Achieving High Performance Enclosures by Designing for Construction

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Advanced Enclosures – Designing for Construction

• What is an Advanced Enclosure
• Performance Criteria for Advanced Enclosures
• Importance of Enclosure Transitions
• BIM’s Role in Enclosure Design
Classic Advanced Enclosure: Spaceship Earth

- Completed 1982
- Unique complex structure and skin
- Common materials
- Simple analysis software
- 1/10 scale model to visualize
Modern Advanced Enclosure: Bahá’í Temple

- Complex structure and skin
- Unique materials
- Extensive modeling and analysis

Rendering courtesy of Hariri Pontarini Architects

Model courtesy of Hariri Pontarini Architects
What is an Advanced Enclosure?

Rosewood Abu Dhabi, UAE

Image courtesy of Handel Architects

Sutter Medical – Eden Hospital

Image courtesy of Sutter Health, Pacific Medical Buildings and Devenney Group Ltd., Architects
Components of an Enclosure

- Geometry
- Materials
- Structure
- Energy
- Environmental
- Value

DeYoung Museum
Components of an Enclosure

• Geometry
• Materials
• Structure
• Energy
• Environmental
• Value
• Constructability
Enclosure Performance

- Owner Requirements
- Code Requirements
- Structural Movement
- Cladding Elements
  - Cladding Type
    - Barrier Wall
    - Drainage Wall
    - Glazing
  - Attachment to Structure
  - Continuity of Barriers
Importance of Cladding Transitions

• Location where multiple systems come together
• Rarely fully detailed
• Different materials and installers

• Where leaks happen!
Importance of Cladding Transitions

• When the transition is addressed can have a significant impact on the risk of water intrusion and cost
Importance of Cladding Transitions

![Graph showing the risk/cost of correction over the design and construction stages.](image-url)
Understand the Condition

• What is the design intent
• How do components respond to structural loading/deflection
• What materials will be used
• What are the surrounding systems and details

• Always think in 3D!
How to Approach Cladding Integrations

• Determine the best method to present the detail
  – Typical section cut details
  – Exploded isometric
Sequence Drawing
Future of Enclosures

• Blurring the line between design and construction
Advancement of BIM

- Design team develop design models
- Subs develop fabrication models
- GC develops coordination model

Design Model

Coordination Model

Image courtesy of Sutter Health, Pacific Medical Buildings and Devenney Group Ltd., Architects
Structural Design & Fabrication

• Useable Models

Photo courtesy of Tekla
Detail Integration and Constructability

Image courtesy of Sutter Health, Pacific Medical Buildings and Devenney Group Ltd., Architects
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Virtual Construction Mockups
Virtual Construction Mockups
Virtual Construction Mockups
Virtual Performance Mockups

- Design
- Analysis
- Fabrication
- Construction
Virtual Performance Mockups – Design
Virtual Performance Mockups – Analysis

FIG. 3 - TYPICAL FIXED WINDOW HEAD - ASHRAE 2009 99% DESIGN CONDITION
Virtual Performance Mockups – Analysis
Virtual Performance Mockups – Analysis
Virtual Performance Mockups – Fabrication

Photo courtesy of Bagatekos
Virtual Performance Mockups – Construction
Virtual Performance Mockups – Construction
Performance Mockups – Reality
Summary

• Many factors and tools contribute to designing advanced enclosures, and most can be applied to any project when performance drives design.
• Proactive detailing and coordination of enclosure integrations is pivotal in achieving performance.
• Technology is a valuable tool in the coordination process and helps blur the line between design and construction.
• Virtual mockups, both construction and performance focused, can help validate field success… but should not replace physical prototypes.
Thank You