

## Prevention through Design in Construction

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# Why Ptd?

*“Anticipating and **DESIGNING OUT** hazards in tools, equipment, processes, materials, structures, and the organization of work is *the most effective way to prevent occupational injuries, illnesses, and fatalities.*”*

John Howard, M.D.

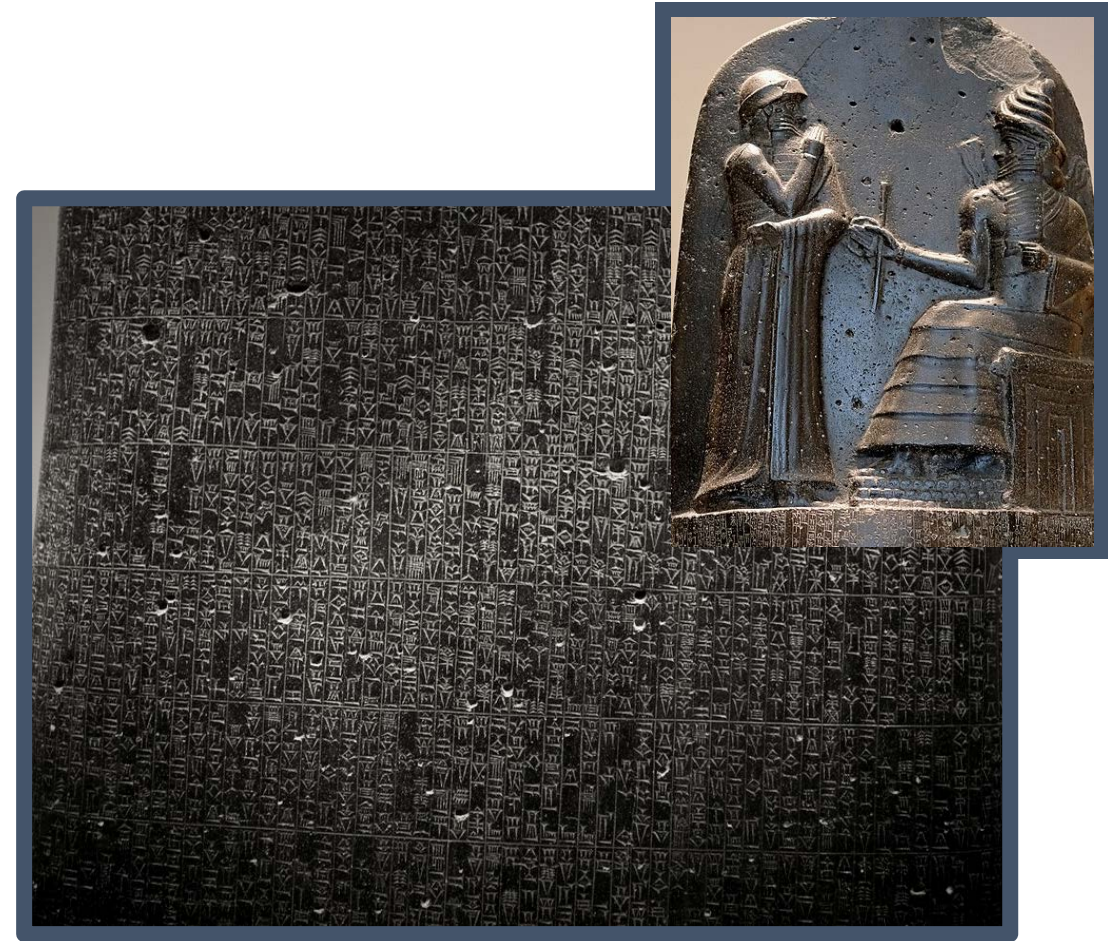
Director, National Institute for Occupational Safety and Health  
Centers for Disease Control and Prevention

# Historical precedents of PtD

## Code of Hammurabi

1750 BCE

229: *“If a builder builds a house for someone, and does not **construct it properly**, and the house which he built falls in and kills its owner, then that builder shall be put to death.”*



# Historical precedents of PtD

Have we stagnated? Or even regressed?

## Insulae (*Ancient Rome 1<sup>st</sup> & 2<sup>nd</sup> Century CE*)

- Multi-family apartments over commercial ground floor
- Could reach up to 9 stories
- Often poorly constructed and prone to fire
- Augustus imposed a 21m height restrictions. Later reduced to 17m under Trajan.



