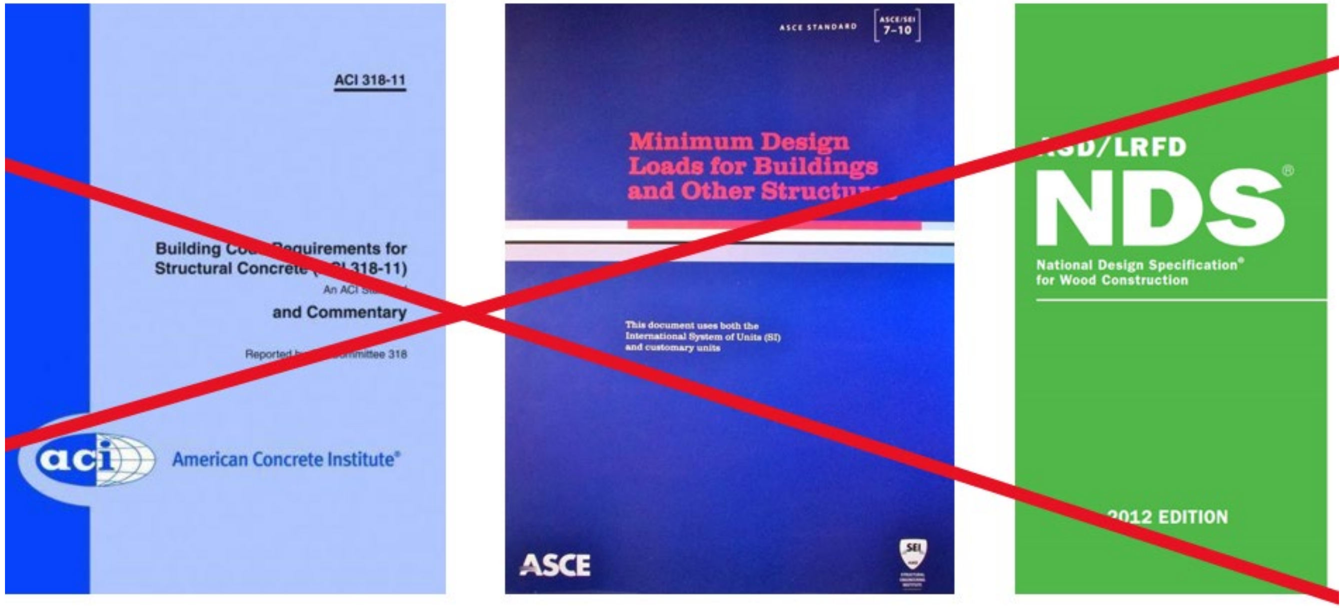
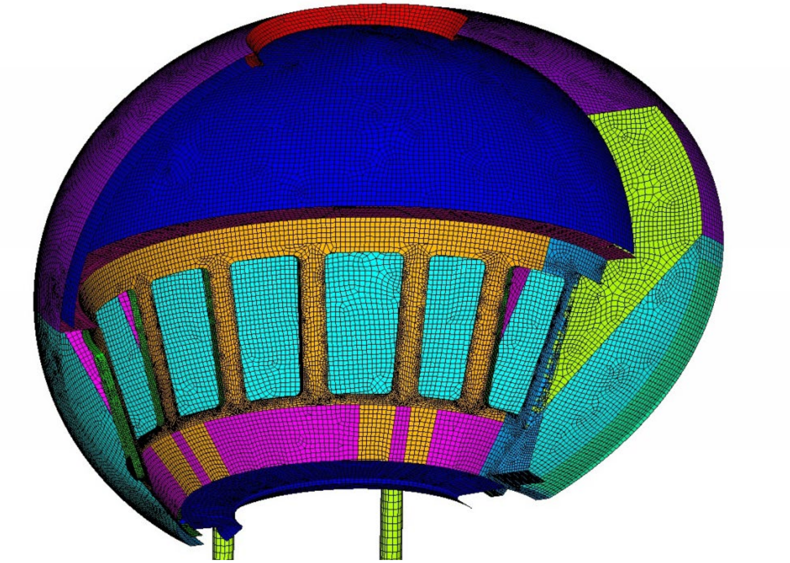
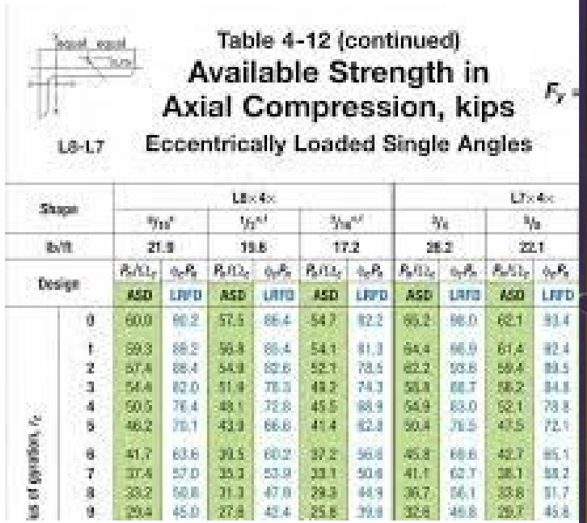
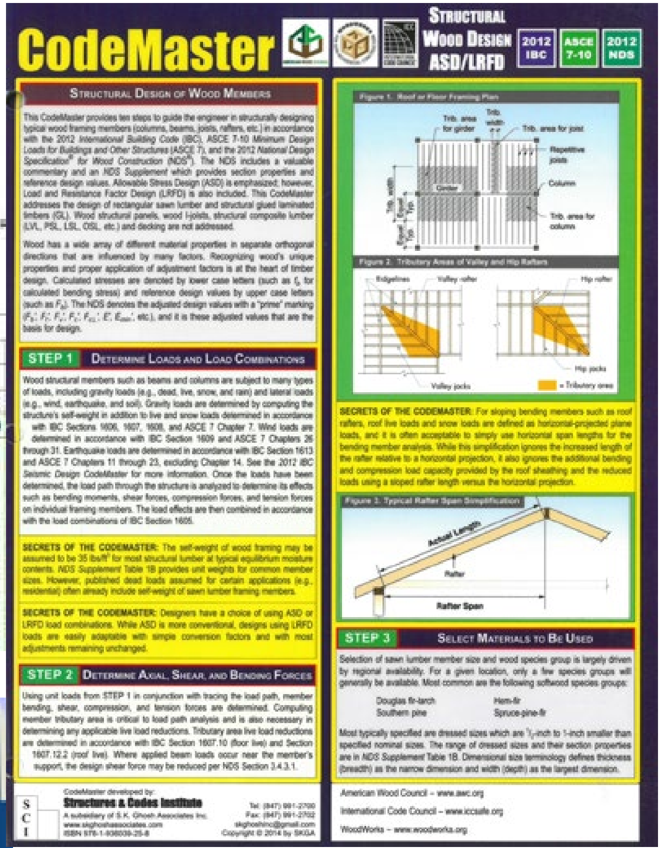
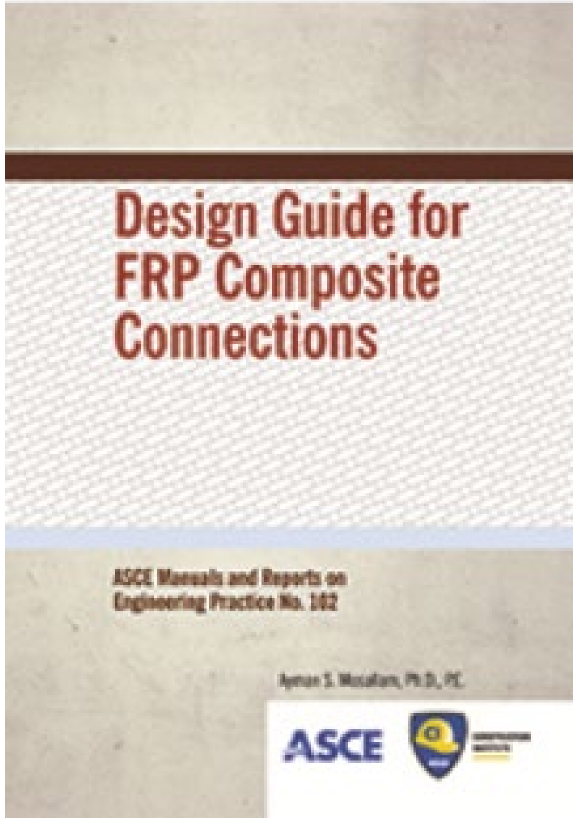


