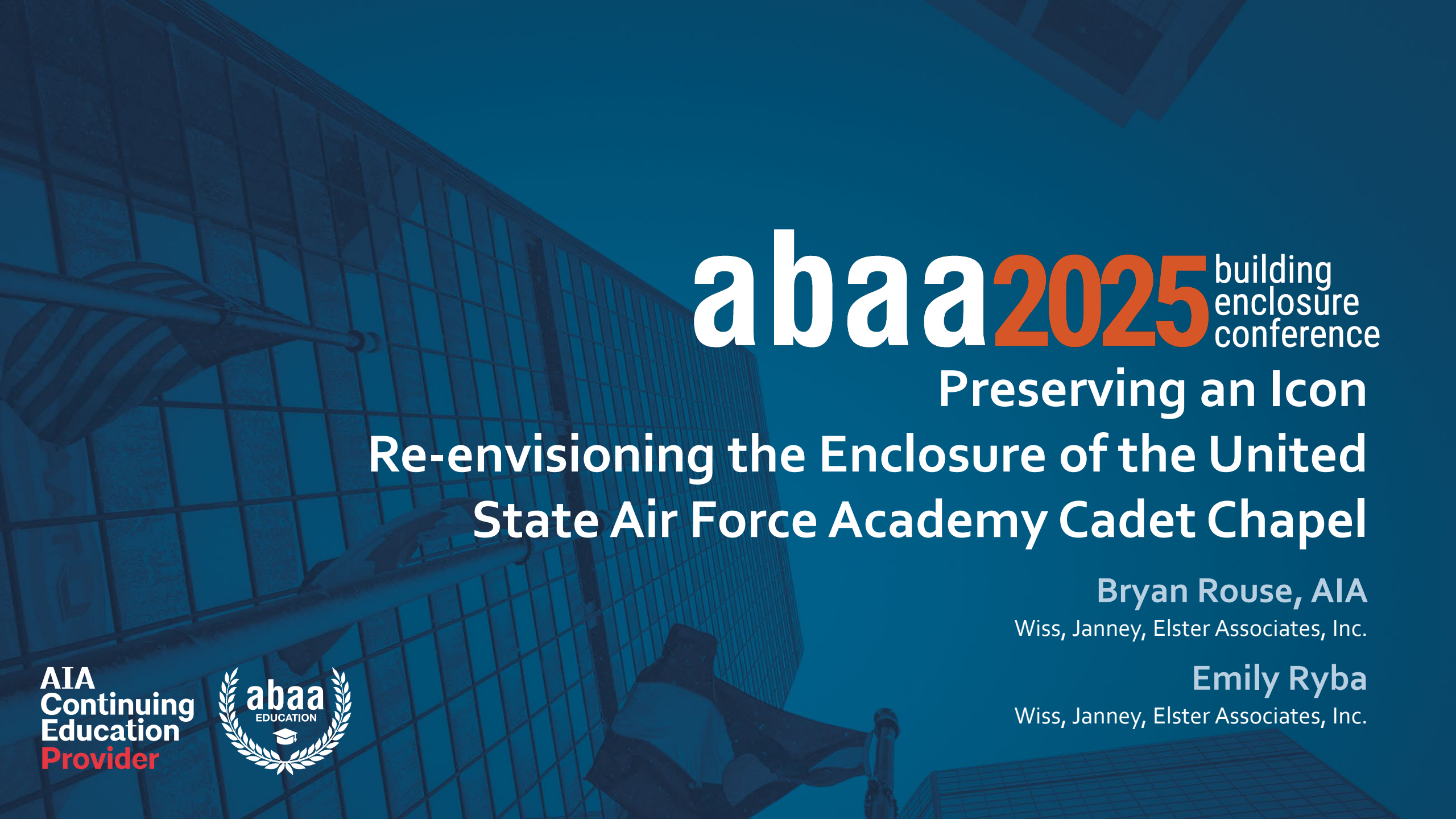


abaa 2025 building enclosure conference

Preserving an Icon

Re-envisioning the Enclosure of the United State Air Force Academy Cadet Chapel

Bryan Rouse, AIA
Wiss, Janney, Elster Associates, Inc.

Emily Ryba
Wiss, Janney, Elster Associates, Inc.

AIA Continuing Education Provider

abaa EDUCATION

Bryan Rouse, AIA

Associate Principal
WJE

Emily Ryba

Associate III
WJE

Preserving an Icon Re-envisioning the Enclosure of the United State Air Force Academy Cadet Chapel

The United States Airforce Academy Cadet Chapel, an award winning National Historic Landmark, exemplifies modernist architecture with its minimalist style and use of contemporary materials. Despite its brilliance, the building has experienced persistent water leakage to the interior since its construction.

This case study will explore the design challenges of integrating a modern rainscreen system behind a replication of the historic aluminum cladding, including the decision-making process leading to unique solutions for this distinctive building.

abaa building enclosure conference

Bryan Rouse, AIA

Since joining WJE in 1995, Bryan Rouse has performed hundreds of evaluations and investigations of distressed and deteriorated conditions in existing buildings and other structures. His responsibilities have included designing repairs, developing construction documents, and providing field observation services for repair work during the construction phase.

Emily Ryba

Emily Ryba is experienced in historical research and the production of construction documents for the repair and rehabilitation of historic buildings. She has assisted on surveys of buildings of contemporary and historic construction and has conducted facade and condition assessments and investigations, as well as numerous water penetration and air leakage testing procedures.

abaa EDUCATION

Learning Objectives

1. Identify the causes of water leakage issues in a significant, historic modernist structure.
2. Analyze the building enclosure design and water management system of the existing building compared to the current repair design.
3. Discuss determination and implementation of the design-phase performance mock-up process for the repair design.
4. Evaluate the results and lessons learned from the mock-up construction and testing to inform the final repair design.

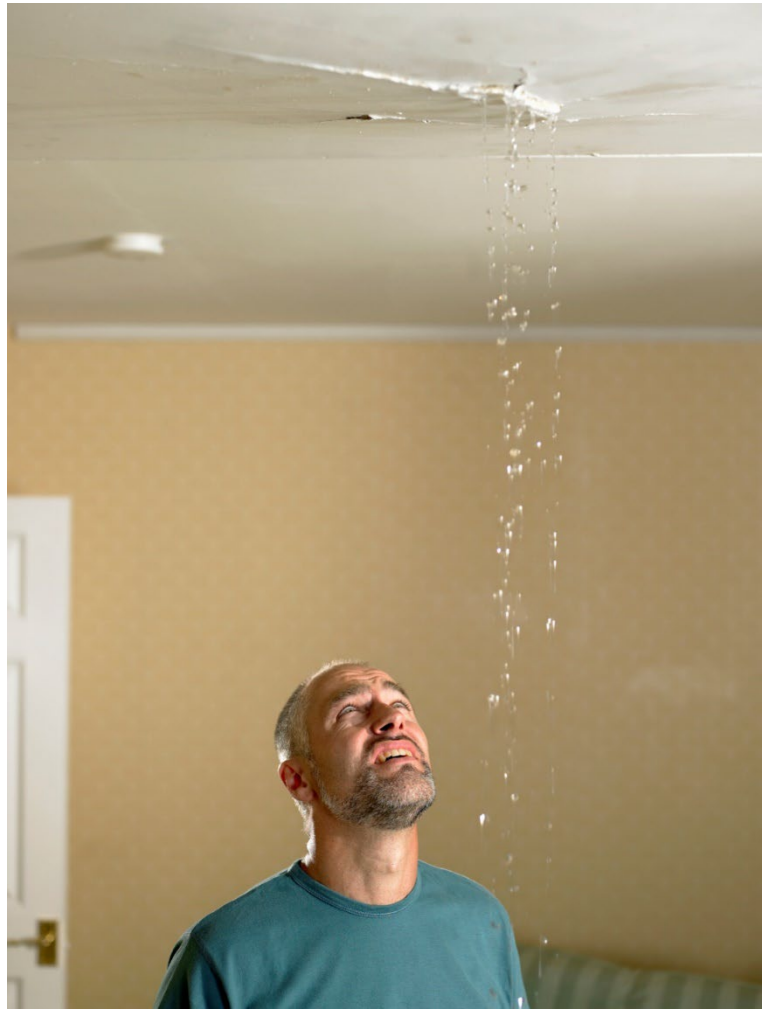
PROJECT HISTORY

PROJECT HISTORY

- Designed by Walter Netsch at SOM (Chicago)
- Built 57 years ago
  - Premiere example of modernist architecture
  - National Historic Landmark in 2004

PROJECT HISTORY

- Leaked Immediately

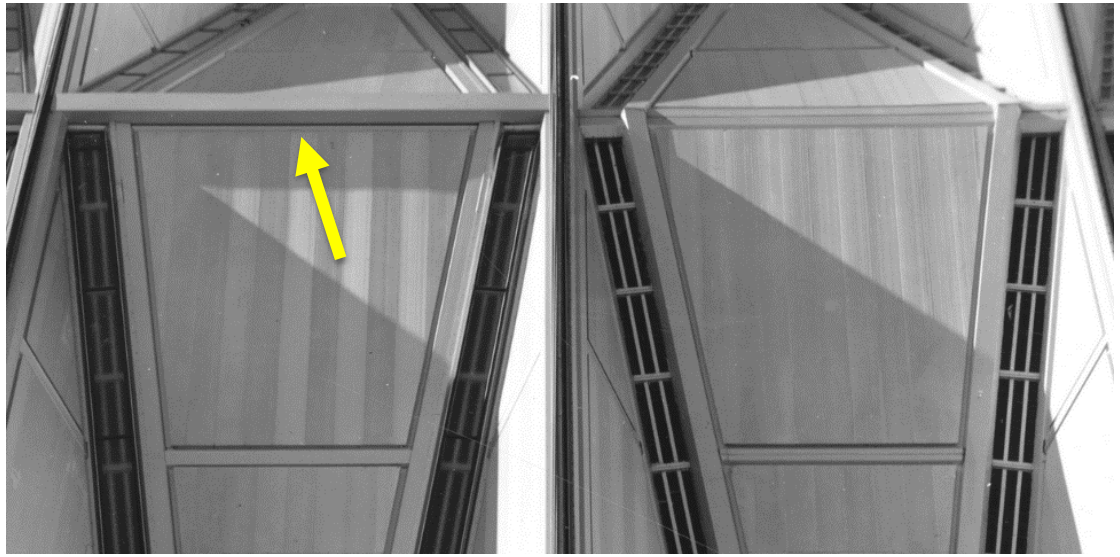


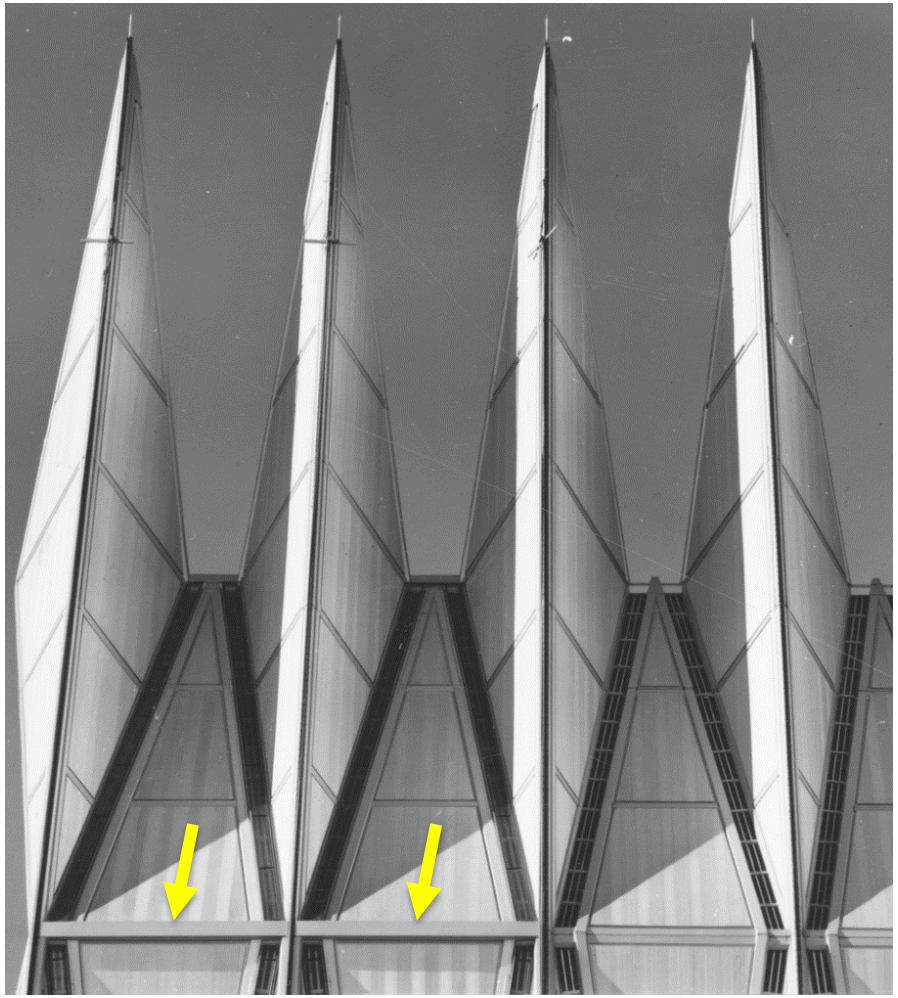
PROJECT HISTORY

- Leaked Immediately
  - Overclad some of the details

PROJECT HISTORY

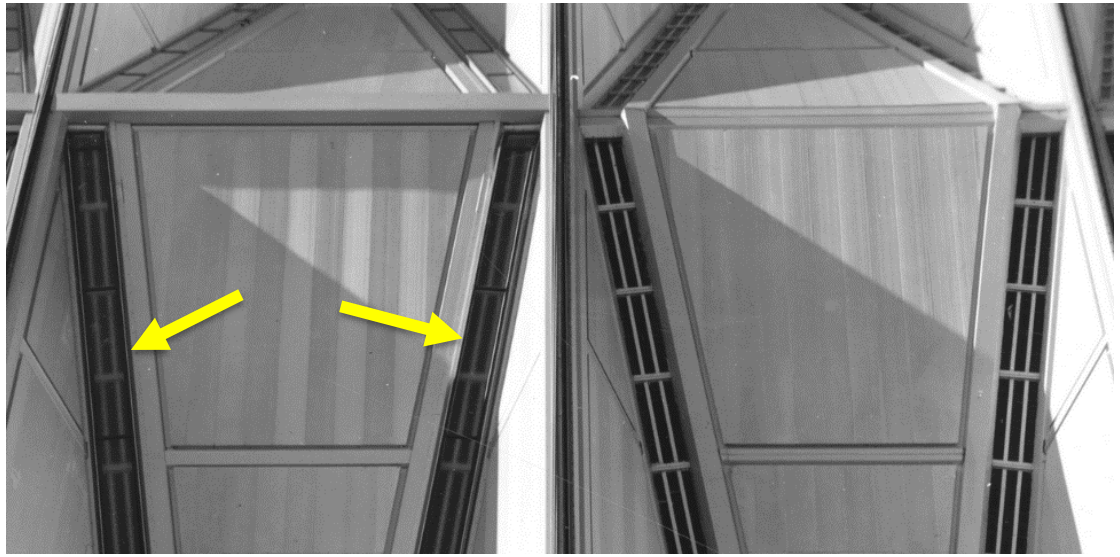
- Leaked Immediately
  - Overclad some of the details
  - Added gutters

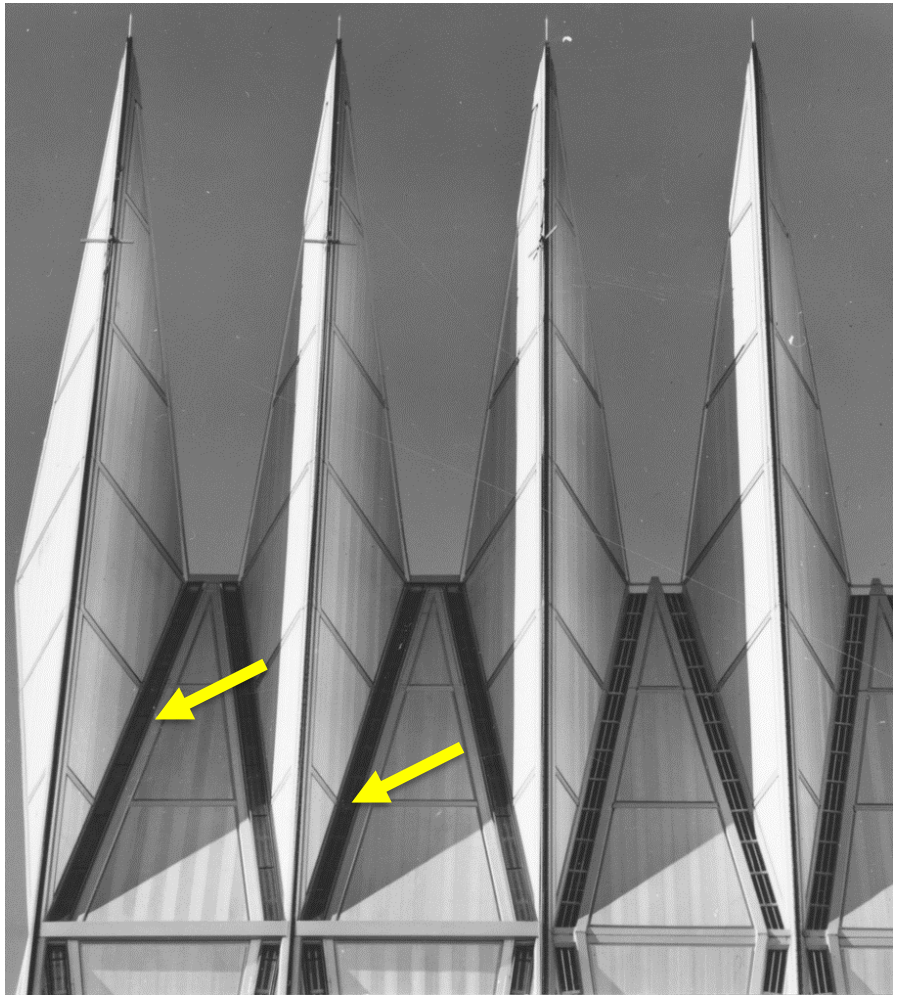




PROJECT HISTORY

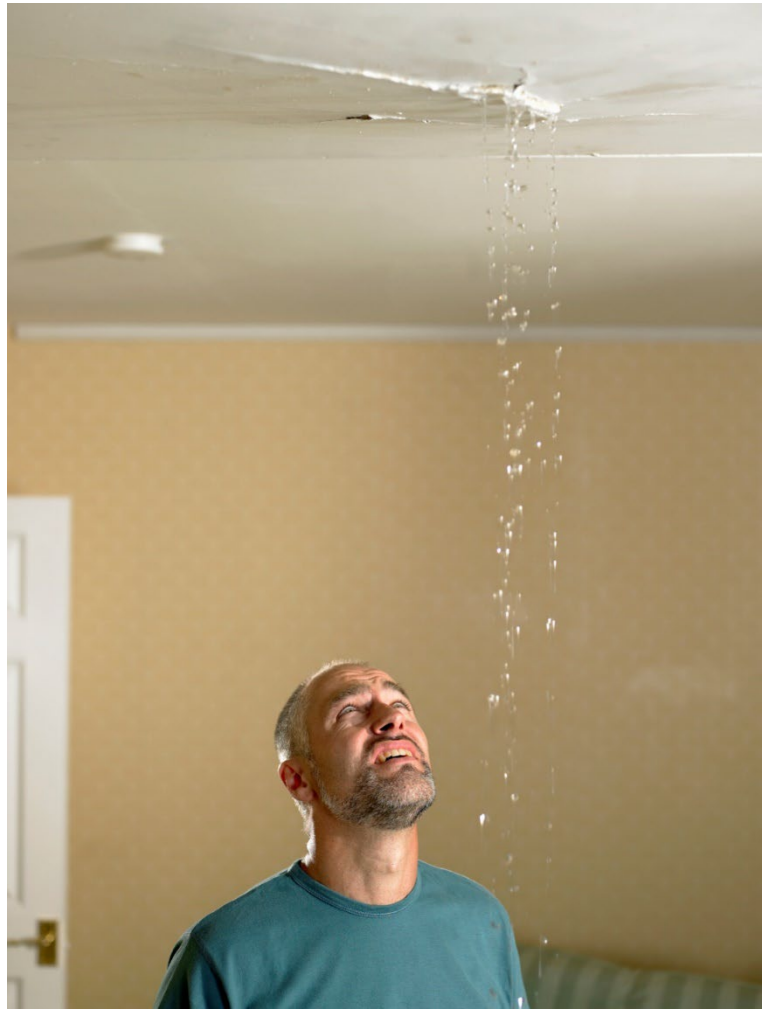
- Leaked Immediately
  - Overclad some of the details
  - Added gutters
  - Added storm windows





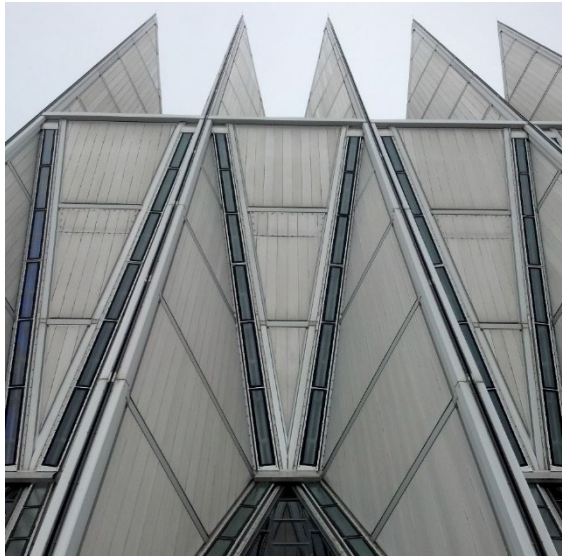
PROJECT HISTORY

- Leaked Immediately
  - Overclad some of the details
  - Added gutters
  - Added storm windows
- Still leaked



PROJECT HISTORY

- Leaked Immediately
  - Overclad some of the details
  - Added gutters
  - Added storm windows
- Still leaked
  - Second generation of storm window

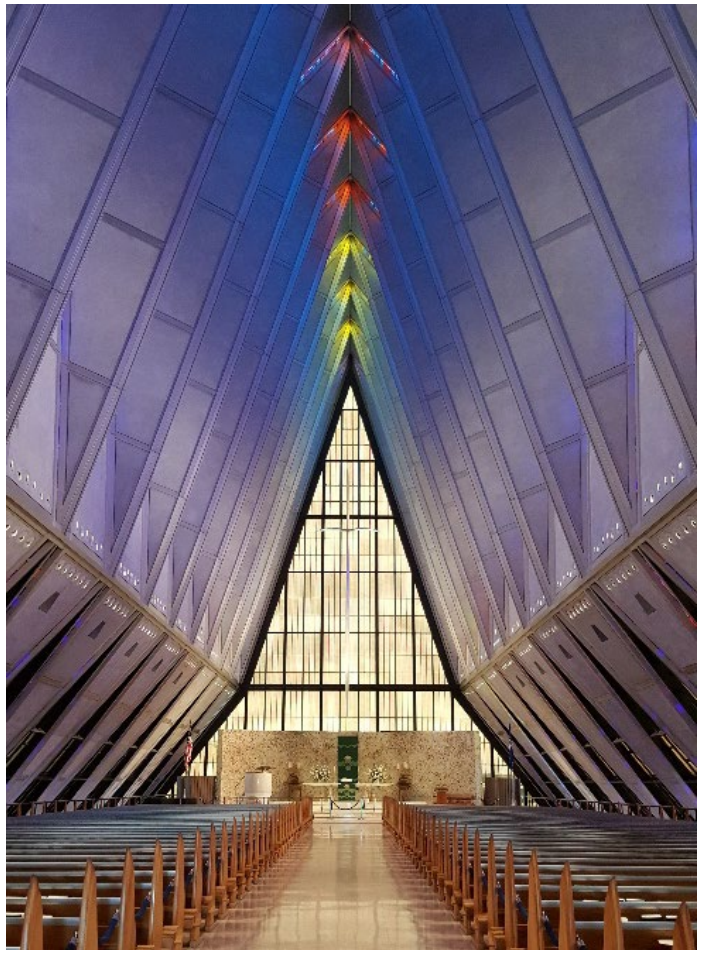


PROJECT HISTORY

- Leaked Immediately
  - Overclad some of the details
  - Added gutters
  - Added storm windows
- Still leaked
  - Second generation of storm window
  - Multiple campaigns of sealant on top of sealant

Chapel Restoration Design

Goal: Solve the water leakage without changing the appearance



Tetrahedron

[te-tr*uh*-**hee**-dr*uh*n]

Tetrahedron

[te-tr*uh*-**hee**-dr*uh*n]

"I started scribbling, drawing, trying to get a repetitive feature"

Ken [Nasland] said "What are you doing? Trying to draw a tetrahedon?"

I said, "**What's a tetrahedron**?"

– Walter Netsch, SOM Journal, 2001

OVERVIEW
Structure - Tetrahedron

Google

tetrahedron

OVERVIEW
Structure - Tetrahedron

WIKIPEDIA
The Free Encyclopedia

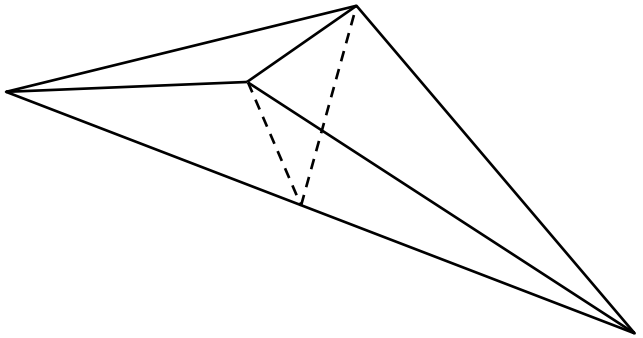
OVERVIEW
Structure - Tetrahedron

WIKIPEDIA
The Free Encyclopedia

…a tetrahedron is a polyhedron composed of four triangular faces, six straight edges, and four vertex corners. The tetrahedron is the simplest of all the ordinary convex polyhedra and the only one that has fewer than 5 faces.

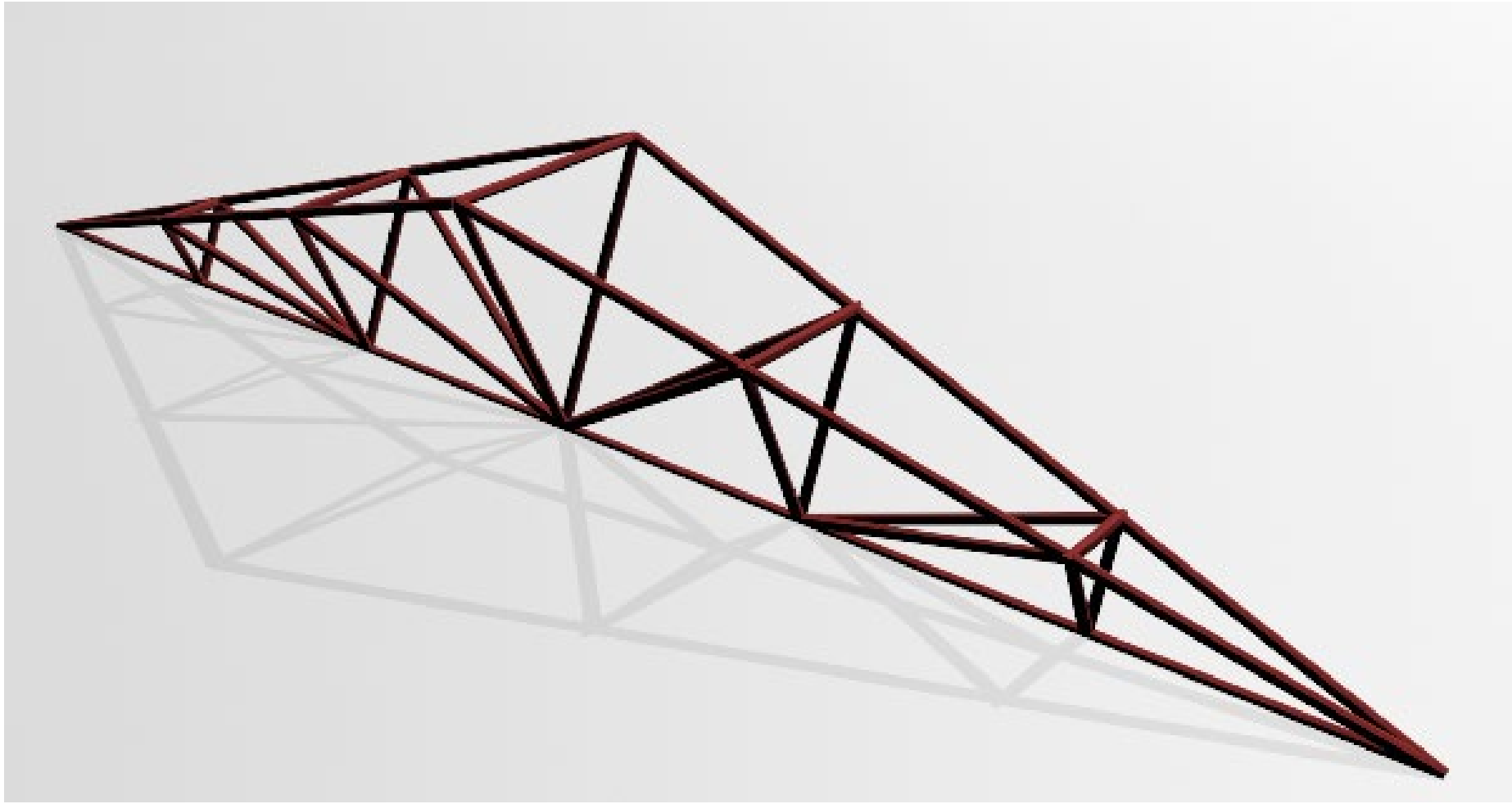
OVERVIEW
Structure - Tetrahedron

WIKIPEDIA
The Free Encyclopedia

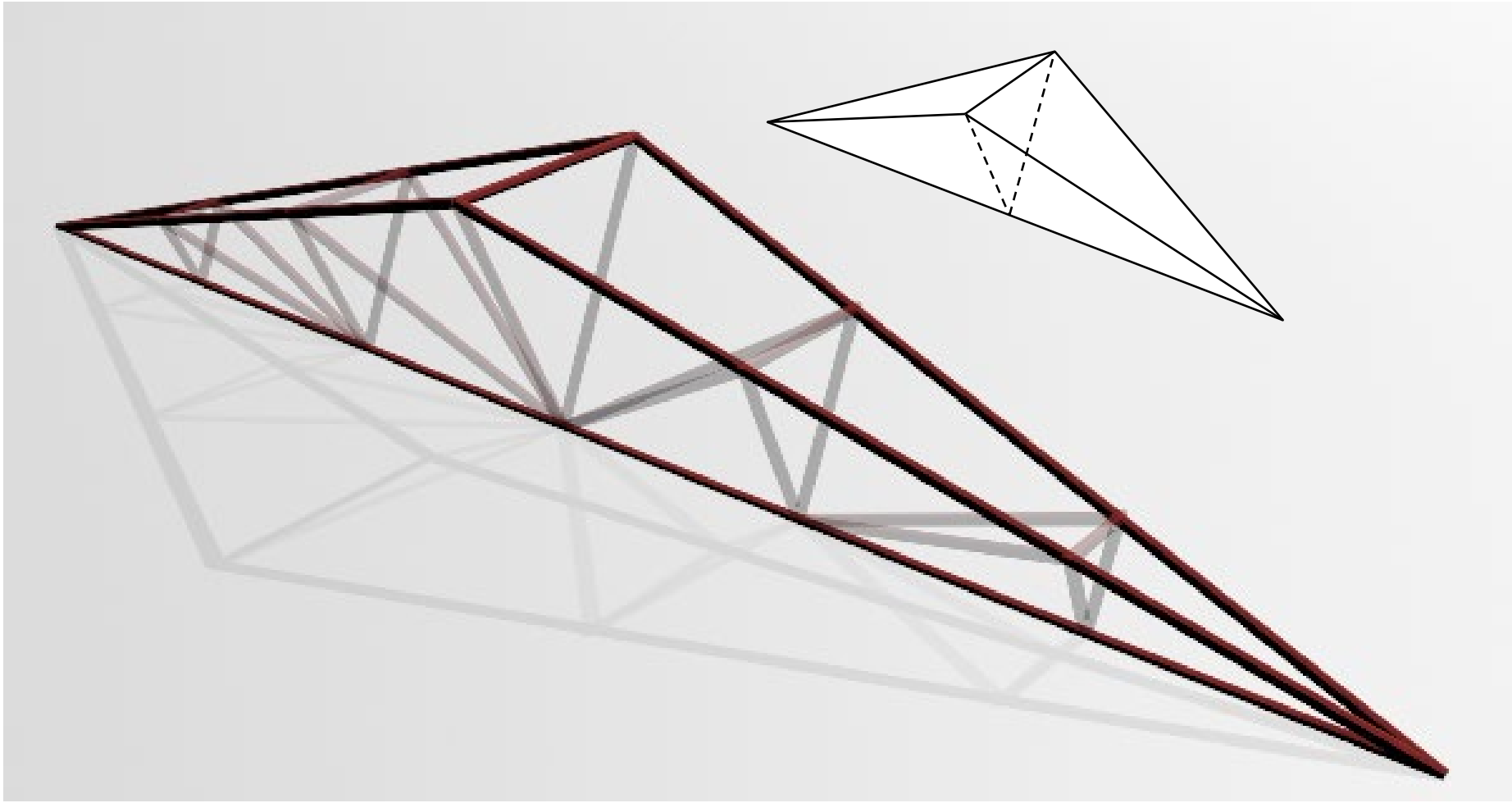


…a tetrahedron is a polyhedron composed of four triangular faces, six straight edges, and four vertex corners. The tetrahedron is the simplest of all the ordinary convex polyhedra and the only one that has fewer than 5 faces.

