Mitigating Construction Safety Issues: Pre-Planning and Design

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3 September 2015
Learning Objectives

• Discuss the Zero Accident Techniques for construction projects

• Assess how preplanning can contribute to overall site effectiveness

• Define the design for construction safety and health (DfCSH) concept

• List the reasons for implementing DfCSH
Construction Safety

Construction Injury Rates

Figure 1. OSHA recordable injury rates 1989-2011
Hierarchy of Controls

Apply the highest level of control commensurate with the risk level—lower value controls may be used in the interim until long-term controls are implemented.

ELIMINATION

SUBSTITUTION

ENGINEERING

ADMINISTRATIVE

BEHAVIOR

PPE

Increasing effectiveness and sustainability

Increasing participation and supervision needed
Zero Accidents Task Force

Purpose:
To convince management (owners and contractors) of the value of an effective safety program, through research on the total cost and human impact of accidents.

Scope:
Identify techniques most successful in eliminating accidents.

Construction Industry Institute (CII)
Three Most Important Techniques
Worker Opinion

- Fall protection
- **Pre-task safety planning**
- Safety person assigned to project
- Safety training
- Protective equipment
- Incentives for safety
- Attitude
- Coordination
## Time Spent on Safety (Model Crew Times)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Excellent</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-job planning</td>
<td>11,021</td>
<td>6,875</td>
</tr>
<tr>
<td>Safety meetings</td>
<td>5,455</td>
<td>3,567</td>
</tr>
<tr>
<td>Safety training</td>
<td>1,587</td>
<td>606</td>
</tr>
<tr>
<td>Safety orientation</td>
<td>692</td>
<td>449</td>
</tr>
<tr>
<td>Accident Investigations</td>
<td>267</td>
<td>123</td>
</tr>
</tbody>
</table>

Time shown in hours per year for 100 workers
Zero Accident Techniques

- Pre-Project/Pre-Task Planning
- Orientation and Training
- Monetary Incentives
- Alcohol and Substance Abuse Program
- Incident Investigation / Accountability
Planning

Figure 1 – The result of poor planning by the introduction of a contributor (footing) to a potential crane failure through inadequate planning. (Photo by TJ Lyons)
Planning

Figure 3 - Riggers lay-out their tools to inspect and ensure placement, pick-points and capacity before the lift sequence is started (Photo by TJ Lyons)
Planning

Figure 7  Lack of simple preplanning creates contributors to later, potential failures. Here poor truck placement limits proper outrigger extension and allows workers and loads under active power lines. (Photo by TJ Lyons)
Time-Safety Influence Curve

(Szymberski, 1997)
Design for Construction Safety and Health (DfCSH)

• Modifications to the permanent features of a construction project in a way that the facility is inherently safer to construct

• Attention during the preparation of plans and specifications for construction; in such a way that construction site safety is considered

• Utilization of specific design for construction safety suggestions

• Communication of risks regarding the design in relation to the site and the work to be performed
Design Review Process

**Concept**
- Owner
- AE
- GC/CM

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

**30% Design**
- Owner, AE, GC/CM
- 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/CM
- 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/CM
- All trade contractors

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

© T. Michael Toole and John Gambatese 2011
Conventional vs. Telescoping Canopy

<table>
<thead>
<tr>
<th>Risk</th>
<th>Conventional Canopy</th>
<th>Telescopic Column Canopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working at Height (Exposure in total work hours)</td>
<td>3,250 Hrs</td>
<td>50 Hrs</td>
</tr>
<tr>
<td>Time frame to carry out activity</td>
<td>25 to 30 Days</td>
<td>6 to 8 Days</td>
</tr>
</tbody>
</table>

Table 5. Comparison of conventional and telescoping canopy (Behm et al. 2011)
Impact of DfCSH on Project Costs

<table>
<thead>
<tr>
<th></th>
<th>Decrease</th>
<th>No Change</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design Cost</strong></td>
<td>3%</td>
<td>46%</td>
<td>51%</td>
</tr>
<tr>
<td><strong>Construction Cost</strong></td>
<td>15%</td>
<td>36%</td>
<td>49%</td>
</tr>
<tr>
<td><strong>Total Project Cost</strong></td>
<td>15%</td>
<td>35%</td>
<td>50%</td>
</tr>
</tbody>
</table>

Table 2. Impact of DfCSH on Project Costs (% of responses) (n = 258)
Source: Gambatese 2011
Impact of DfCSH on Project Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>% of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Decrease</td>
</tr>
<tr>
<td>Construction injuries</td>
<td>81%</td>
</tr>
<tr>
<td>Design costs</td>
<td>2%</td>
</tr>
<tr>
<td>Construction costs</td>
<td>15%</td>
</tr>
<tr>
<td>Total costs to owner</td>
<td>11%</td>
</tr>
<tr>
<td>Design durations</td>
<td>1%</td>
</tr>
<tr>
<td>Construction durations</td>
<td>12%</td>
</tr>
<tr>
<td>Total durations</td>
<td>6%</td>
</tr>
<tr>
<td>Construction quality</td>
<td>1%</td>
</tr>
<tr>
<td># of lawsuits against owners</td>
<td>42%</td>
</tr>
<tr>
<td># of lawsuits against AEs</td>
<td>30%</td>
</tr>
<tr>
<td>Reputation of AEs</td>
<td>3%</td>
</tr>
</tbody>
</table>

Table 3. Impact of DfCSH on Project Outcomes
Source: Toole, Gambatese and Abowitz 2012
QUESTIONS?

Darryl C. Hill
LinkedIn
Twitter: @DrDCH
What year was ASSE founded?
Name 2 of the 5 ASSE female (past) Presidents?
Who was ASSE President for the 100th anniversary?
Name 2 of the 5 Zero Accident Techniques for construction projects
Who is the current ASSE Foundation chair?