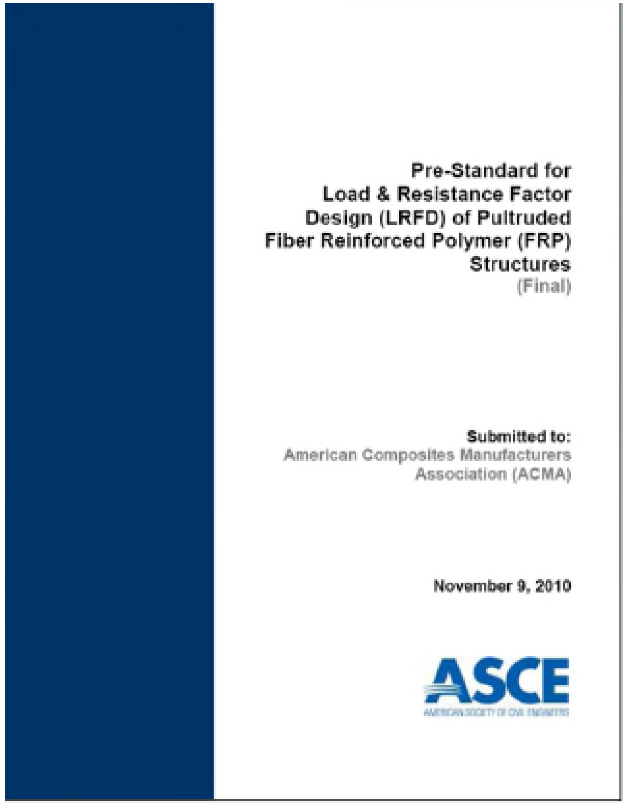


Challenges for Pultrusion in Structural Engineering





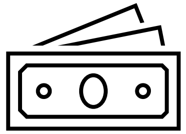




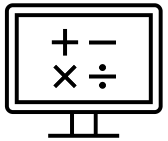
Challenges for Pultrusion in Structural Engineering

