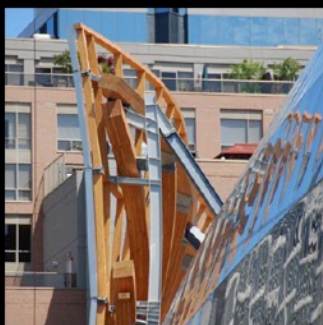
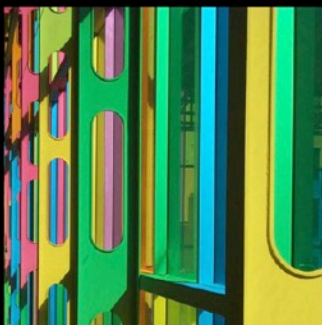




Modern Steel Construction

Arch 173: Building Construction 2
Winter 2023

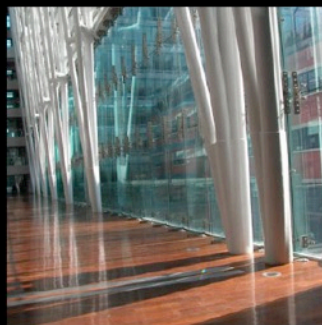
Terri Meyer Boake



Canadian Institute of
Steel Construction
Guide for Specifying
Architecturally Exposed
Structural Steel



by Terri Meyer Boake



cisc  icca

BIRKHAUSER

Understanding Steel Design

AN ARCHITECTURAL
DESIGN MANUAL

by Terri Meyer Boake
with Drawings by Vincent Hui

BIRKHAUSER

DIAGRID STRUCTURES

SYSTEMS
CONNECTIONS
DETAILS

TERRI MEYER BOAKE

BIRKHAUSER

TERRI MEYER BOAKE

ARCHITECTURALLY EXPOSED STRUCTURAL STEEL

SPECIFICATIONS, CONNECTIONS, DETAILS

BIRKHAUSER

TERRI MEYER BOAKE

COMPLEX STEEL STRUCTURES

NON-ORTHOGONAL
GEOMETRIES IN
BUILDING WITH STEEL

Types of steel:

- Regular carbon
- High strength
- Weathering steel (aka Corten)
- Stainless steel













BRITISH
COLUMBIA

The Best Place on Earth





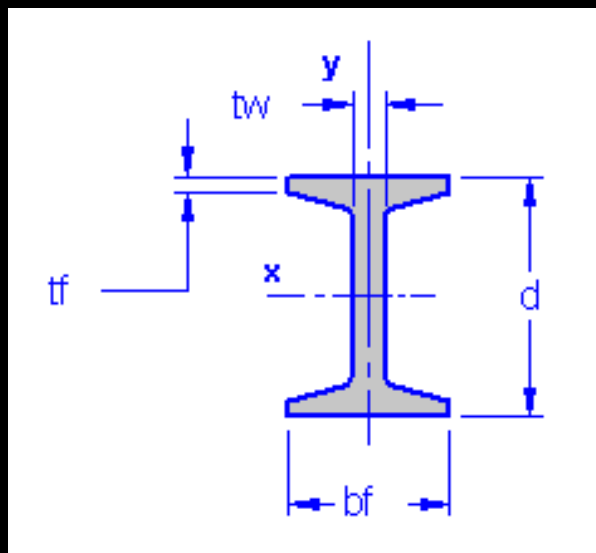
Galvanizing is NOT a type of steel. It is a dipping process in hot zinc for corrosion protection



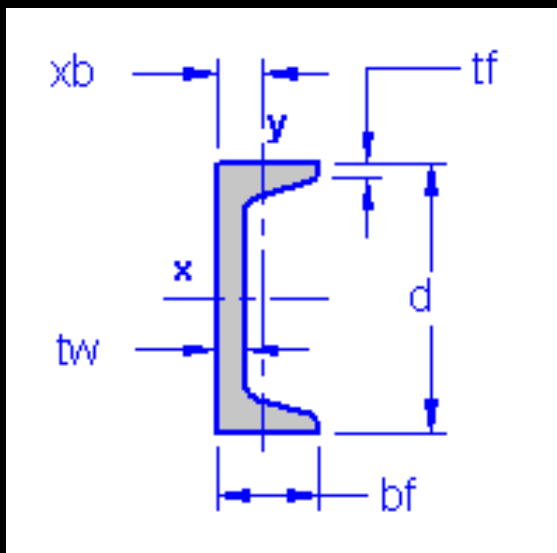
Structural Steel Shapes

Shapes are either hot rolled
or

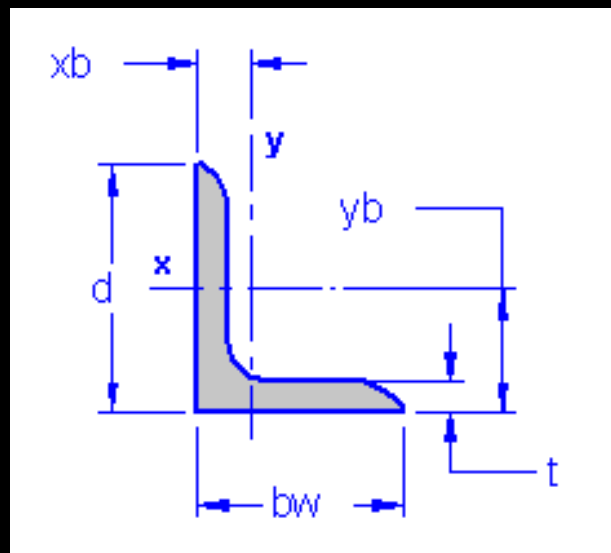
Formed from plate material and
bent, formed into shapes



Wide Flange

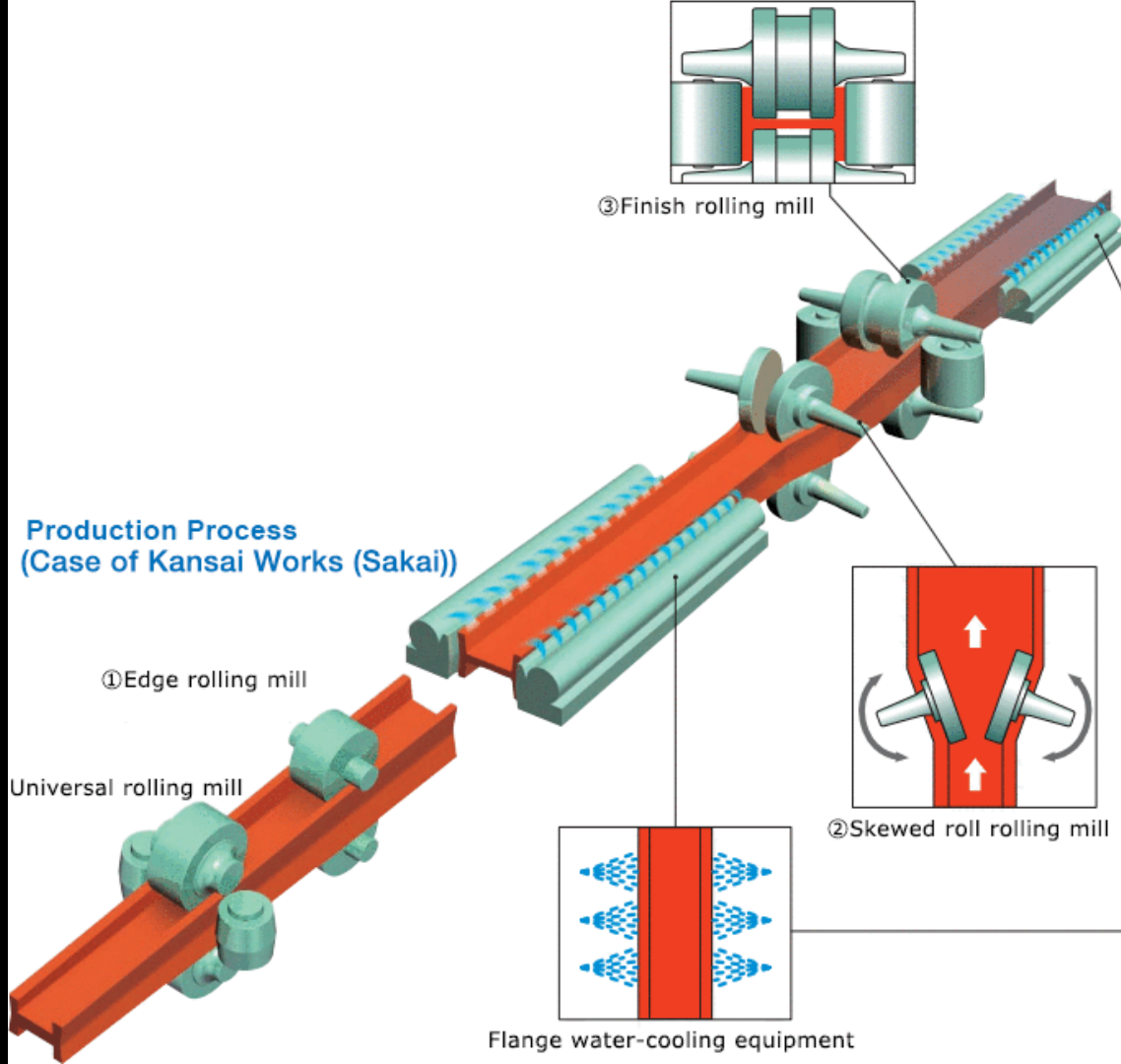


Channel



Angle

**Production Process
(Case of Kansai Works (Sakai))**







Q235 Q235 Q235
1-7977 1-7977 1-7977

Q235
Q235

Q235 Q235
1-7983 1-7983

Q235 Q235 Q235
1-7983 1-7983 1-7983

ZIBO-SINO

2004 9 25





10x6
33
HW0216

10x6
33
HW0216

10x6x500
33
HW0216

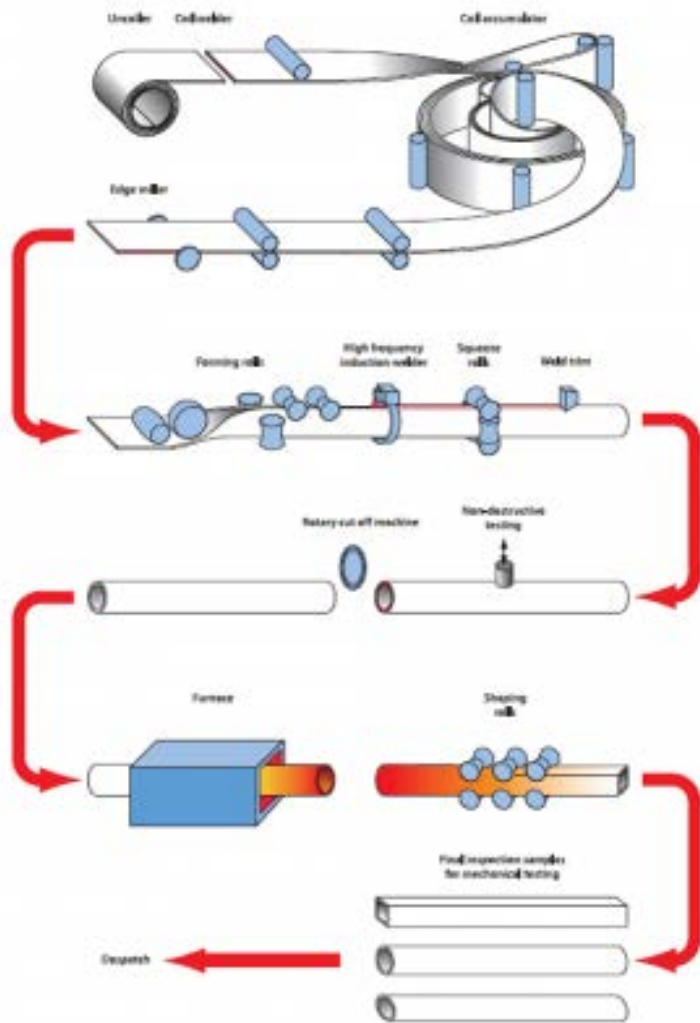
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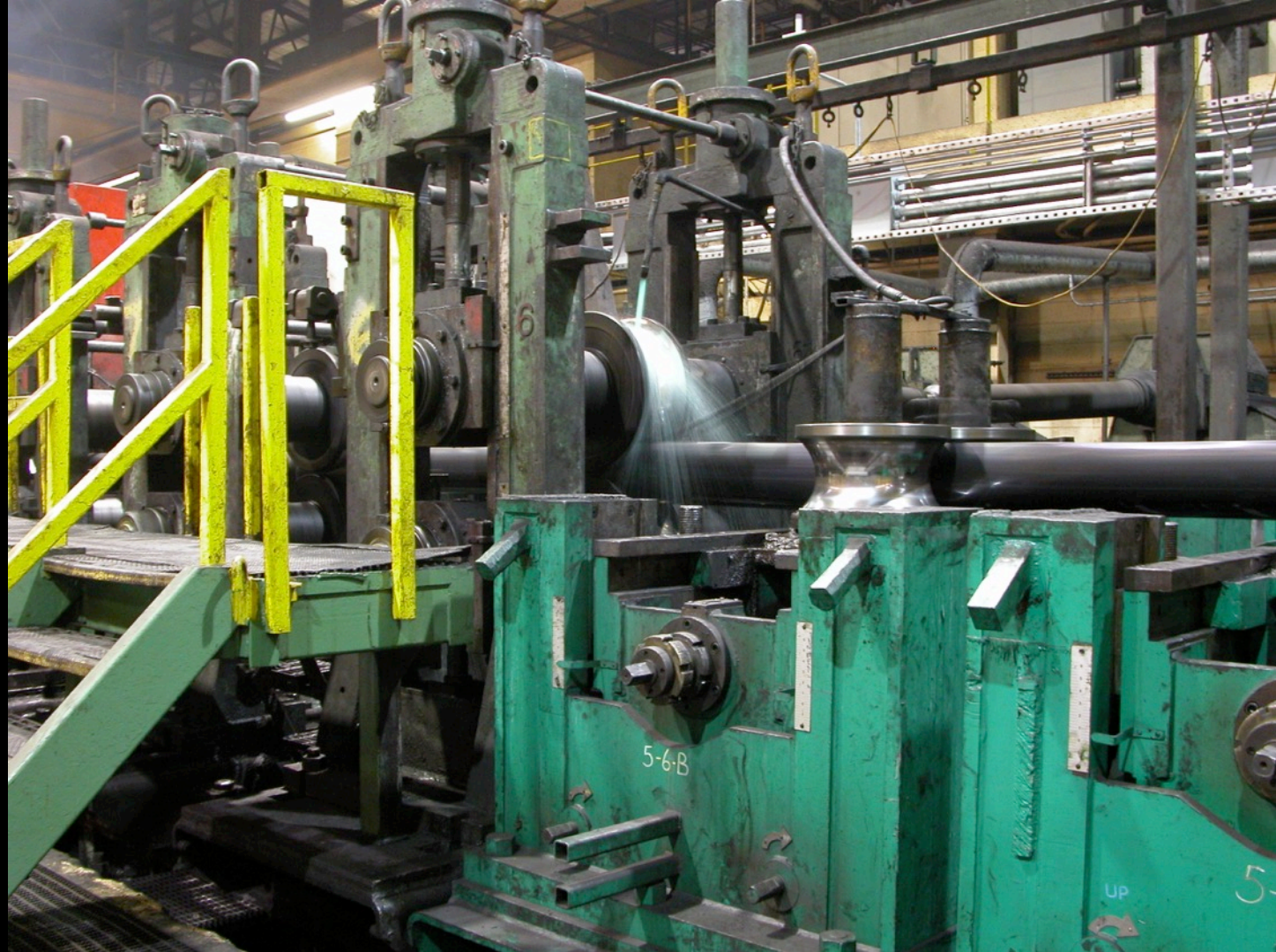
10x6x500
33

10x6
33
HW0216



Hollow Structural Sections
AKA HSS











STKR400 SIZE: 300x200x120x1110 HEAT NO. 2050125
STKR400 SIZE: 300x200x120x1110 HEAT NO. 2050125
STKR400 SIZE: 300x200x120x1110 HEAT NO. 2050125

STKR400 SIZE: 300x200x120x1110 HEAT NO. 2050125
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STKR400 SIZE: 300x200x120x1110 HEAT NO. 2050125
STKR400 SIZE: 300x200x120x1110 HEAT NO. 2050125
STKR400 SIZE: 300x200x120x1110 HEAT NO. 2050125

SHANDONG METAL CO., LTD
PO BOX: 1000000000
SPC: STKR400
HEAT NO. 2050125

2005 1 12







Because the HSS is bent formed into shape the corners are rounded.

How rounded depends on the thickness of the steel plate.

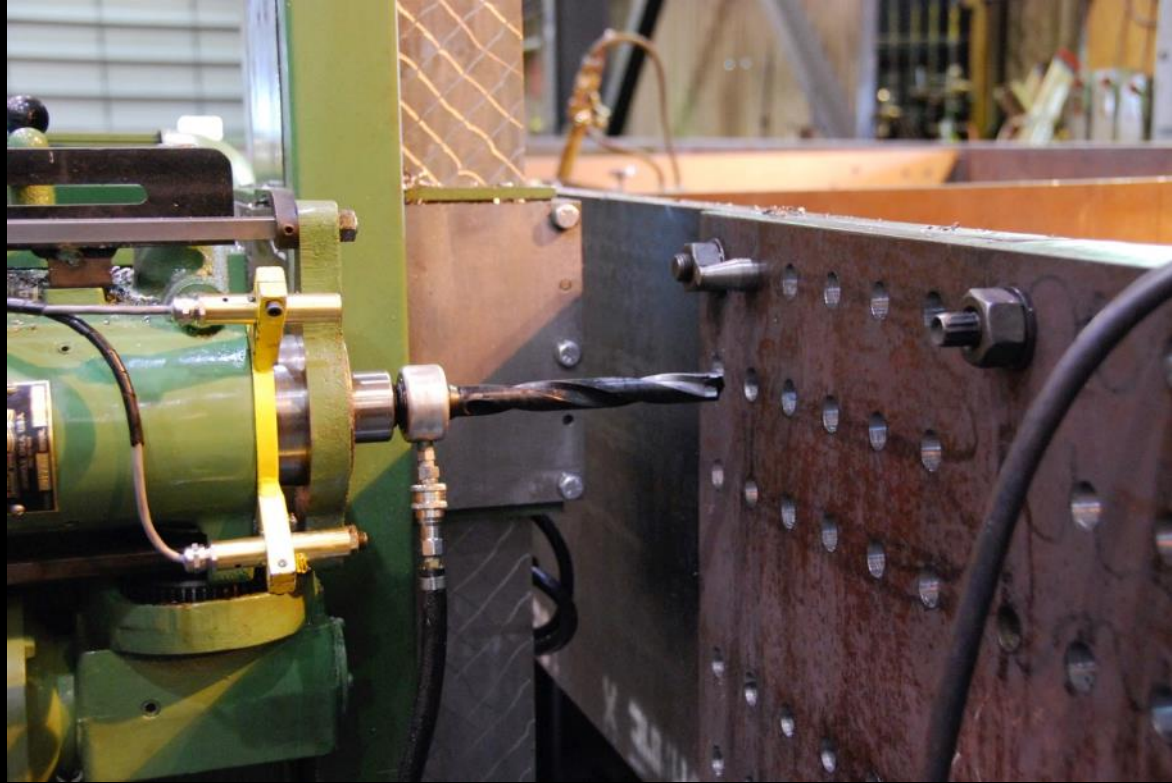
HSS come:

Square, rectangular, circular and in Europe, elliptical



Fabrication Processes



















Principles of Connection

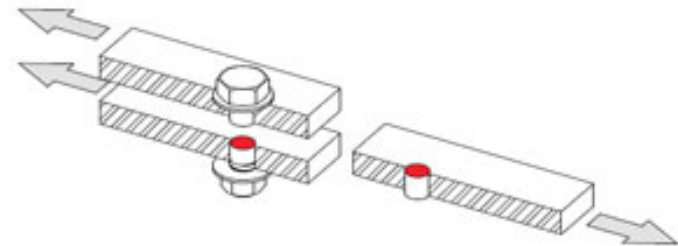
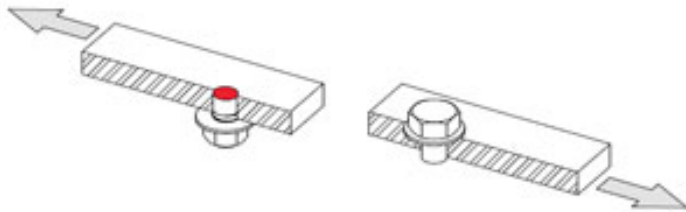
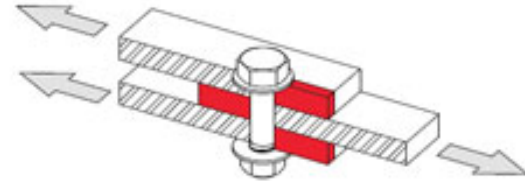
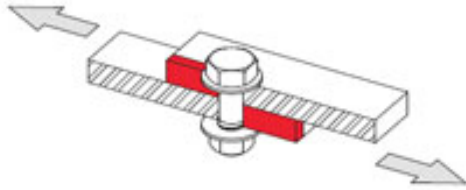
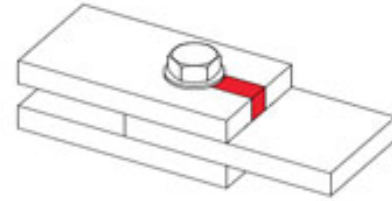
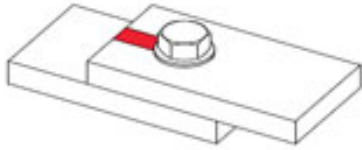


Hex Head Bolt

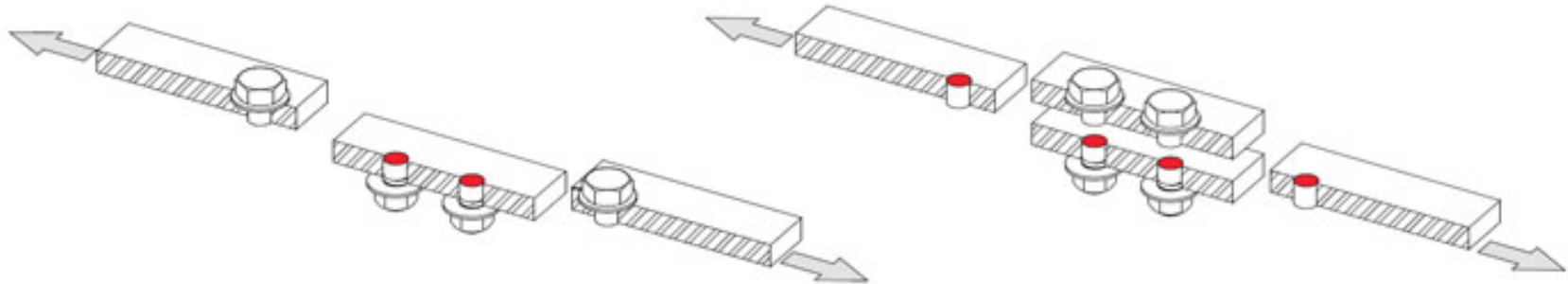
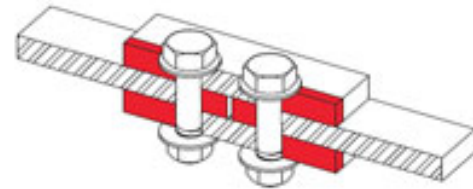
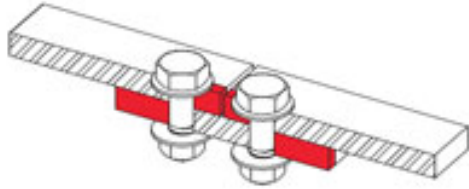
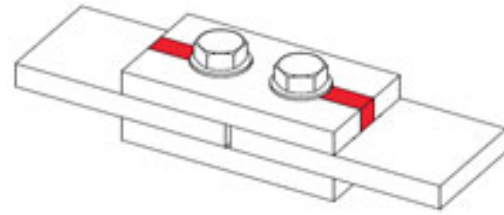
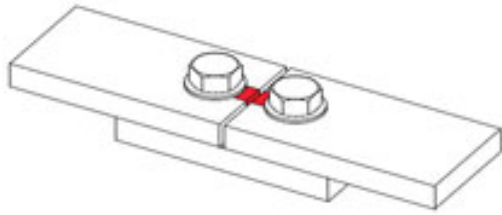


TC (Tension Control) Bolt

Lap Joints



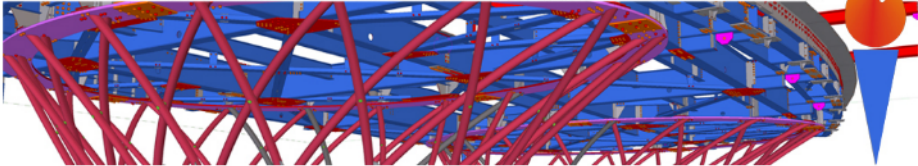
Butt Joints

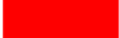


IMPORTANT RESOURCES!

Fun is in the Details: Innovation in Steel Connections

[CISC](#) [Home](#) [Basic Connections](#) [Steel Framing](#) [AESS](#) [Innovative Connections](#) [Historic Projects](#) [Contemporary Projects](#) [Finishes](#)





Fun is in the Details: Innovation in Steel Connections

A Curriculum Materials Project

Welcome to "Fun is in the Details: Innovation in Steel Connections"! This curriculum materials project has been funded by the **Steel Structures Education Foundation** the former educational arm of the **Canadian Institute of Steel Construction** ([CISC](#)).

The web site is structured into *SEVEN primary sections on CONNECTION DESIGN* that will take you through the understanding and development of steel connections. Navigation is accessible at the top of each page, with subheadings for each section available in the left sidebar or through the pull down menu at the top.

Basic Connections	Steel Framing	AESS	Innovative Connections	Historic Projects	Contemporary Projects	Finishes
						

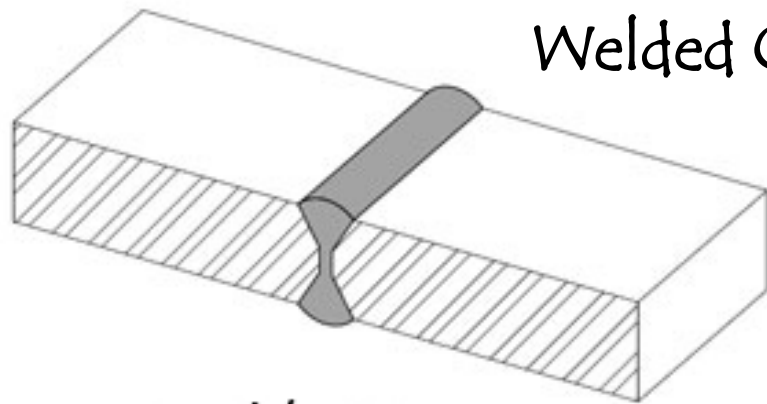
This web based project is designed to increasing the understanding of connection design in steel structures to better assist students of architecture and engineering in creating more convincing and compelling structures. The project looks at how to take basic methods of creating connections and transform them into innovative connections, using similar principles. Although Standard Structural Steel connections will be included, the emphasis will be on an exploration of Architecturally Exposed Structural Steel (AESS). The project will reference the new CISC AESS documents, in particular the " [Category Matrix](#) " and " [CISC Guide for Specifying Architecturally Exposed Structural Steel](#) ".

Please check out my [Facebook page for AESS](#) . Many more projects there!