OVERVIEW
Structure - Tetrahedron

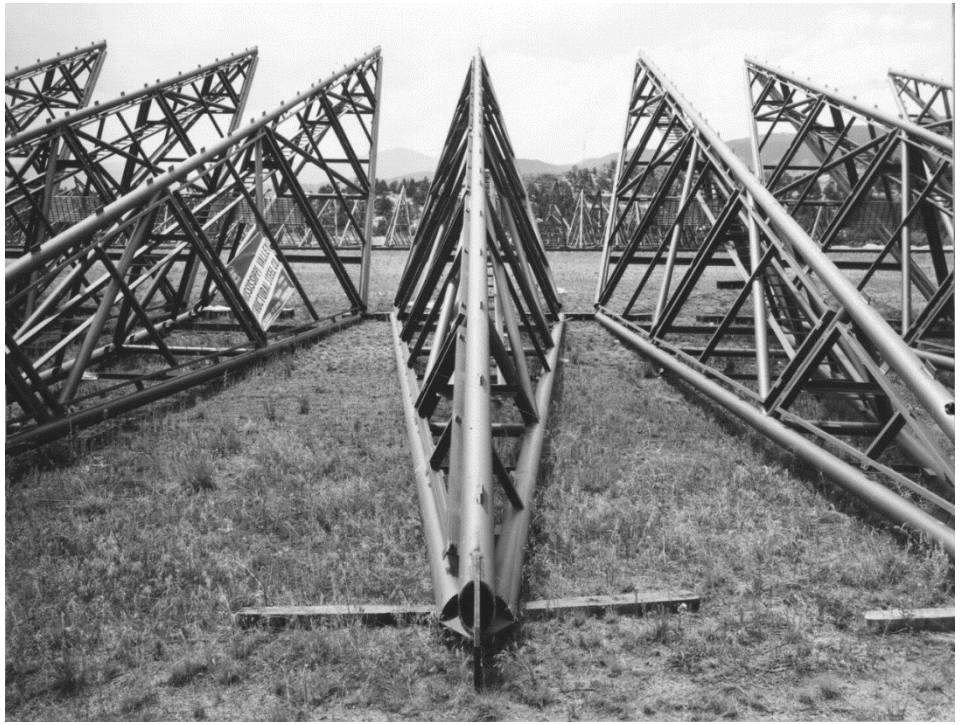


OVERVIEW
Structure - Tetrahedron

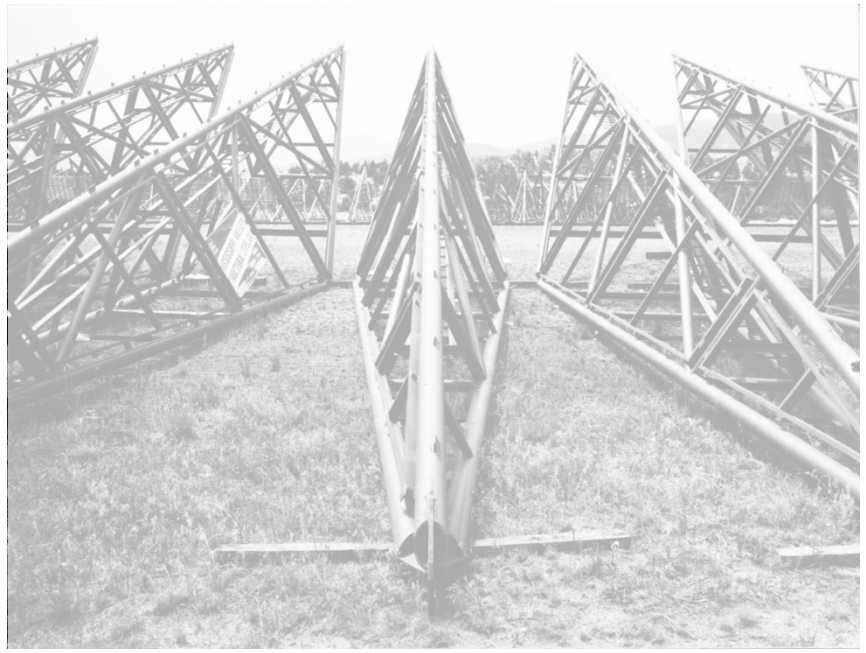


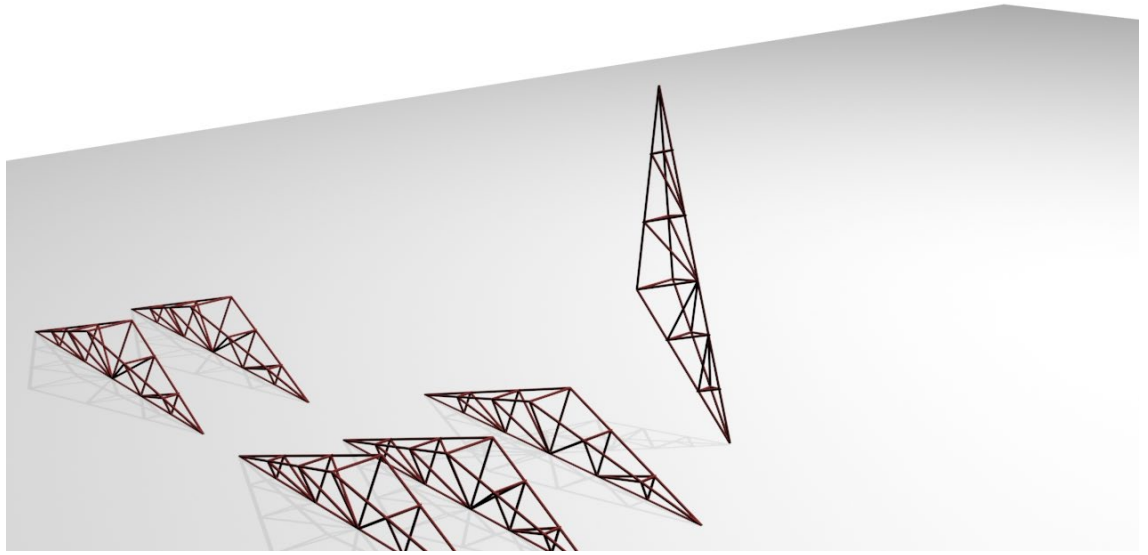
OVERVIEW
Structure - Tetrahedron

OVERVIEW
Structure - Tetrahedron

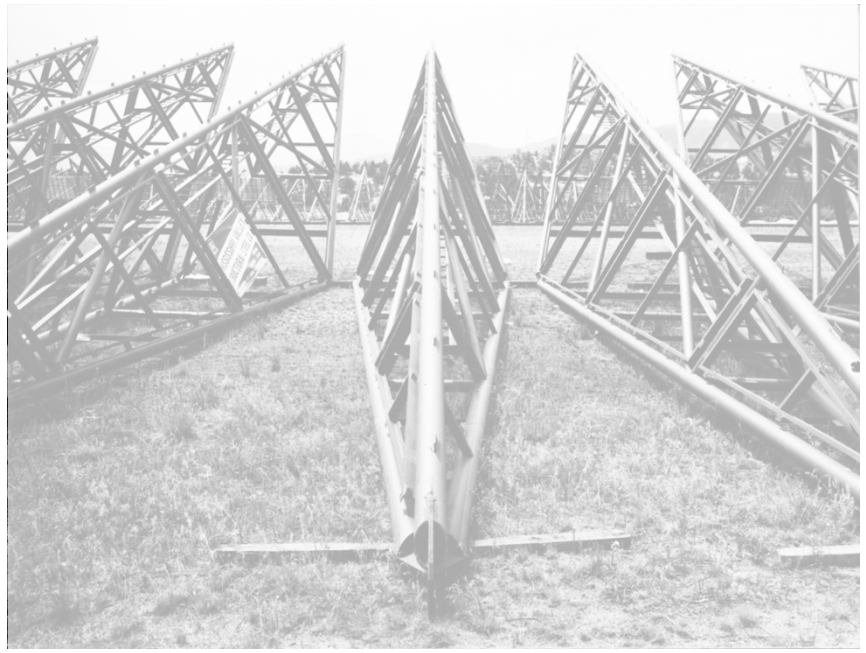


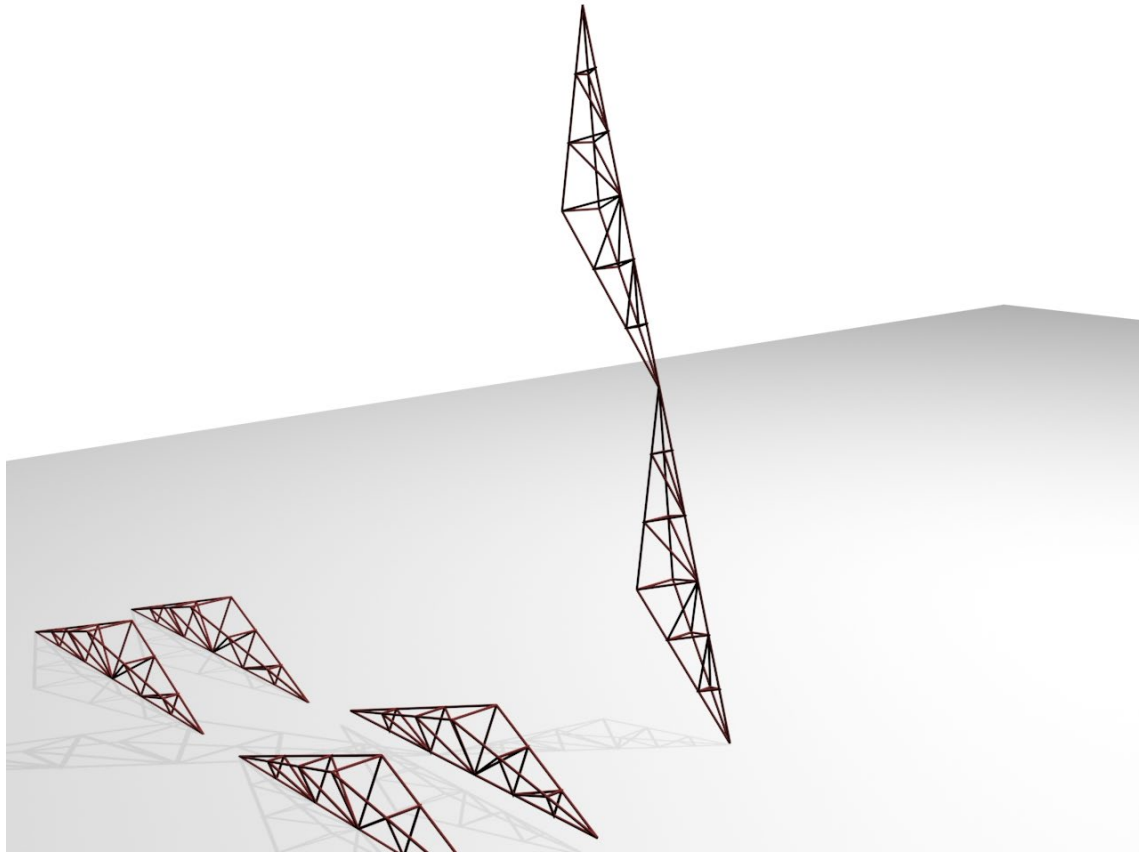
OVERVIEW
Structure - Tetrahedron



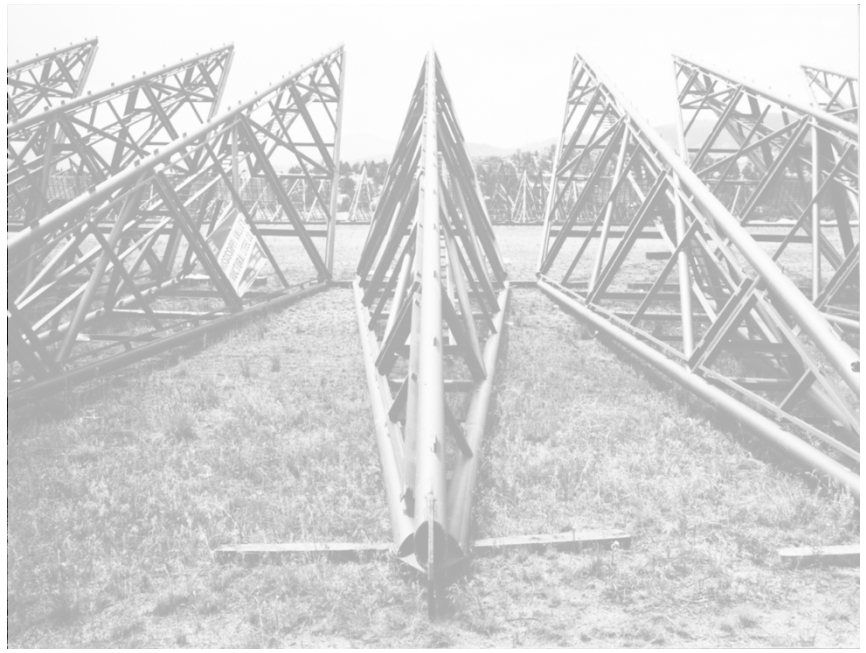


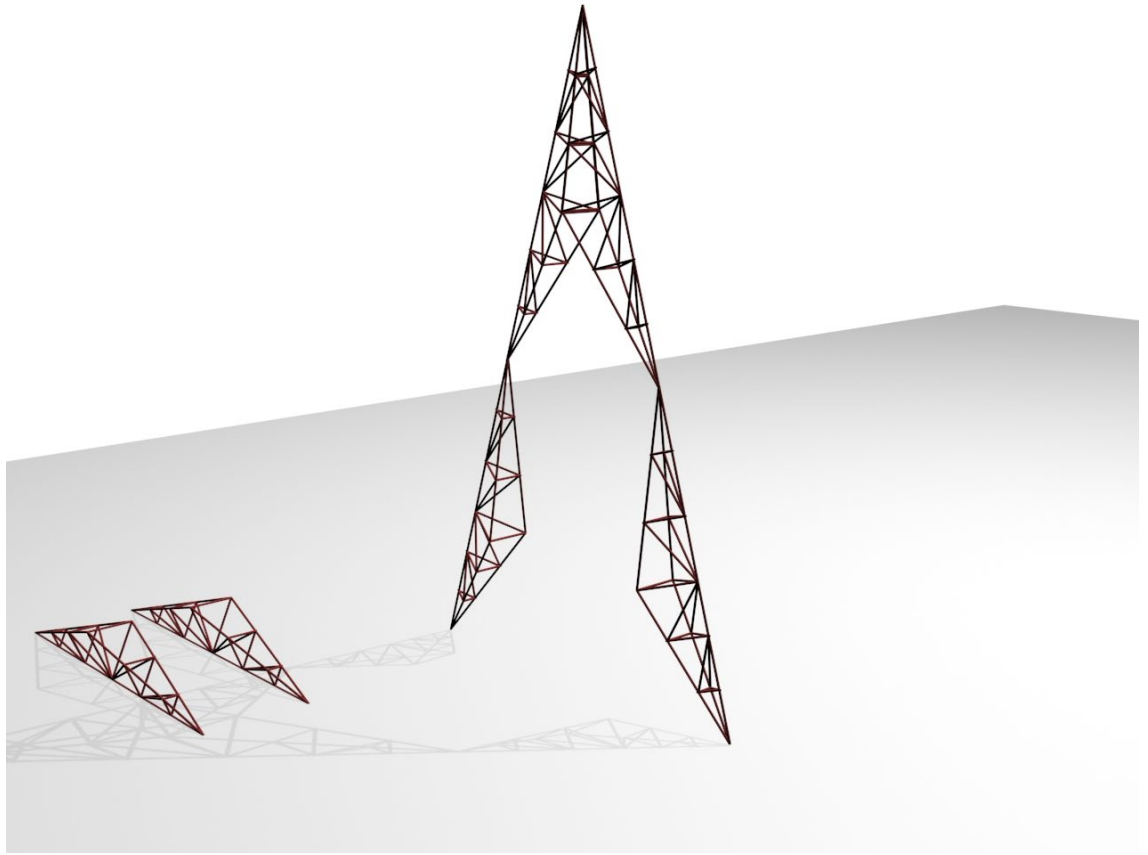
OVERVIEW
Structure - Tetrahedron



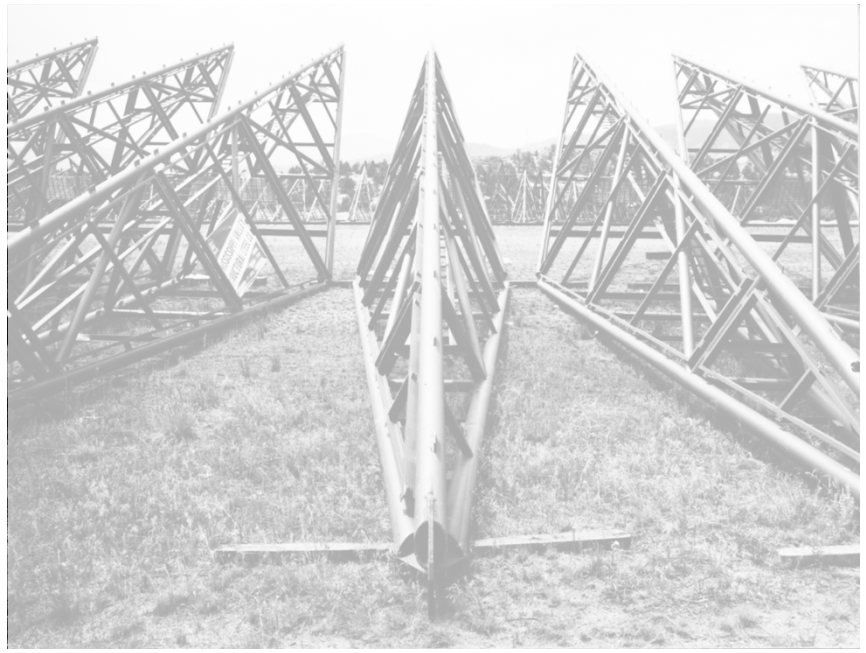


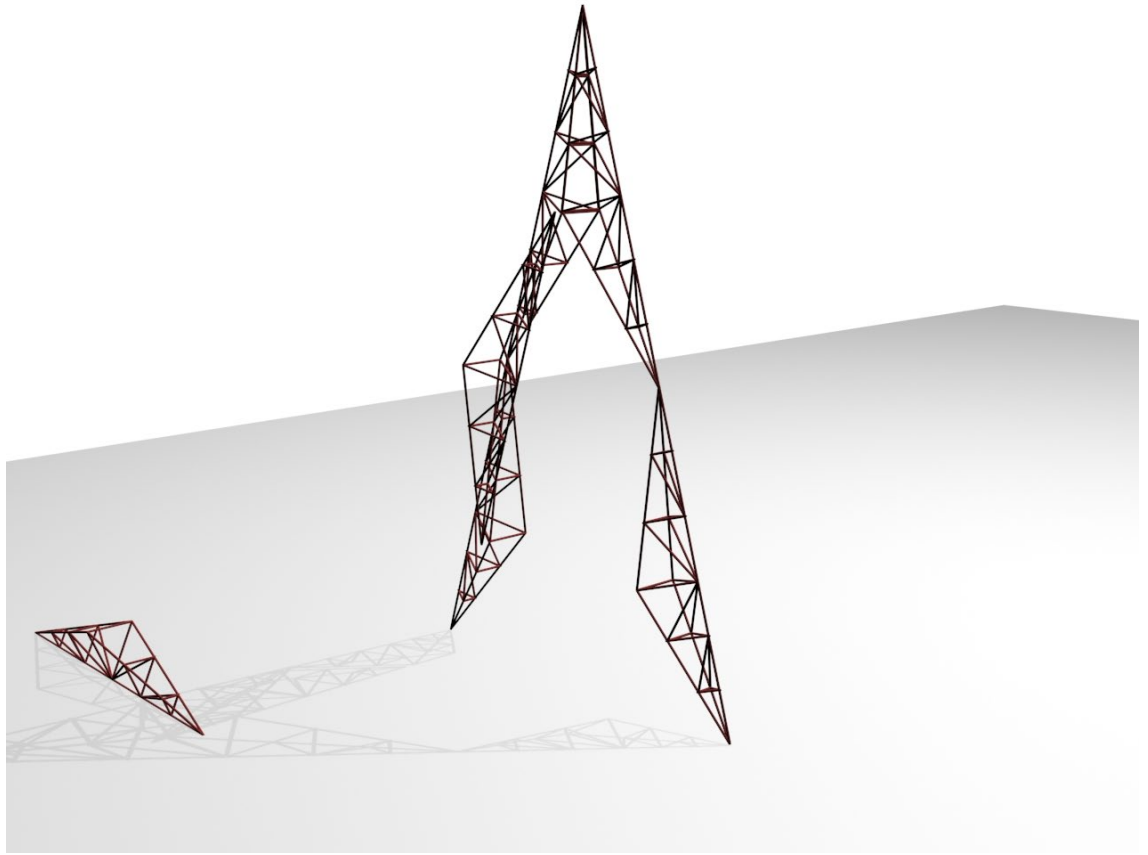
OVERVIEW
Structure - Tetrahedron



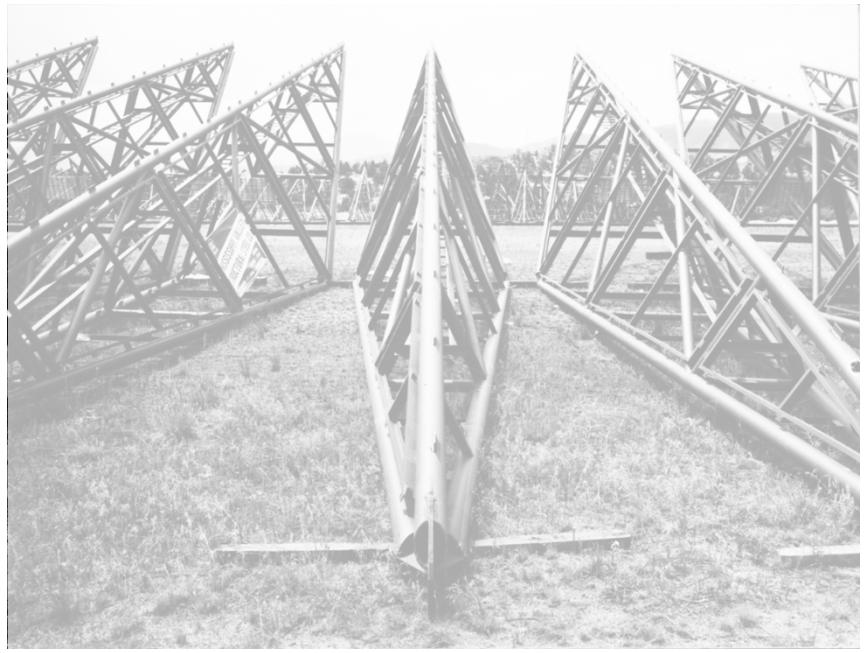


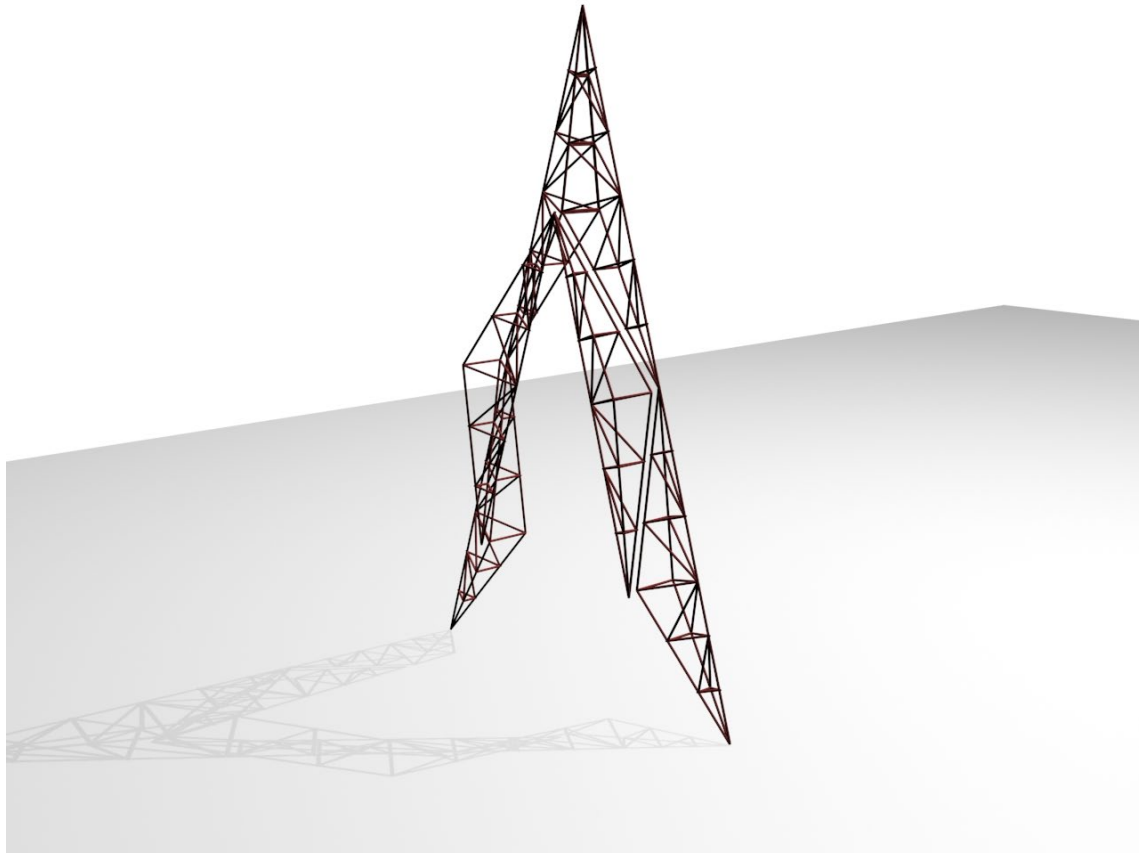
OVERVIEW
Structure - Tetrahedron



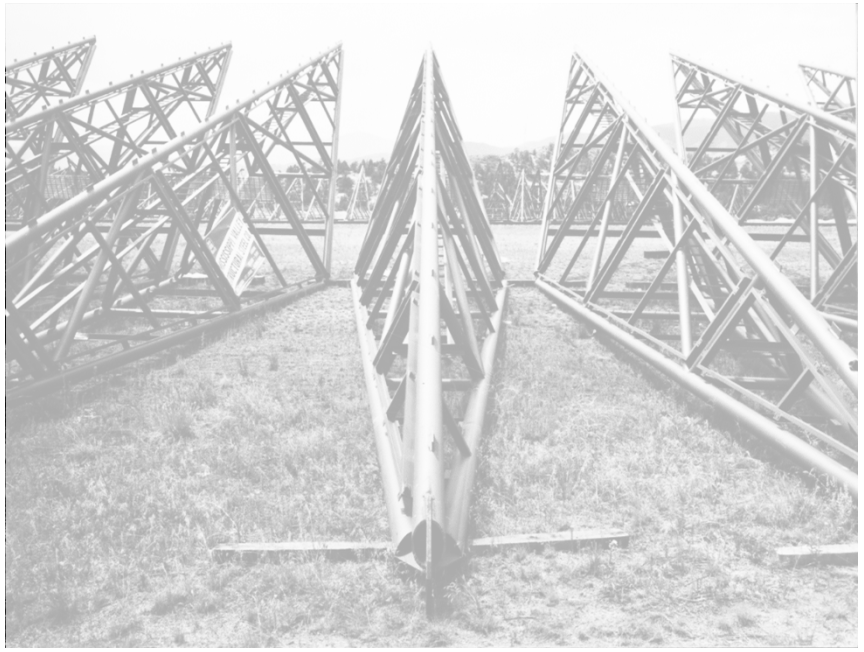


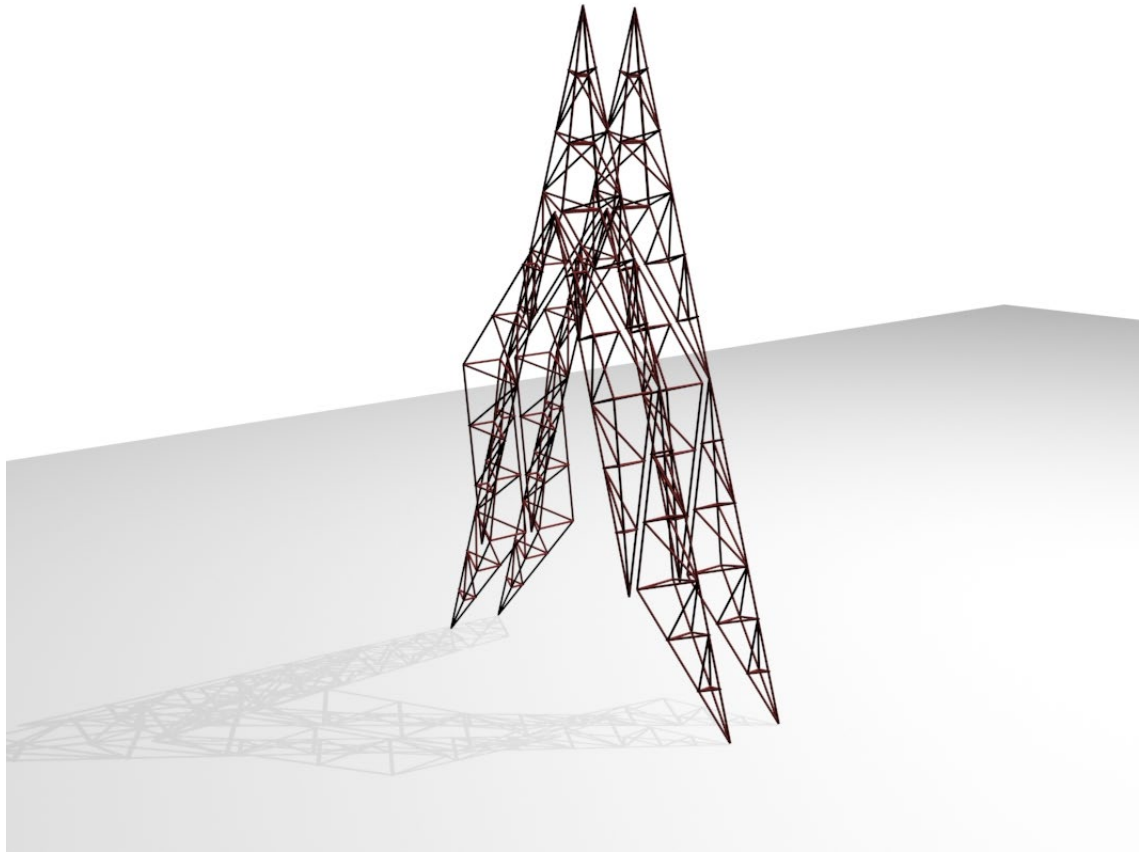
OVERVIEW
Structure - Tetrahedron



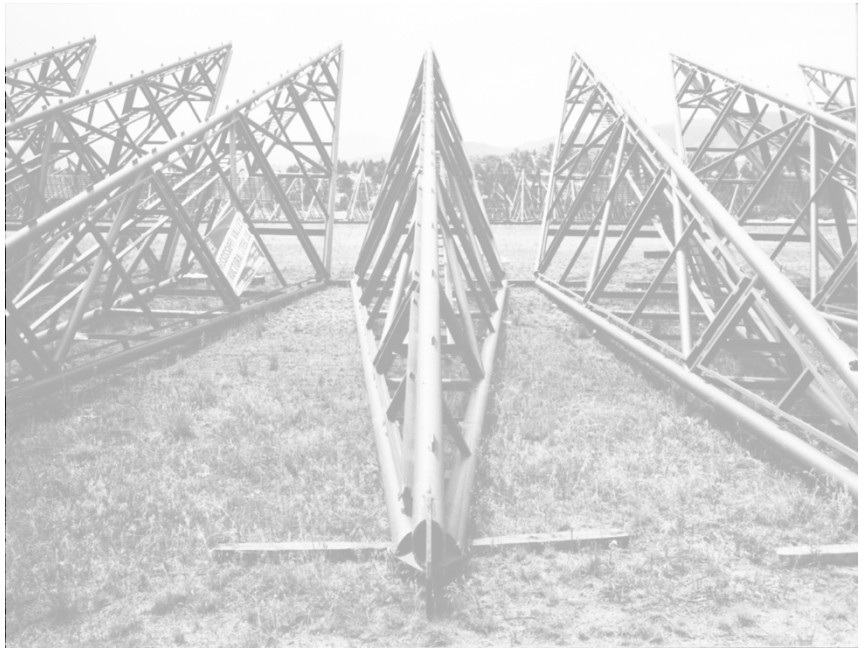


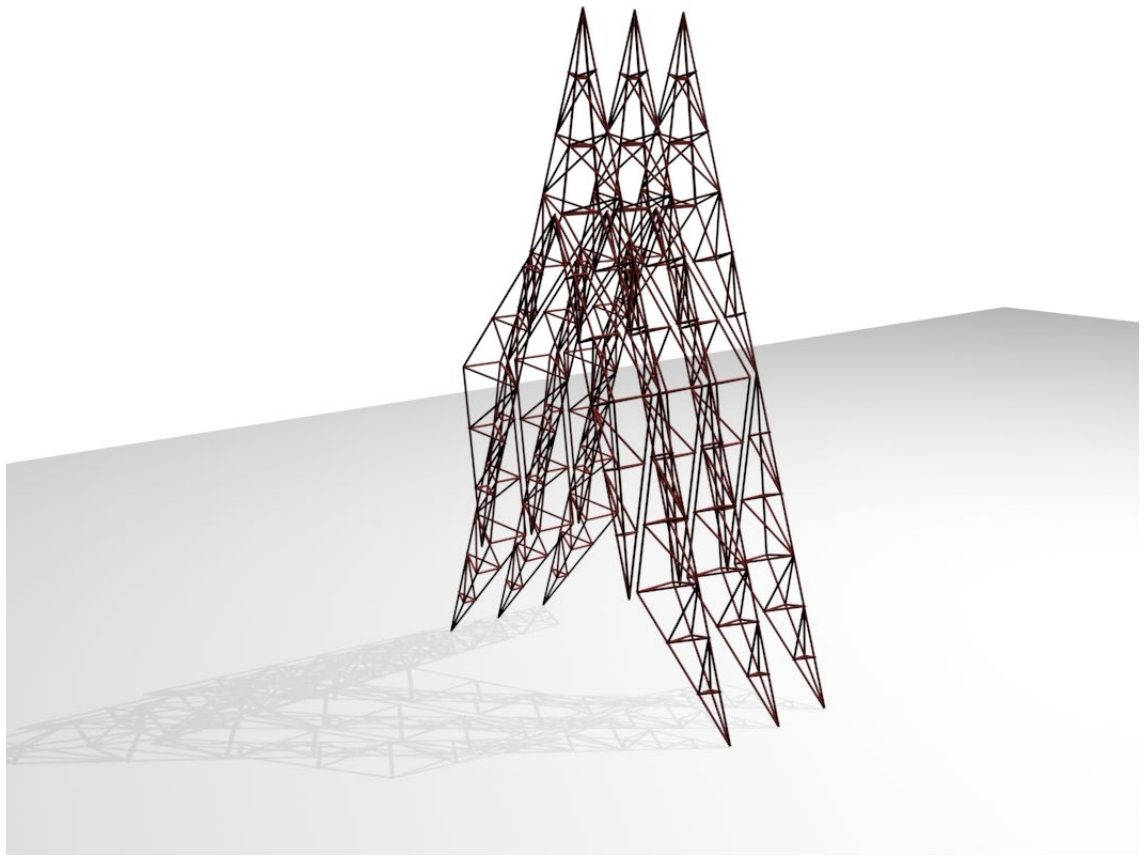
OVERVIEW
Structure - Tetrahedron



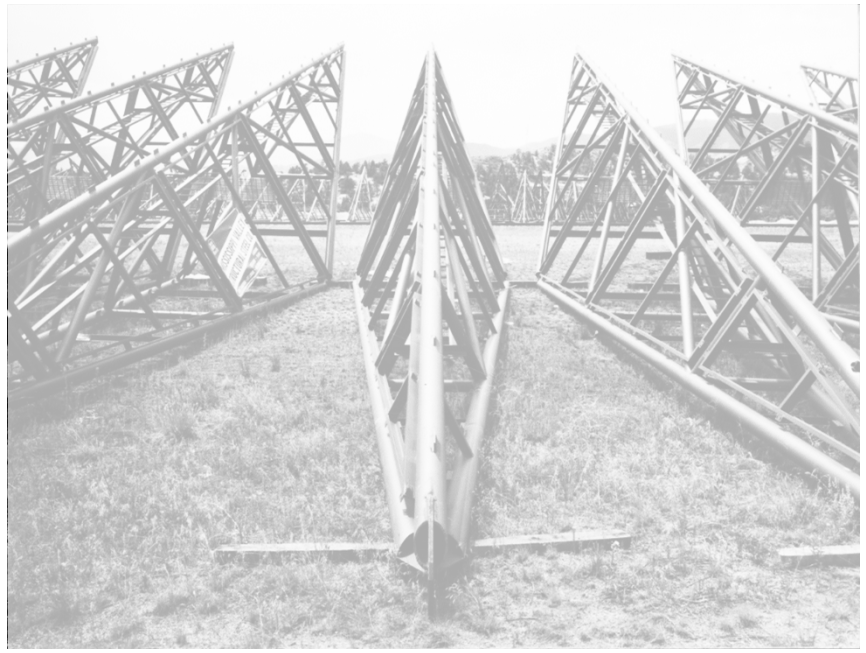


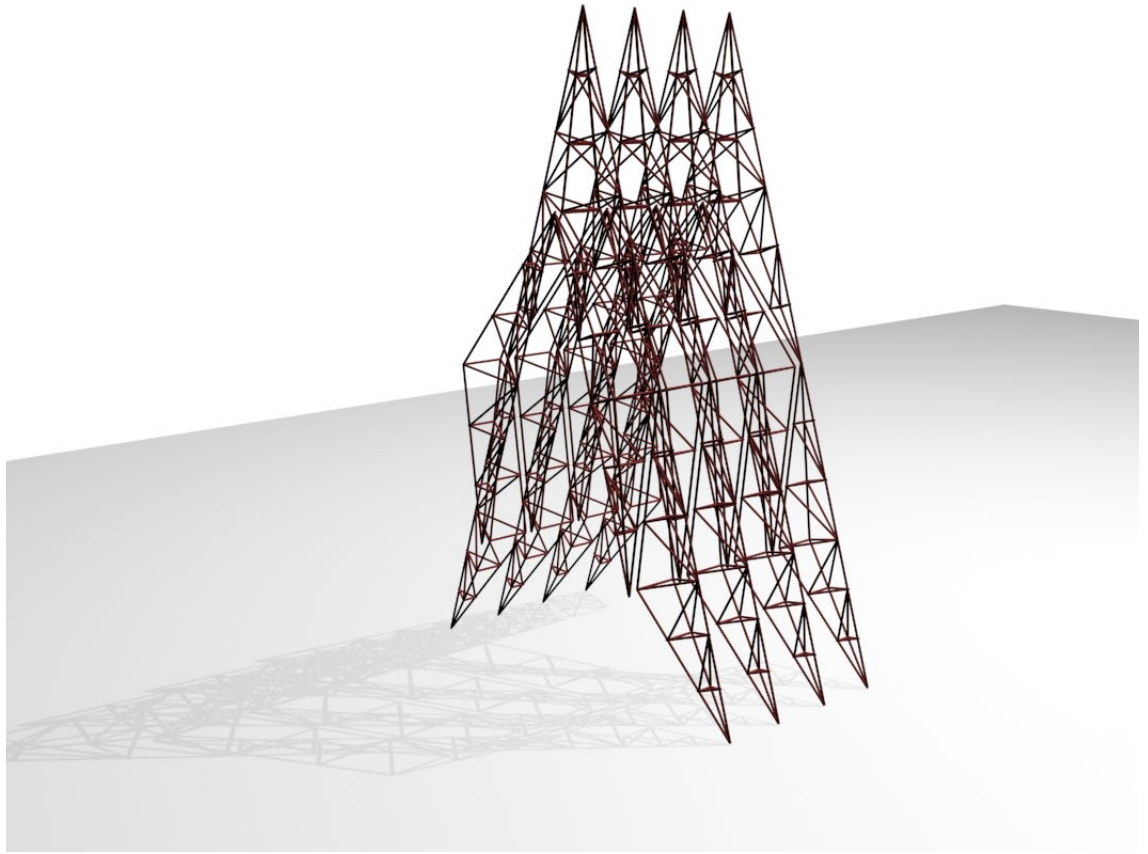
OVERVIEW
Structure - Tetrahedron



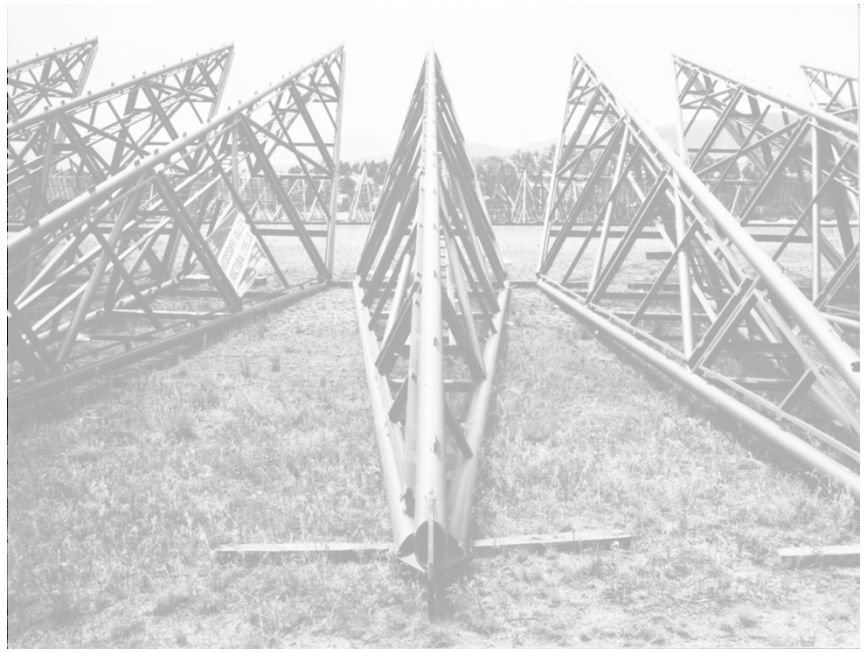


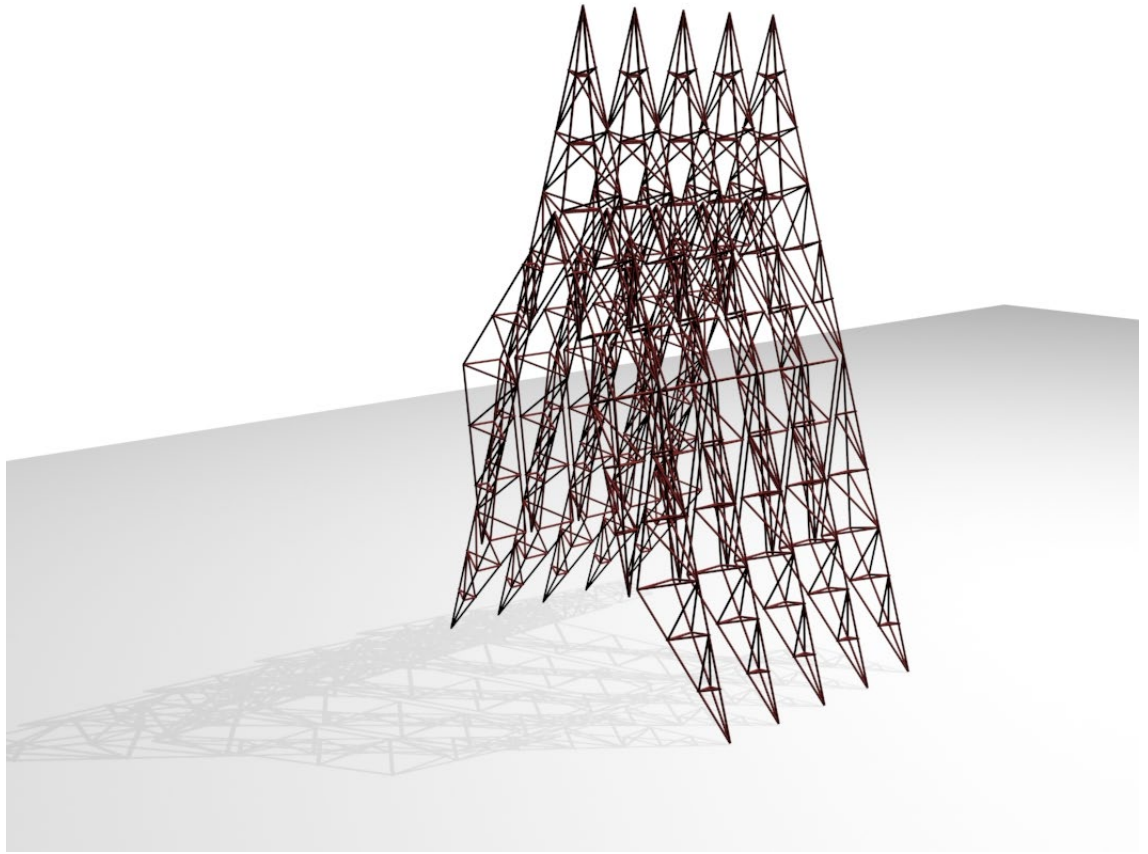
OVERVIEW
Structure - Tetrahedron



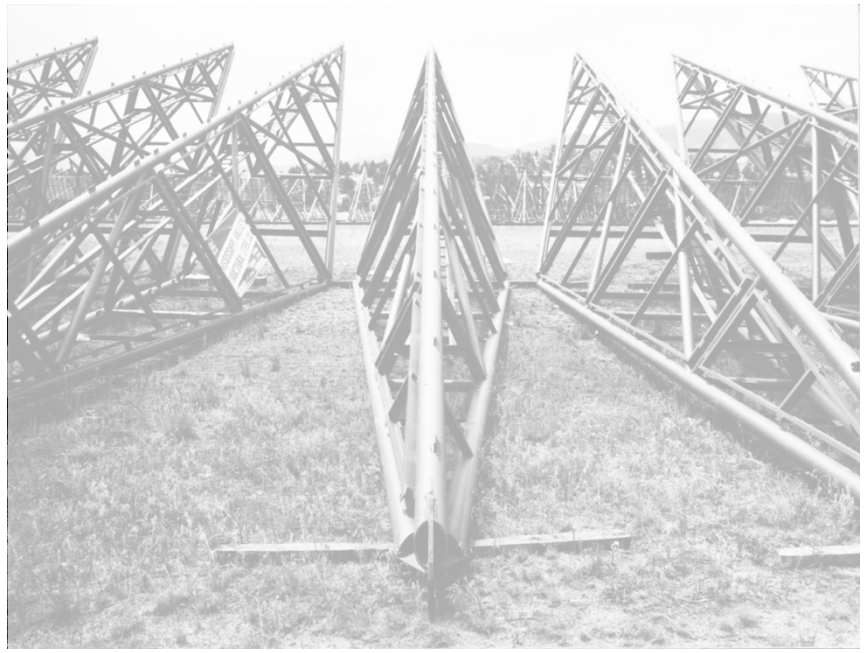


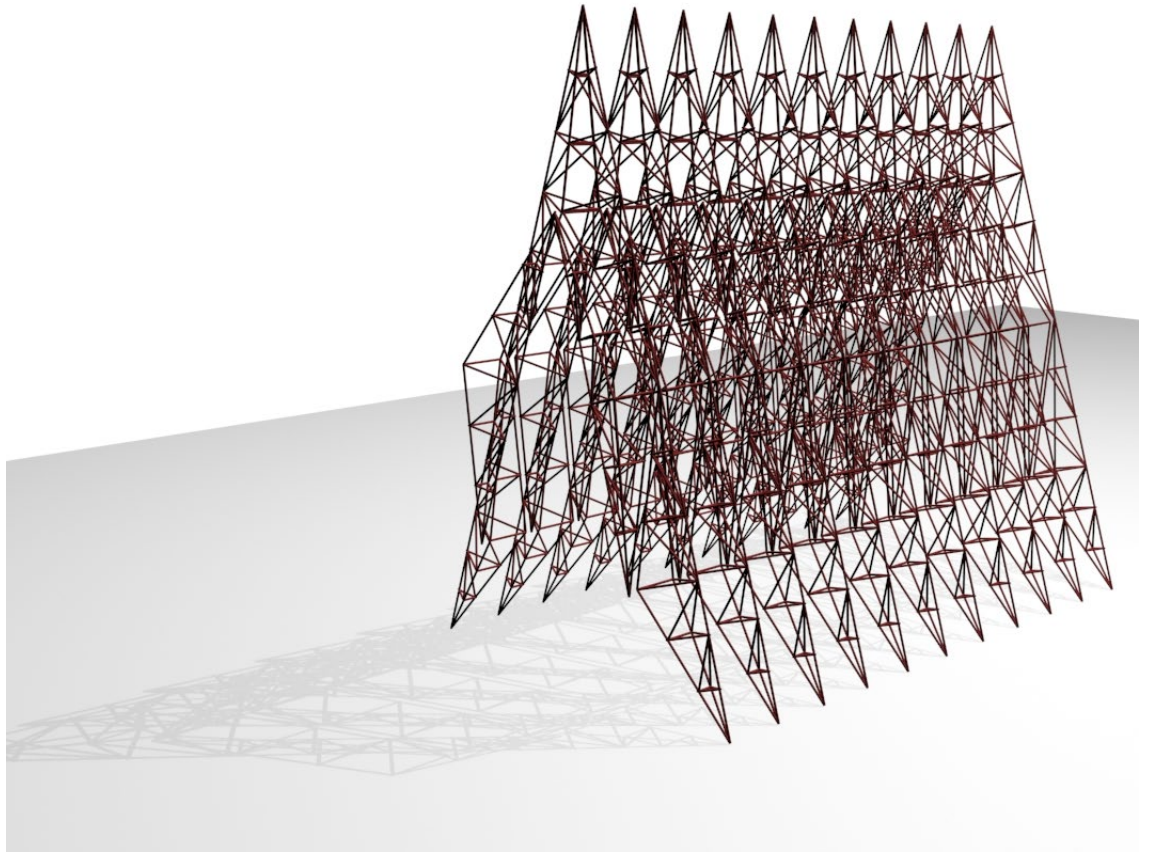
OVERVIEW
Structure - Tetrahedron



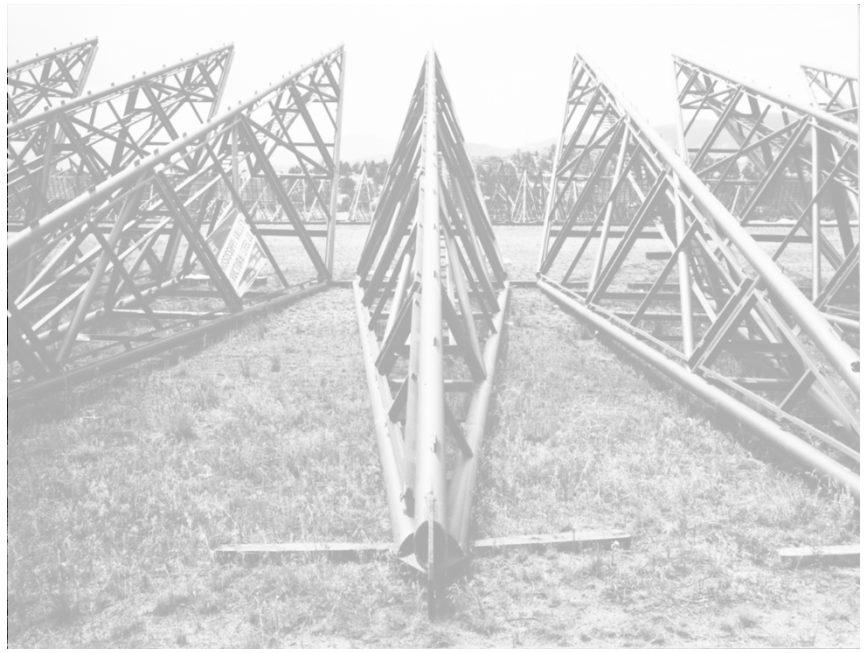