Codes

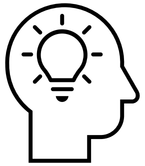
Analysis Software Costs



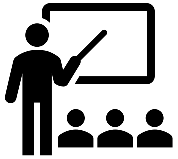
Lack of Expertise in Analysis Software



Lack of Expertise in Composites Behavior: Non-Linear, Non-Isotropic



Lack of Education in Composites for Practicing Engineers, Plan Check Engineers



Challenges for Pultrusion in Structural Engineering: Analysis

Type 1	Fire Resistive	Least Combustible
Type 2	Non-Combustible	
Type 3	Ordinary	
Type 4	Heavy Timber	
Type 5	Wood Frame	Most Combustible

Challenges for Pultrusion in Structural Engineering: Fire

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Key Advantages

Structural Properties:

- Lightweight
- High-strength
- Dimensional stability
- Non-Isotropic
- Impact resistant
- Unlimited shapes, lengths

Long-Term:

- Long life cycle
- Low-maintenance
- Durability
- Corrosion resistance
- Chemical resistance
- Non-conductivity (thermally and electrically)
- Non-magnetic

Pultrusion

- Lighter weight
- Stronger
- No Rot, mildew, mold, warp when subject to moisture
- No Insect infestation
- No coatings required

Wood

Pultrusion v. Wood

Pultrusion

- Non-Conductive
- Corrosion Resistant
- Lighter weight
- No welding
- Lead time, availability