Terri Meyer Boake - University of Waterloo | Vincent Hui - Ryerson University | © Copyright 2020 Canadian Institute of Steel Construction

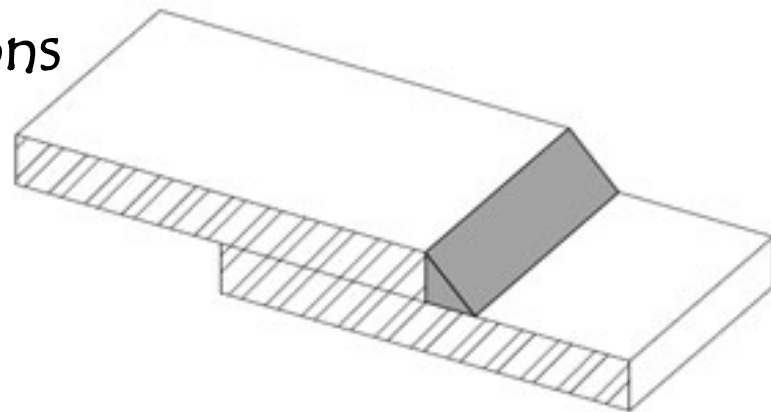
<http://tboake.com/SSEF1/basic.shtml>

Welded Connections



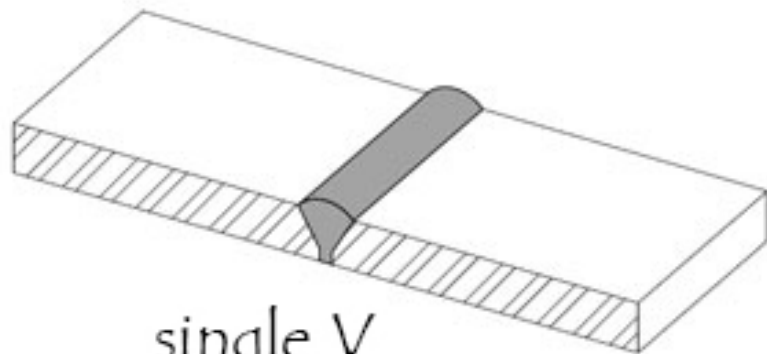
double V

BUTT



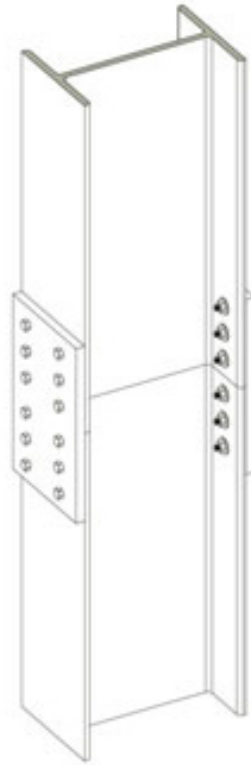
fillet weld

LAPPED



single V

Column Splices





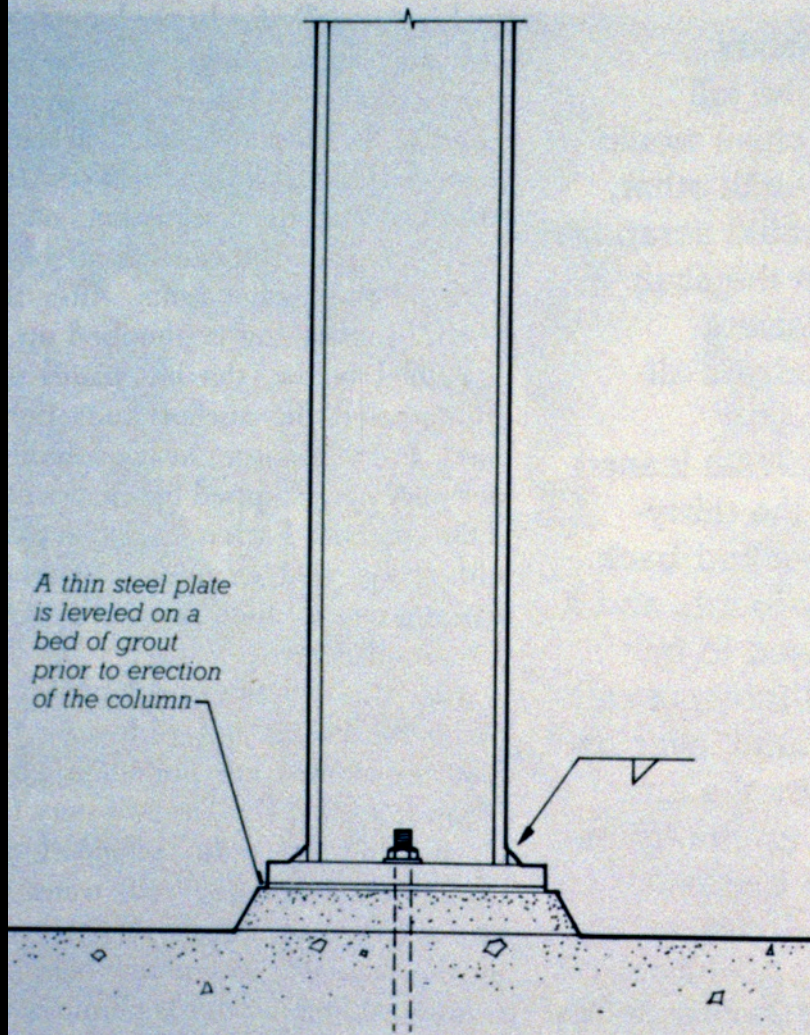




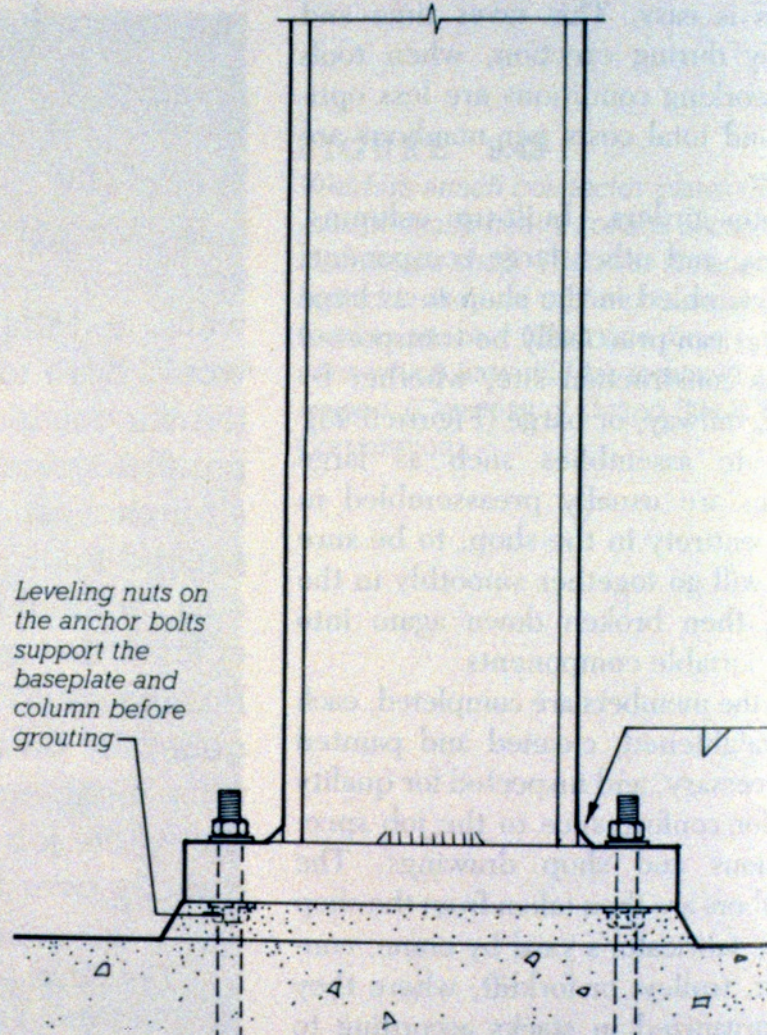




A thin steel plate is leveled on a bed of grout prior to erection of the column



Leveling nuts on the anchor bolts support the baseplate and column before grouting

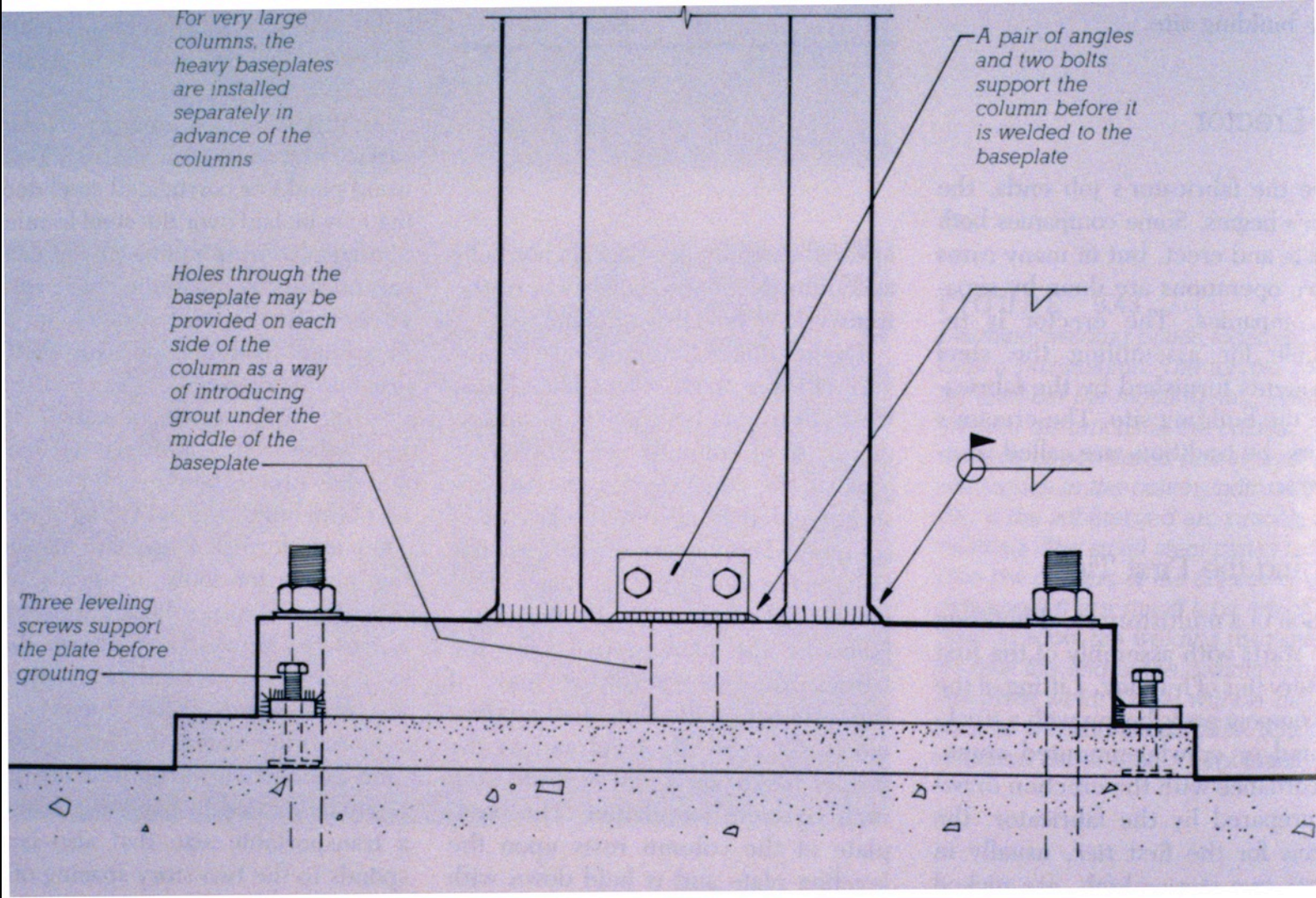


For very large columns, the heavy baseplates are installed separately in advance of the columns

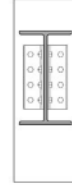
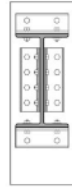
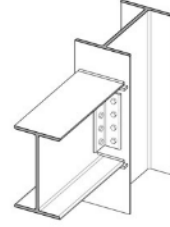
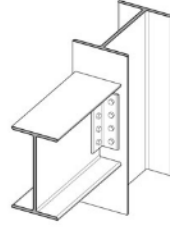
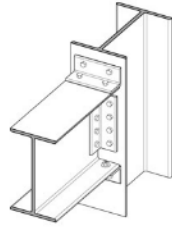
A pair of angles and two bolts support the column before it is welded to the baseplate

Holes through the baseplate may be provided on each side of the column as a way of introducing grout under the middle of the baseplate

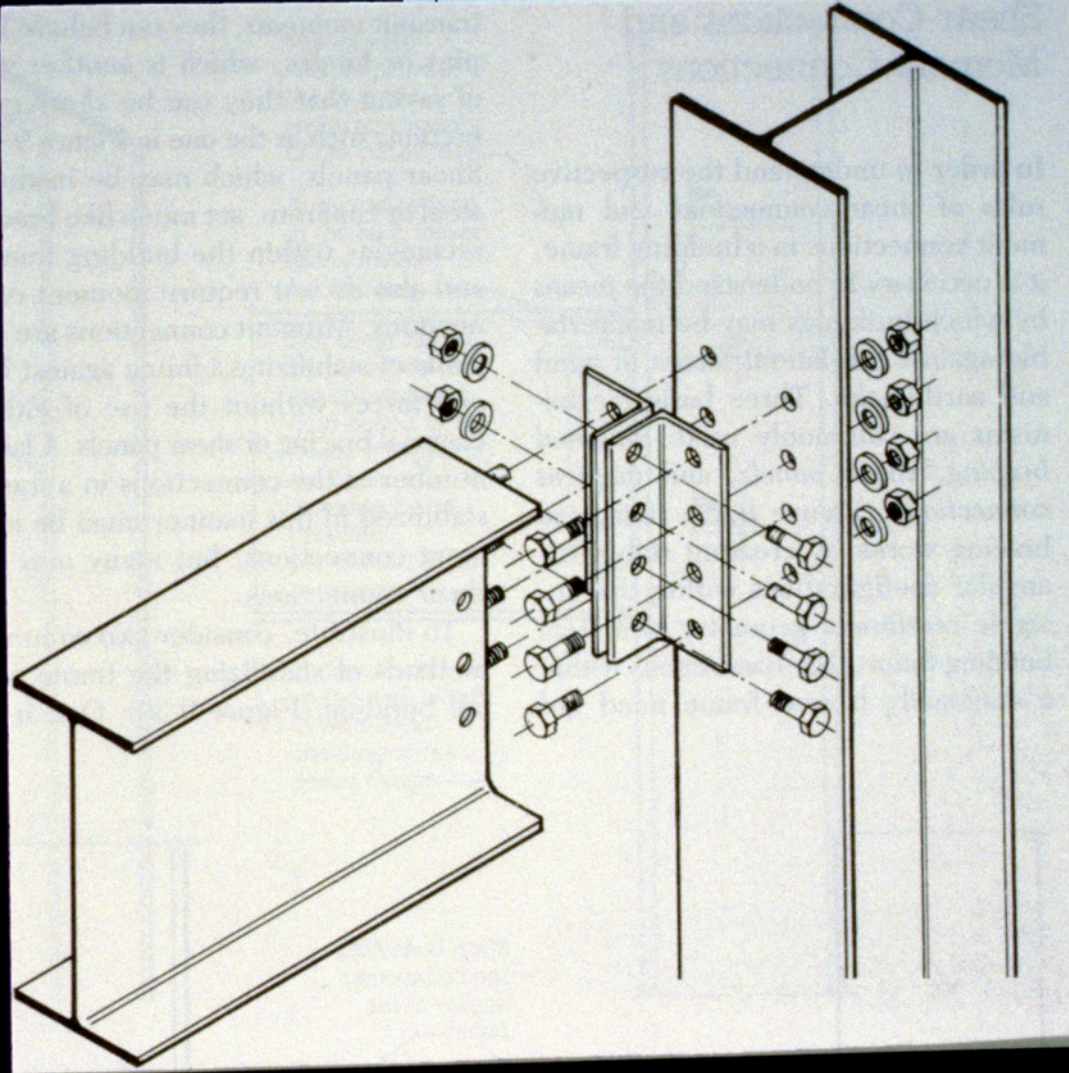
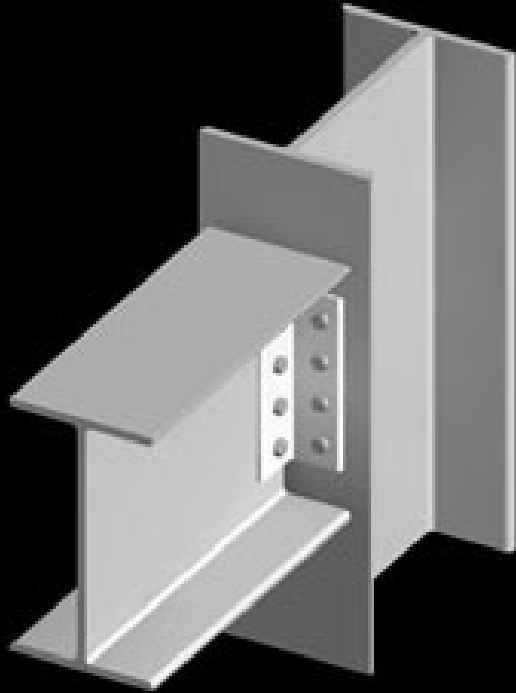
Three leveling screws support the plate before grouting



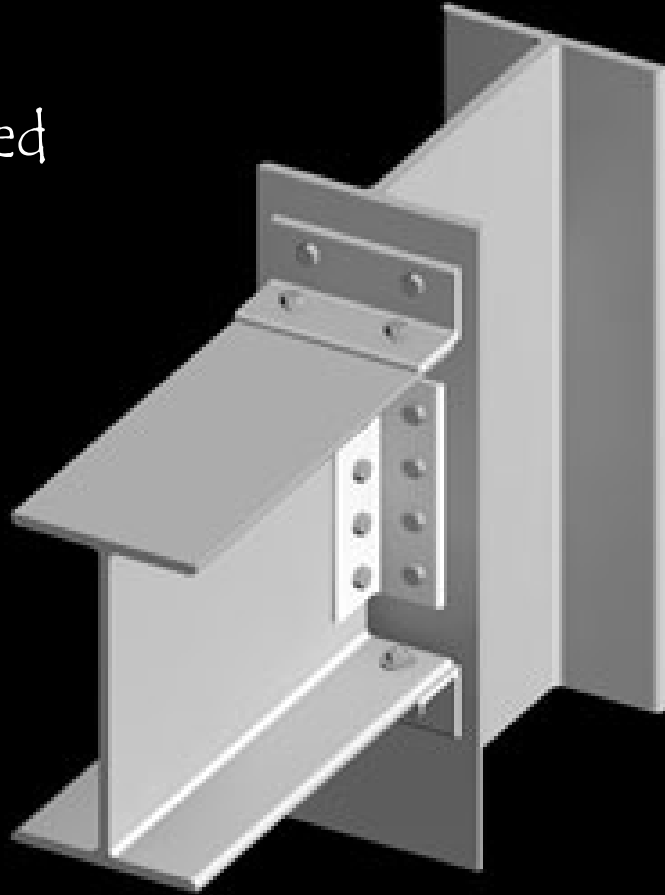
Beam to Column Connections

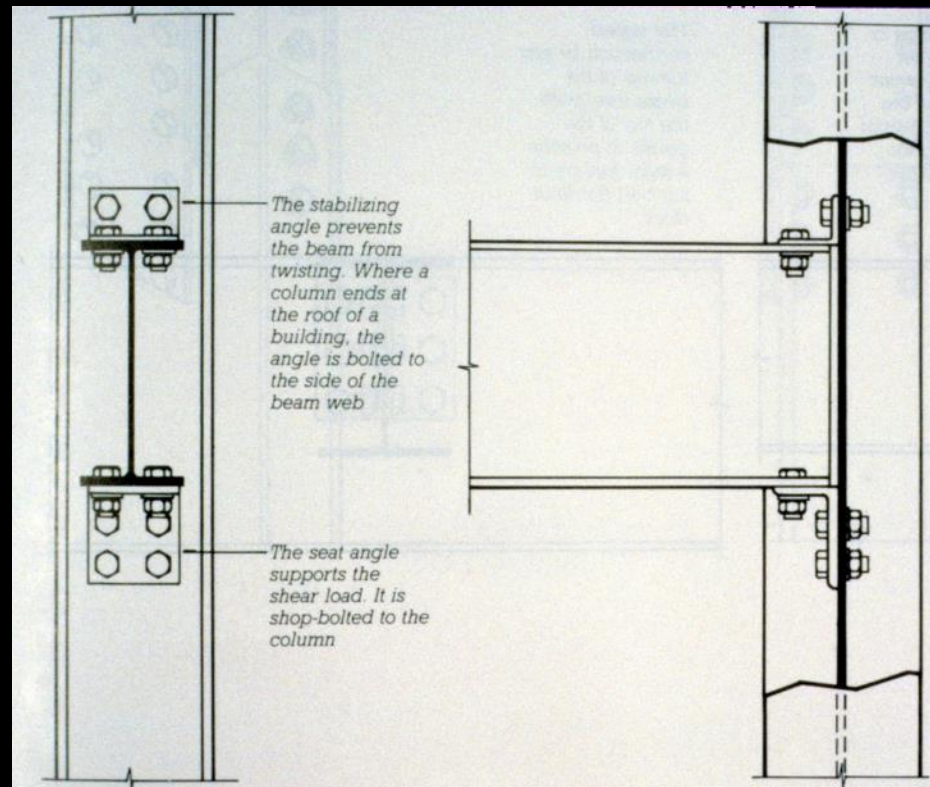
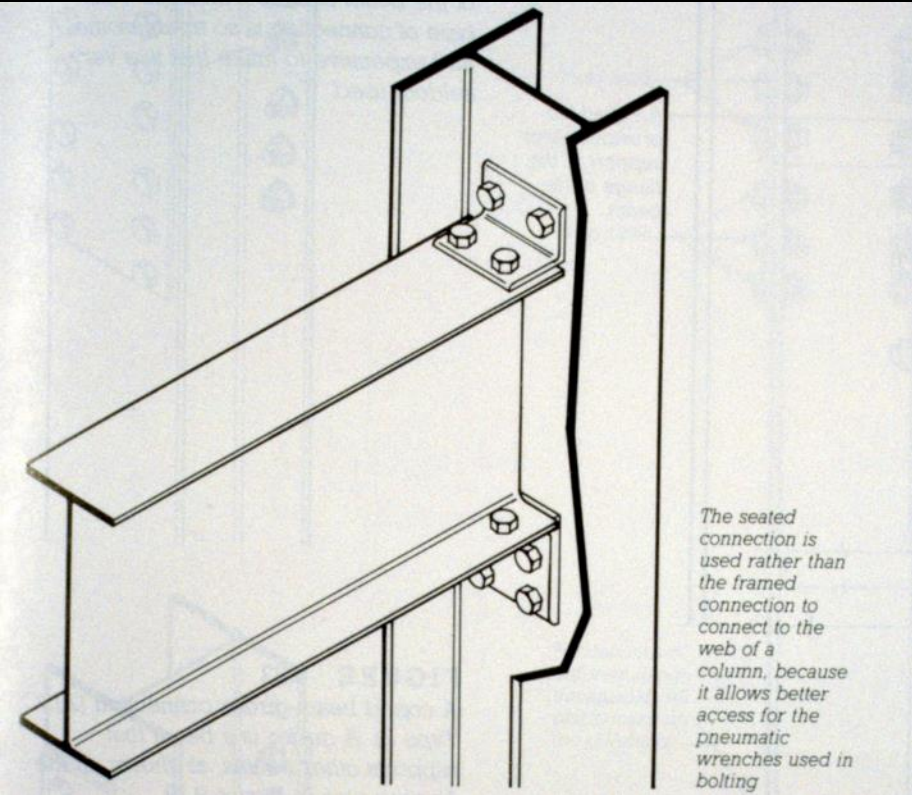


Framed

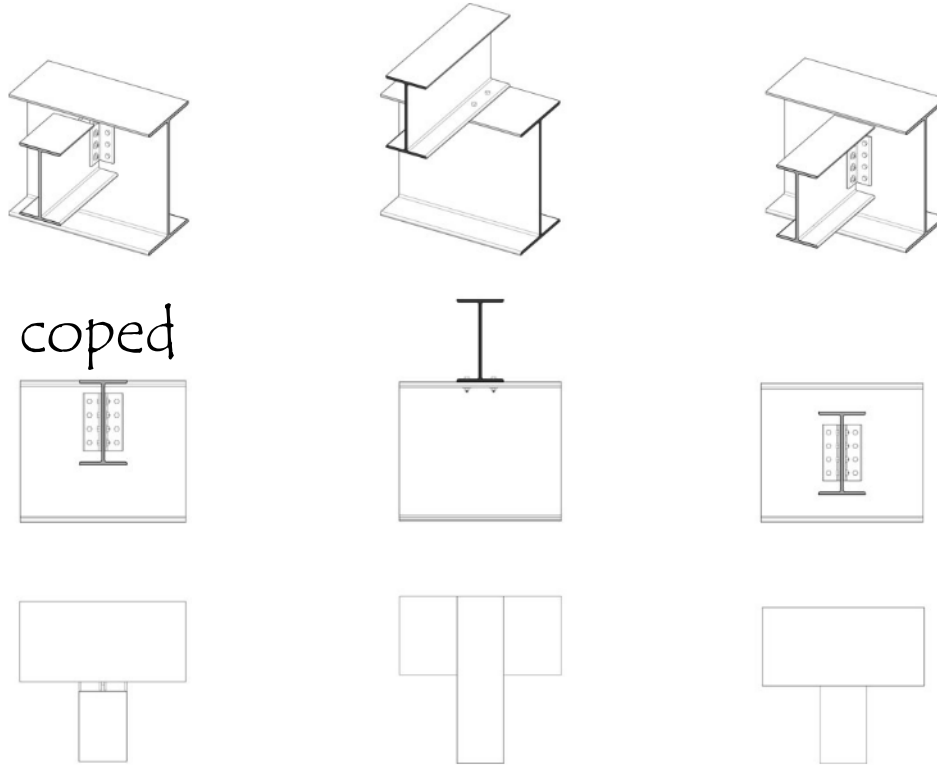


Seated

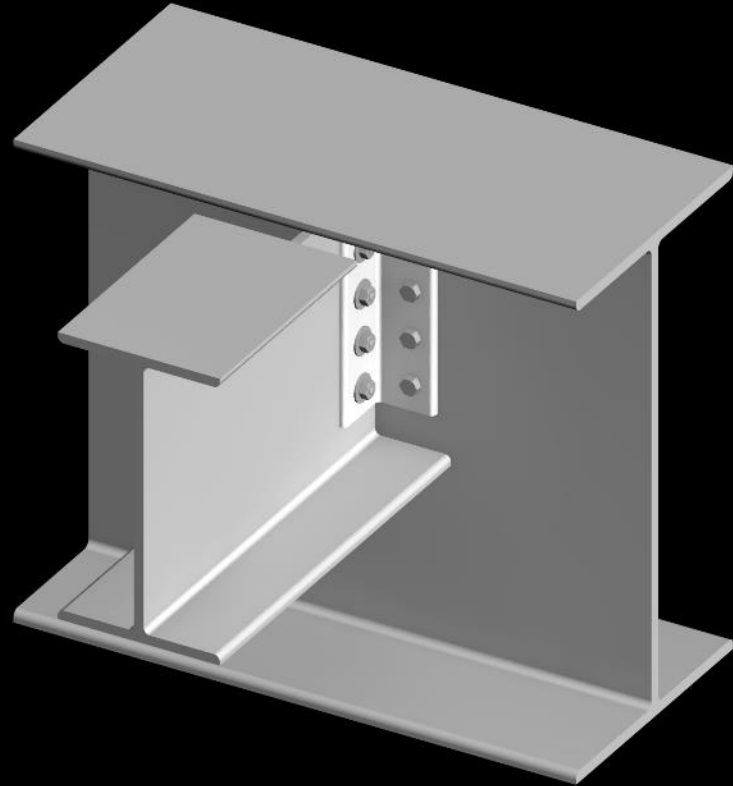




Beam to Girder Connections



In a coped connection the top flange of the beam is cut away so that the top of the beam and top of the girder will align.

