The Fifth Discipline
Filling the Gaps of Multi-Trade Prefabrication

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Design Team:
Maya Lin Studio with Bialosky + Partners Architects, Toshiko Mori Architect, Michael Van Valkenburgh Associates, and Cannon Design

Construction Manager:
Skanska USA Building w/ Consigli Construction (Strategic Partner)

Project Program:
763,452 s.f. of Chemistry & Biology research Laboratories, Executive Office, & Social
Presentation Agenda

• I. Prefab Planning
  – Responsibility Pie & Project Labor Agreements
  – Preliminary Logistics & Off Site Construction Facility

• II. Technology Flow & Modularization Process
  – Create Prefab Zones
  – Engineer Structural Modules
  – Coordinate Modules
  – Sign-Off Shop Drawings
  – Create Assembly Drawings

• III. Fabrication & Implementation
  – Module Fabrication
  – Module Transport
  – Rigging & Installation
  – System Activation
I. Responsibility Pie & Project Labor Agreements

- PLA was carefully written to avoid any “Double Handling” by Trade Unions

- An Agreement was reached for the Module Construction, Handling, and Rigging (Thank you Marty Walsh!)

- Subcontractors were educated on the process and asked to approach prefabrication as typical practice with a common hanger system ("Silos with Windows" are OK!)
I. Preliminary Logistics & Off Site Construction Facility

- Is Prefab worth it? (Schedule & Cost)
- Can we physically fit modules into the current design?
- How will we assemble, transport, & install the modules efficiently?
II. SKANSKA Modular Process

- Invent a workflow
- Assign Responsibilities at each Stage
- Know your Software Limitations
II. Design MEP Systems (Cannon)

- MEP Systems were Not Designed For Prefabrication
- However, the repetitive nature of the program resulted in similar design layouts for the Laboratory Levels.
II. Create & Analyze Schematic Modules (Skanska)

- Identify Zones, Sizes, Bill of Materials, & Weights

![Schematic Diagram]

<table>
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<th>Unit Weight</th>
<th>Total Weight (lbs)</th>
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<td><strong>Total Weight</strong></td>
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<td><strong>621</strong></td>
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II. Engineer Modules to Match Schematics (WAI)

- Structural Engineers design Modules to meet proposed Loads
- All Modules consist of a flexible system of “hoops” and “loops”
- Skanska can adjust frames to fit coordination
- Re-engineering needs to be done if frames exceed tolerance
II. Coordinate MEP’s & Adjust Modules (Team)

- Skanska “stretches” modules to fit around modularized areas
- These frames have a maximum 32’ length and 11’-6” width
- Hoops can be moved along the frame within a set tributary width
II. Re-Coordinate MEP’s & Re-Engineer Modules (Team)

- Coordination with trades ensures maximum density of modules
- Valves are placed in common locations for ease of maintenance
- Piping is attached directly to the hoop, eliminating unistrut, etc.
II. Finalize Structure & Sign-Off Shops (WAI)

- Structural Engineer’s shop drawings cover the assembly of the module frames.
II. Finalize MEP’s & Sign-Off Shops (Subs)

- Subcontractor shop drawings use the modules as a guide
- Each party produces shop drawings for their respective elements

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II. Create Supplemental Assembly Sheets (Skanska)

- Skanska’s drawings show all trades in modules
- Used by CM at OSCF for Coordination and Clarification Only
- Not Contractual or Fabrication Drawings!
III. Module Fabrication (Skanska & Subs)

• Fabrication Schedule determined by Field Install Schedule
• Coordination must be complete before modules can be released
• Appropriate Trade constructs empty module (Common Hangers)
• Labor Schedule controlled to keep one trade per module at any given time

Controlled Environment = Safe, Clean, and Warm!
III. Module Transport (Skanska)

- Module shipping weights - Crane sizing; Center of mass
- Pick points - Lifting into building; Hoisting as a full sequence
- Driven back to module engineering design - Early design

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III. Rigging & Installation (Skanska)

- Trimble layout of module hangers
- Lifting frame for sequence lifting - 96ft
- 2-5 modules/sequence
- 1 week/floor from floor to ceiling
III. System Activation (Subs)
III. Lessons Learned - Prefab Efficiency

- Single trade pre-fab (piping racks) took 4 wks/fl compared to stick built floors taking 12 wks/fl of field-time.
- Multi-trade pre-fab took 1 wk/fl of field-install time.
- This allowed the design to evolve,
- Reduced at-height work, reducing risk of lift/ladder injuries
- Allowed work on the site to progress
III. Lessons Learned - The Fifth Discipline

- Involve your Riggers in the Early Planning Process
- Schematic Layout & Preliminary Module Analysis takes Teamwork & Expertise (Not Just a BIM’er with Software!)
- Be nice to your Structural Engineers, and may they be flexible in return.
- “Silos” / Credit: VIB Architecture 3
Thank you BIM Forum!

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