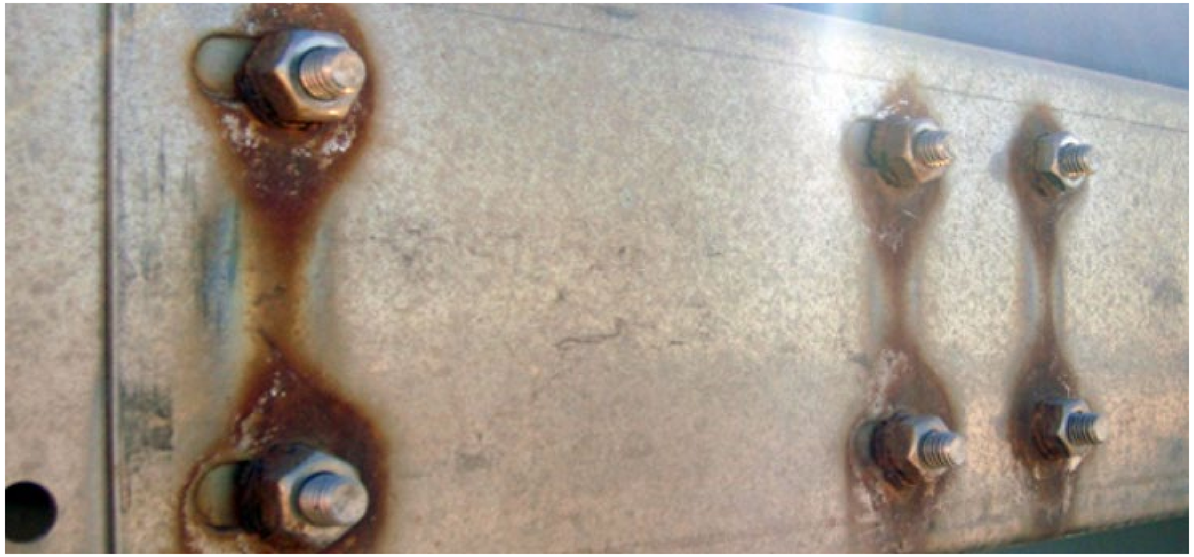
Steel

Pultrusion v. Steel

Pultrusion

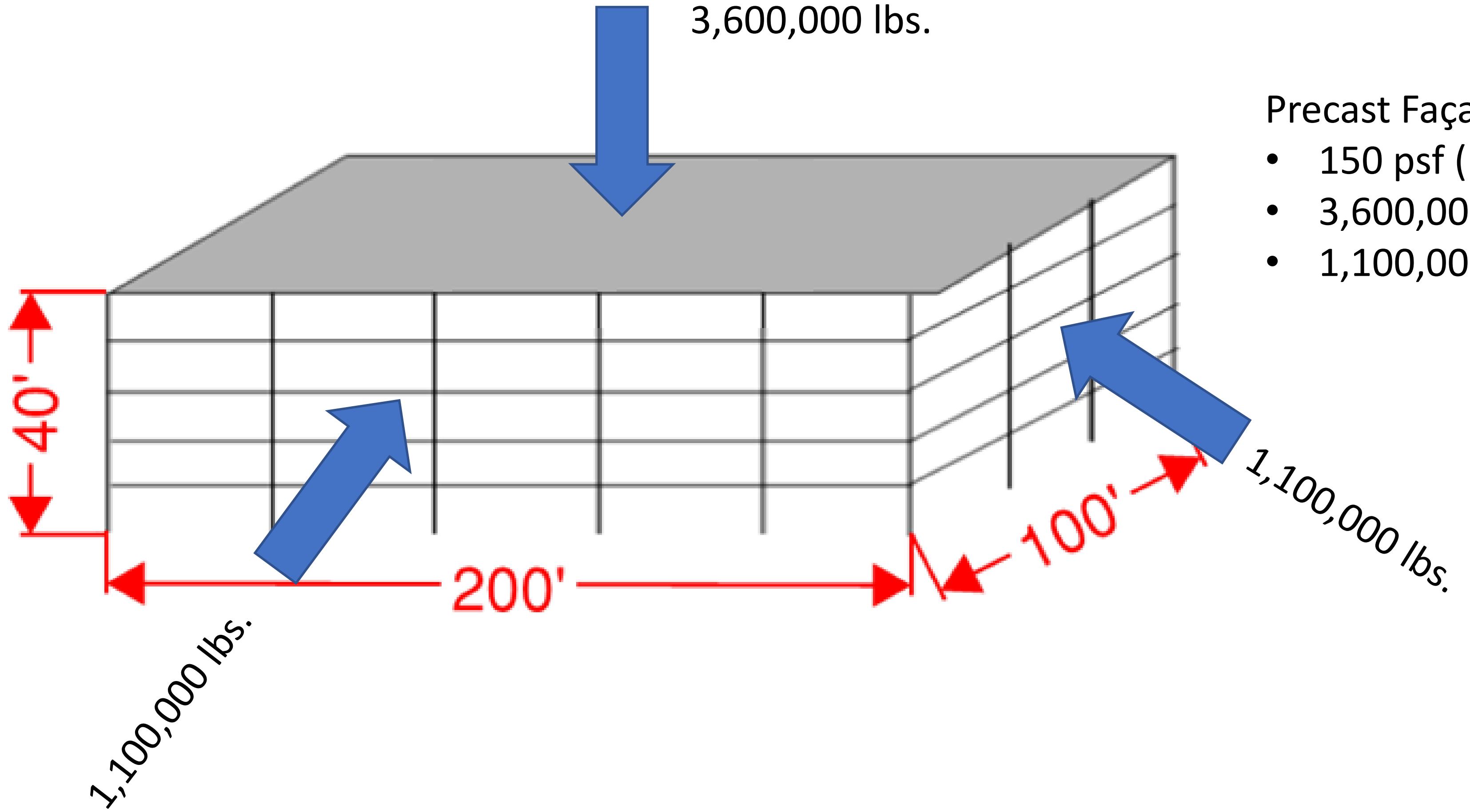
- Non-Conductive (thermally, electrically)
- Corrosion Resistant
- Lighter weight (30% lighter)
- Impact Resistant

Aluminum



Pultrusion v. Aluminum

Building Weight



Precast Façade:

- 150 psf (12" thick)
- 3,600,000 lbs. gravity load
- 1,100,000 lbs. seismic load