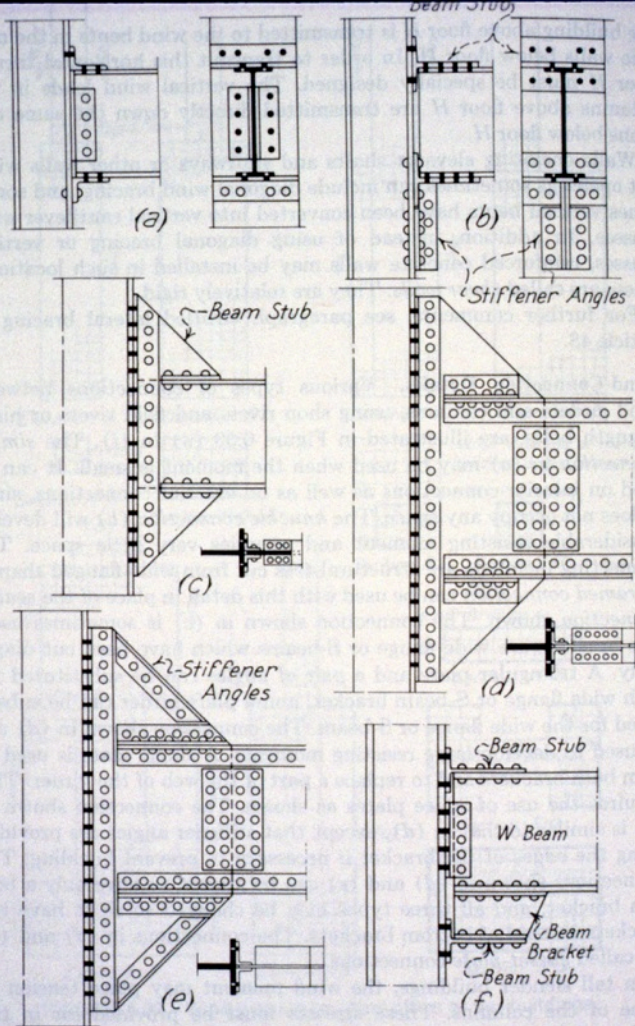


Framed
connection
has the beam
flange below.



Regular
connection
has the beam
sitting on top
of the girder





For taller buildings greater resistance to horizontal wind loads requires moment resisting connections.

FIGURE 6.30 Types of wind connections.

Connection types:

HINGE

- Transfers vertical and horizontal loads
- Not intended to resist some rotation

PIN

- Transfers vertical and horizontal loads
- Free to rotate

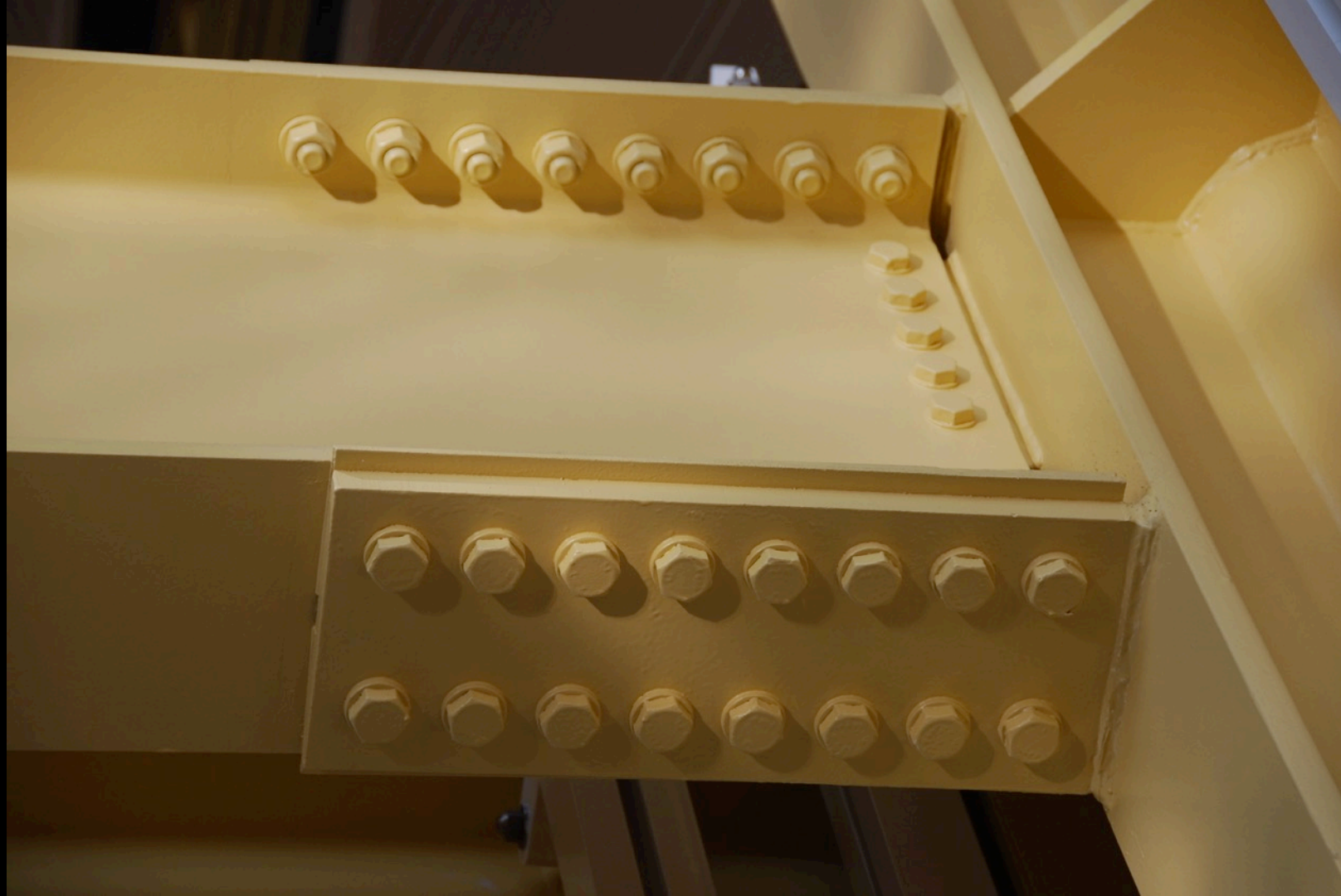
MOMENT

- Resists bending and rotation















Canadian War Museum
Ottawa, ON















SPAN

How do we span to make floor and roof systems?

- beams, girders
- Joists
- Planar trusses
- Box trusses
- Innovative suspension systems

ESTABLISH HIERARCHY

– LOAD PATH – top down:

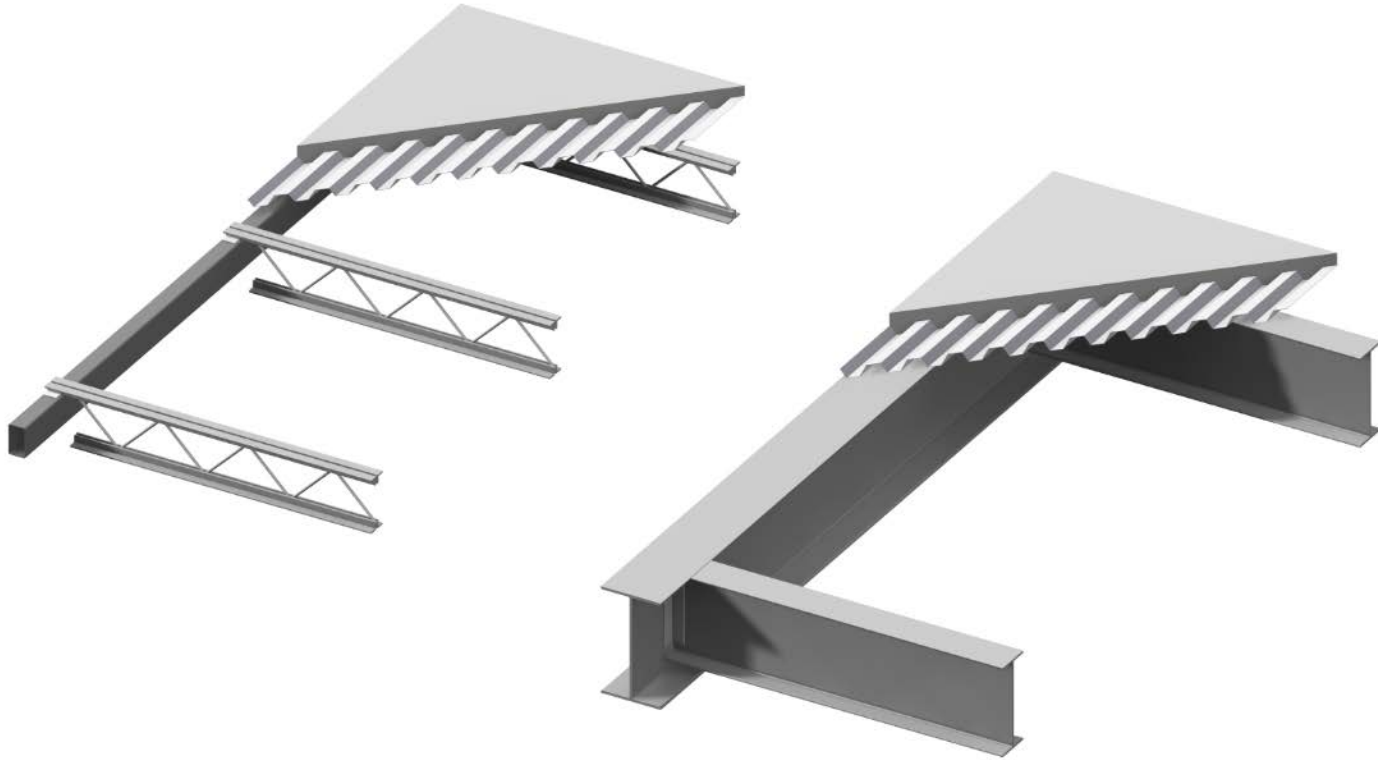
Decking sits on

Joists or Beams

Sit on Girders

Girders frame into columns

Floor Systems





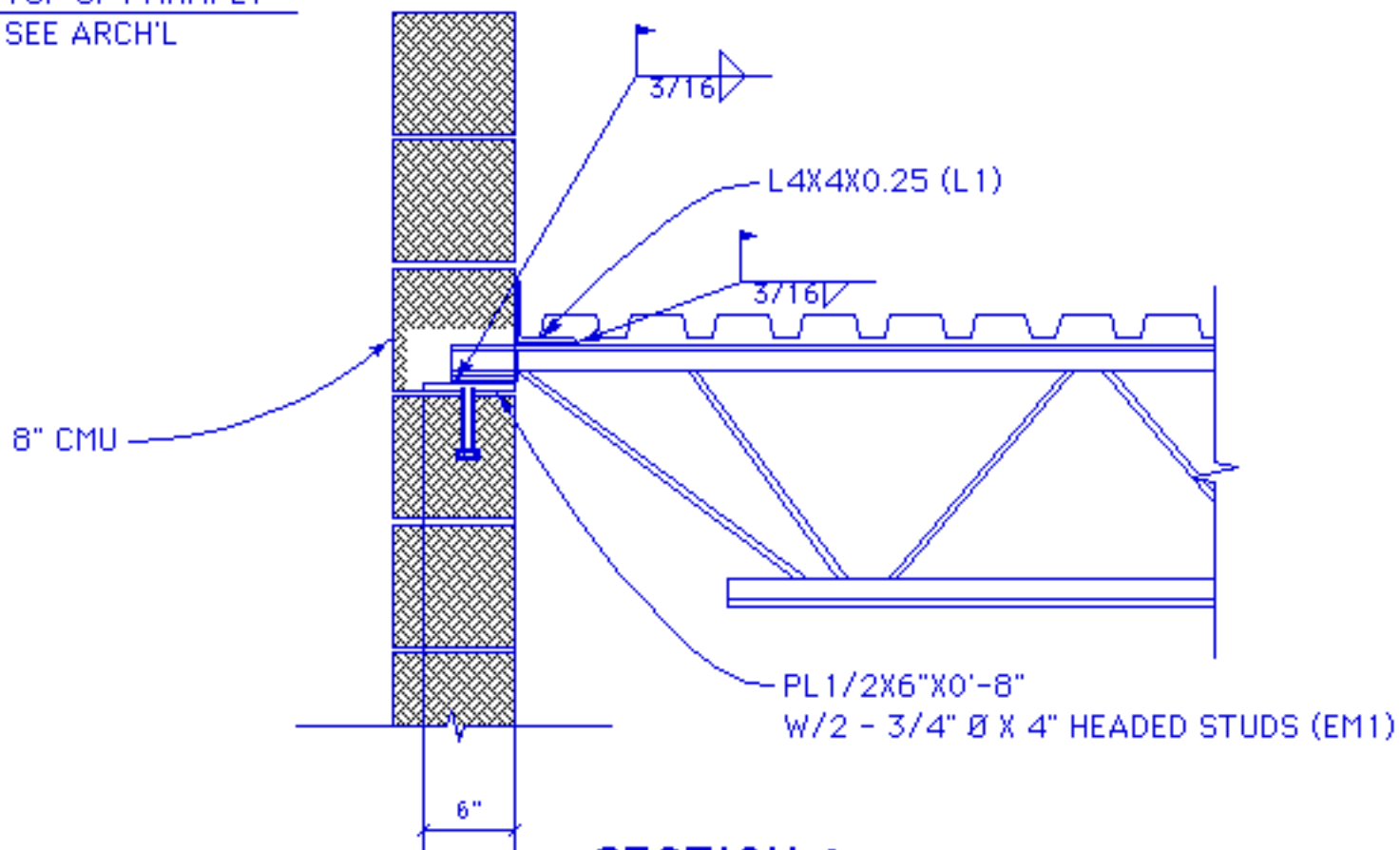


Open web steel joists





TOP OF PARAPET
SEE ARCH'L



SECTION 1











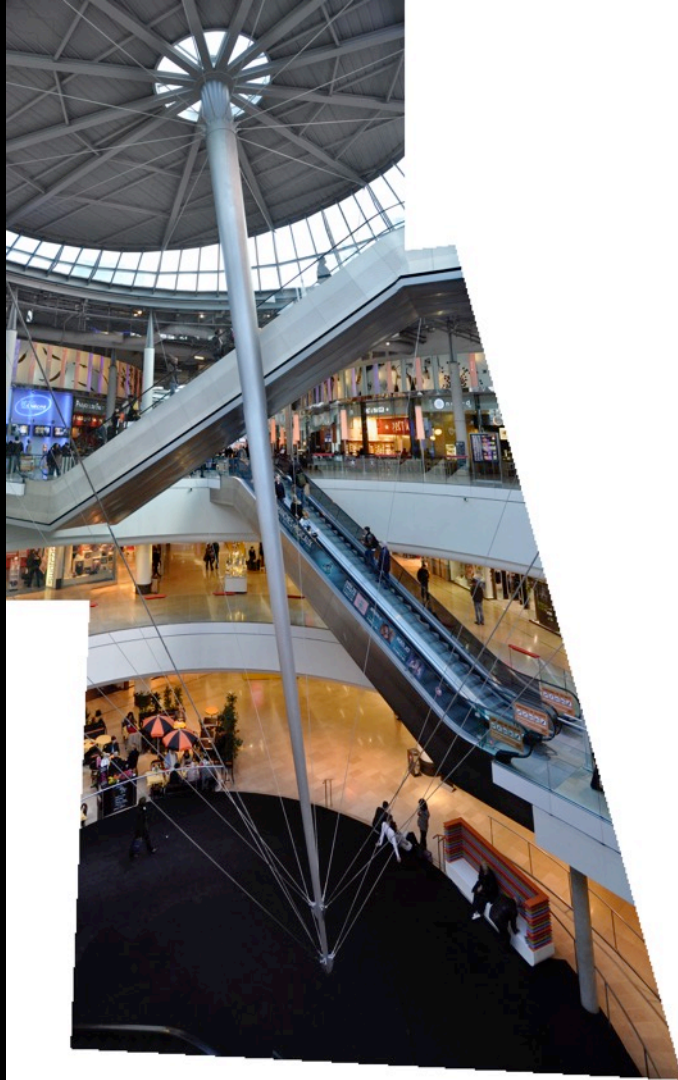


















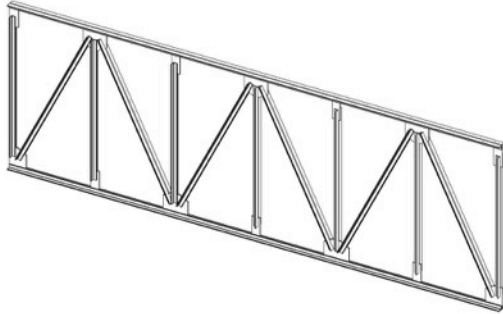
PLANAR TRUSSES



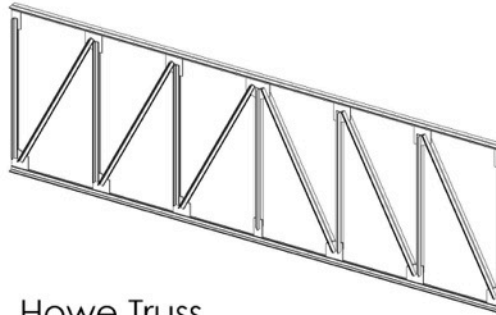
King Post Truss



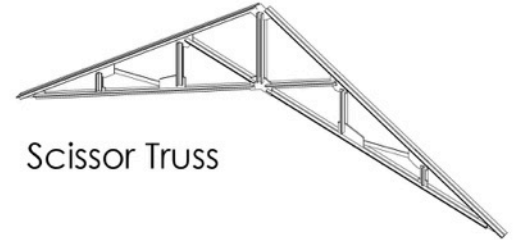
Pitched Howe Truss



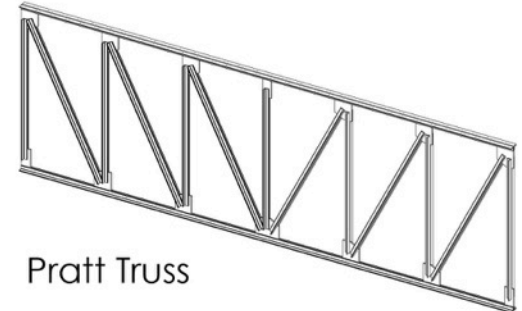
Modified Warren Truss



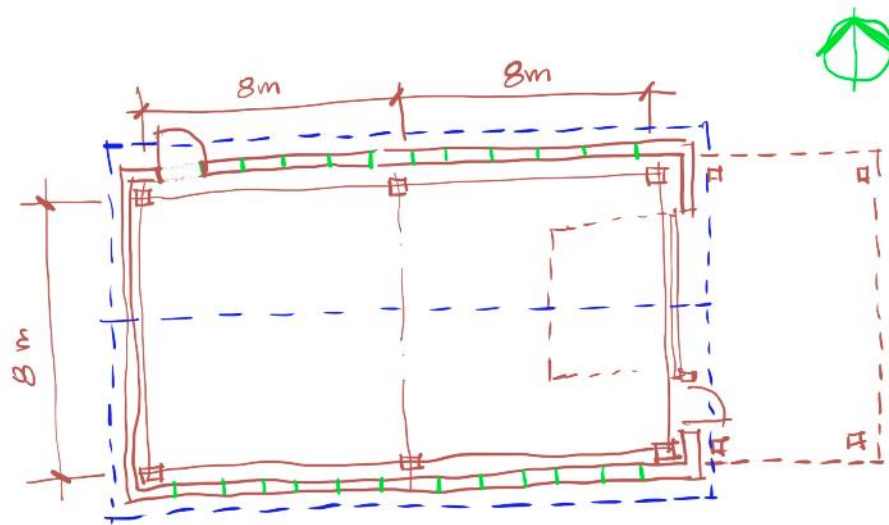
Howe Truss



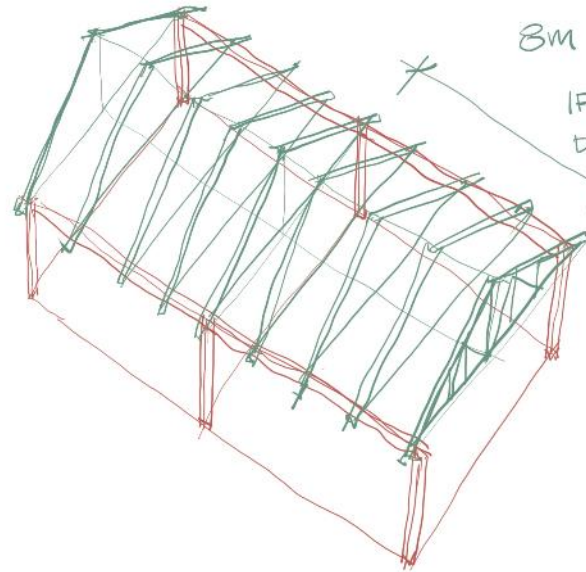
Scissor Truss



Pratt Truss

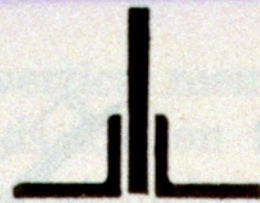


BASIC PLAN

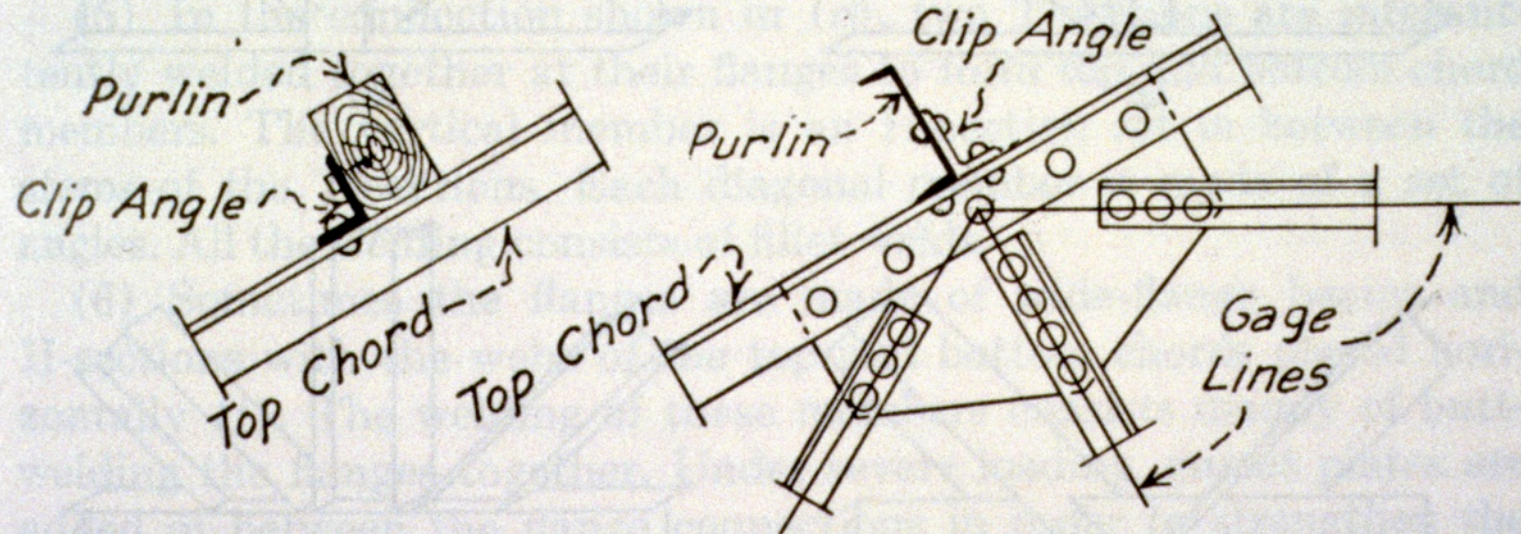


$$8m \div ?$$

IF 4, THEN ROOF
DECK SPANS 2m



(a) Top Chord (b) Bottom Chord (c) Bottom Chord
Sections for Members subjected to Bending Stress



(d) Method of Fastening Purlins to Top Chord

FIGURE 6.17 Simple steel roof truss details.

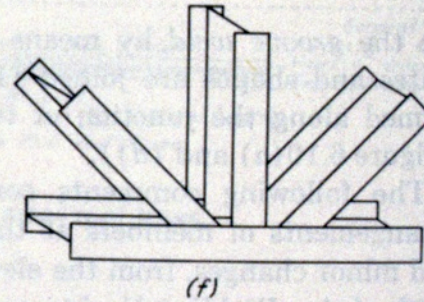
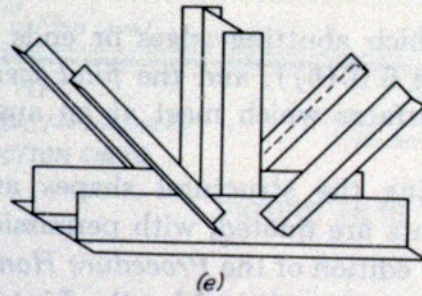
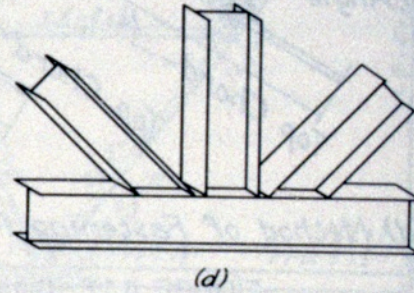
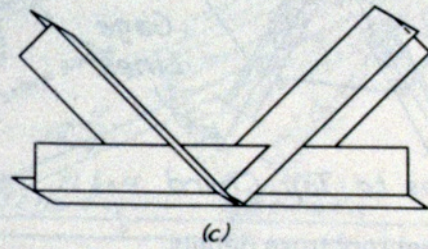
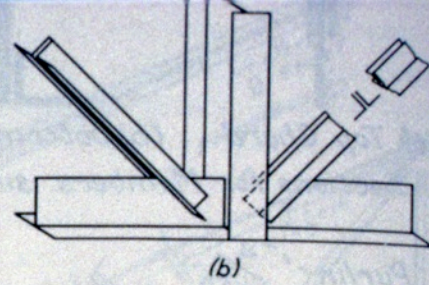
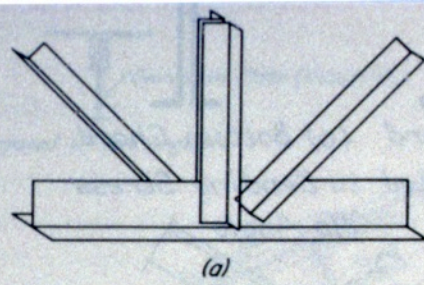


FIGURE 6.18 Connections for simple welded trusses. Lincoln Electric Company.

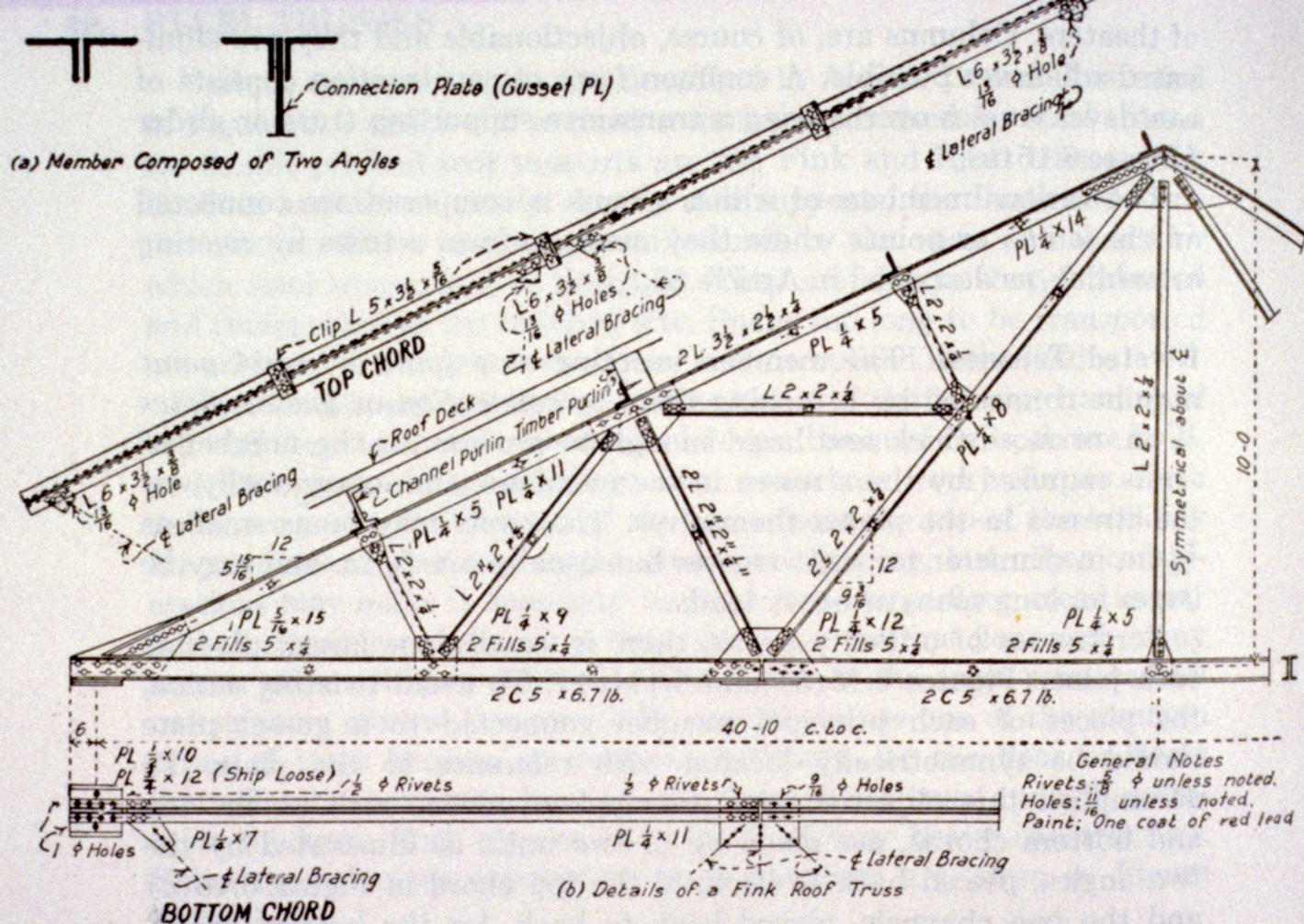


FIGURE 16.16 Fink steel roof truss.



















