

# PtD Integration into Engineering Education and Project Execution

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*Prevention through Design Workshop  
March 11 of 2020, Tempe, AZ*

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## Outline

*Prevention through Design Workshop  
March 11 of 2020, Tempe, AZ*

- Challenges Integrating PtD - Engineering Education
- Challenges Integrating PtD - Project Execution
- Actions and not just words - a need for fundamental change



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# Challenges Integrating PtD Engineering Education

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## Challenges in Engineering Education

- ✓ The No. 1 Canon of ASCE's Code of Ethics is  
*"Engineers shall hold paramount the safety, health and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties."*

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## Challenges in Engineering Education

Through Policy Statement 350, ASCE

- ✓ believes that improving construction site safety requires the attention and commitment from all parties involved.
- ✓ encouraged Educators to incorporate project site safety and constructability concepts in design and construction curricula.



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## Challenges in Engineering Education

- ✓ And yet the fundamental ABET accreditation, heavily influenced by the ASCE Committee on Curriculum and Accreditation supports an engineering curriculum that is nearly devoid of safety education and training.



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## Challenges in Engineering Education

- ✓ Our Engineering curriculum is designed to prepare graduates to apply the mathematics and science of our profession to design but falls short of preparing them for the project execution side of our industry.

$$\int_{-\infty}^{\infty} e^{i\pi} - x^2 dx = \sqrt{\lim_{n \rightarrow 1} \sum_{n=1}^{\infty} a_n x^n} = \sum_{n=1}^{\infty} a_n$$
$$- \frac{e^{i\pi}}{1} + 1 = 0 \quad \frac{\partial u}{\partial x} + u \frac{\partial u}{\partial x} + \partial_x^2 u = 0$$
$$\varphi(s+t) = \varphi(s) \sqrt{1-\varphi(t)^4} + \varphi(t) \sqrt{1-\varphi(s)^4}$$
$$s \frac{d}{ds} \int_0^{\infty} \frac{1}{\sqrt{1-z^4}} \varphi(s)^2 \varphi(t)^2 dz = M$$
$$\int_0^{\infty} \frac{1}{\sqrt{1-z^4}} dz = \frac{\Gamma(1/4)^2}{2\sqrt{\pi}}$$
$$u_t - u_{xx} + 3uu_x - 2u_x u_{xx} - uu_{xxx} = 0$$

## Challenges in Engineering Education

- ✓ Except for electives or specific disciplines in construction management, safety in our engineering education is usually limited to discussion of safety factors in design codes, and there is little attention given to constructability issues and structural stability.



## Challenges in Engineering Education

- ✓ If safety is really paramount shouldn't our engineering curriculum have much broader exposure to constructability and site safety not just narrow code definitions?
- ✓ Are our professional ethics more than aspirational?

## Challenges in Engineering Education

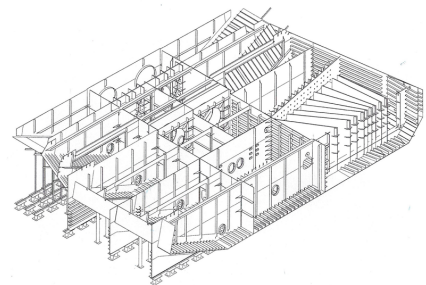
- ✓ Generally speaking, academia lacks practical hands-on safety experience. How can we close the experience gap? We will need to support our educators!
- ✓ There are large pressures to embrace the increasing body of knowledge while decreasing the credits to earn a bachelor's degree.

# Challenges Integrating PtD Project Execution

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## Challenges in Project Execution

- ✓ Designers of Record have superior understanding of overall system design behavior including their intended load paths, lateral load carrying elements, strength of materials and structural stability.
- ✓ But most have significant limitations in constructability and project execution.



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## Challenges in Project Execution

- ✓ Contractors have superior understanding of construction means and methods, constructability, cranes, sequences of construction and shoring methods, but may lack key knowledge of the overall system design and behavior.



## Challenges in Project Execution

Procurement regulations for our public infrastructure have traditionally required the Design-Bid-Build method.

- ✓ Design-Bid-Build procurement bifurcates the responsibility of the designer and the contractor and strictly defines roles, responsibilities and scope of work for each.
- ✓ Contractor selection occurs late in design process creating further barrier to early communications.

## Challenges in Project Execution

- ✓ Costly liability and our litigious climate has driven legal ring fencing of contract responsibilities causing isolation where collaboration between designer and contractor is a commonsense necessity!



## Challenges in Project Execution

- ✓ What happens when it costs more in a low bid procurement? Are we really committed to Safety First? All too often money matters and we gamble with lives!
- ✓ Is Design-Bid-Build best value when it comes to safety of our workers?





## Challenges in Project Execution

- ✓ The Owner's role - contracts and behavior
  - What's the expectation for safety? Is it clear?
  - Is it addressed in detail in the contract?
  - Is the procurement DBB, DB, CM, PPP?
  - Broad form hold harmless and risk transfer?
  - Is the owner supportive of PtD even if the design costs more?

## Challenges in Project Execution

- ✓ The Owner's role - contracts and behavior
  - Most public contracts prohibit the contractor from taking exceptions to terms and conditions.
  - How do you communicate expectations for terms and conditions related to a safe site.
  - Risk sharing versus risk shedding.