Building Weight: Precast Facade

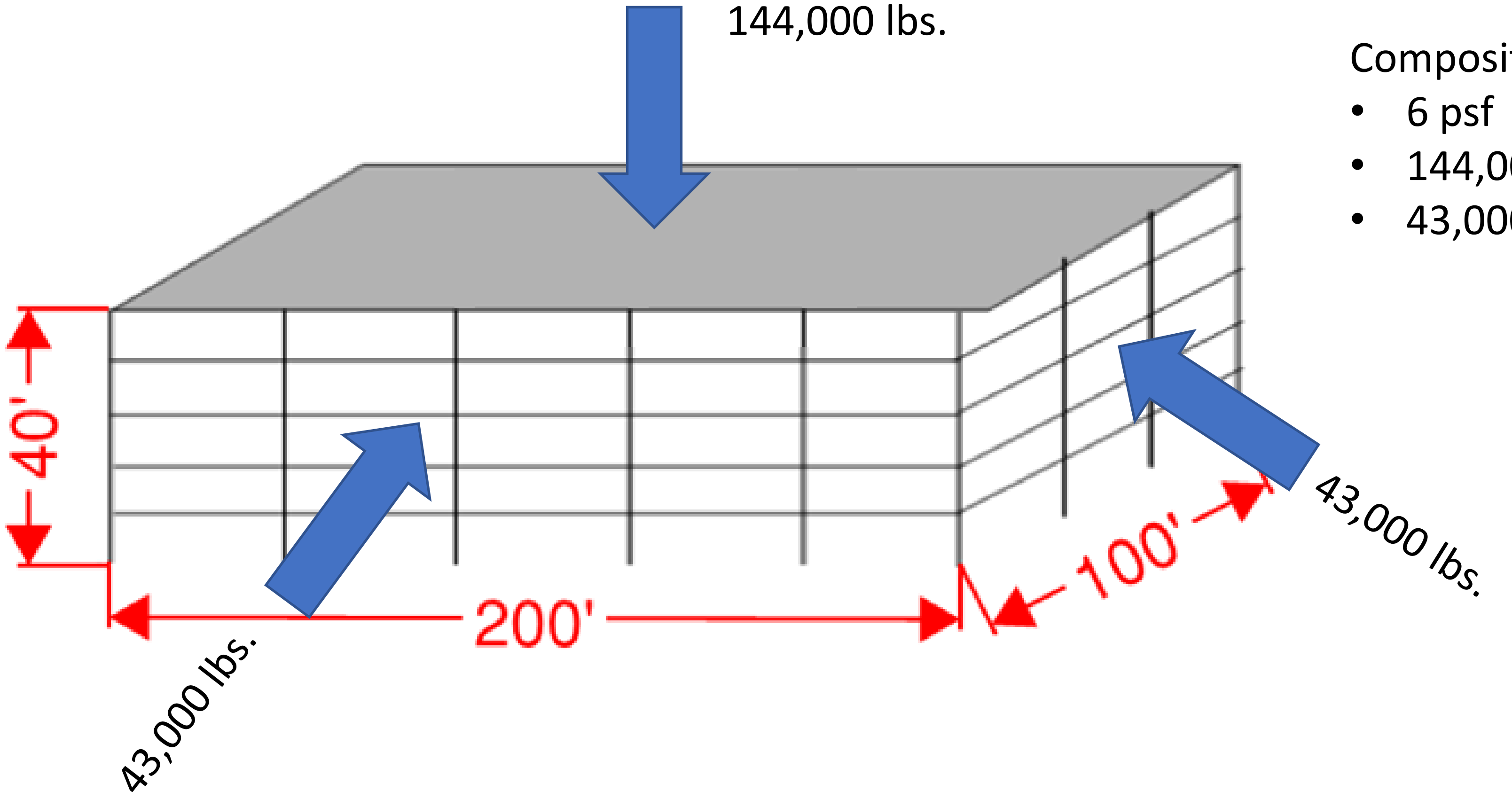
95% lighter

Foundations,

Gravity

Support Frame,

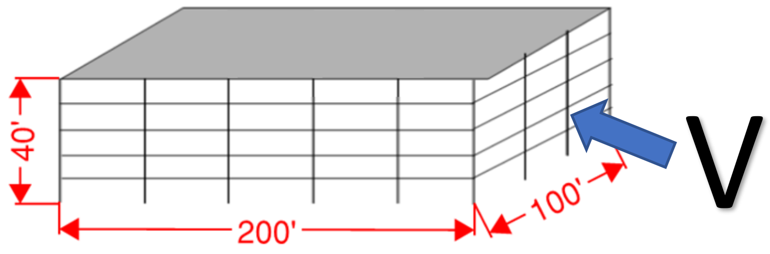
Braced Frames



Composites Façade:

- 6 psf
- 144,000 lbs. gravity load
- 43,000 lbs. seismic load

Building Weight: Composite Facade



$$V = C_s W$$

W: Building Weight

$$C_s = \frac{S_{DS}}{\left(\frac{R}{I_e}\right)}$$

S_{DS}: Proximity to fault, seismicity, soil conditions

I_e: Importance Factor

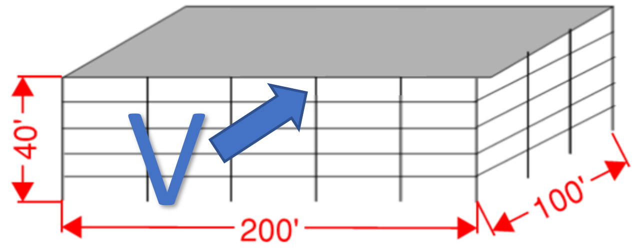
Building Weight: Seismic

System	Response Modification Coefficient
Concrete Shear Wall	6.0
Steel Braced Frame	8.0
Steel Moment Frame	8.0
Masonry Shear Wall	5.5
Wood Shear Wall	6.5

$$V = \frac{S_{DS}}{R} W$$

W ← Building Weight

R ← Response Modification Coefficient



Bigger R = Lower Seismic Force

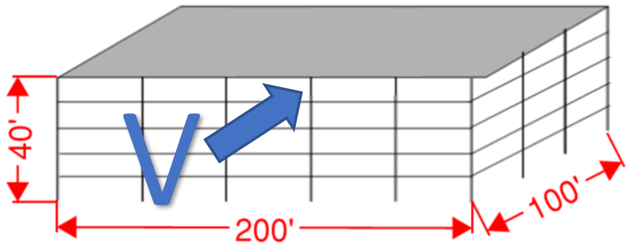
Building Weight: Seismic

System	Response Modification Coefficient
Concrete Shear Wall	6.0
Steel Braced Frame	8.0
Steel Moment Frame	8.0
Masonry Shear Wall	5.5
Wood Shear Wall	6.5
Generic FRP	1.0
Multi-Tier Braced Frame	1.5
Enhanced Connection Strength Braced Frame	2.0