## “5 over 1” (*Modern United States 21<sup>st</sup> Century CE*)

- Multi-family apartments over commercial ground floor
- 6 stories (18m-27m)
- Built around modern wood construction fire codes
- Design decisions related to construction and material cost often make them susceptible issues with moisture, and to fire, especially during construction





# Great Ideas Endure



**Workplace  
design solutions**

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH



**Prevention through Design (PtD)**  
PtD addresses worker exposure to hazards during the design stage

## Preventing Falls through the Design of Roof Parapets

### Summary

Workers are exposed to risks from falls during construction, operation, maintenance, and demolition of buildings. Parapets are the parts of the wall assembly that extend above the roof

building roofs during construction and for operation and maintenance tasks after the building has been completed. Workers may be close to roof edges when transferring material to and from the roof, accessing rooftop equipment, and communicating with coworkers on

and. To prevent falls, parapets

[cdc.gov/niosh/docs/2014-108/](https://cdc.gov/niosh/docs/2014-108/)

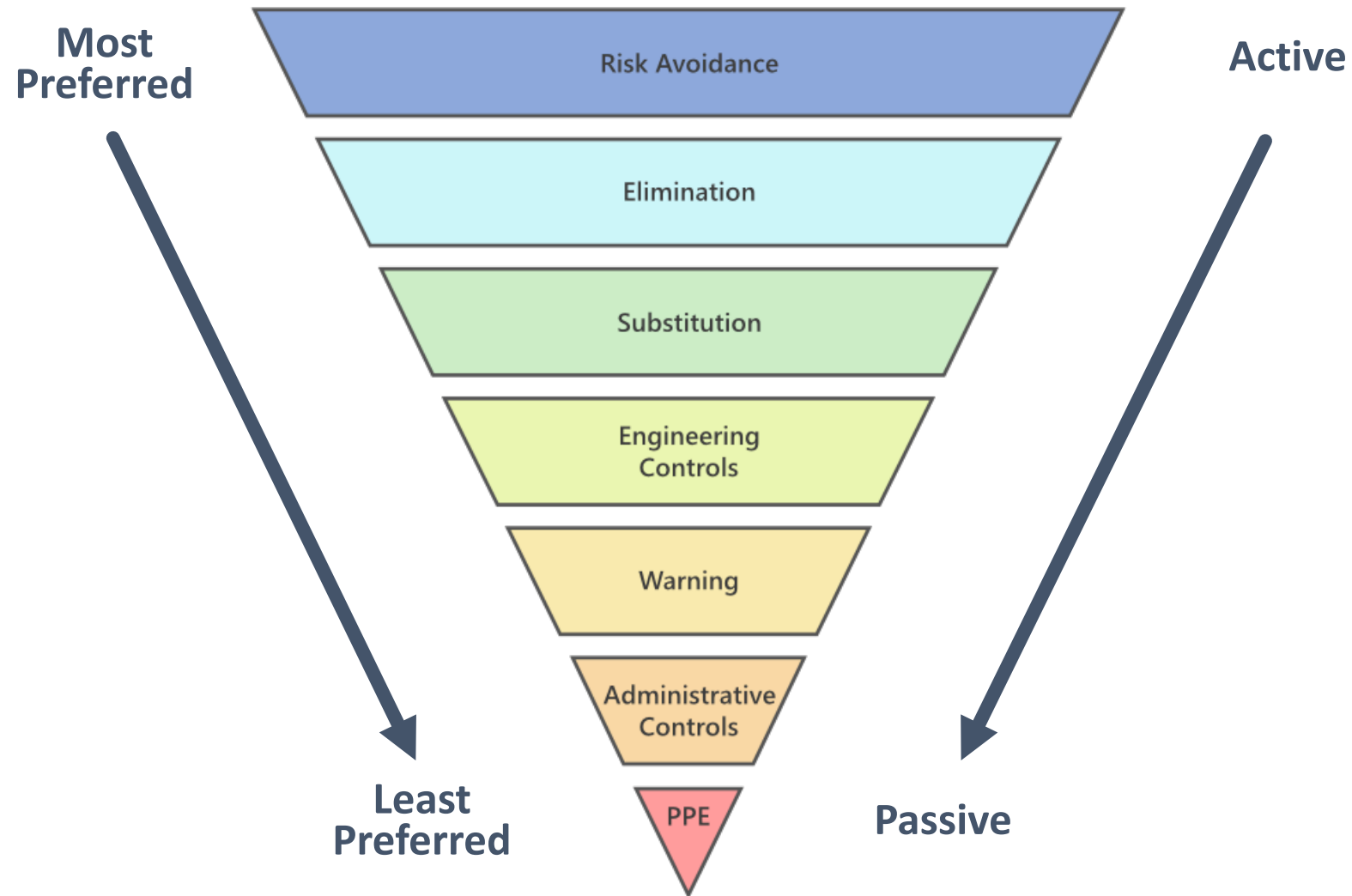
# Prevention through Design

How should we  
**THINK** about PtD?

How can we practice  
PtD?

# Prioritizing Prevention

within the Hierarchy of Controls



# The Process of PtD is “Design”





# PtD Resources: External

Dr. T. Michael Toole, Dean of the College of Engineering at the University of Toledo, maintains a repository of help for PtD in construction:

[designforconstructionsafety.org](http://designforconstructionsafety.org)

OSHA “Sustainability in the Workplace”  
A long term effort for multiple industries  
[osha.gov/sustainability](http://osha.gov/sustainability)

*(NOTE: NIOSH PtD briefs OSHA’s ACCSH next week)*