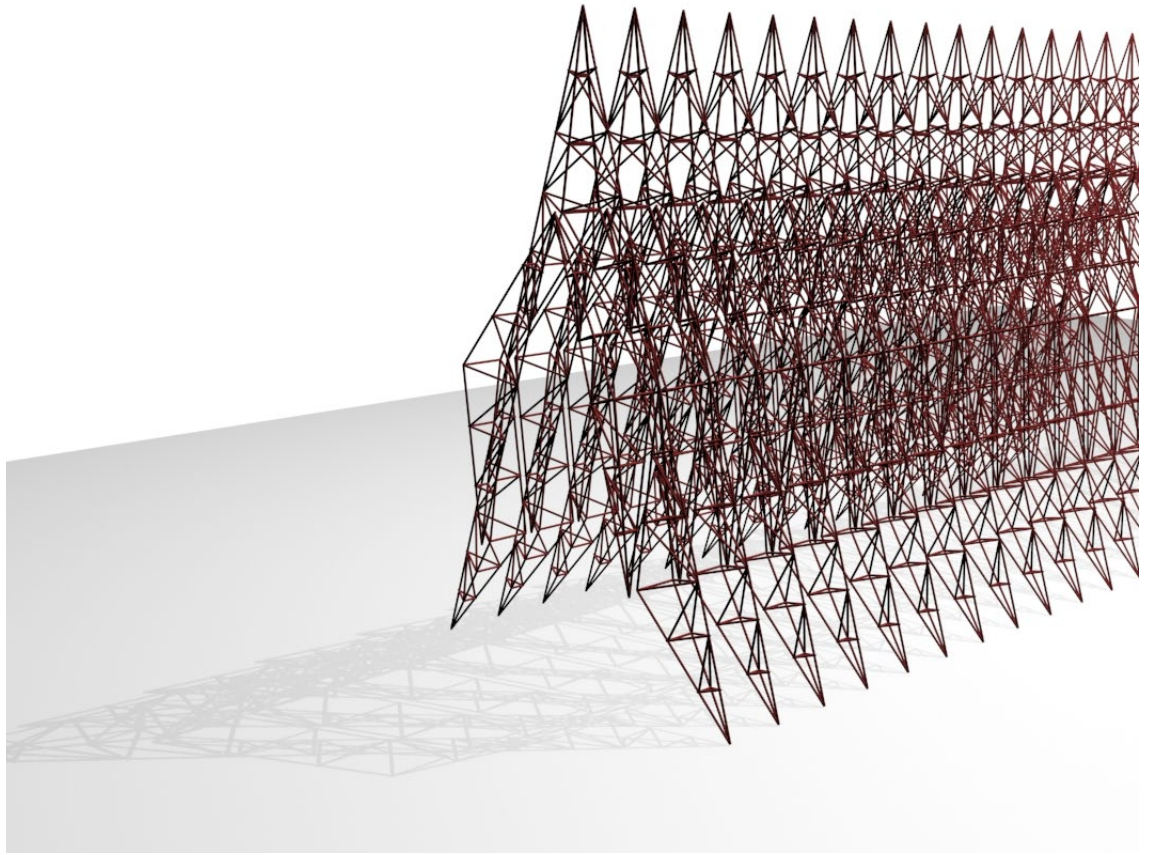
OVERVIEW
Structure - Tetrahedron



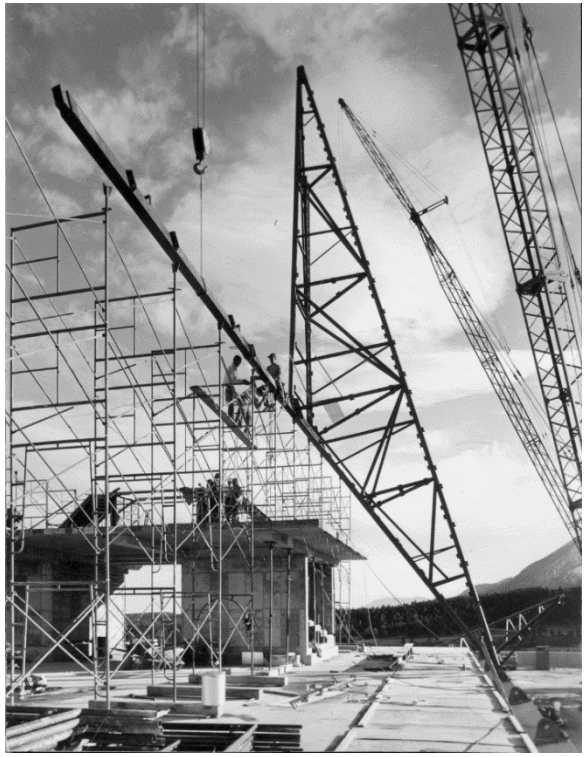


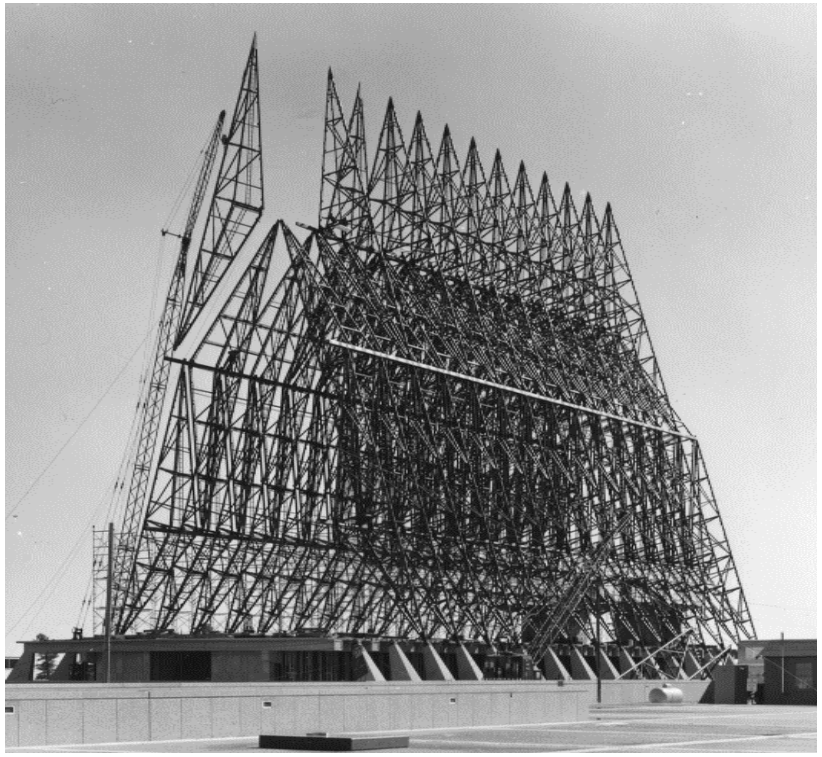
OVERVIEW
Structure - Tetrahedron



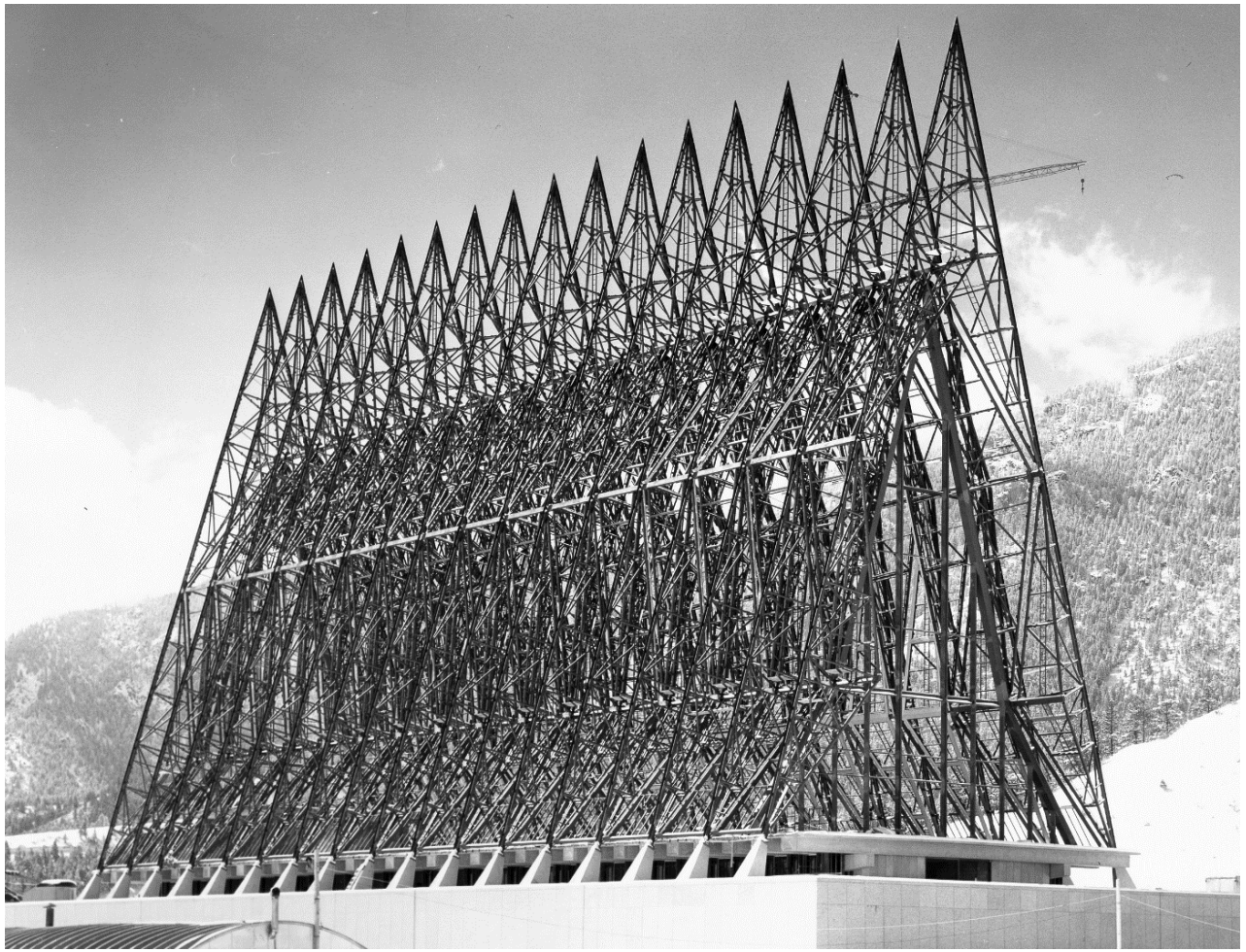


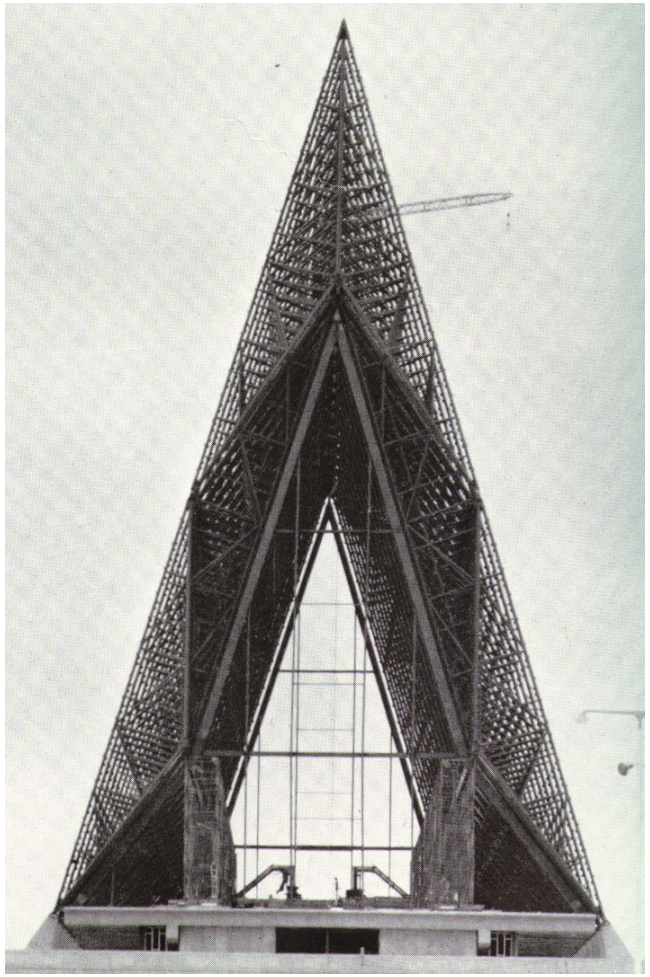
OVERVIEW
Structure - Tetrahedron





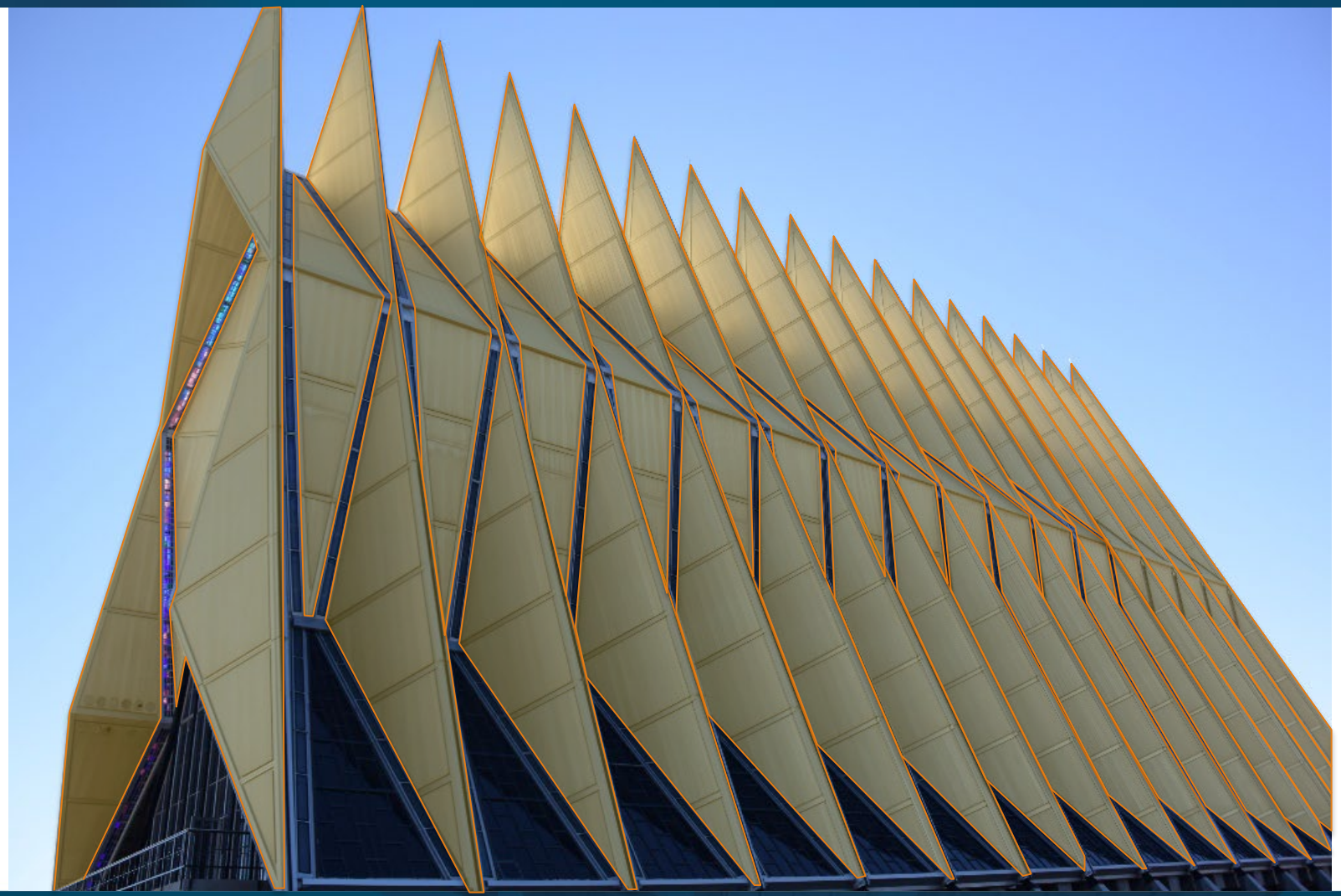
OVERVIEW
Structure – Skeletal Frame



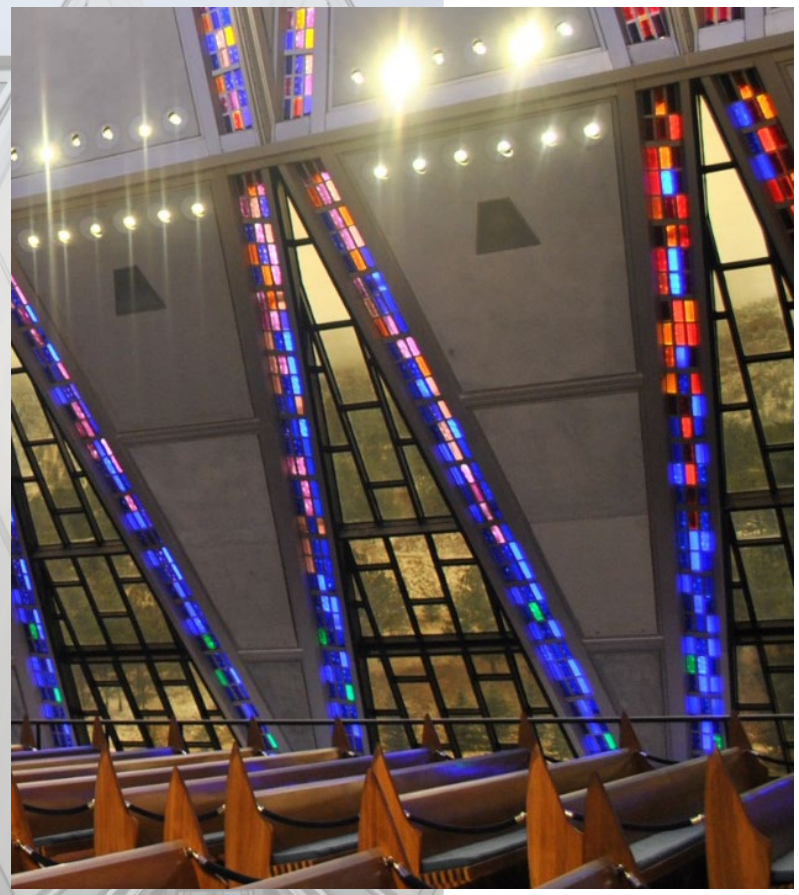


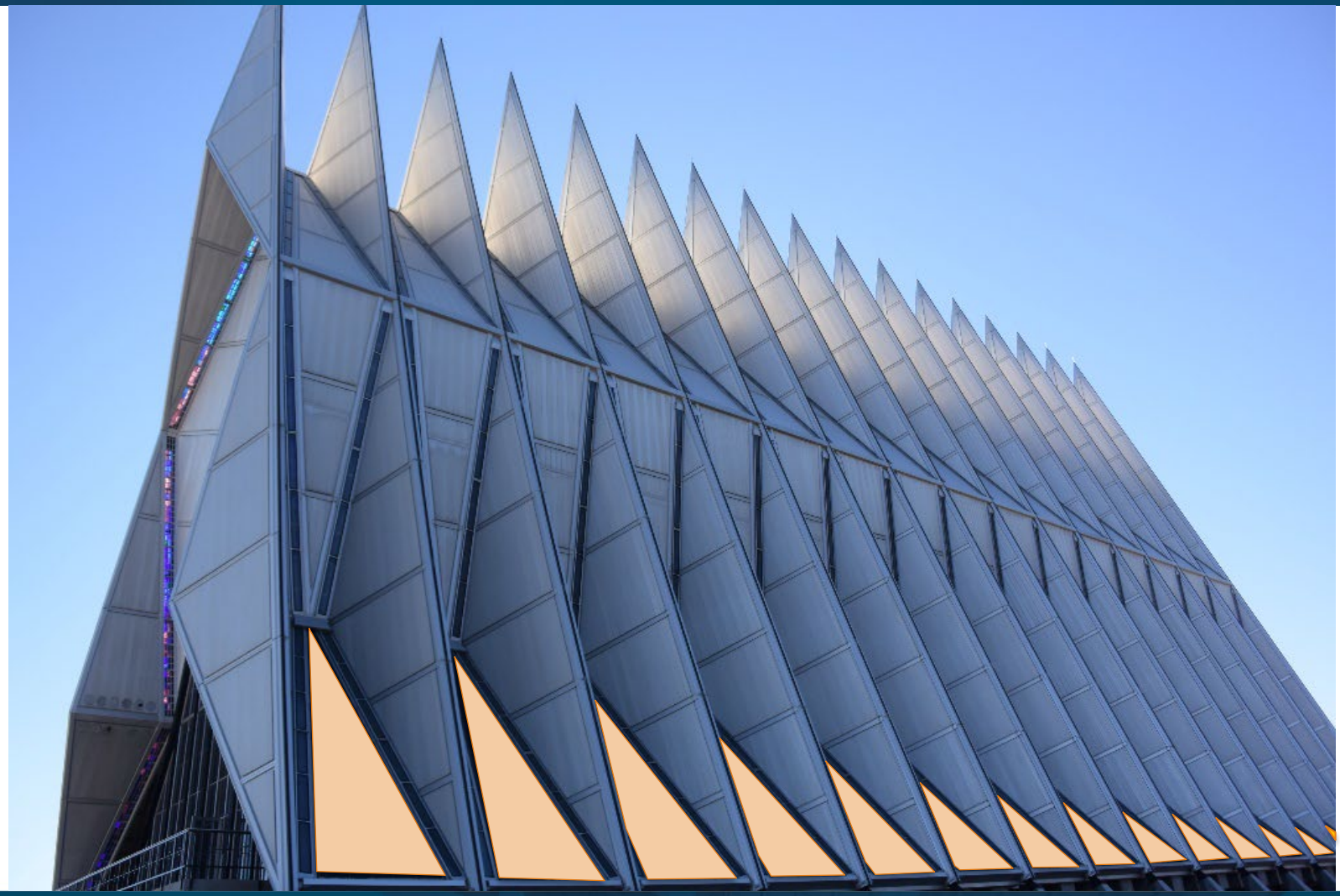
OVERVIEW
Enclosure System

OVERVIEW
Cladding

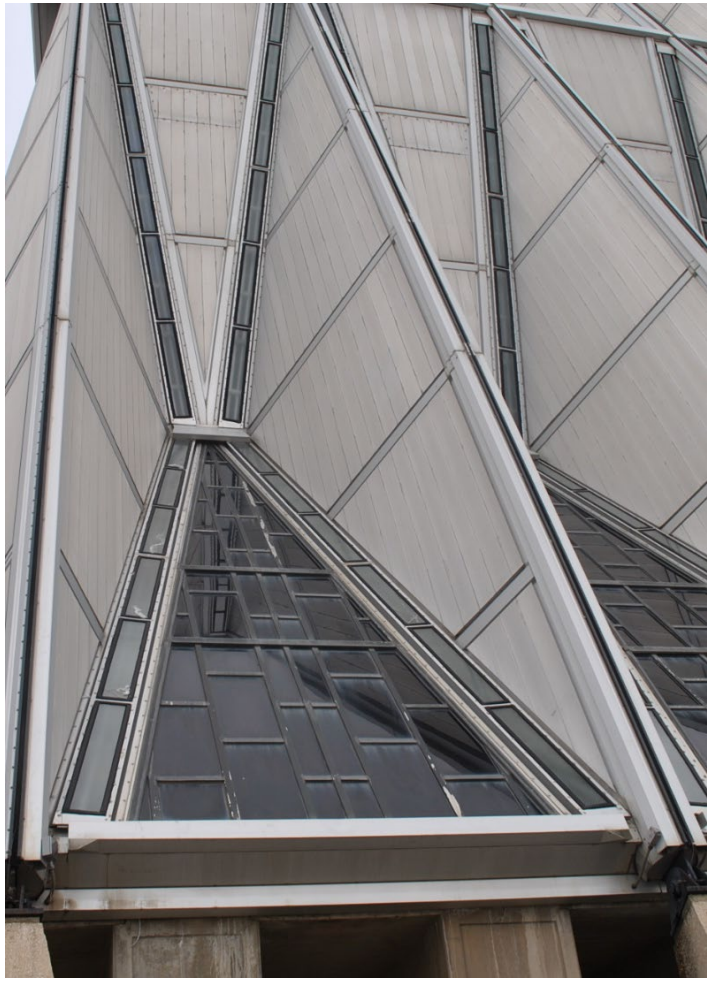


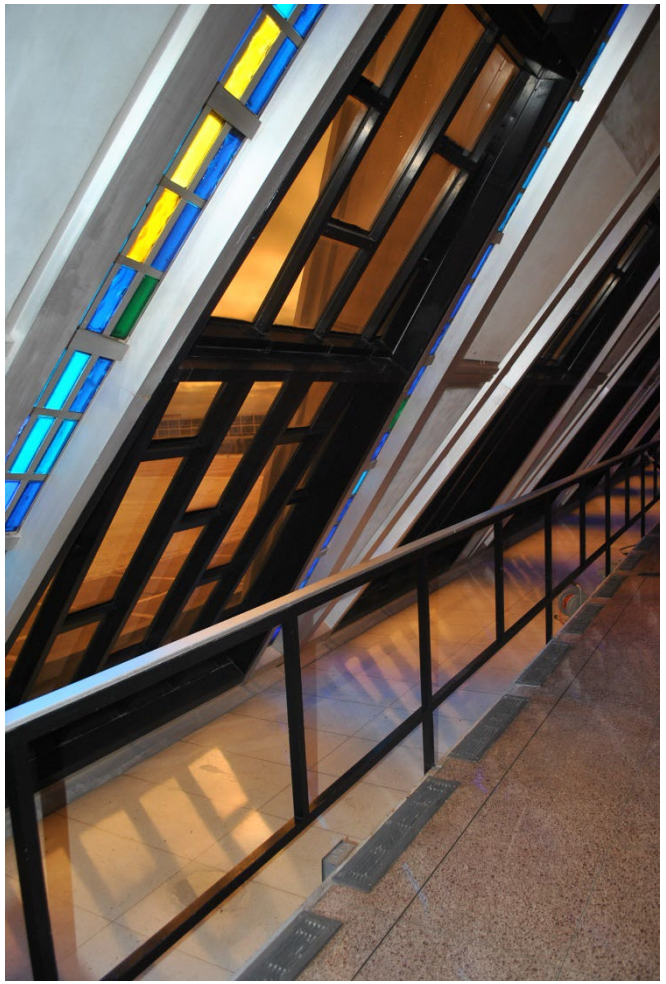
OVERVIEW
Side Windows



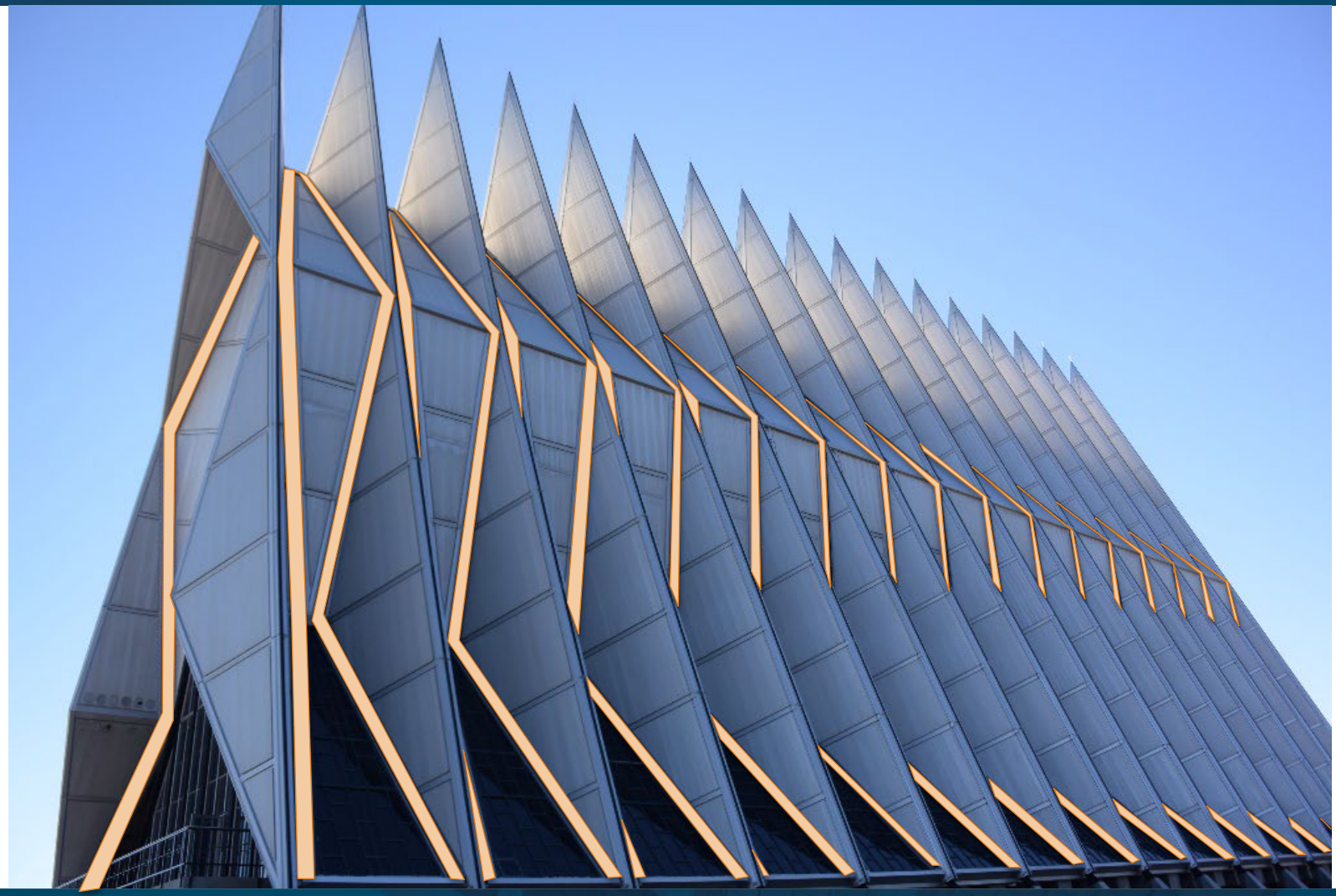


OVERVIEW
Side Windows



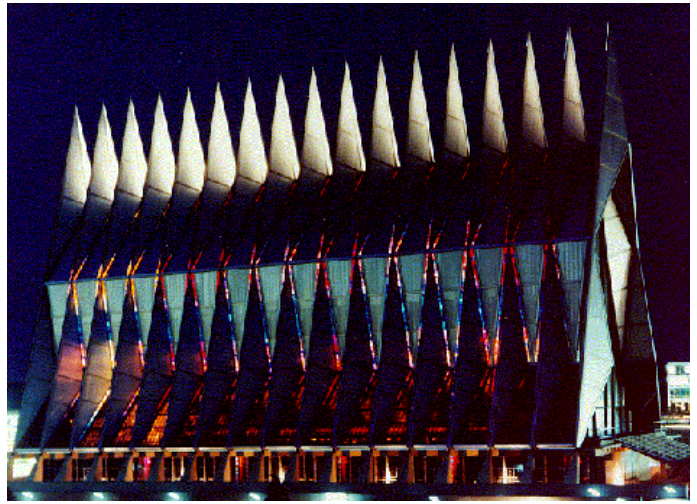


OVERVIEW
Strip Windows

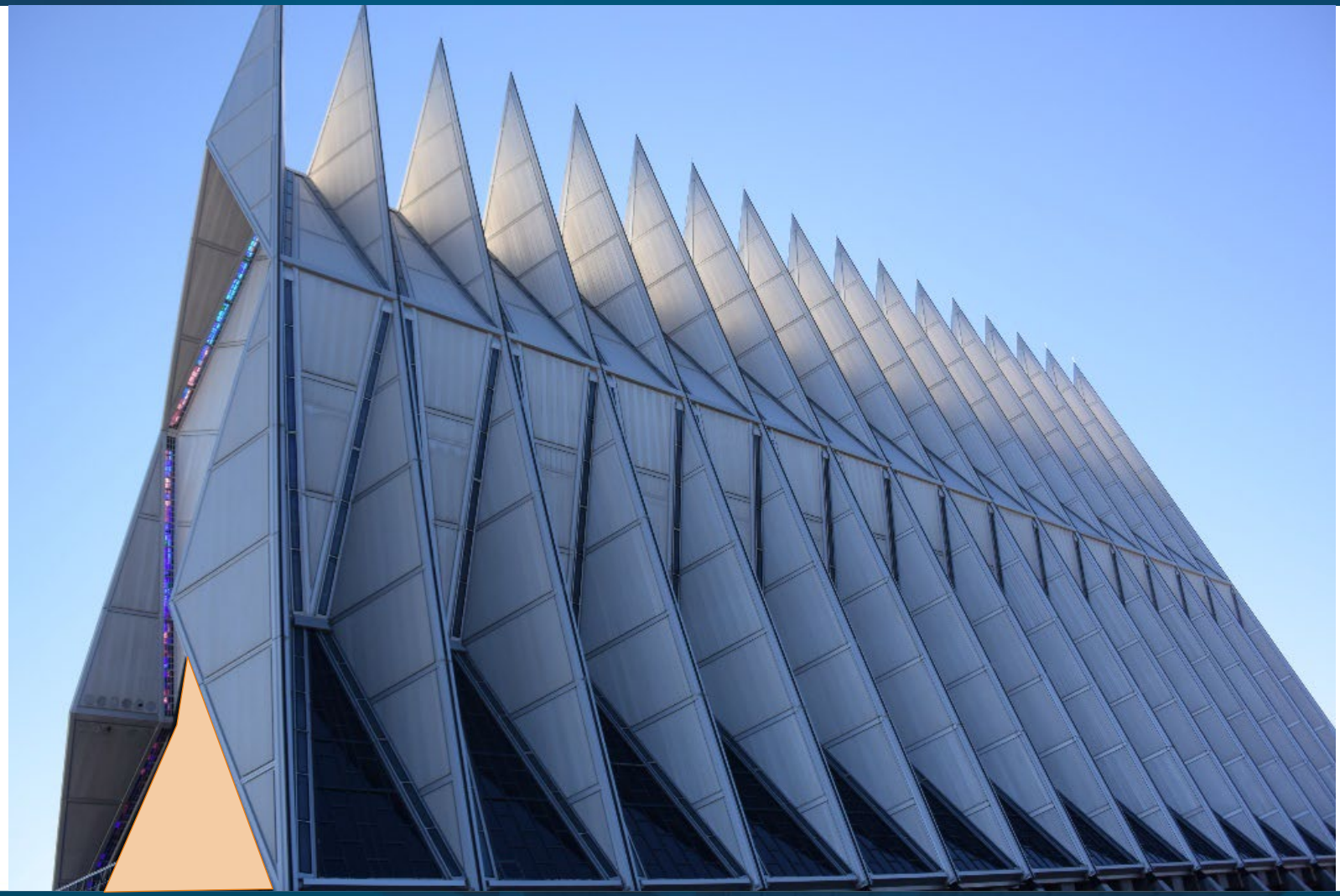


OVERVIEW
Strip Windows

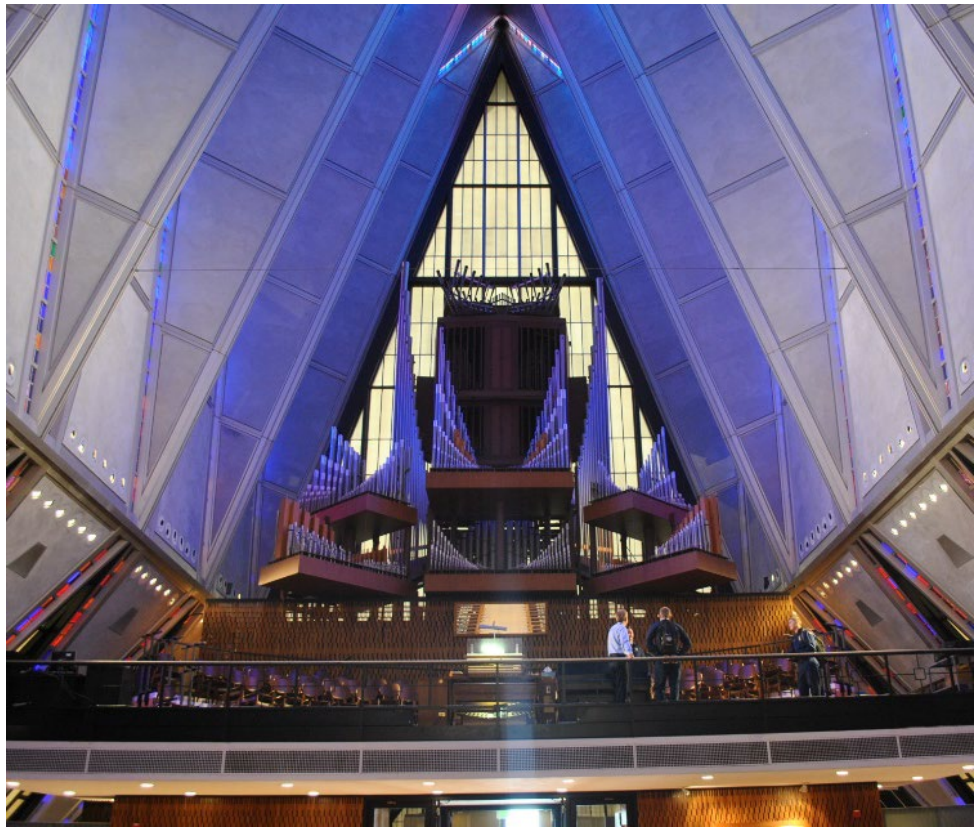
ORIGINAL ASSEMBLY



OVERVIEW
End Walls



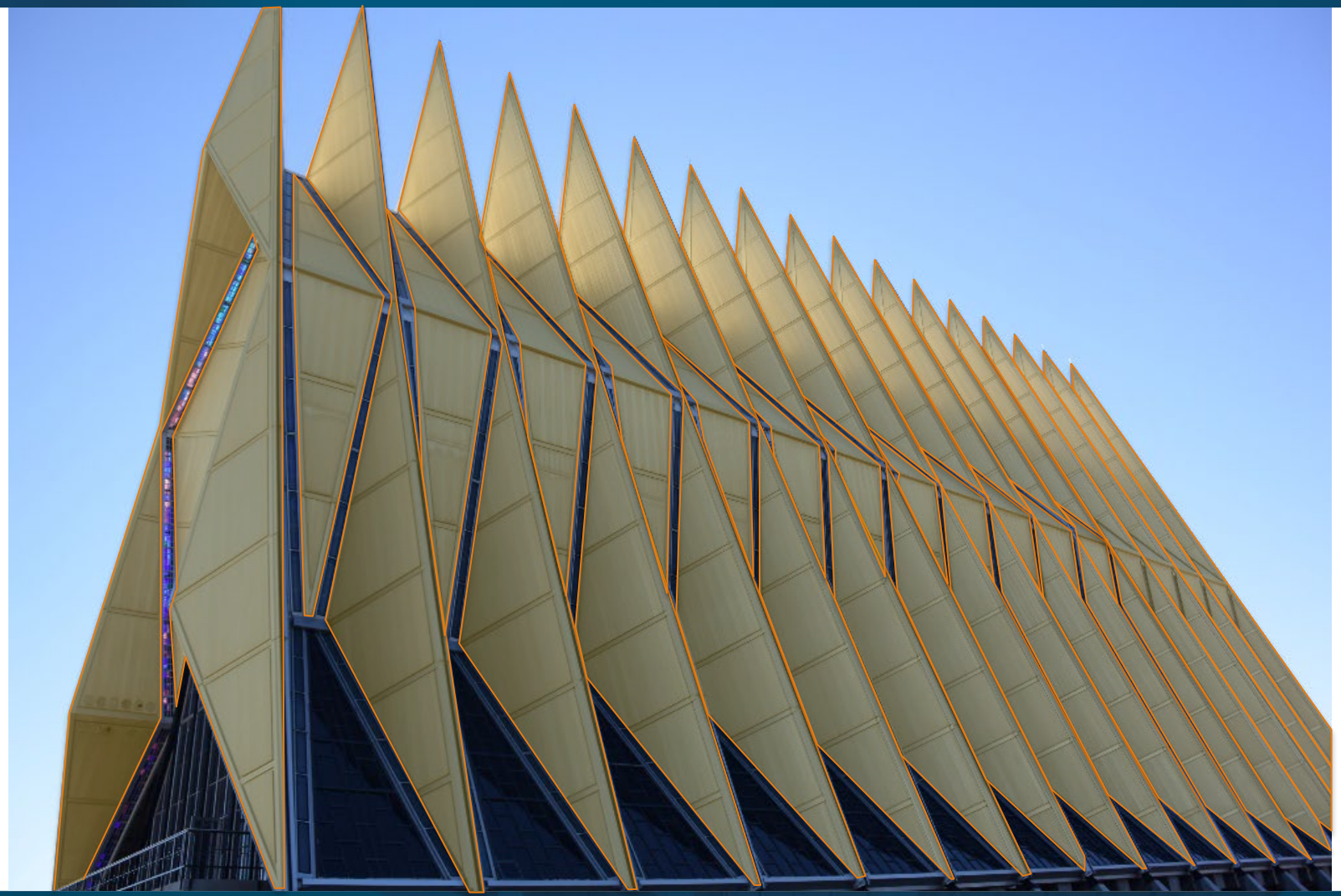
OVERVIEW
End Walls



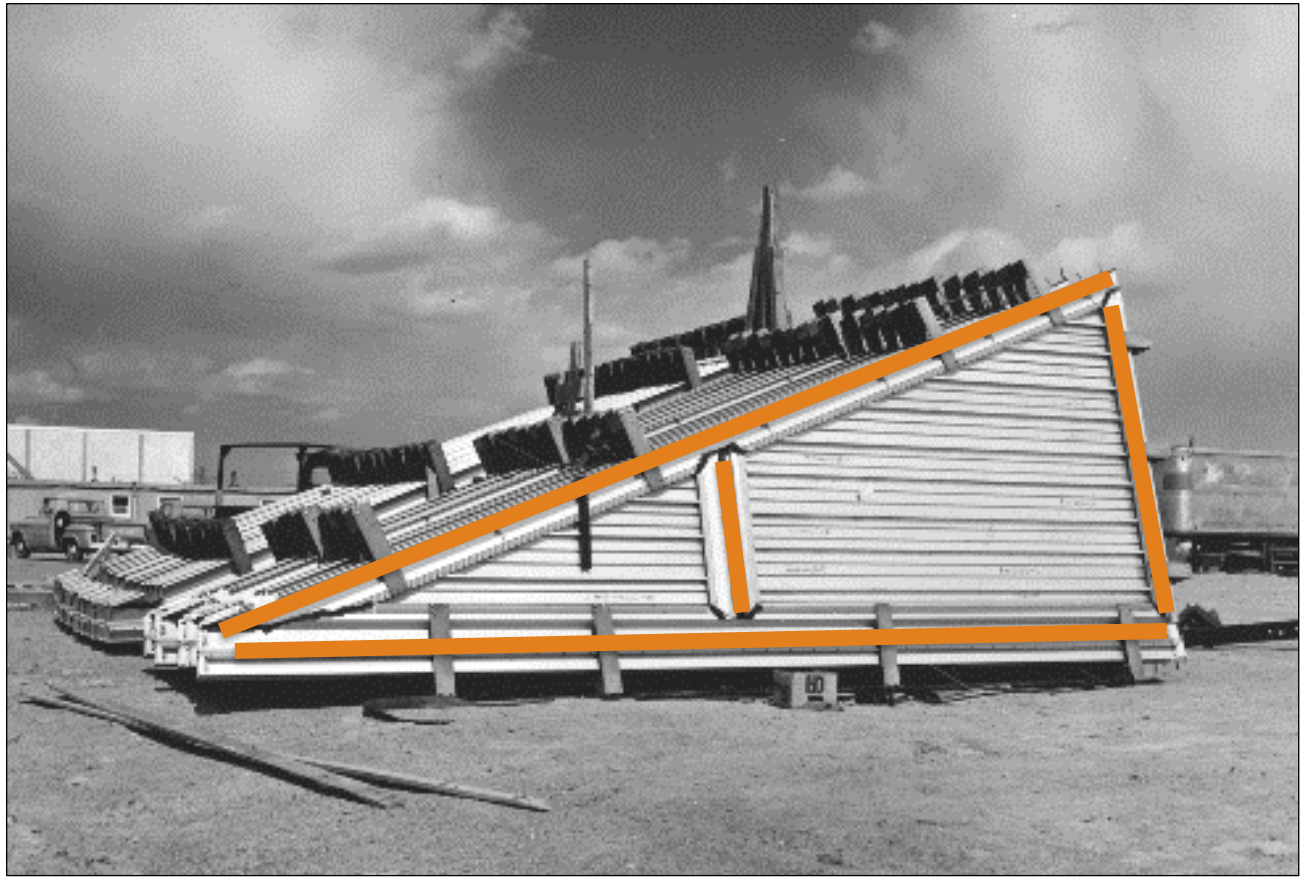
South End Wall

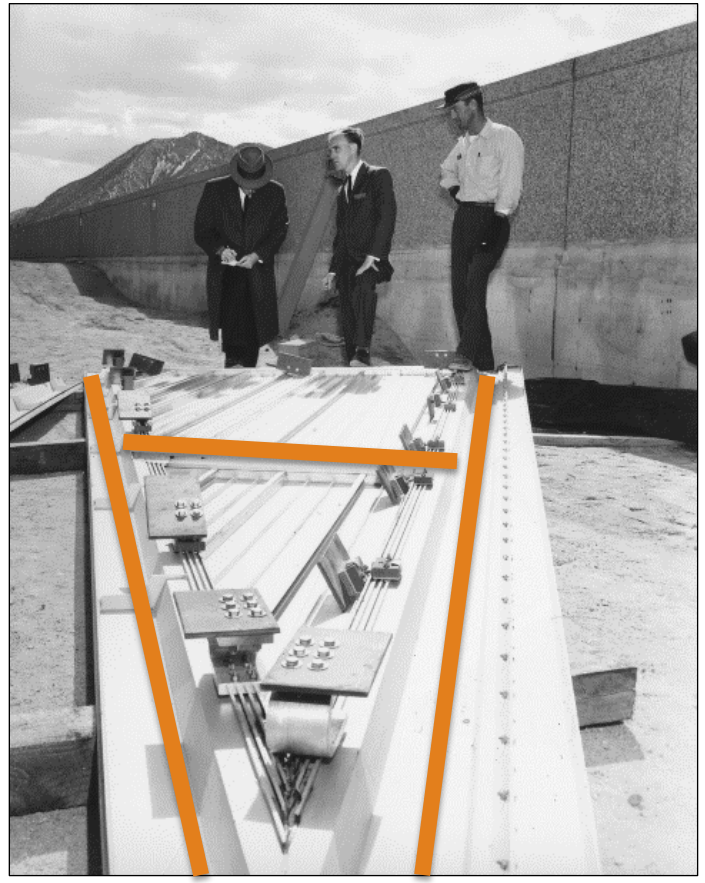
North End Wall

OVERVIEW
Cladding

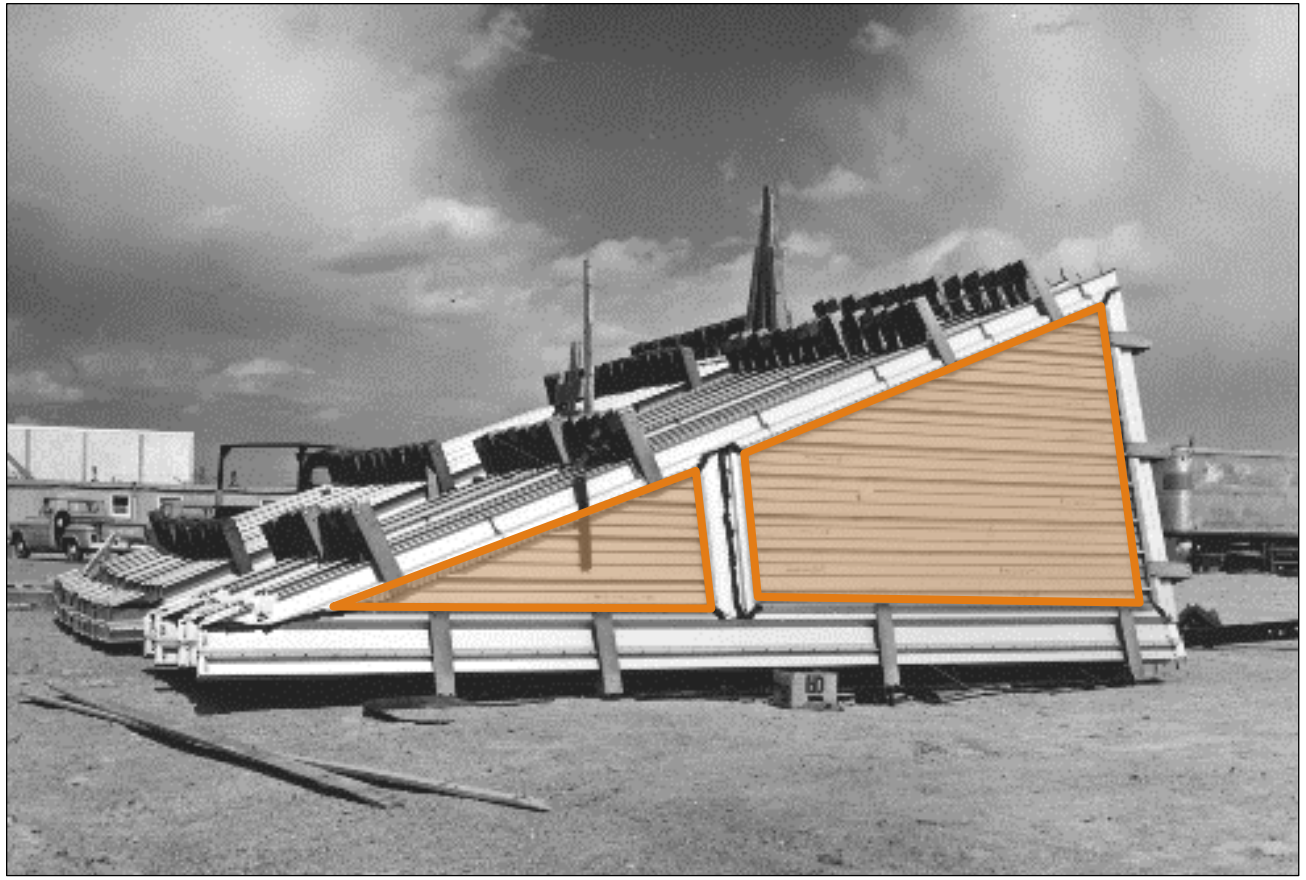


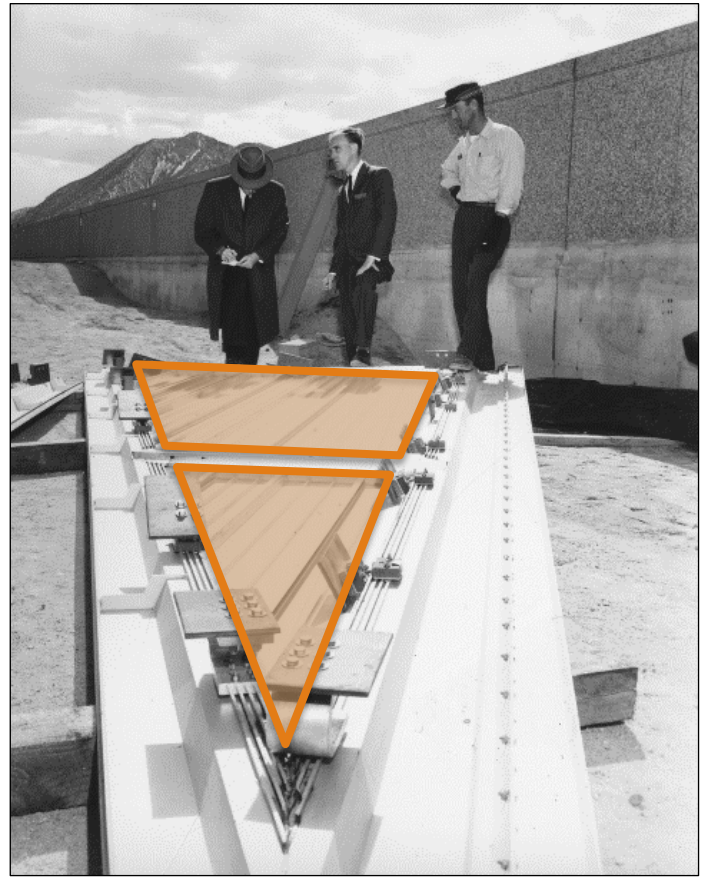
OVERVIEW
Cladding





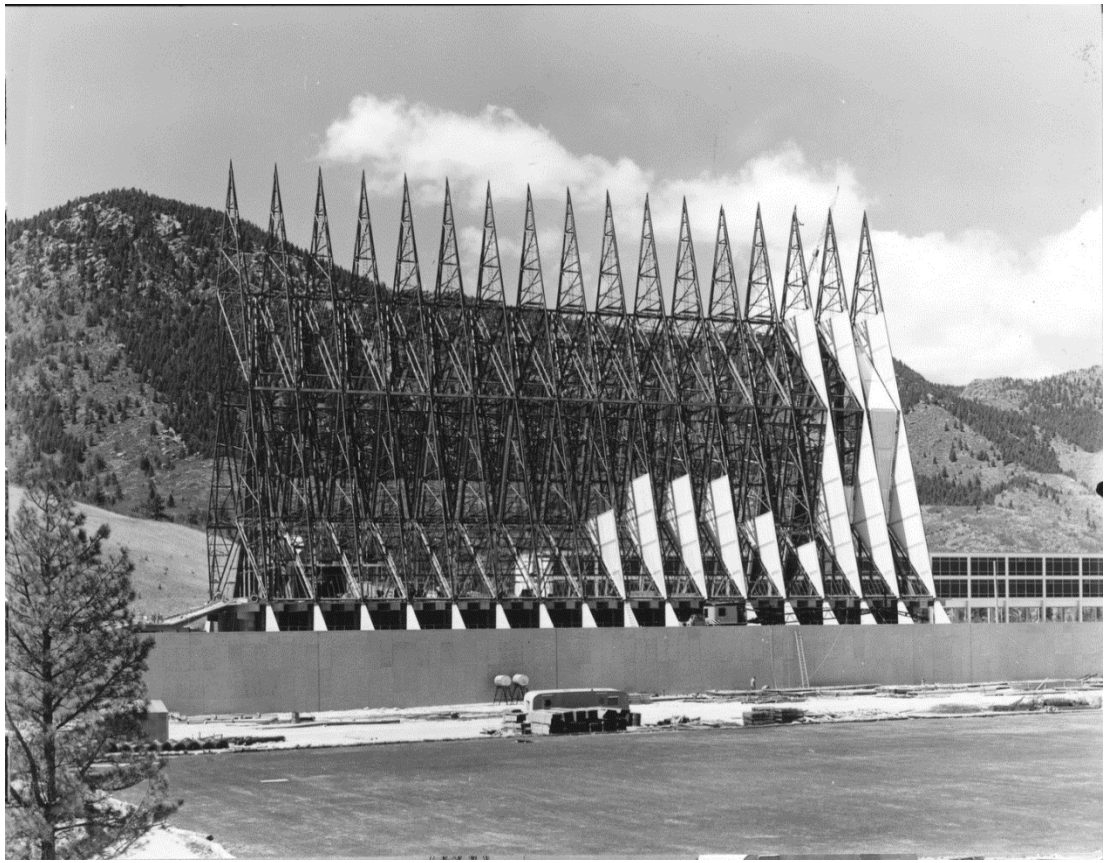
OVERVIEW
Cladding



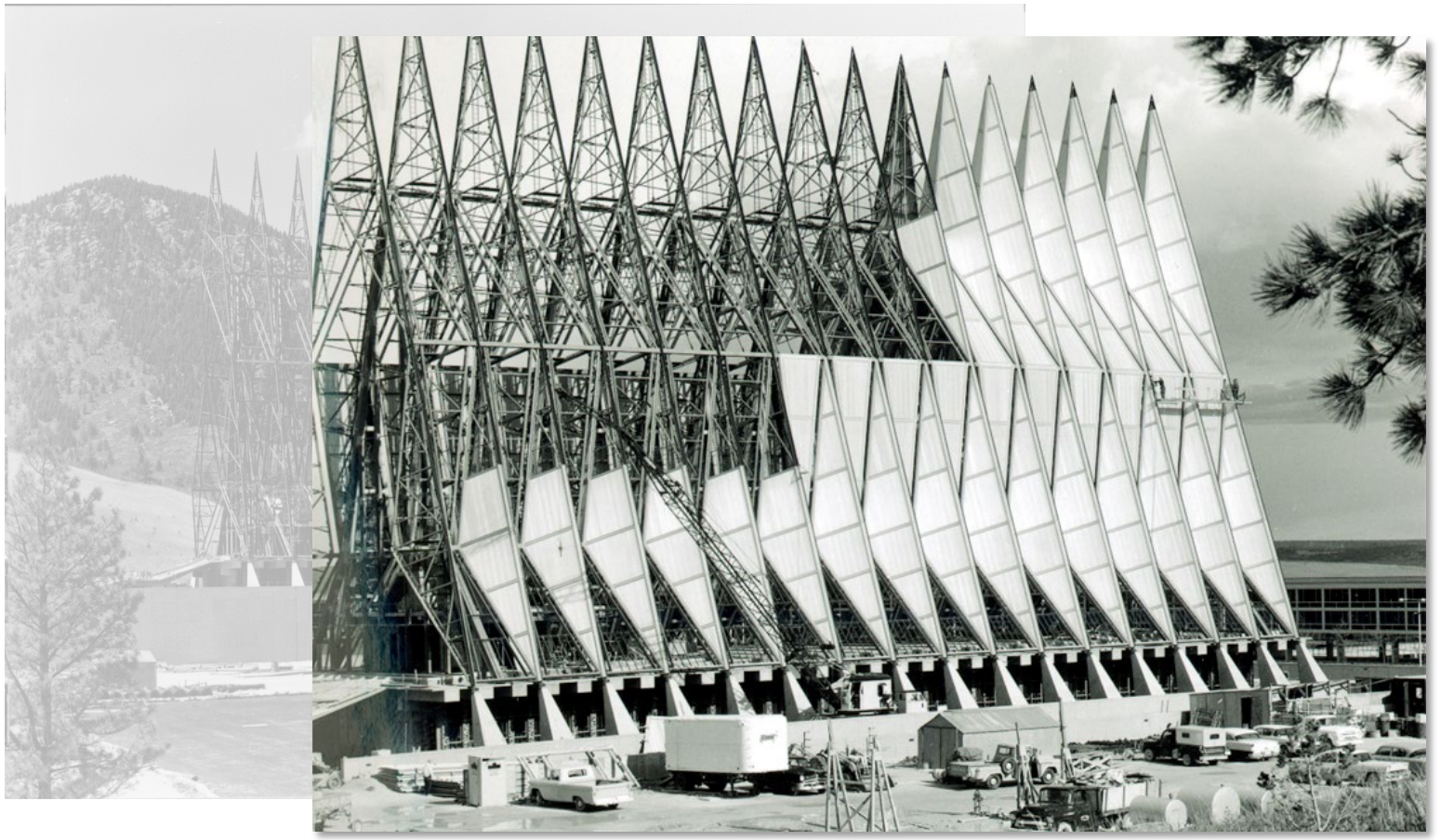


OVERVIEW
Cladding