The New School,
NYC



























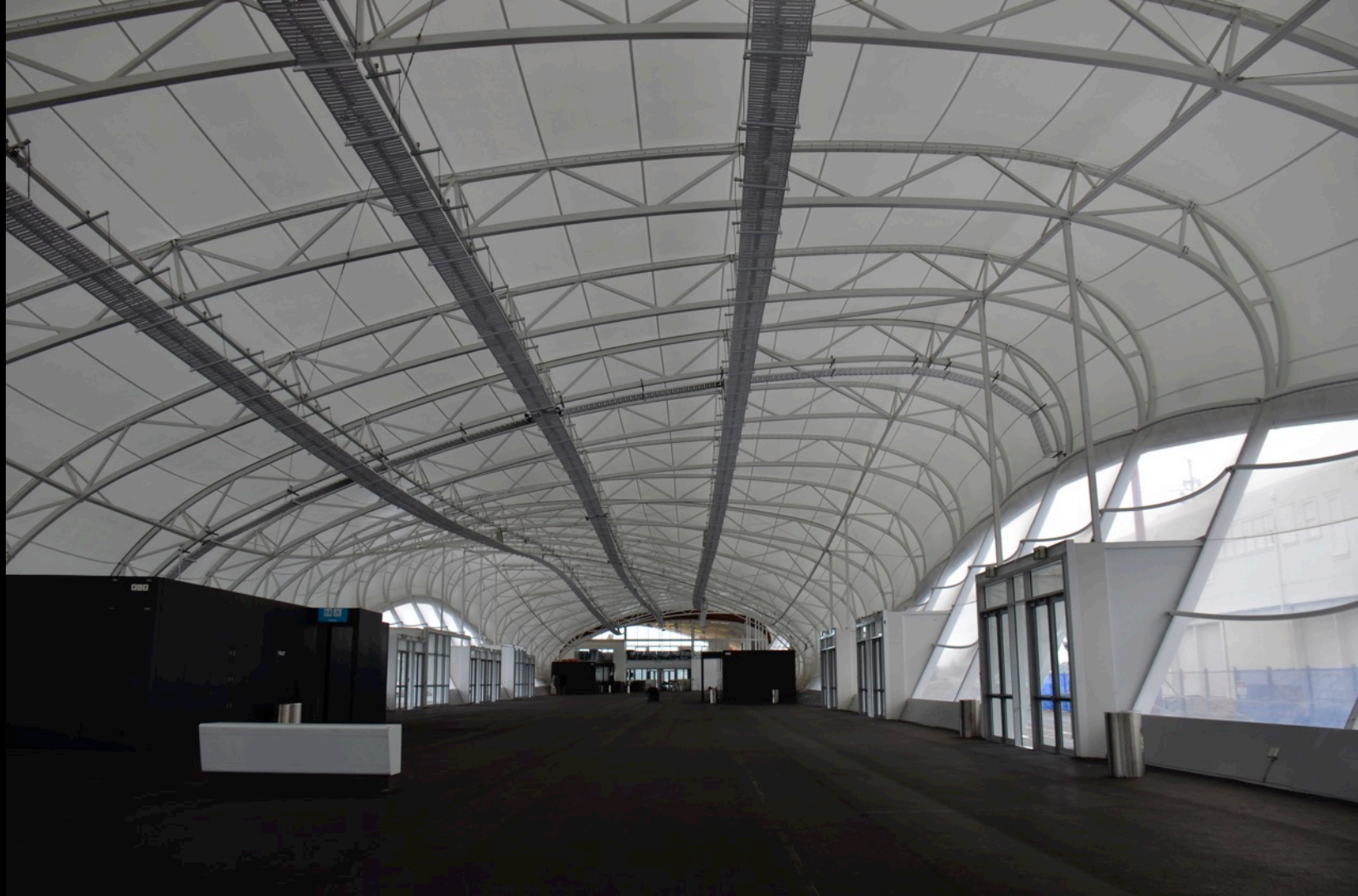




The image shows a long, white, modern building with a distinctive wavy, undulating roofline, situated along a waterfront. Two ferries are docked at a pier in front of the building. The water is a clear, light blue, and the sky is bright blue with scattered white clouds. The building's design is sleek and futuristic, with large, rounded openings at its ends. The ferries are white with blue and yellow accents. The overall scene is bright and sunny, with the sun reflecting off the water's surface.

The Cloud
Auckland, NZ









Les Ailes Shopping Centre
Montreal, QC





War Museum
Ottawa, ON







Calgary Water
Calgary, AB





Box Truss





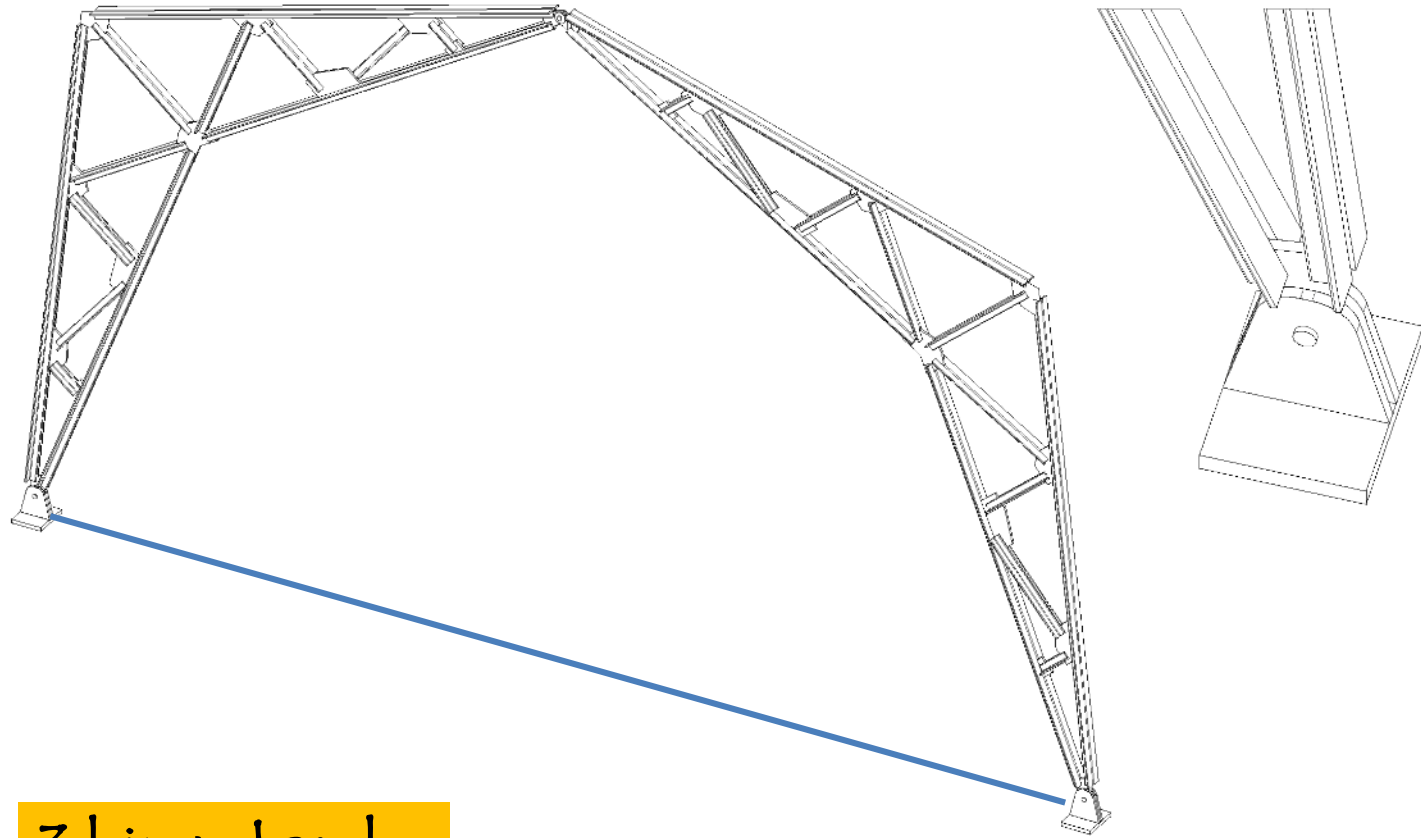
Sainsbury Centre
England



Triangular Truss







3 hinged arch



Rigid Frames

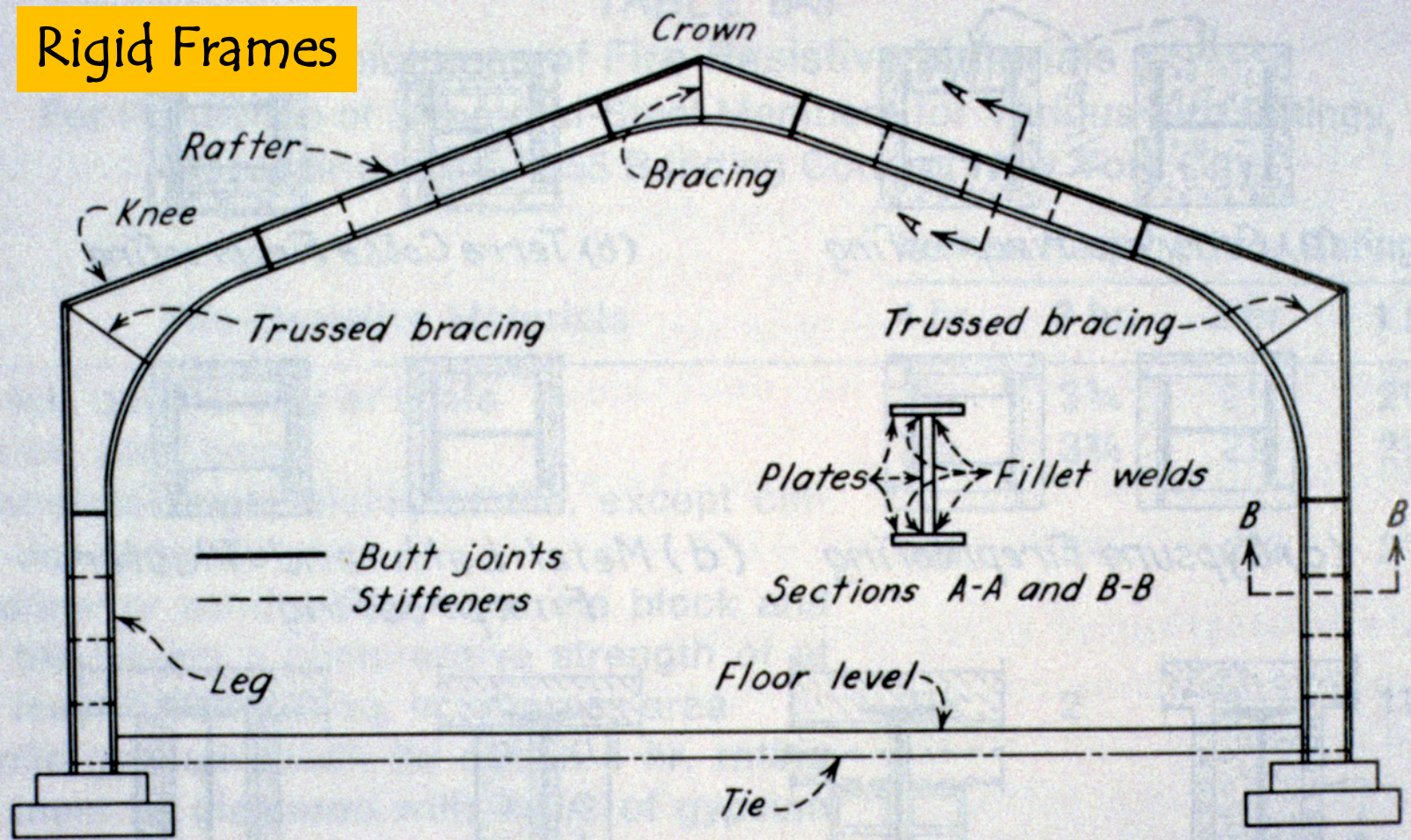


FIGURE 6.32 Steel rigid frame.

Friedrichstrasse Station
Berlin, Germany









'skydome' AKA Rogers Centre
Rod Robbie and Michael Allen
1987











SCALE













Museum of Civilization
Ottawa/Hull
Douglas Cardinal Architect
1987











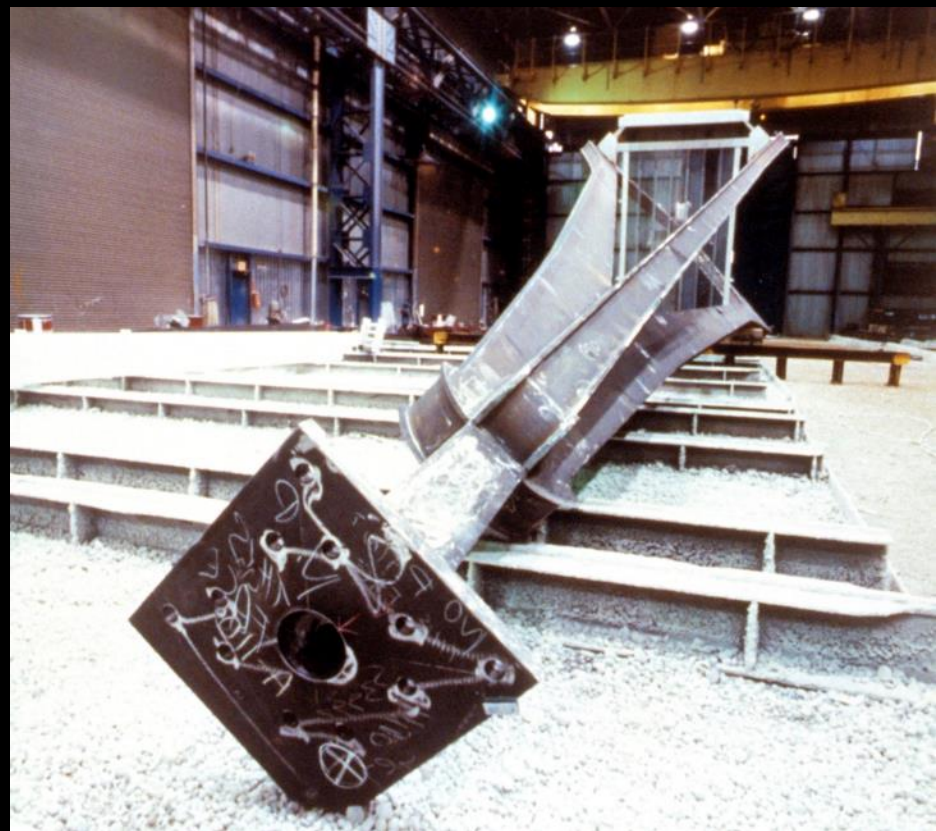
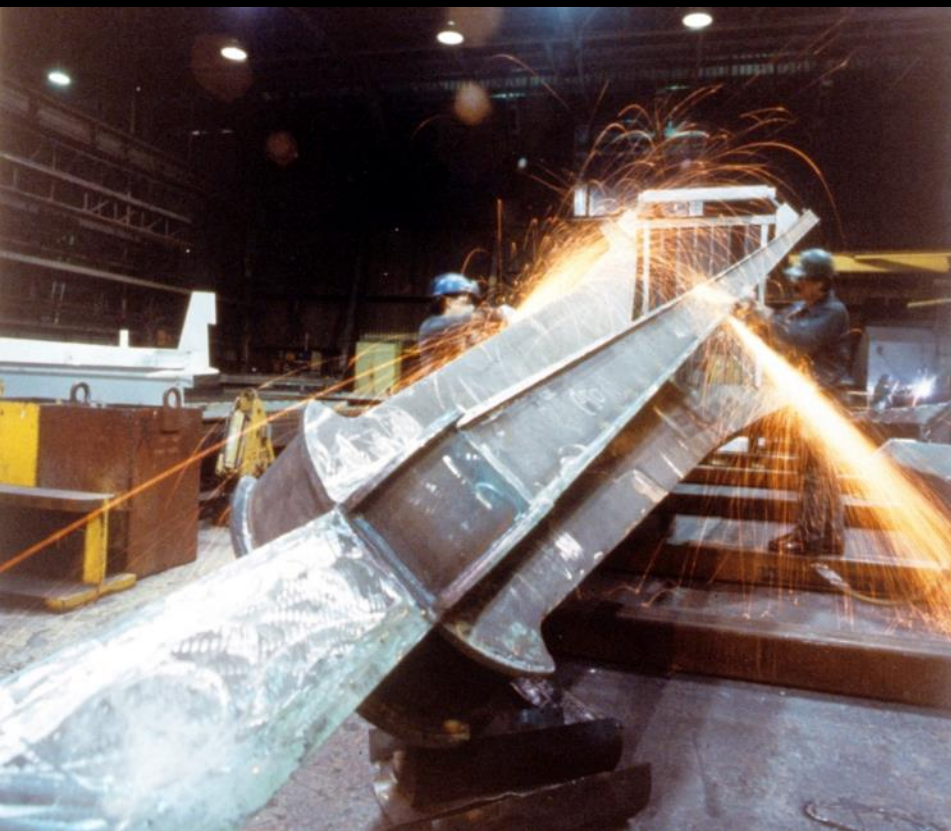




