Virtual Forum #49
Feb. 9 – 11, 2021

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A Case Study: Constructability Economics – Why Constructability Is Important

Stories Built

CECO

Background:

Ceco Concrete Construction

- 100+ years in concrete building
- Invented reusable steel pans
- Primary focus has been formwork execution
- Formwork is the magic key to constructability
- Constructability analysis on all projects

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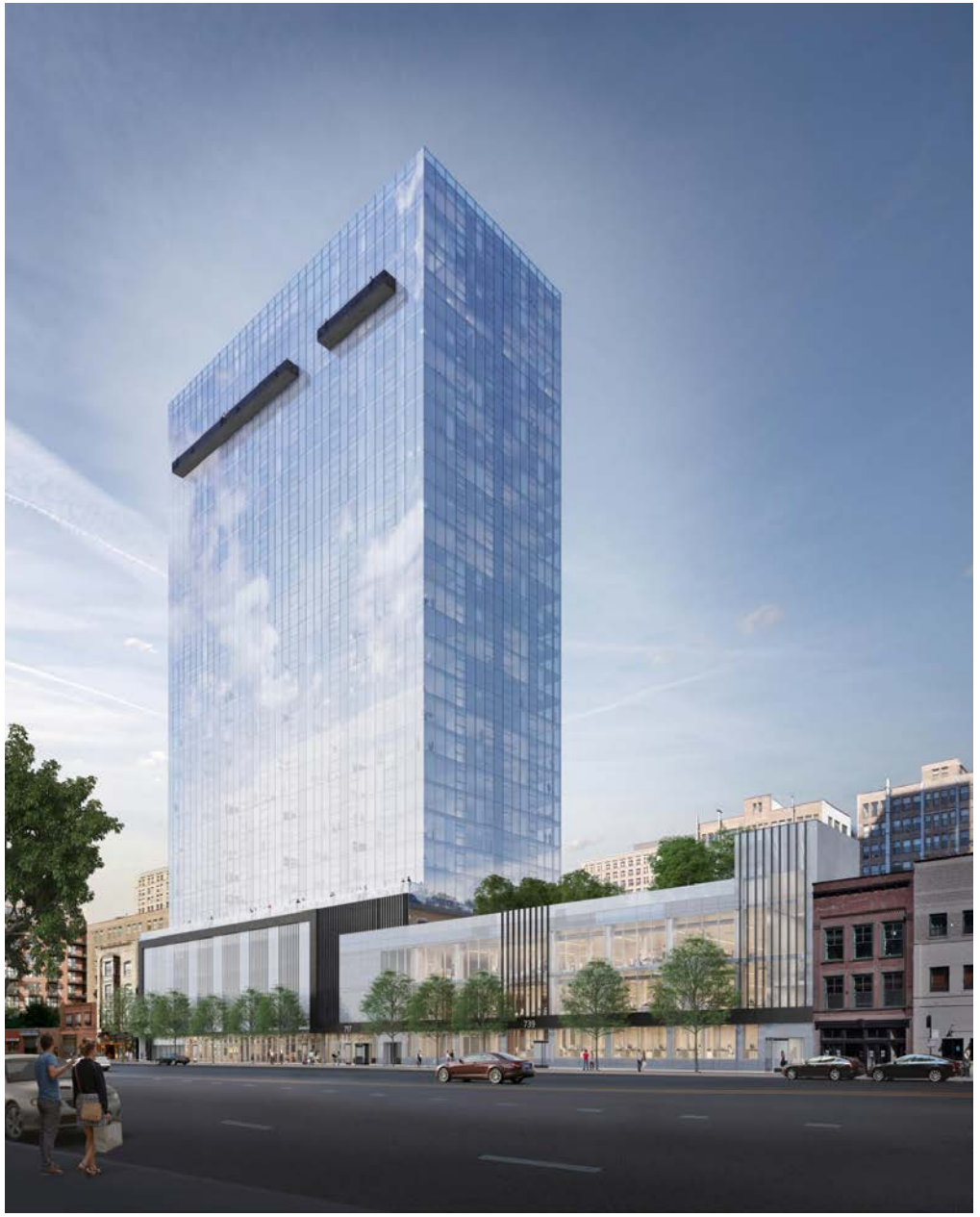
Case Study:

Presentation is Not.....