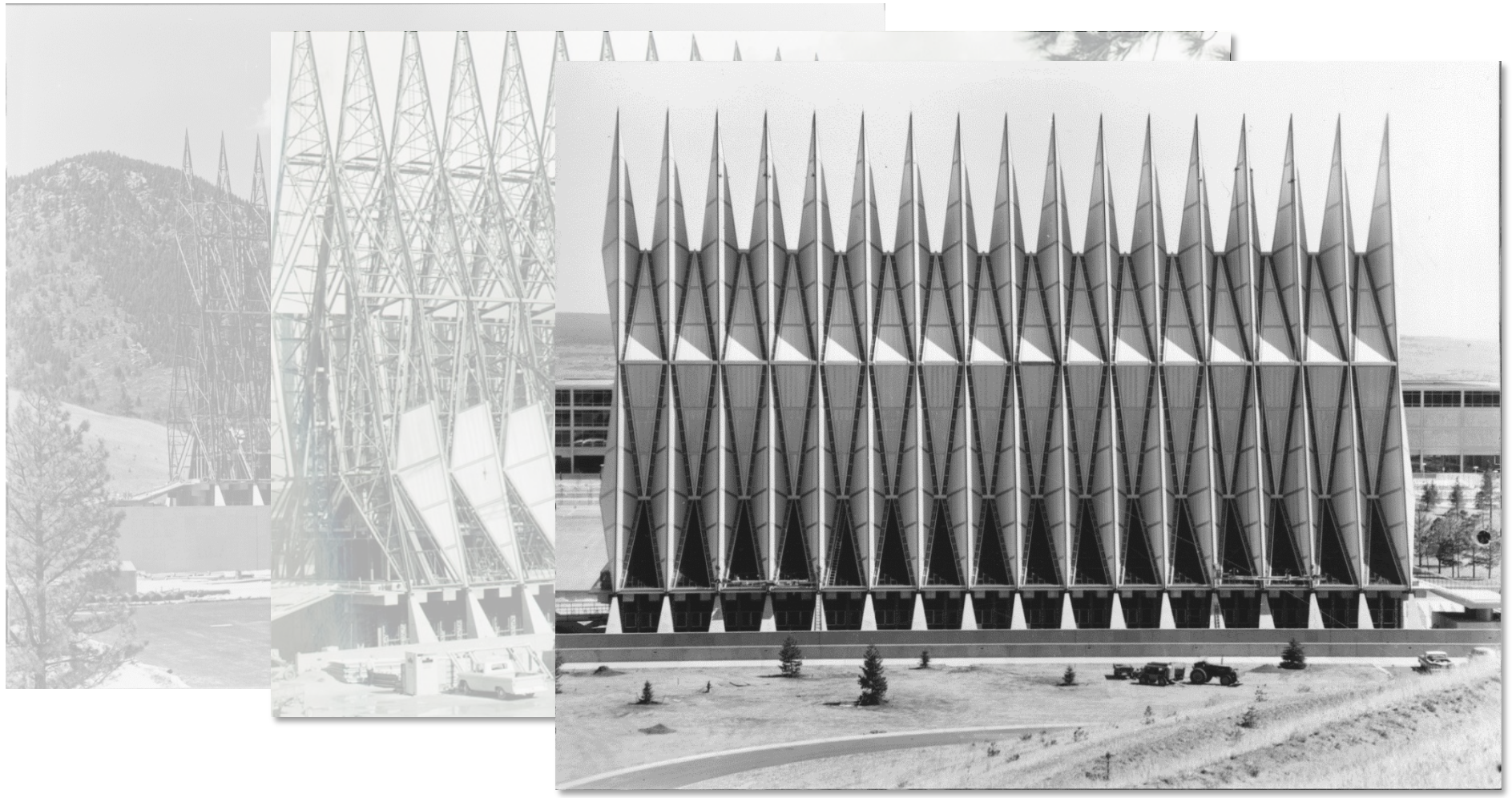
OVERVIEW
Cladding



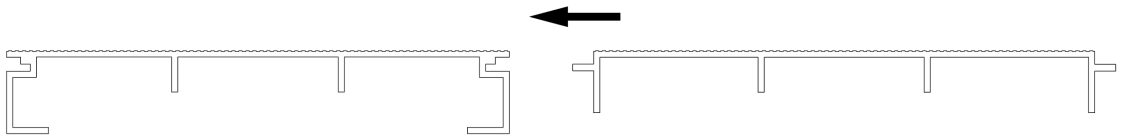
OVERVIEW
Cladding



OVERVIEW
Cladding



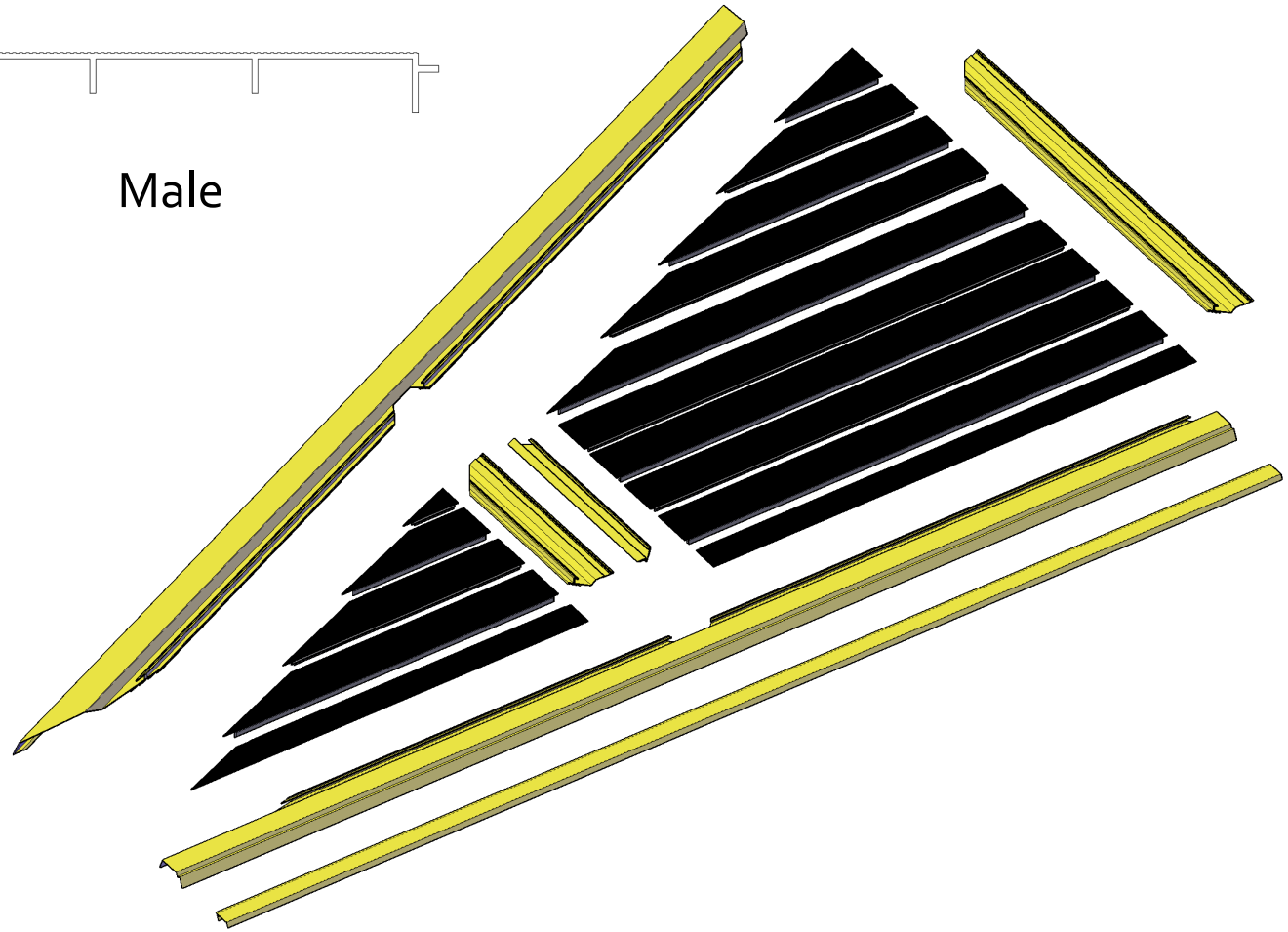
OVERVIEW
Cladding



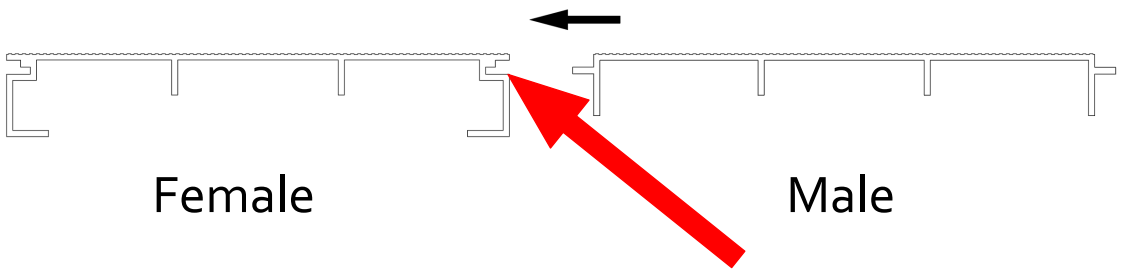
Female

Male

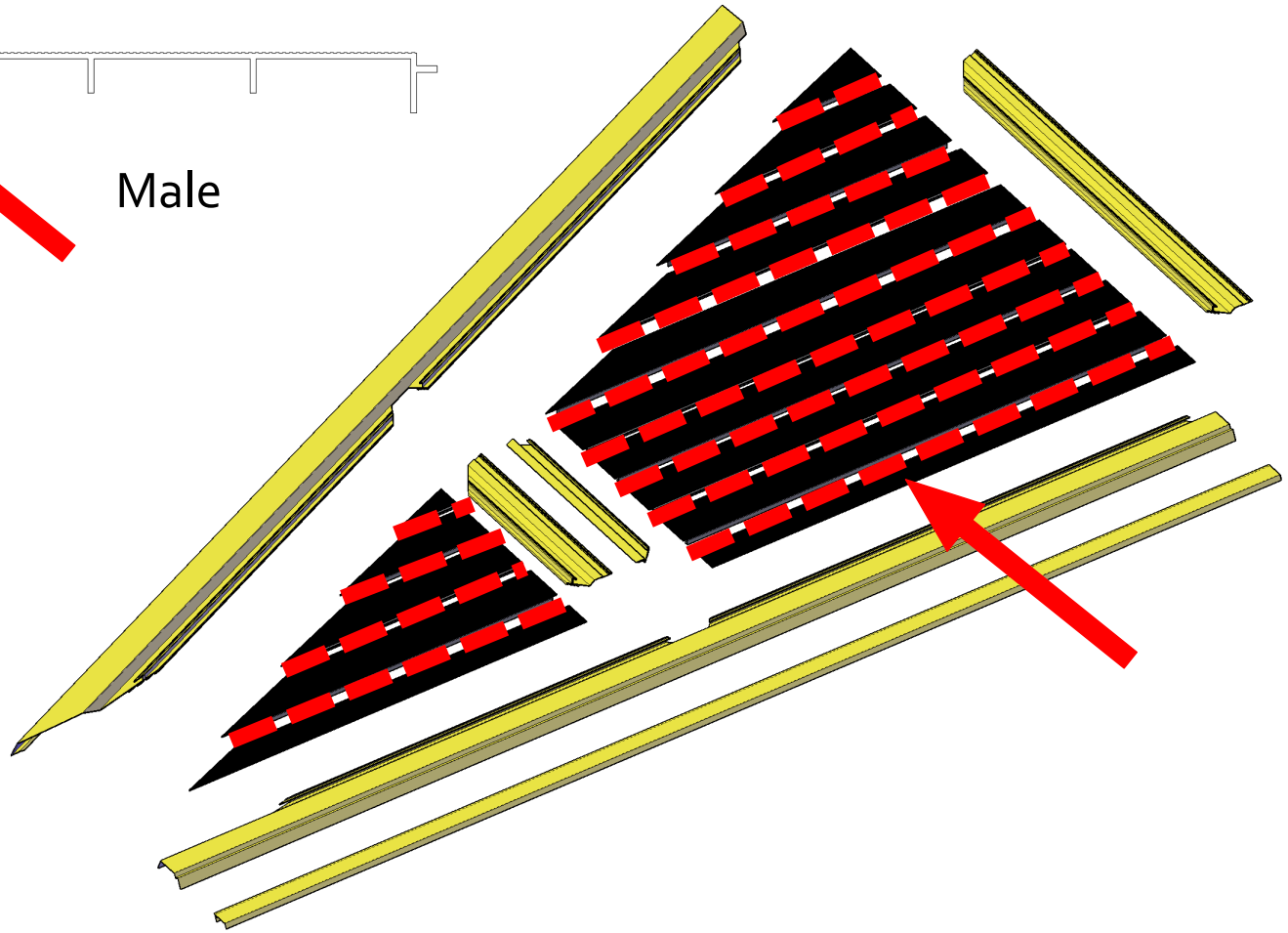
Planks



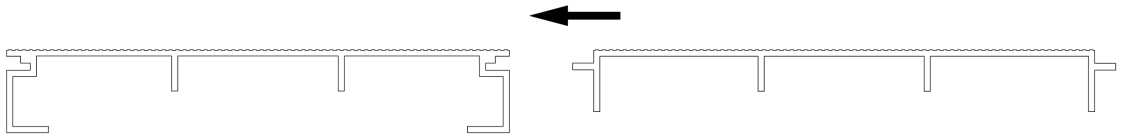
OVERVIEW
Cladding



Planks



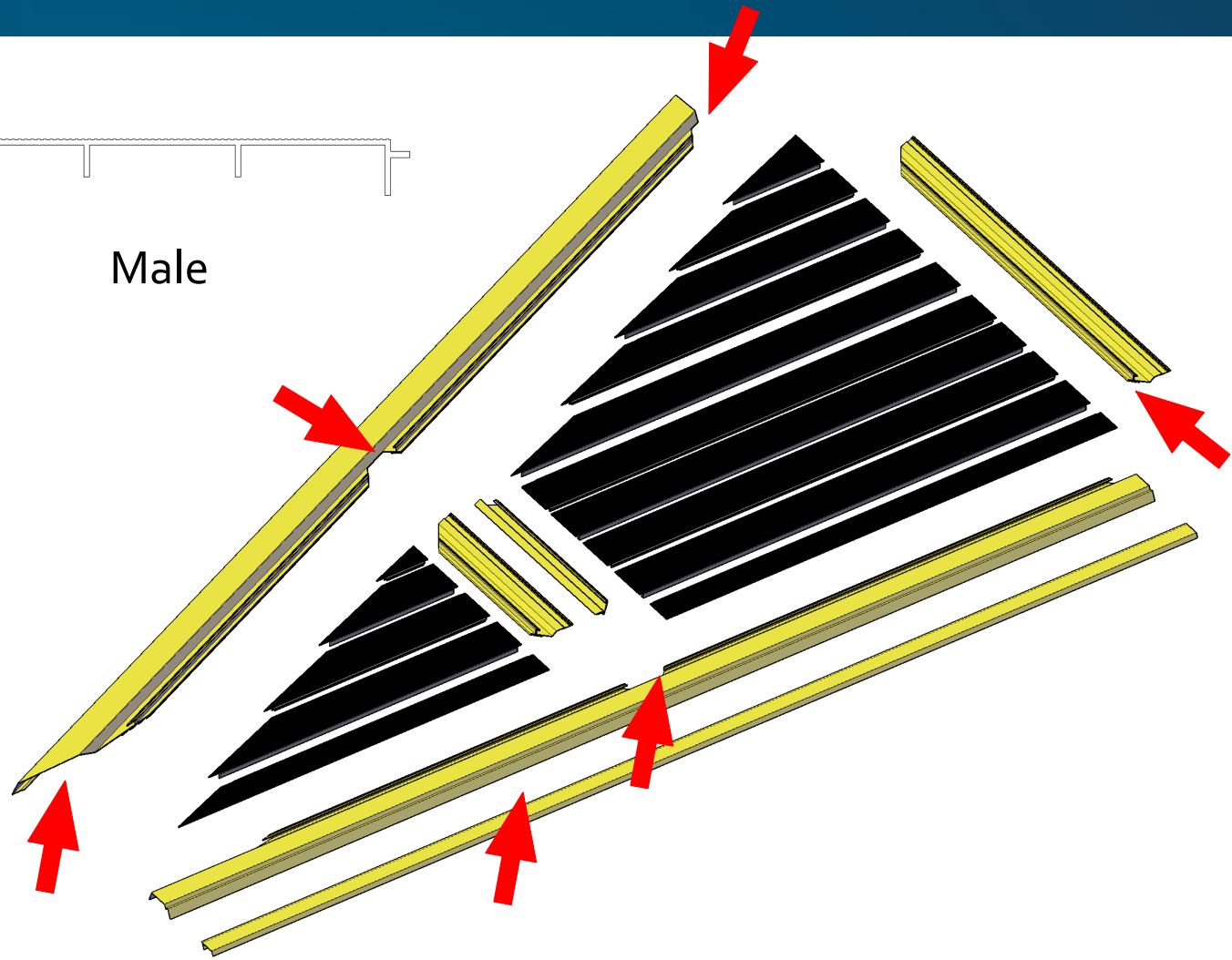
OVERVIEW
Cladding



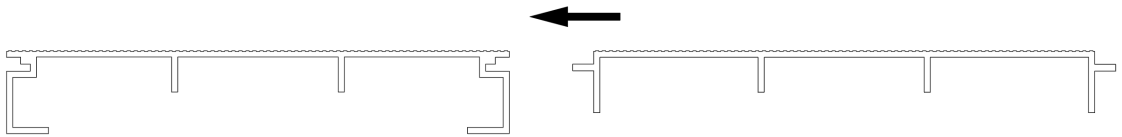
Female

Male

Planks



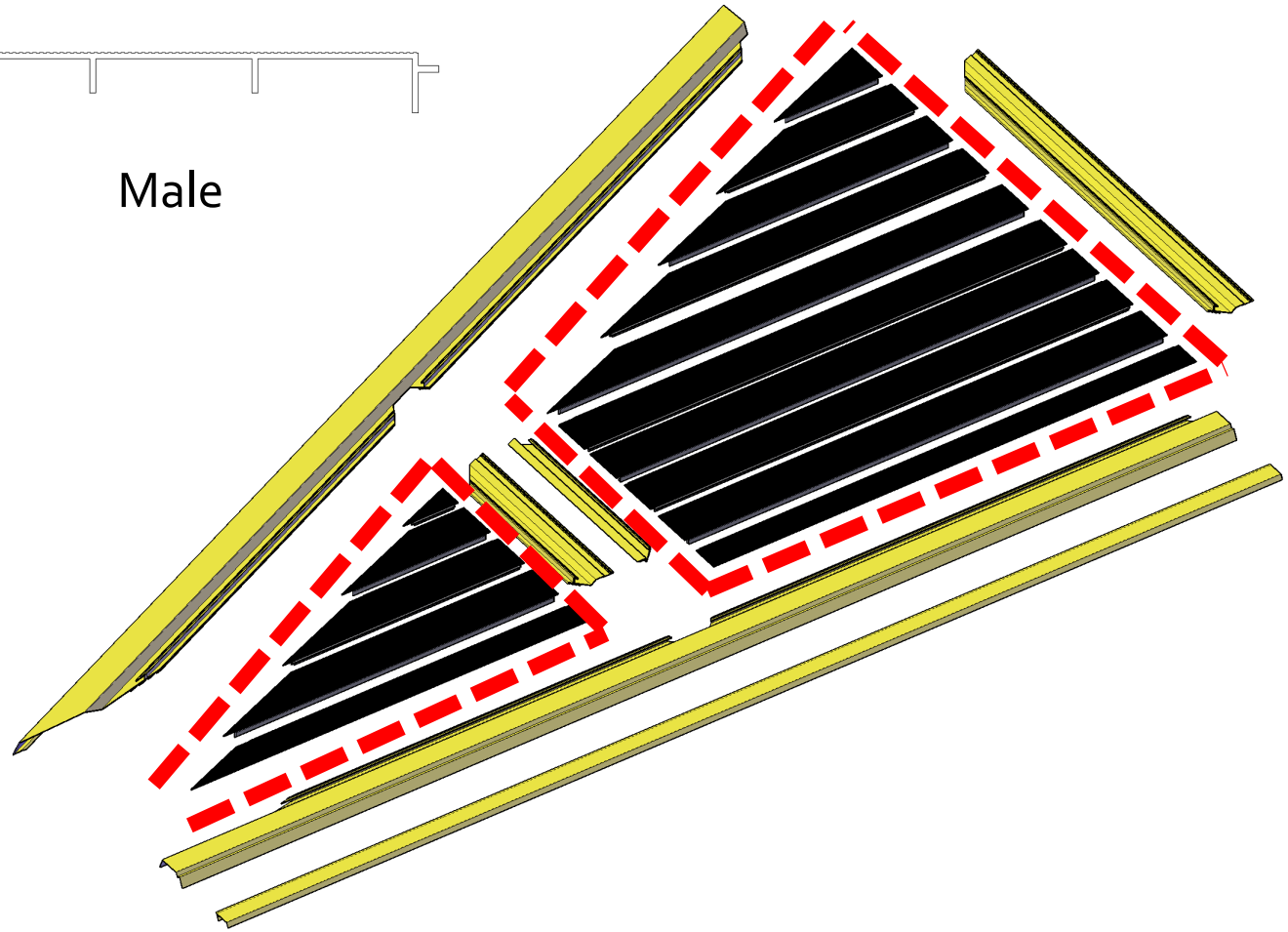
OVERVIEW
Cladding



Female

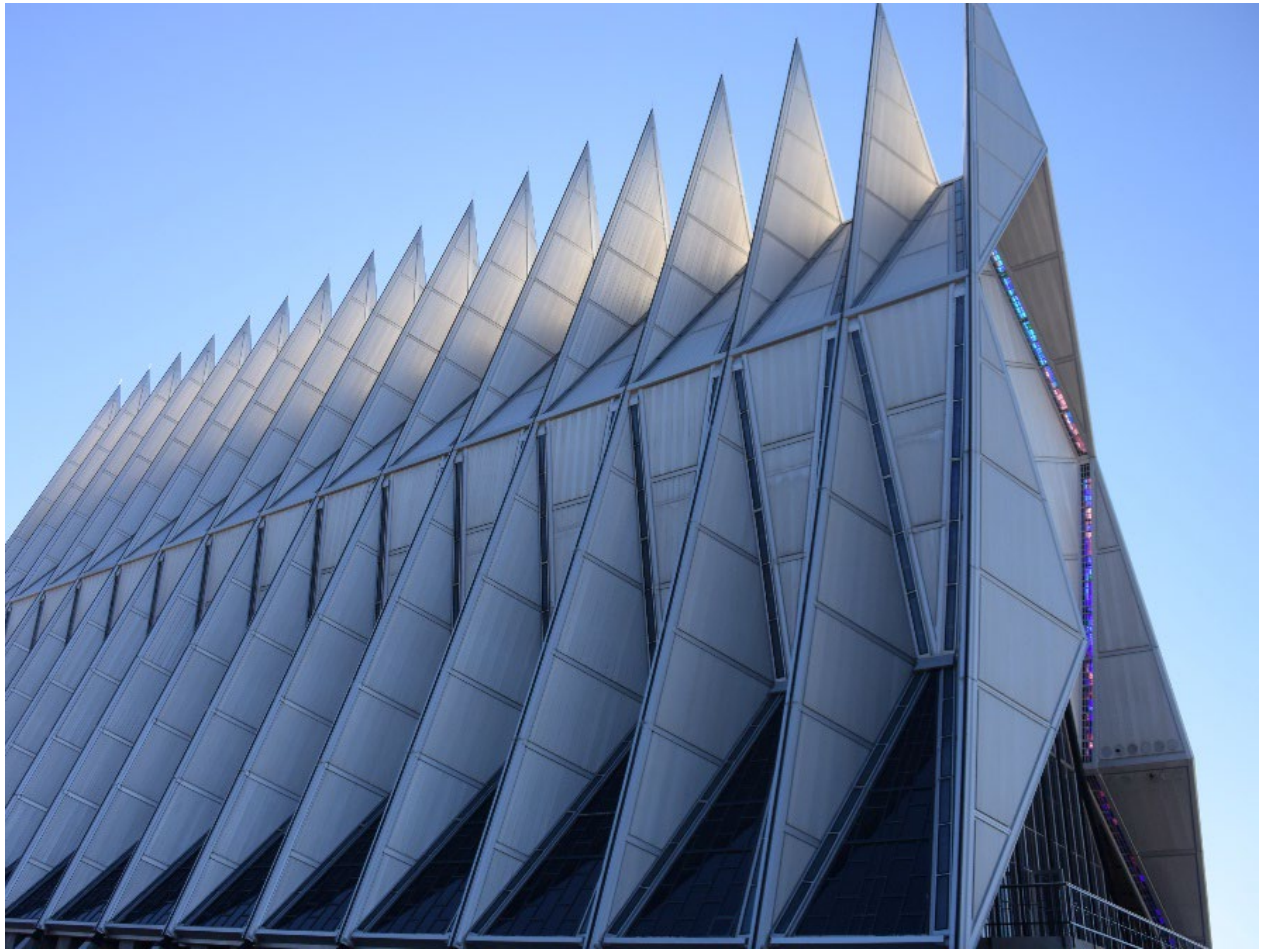
Male

Planks



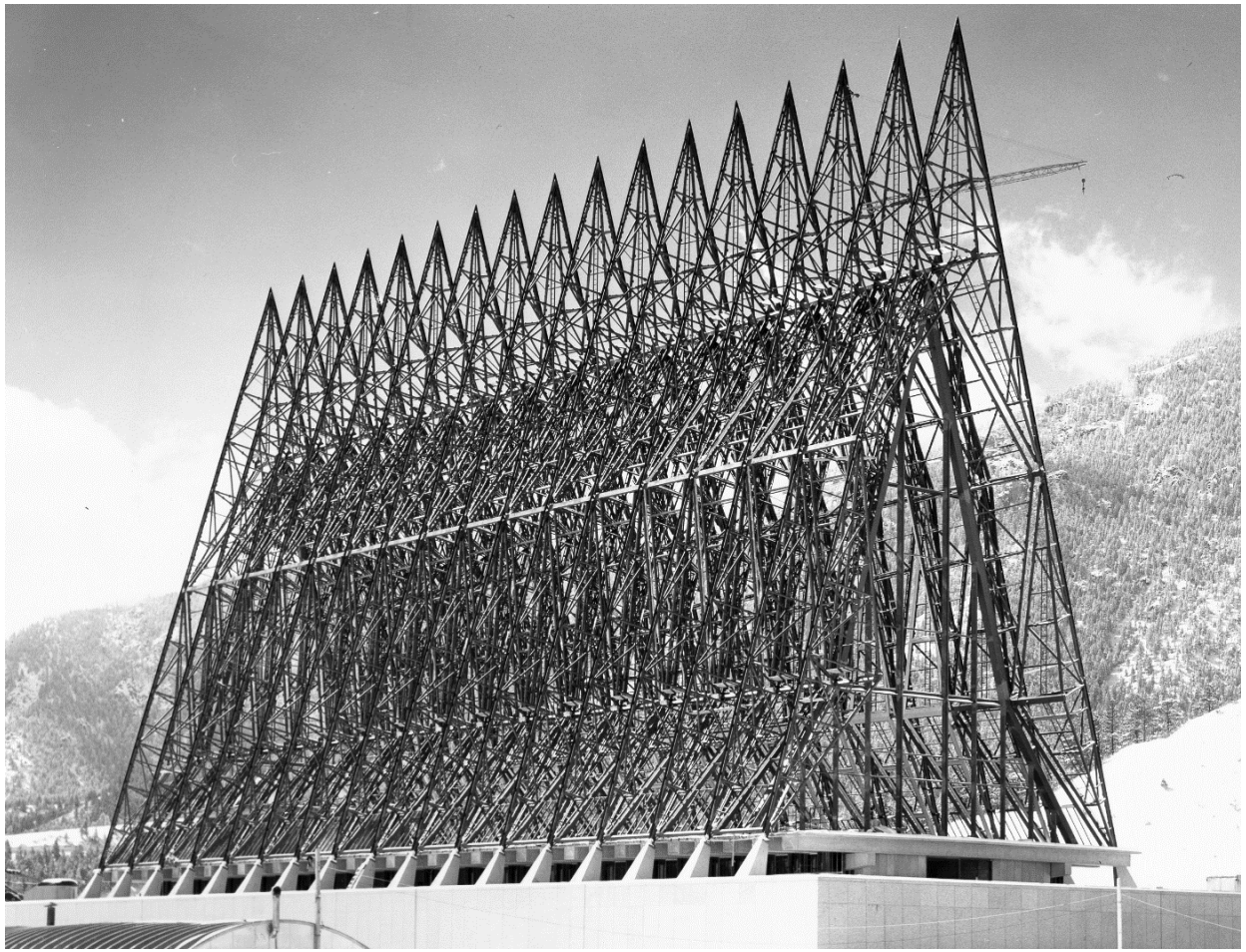
Chapel Restoration Design

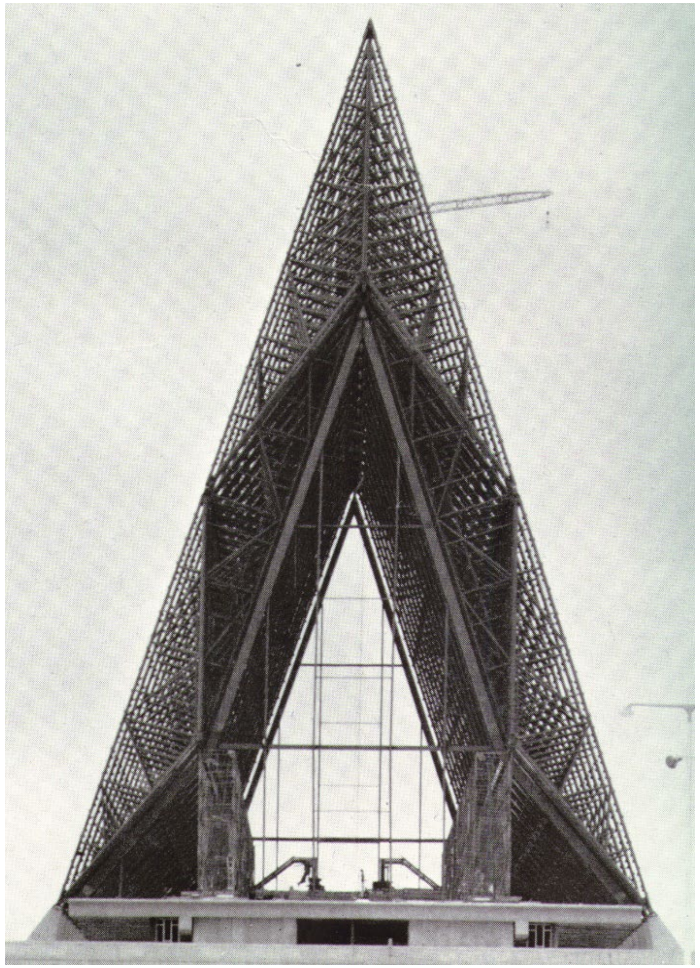
Goal: Solve the water leakage without changing the appearance



Chapel Restoration Design

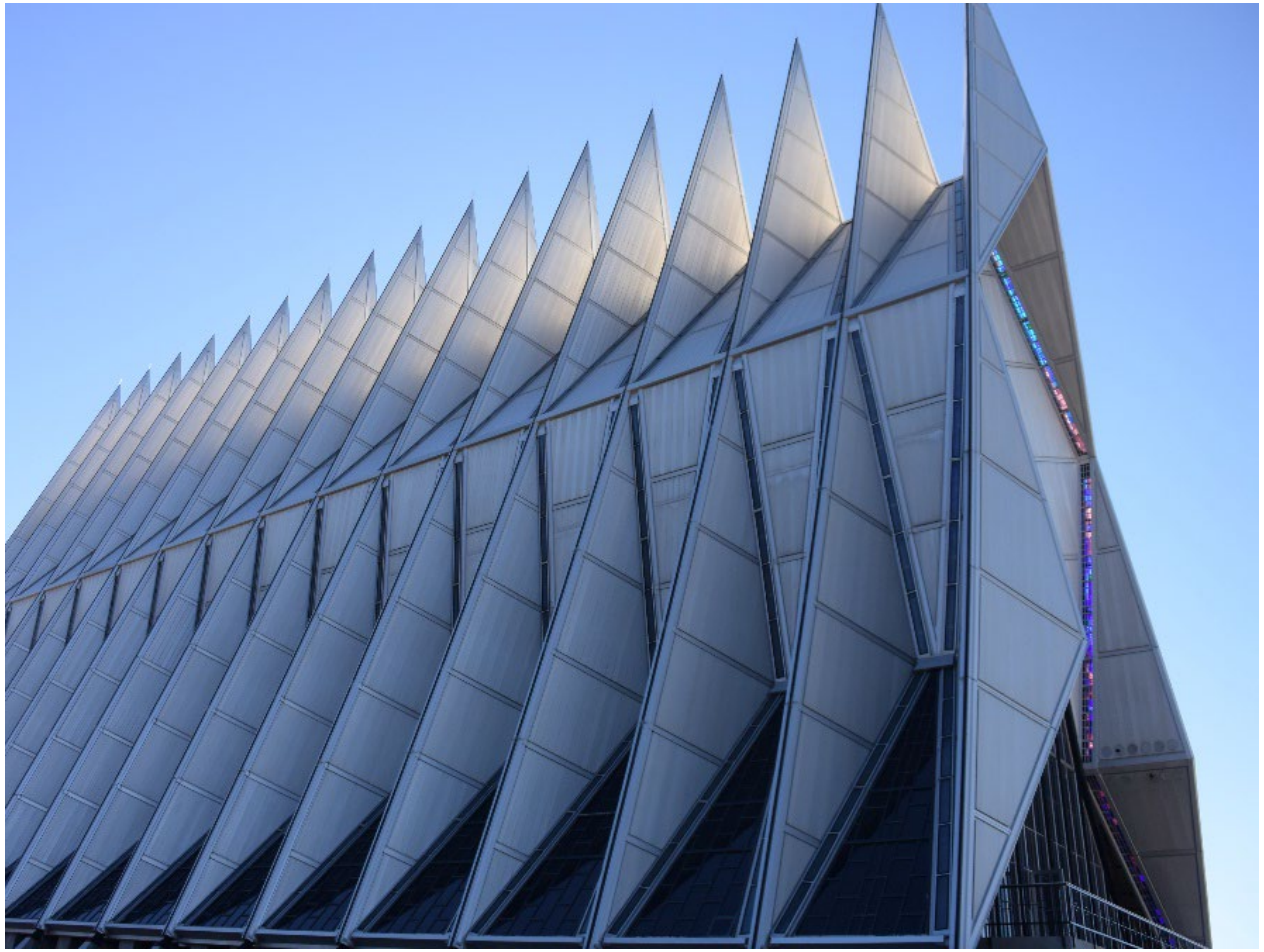
Goal: Solve the water leakage without changing the appearance





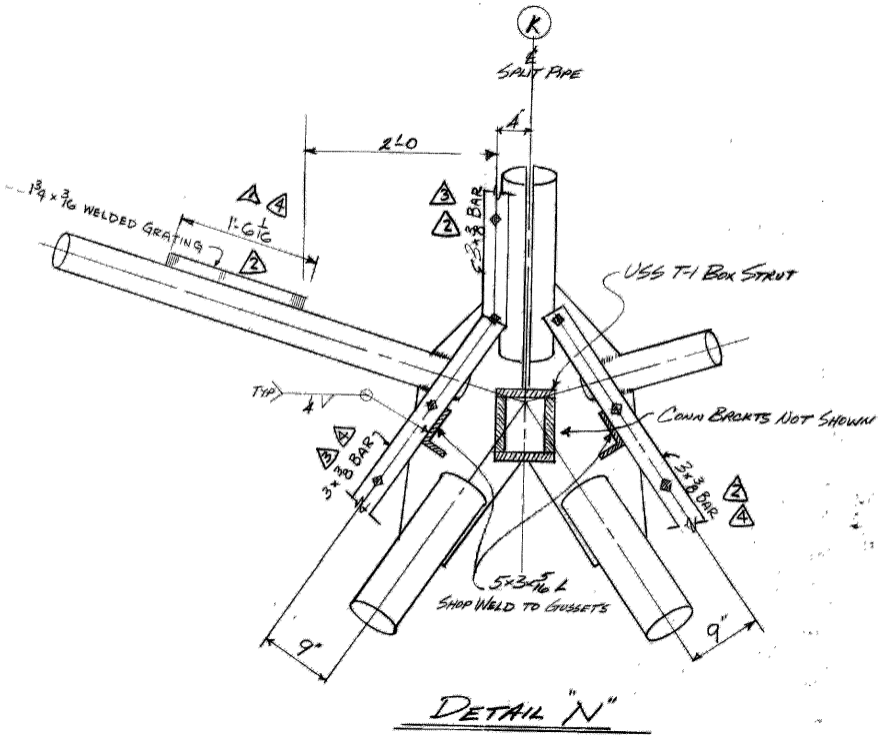
Chapel Restoration Design

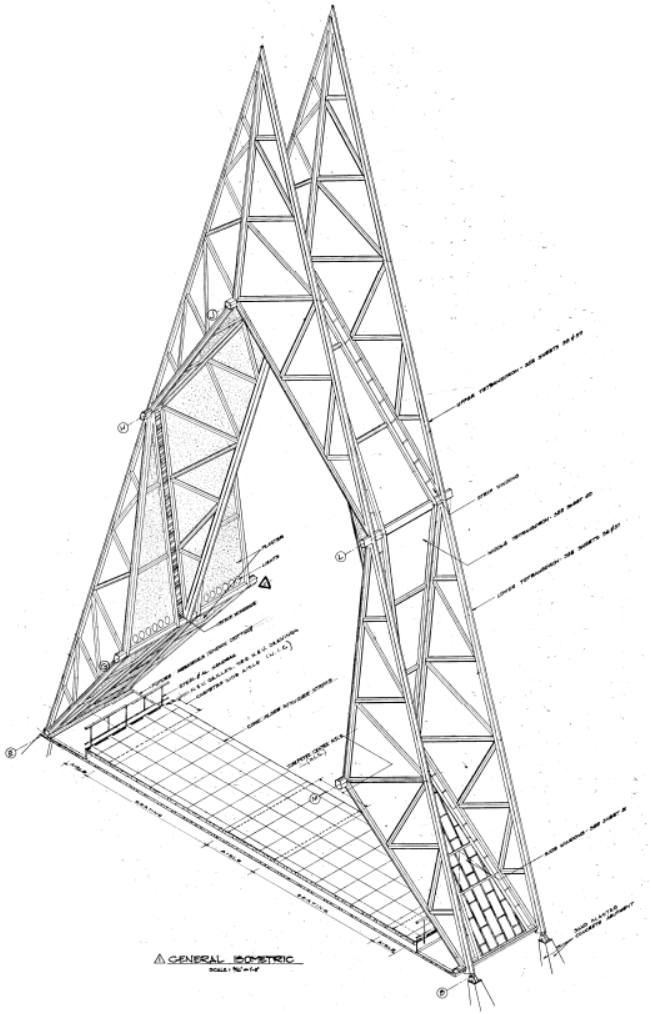
Goal: Solve the water leakage without changing the appearance



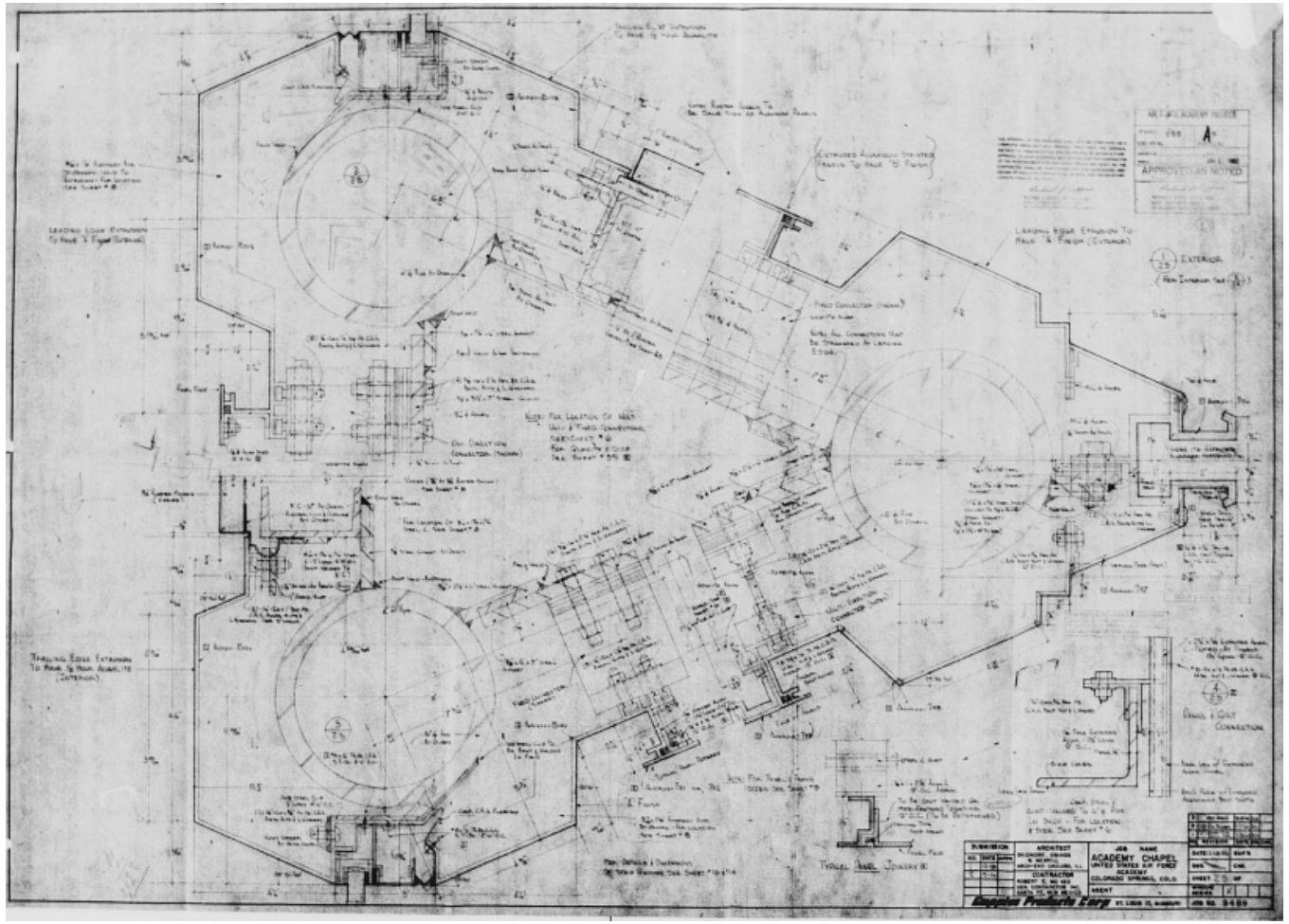
Historical Documents → Investigation → Recladding Design

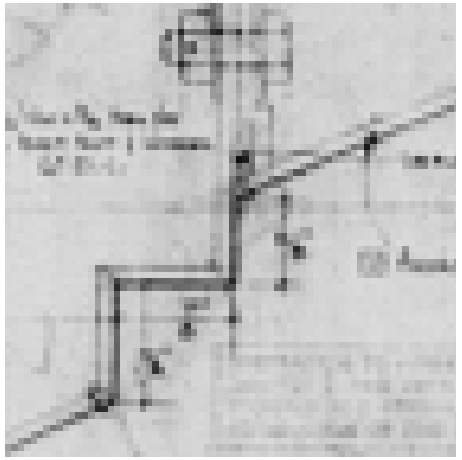
- Architectural Drawings (SOM)
- Structural Steel Shop Drawings (Mississippi Valley)
- Cladding Shop Drawings (Cupples)