The screenshot shows the OSHA website's 'Sustainability in the Workplace' page. The header includes the United States Department of Labor logo, social media icons, a search bar, and a language selector. The main navigation menu lists categories like 'ABOUT OSHA', 'WORKERS', 'EMPLOYERS', 'REGULATIONS', 'ENFORCEMENT', 'TOPICS', 'NEWS', 'DATA', and 'TRAINING'. The page title is 'Sustainability in the Workplace'. The main content area features a sidebar with links to 'HOME', 'OSH-Sustainability Connection', 'Sustainability Spotlight', and 'Contact Us'. The main text explains that sustainable organizations balance the triple bottom line of people, planet, and profit, and that safety and health are integral to this approach. It includes a link to learn more about the connection between occupational safety and health and sustainability. Below the main text, there are sections for 'Latest from OSHA' and 'Sustainability Spotlight', which highlights the Center for Safety & Health Sustainability (CSHS) and its mission to provide over 100,000 occupational safety and health professionals in over 70 countries with a stronger voice in shaping sustainability policies.

# PtD Resources: NIOSH Construction Education Modules

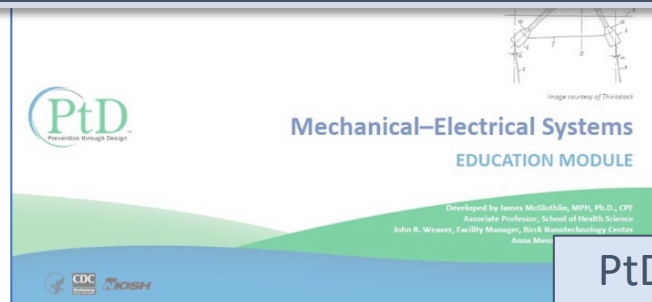
## Architectural Design and Construction



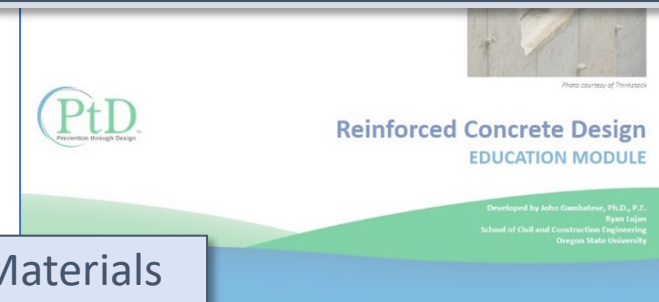
## Structural Steel Design



## Mechanical-Electrical Systems



## Reinforced Concrete Design



PtD Guidance & Publications: Training Materials  
[cdc.gov/niosh/topics/ptd/pubs.html](https://cdc.gov/niosh/topics/ptd/pubs.html)

# PtD Resources: NIOSH Workplace Design Solutions

## Preventing Falls through the Design of Roof Parapets

The cover features a blue header with the text 'design solutions' and 'NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH'. Below this is the PtD logo (Prevention through Design) and the title 'Preventing Falls through the Design of Roof Parapets'. A 'Summary' section is visible, mentioning that workers are exposed to risks from falls during construction, operation, maintenance, and demolition of buildings. The text also notes that workers may be close to roof edges during building roofs during construction and for operation and maintenance tasks after the building has been completed.