$$V = \frac{S_{DS}}{R} W$$

W ← Building Weight

R ← Response Modification Coefficient



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Building Weight: Seismic

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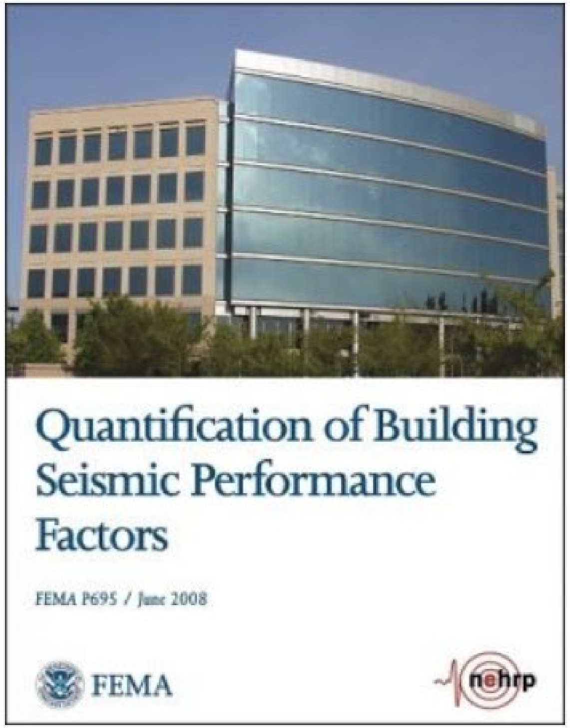
$$V = \frac{S_{DS}}{R} W$$

W ← Building Weight

R ← Response Modification Coefficient

Reduction of Weight Offset by Reduction in R-Value

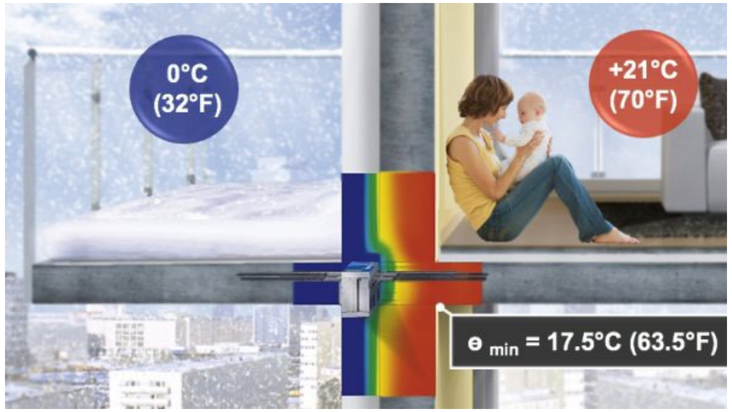


Building Weight: Seismic

Back-Up Structure

Exterior Elevated Elements (EEE)

Balconies: Durability



ASHRAE

BSR/ASHRAE/IES Addendum av
to ANSI/ASHRAE/IES Standard 90.1-2016

Public Review Draft

Proposed Addendum av to Standard 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings

First Public Review (August 2018)
(Draft Shows Proposed Changes to Current Standard)

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research--technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at www.ashrae.org/bookstore or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

This standard is under continuous maintenance. To propose a change to the current standard, use the change submittal form available on the ASHRAE website, www.ashrae.org.

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ASHRAE, 1791 Tullie Circle, NE, Atlanta GA 30329-2305