BCE – Brookfield – Place
Toronto, ON
Santiago Calatrava
1992

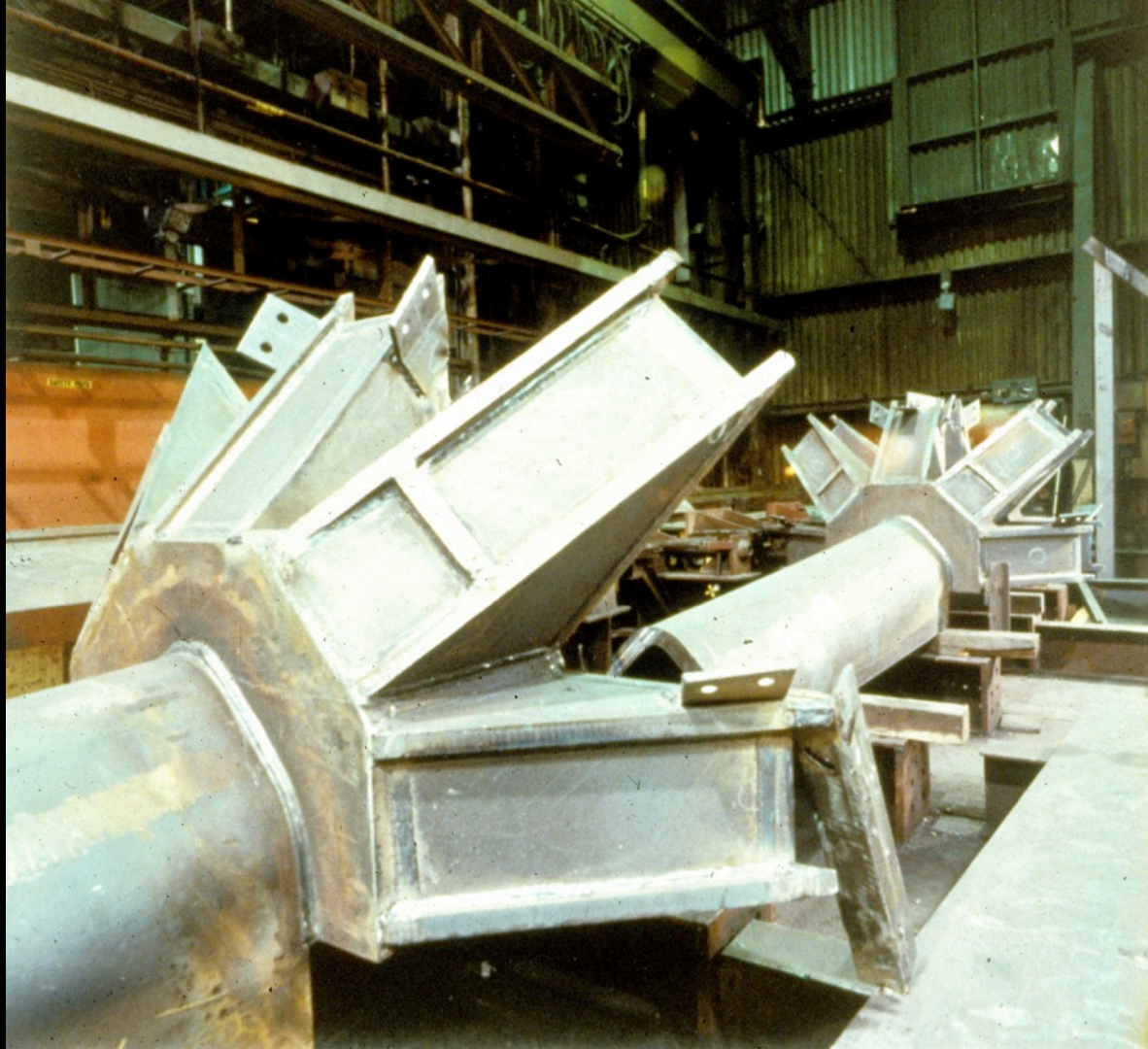




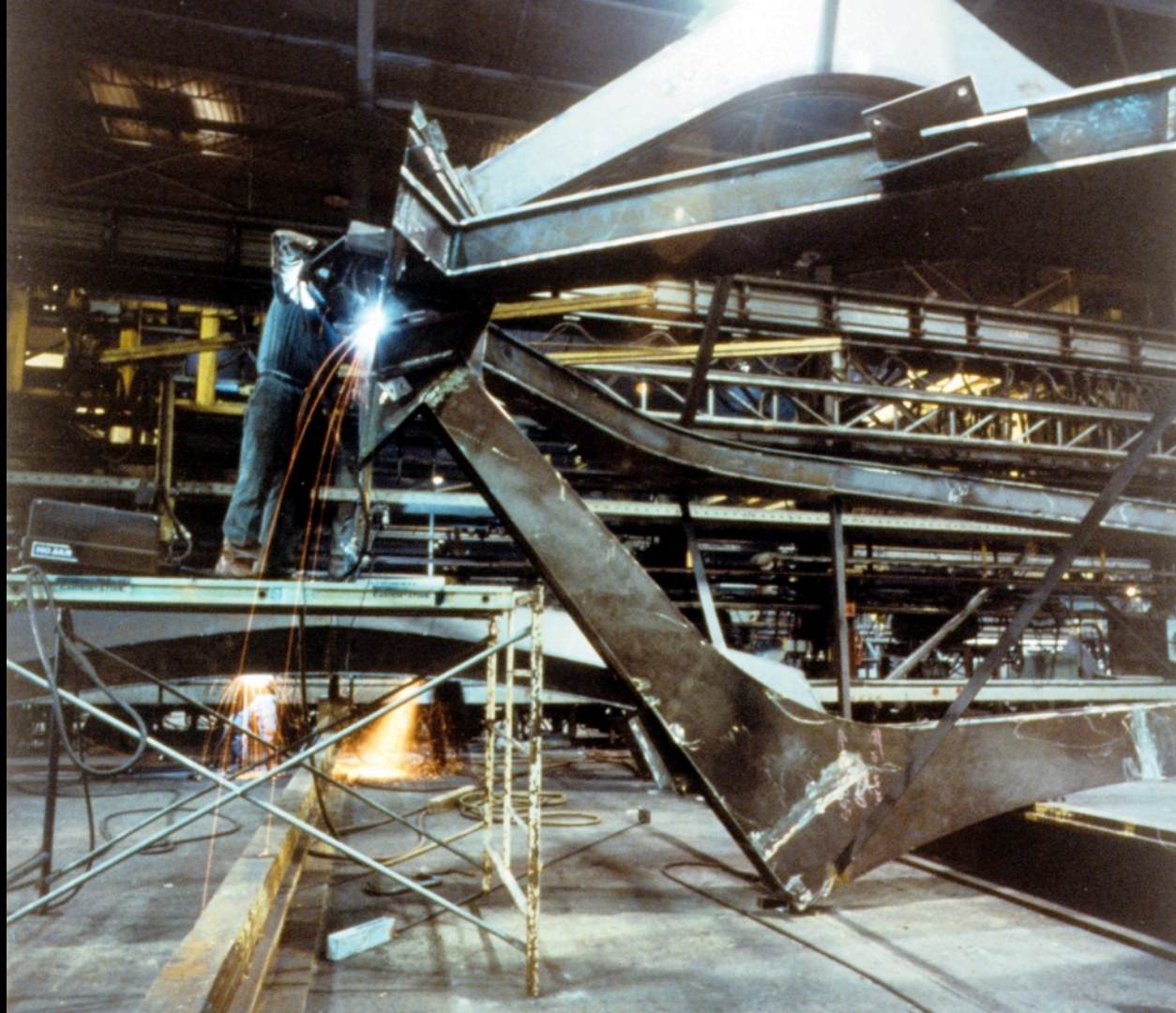


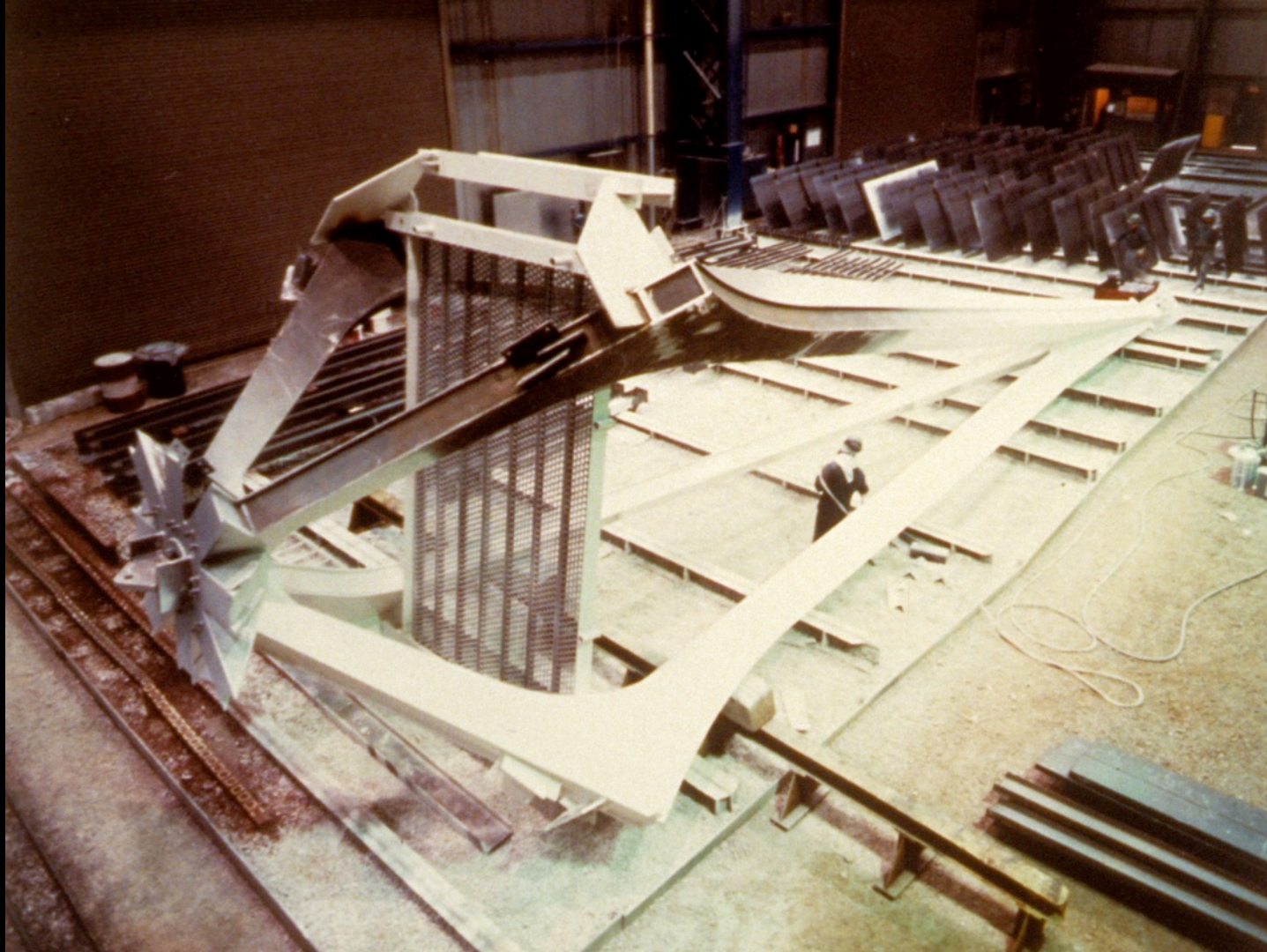


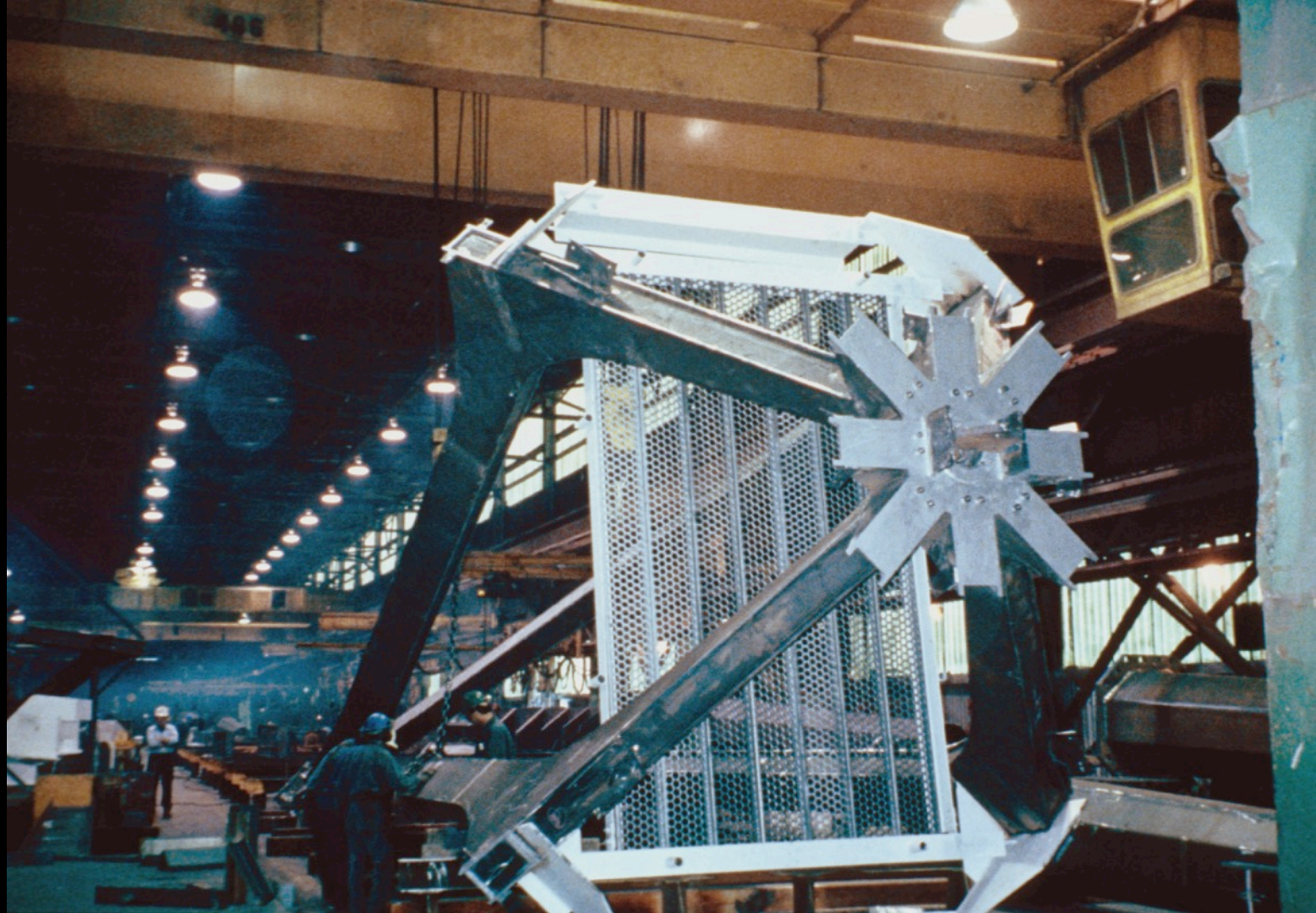




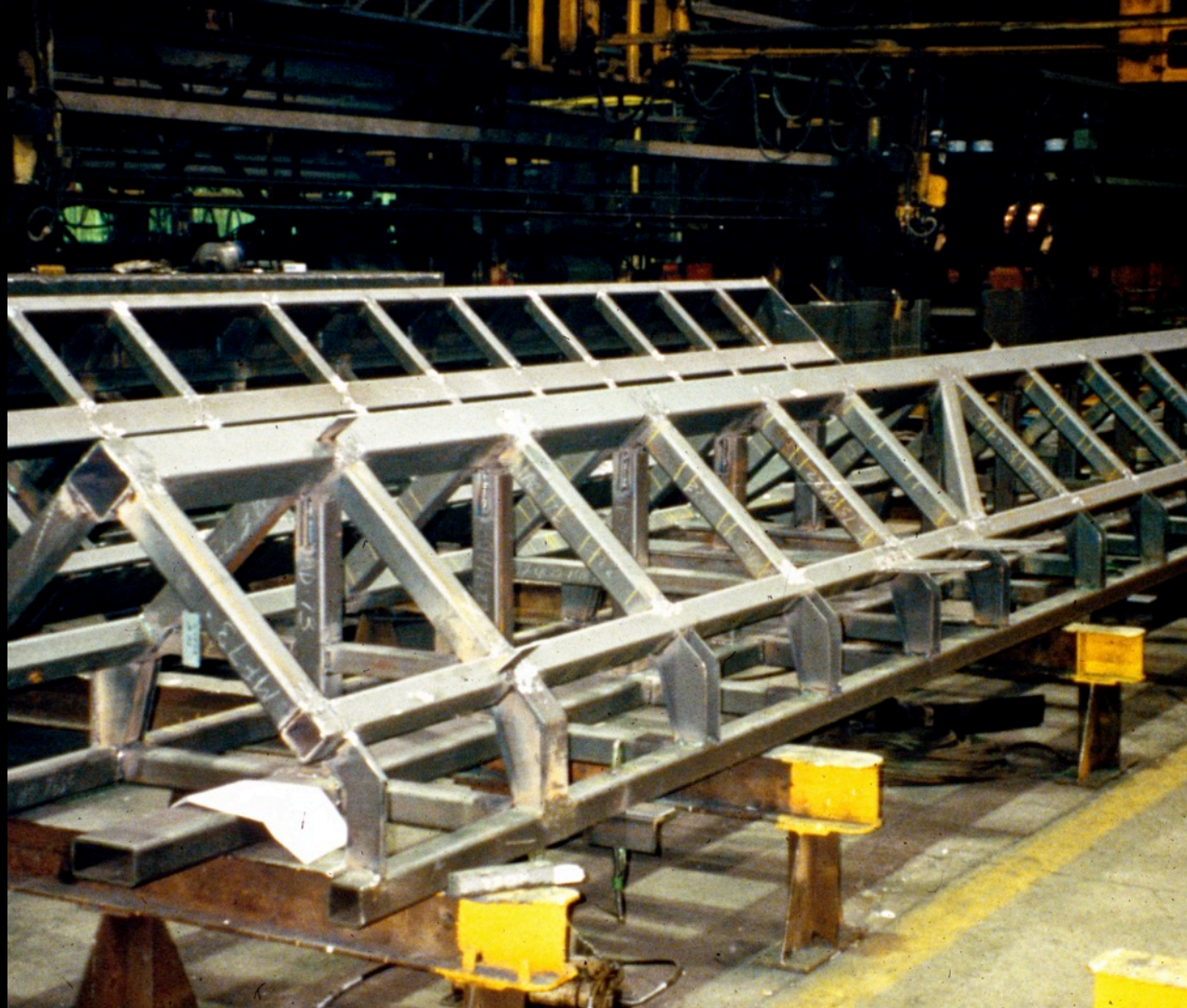


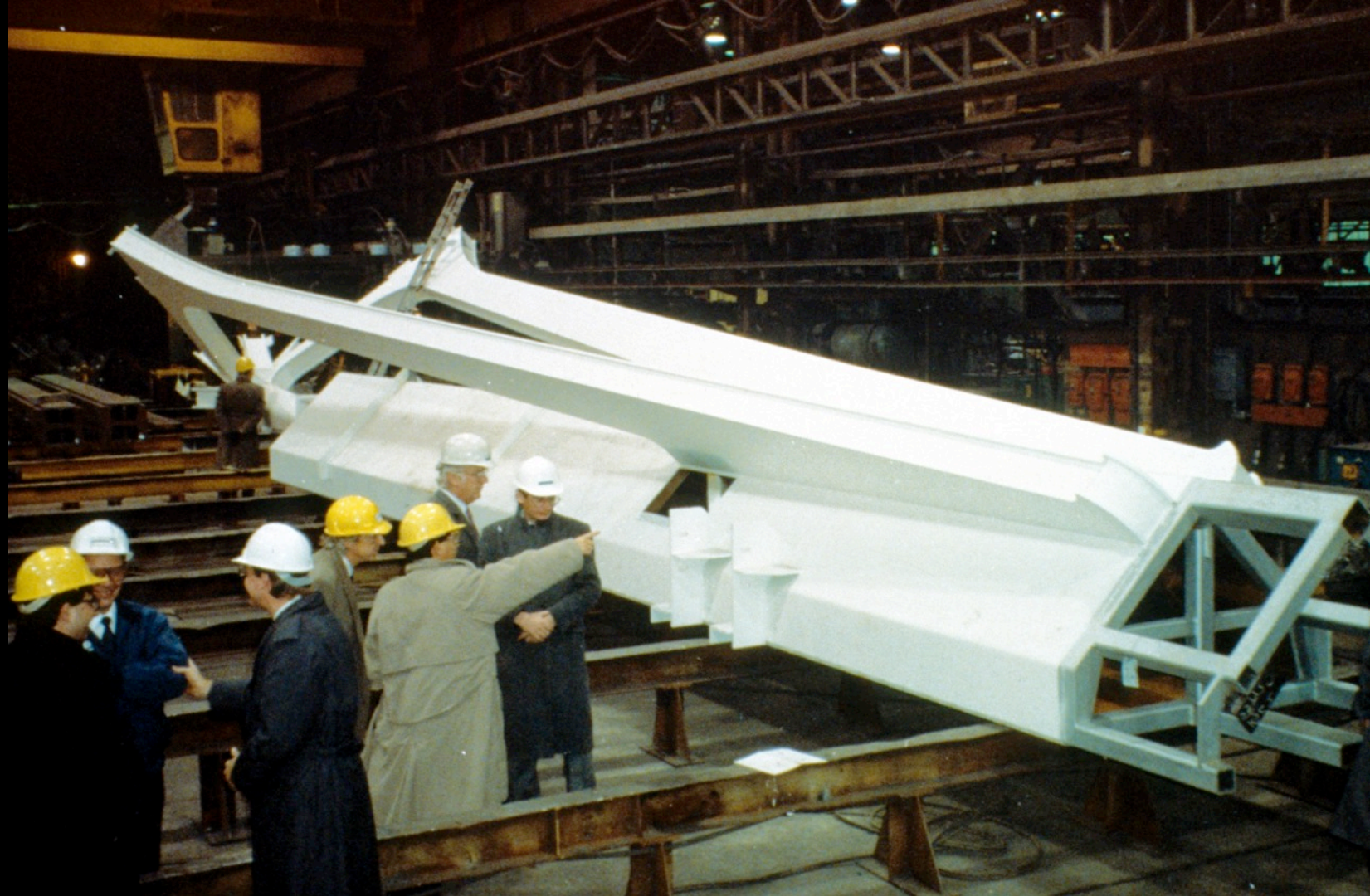






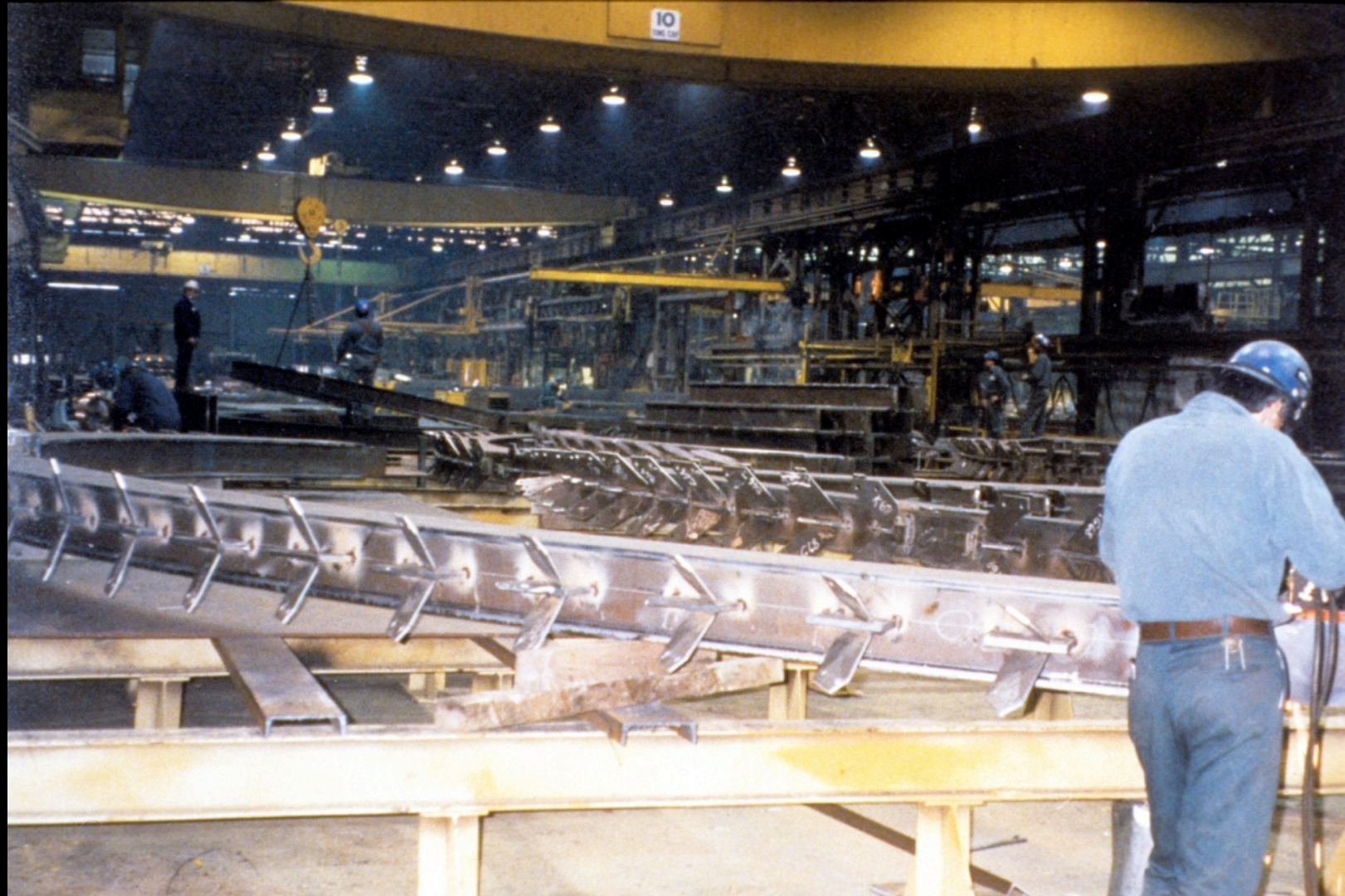




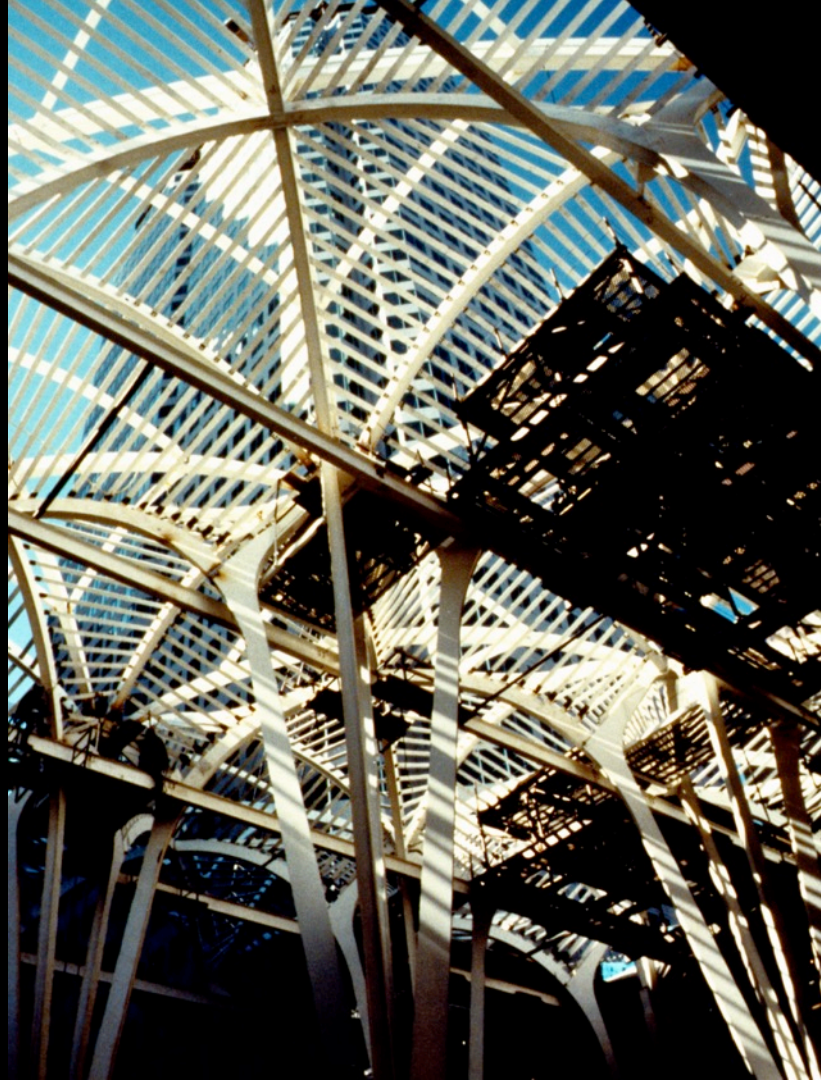




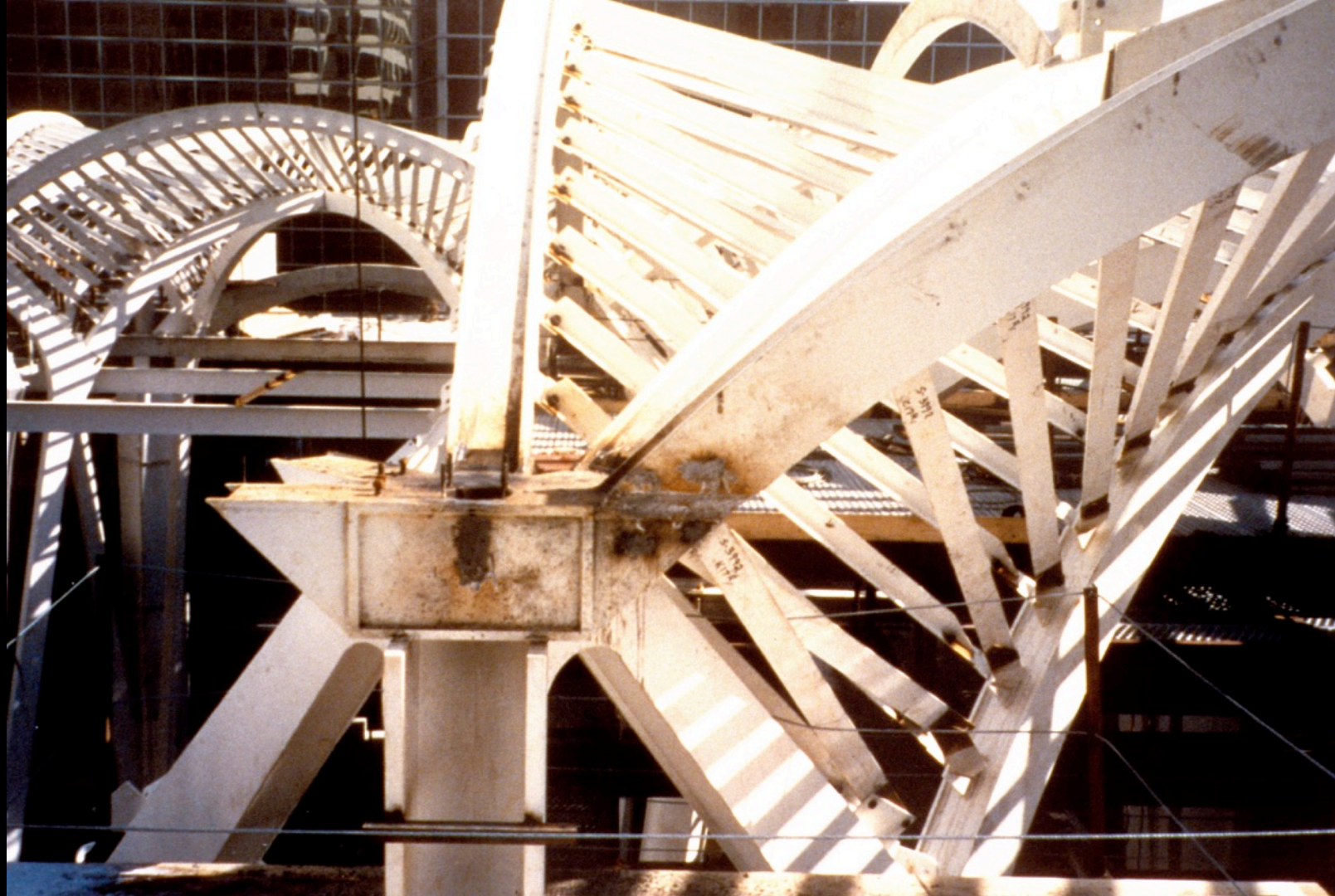