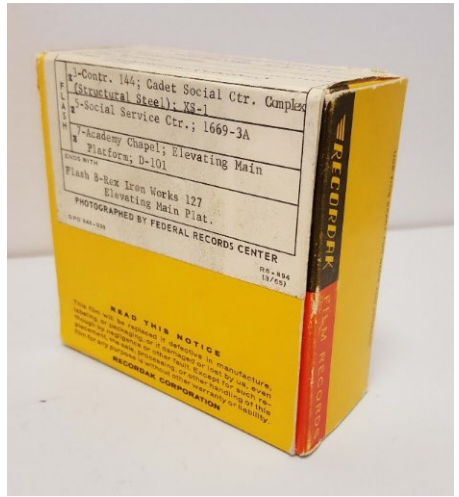




Historical Documents

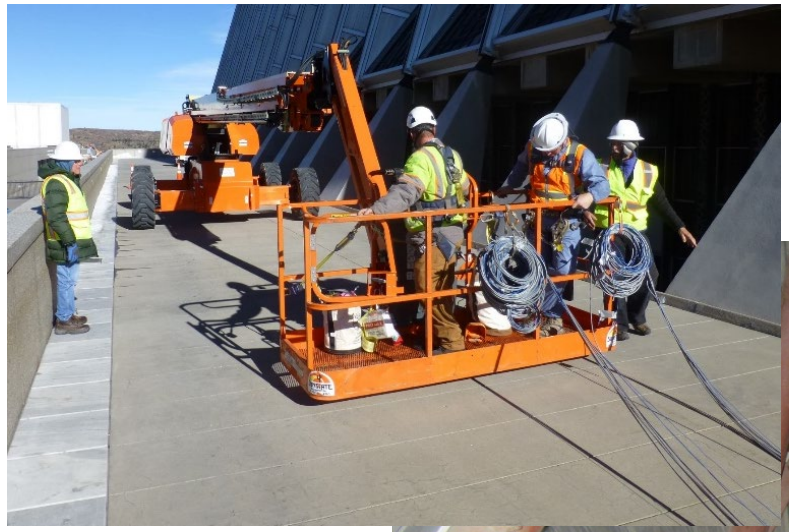




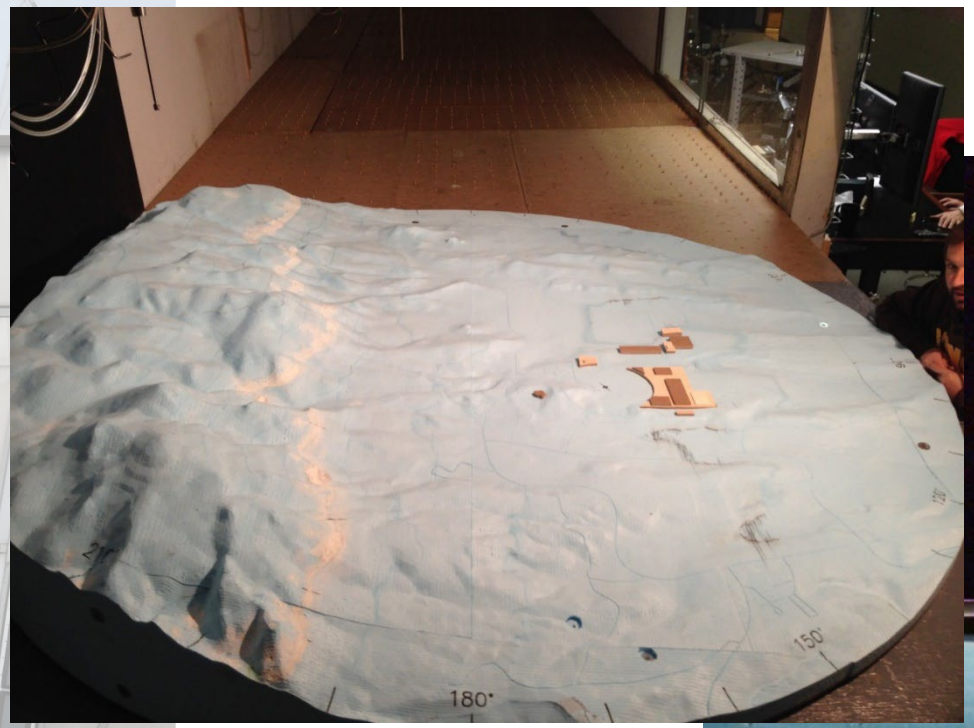


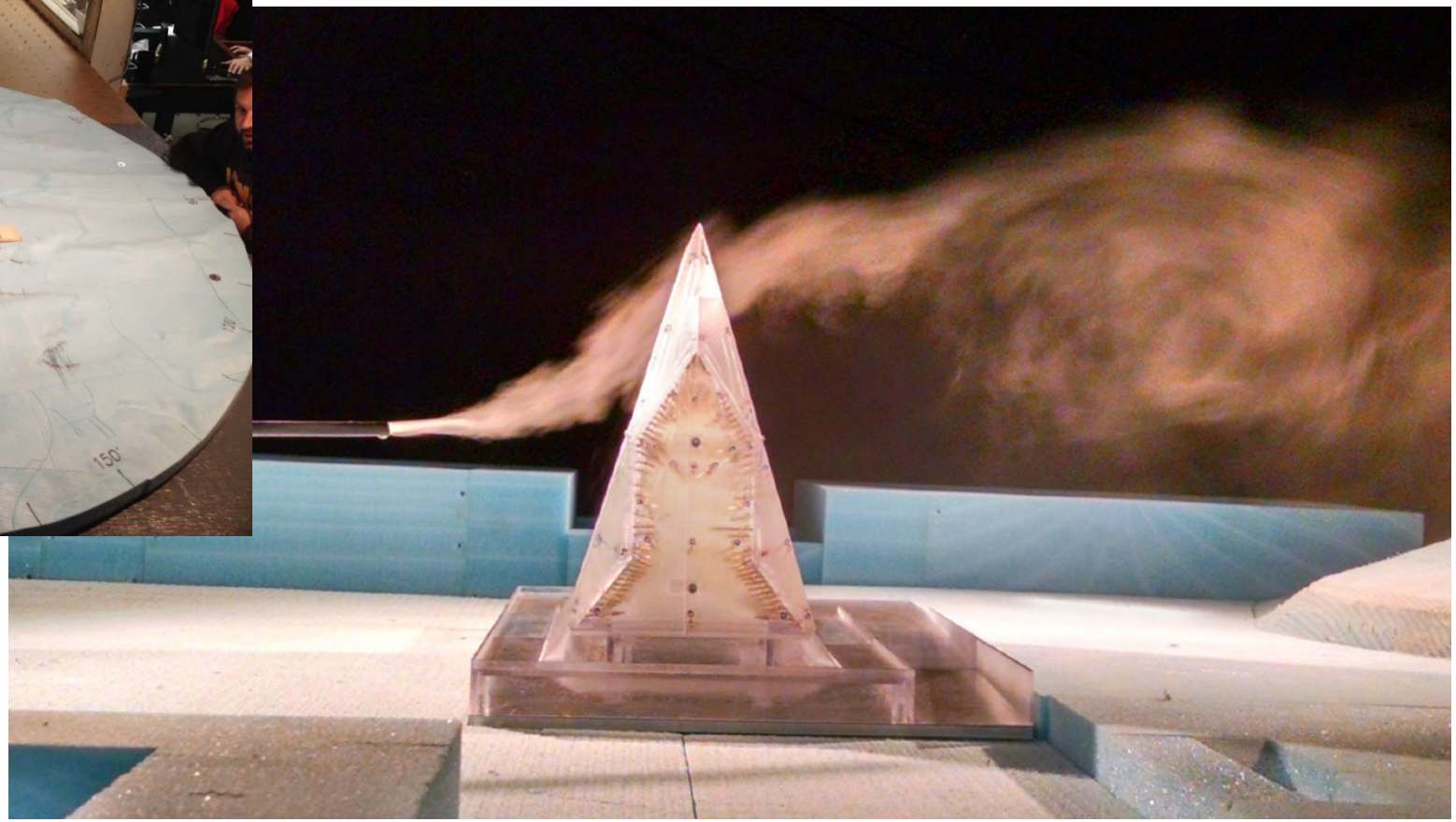
Microfiche

Field Investigation

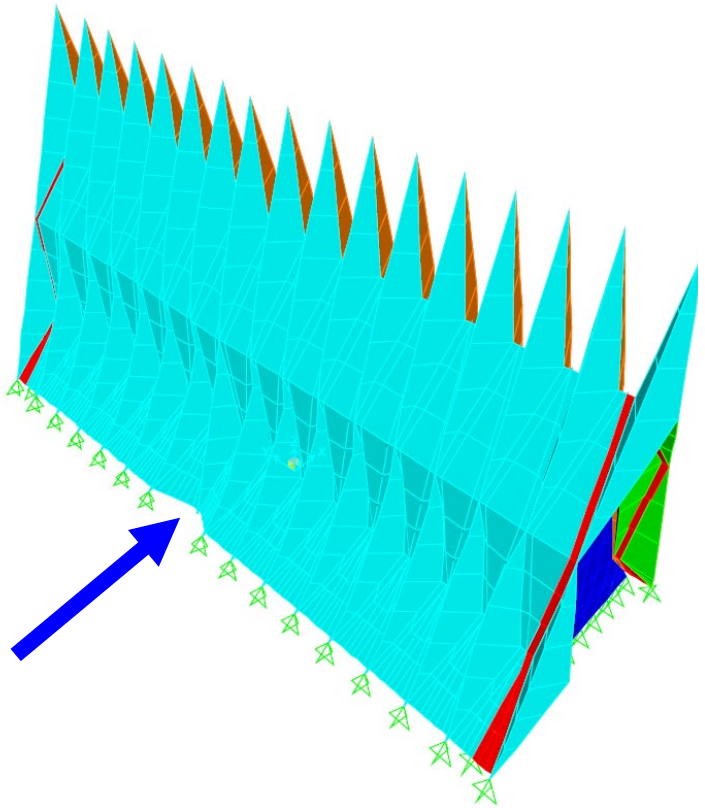


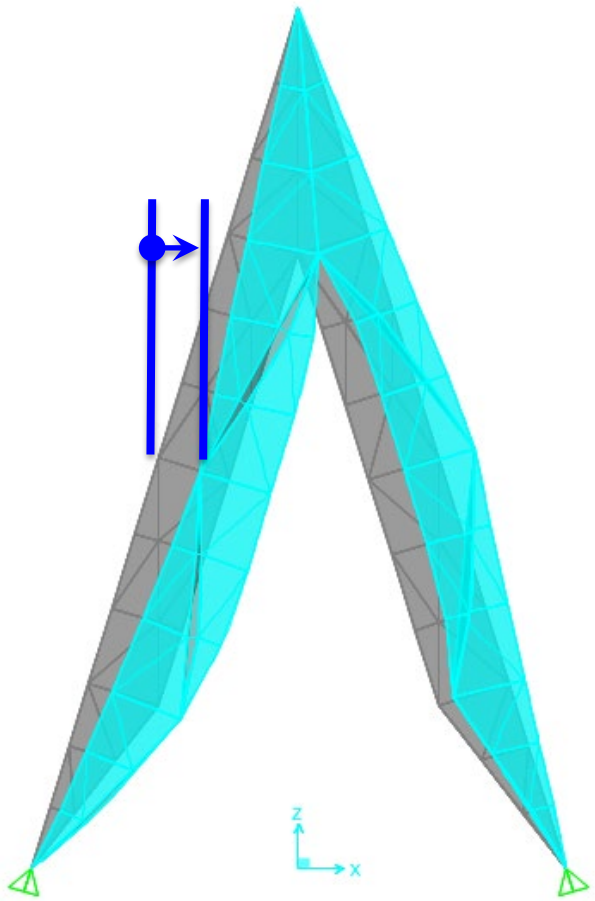
Wind Tunnel Testing

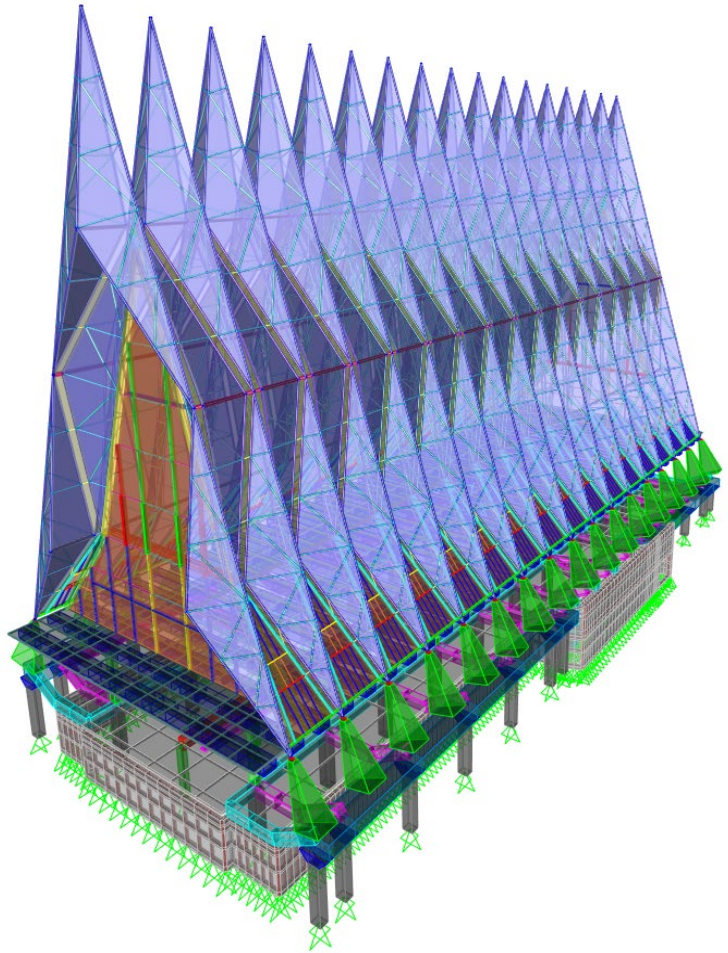




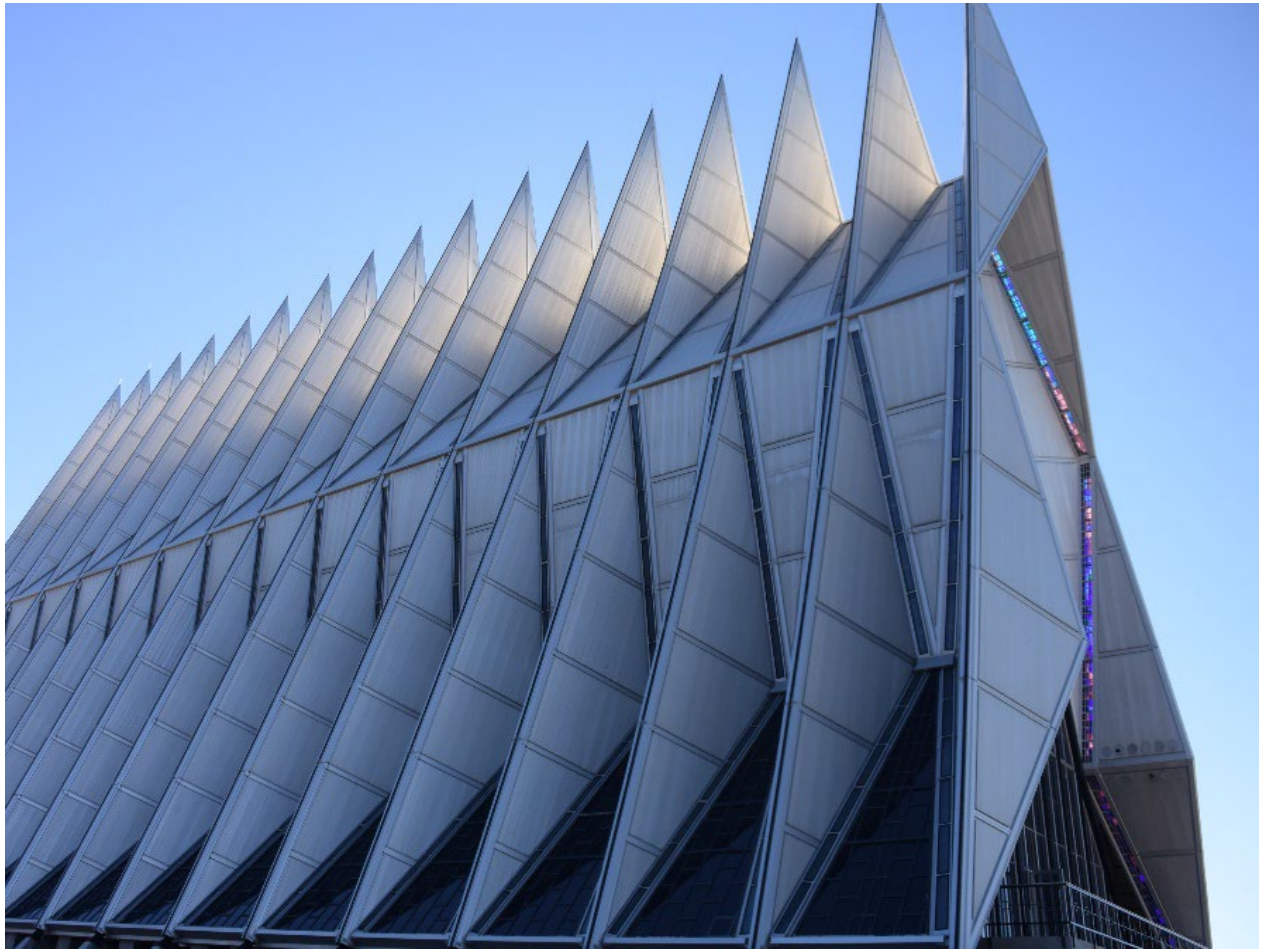
Structural Computer Analysis







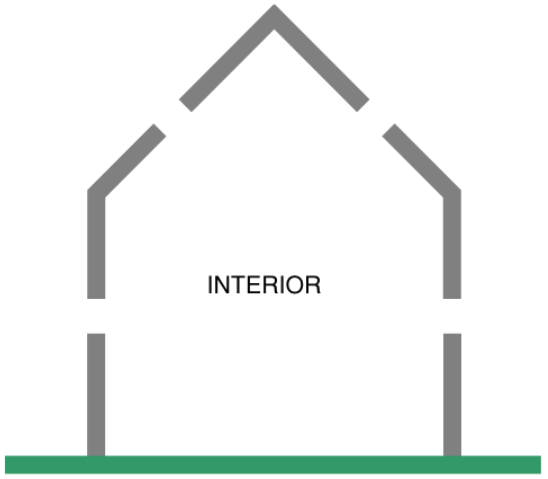
RECLADDING DESIGN



ENCLOSURE
How Buildings Leak

Water Source

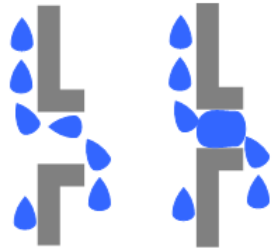
Hole in Exterior Wall



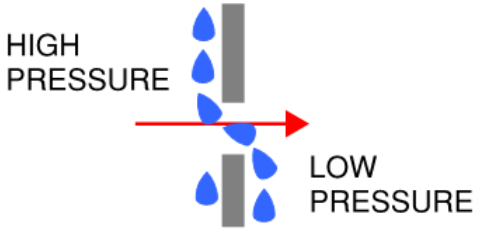
Force to Push Water Through Hole

GRAVITY

KINETIC ENERGY



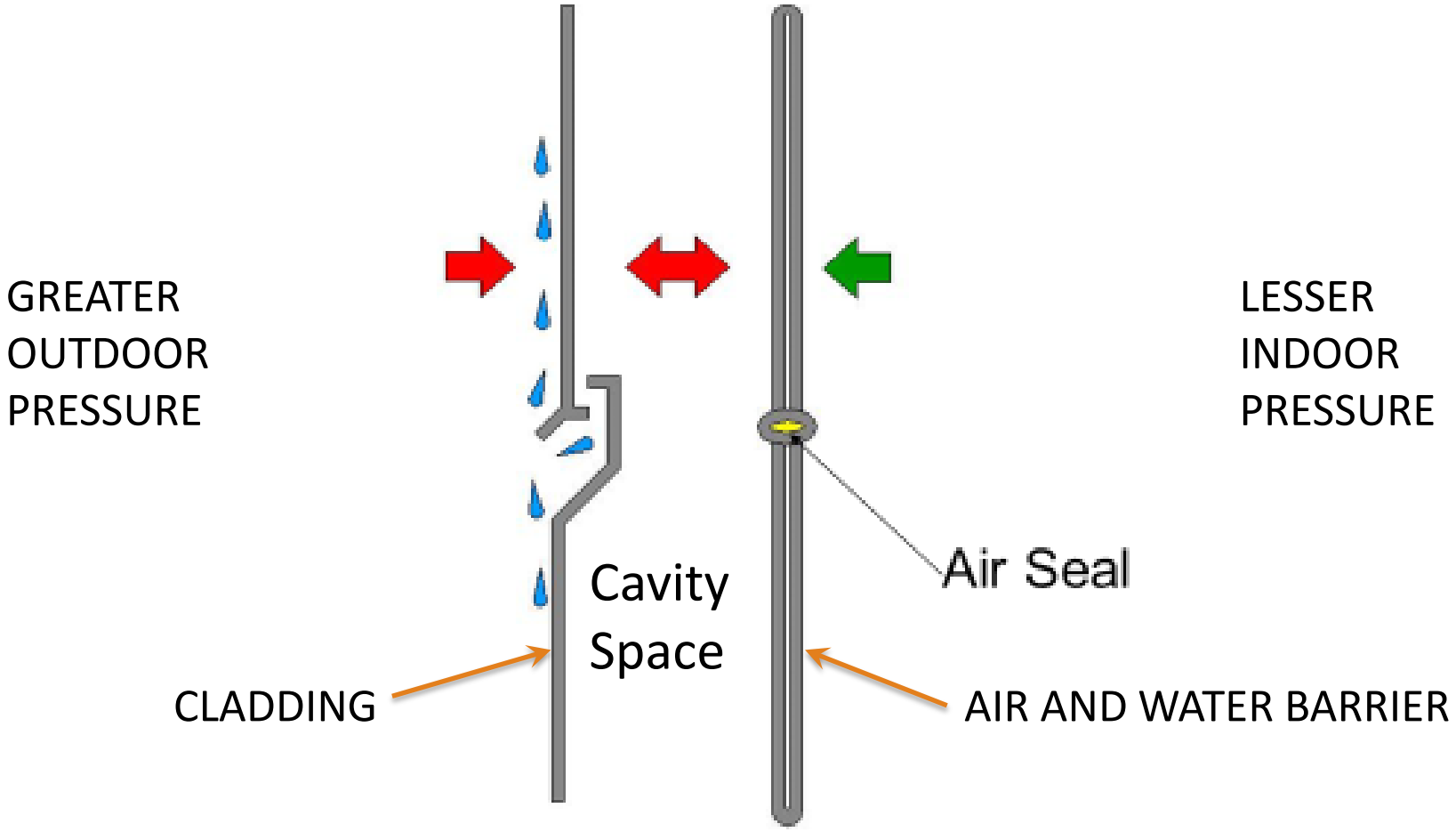
SURFACE TENSION
CAPILLARY ACTION



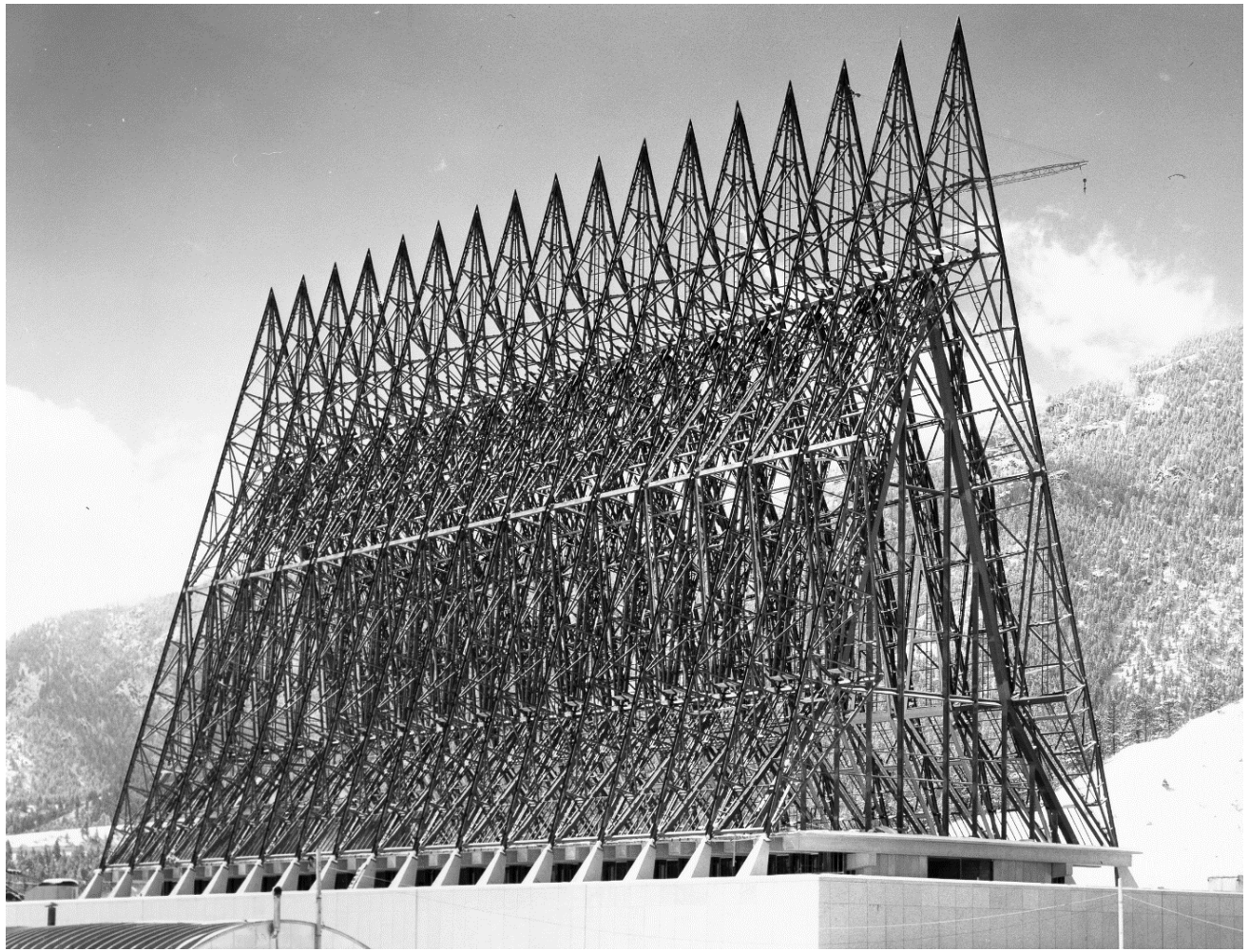
PRESSURE DIFFERENCE

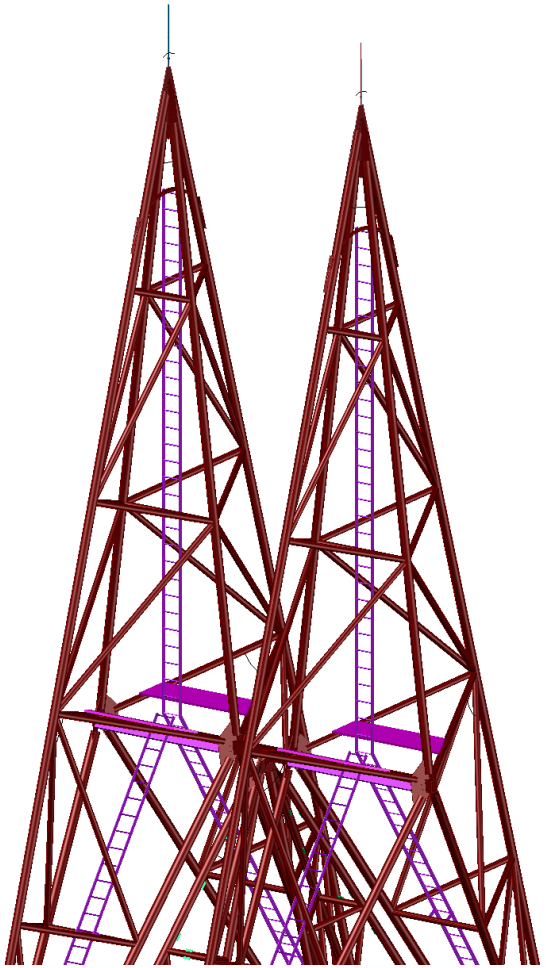
ENCLOSURE
How Buildings Leak

ENCLOSURE
Rainscreen Concept

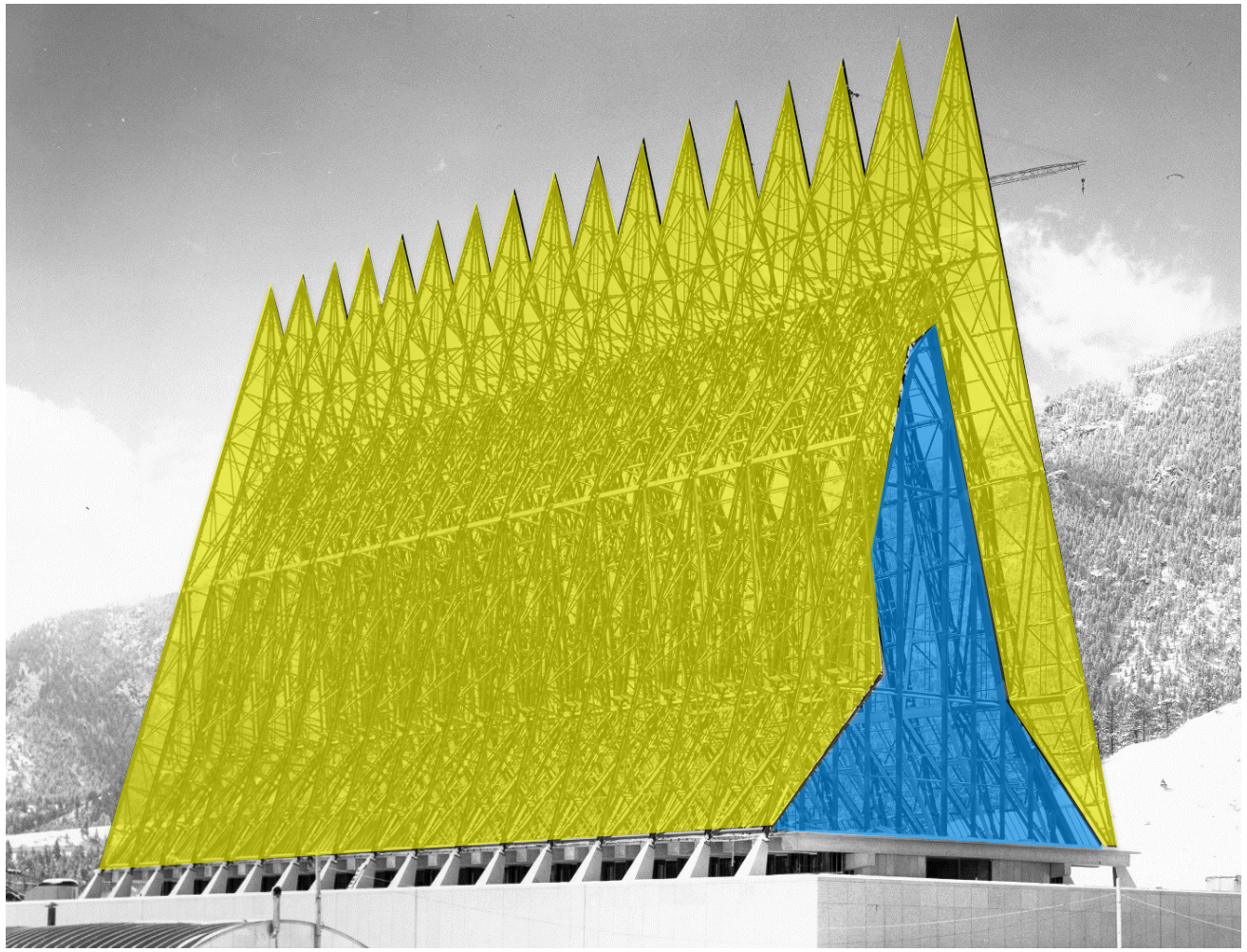


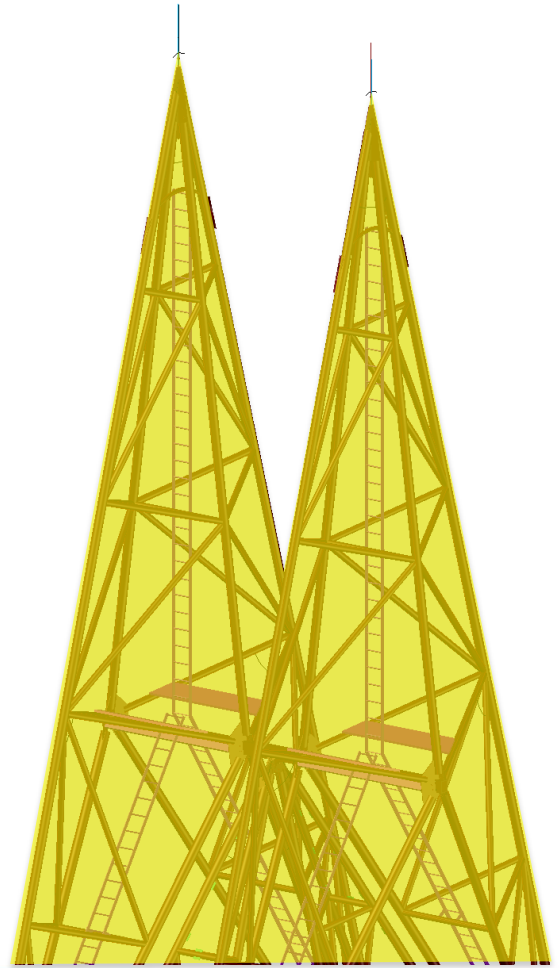
ENCLOSURE
Rainscreen Concept



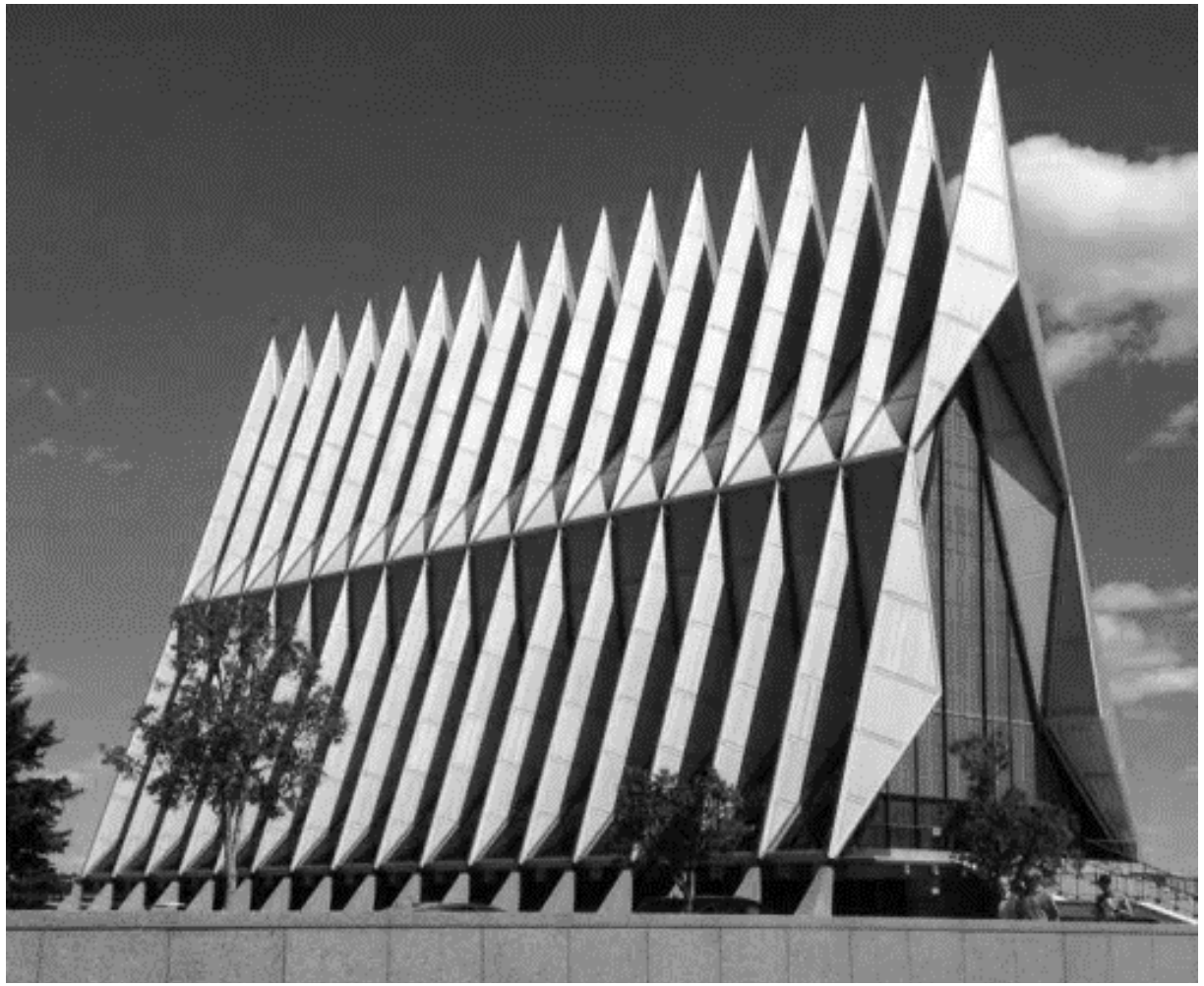


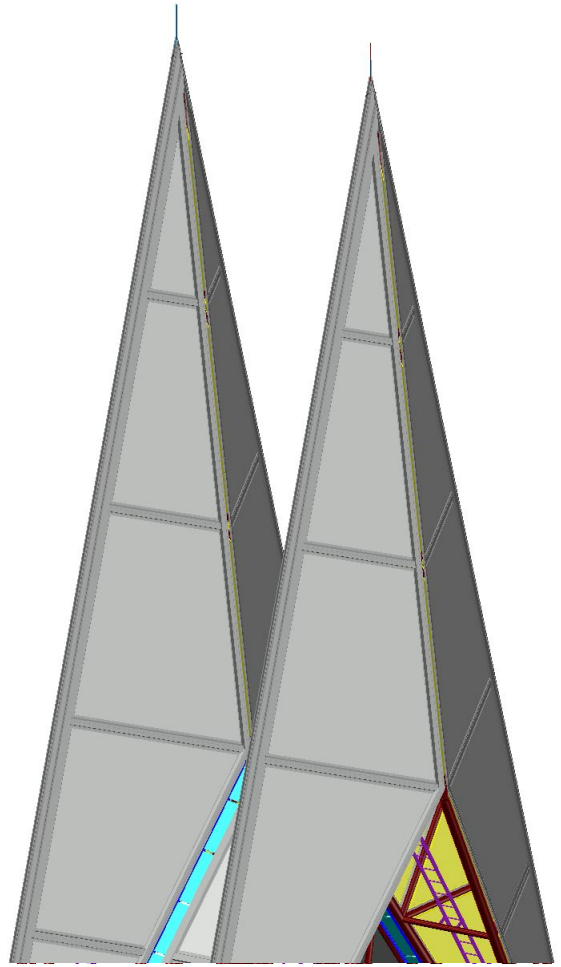
ENCLOSURE
Rainscreen Concept



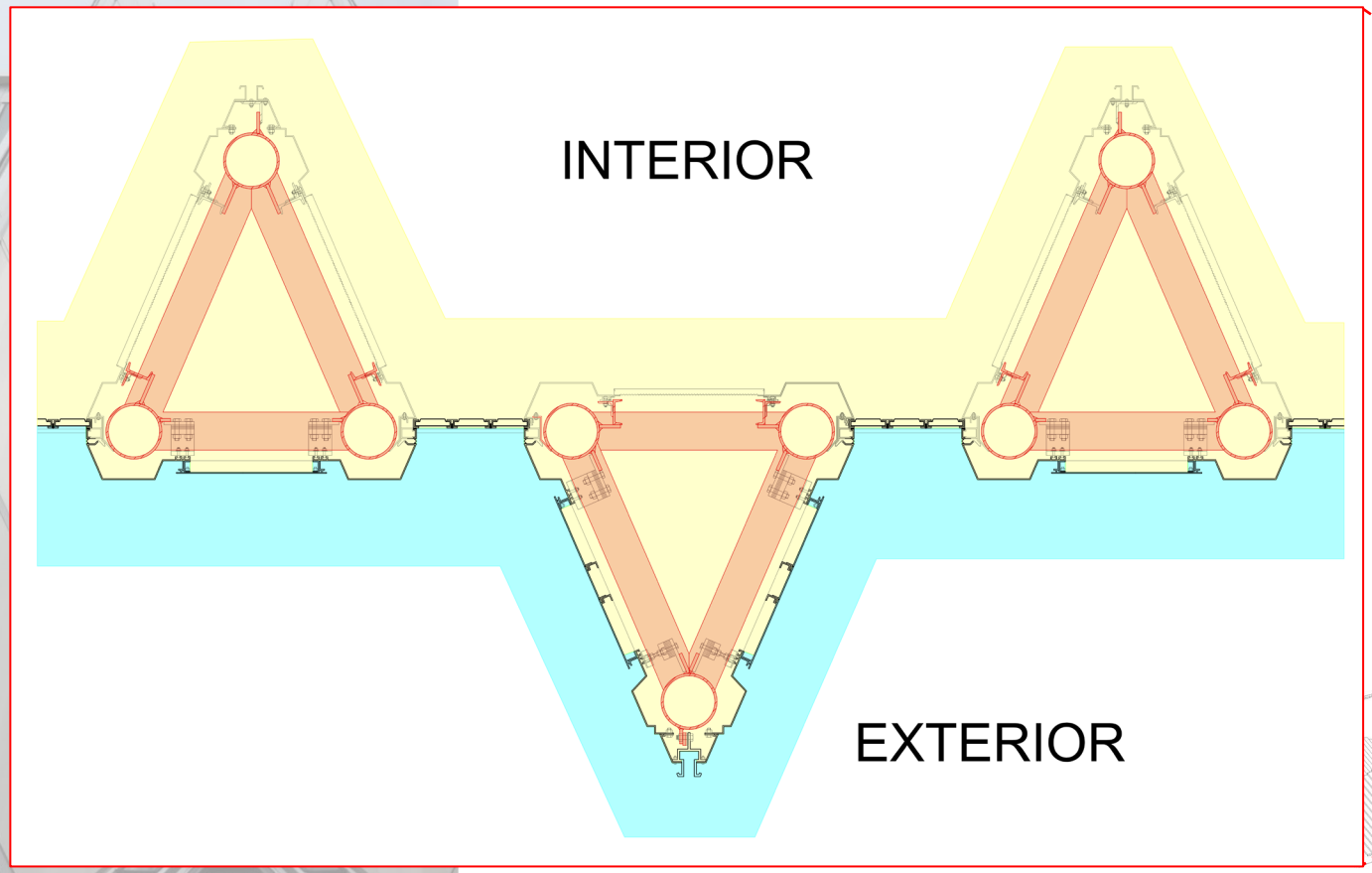


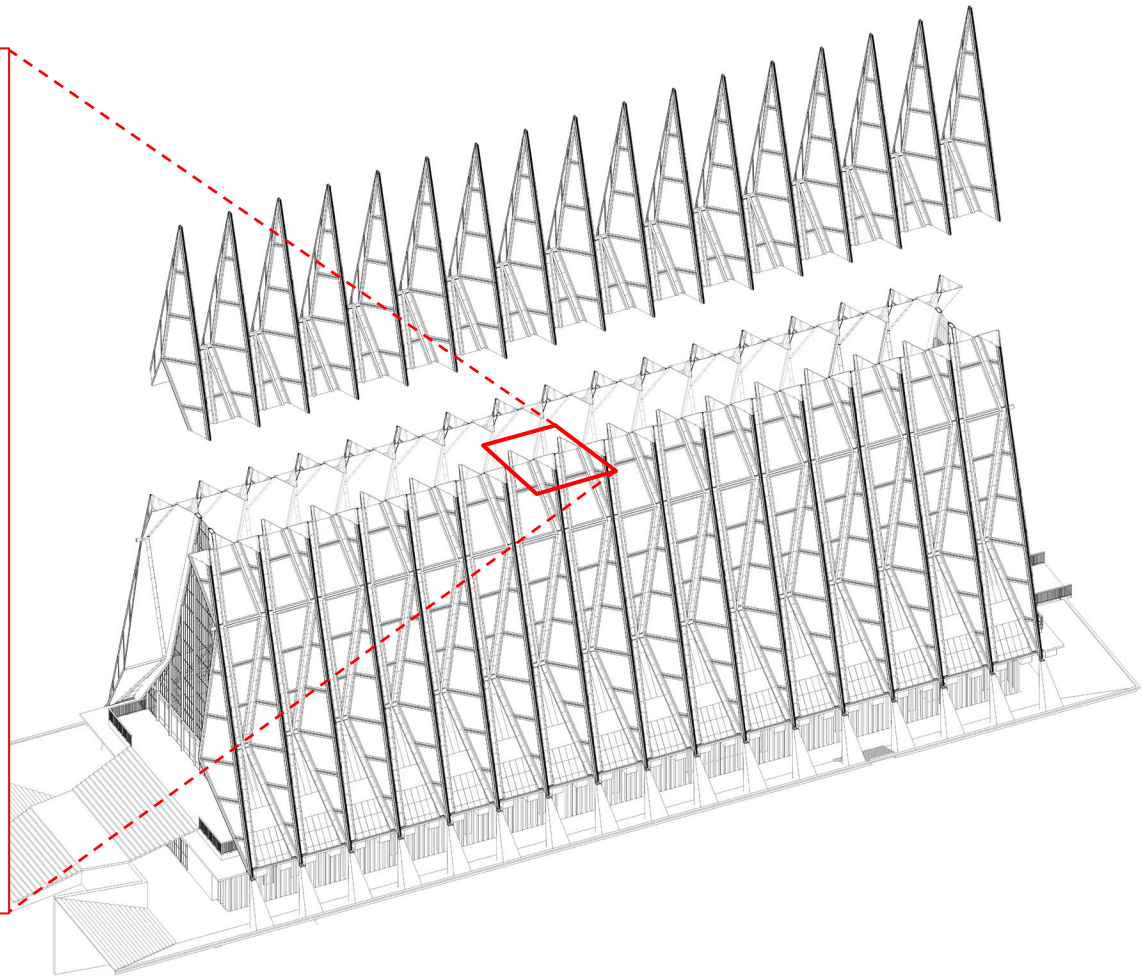
ENCLOSURE
Rainscreen Concept



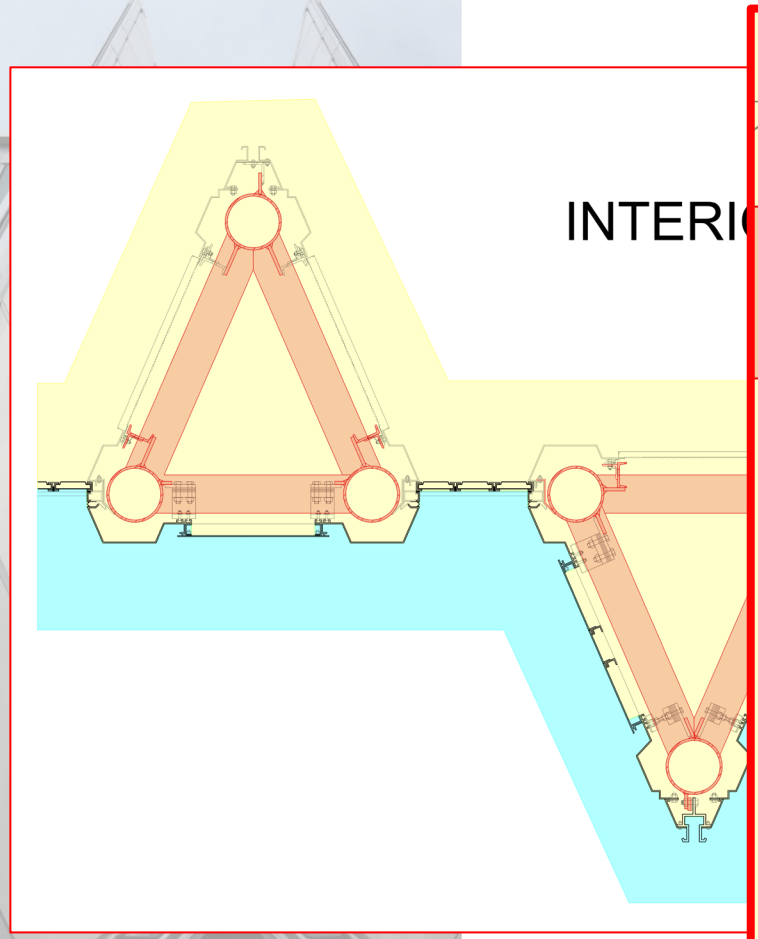


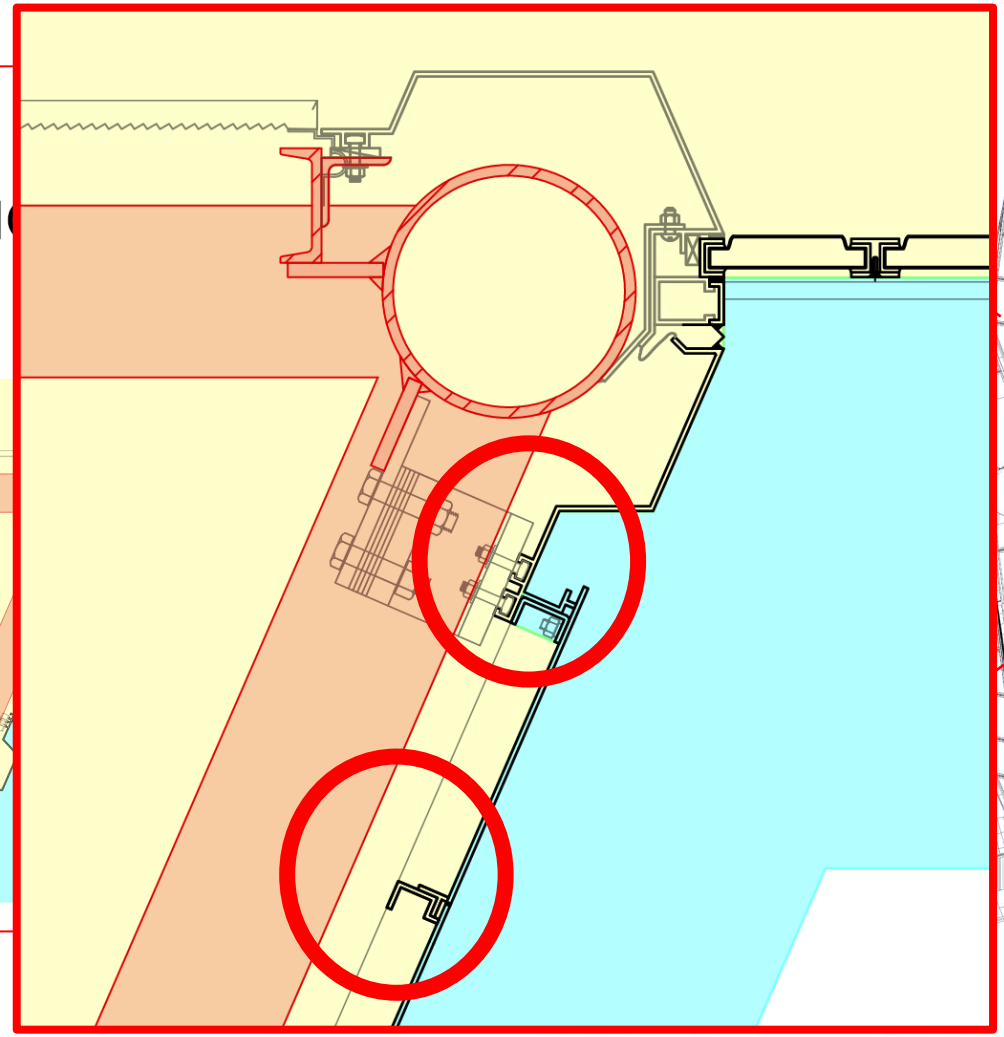
ENCLOSURE
Rainscreen Concept

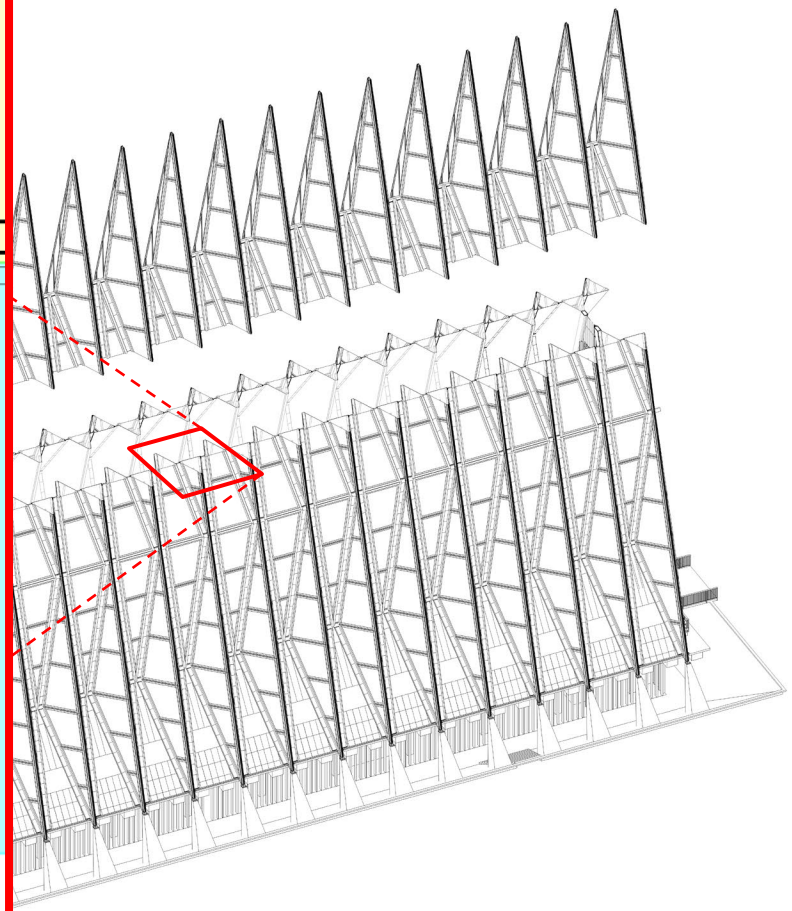




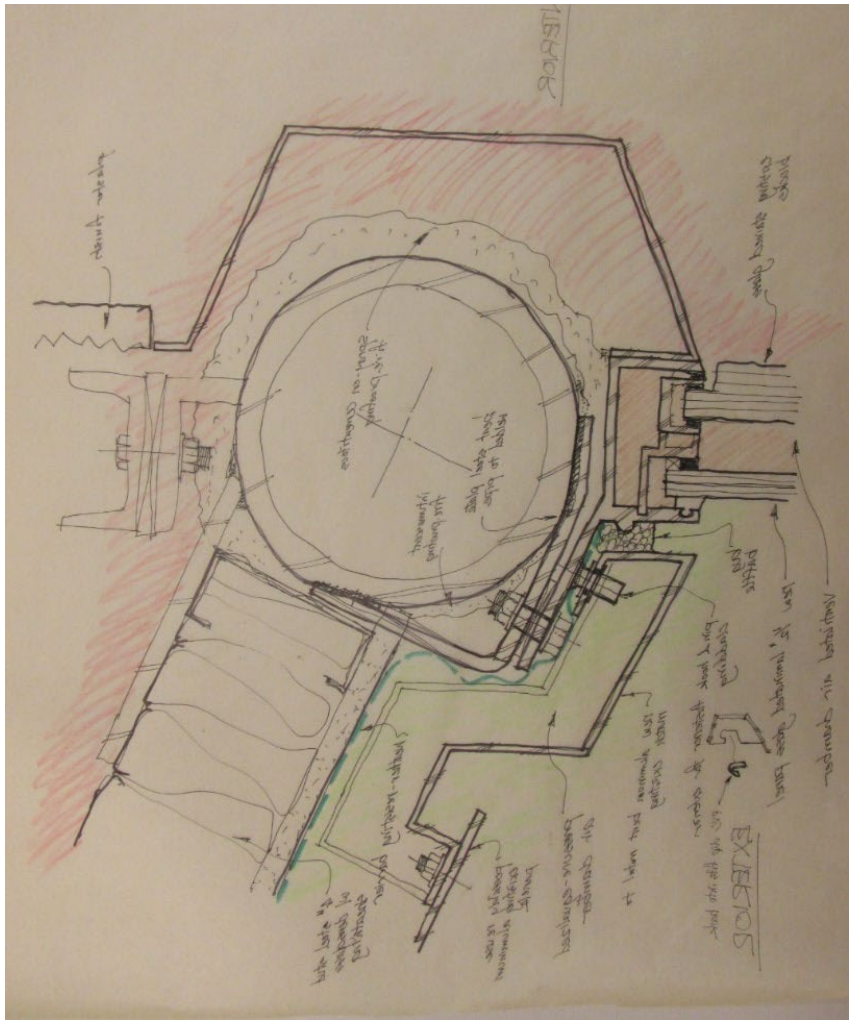
ENCLOSURE
Rainscreen Concept

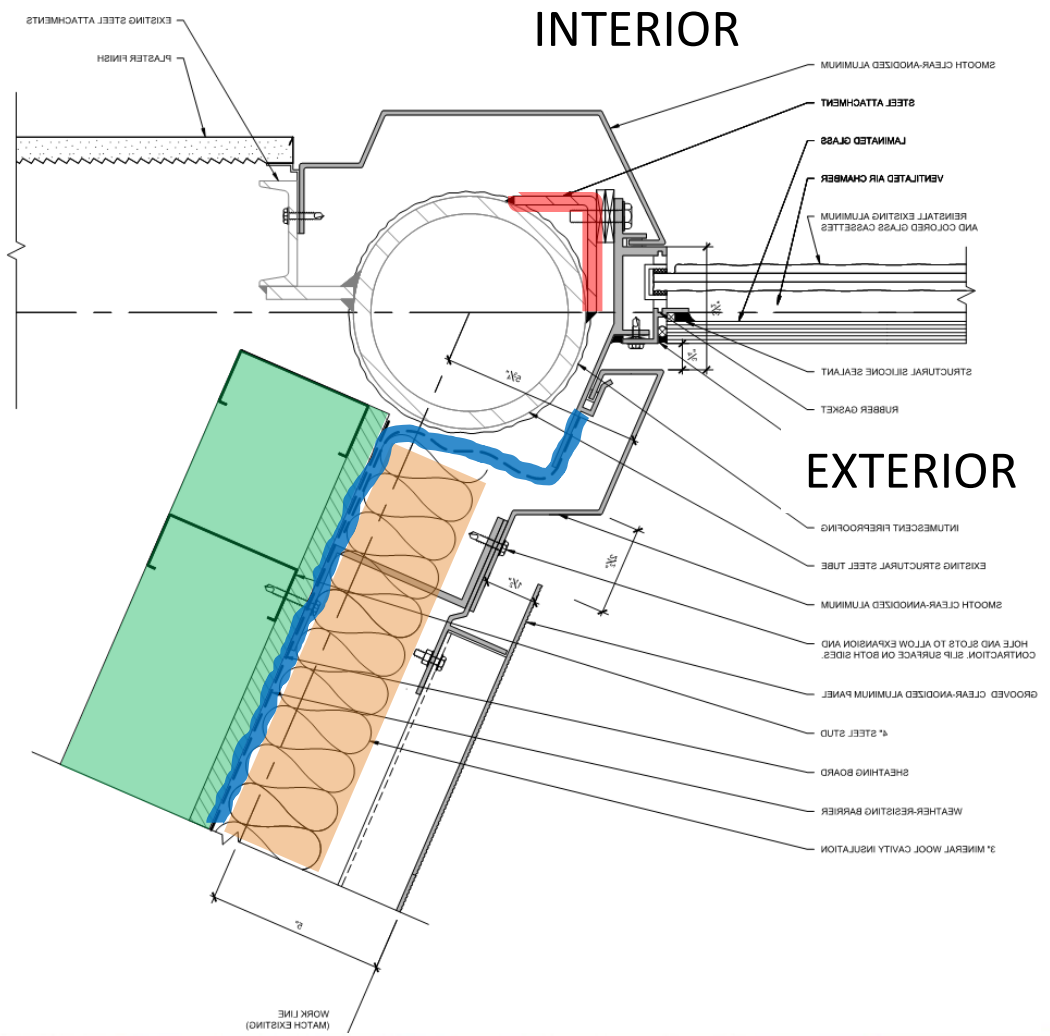






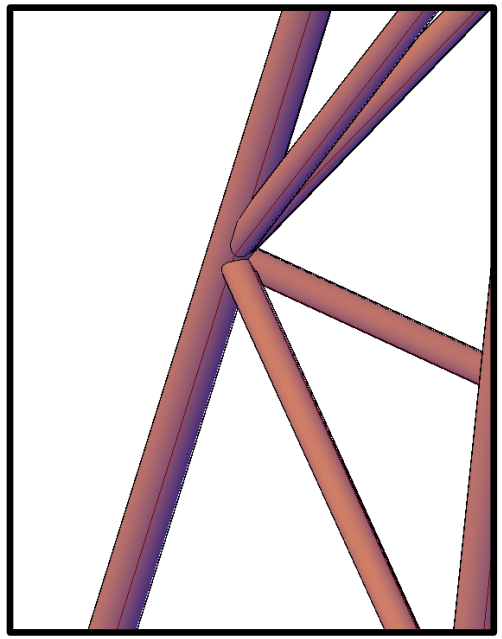
ENCLOSURE
Rainscreen Concept



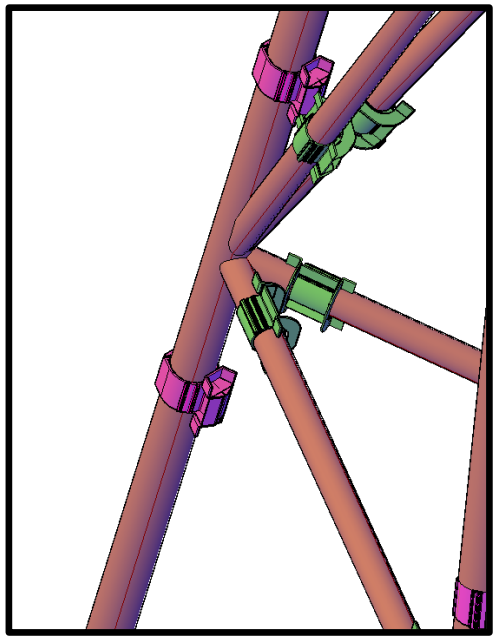


abaa building enclosure conference

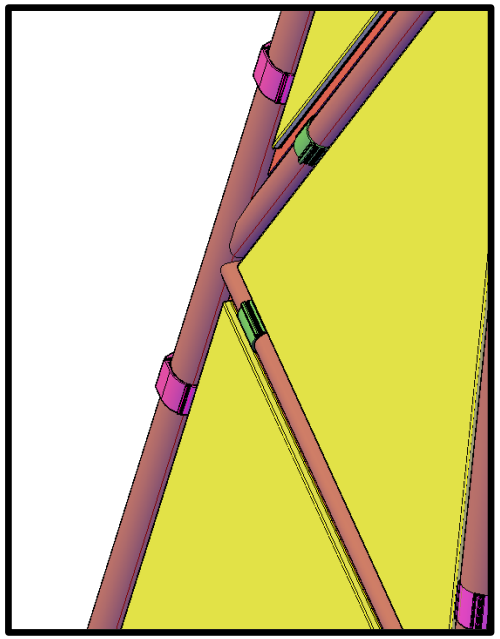
ENCLOSURE
Rainscreen Backup Wall