- Focused on Civil Projects, although Concepts Apply
- About sacrificing architectural creativity
- Tips for Constructability Improvements
- A Constructability Analysis
- A Success Story

Case Study: A CIP Concrete Building



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Case Study: Why→

Structural Engineering today has advanced analysis

- Not just static loading
- Many iterations
- Material optimization

SDC Forum #47 - 2/21/20
Per Cary Kopczynski, PE, SE, FACI – CKC

“Schools Teach Structural Analysis and they Do It Well
Design is Learned in Practice and It is Seldom Learned Well
A Well Engineered Bad Design is Still a Bad Design”

Case Study: Why ??

There is often a misconception of concrete contractors and their motivation for constructable designs.

- Make their life easier, or reduce risk

Case Study: Why ??

Cast-In-Place Concrete offers: Design freedom to embrace architectural creativity, limitless geometry, and owner desires with few systematic barriers

Other pre-fabricated structural systems: Have systematic barriers that force the designer to conform with the system's constructability demands

CIP Concrete design freedom can compromise constructability, if not purposely evaluated.

Case Study: Why ??

This is about….

- Competitive pressures from other structural systems
- Poor results lead to dissatisfied owners, limiting next opportunities
- Growth of our CIP Industry

Case Study: Project

- Urban setting – typical of today and the future
- Recently completed, so economics are relevant
- 32 Level residential (midsized) 400K SF
- Started at grade with parking levels, then transitioned
- Union wages & benefits

Case Study: Ceco Scope of Work

- Concrete Shell above the deep foundations
- CIP material, equipment, labor
- Hoisting & conveyance of structure materials
- All safety: temporary & permanent
- Logistic plan – no laydown
- Topping slabs, but no sitework
- Construction systems design, no structural design