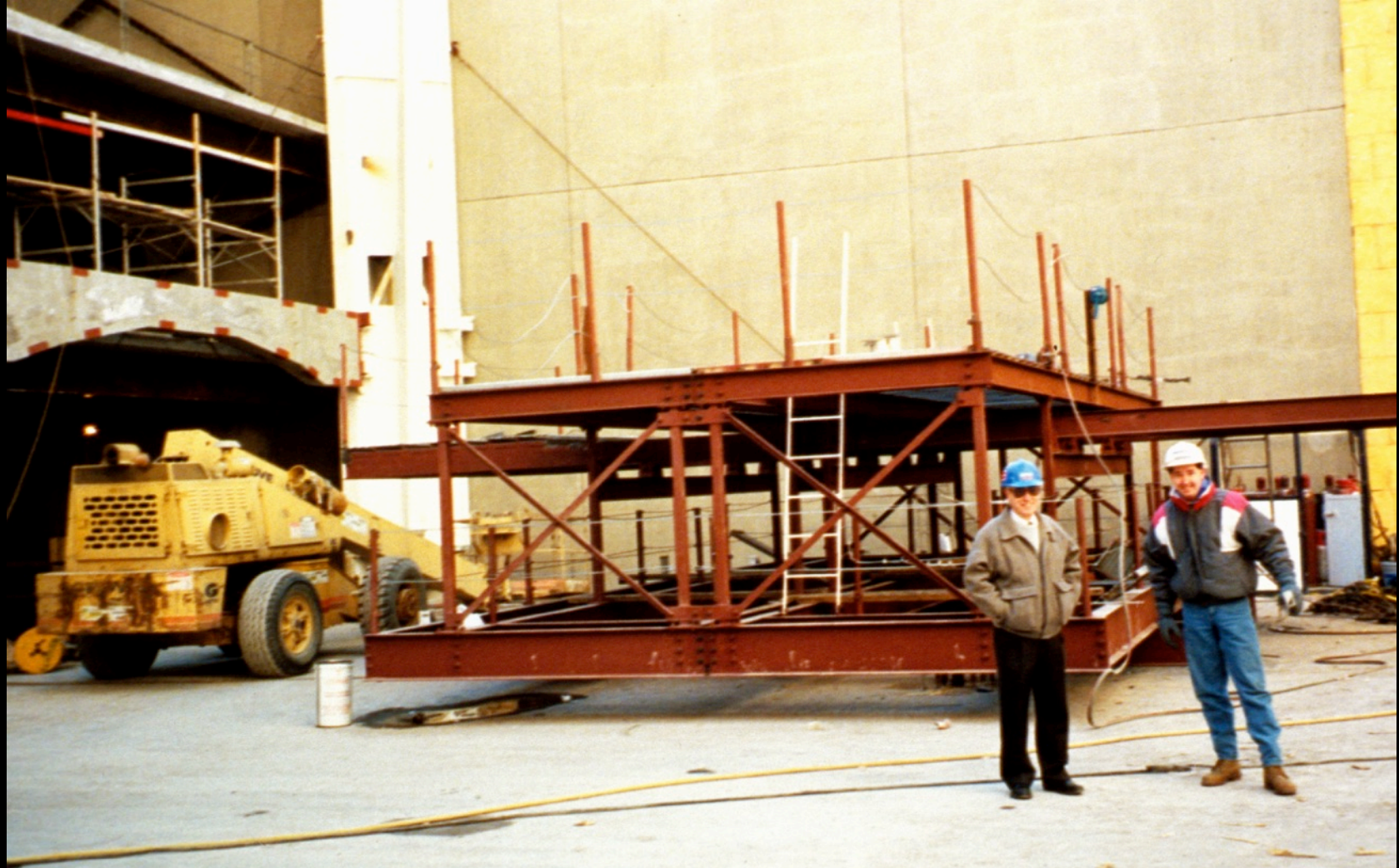




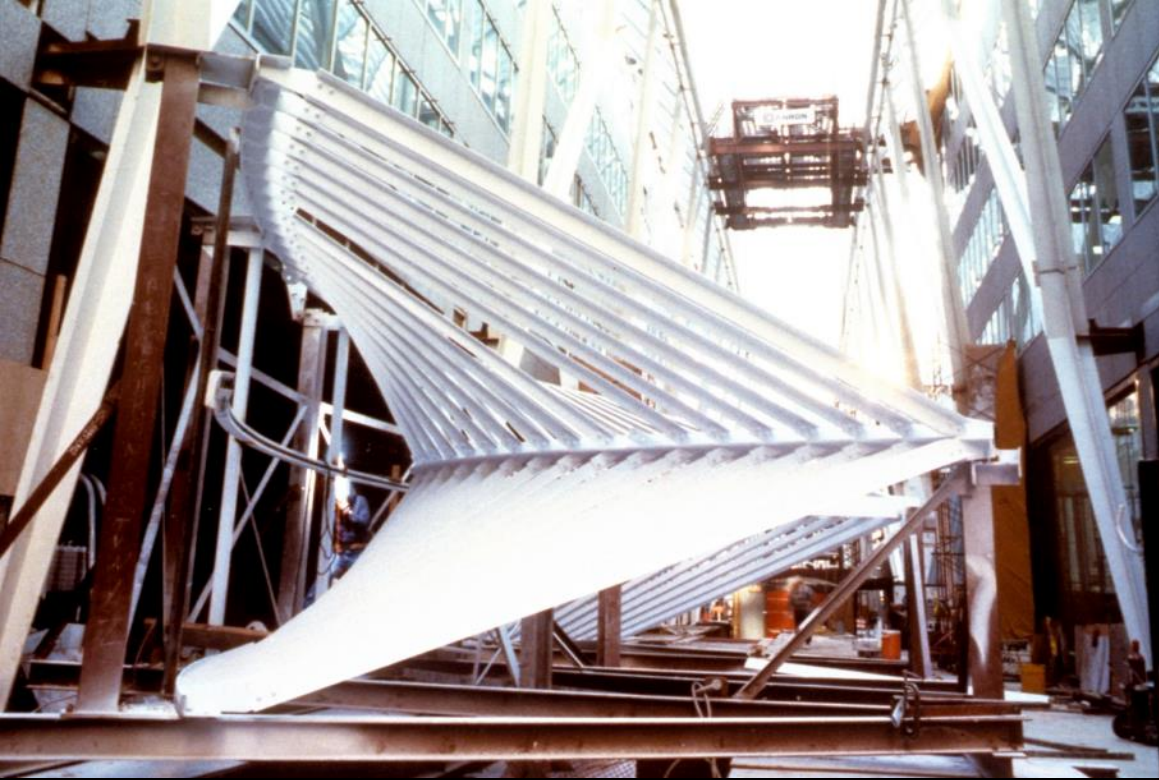




























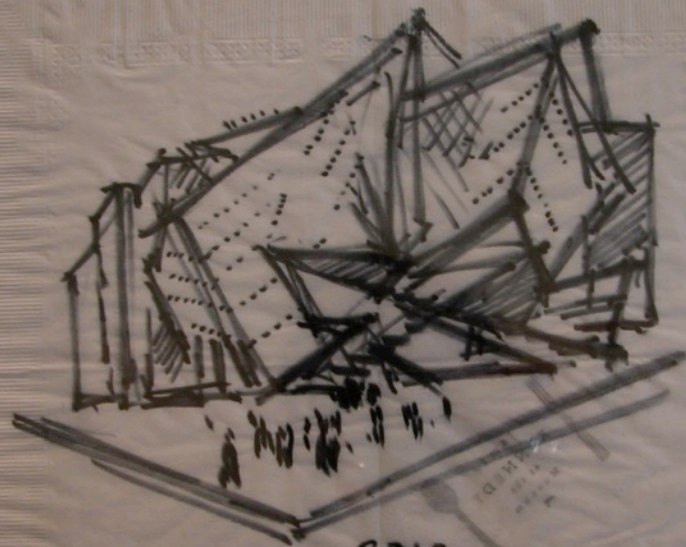






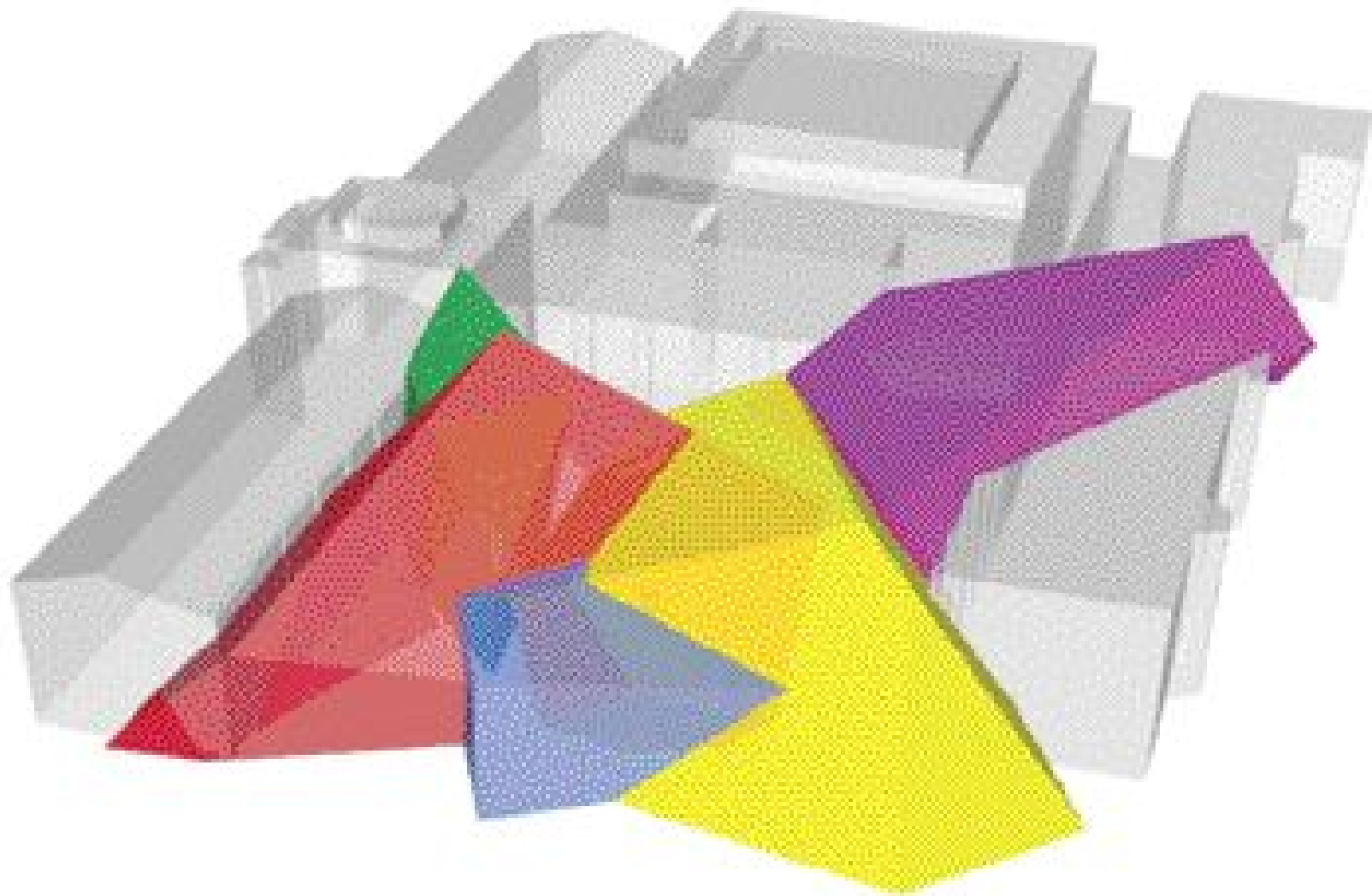


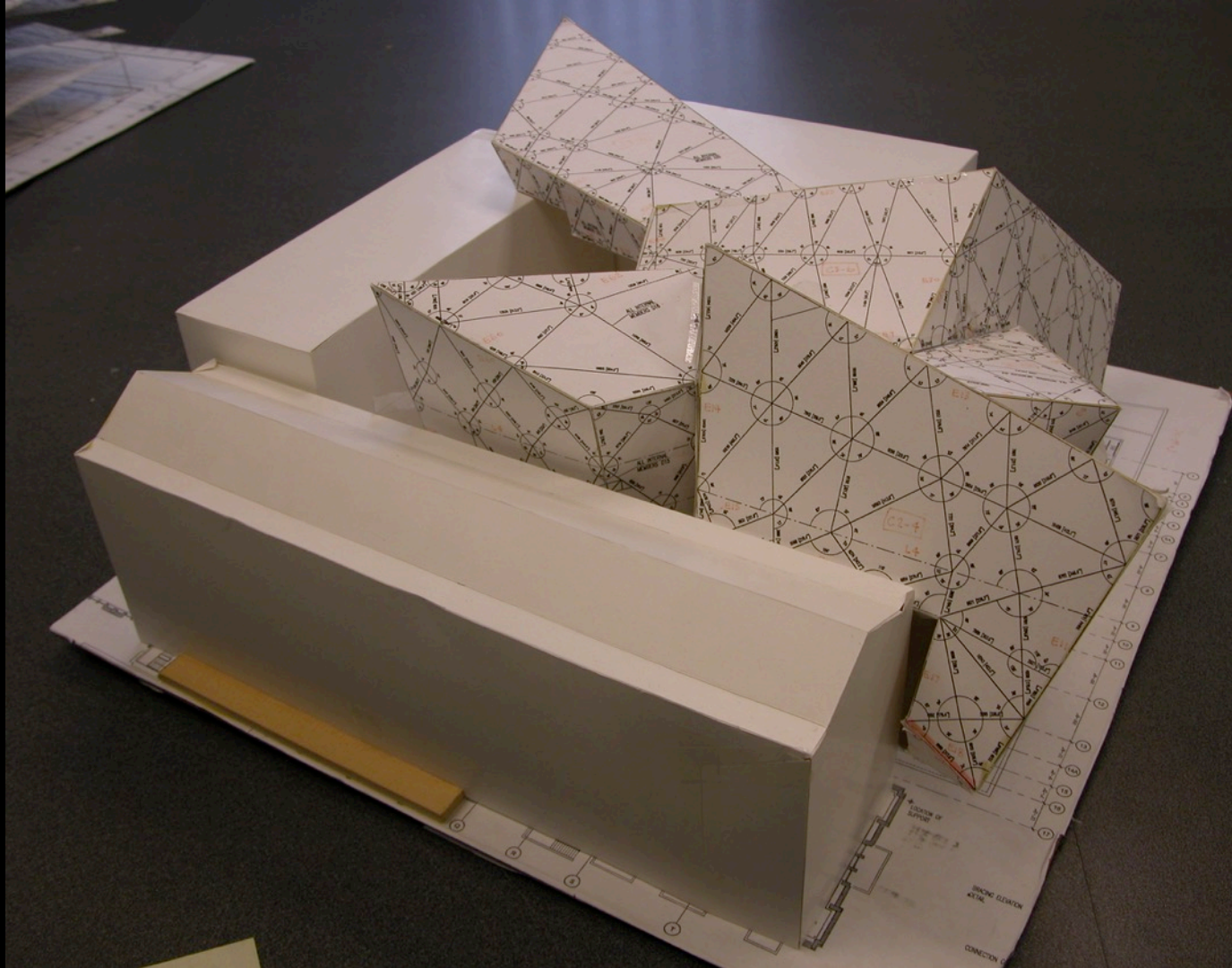
Addition to the Royal Ontario Museum
Toronto, ON
Studio Libeskind
2006

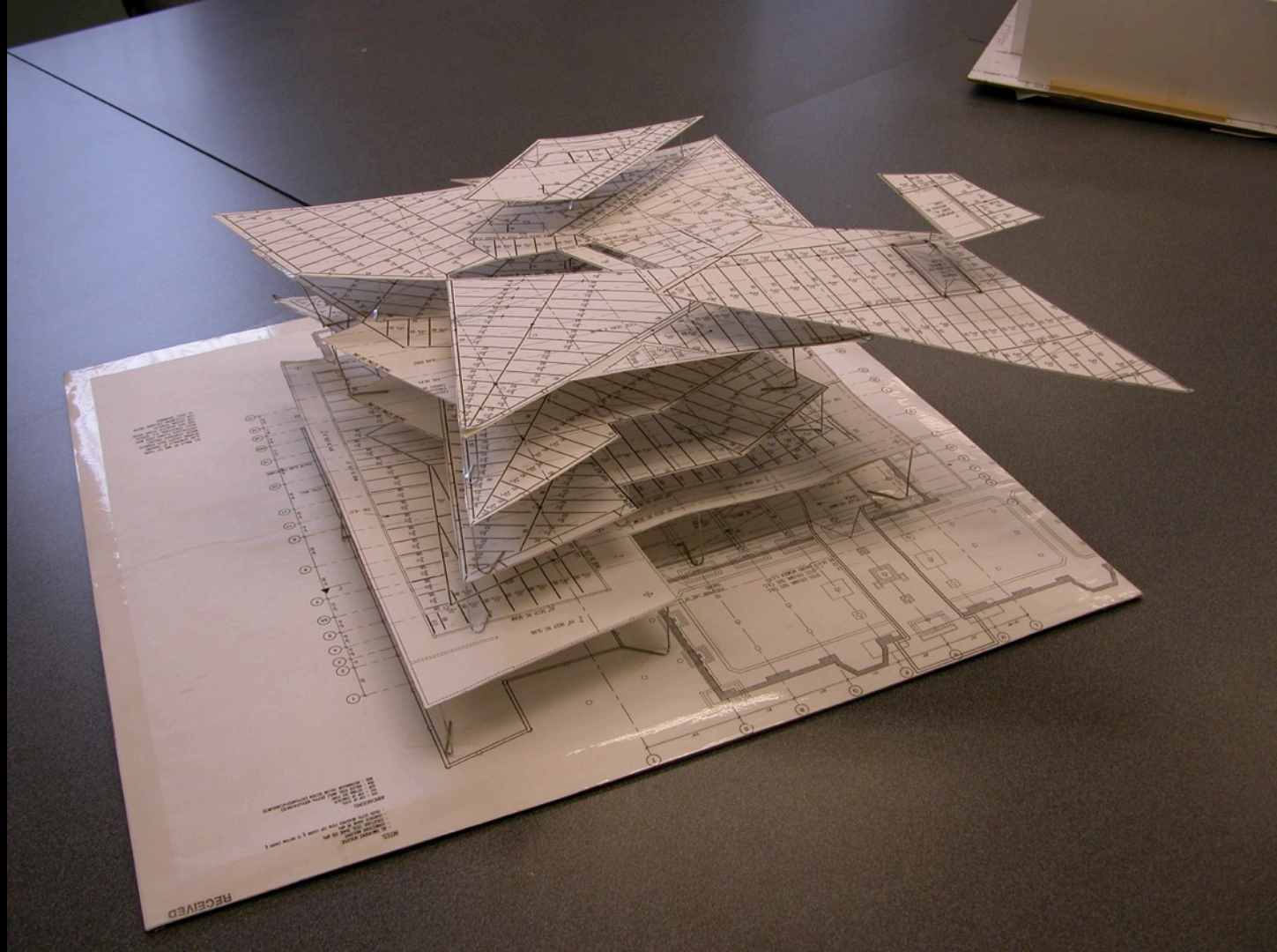


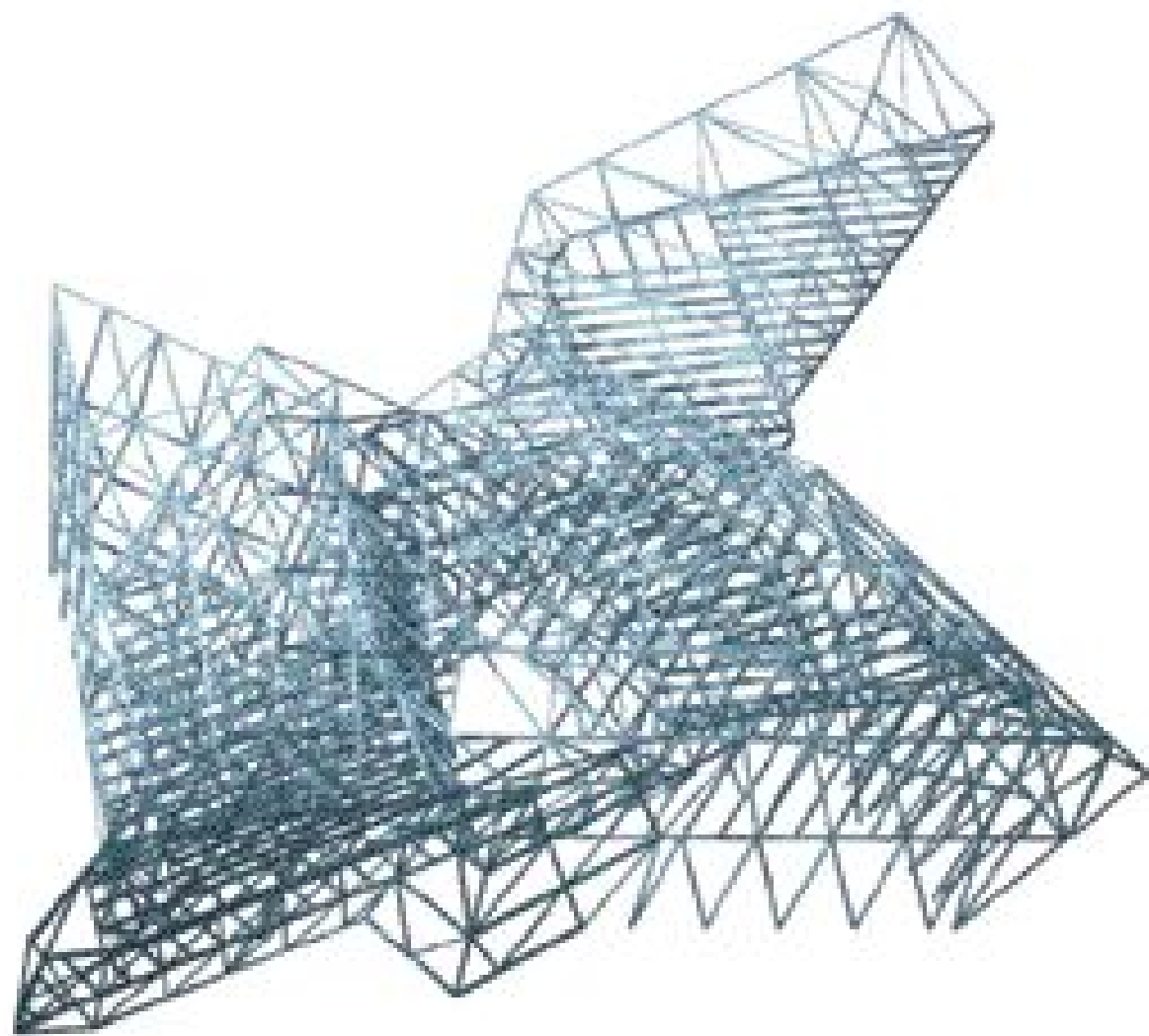
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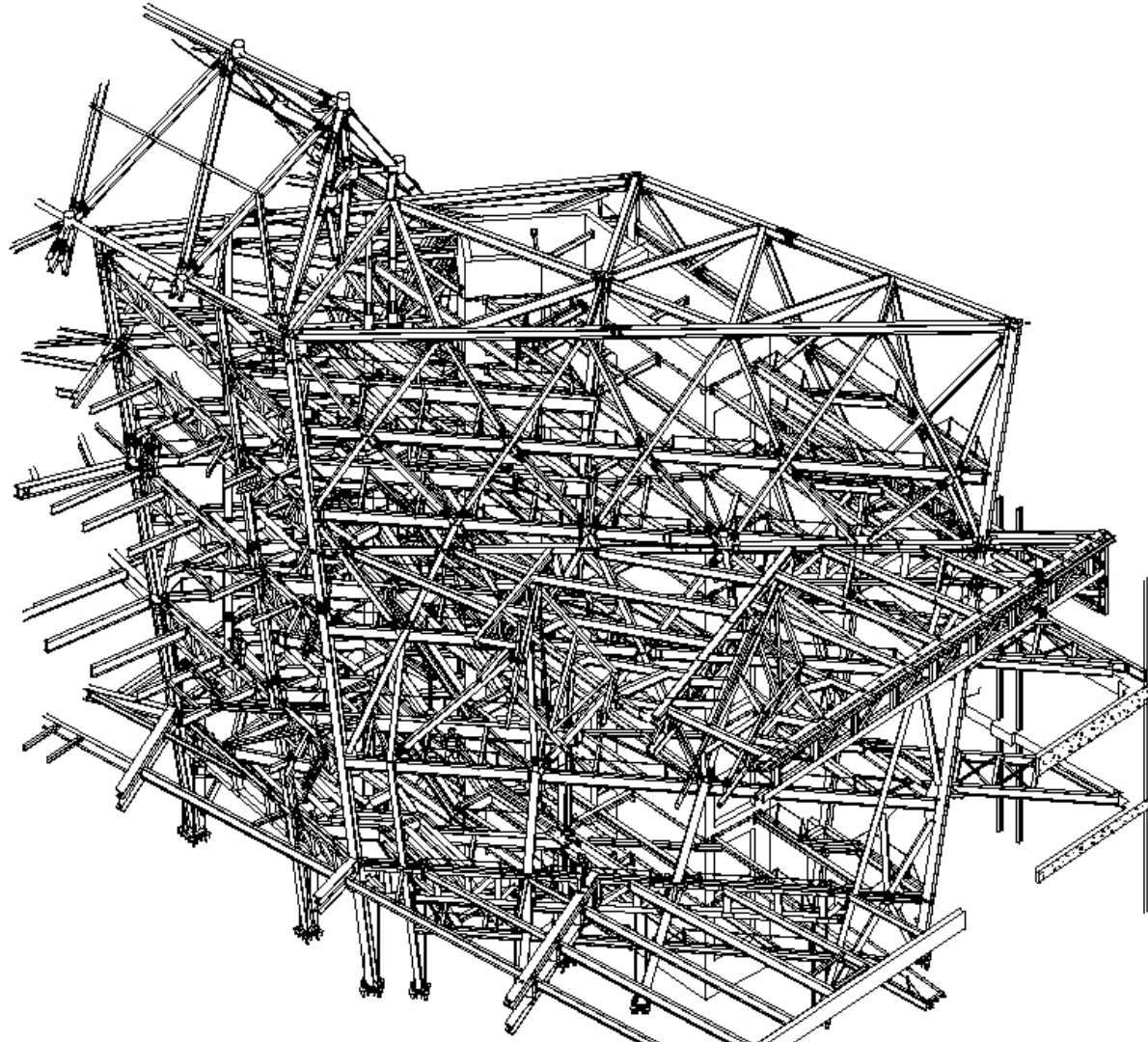