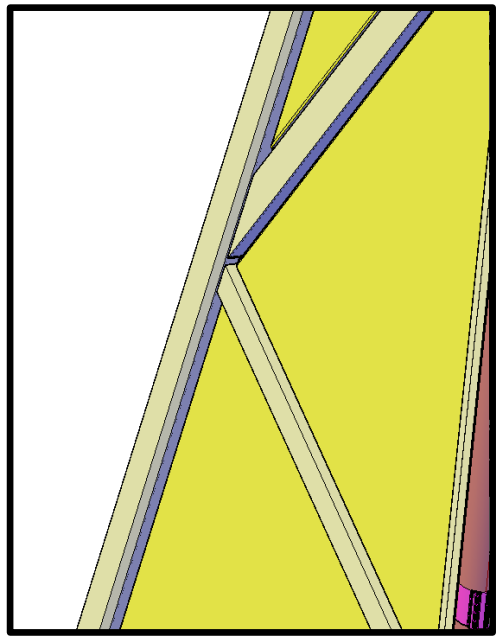
Existing steel



Anchors

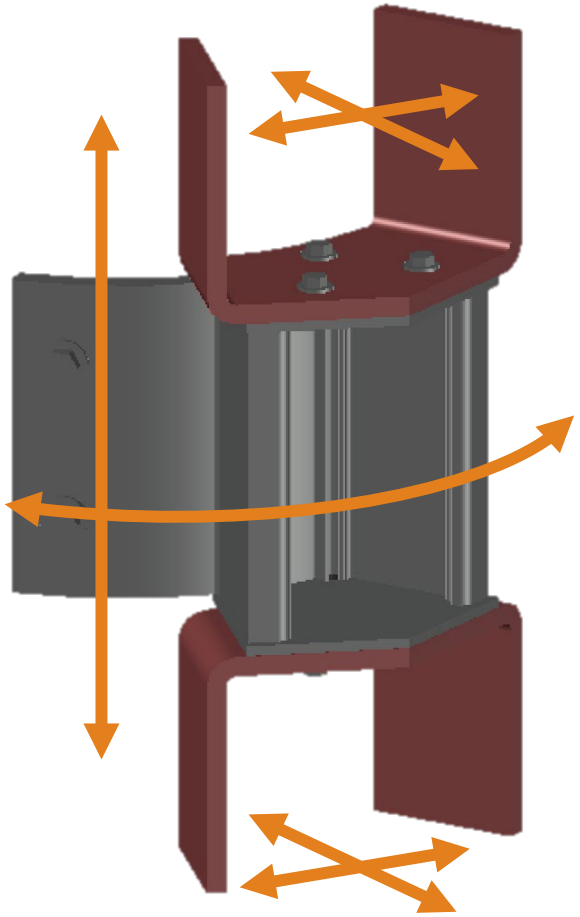


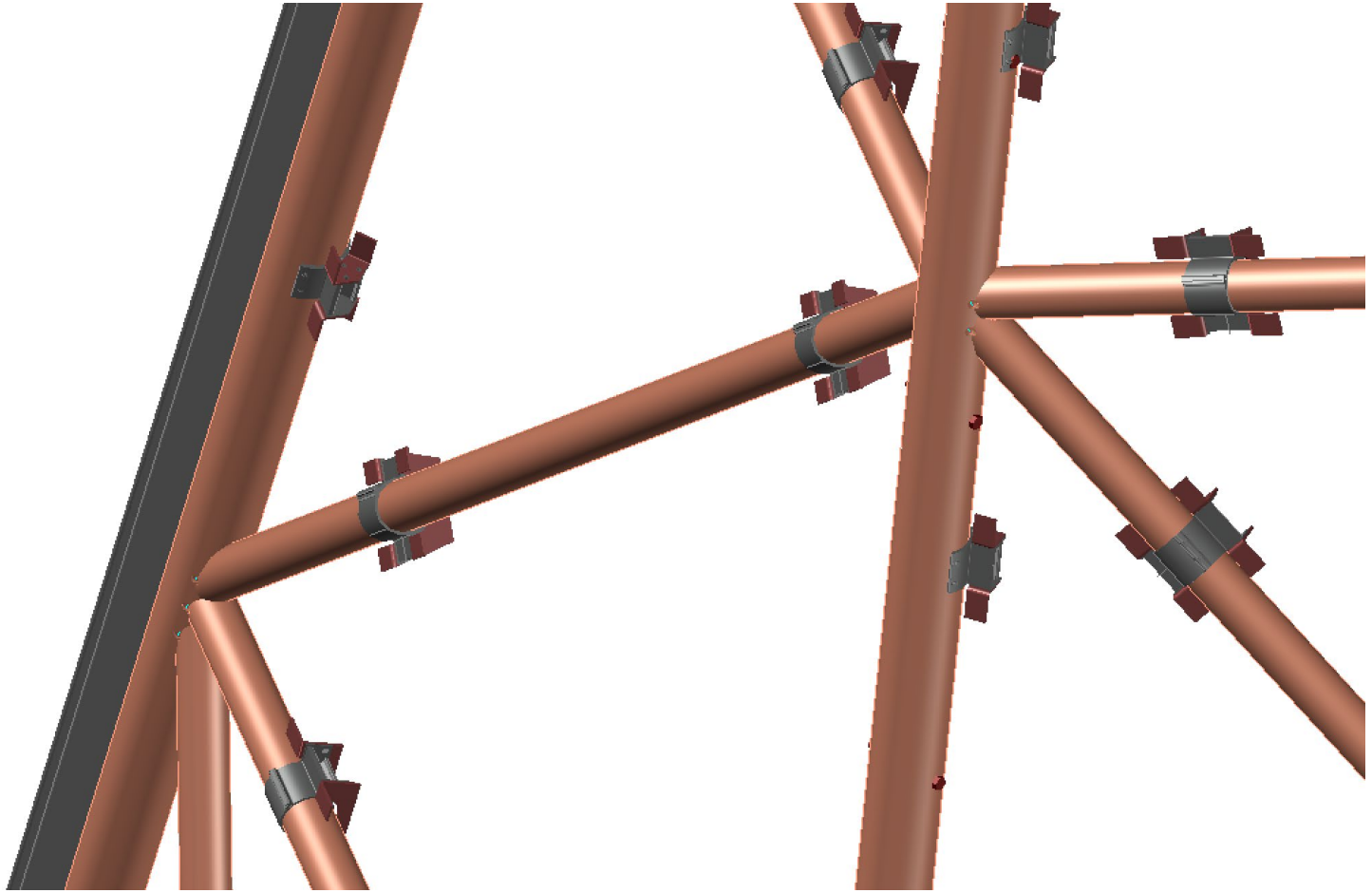
Air and Water-Resistive Panes



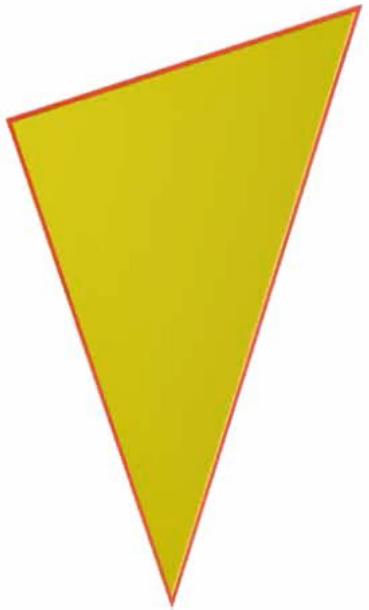
Air and Water-Resistive Covers

ENCLOSURE
Pipe Clamps / Saddles





ENCLOSURE
Backup Panel



ENCLOSURE
Backup Panel

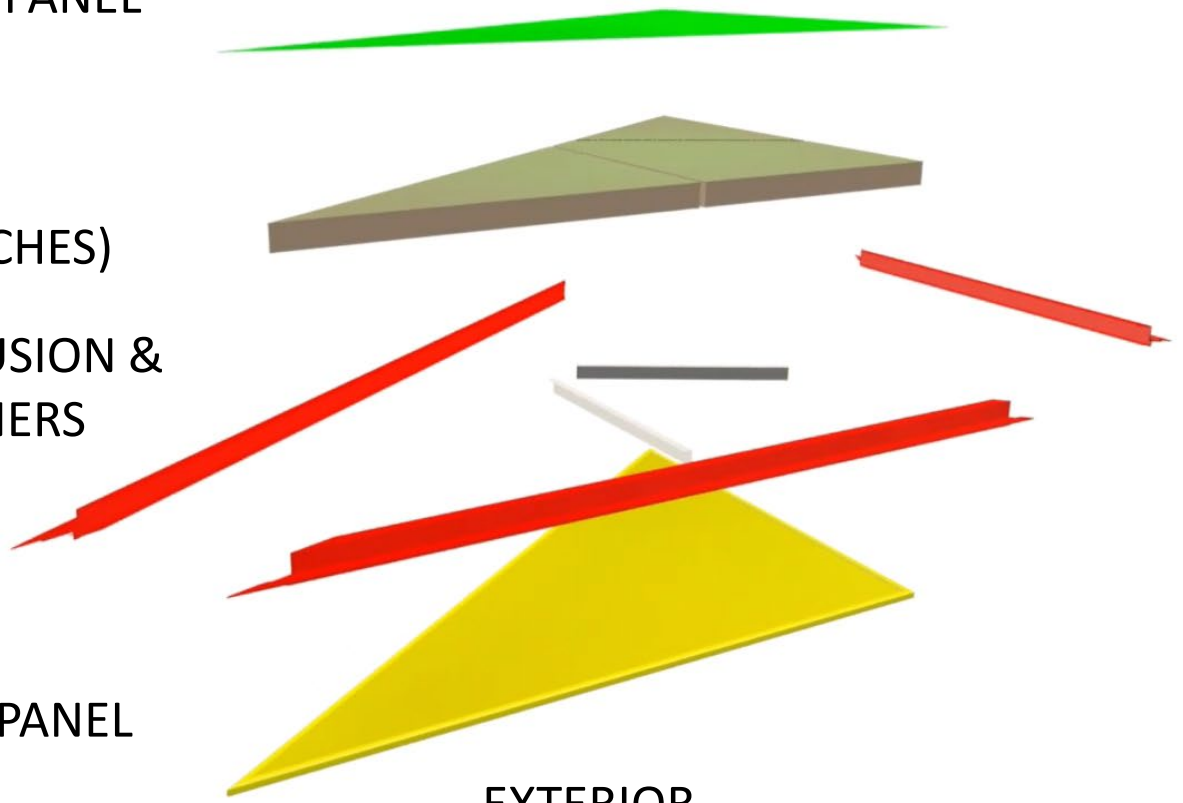
AIR & WATER RESISTIVE PANELS

INTERIOR

ALUMINUM BACK PANEL
(0.060 INCHES)

MINERAL WOOL
INSULATION (3 INCHES)

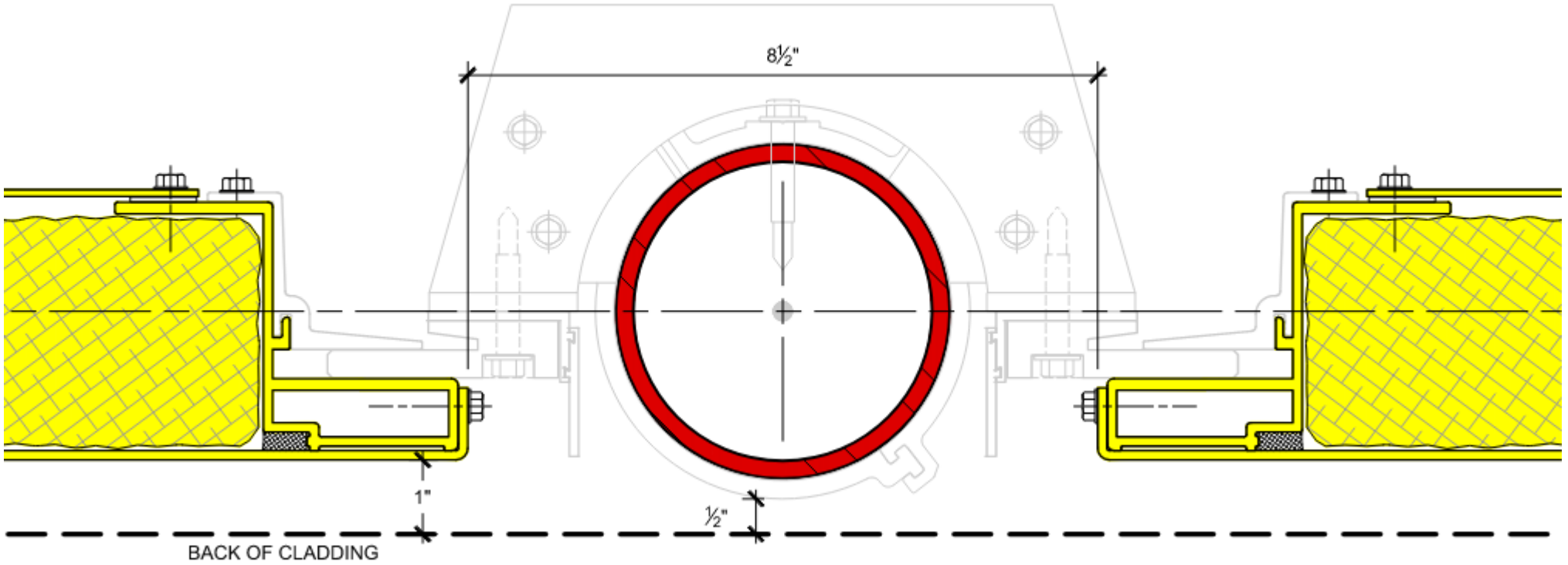
PERIMETER EXTRUSION &
INTERNAL STIFFENERS



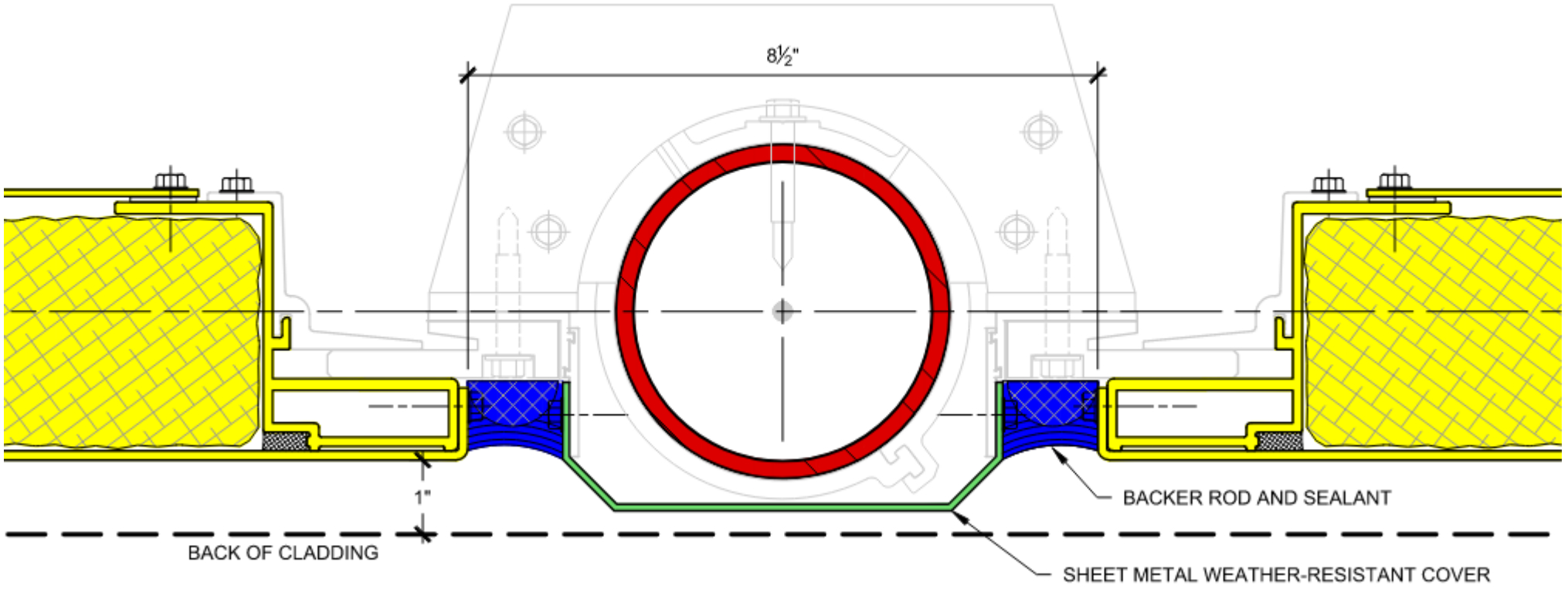
ALUMINUM FACE PANEL
(0.125 INCHES)

EXTERIOR

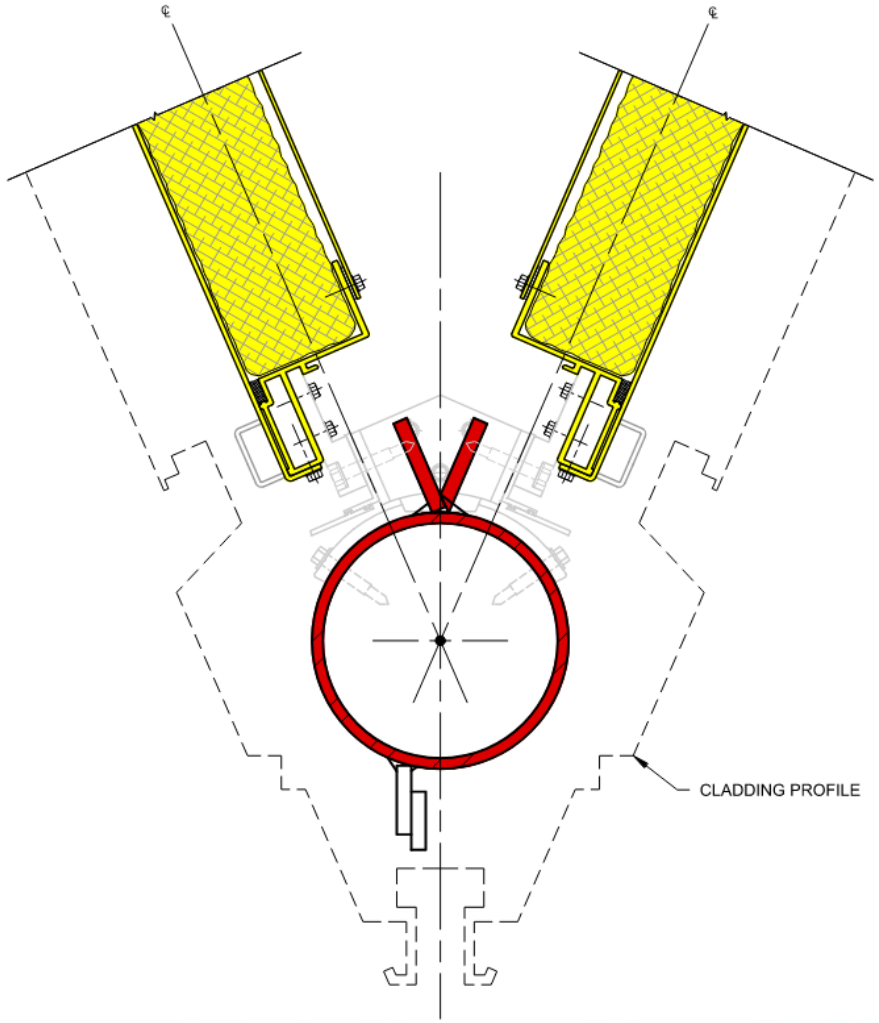
ENCLOSURE
Rainscreen Backup Wall

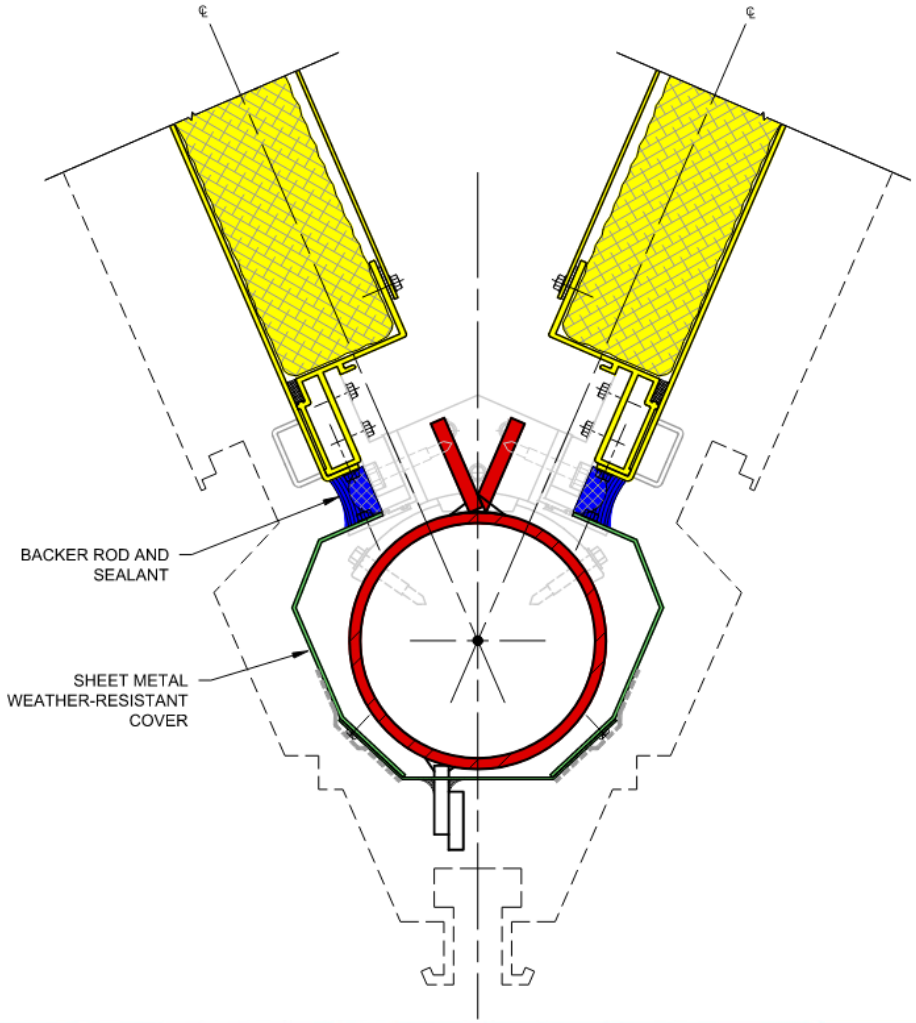


ENCLOSURE
Rainscreen Backup Wall

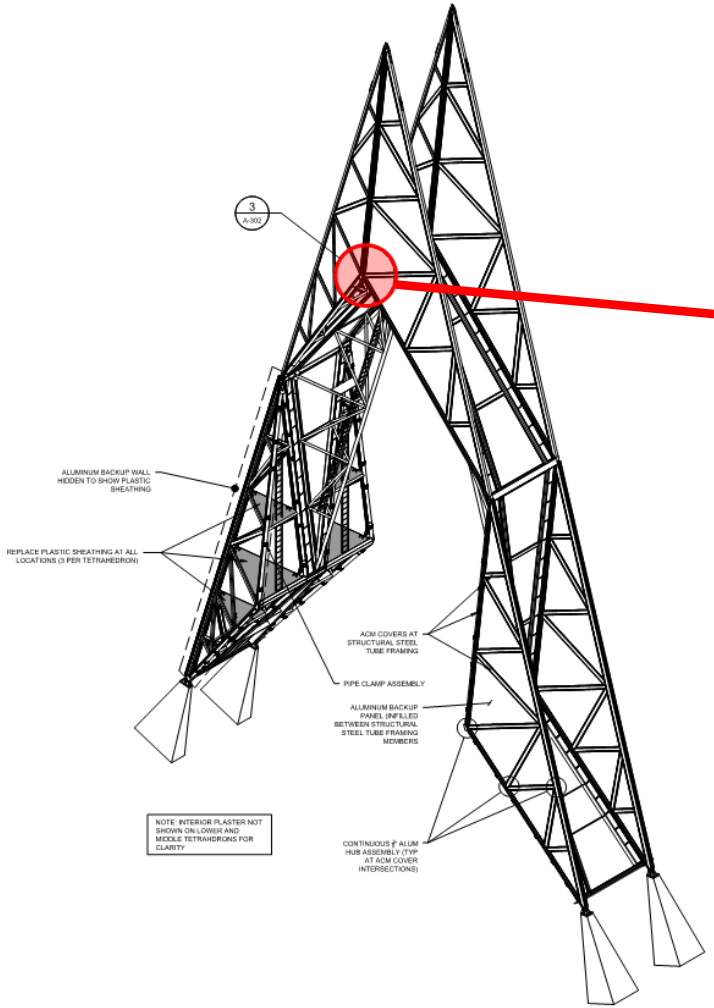


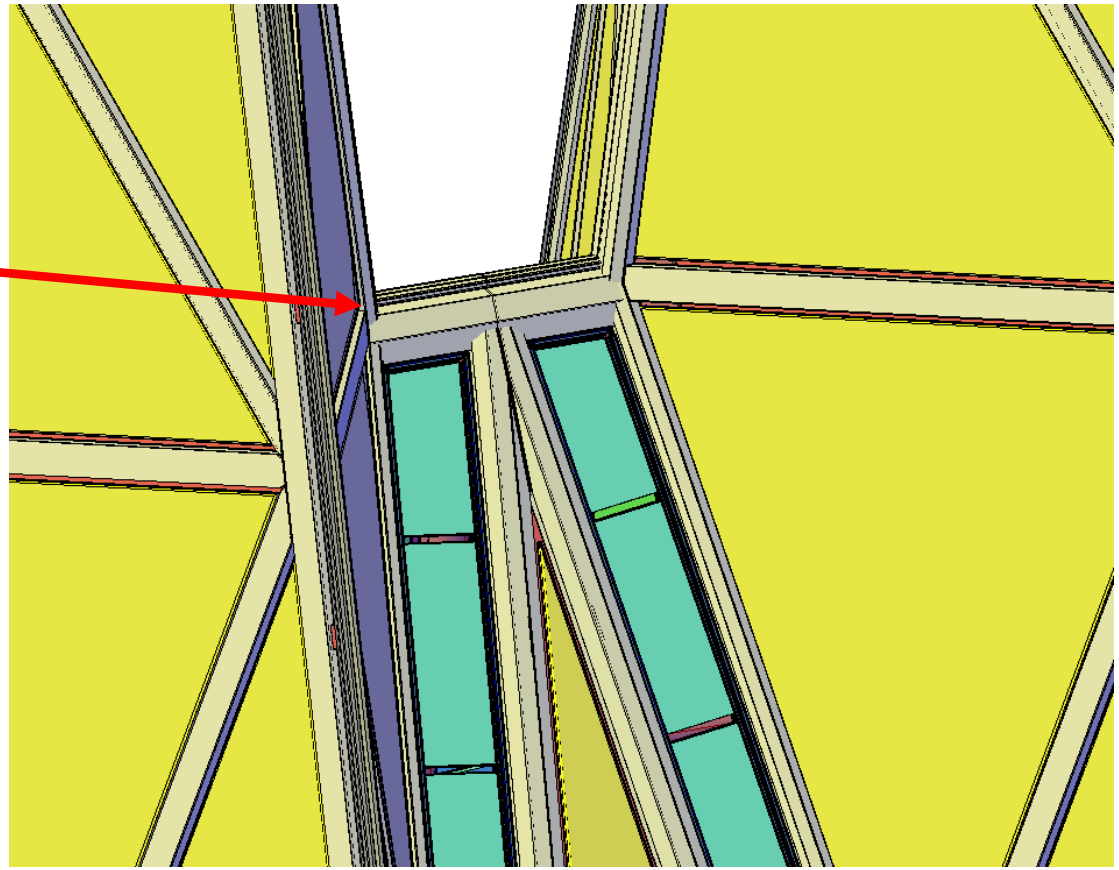
ENCLOSURE
Rainscreen Backup Wall



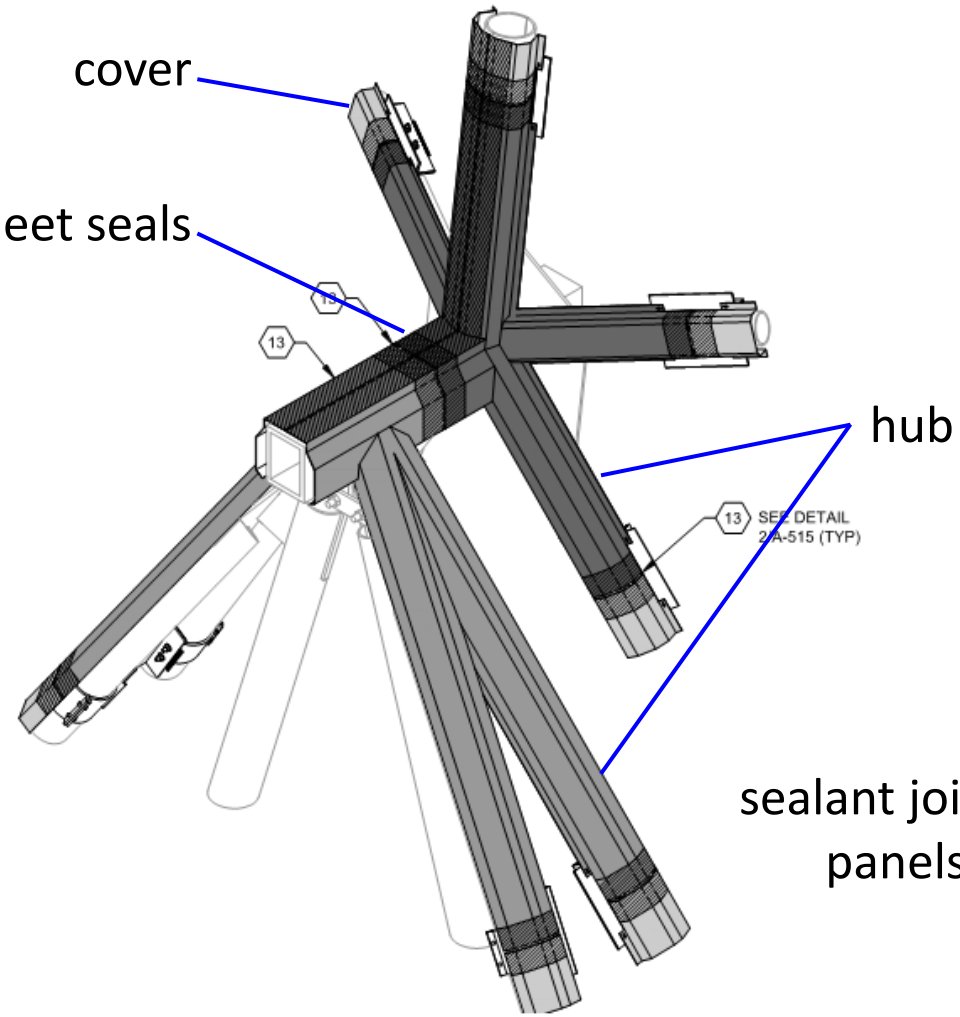


ENCLOSURE
Backup – Structural Steel Covers



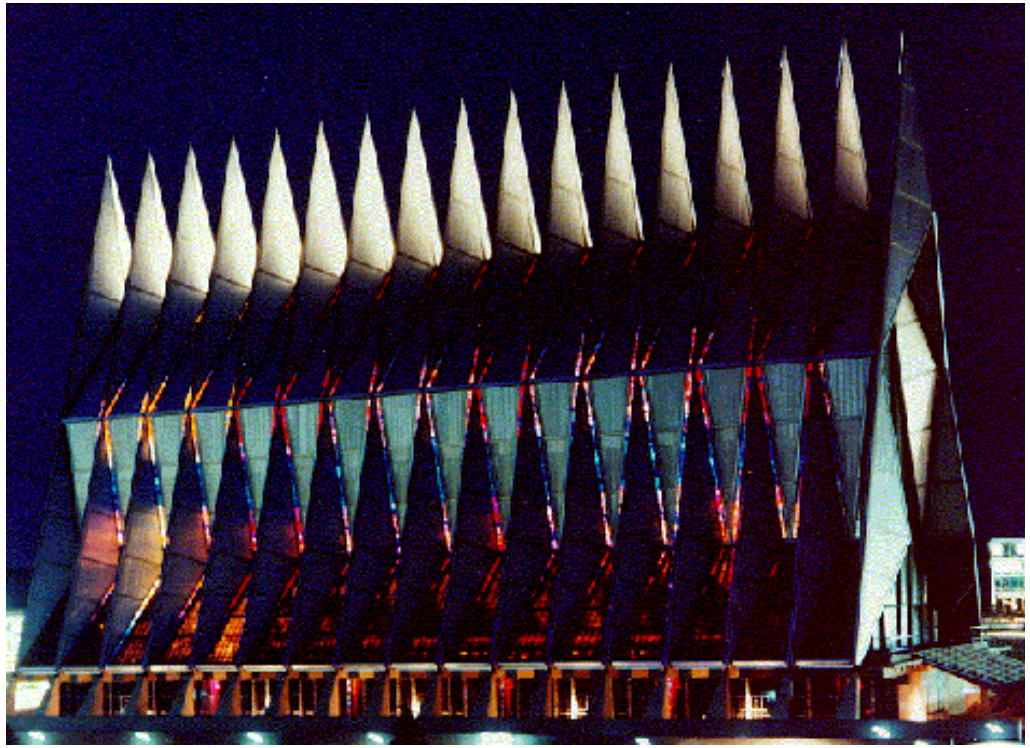


ENCLOSURE
Backup – Structural Steel Covers

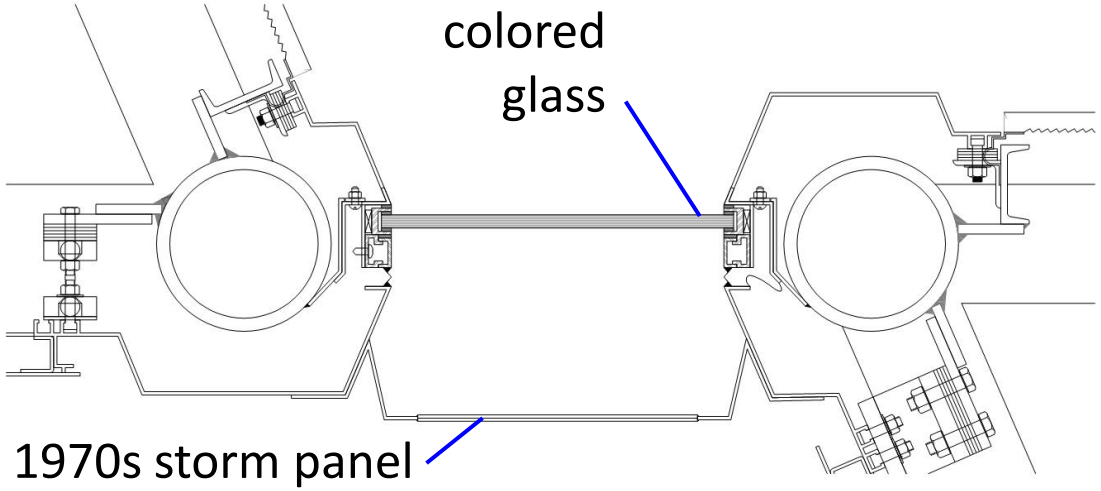


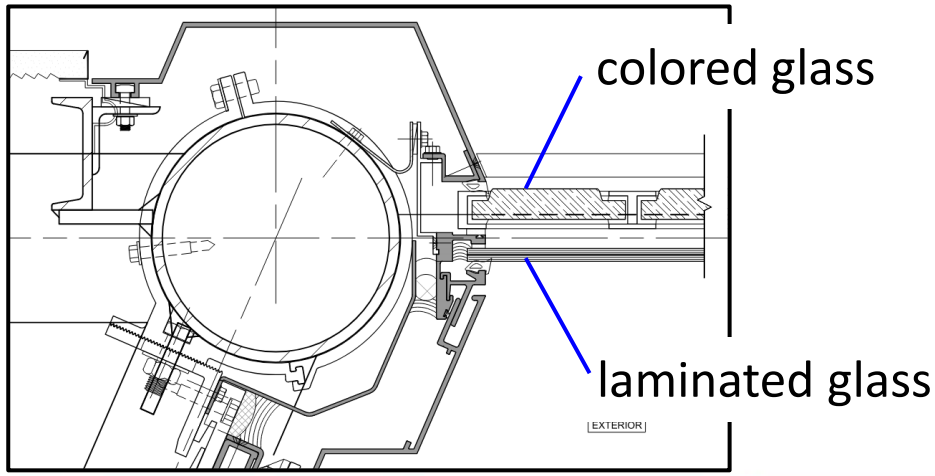
sealant joints between weather panels and covers/hubs

ENCLOSURE
Strip Windows

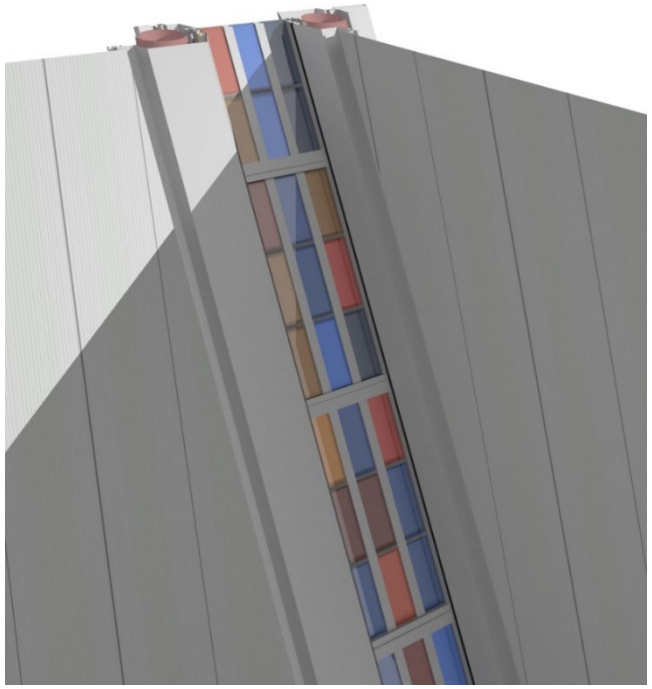


ENCLOSURE
Strip Windows

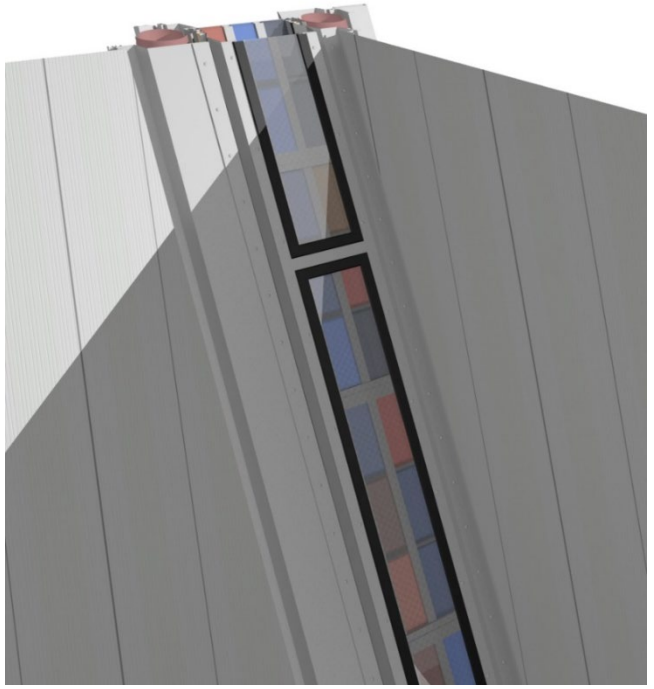




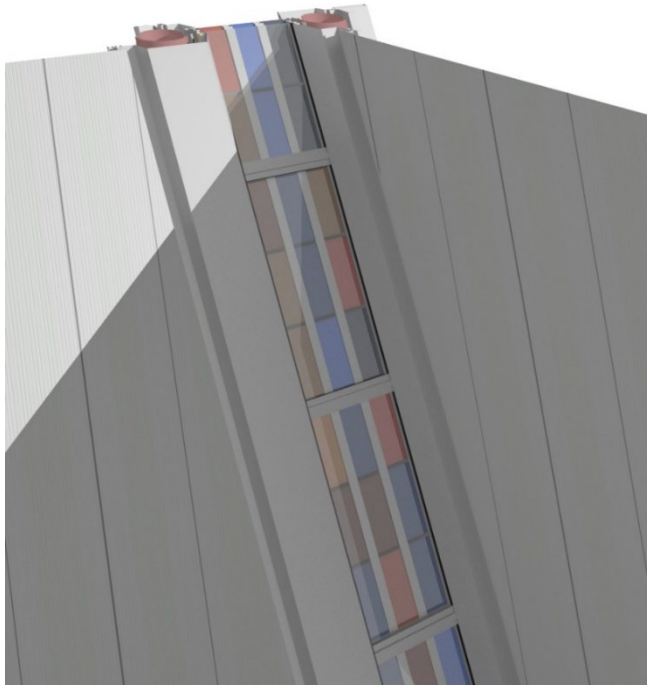
ENCLOSURE
Strip Windows



ORIGINAL DESIGN

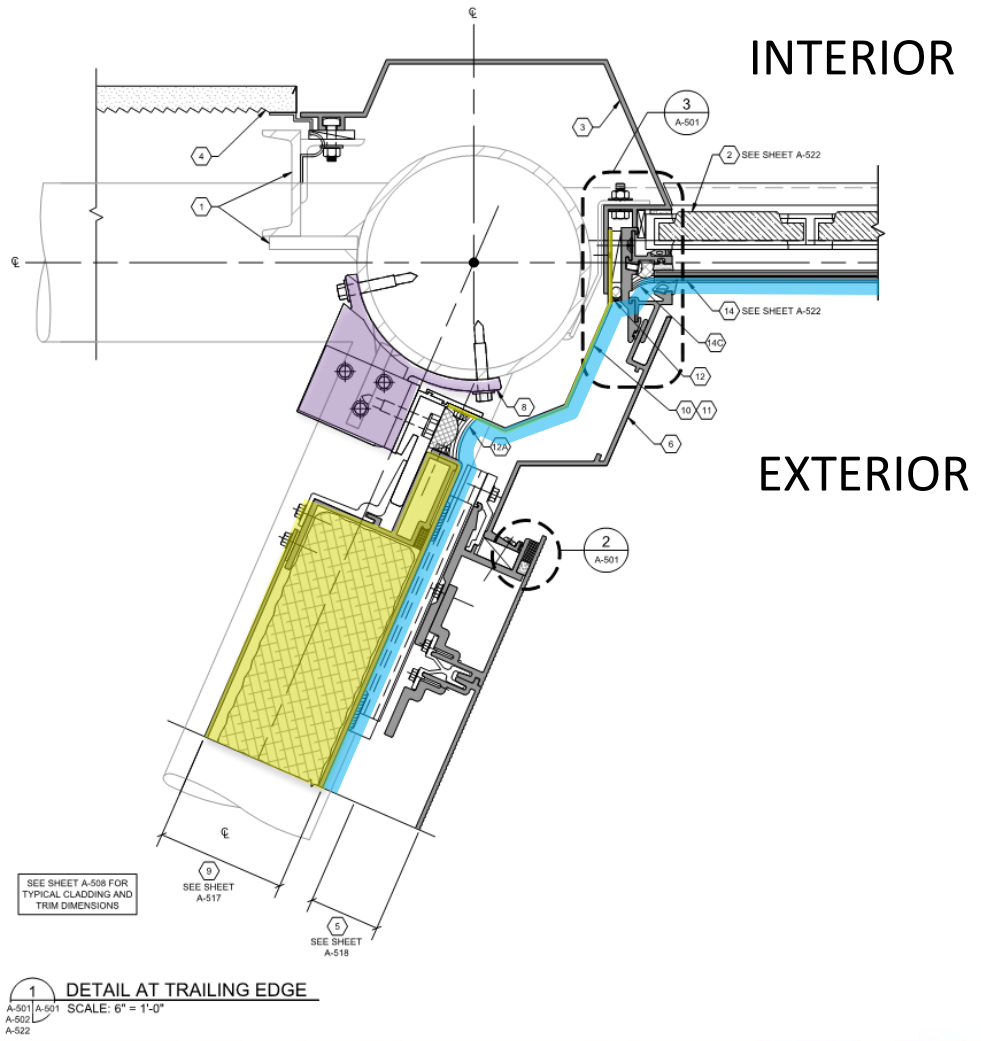


1970s STORM PANEL

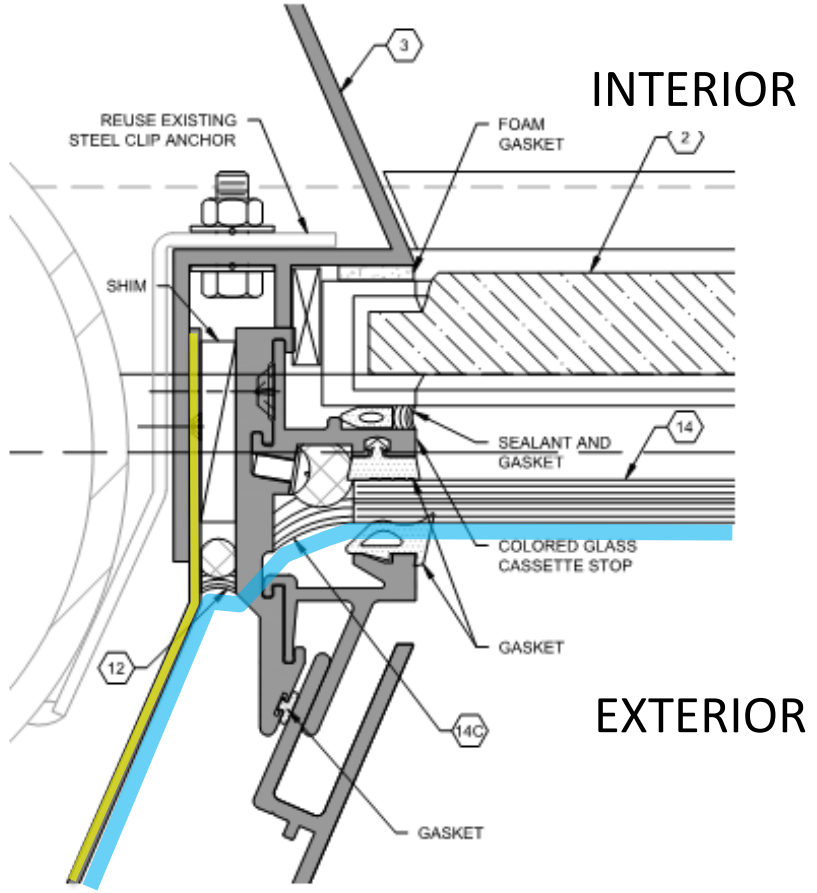


RECLADDING DESIGN

ENCLOSURE
Strip Windows



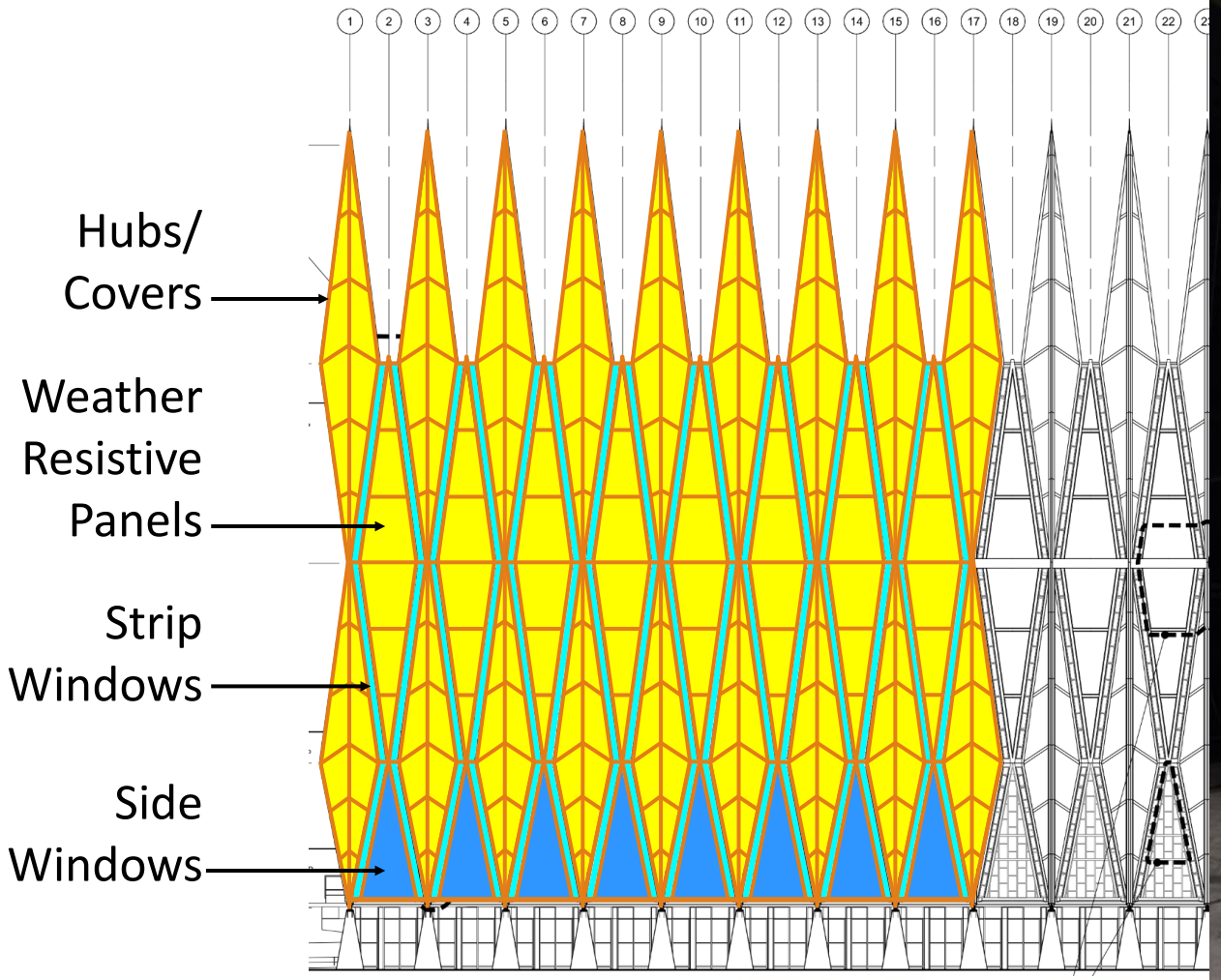
1 DETAIL AT TRAILING EDGE
A-501 A-501 A-502 A-522 SCALE: 6" = 1'-0"



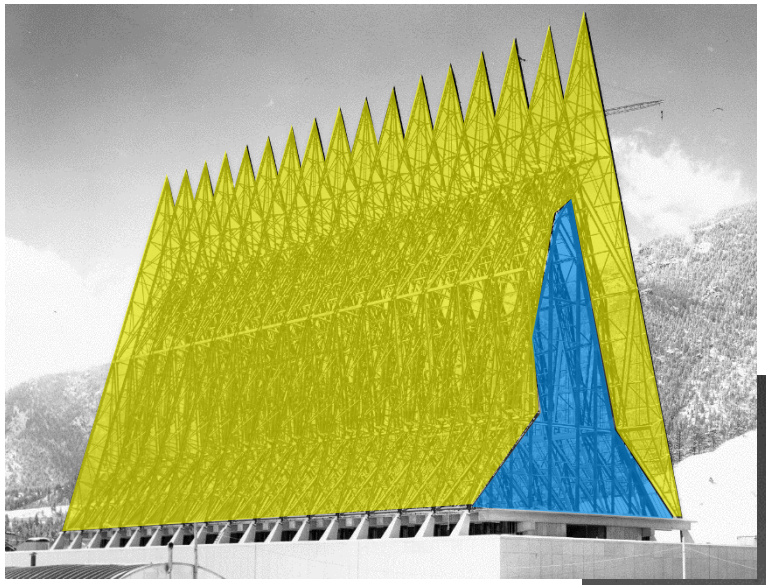
3 ENLARGED DETAIL
A-501 A-501 SCALE: N.T.S.