[cdc.gov/niosh/docs/2014-108](https://www.cdc.gov/niosh/docs/2014-108)

## Supporting Prevention through Design (PtD) Using Business Value Concepts

The cover features a blue header with the text 'design solutions' and 'NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH'. Below this is the PtD logo and the title 'Supporting Prevention through Design (PtD) Using Business Value Concepts'. A section titled 'Prevention through Design' is visible, with a reference to 'financial or non-financial measures.' [AIHA 2009; Occidental College 2002].

[cdc.gov/niosh/docs/wp-solutions/2015-198](https://www.cdc.gov/niosh/docs/wp-solutions/2015-198)

## Preventing Falls from Heights through the Design of Embedded Safety Features

The cover features a blue header with the text 'design solutions' and 'NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH'. Below this is the PtD logo and the title 'Preventing Falls from Heights through the Design of Embedded Safety Features'. A 'Description of Exposure' and 'Standards' section is visible, with the OSHA Standard 29 CFR 1926.502 cited.

[cdc.gov/niosh/docs/wp-solutions/2014-124](https://www.cdc.gov/niosh/docs/wp-solutions/2014-124)

## Preventing Hazardous Noise and Hearing Loss during Project Design and Operation

The cover features a blue header with the text 'design solutions' and 'NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH'. Below this is the PtD logo and the title 'Preventing Hazardous Noise and Hearing Loss during Project Design and Operation'. A section titled 'Prevention through Design (PtD)' is visible.

[cdc.gov/niosh/docs/2016-101](https://www.cdc.gov/niosh/docs/2016-101)

# PtD Resources: NIOSH Design Comparison Tool

**SLiDeRule** for Buildings

About News Links Support Research Contact us

## Safety in Design...

Enhancing construction worker safety through a building's design

The design of a building influences the safety hazards that are present during construction. Architects and engineers can help to improve construction worker safety by addressing safety in their designs.

**SLiDeRule** (Safety in Design Risk Evaluator) helps building designers assess the construction safety risk associated with their designs. Use *SLiDeRule* for buildings 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
- Compare prospective designs based on construction safety risk
- Learn about design features that increase and decrease the risk of injury
- Create building designs that minimize the risk of construction worker injury

By using *SLiDeRule*, hazards can be eliminated, safety risk reduced, and construction worker injuries and fatalities prevented.

[Read more about SLiDeRule...](#)

⇒ ASSESS A PROJECT  
Use the online calculator

⇒ Overview

⇒ Case Studies

⇒ Tutorial

[Terms and Conditions of Use](#) [Statement of Liability](#) [Privacy Policy](#) [Sitemap](#)  
SLiDeRule | Powered by Mantra & WordPress

- Sliderule for Buildings  
[www.constructionsliderule.org](http://www.constructionsliderule.org)

- Estimates a Safety Profile for different building options, e.g. steel vs. concrete, etc.

# U.S. Green Building Council (USGBC)

## LEED Pilot credit: Prevention through Design

### New LEED Pilot Credit: Prevention through design

[www.usgbc.org/articles/new-leed-pilot-credit-prevention-through-design](http://www.usgbc.org/articles/new-leed-pilot-credit-prevention-through-design)

### Details & Worksheet

[www.usgbc.org/credits/preventionthroughdesign](http://www.usgbc.org/credits/preventionthroughdesign)

### Webinars

#### #1: Life Cycle Safety: Basics and Connections to Sustainability

[usgbc.org/education/sessions/life-cycle-safety-basics-and-connections-sustainability-6679047](http://usgbc.org/education/sessions/life-cycle-safety-basics-and-connections-sustainability-6679047)

#### #2: LEED Pilot Credit Prevention through Design (PtD) Background & Requirements

[usgbc.org/education/sessions/leed-pilot-credit-prevention-through-design-ptd-background-requirements-10947289](http://usgbc.org/education/sessions/leed-pilot-credit-prevention-through-design-ptd-background-requirements-10947289)