Balconies: Thermal Break

Balconies: Modular/ Prefabricated

Photo Credit: https://endurable.com/decks-balconies

Durable

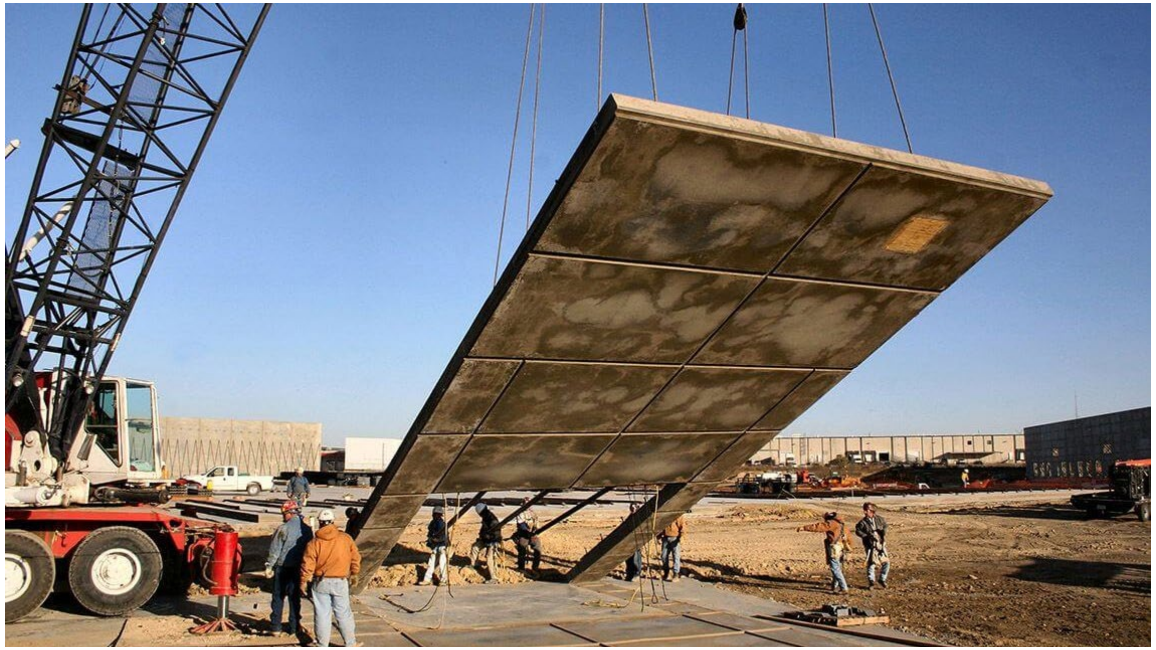
Lightweight

Enhanced Energy Performance

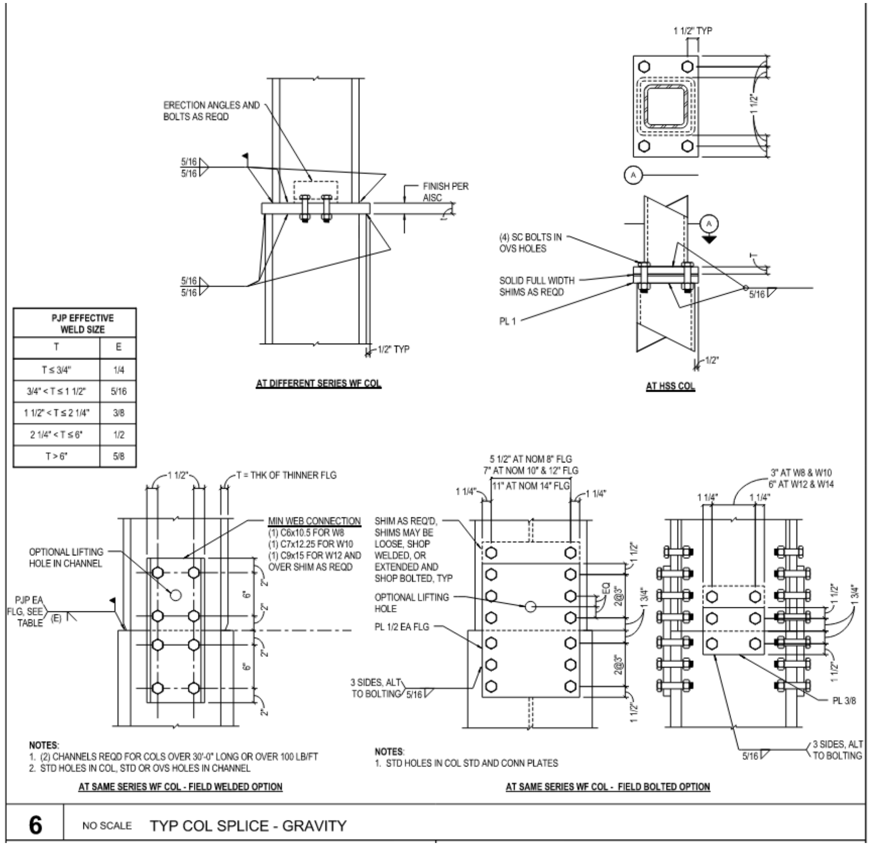
Prefabricated

Balconies: Composite

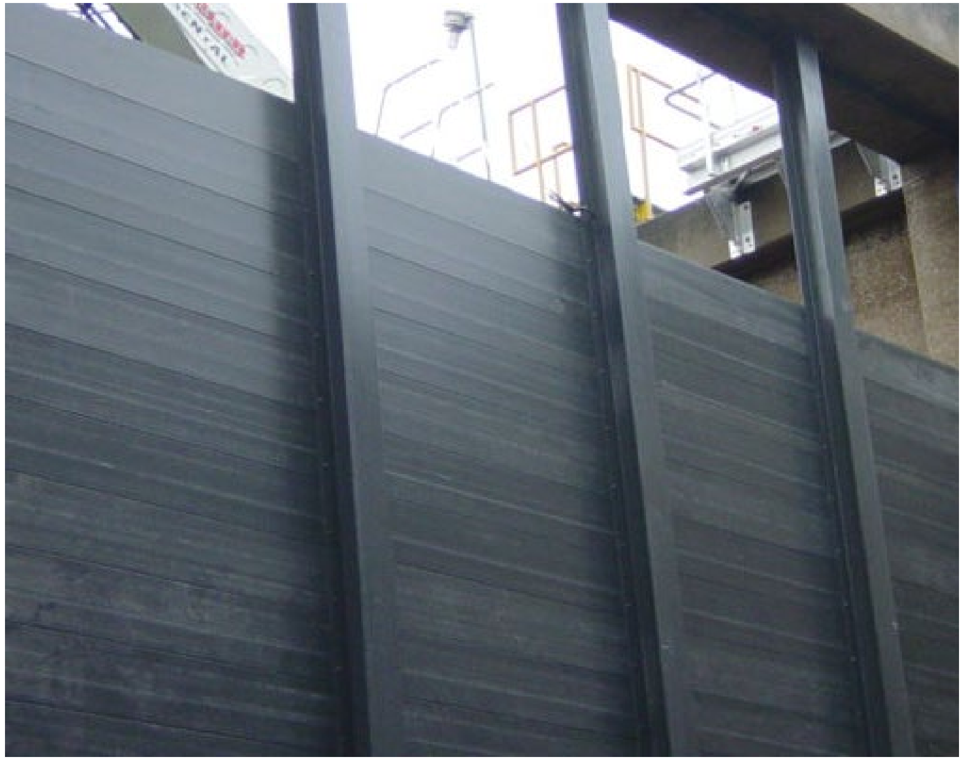
Photo Credit: https://endurable.com/decks-balconies