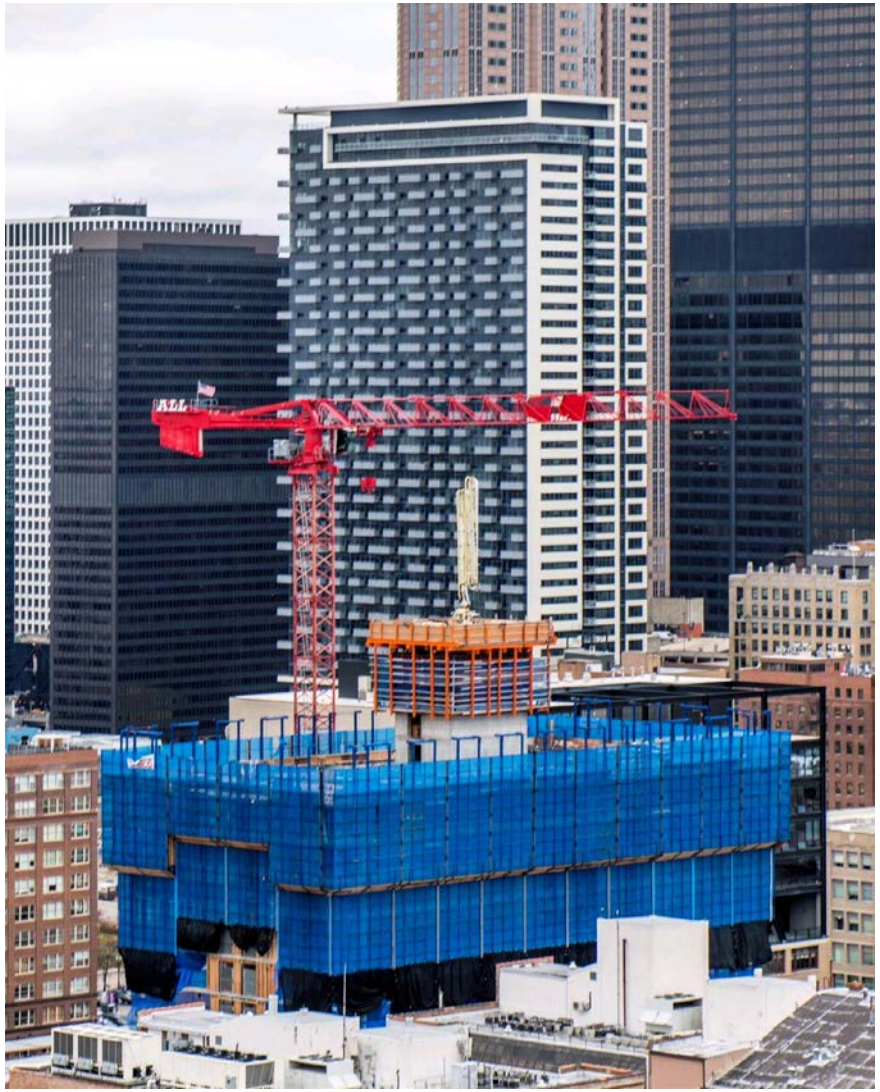
Case Study: Constructability

- Early concrete contractor involvement
- Start – Finish ,w/ demob 36 wk
- Good CIP Concrete Constructability
- Late utility design caused 3 wk delay during construction

Case Study: The Economics

Materials:

- Concrete -56%
- Rebar – 29%
- PT - 11%
- Studrails – 2%
- Topping Insul – 1%
- Supplies – 1%
- Total = 100%



Case Study: The Economics

How about Labor?

- Forming – 35%
- Rebar/PT – 21%
- Tower crane – 11%
- Finishing – 9%
- Site Conditions – 6%
- Safety – 5%
- Barriers – 5%
- Placing – 4%
- Eng/Remedial/Pumping – 4%
- Total = 100%

Case Study: The Economics

Time Dependent Costs:

- Formwork
- Crane
- Barriers
- Super., PM, PE, Admin
- Equipment
- Pump
- Total: $10,000+ / Day

What about these time dependent costs?

- GC and / or CM
- Owners Rep
- Designer's & Consultants
- Inspectors
- Construction Financing

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Case Study: The Economics

These costs also need to be part of every project, but not part of this discussion

Concrete Contractors - More than just materials & labor

- General Super
- Safety Support
- Accounting / Payroll
- Estimating
- Marketing
- Human Relations
- Finance / Bonding
- Insurance / Legal
- Leadership
- Margin