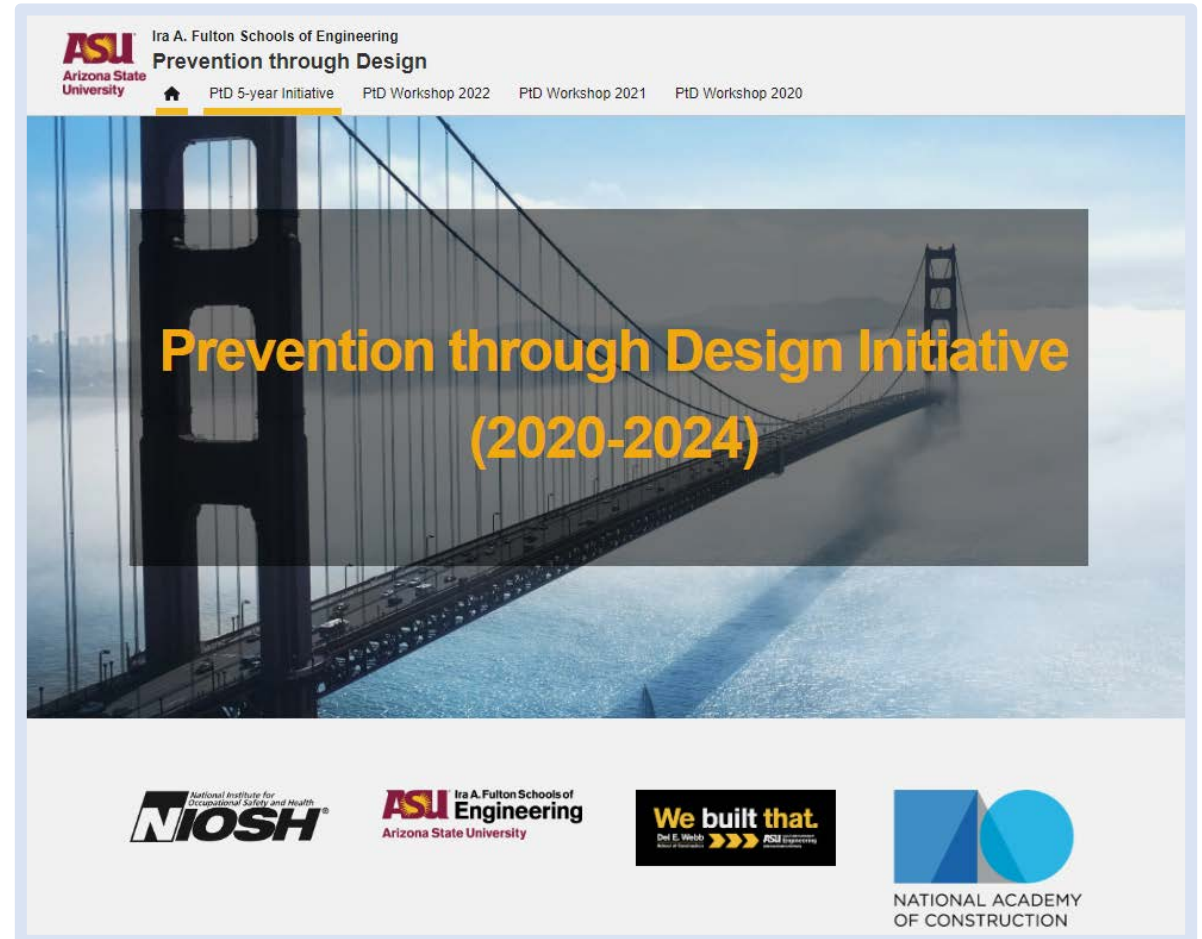
# PtD Resources: PtD Workshops

Dr. Edd Gibson and Dr. David Grau of Arizona State have had a PtD emphasis in their Global Safety Center for years.

Thanks to NIOSH Construction (Scott Earnest), they now partner with NIOSH in an exciting PtD Initiative.

Workshop participation is close to no-cost. Presentations from 2020, 2021, and soon, 2022, are, or will be, freely available.

Dr. Gibson hopes to influence the growth of PtD well beyond construction, to all fields of Engineering.



The image shows a screenshot of the website for the Prevention through Design Initiative at Arizona State University. The header includes the ASU logo and the text "Ira A. Fulton Schools of Engineering Prevention through Design". Below the header is a navigation menu with links for "PTD 5-year Initiative", "PTD Workshop 2022", "PTD Workshop 2021", and "PTD Workshop 2020". The main content area features a large image of the Golden Gate Bridge with the text "Prevention through Design Initiative (2020-2024)" overlaid in yellow. The footer contains logos for NIOSH, ASU Ira A. Fulton Schools of Engineering, "We built that." (with "Del E. Webb" and "ASU" subtext), and the National Academy of Construction.

