Prevention through Design:
We need to talk about safety during design

Brasfield & Gorrie Safety Week Webinar

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“We need to talk….”
about safety…..
during design

Overview

Why
Who
When
How
Project success requires that design reflects input from all stakeholders, including:

- Users/occupants
- Owner facility management personnel
- Contractors

Constructability feedback must start early in the design process
IDC is more critical today than ever before

- Project schedules decreasing
- Project complexity increasing
- Design professionals’ design expertise narrowing
- Design professionals’ construction knowledge decreasing
Disjointed Design and Construction

- Cost overruns
- Schedule overruns
- Quality suffers
- LEED goals not met
- People get hurt
Disjointed Design and Construction

- Kansas City Hyatt collapse
- L’Ambiance Plaza collapse

Source: http://ctcameraeye.com/l-ambiance-plaza-collapse-the-first-few-hours/
Benefits of Integrated Design and Construction

› Obvious: Cost, Schedule, Quality
› Accepted: Sustainability
› Emerging: Prefabrication
› Emerging: Safety
Early Constructability Input gives Bang for the Buck

- Ability to influence safety is greatest early in the project schedule during planning and design (Szymberski, 1997)
Prevention through Design (PtD)

“Addressing occupational safety and health needs in the design process to prevent or minimize the work-related hazards and risks associated with the construction, manufacture, use, maintenance, and disposal of facilities, materials, and equipment.”

(http://www.cdc.gov/niosh/topics/ptd/)
PtD in Construction is...

- Explicitly considering construction safety in the design of a project.
- Being conscious of and valuing the safety of construction workers when performing design tasks.
- Making design decisions based in part on a design element's inherent safety risk to construction workers.

“Safety Constructability”
Why PtD? Annual Construction Accidents in U.S.

- Nearly 200,000 serious injuries
- 1,000+ deaths
When Safety is Not Discussed during Design

1. Users/Occupants can be hurt
   Example: Luke

2. Designs are unconstructable
   Example: high school masonry wall collapse

3. Designs are more hazardous to construct than they need to be
   Examples: structural steel, concrete

4. Designs are more hazardous to maintain than they need to be
   Examples: access to light bulbs, valves, air filters…
Why PTD? Design-Safety Links

- **22%** of 226 injuries that occurred from 2000-2002 in Oregon, WA, and CA\(^1\)
- **42%** of 224 fatalities in US between 1990-2003\(^1\)
- **60%** of fatal accidents resulted in part from decisions made before site work began\(^2\)
- **63%** of all fatalities and injuries could be attributed to design decisions or lack of planning\(^3\)

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\(^2\) European Foundation for the Improvement of Living and Working Conditions

\(^3\) NSW WorkCover, *CHAIR Safety in Design Tool*, 2001
Hierarchy of Controls

- **Elimination**
  - Eliminate the hazard during design

- **Substitution**
  - Substitute a less-hazardous material or form during design

- **Engineering Controls**
  - “Design-in” engineering controls, Incorporate warning systems

- **Administrative Controls**
  - Well-designed work methods & organization

- **PPE**
  - Available, effective, easy to use

PtD
Why PtD? Tangible Benefits

- Reduced site hazards
  - Fewer worker injuries and fatalities
- Reduced workers’ compensation premiums
- Increased productivity and quality
- Fewer delays due to accidents
- Encourages designer-constructors collaboration
- Improved operations/maint. safety
PTD Example: Groundwater Well Drilling

- Design spec:
  - Dig groundwater monitoring wells at various locations.
  - Wells located directly under overhead power lines.

- Accident:
  - Worker electrocuted when his drill rig got too close to overhead power lines.

- Engineer could have:
  - specified wells be dug away from power lines; and/or
  - better informed the contractor of hazard posed by wells’ proximity to powerlines through the plans, specifications, and bid documents.
PTD Example: Anchorage Points
PTD Example: Roofs and Perimeters

Parapet walls

Upper story windows

Skylights
PTD Example: Structural Steel Design

*Detailing Guide for the Enhancement of Erection Safety*

Published by the National Institute for Steel Detailing and the Steel Erectors Association of America
The Erector Friendly Column

• Include holes in columns at 21” and 42” for guardrail cables and at higher locations for fall protection tie-offs

• Locate column splices and connections at reasonable heights above floor

Photo: AISC educator ppt
Provide enough space for making connections
Know approximate dimensions of necessary tools to make connections

Photo: AISC educator ppt
What is Needed for Integrated Design and Construction?

- Construction professionals interacting with design professionals during design.
- This is not possible with DBB unless CM, design-assist or informal review.
- DB and IPD makes integration possible.
- Co-location, trust, decision tools, sufficient design duration, extended design reviews make effective collaboration easier.
PtD Design Review

- Hazard identification
  - What construction safety hazards does the design create?

