

**Virtual Forum #49**  
**Feb. 9 – 11, 2021**  
**Phil Diekemper**

**A Case Study:  
Constructability  
Economics – Why  
Constructability Is  
Important**



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## **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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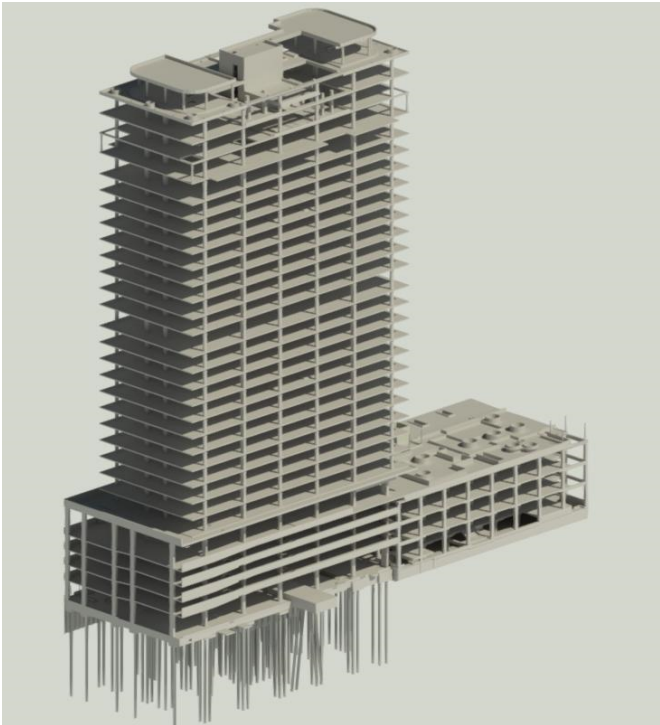


## **Case Study:**

### **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”**

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## **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 (mid-sized) 400K SF
- Started at grade with parking levels, then transitioned
- Union wages & benefits



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## Case Study: Ceko 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**



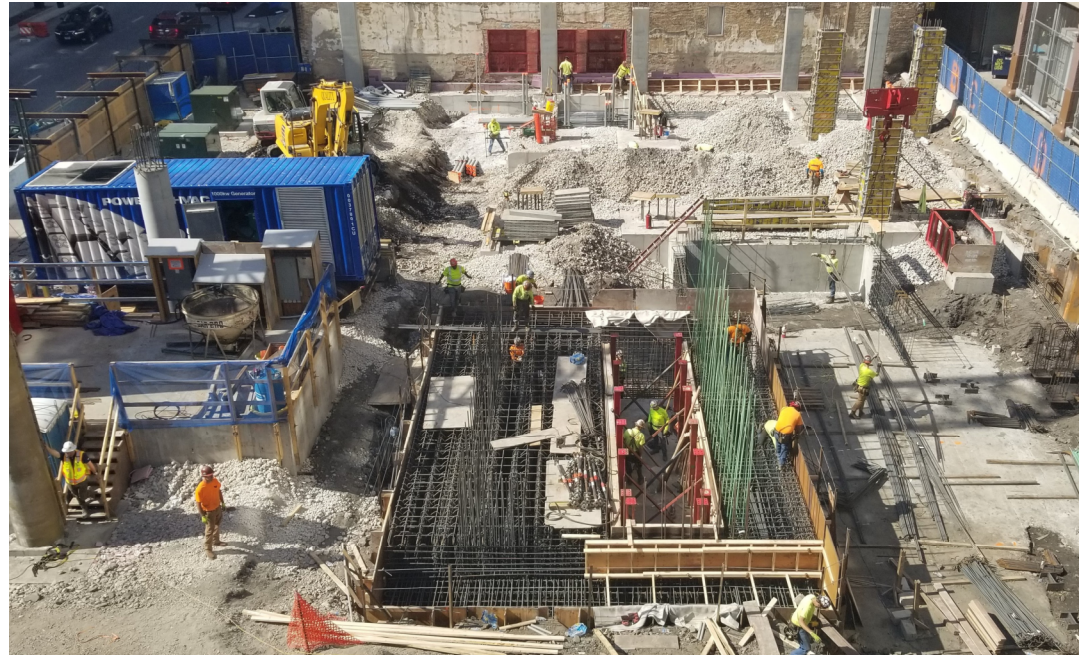
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## Case Study: Constructability

- **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%



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## 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%**



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## 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**

## 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

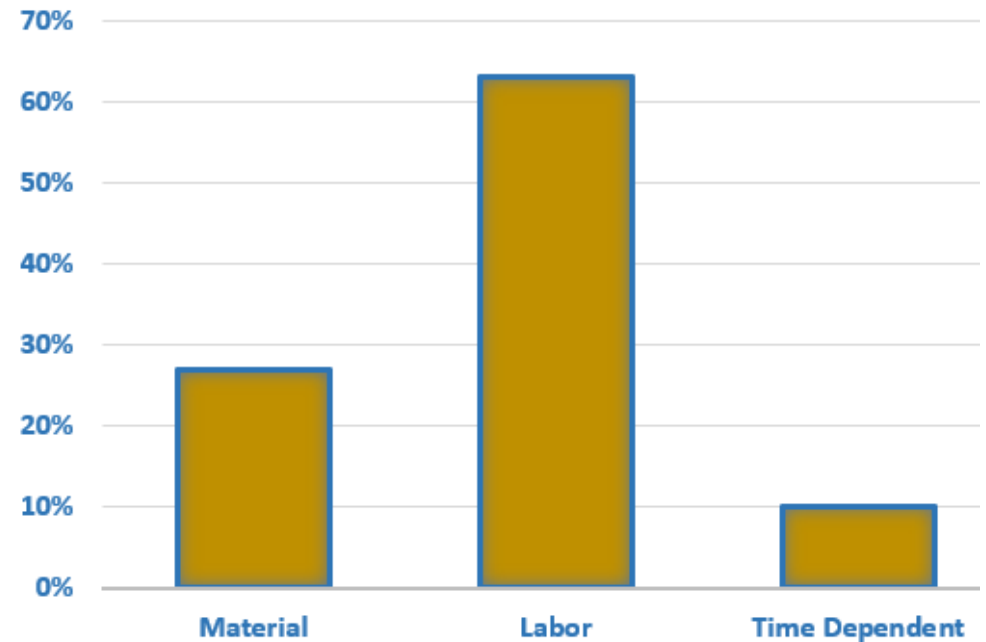
**Costs Sliced Differently  
- as a % of Total Cost**

**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**



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## 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.**

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Thank you!

**Phil Diekemper, Sr. VP**

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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.