[ptd.engineering.asu.edu](http://ptd.engineering.asu.edu)



# PtD in Capital Projects Process Website

Central resource for PtD related guidance relating to large capital projects

The screenshot shows the NIOSH website page for 'PtD & CPP Overview'. The page features a navigation menu on the left with categories like 'Introduction', 'Conceptual Design', 'Preliminary Design', 'Detailed Design', 'Procurement', 'Project Execution', 'Commissioning & Closeout', 'Operations & Maintenance', and 'Decommissioning'. The main content area is titled 'CAPITAL PROJECT PROCESS' and includes an 'Introduction' section. The introduction text states: 'Prevention through Design (PtD) is a comprehensive approach for addressing safety and health issues by “designing out” hazards and minimizing residual risks. The concept involves the consideration of safety and health in the design of a product, process, or system. During planning and design, the safety and health of those impacted by the design in each downstream lifecycle phase is considered. The project lifecycle starts with concept development, and continues through design, construction or manufacturing, operations, maintenance, and eventual disposal. The PtD concept applies to the design of a facility, a material, a process, and a piece of equipment. PtD includes anticipating manufacturing, construction, operations, and maintenance tasks, identifying related hazards, and developing designs and engineering controls to eliminate hazards and protect employees. PtD is a risk management technique that has been applied successfully in many industries, including manufacturing, healthcare, telecommunications, and construction. PtD protects humans and eliminates the need to control exposures during operations by designing out the hazards using best design practices, risk management, and lessons learned.' To the right of the text is a logo for 'PtD Prevention through Design' featuring a stylized rainbow. Below the main text is a section titled 'What is PtD?' with a teal background. At the bottom right, there is a snippet of text: '...duction industry ...tion equipment, ...applies, and is being ...way, bridge'.

Content was originally compiled by Dr. John Gambatese, much of is available in PDF form at: [PtD in the Project Delivery Process August 2019](#)

# PtD in Capital Projects Process Website

## Suggested PtD practices

Occupational Safety and Health (NIOSH)

Prevention through Design > PtD in Practice

Workplace Safety and Health Topics

- Prevention through Design
  - PtD & CPP Overview
  - PtD in Practice
    - Safe Design Examples
    - Processes from Industry
    - Case Studies
  - Toolbox

NIOSH Homepage

- [NIOSH A-Z](#)
- [Workplace Safety & Health Topics](#)
- [Publications and Products](#)
- [Programs](#)

Promoting productive workplaces through safety and health research **NIOSH**

## CAPITAL PROJECT PROCESS

### Safe Design Examples

### Planning Examples

General Conditions and Special Provisions

Technical Specifications

#### Materials

Construction materials can be hazardous to construction workers if the materials are flammable, contain toxic substances, or do not meet their specified use requirements.

- Ensure that specified materials of construction are appropriate for the flammability hazards which may be encountered on the work site.
- Do not specify materials which contain asbestos or other known hazardous substances.
- Ensure that all materials meet the expected environmental and work site conditions.

# PtD in Capital Projects Process Website

## Case Studies

The screenshot displays the NIOSH website interface. At the top, the header reads 'Occupational Safety and Health (NIOSH)' with a navigation path 'vention through Design > PtD in Practice'. Social media icons for Facebook, Twitter, LinkedIn, and YouTube are visible. The main content area is titled 'CAPITAL PROJECT PROCESS' and 'Case Studies'. A sub-header states: 'This page provides real world case studies of prevention through design being practiced in the capital projects process.' Below this, there are eight case study cards arranged in a 4x2 grid:

- Electric Wiring**: Eliminate hazards by placing wiring within floor slab rather than in ceiling.
- Concrete Straps**: Temporary straps embedded into concrete for fall protection.
- Telescoping**: New column design allows for construction of canopy at safe level and then raised to a height later.
- Cable Trays**: Cable trays to support retrofit and carry duct-work were constructed on ground rather than in place.
- Soil Retention**: Use of trench boxes and guardrails to protect workers from cave-ins and falls during digging into earth.
- Stairwell Design**: Permanent stairs of the building are redesigned so that it can be utilized during construction by workers.
- Parapets Height**: Construct parapets of sufficient height on roofs to
- Guardrail**: Use of barriers to protect construction personnel from