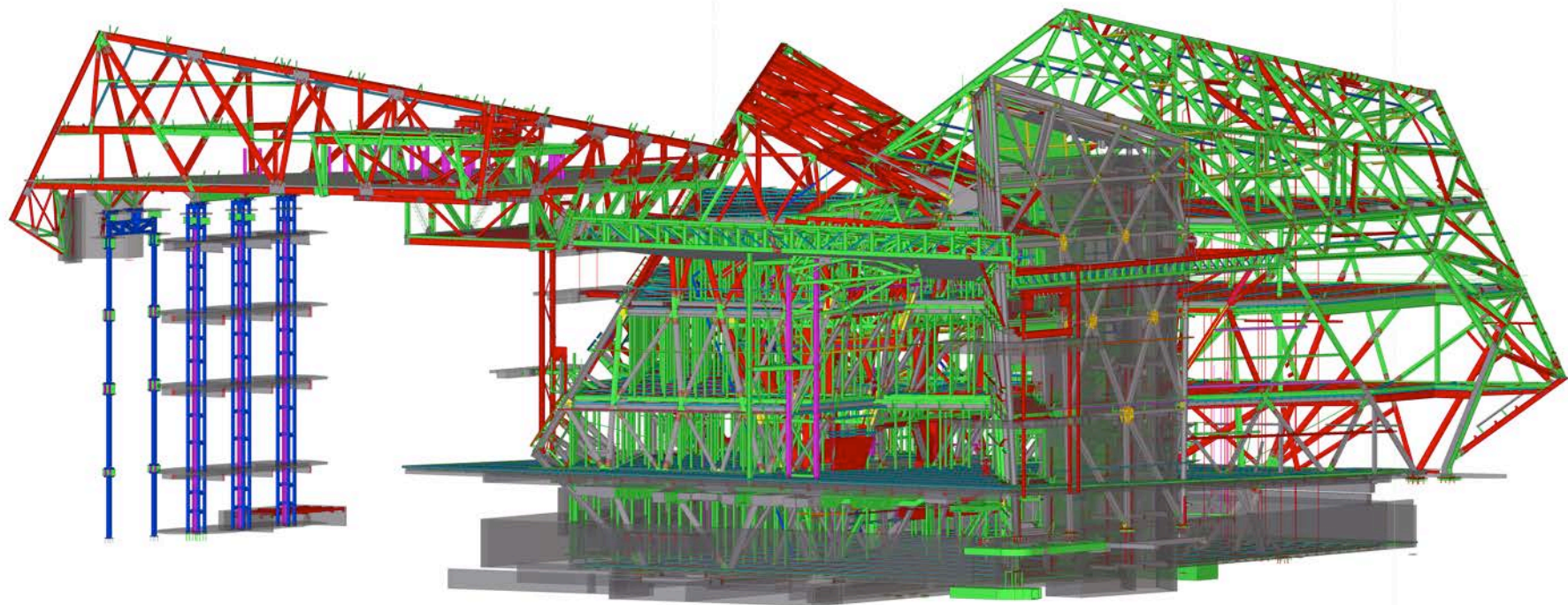


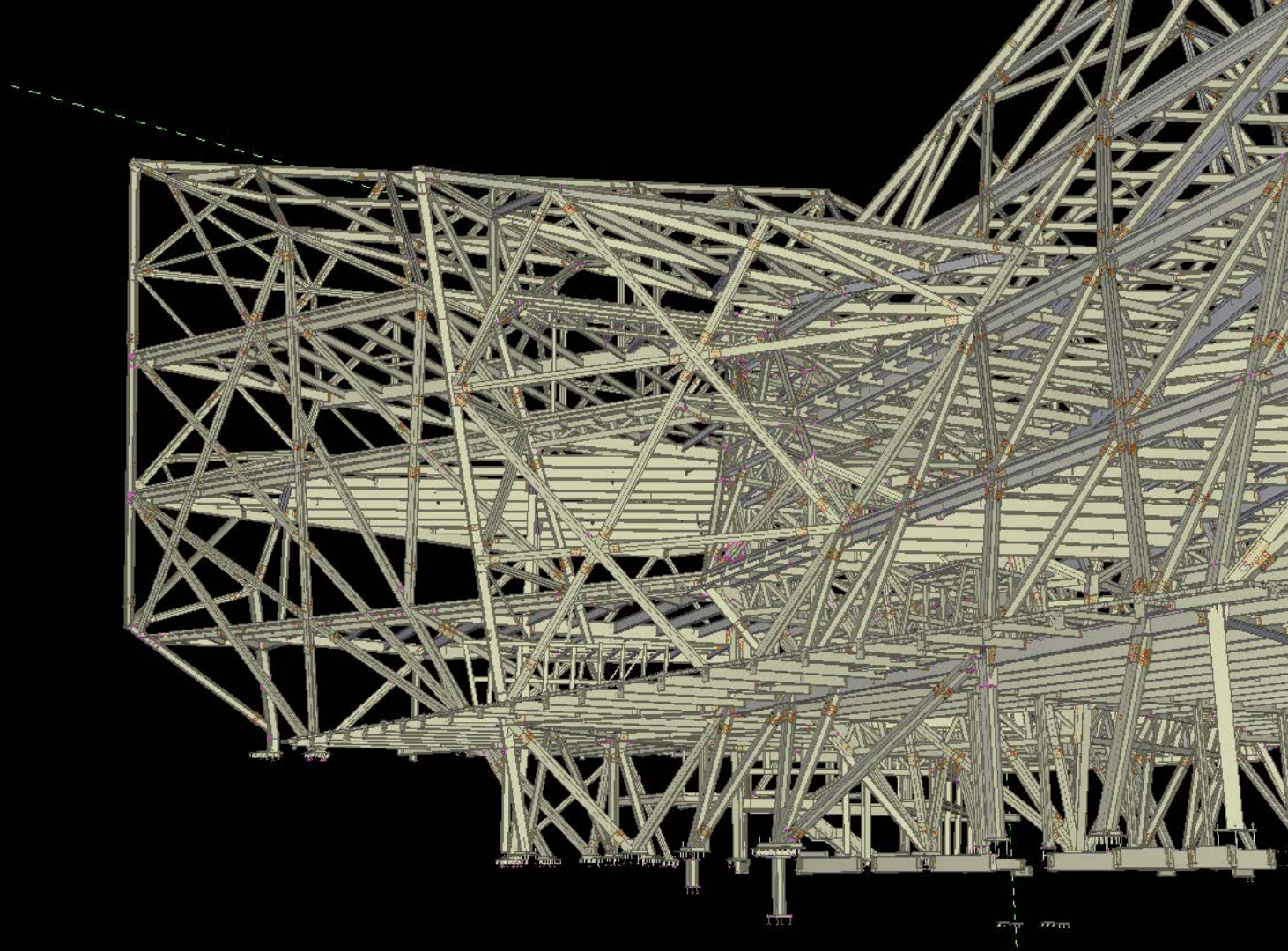


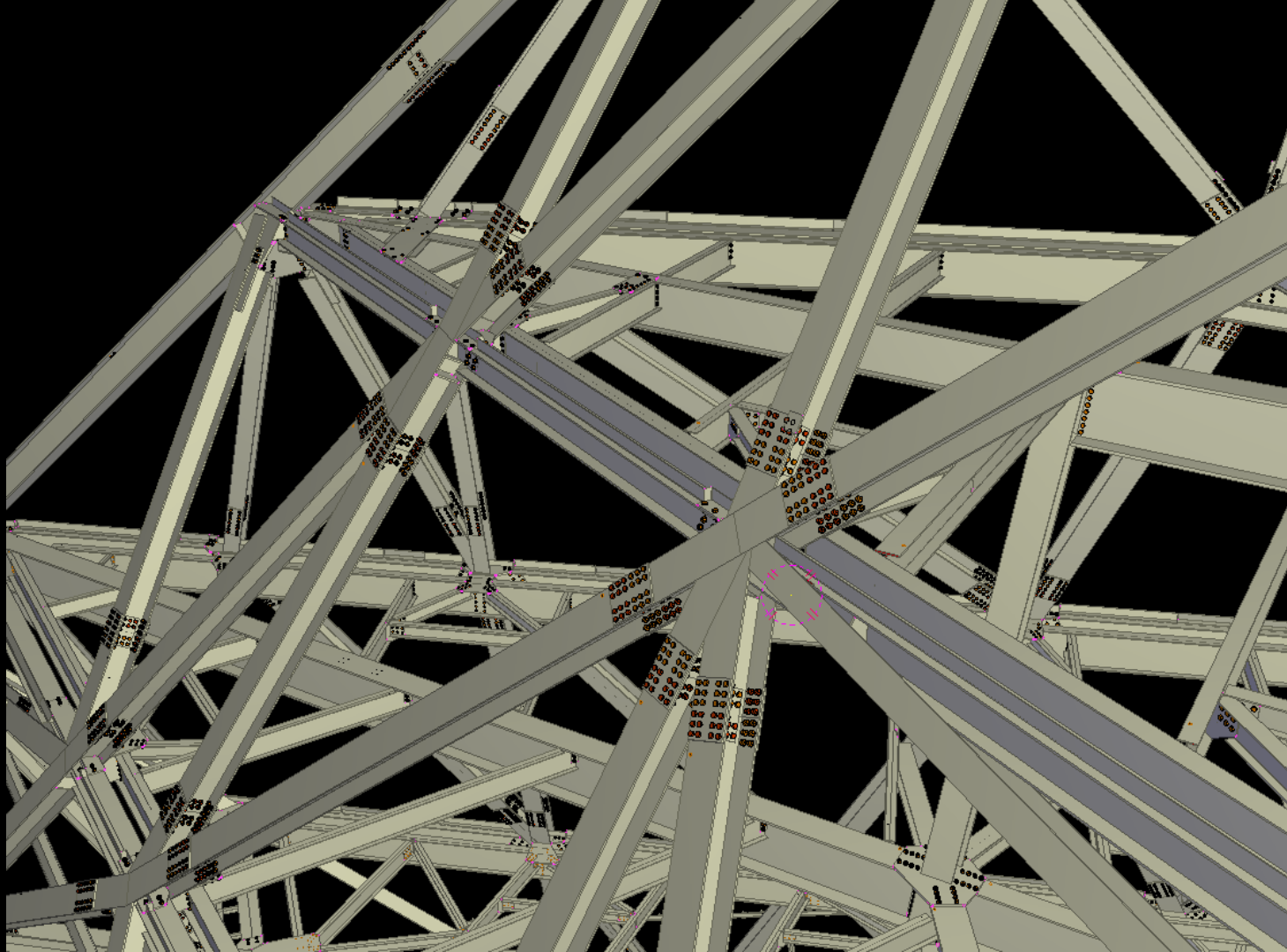


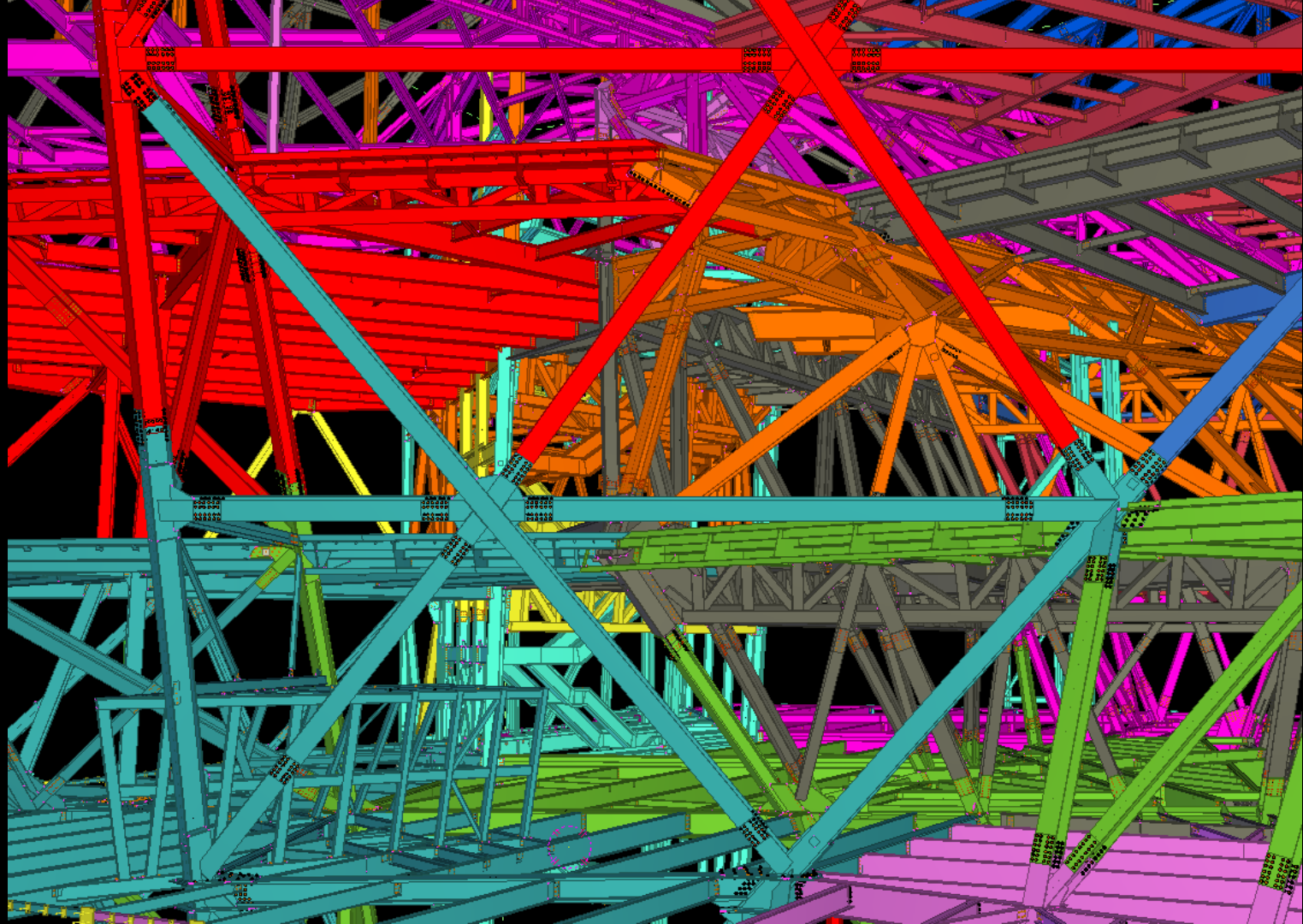


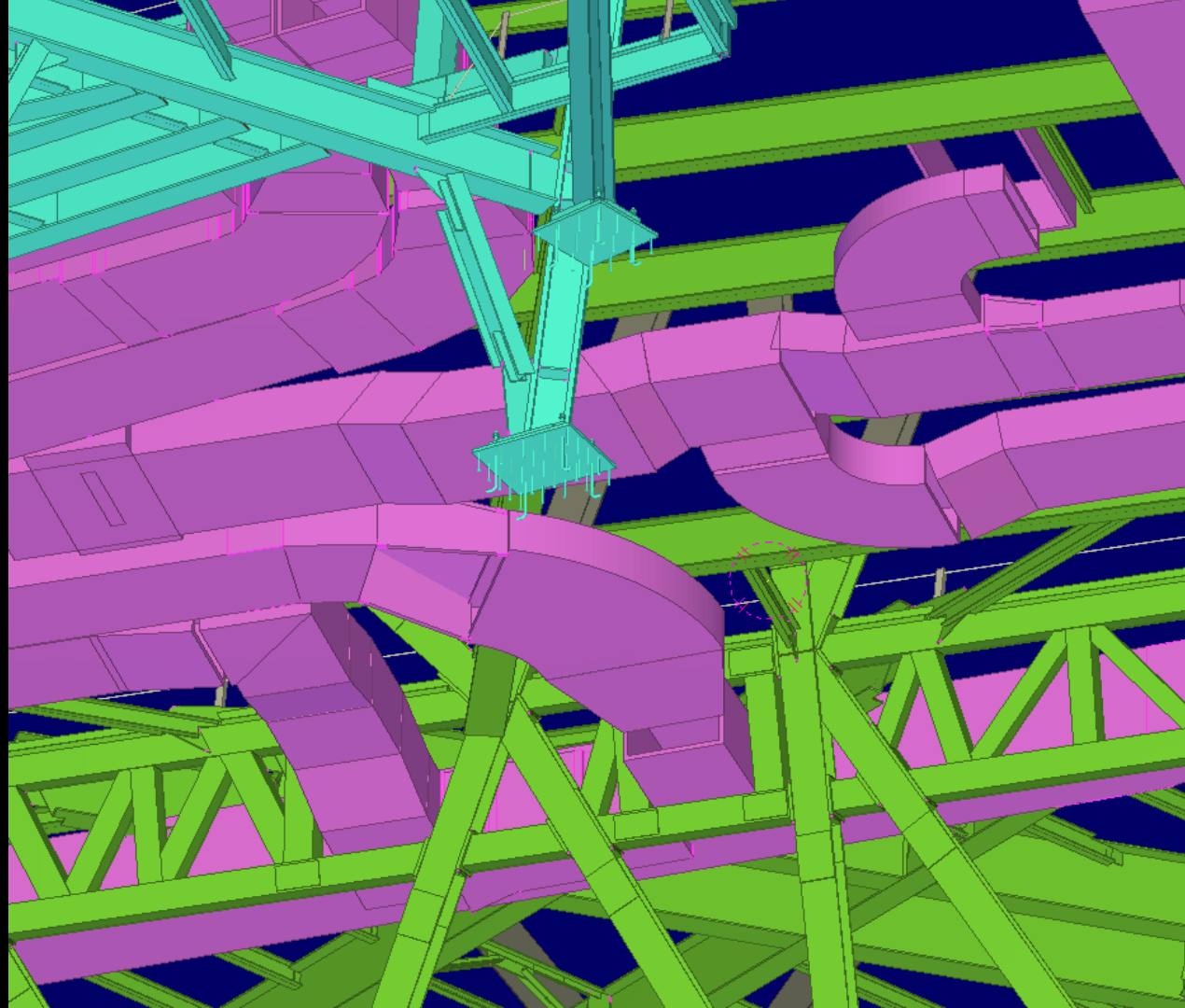


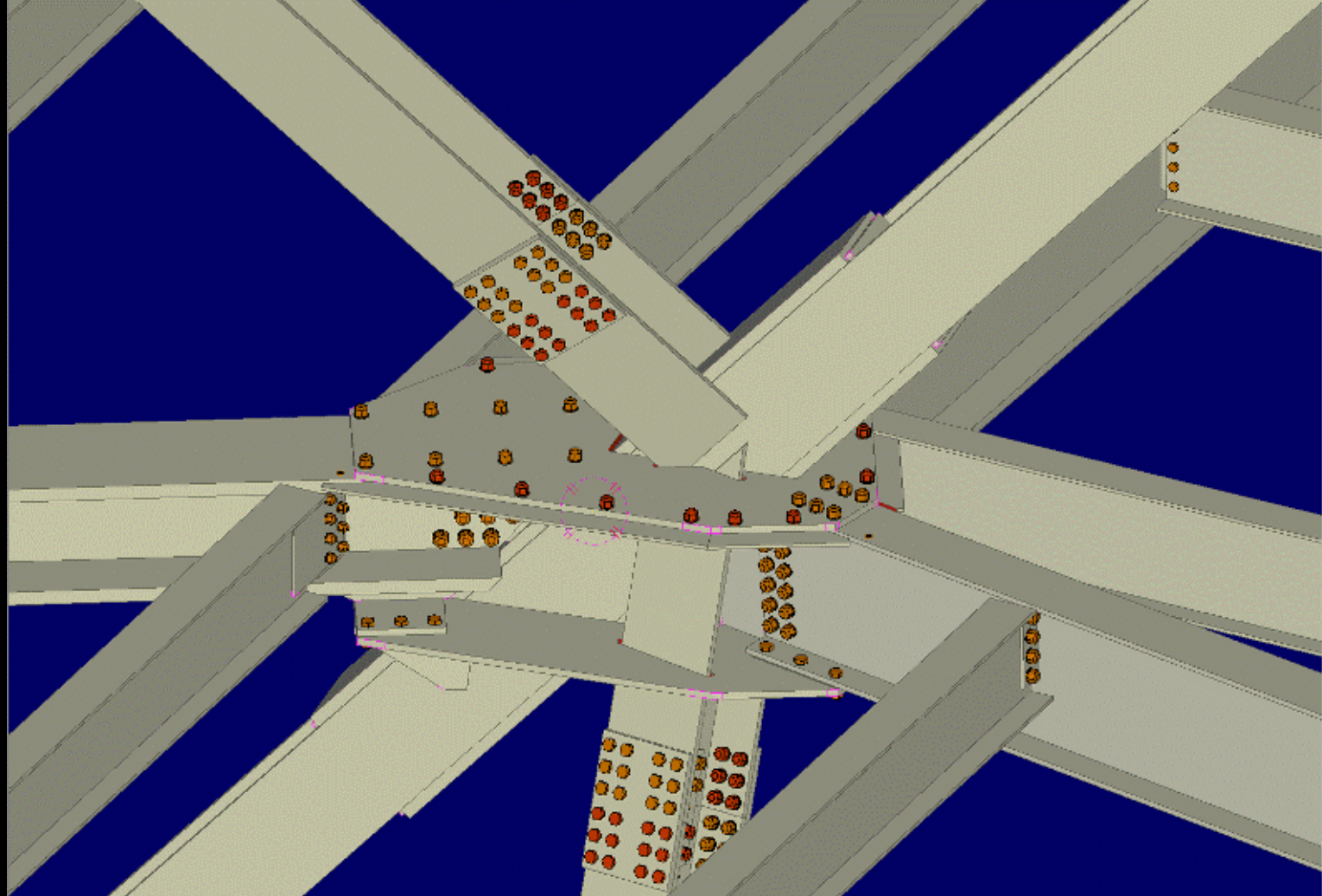
































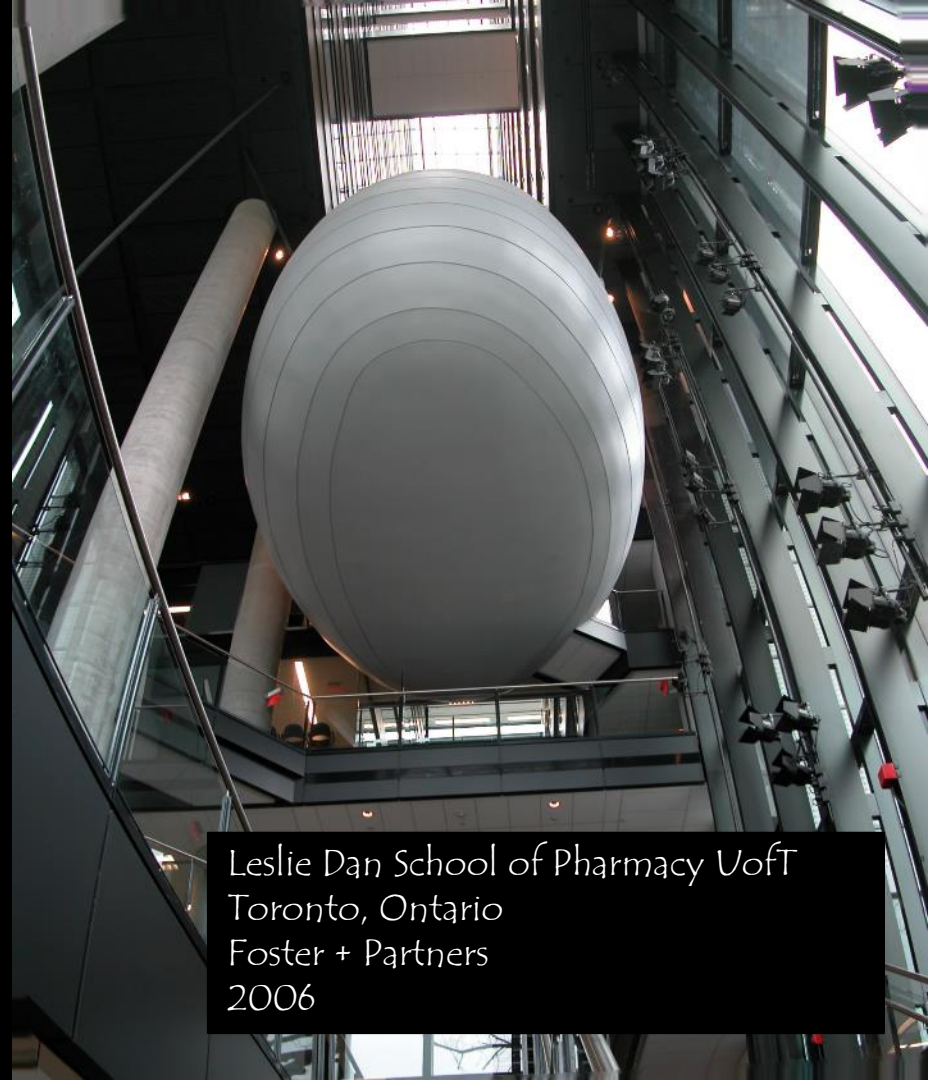




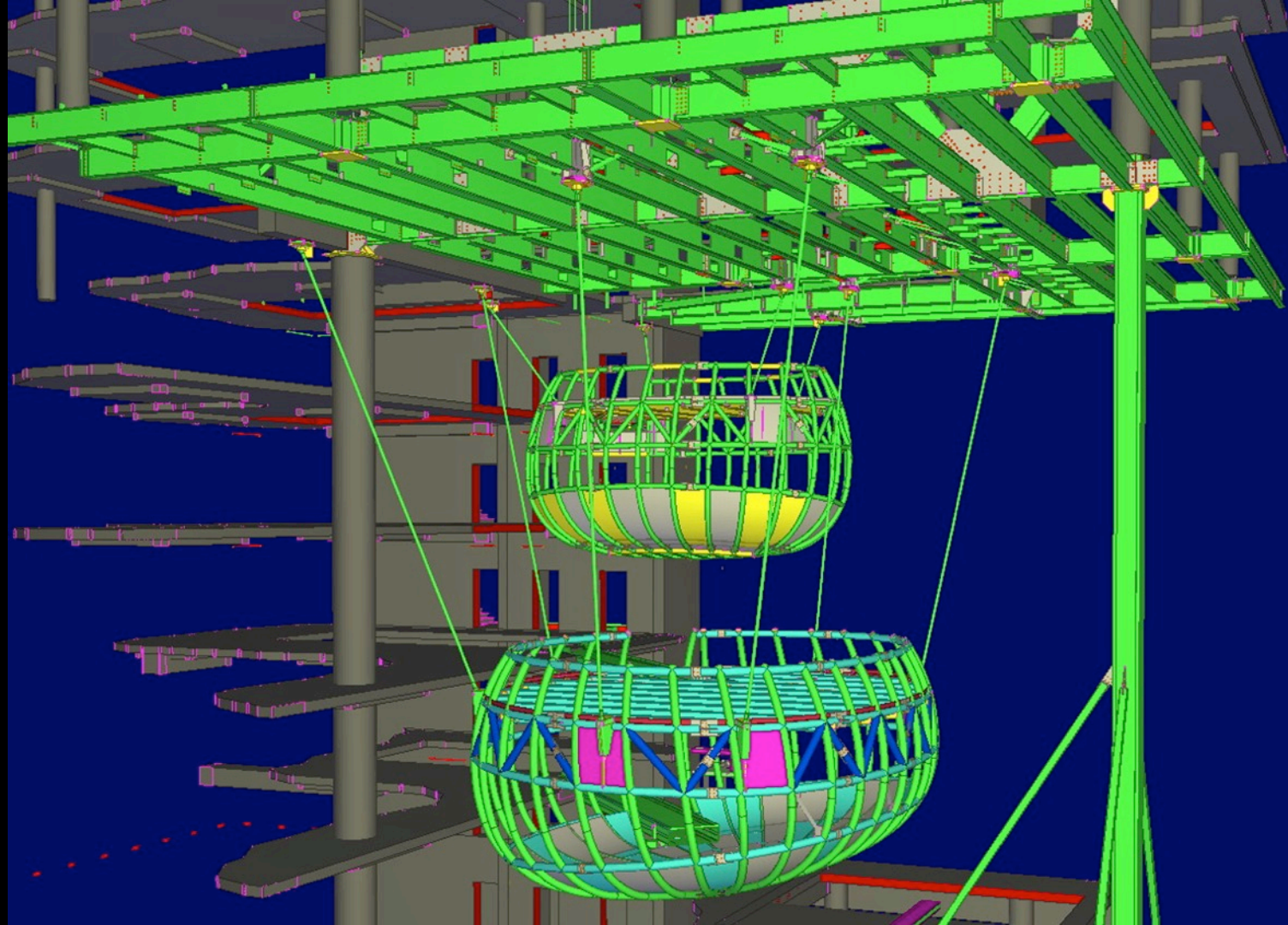


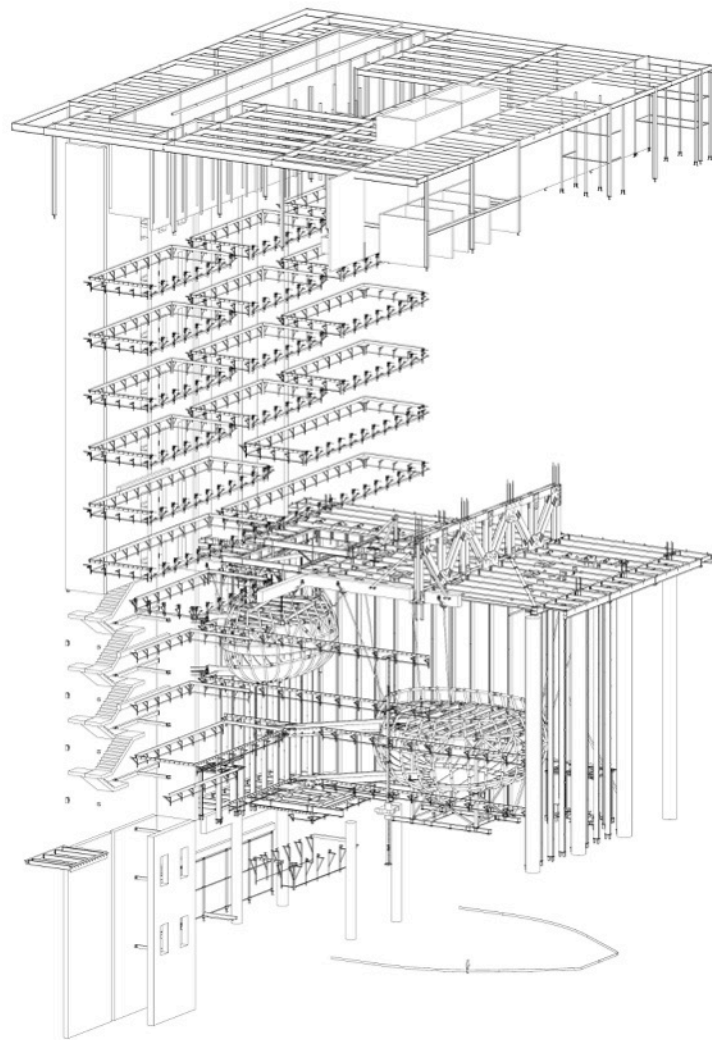


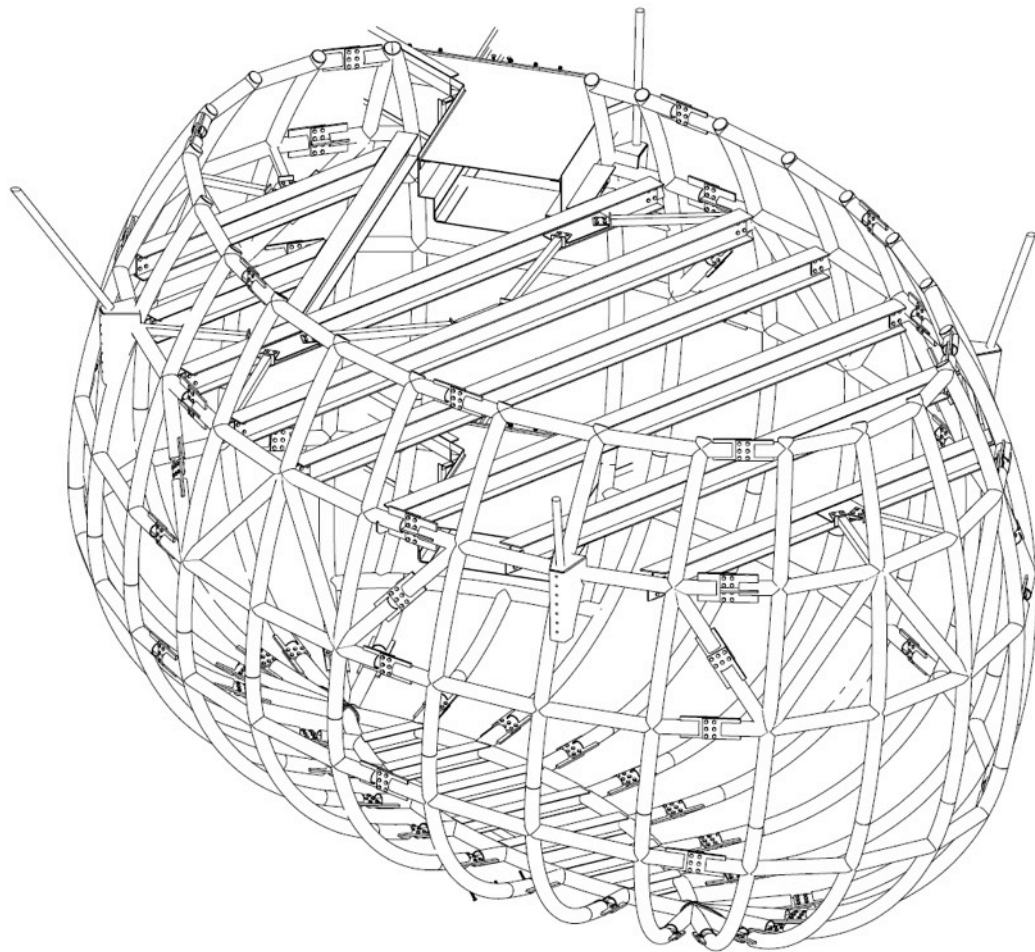


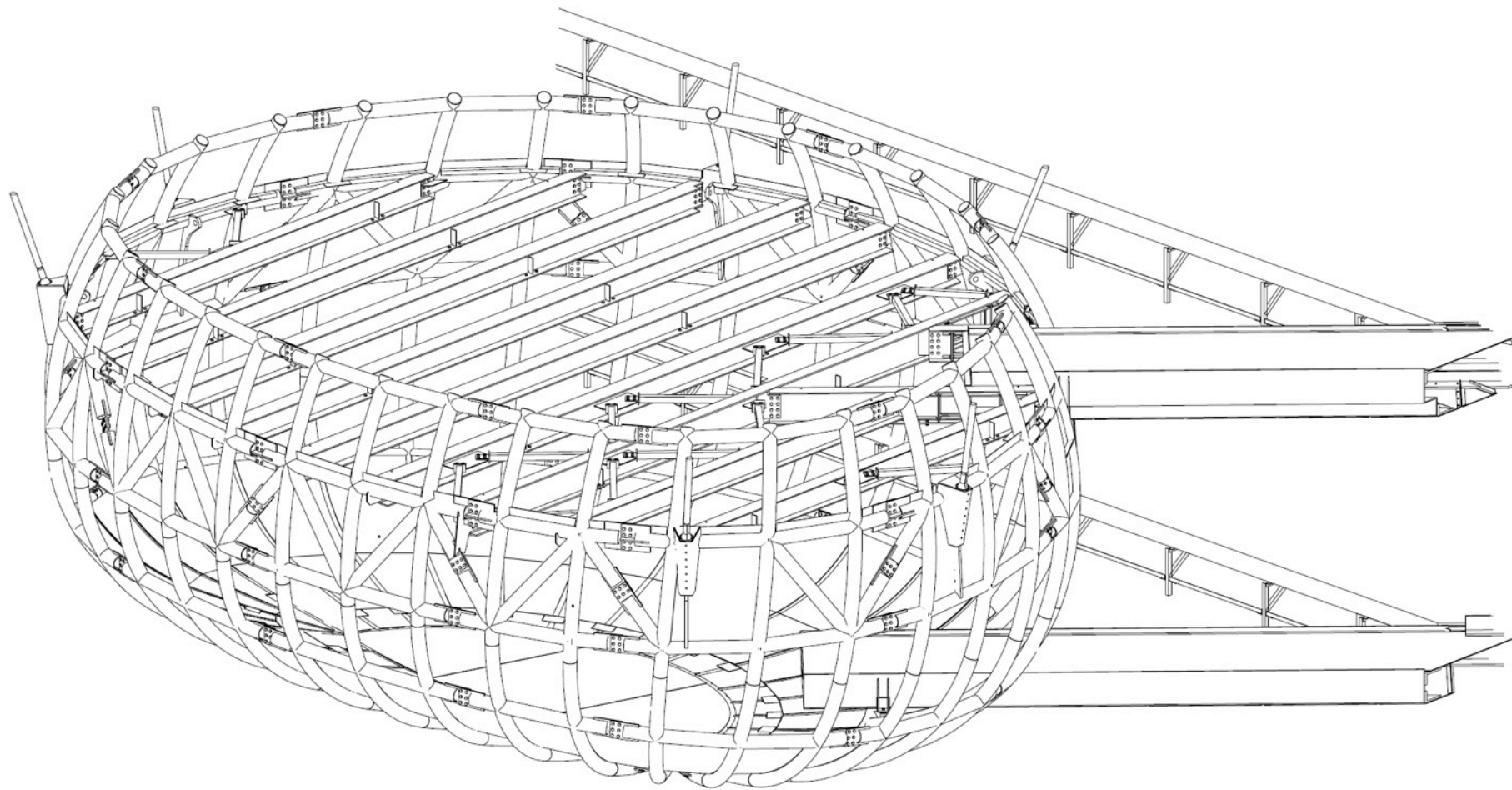


Leslie Dan School of Pharmacy UofT
Toronto, Ontario
Foster + Partners
2006













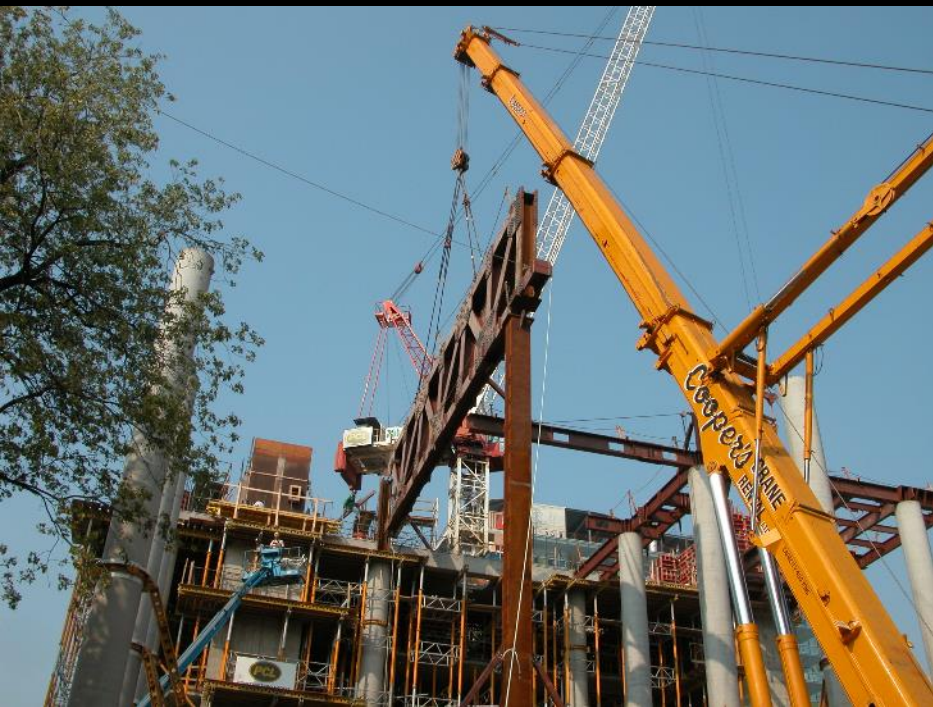






















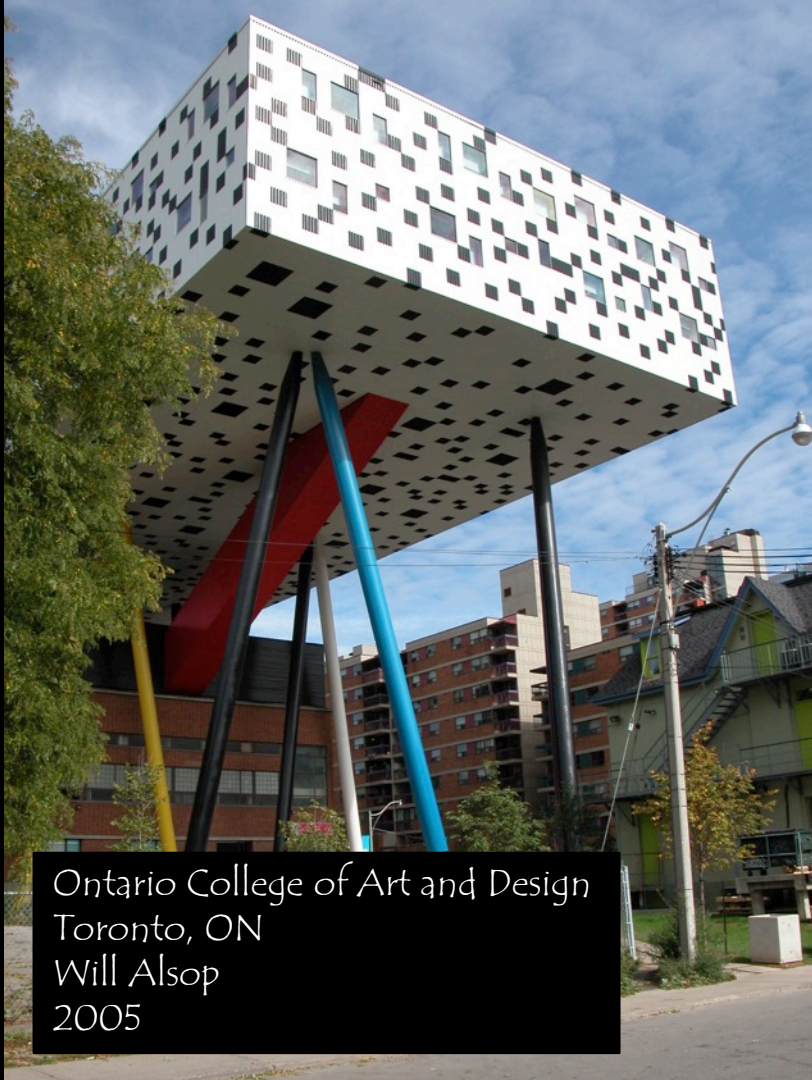




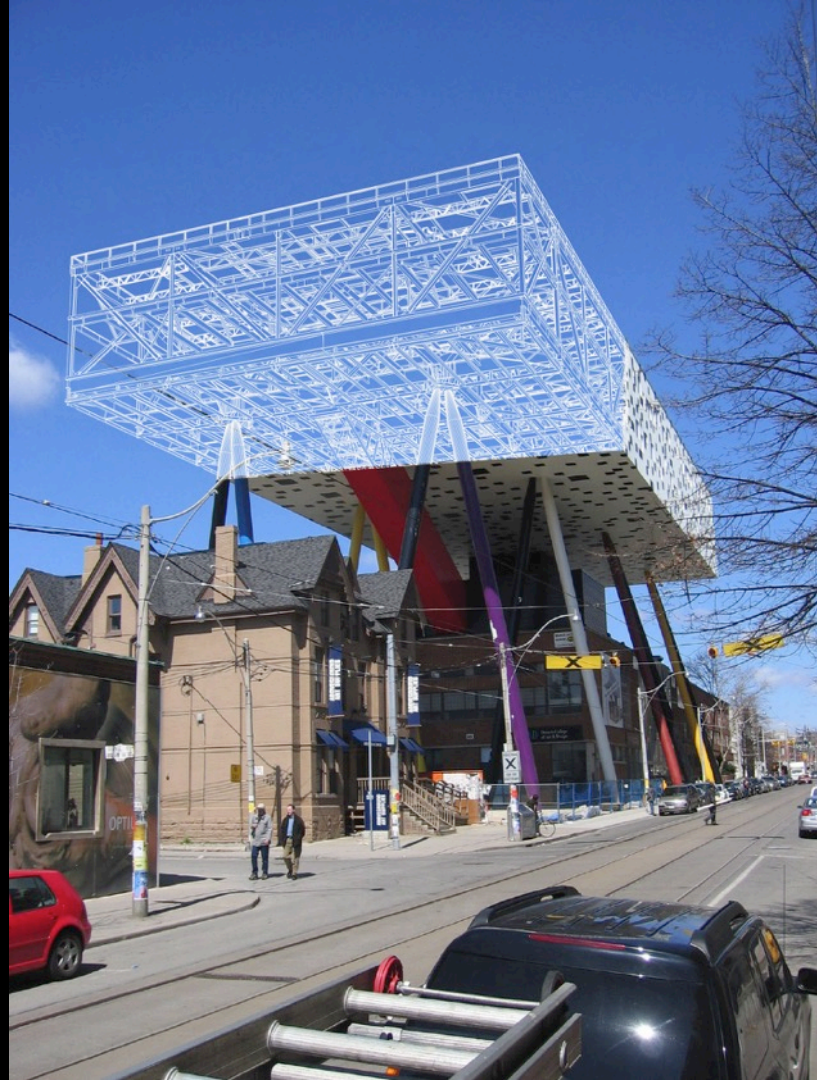


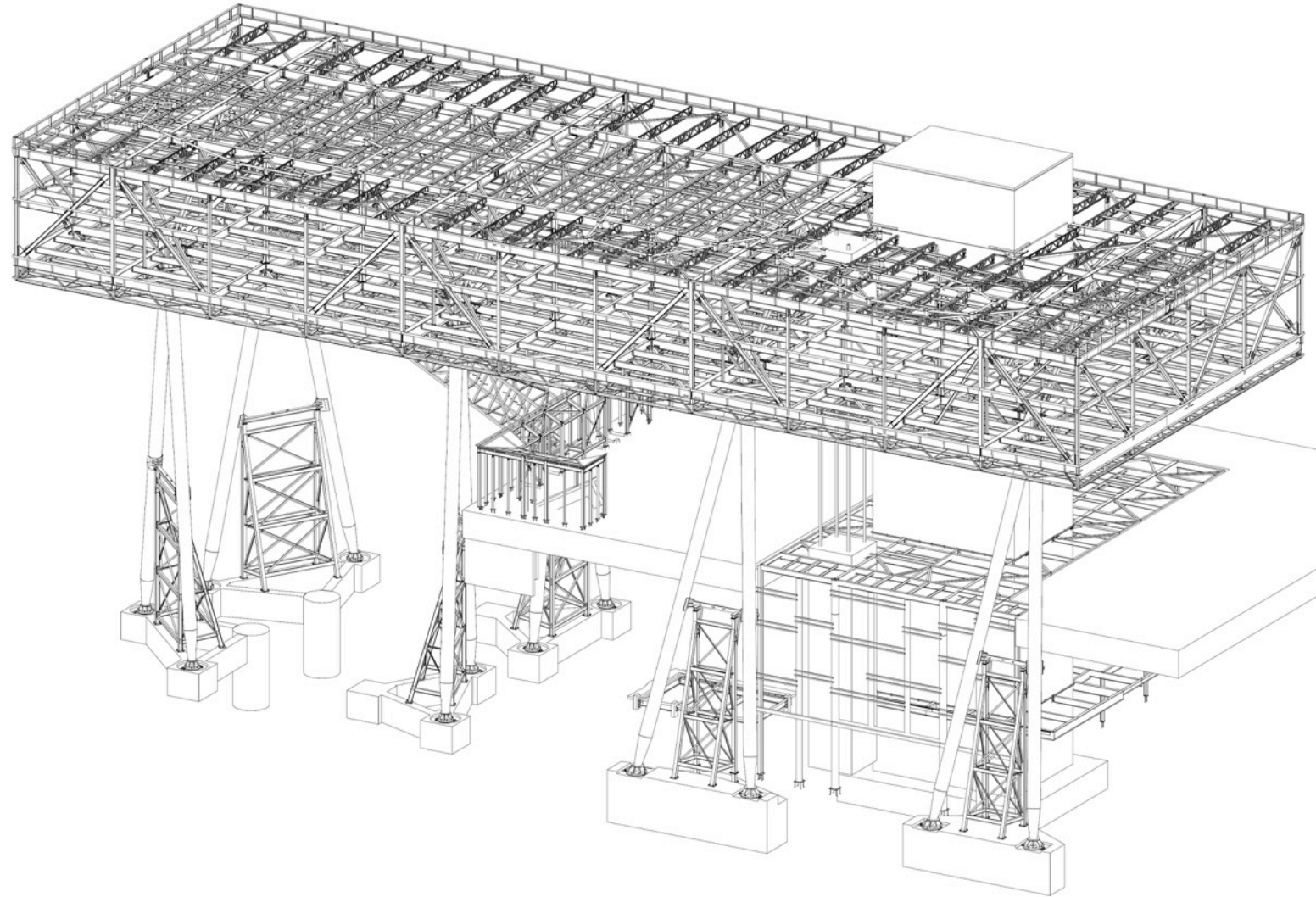


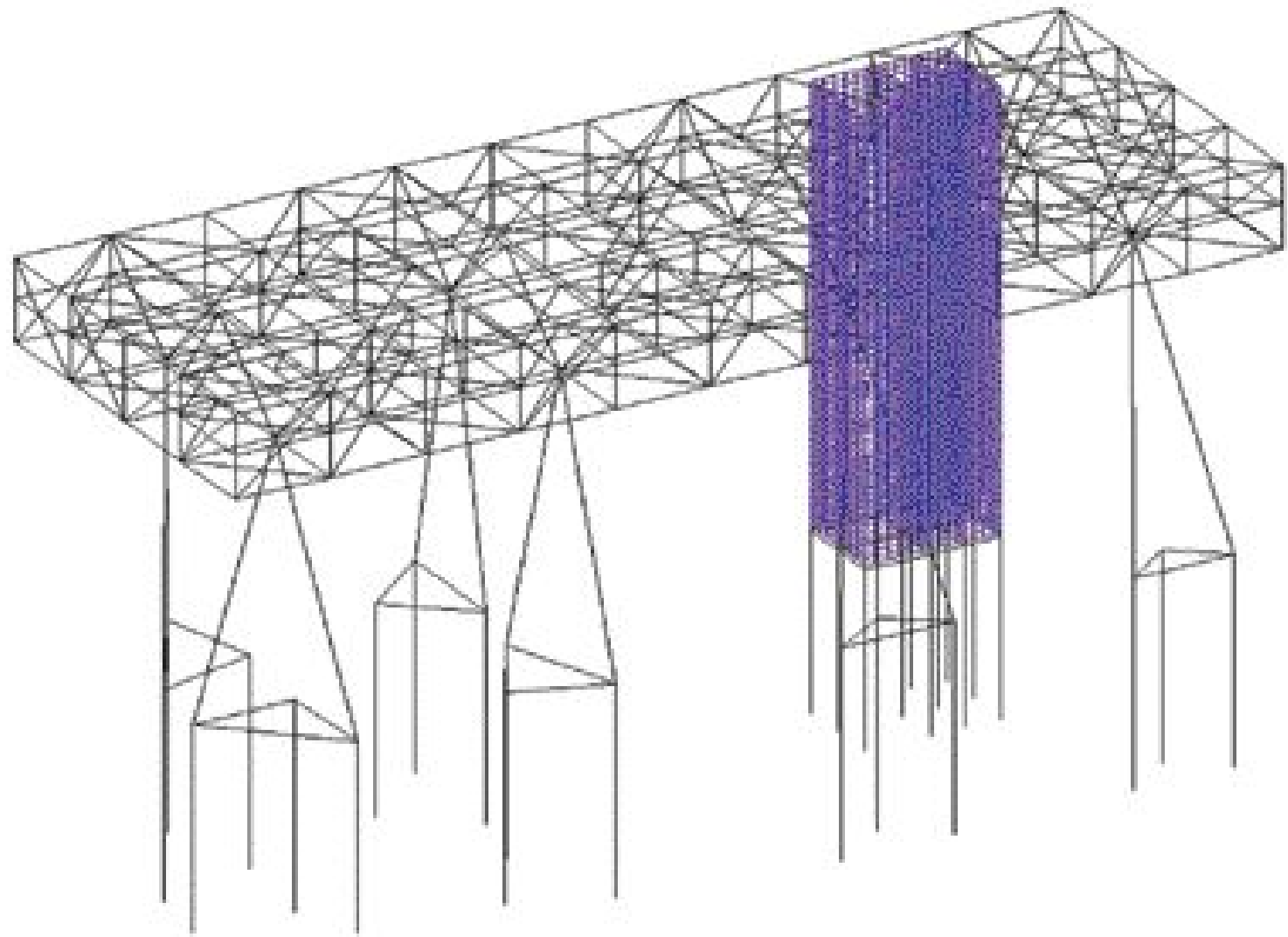


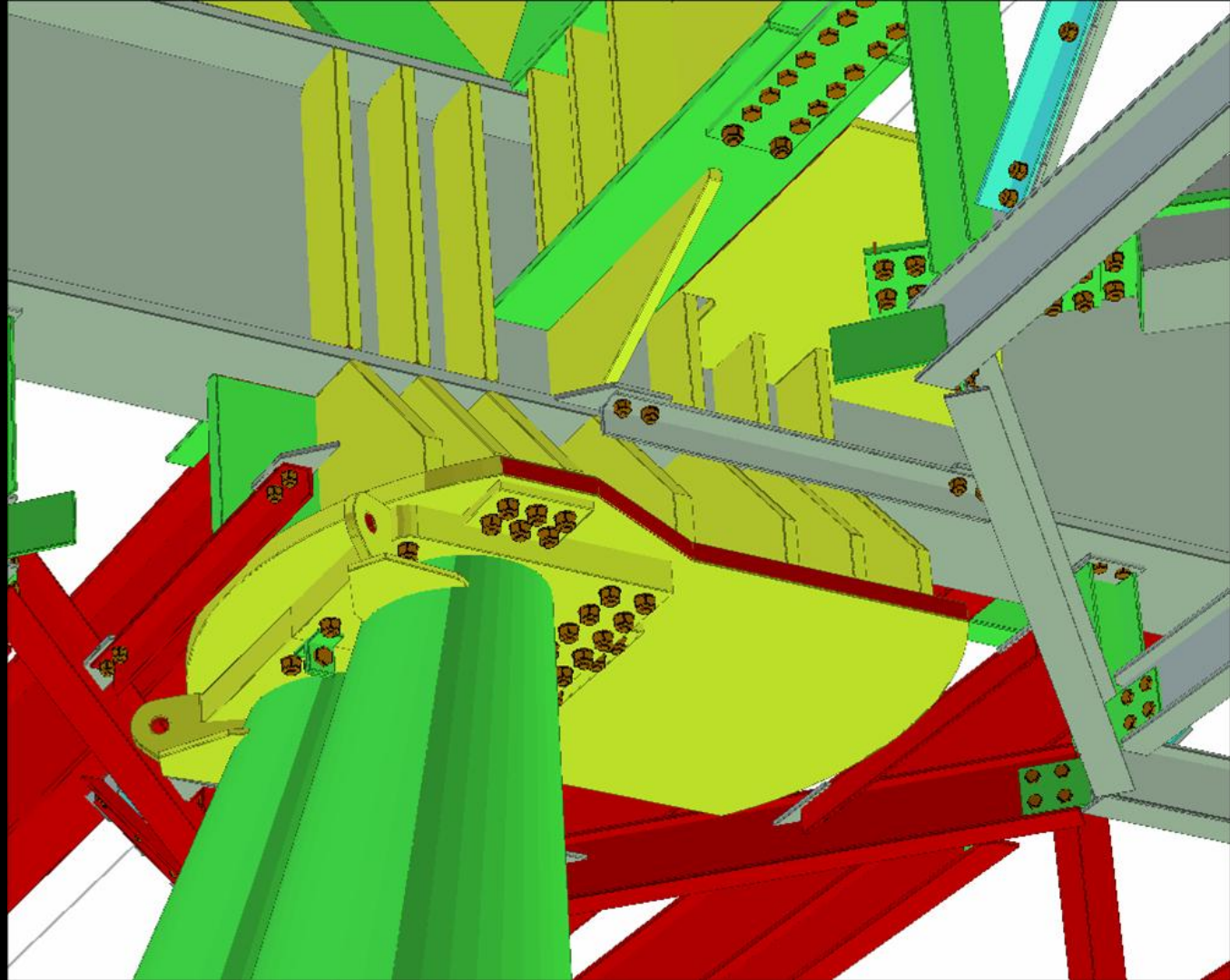


Ontario College of Art and Design
Toronto, ON
Will Alsop
2005













2003 7 9









2003 7 9







2003 7 16



2003 7 28





2003 7 31



2003 8 14

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with you.











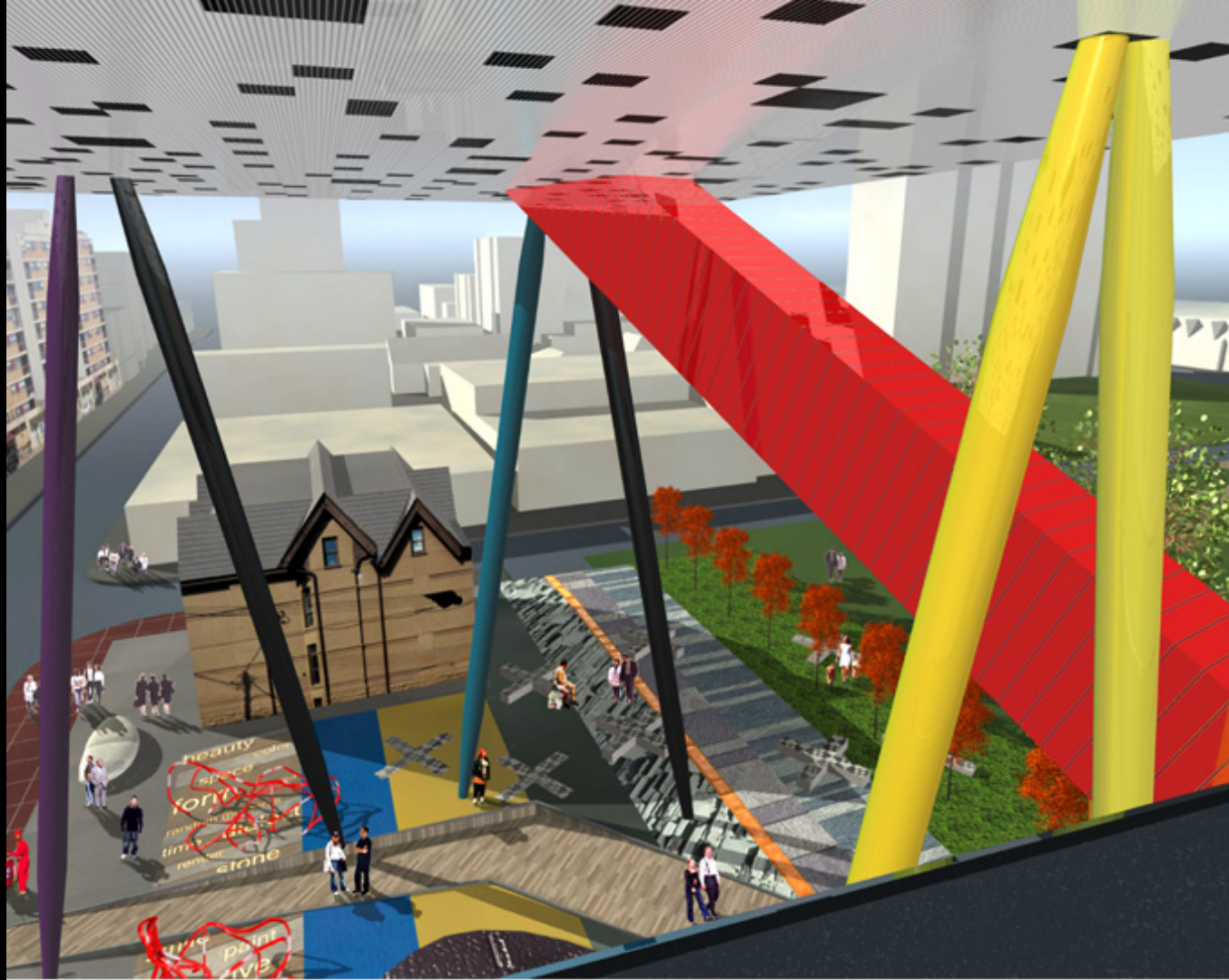




2003-10-8















Terri Meyer Boake, BES, BArch, MArch, LEED AP
Professor School of Architecture University of Waterloo
email: tboake@uwaterloo.ca



Renaissance Hotel, Barcelona, Spain - Ateliers Jean Nouvel

Arch 570:
Architecturally
Exposed Structural
Steel Design

Fall 2021