Case Study: The Economics

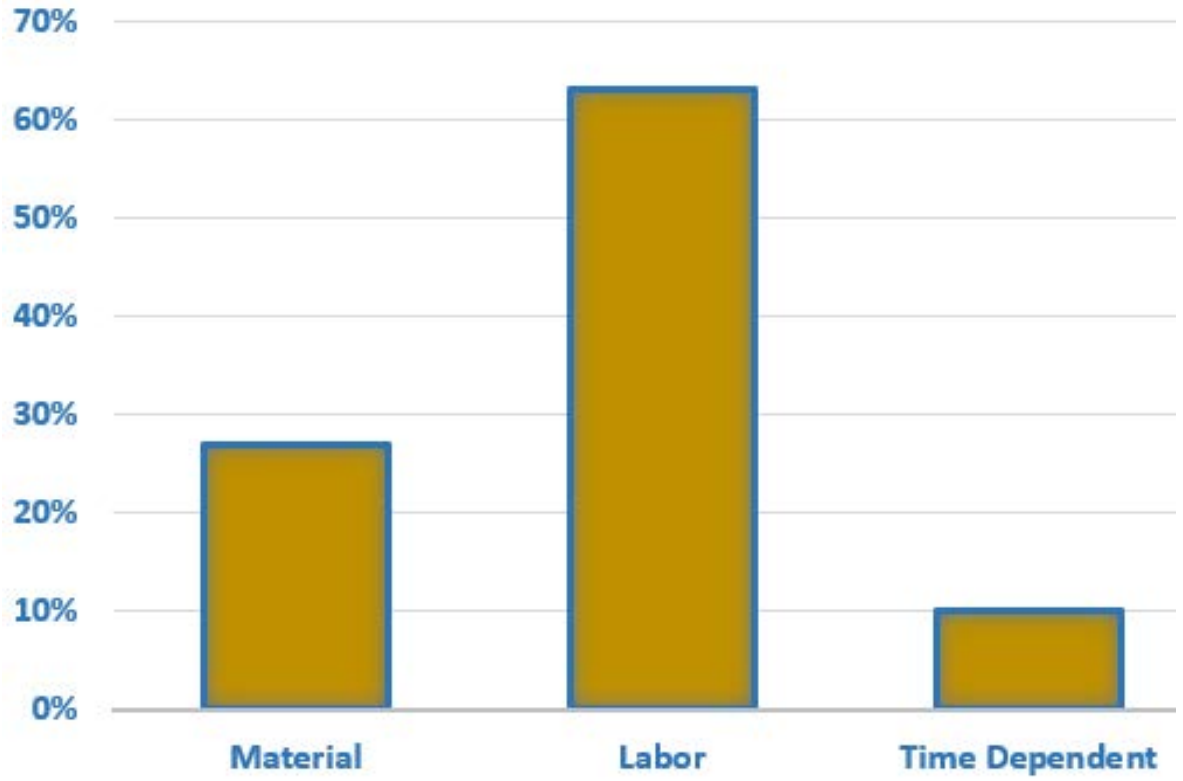
Costs Sliced Differently – as a % of Total Cost

Materials – 27%

Labor – 63%

Time Dependent – 10%

W/O: OH, Margin, other time dependent costs



Case Study: The Economics

What if – this was not a constructable design?

Materials – < 27%

Labor – > 63%

Time Dependent* – >10%

W/O: OH, Margin, other time dependent costs

*** Most volatile, toughest to control**

Case Study: The Economics

Put yourself back at the beginning of the industrial revolution.

A poor design forces the contractor to employ custom laborious processes

A constructable design allows the contractor to apply assembly line processes

Constructability Analysis

We ask critical questions such as:

- Has formwork repetition, panel size and mechanization for movement been maximized?
- Have the economics of materials vs. labor been vetted?
- Are site logistics, deliveries, pour sequencing and materials hoisting considered in the design documents?
- Have construction loads, column transitions, shrinkage; time, temperature and post-tensioning (PT) forces been addressed efficiently?
- Have the specifications been reviewed, and trade tolerance conflicts been considered in design for constructability?
- Have reinforcing congestion, PT anchorage, and mechanical or embedded items been considered for conflict resolution and constructability early enough to adjust?
- Has drainage, cracking, or freeze-thaw concerns been addressed?
- Are the architectural & structural documents coordinated and detailed for consistent clarity?
- Are the design documents sufficiently dimensioned, and with section cuts, to limit RFI's and ensure finish trades preparation is consistent with the concrete?

Case Study: The Economics

Bottom Line:

- We(CIP Concrete) must improve, innovate, collaborate or we'll lose our opportunity.
- Less materials can cost more in the end.
- Constructability is about Labor & Time.
- No design analysis software considers constructability concerns, but constructability is critical to good design.
- Design changes after an assembly line process is in place often is a double negative to constructability (labor & time).

Case Study: The Economics

Involve your concrete contractor early, they hold the keys (labor and time) to Constructability Economics. Early involvement increases the potential of constructability gain.

Thank you!

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Disclaimer: Costs vary from project to project, location and design. The Case Study is intended only to illustrate common cost relationships.

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