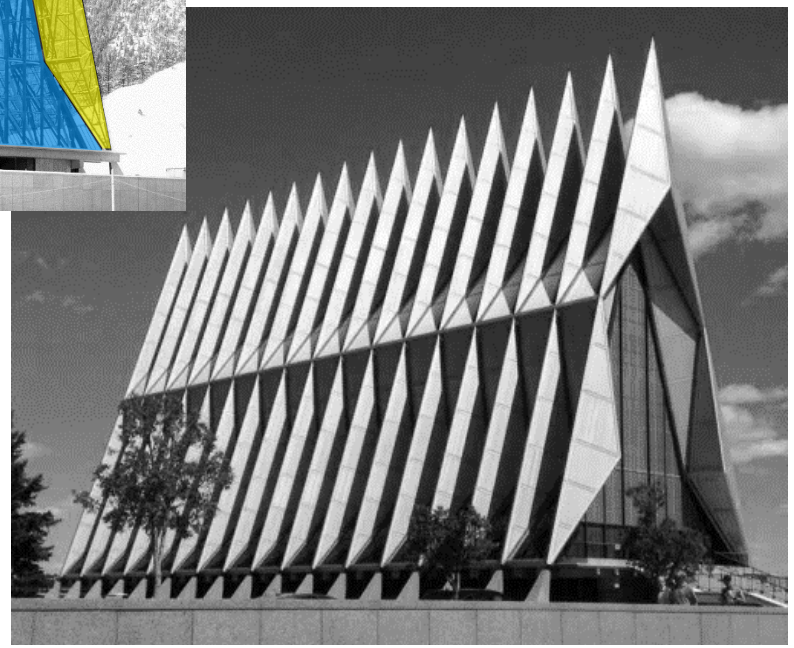
abaa building enclosure conference

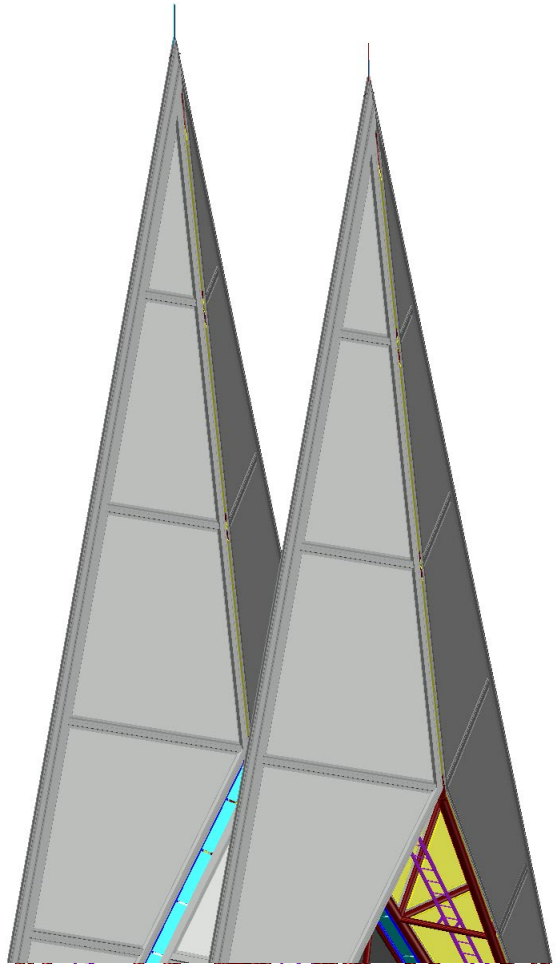
ENCLOSURE
Air and Water Barrier System



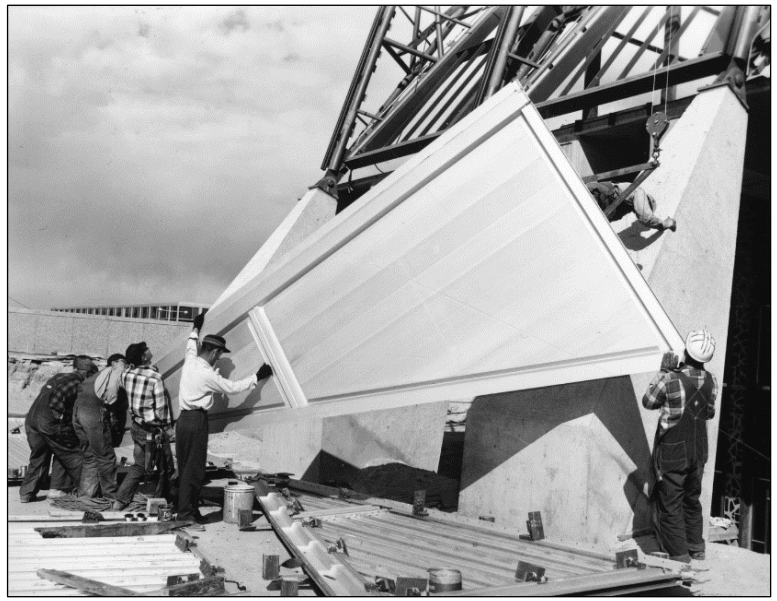
ENCLOSURE
Cladding Panels

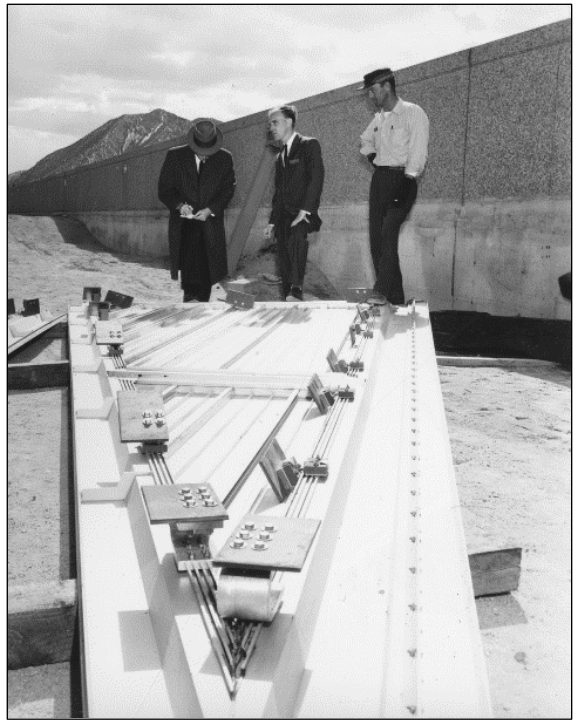




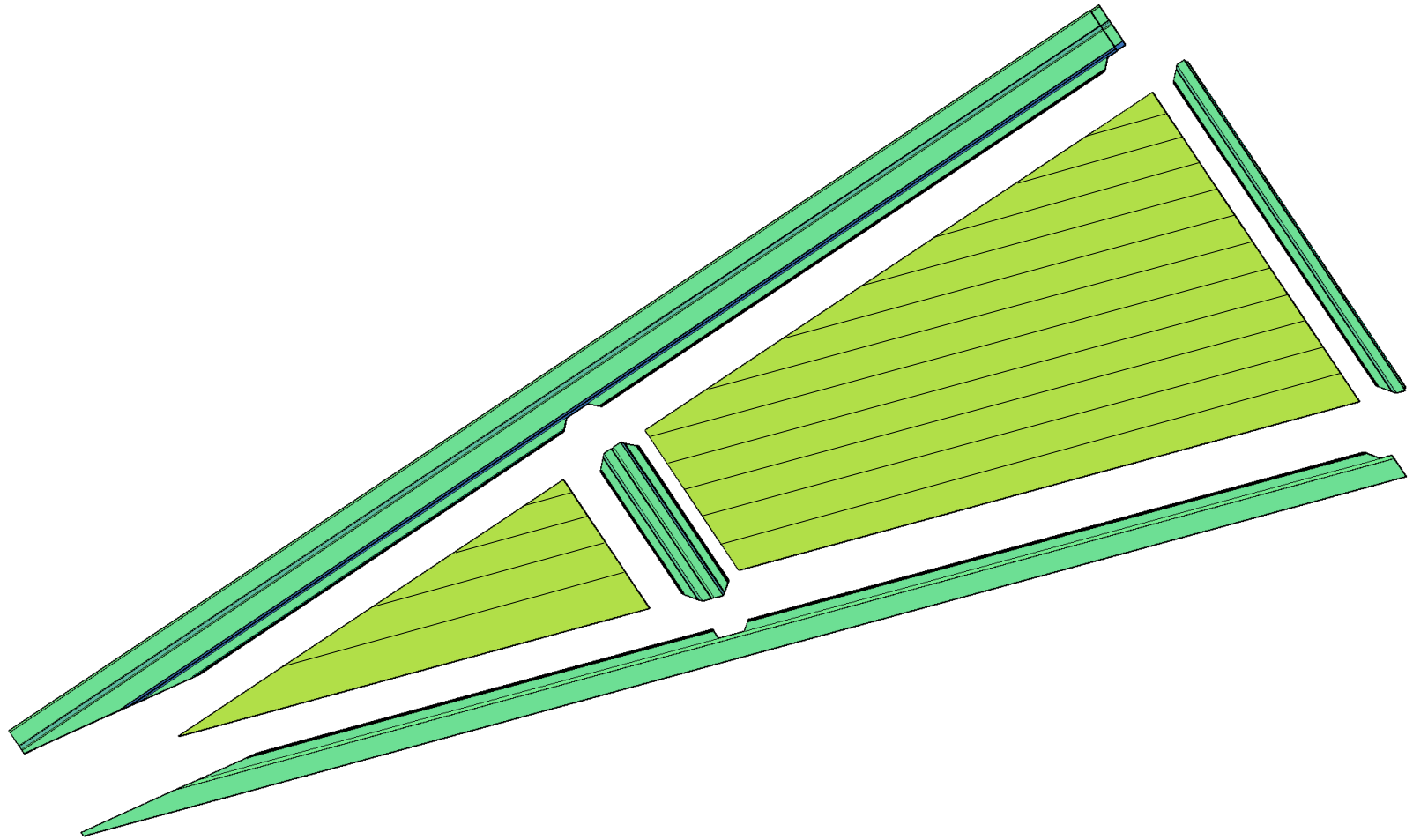


ENCLOSURE
Cladding Panel Attachment

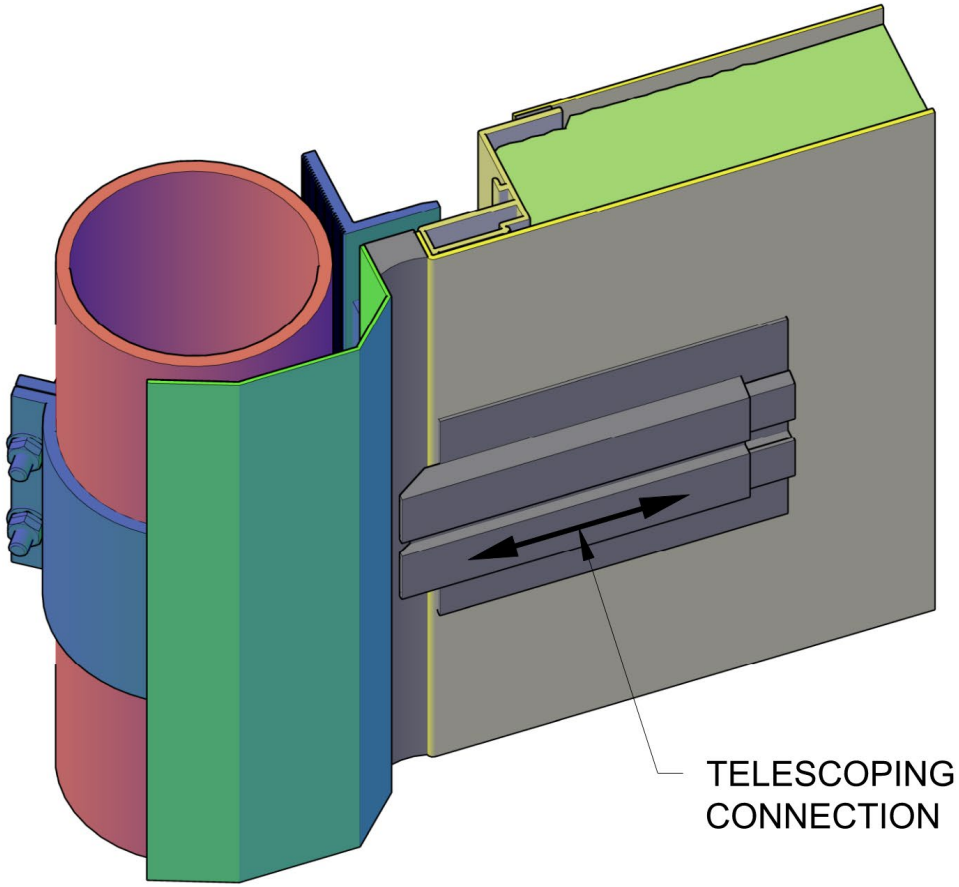


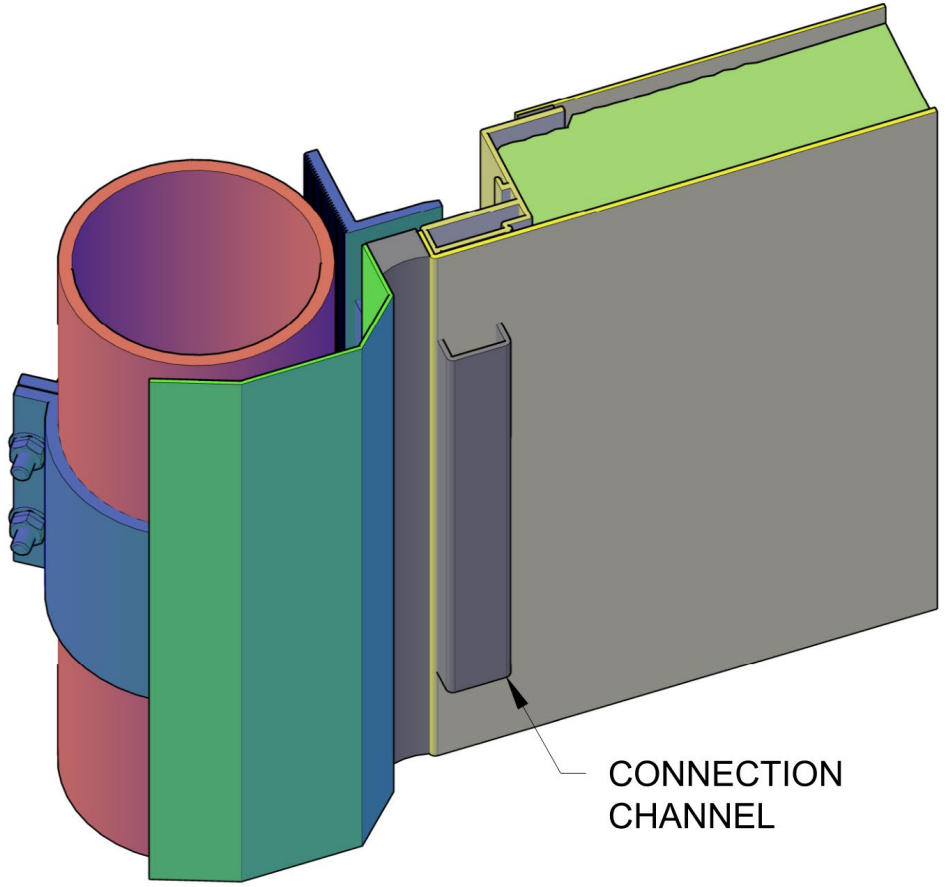


ENCLOSURE
Cladding Panel Attachment

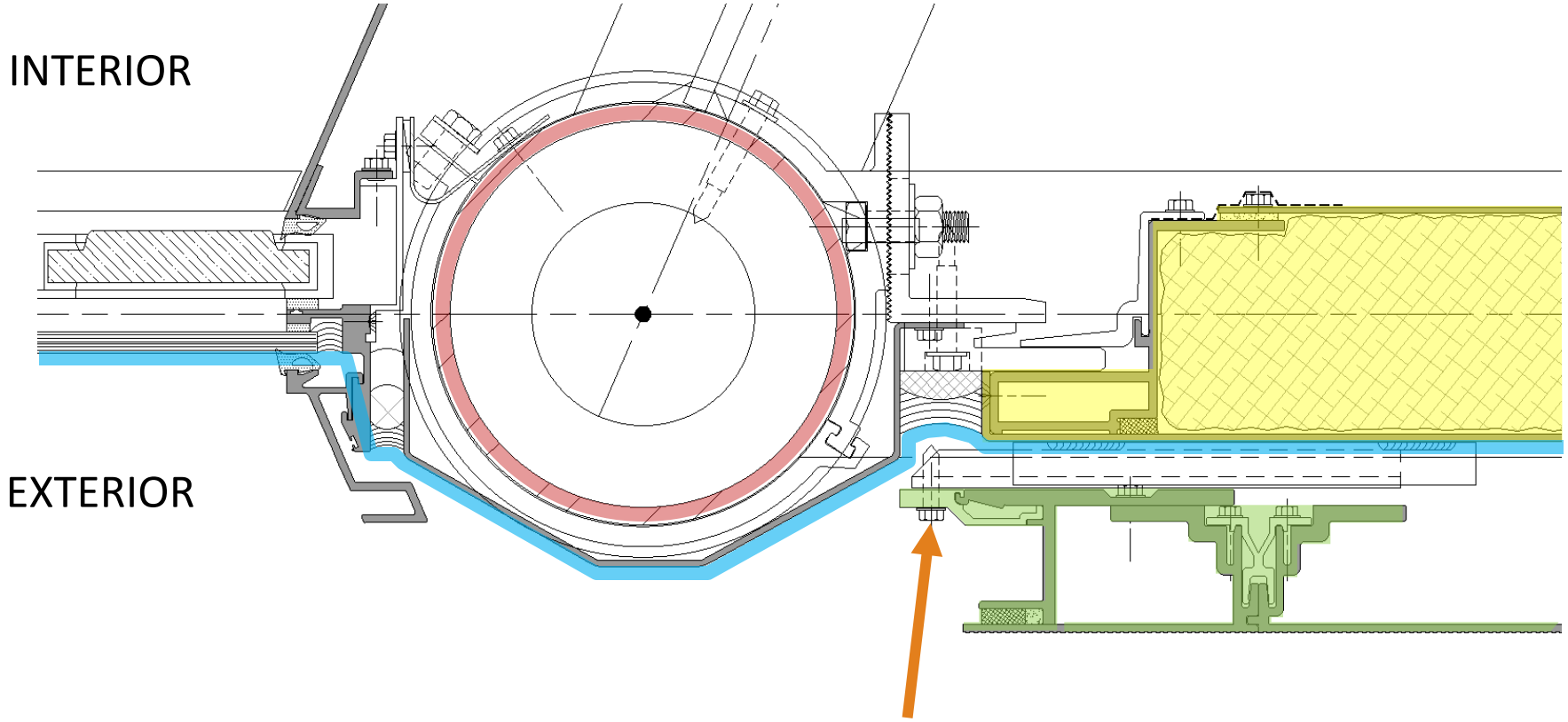


ENCLOSURE
Cladding Panel Attachment

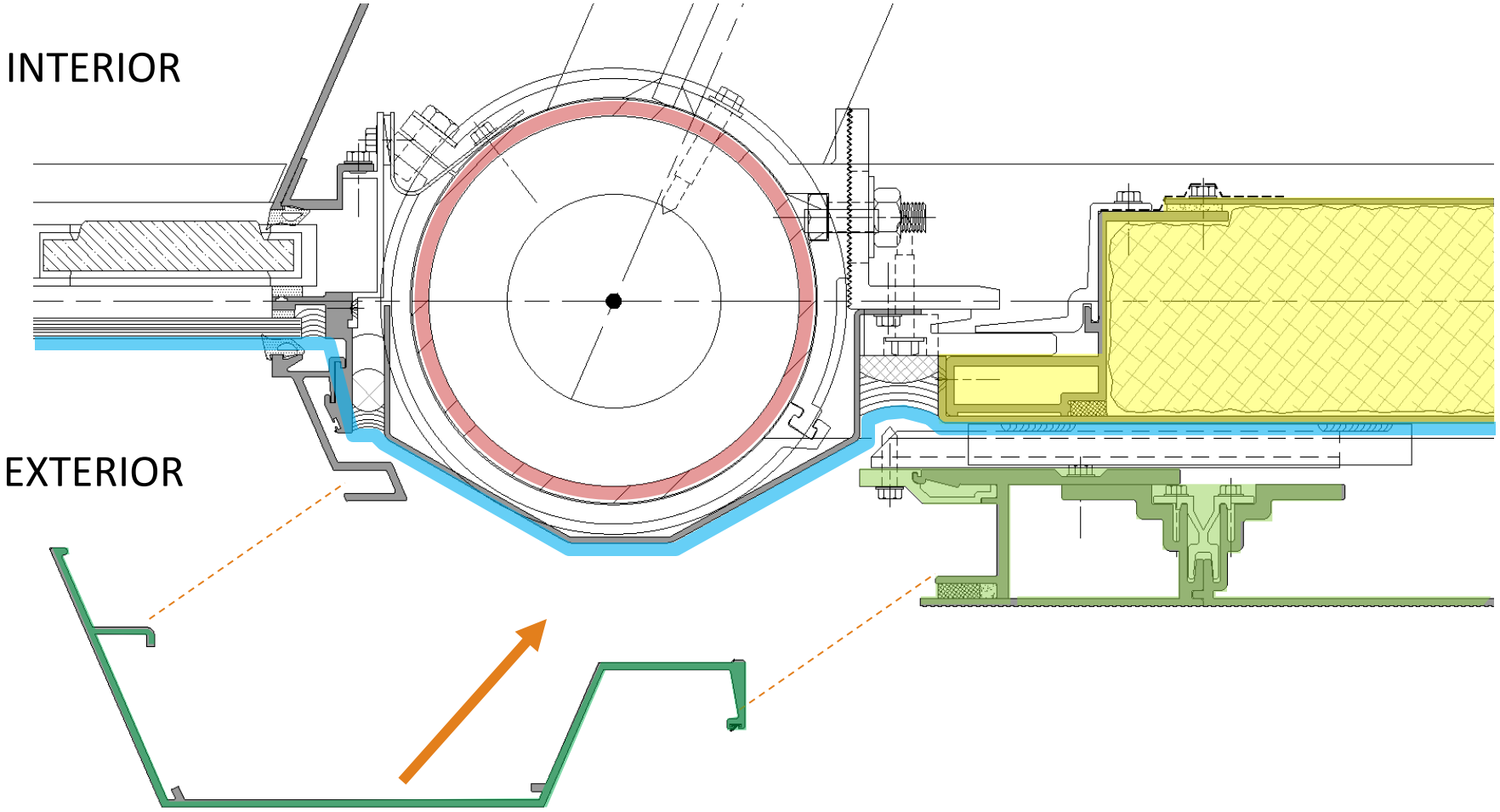




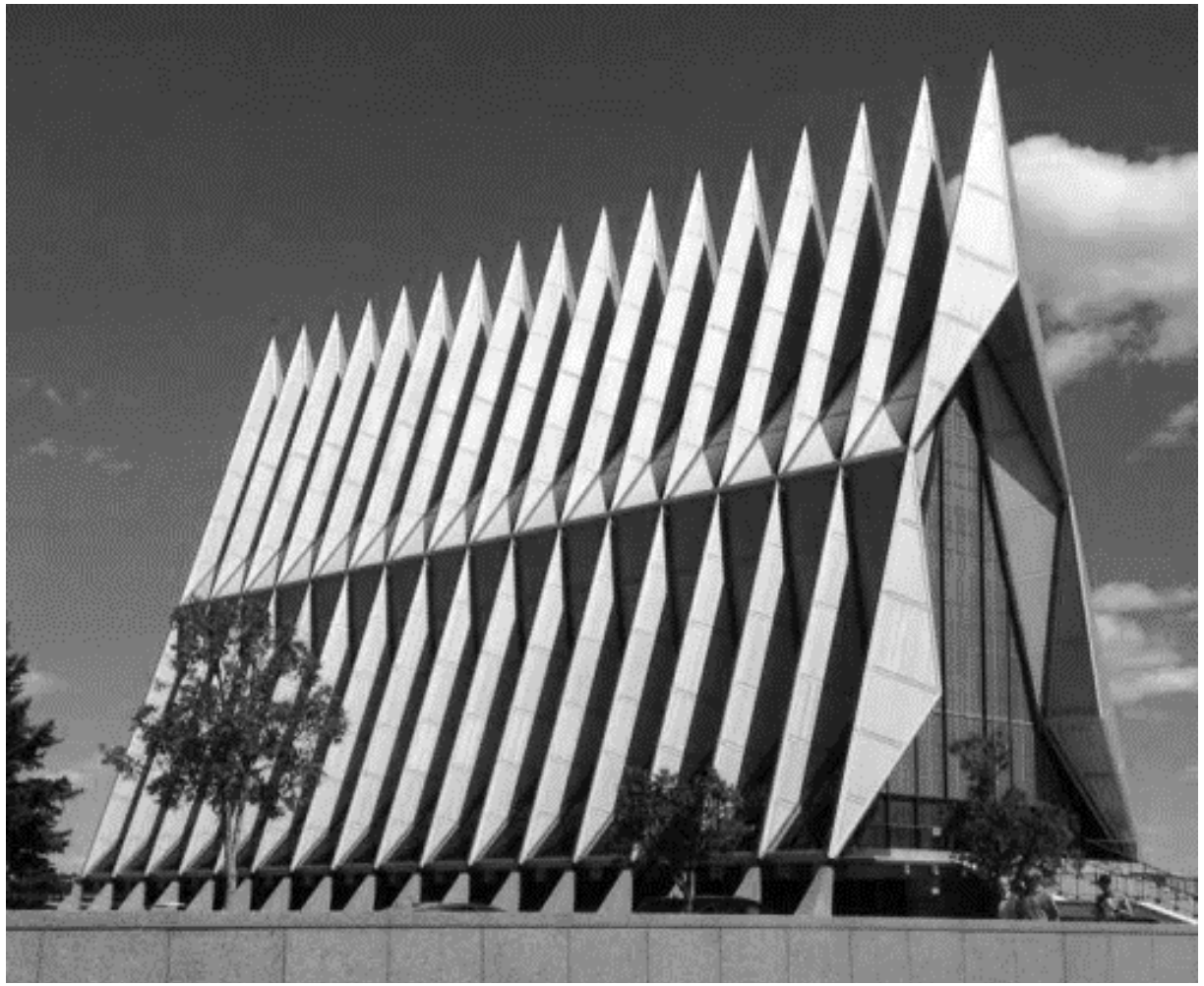
ENCLOSURE
Cladding Panel Attachment

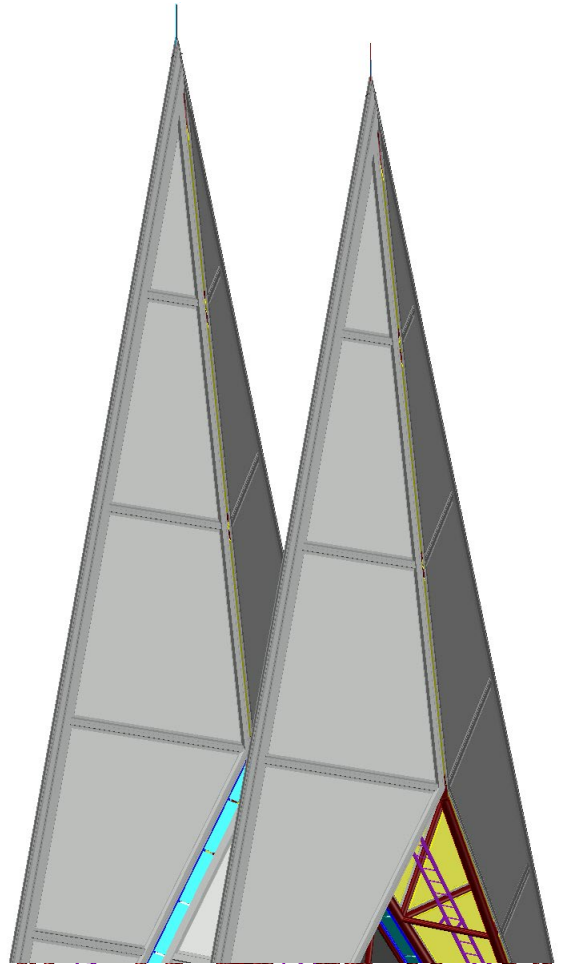


ENCLOSURE
Cladding Panel Attachment



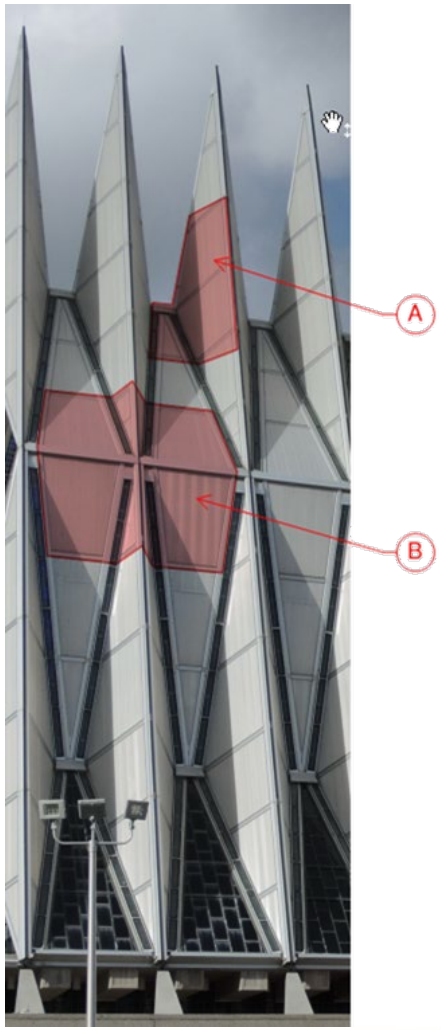
ENCLOSURE
Completed Rainscreen





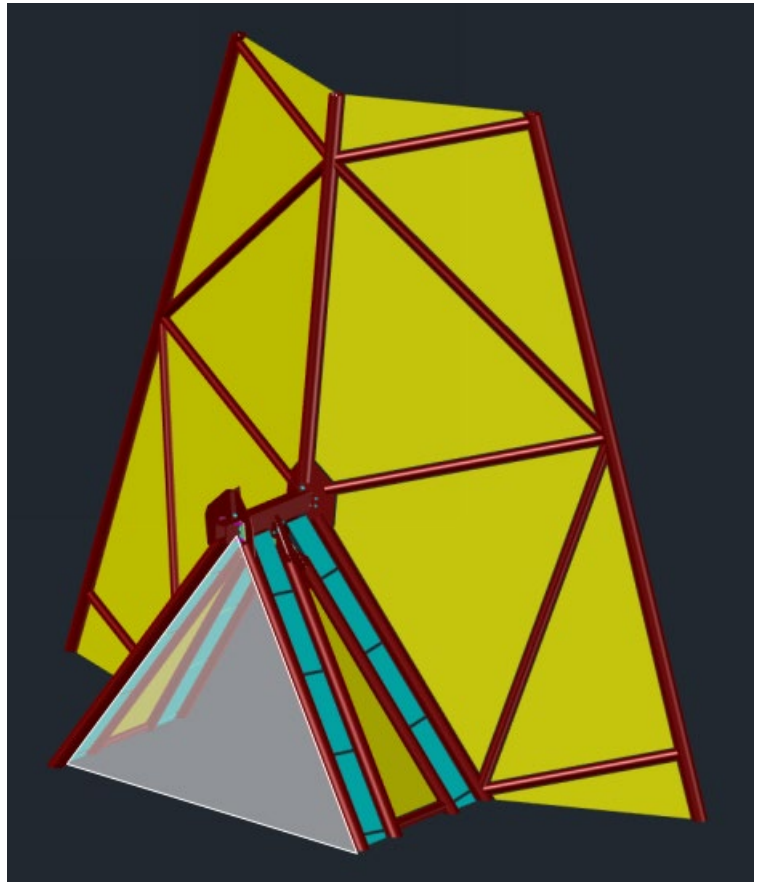
DESIGN PHASE PERFORMANCE MOCK-UP

- ALLOWS CONSTRUCTABILITY EVALUATION
- ALLOWS AESTHETIC BUY-IN BY STAKEHOLDERS
- ALLOWS PERFORMANCE CONFIRMATION
- ALLOWS FINAL DESIGN TO GATHER "LESSONS LEARNED" WHICH WILL REDUCE BID UNCERTAINTIES

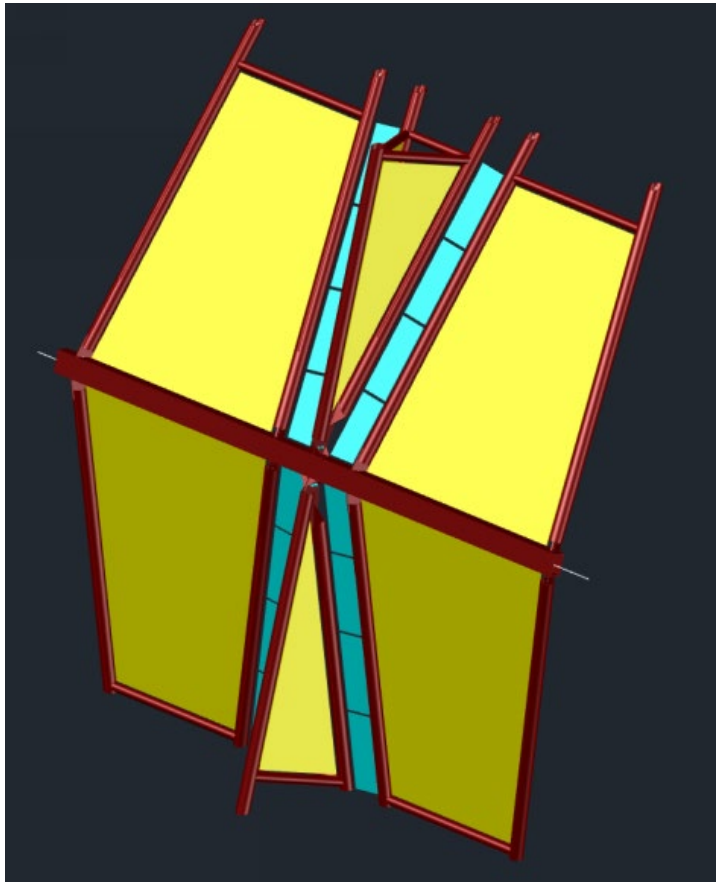


MOCK-UP

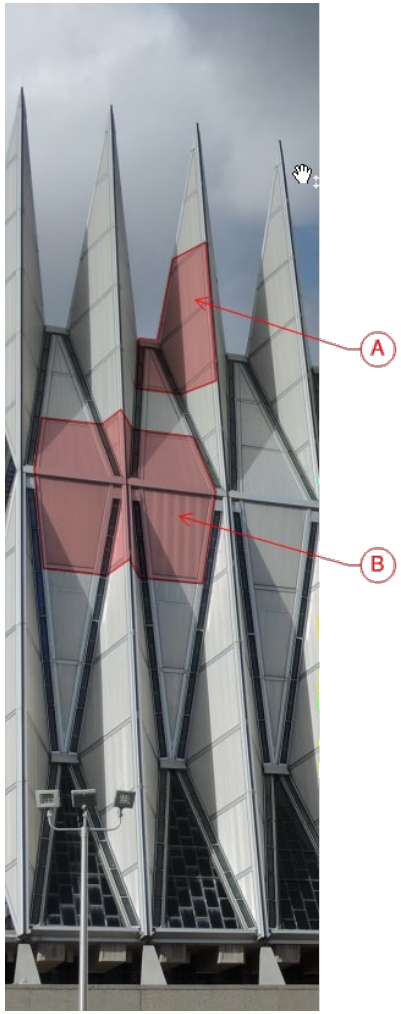
DESIGN PHASE PERFORMANCE MOCK-UP



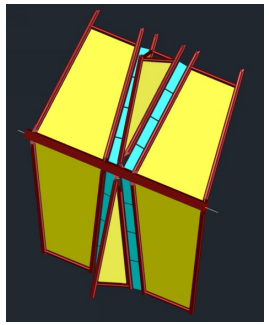
Mock-up “A”



Mock-up “B”

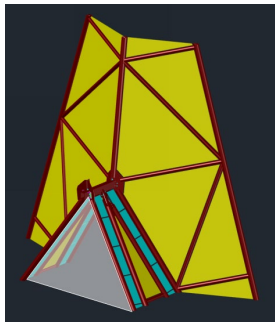


DESIGN PHASE PERFORMANCE MOCK-UP – Steel Erection



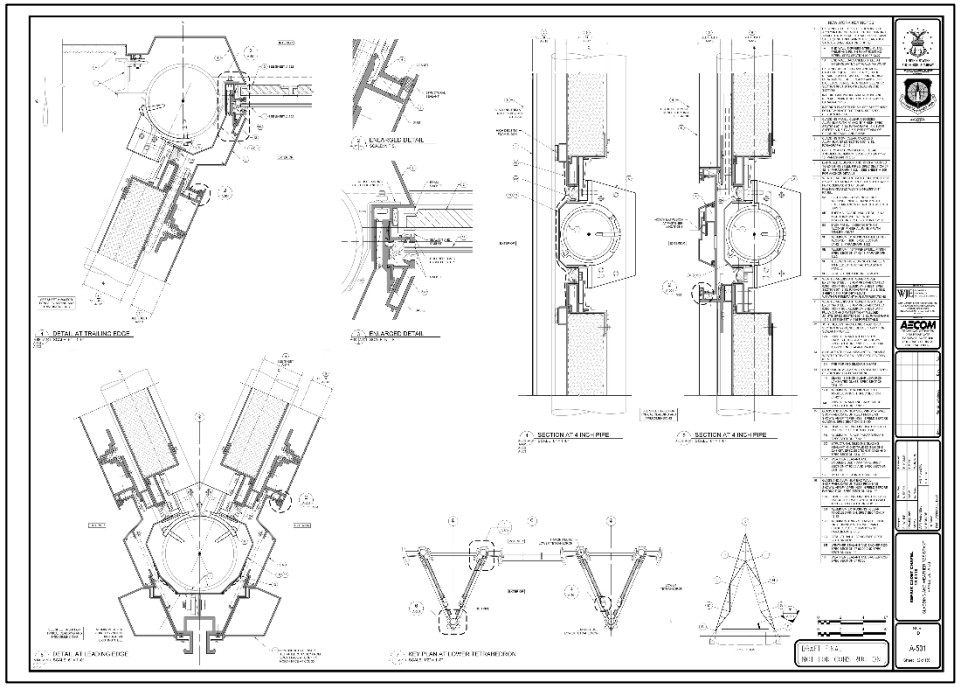
Mock-up “B”

Mock-up “A”



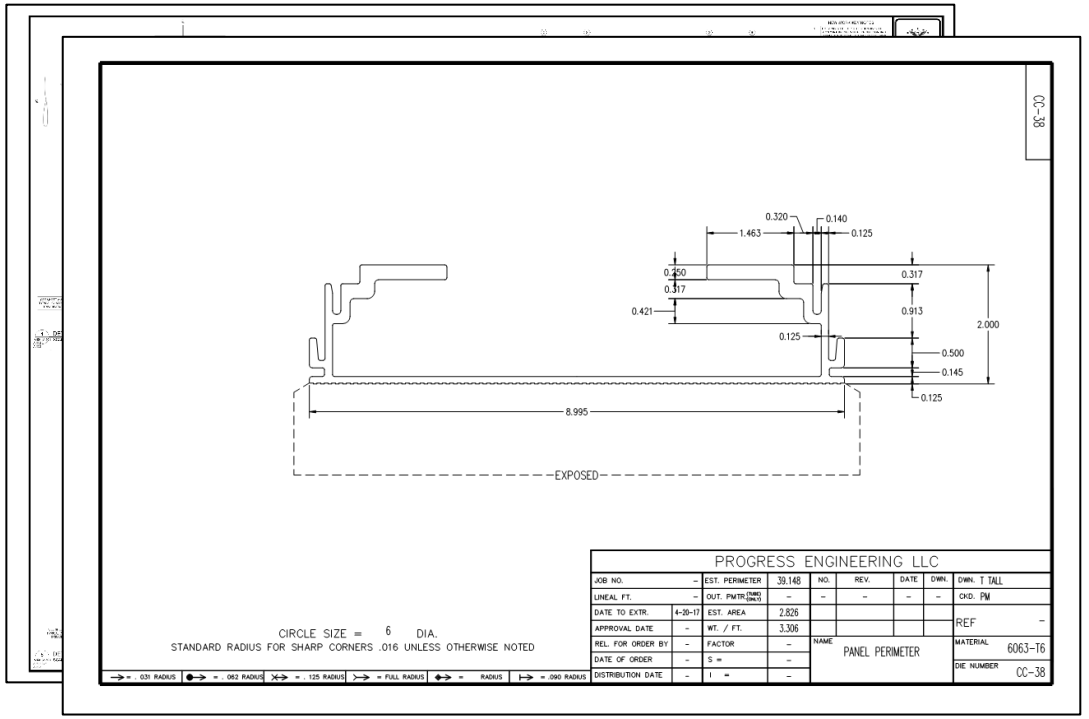
DESIGN PHASE PERFORMANCE MOCK-UP – Aluminum Extrusions

- Design Drawings
  - Architect



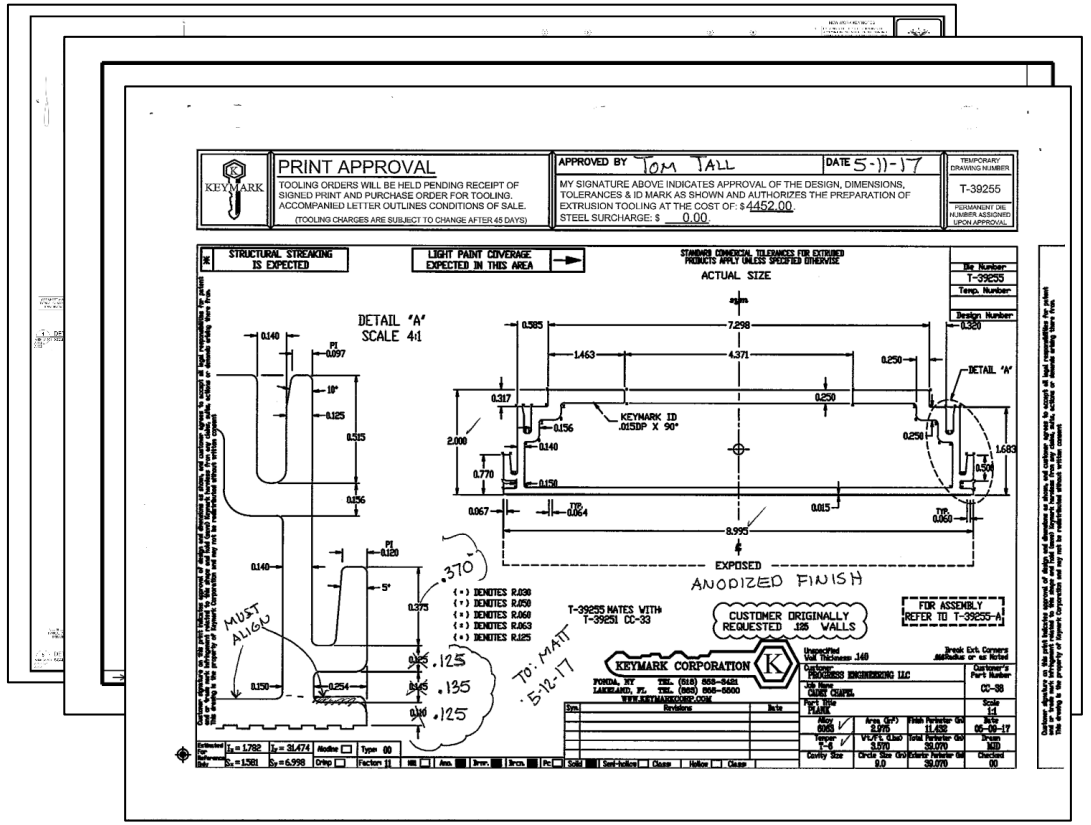
DESIGN PHASE PERFORMANCE MOCK-UP – Aluminum Extrusions

- Design Drawings
  - Architect
- Die Drawings
  - Contractor



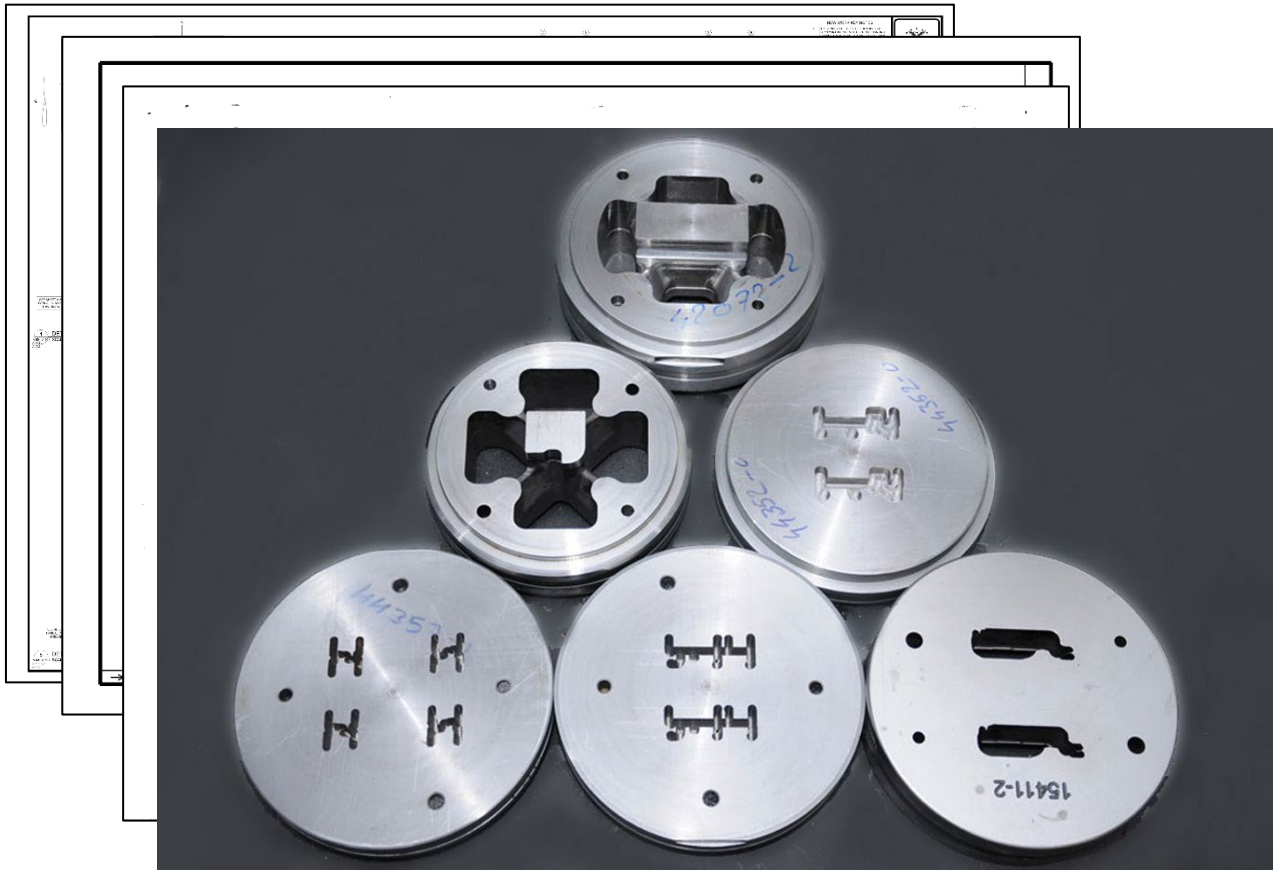
DESIGN PHASE PERFORMANCE MOCK-UP – Aluminum Extrusions