Course Home Page

course outline

last updated November 27, 2021 2:24 PM

Territorial Acknowledgement

We acknowledge that the School of Architecture is located on the traditional territory of the Neutral, Anishinaabeg and Haudenosaunee peoples. The University is situated on the Haldimand Tract, the land promised to the Six Nations that includes 10 kilometres on each side of the Grand River. (see references here: <https://uwaterloo.ca/engineering/about/territorial-acknowledgement>)

Course Description:

THIS COURSE IS ALL ABOUT DESIGN, NOT CALCULATIONS. LEARNING OUTCOMES INCLUDE AN INCREASE IN YOUR ABILITY TO UNDERSTAND HOW STRUCTURES WORK, AND DETAIL THE SAME. PORTFOLIO WORTHY DESIGN PROJECTS.

Using an international database of case studies this course examines in detail the architectural design, specification, fabrication and construction process for Architecturally Exposed Structural Steel (AESS). It references the standards that were developed by the Canadian Institute of Steel Construction. Lectures will address topics including, the AESS Category Approach, fabrication standards and practices, project communication, tensile structures, diagrid structures, curved steel, castings, pedestrian bridges, steel with glazing, steel with timber. The work of the term will use current steel based competitions to explore detailed design application of the material.



Unless you take my Arch
570 elective in 3B!