Long Spans: Precast v. Tilt-Up



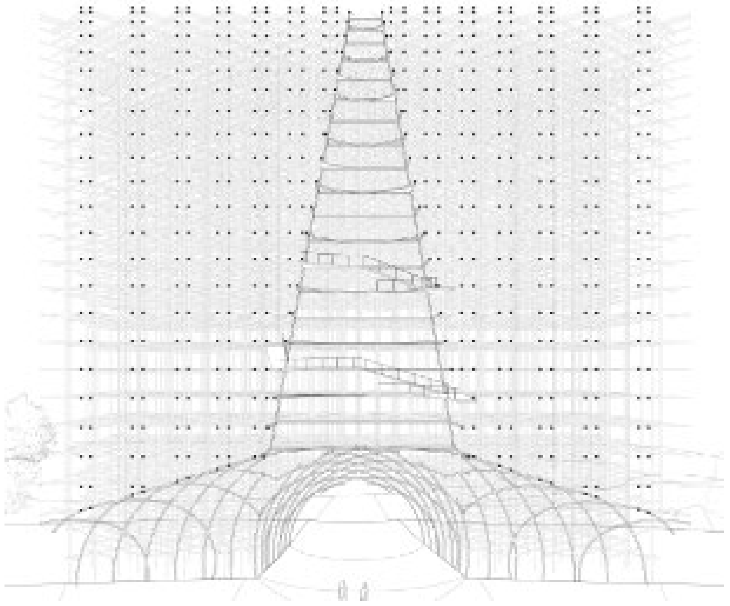
Long Spans: Steel Splices



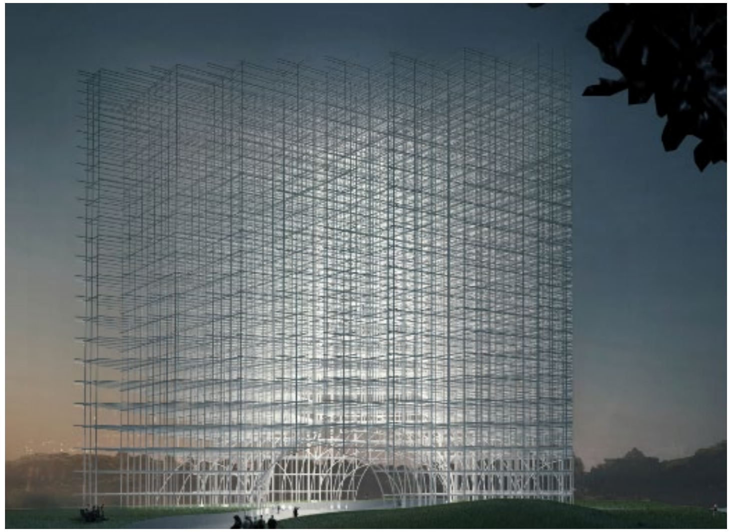
https://www.libertypultrusions.com/pultrusion-products/

https://www.caddetails.com/

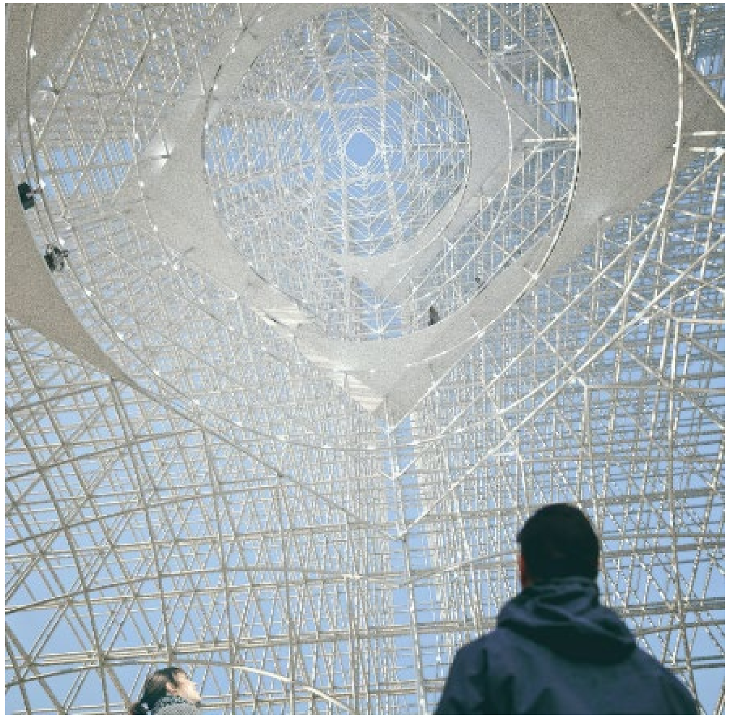
Long Spans: Composite Pultrusion



Why is it all steel pipes? Can we use alternative materials?



Is the node this simple and brutal? It looks nothing more than scaffoldings.



Special Structures: Composite Pultrusion

- Lighter Structure = Fuel savings at every stage of transport.
- No galvanizing = Low CO2 emissions.
- Less heat than metal manufacturing

SE2050
COMMITTING TO ZERO

- End of Useful Life = Recycle

Sustainability: Composite Pultrusion

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Questions?

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eguglielmo@martinmartin.com

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