- Risk assessment
  - What is the level of safety and health risk associated with each hazard?

- Design option identification and selection
  - What can be done to eliminate or reduce the risk?
  - Remember the hierarchy of controls......
3D/4D Help Identify Hazards
PtD Process

Get the right people talking about the right things at the right time!
Concept
- Owner
- AE
- GC/C&M

Establish PtD process
Identify PtD checklists, other tools
Select primary materials
Identify opportunities for prefab./modular.

30% Design
- Owner, AE, GC/C&M
- Key trade contractors
- Key equip. manufact.

Finalize design aspects to facilitate prefabrication
Review design checklists
Perform preliminary hazard analysis
Apply multi-attribute decision tools
Select secondary materials

60% Design
- Owner, AE, GC/C&M
- Key trade contractors

Use design checklists
Draft erection plans
Communicate critical hazards on plans and specs
Identify needed anchorage points, work platforms

90% Design
- Owner, AE, GC/C&M
- All trade contractors

Review safety constructability of all plans, specs
Identify safety expectations in all contract docs
Identify safety parameters for subcontracts

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What can You Do to be a Safety Leader?

› Call out and manage hazards that are present on your project.
  • If design is involved, insist that the design professional work with you on a solution.
  • Bring in the owner if needed.

› Push owner clients to enable integrated design and construction.
  • On DBB projects, use design-assist or informal reviews.

› Identify the specific construction and maintenance hazards most important to the owner.
What You can Do, continued

- Insist on discussing safety during design/constructability reviews with the AE.
  - Again, use the owner as leverage with the AE if needed.
  - Use 3D and 4D models during reviews
  - Make it easier for AEs to design for safety by providing them with design checklists.

- Work with your firm’s safety managers to develop and deliver safety training to AEs
  - Goal: Increase AE awareness of hazards and willingness to proactively reduce them through design.
How motivate AEs, Owners to Design for Safety?

- Professional Ethics
- Social sustainability principles
- Prefabrication achieves safety and other key goals
- Personal stories
PTD and Professional Ethics

- National Society of Professional Engineers (NSPE) Code of Ethics:
  - Engineers shall hold paramount the safety, health, and welfare of the public.

- American Society of Civil Engineers (ASCE) Code of Ethics:
  - Engineers shall recognize that the lives, safety, health and welfare of the general public are dependent upon engineering decisions ....
PtD and Sustainability

[Diagram showing the concept of sustainability with three main pillars: Environmental, Economic Viability, and Social Equity]
PtD’s Tie to Sustainability

  - Focus on people as much as on the environment
    - Meet the needs of people who can’t speak for themselves
Corporate Social Responsibilities

› “Commitment by business to behave ethically and contribute to economic development;

› “Improve quality of life of the local community and society at large.”

› “Improve quality of life of the workforce and their families;

Source: World Business Council for Sustainable Development
PtD and Social Sustainability/Equity

- Do not our duties include minimizing all risks that we have control over?
- Do not we have the same duties for construction, maintenance, line workers as for the “public”?
- Is it ethical to create designs that are not as safe as they could (practically) be?
B&G’s Corporate Values

- We are Committed to Excellence
- We Do the Right Thing
- We Treat People with Respect
Prefabrication is Safer

- Shift work away from hazardous environment
  - At height
  - Underground
  - Confined space

- Controlled environment

- Manufacturing approach
Prefabrication

Steel Stairs

Concrete Wall Panels

MEP Corridor Racks
Tell Your Story

- Why safety matters to you
- Change occurs one person at a time
Want to Learn more about PtD?

Prevention through Design
Design for Construction Safety

News and Updates:

Presentation by Mike Toole at the COAA Spring Leadership Conference on May 16, 2014.

"Means and methods" continue to be misunderstood. Read my PtD does not conflict with typical contractual references to means and methods.

Read actions that other organizations should take to effectively implement DCS on their projects (revised Jan 2014).

Researchers at Oregon State University have created a tool to "Determine the level of safety risk associated with an entire building, a specific building system, or each of the many design features within a building."

PtD-related initiatives include the Safety in Design group (which contains many helpful links and files) and the AIASE/ASSE Small Standards Information Center.

Researchers and practitioners have created The Sustainable Construction Safety and Health (SCSSH) rating system to evaluate construction worker safety and health on construction projects.

A free American Institute of Architects (AIA) approved course, "Overview of Construction Prevention through Design" is being offered by East Carolina University through a grant from the Virginia Tech Occupational Safety and Health Research Center. Email Mike Behm, behmjm@ecu.edu, for information.

www.designforconstructionsafety.org
Summary

- Integrated design and construction improves safety, cost, schedule, quality….
- PtD = safety constructability
- PtD reflects the Hierarchy of Controls
- You can motivate design professionals to do their part in making construction safer.
Thank you for your time

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www.designforconstructionsafety.org

Questions & Answers