## Challenges in Project Execution

- ✓ Alternative Delivery Methods have gained traction, but change is slow and procurement regulations are at times restrictive.
- ✓ “The Burden of Our Experience” - Changing the behavior paradigm and mutual respect.

## Challenges in Project Execution

- ✓ Constructability Reviews – recognize the importance of construction engineering and a collaborative review!
- ✓ Who, how often and are they effective?
- ✓ Is a discussion on worker & public safety included?

## Challenges in Project Execution

- ✓ Constructability Reviews - the contractor's dilemma
  - Is there a conflict of interest?
  - What are we selling?

## Challenges in Project Execution

- ✓ Complexities of Contracts that allow for Design Build specialty items in Building Construction - elevators, curtainwall, structural connections.
  - Risk transfer of Connection Design? The risk of blurring the lines of design responsibility.

# Actions and Not Just Words

## A Need for Fundamental Change

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## Actions for Engineering Education

- ✓ Be an advocate for change to the curriculum and certification requirements for engineering education.  
**Safety as a requirement not an elective.**
- ✓ Fully support integration of Safety throughout our engineering curriculum. It has a place in every class and will serve to build strong base for an engineer's role in site safety.

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## Actions for Engineering Education

- ✓ Curriculum should include discussions of:
  - Lessons learned from actual case studies
  - Industry metrics; LTIR and fatality statistics
  - Proactive measures, near miss, root cause etc.
- ✓ Consideration of an industry supported clearing house for safety education materials

## Actions for Engineering Education

- ✓ ASCE Policy Statement 350, encourages educators to include Constructability Concepts in design and construction curriculum. If safety is our No 1 goal, encouraging isn't good enough, exposure to these concepts should be a requirement!

## Actions for Engineering Education

- ✓ Subject matter on Constructability should include:
  - Sequences of Construction & structural stability
  - Key load carrying elements and schedule impacts
  - Understanding lateral load carrying elements, both permanent and temporary
  - Structural connections, installation progress and safety
  - Metal deck and SIP forms, support and lateral support
  - Hybrid and composite structures
  - Shoring and concrete floors and cantilevers
  - Tower cranes and hoists

## Actions for Project Execution

- ✓ Educate Owners on the benefits of addressing safety in contracts, and their ability to influence outcomes.
- ✓ Support Integration and Collaboration!
- ✓ Be an advocate alternate contract delivery methods that embrace early contractor involvement and prevent isolation of the contractor and designer.

## Actions for Project Execution

- ✓ When Owner contracts do not set expectations for site safety and assign responsibility, demand clarification in pre-bid Q & A forums.

## Actions for Project Execution

- ✓ Facilitate communication and collaboration between the designer and the contractor early and often.
  - Respect and Trust.
  - Give serious consideration to collocating key designer and contractor representatives.
  - This is particularly important during review of the working shop drawings.

## Actions for Project Execution

- ✓ Constructability reviews must be integrated into the overall design process during early design stages.
  - Reviews should be conducted by experienced construction professionals in collaboration with the design team.
  - Workers safety and structural stability should be a set part of every agenda.
  - Build schedule hold points into the design schedule for formalized constructability and safety reviews: at a minimum, Schematic, DD and CD.

## Challenges in Project Execution

- ✓ What happens when it costs more in a low bid procurement? Are we really committed to Safety First? All too often money matters and we gamble with lives!
- ✓ Safety in our professional ethics. Are they more than aspirational?



## Who's responsible for Safety?

In a November 12, 2019 editorial regarding the FIU Pedestrian Bridge collapse in Miami, ENR made reference to the NTSB investigation noting that *the NTSB said each member of the team had an "implied authority" to shut the road to all traffic or require reshoring—not spelled out in contracts but as tangible as the tons of concrete above the passing motorists. None acted on that authority.*

## Who's responsible for Safety?

*In the paper world of contracts, only contractors are responsible for means and methods.*

*In the real world, partly as a result of NTSB investigations and civil lawsuits—but unstated by the board—design engineers face expanding liability. They will always be the first ones consulted when it comes to protecting human life.*

## Who's responsible for Safety?

ENR concluded:

*Few collect fees commensurate with that awesome liability. But recognizing how wide that responsibility stretches and keeping the obligation to public safety front of mind, might have helped overcome the false sense of security and groupthink that obscured the unfolding disaster.”*

## Key Takeaways

- ✓ Support the integration of Safety and Constructability as a requirement in college engineering curriculum
- ✓ Support academia with your knowledge and resources in making a difference in the education of our future engineers.

## Key Takeaways

- ✓ Educate owners on how their contract terms and conditions influence project safety and positive outcomes.
- ✓ Support the reality of risk sharing not risk shedding.
- ✓ Support procurement that values early contractor involvement and integration of constructability.
- ✓ Be an advocate for contracts that value communications and collaboration between designers and contractors.
- ✓ Be respectful of relative expertise.

Safety in our professional ethics.  
Are they more than aspirational?

Walk the Talk and Choose to  
Make a Difference!

# Thank you!

<https://ptd.engineering.asu.edu/>

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