- Design Drawings
  - Architect
- Die Drawings
  - Contractor (detailer)
- Tooling Drawings
  - Extruder
  - Reviewed by Contractor



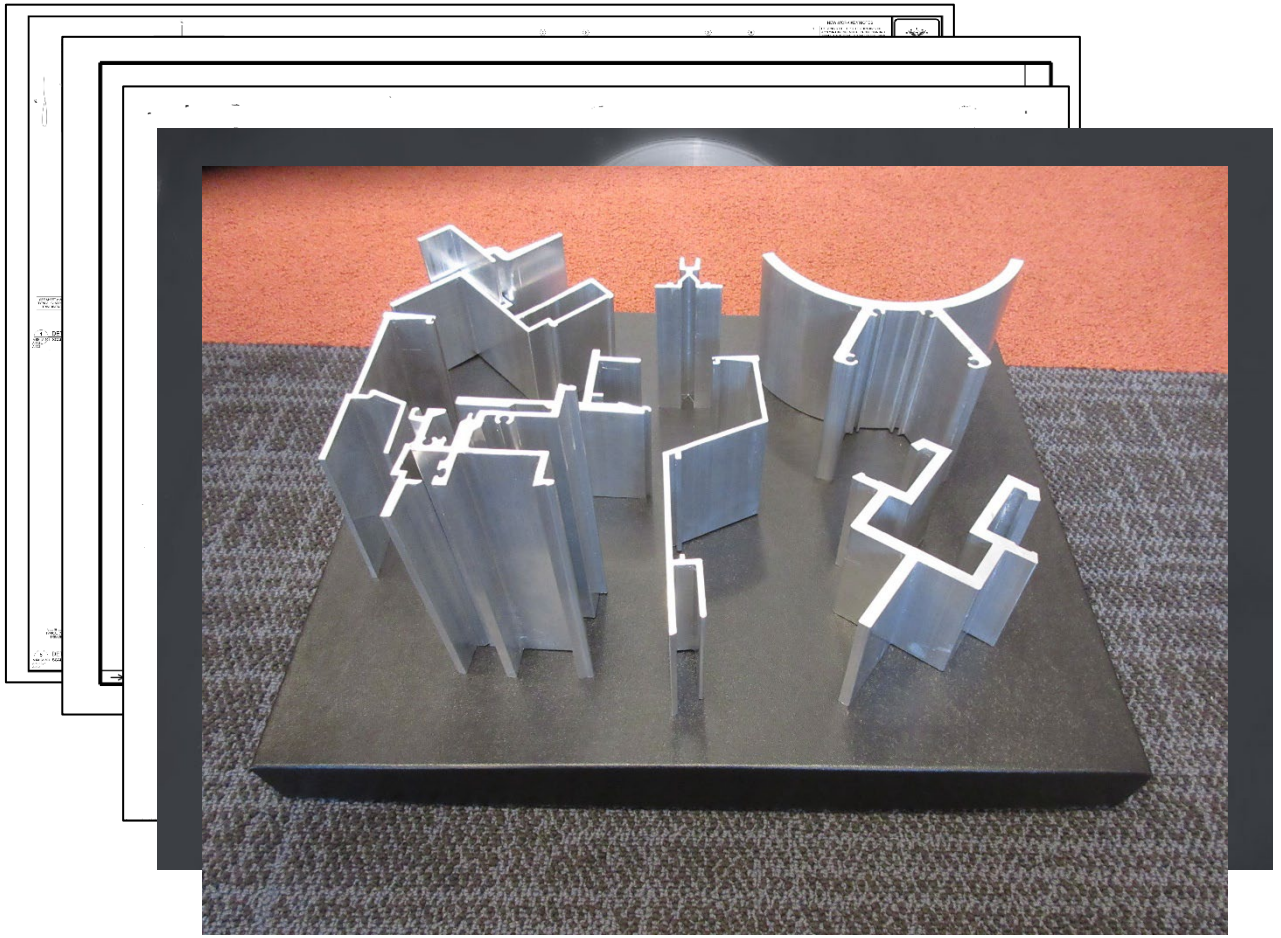
DESIGN PHASE PERFORMANCE MOCK-UP – Aluminum Extrusions

- Design Drawings
  - Architect
- Die Drawings
  - Contractor
- Tooling Drawings
  - Extruder
  - Reviewed by Contractor
- Dies Fabrication
  - For the Extruder



DESIGN PHASE PERFORMANCE MOCK-UP – Aluminum Extrusions

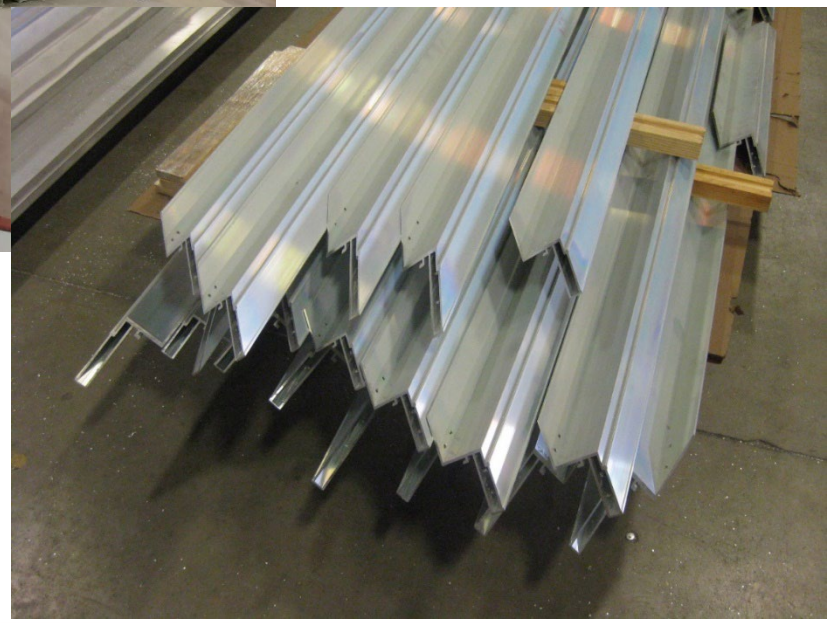
- Design Drawings
  - Architect
- Die Drawings
  - Contractor
- Tooling Drawings
  - Extruder
  - Reviewed by Contractor
- Dies Fabrication
  - For the Extruder
- Extrusion Samples
  - Extruder
  - Reviewed by Contractor



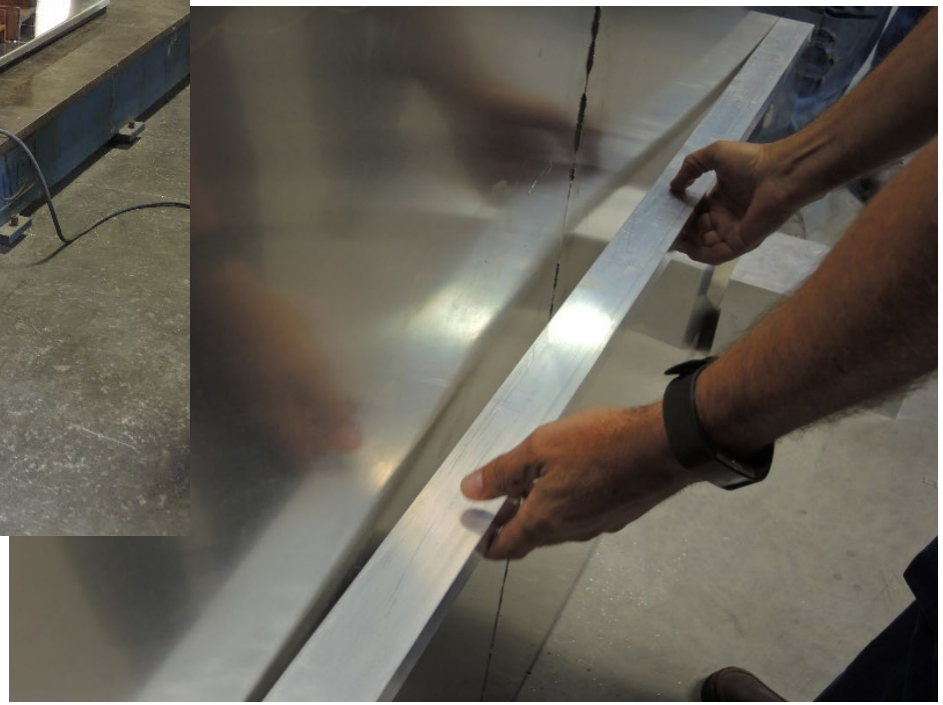
DESIGN PHASE PERFORMANCE MOCK-UP – Aluminum Extrusions

- Design Drawings
  - Architect
- Die Drawings
  - Contractor
- Tooling Drawings
  - Extruder
  - Reviewed by Contractor
- Dies Fabrication
  - For the Extruder
- Extrusion Samples
  - Extruder
  - Reviewed by Contractor
- Extrusions
  - Minimum run ~500 pounds

DESIGN PHASE PERFORMANCE MOCK-UP – Panel Fabrication

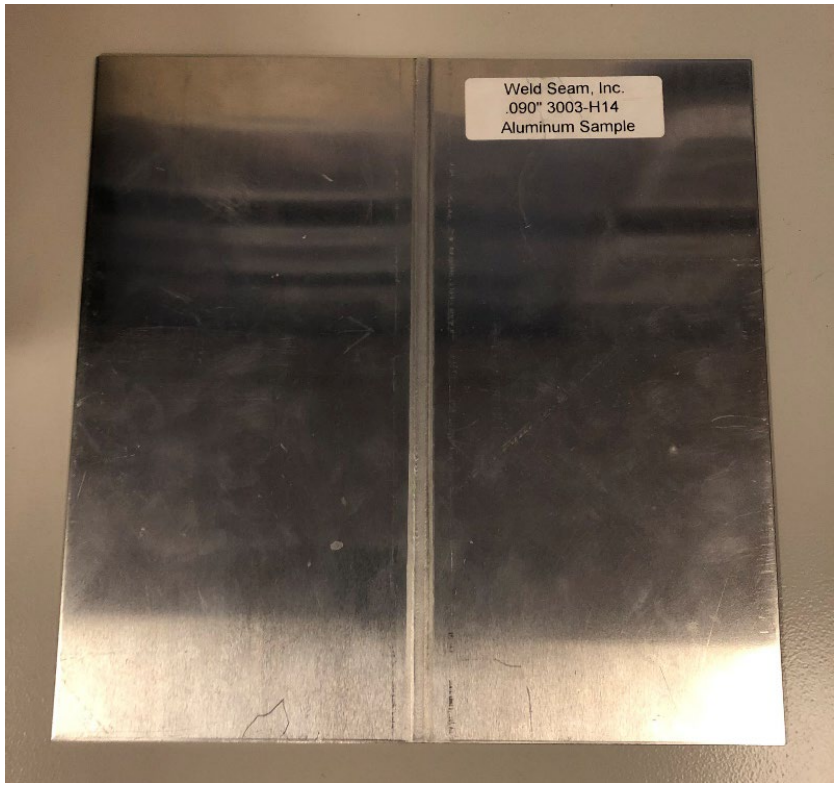


DESIGN PHASE PERFORMANCE MOCK-UP – Panel Fabrication

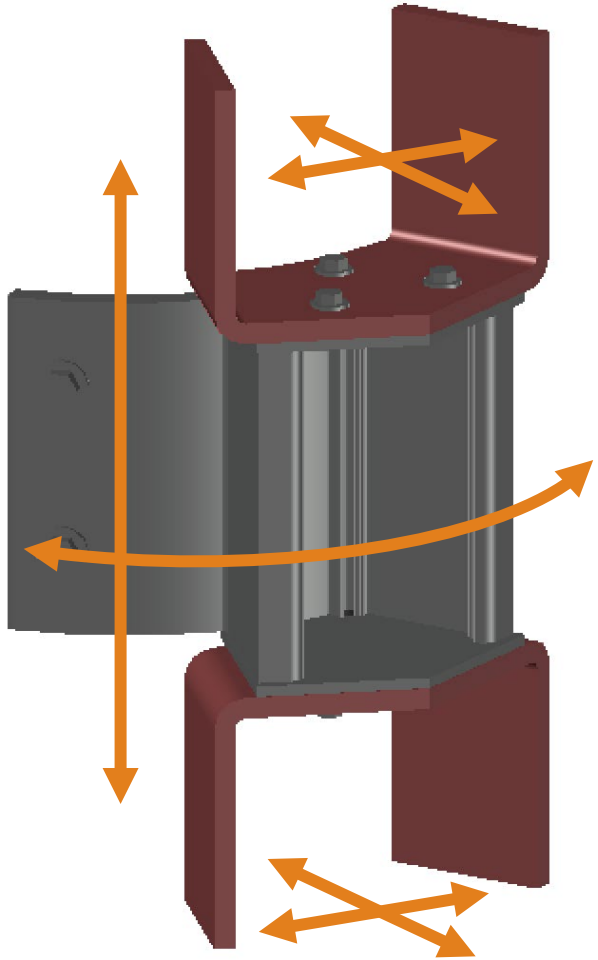


DESIGN PHASE PERFORMANCE MOCK-UP – Panel Fabrication

Lesson Learned #1

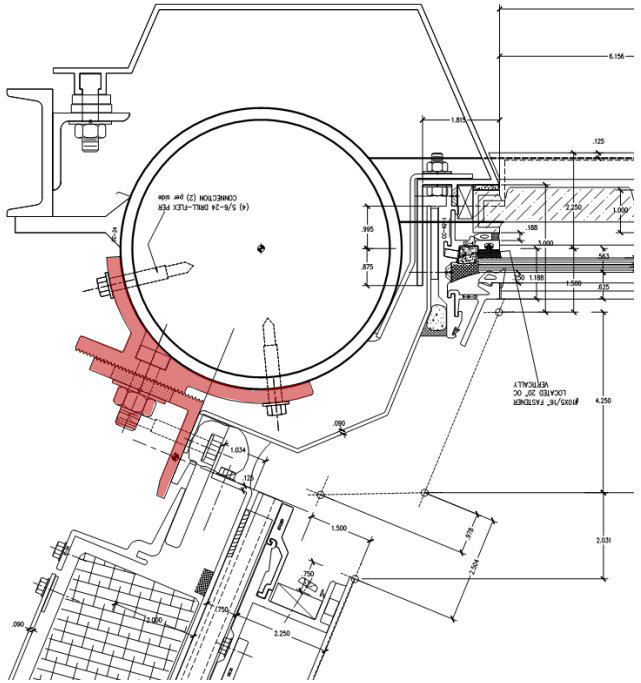


DESIGN PHASE PERFORMANCE MOCK-UP - Assembly

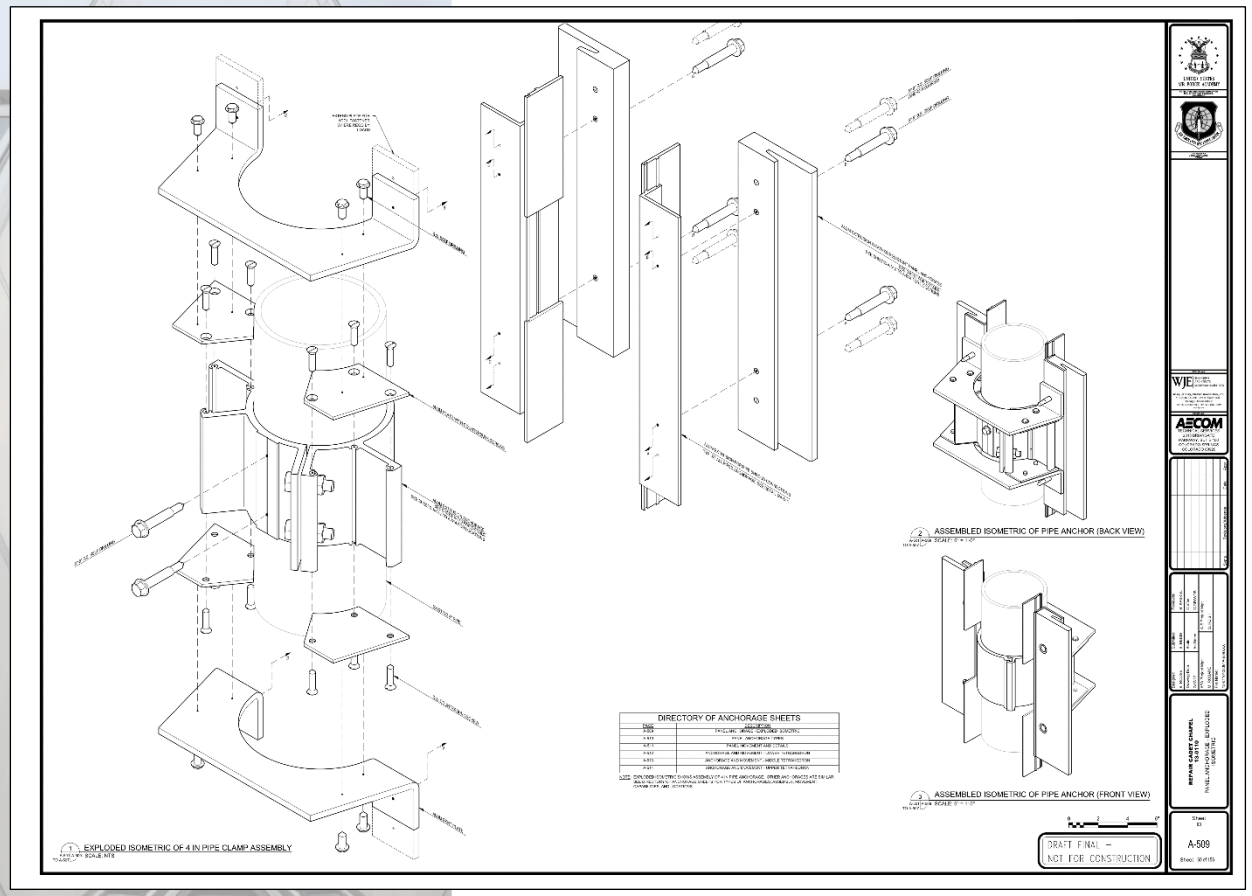


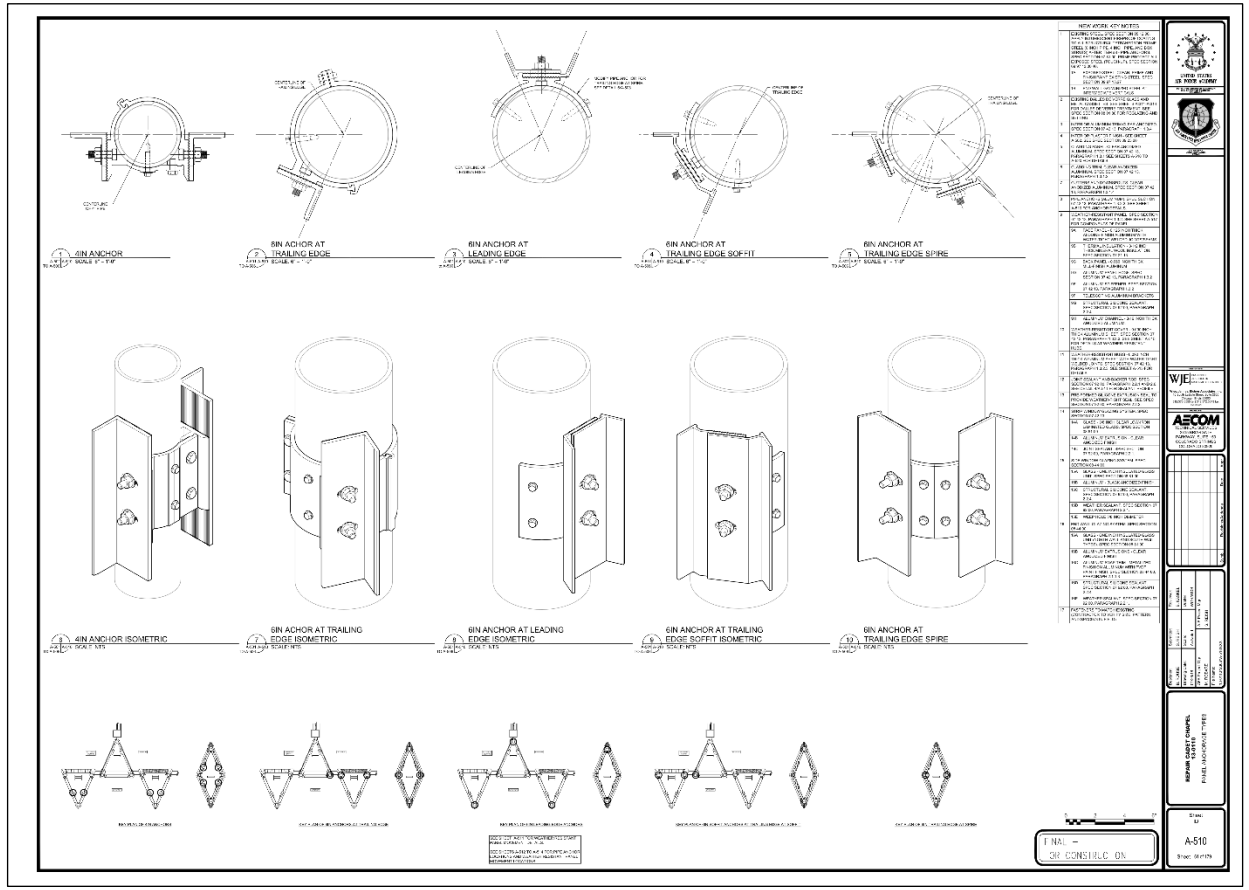
DESIGN PHASE PERFORMANCE MOCK-UP - Assembly

Lesson Learned #2



DESIGN PHASE PERFORMANCE MOCK-UP - Assembly

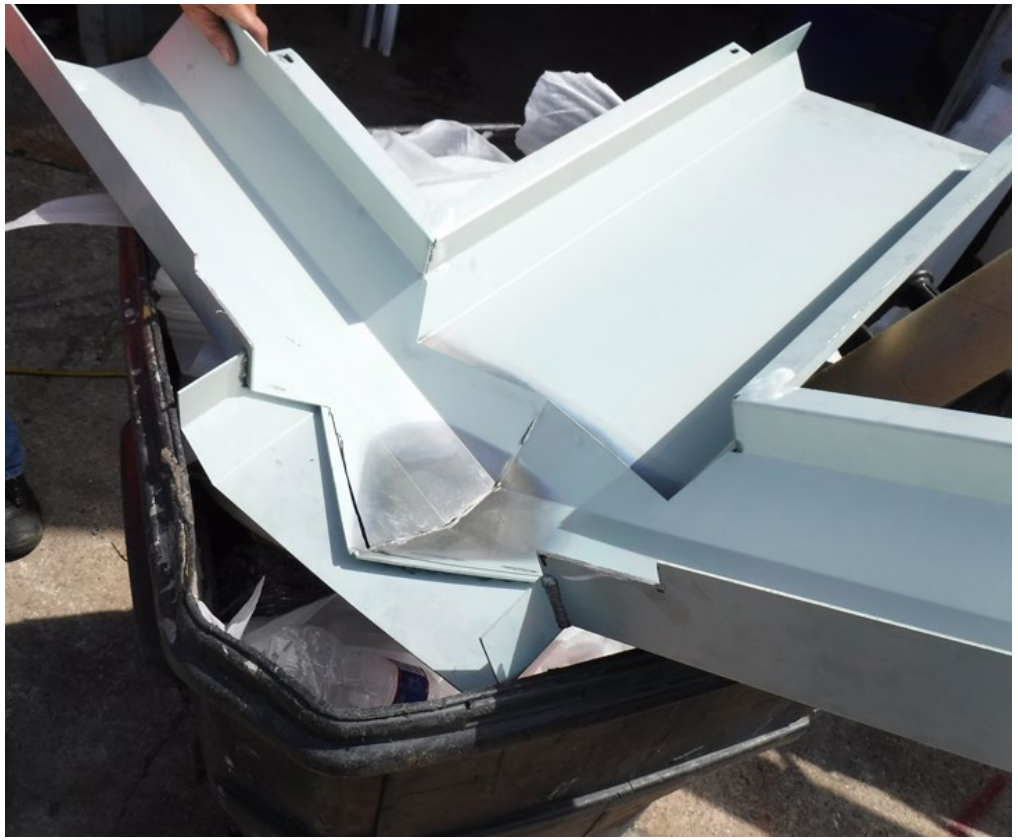




DESIGN PHASE PERFORMANCE MOCK-UP - Assembly

DESIGN PHASE PERFORMANCE MOCK-UP - Assembly

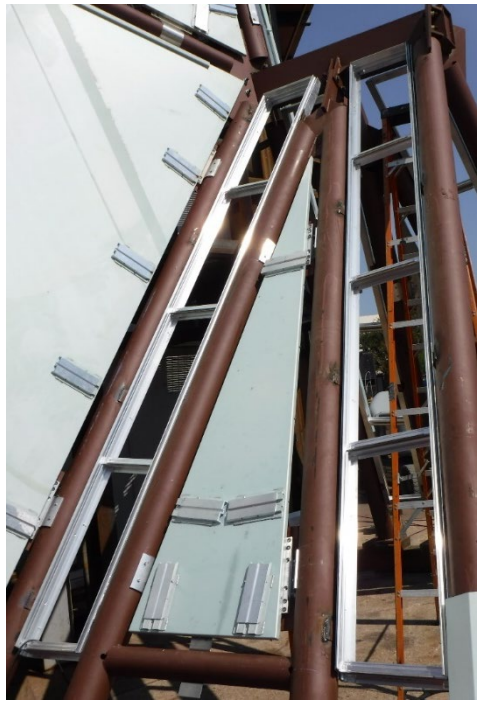
DESIGN PHASE PERFORMANCE MOCK-UP - Assembly

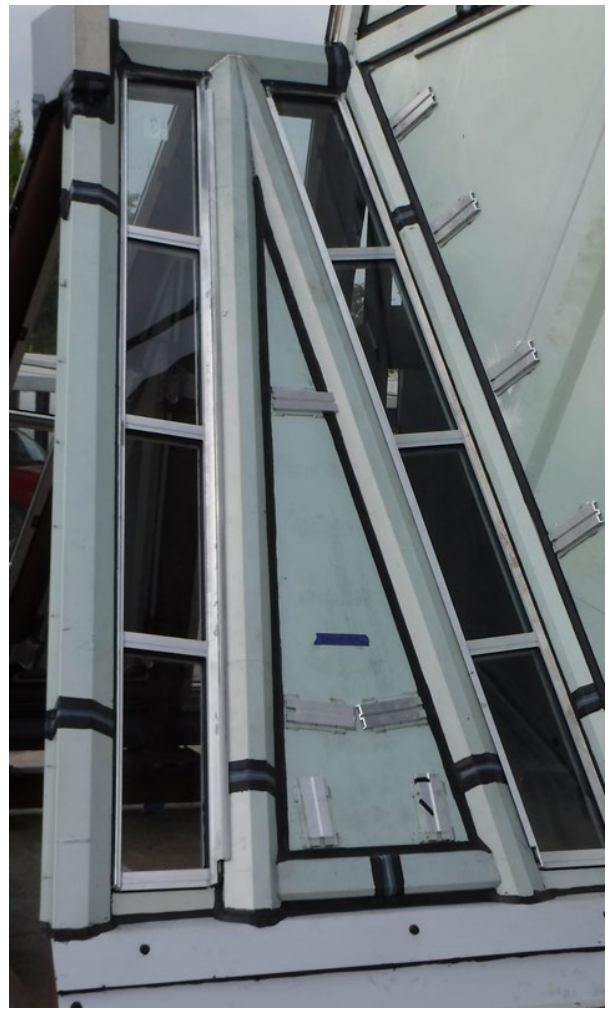


Lesson Learned #3

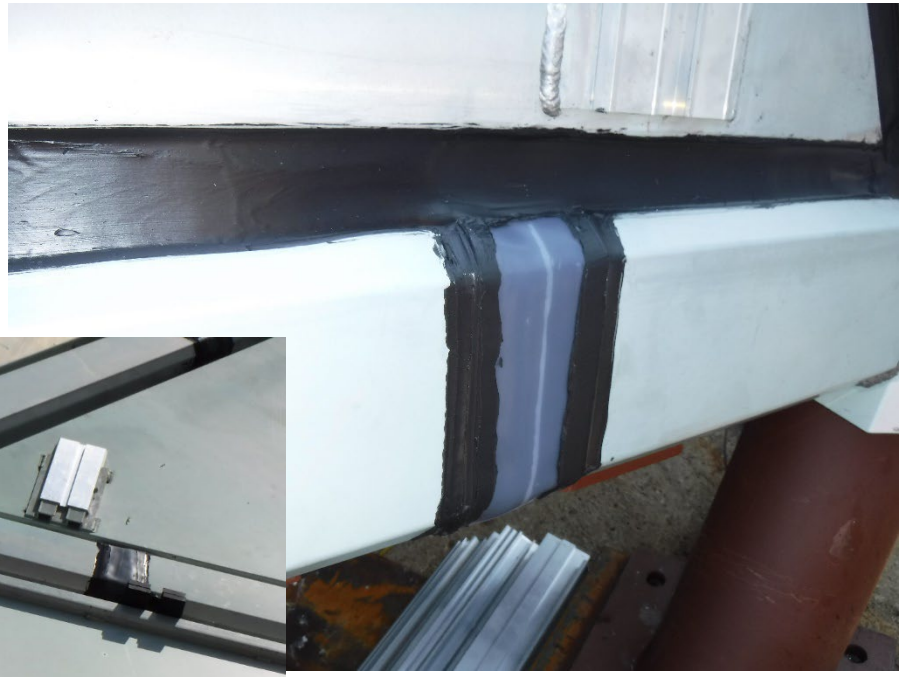
DESIGN PHASE PERFORMANCE MOCK-UP - Assembly

Lesson Learned #4

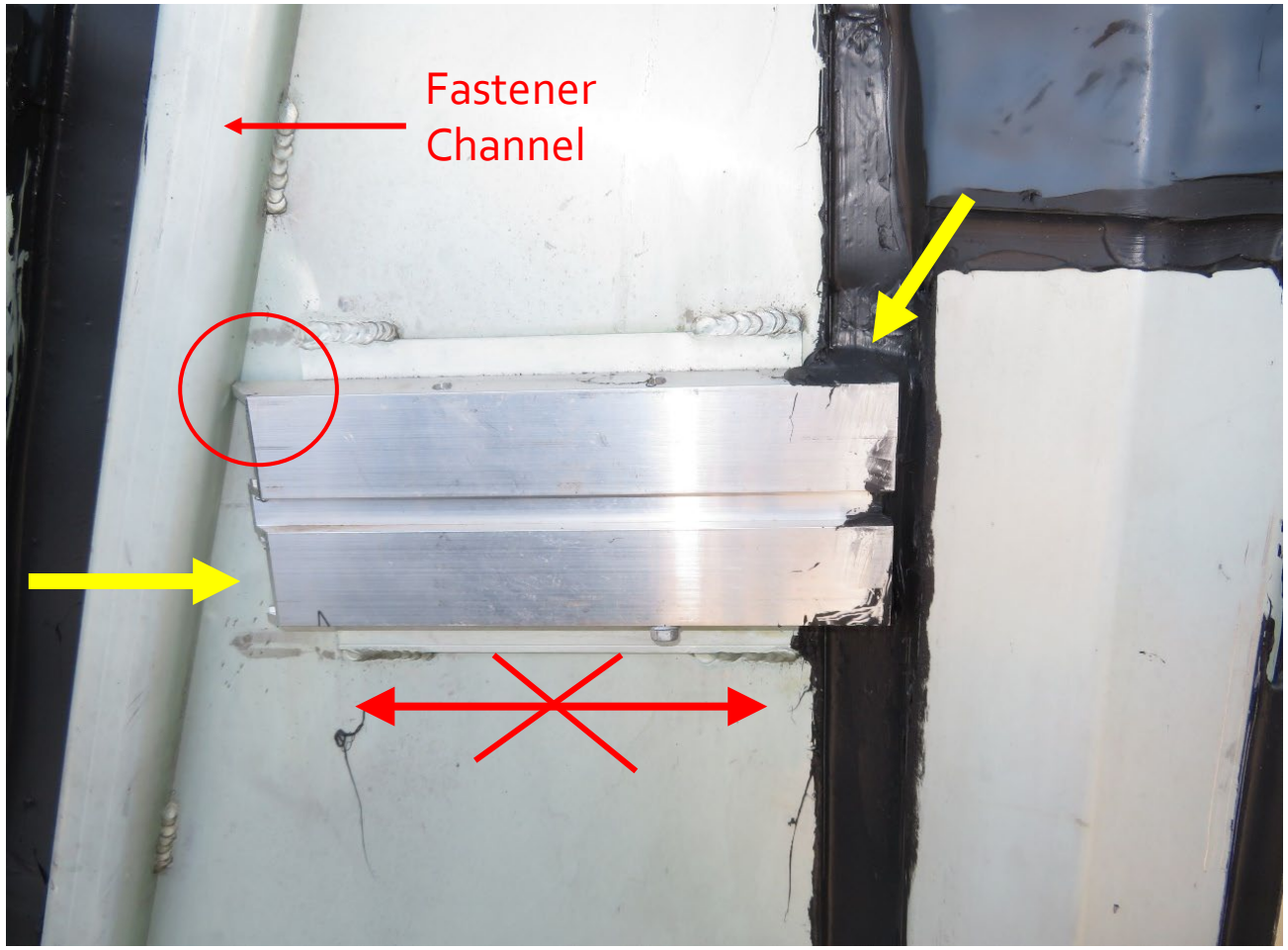




DESIGN PHASE PERFORMANCE MOCK-UP - Assembly



DESIGN PHASE PERFORMANCE MOCK-UP - Testing

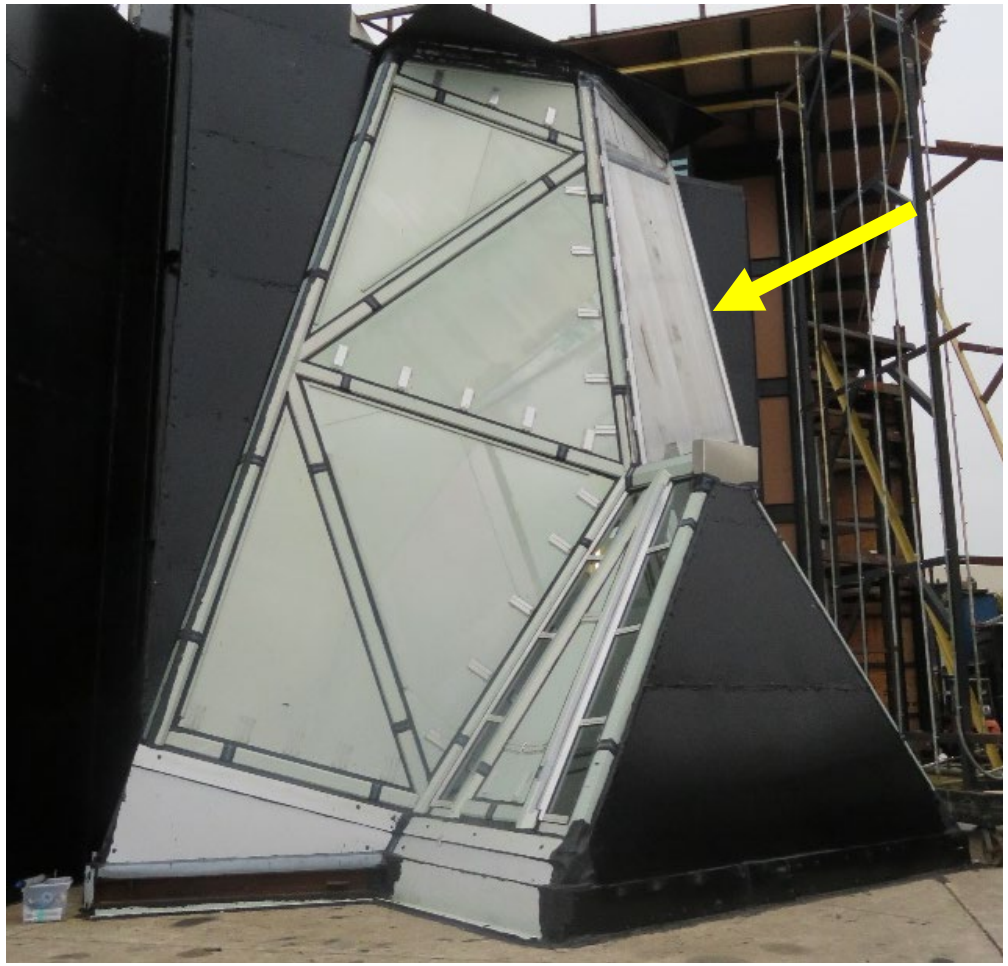


Lesson Learned #5

DESIGN PHASE PERFORMANCE MOCK-UP - Assembly

DESIGN PHASE PERFORMANCE MOCK-UP - Assembly

DESIGN PHASE PERFORMANCE MOCK-UP - Assembly

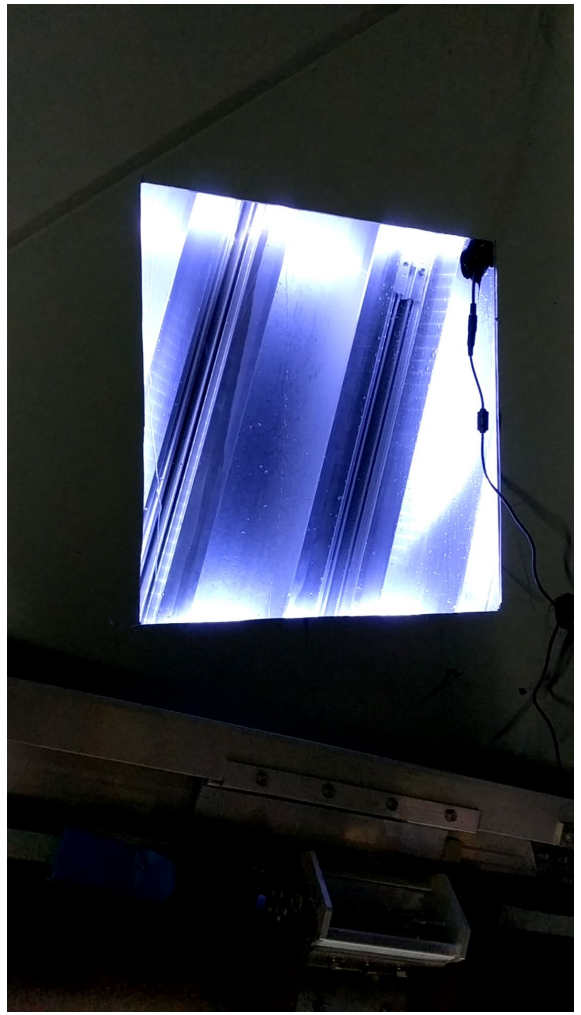


DESIGN PHASE PERFORMANCE MOCK-UP - Testing

DESIGN PHASE PERFORMANCE MOCK-UP - Testing

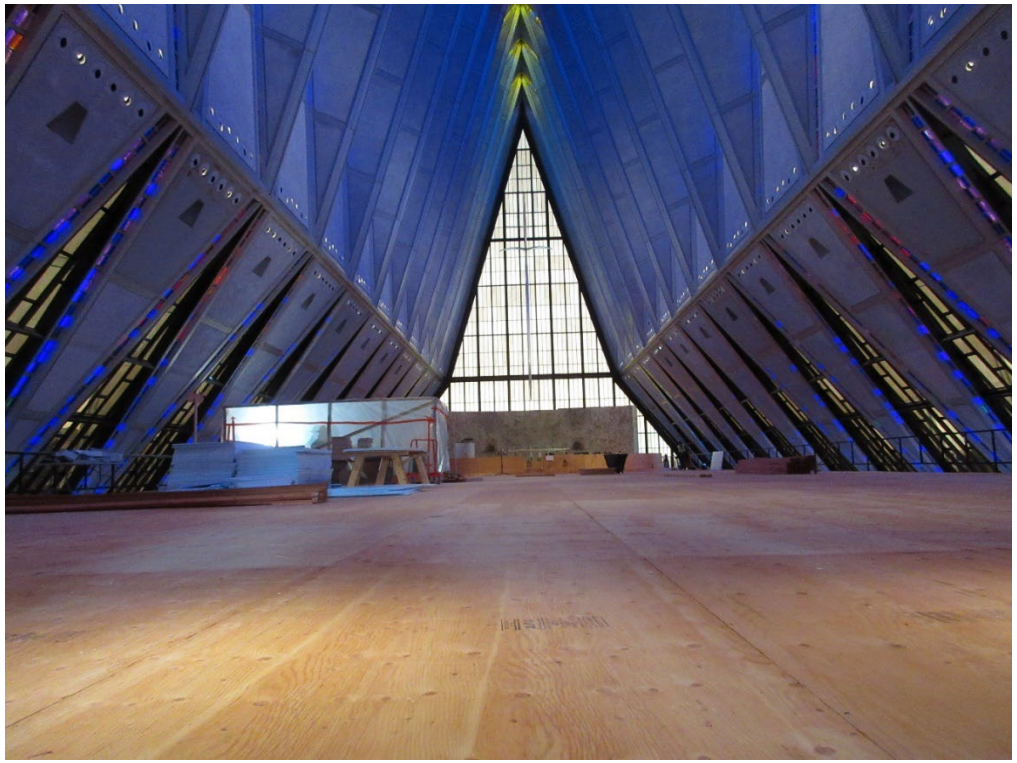
Lesson Learned #6

DESIGN PHASE PERFORMANCE MOCK-UP - Testing

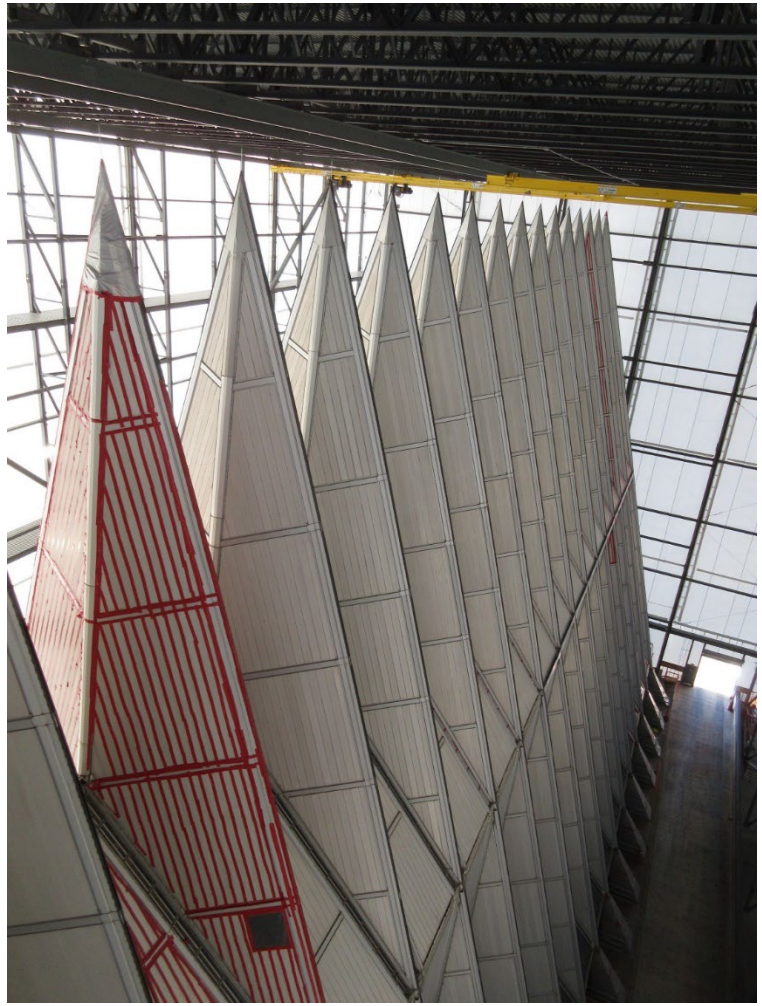


BONUS

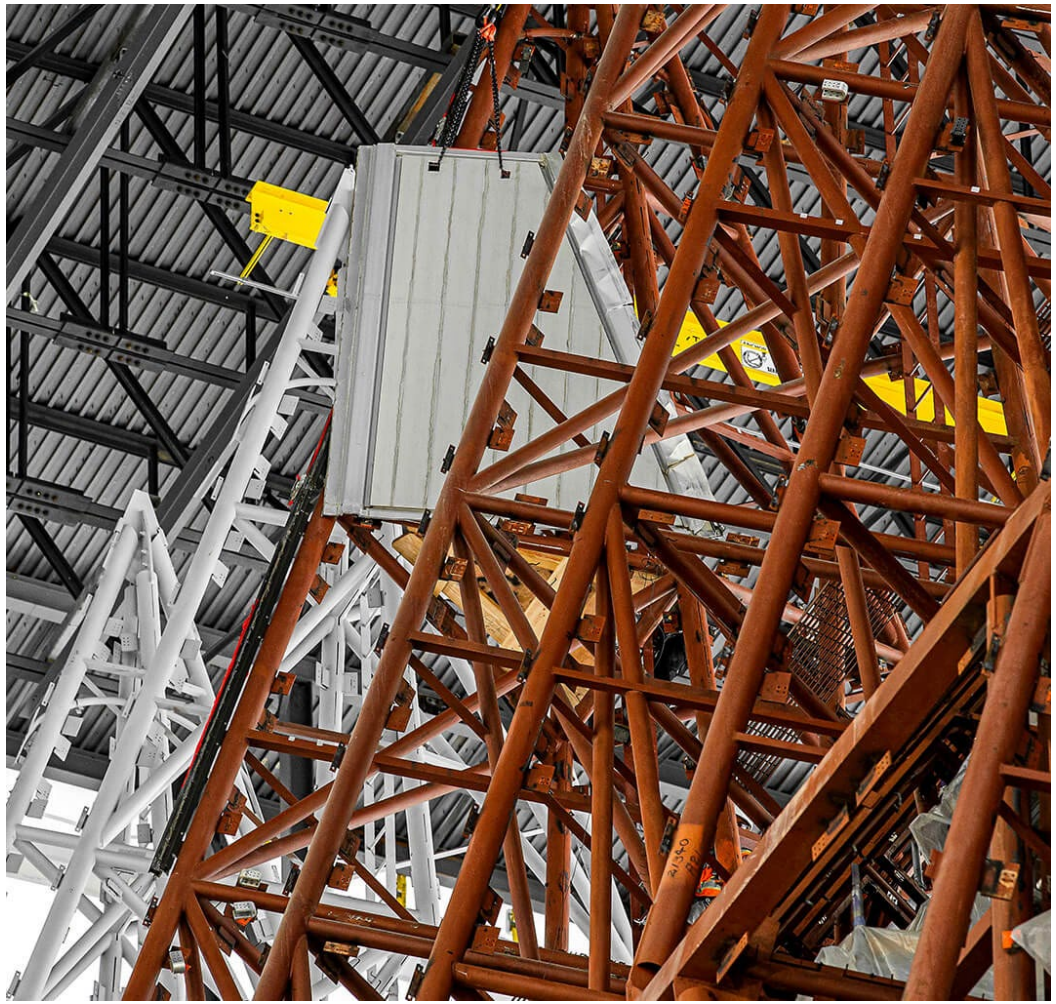
BONUS



BONUS

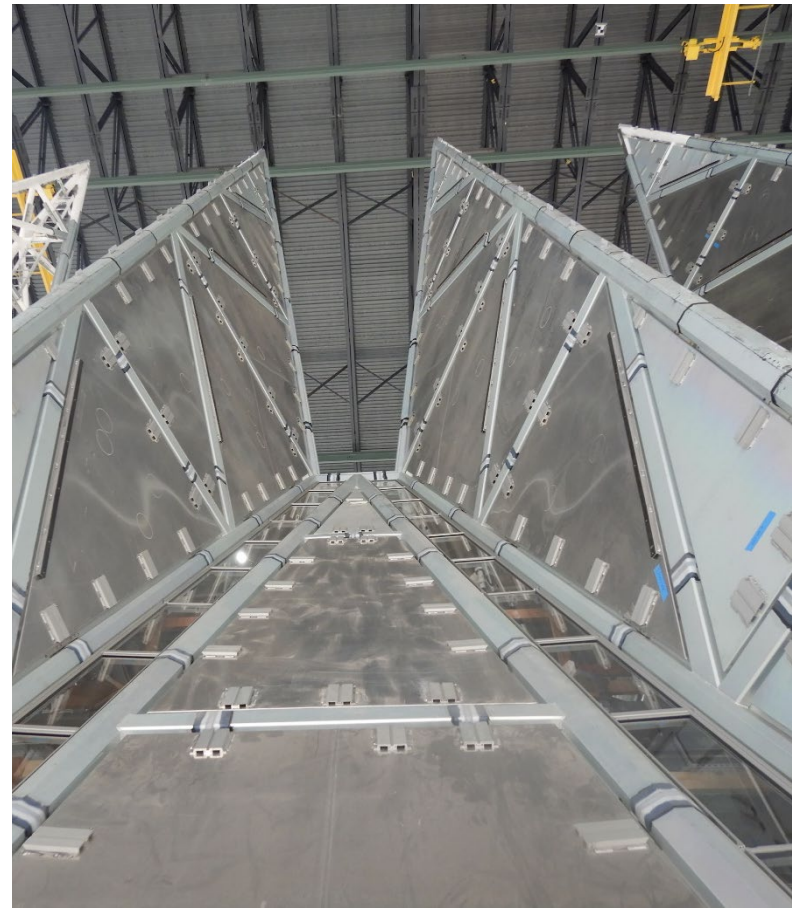


BONUS



Images from the United States Air Force Academy

BONUS



BONUS

Thank You

Bryan Rouse
brouse@wje.com
312.372.0555

Emily Ryba
eryba@wje.com
303.914.4300

Bryan Rouse, AIA
Associate Principal
WJE

Emily Ryba
Associate III
WJE


abaa2025
building
enclosure
conference