The left sidebar contains a navigation menu under 'Workplace Safety and Health Topics':

- Prevention through Design -
- PtD & CPP Overview +
- PtD in Practice -**
- Safe Design Examples
- Processes from Industry
- Case Studies
- Toolbox +

Below the menu are links to 'NIOSH Homepage', 'NIOSH A-Z', 'Workplace Safety & Health Topics', 'Publications and Products', and 'Programs'. The NIOSH logo and tagline 'Promoting productive workplaces through safety and health research' are located in the top right corner of the page content.

# PtD in Capital Projects Process Website

## Sample PtD Documents

The screenshot displays the NIOSH website interface. At the top, the header reads "Occupational Safety and Health (NIOSH)" and "Prevention through Design > Toolbox". The main content area is titled "CAPITAL PROJECT PROCESS" and "Sample PtD Documents". A list of document links is provided, each with a PDF icon and file size. A sidebar on the left contains a navigation menu with "Sample PtD Documents" highlighted. The NIOSH logo and tagline are visible in the top right corner.

Occupational Safety and Health (NIOSH)

Prevention through Design > Toolbox

Workplace Safety and Health Topics

Prevention through Design -

- PtD & CPP Overview +
- PtD in Practice +
- Toolbox -
- User's Guide to PtD
- LEED Certification
- PtD Benefit-Cost Model
- Sample PtD Documents**
- Bibliography

Promoting productive workplaces through safety and health research / **NIOSH**

## CAPITAL PROJECT PROCESS

### Sample PtD Documents

- [Organizational PtD Policy](#) [PDF - 38 KB]
- [Project PtD Policy](#) [PDF - 39 KB]
- [Design for Safety Process Flowchart](#) [PDF - 93 KB]
- [Design Safety Checklist](#) [PDF - 107 KB]
- [Sample Risk Assessment Forms](#) [PDF - 18 KB]
- [Example Process Integration](#) [PDF - 94 KB]
- [Example Design Option Risk Assessment and Mitigation Form](#) [PDF - 14 KB]
- [Example Design Alternative Risk Comparison](#) [PDF - 23 KB]
- [Example Design Alternative Evaluation Sheet](#) [PDF - 34 KB]

#### General Documents

- [PtD Appendix](#) [PDF - 206K]
- [PtD Checklist Basic](#) [PDF - 391K]

NIOSH Homepage

[NIOSH A-Z](#)

[Workplace Safety & Health Topics](#)

# PtD in Capital Projects Process Website

## PtD Bibliography

The screenshot displays the NIOSH website interface. At the top, the header reads "Occupational Safety and Health (NIOSH)" and "Prevention through Design > Toolbox". The NIOSH logo is present with the tagline "Promoting productive workplaces through safety and health research".

The left sidebar contains a navigation menu under "Workplace Safety and Health Topics":

- Prevention through Design (expanded)
  - PtD & CPP Overview
  - PtD in Practice
  - Toolbox
    - User's Guide to PtD
    - LEED Certification
    - PtD Benefit-Cost Model
    - Sample PtD Documents
    - Bibliography**

Below the sidebar, there are links for "NIOSH Homepage", "NIOSH A-Z", "Workplace Safety & Health Topics", and "Publications and Products".

The main content area is titled "CAPITAL PROJECT PROCESS" and includes "Open All" and "Close All" buttons. Below this is a descriptive paragraph: "This bibliography presents representative literature compiled on the topic of Prevention through Design (PtD) and organized according to areas of focus. Included are journal papers, industry articles, research reports, and on-line references. The bibliography is representative but not comprehensive; additional documents and information can be found through an extensive literature search. To obtain copies of the documents, contact the authors or publisher directly. For updates to the bibliography, please contact NIOSH."

The "Bibliography" section is organized into a list of expandable categories:

- PtD Concept
- Impacts & Effectiveness
- Legal Issues
- Education

# Change the “gold standard,” by Monday

- The Army Corps of Engineers EM 385-1-1, Safety and Health Requirements Manual, is OPEN FOR COMMENTS and INPUTS until June 13<sup>th</sup>.
- It is in many ways considered “the gold standard,” is largely focused on construction, and used by many others, including many private firms who want to be ready for bids.
- Get your comments and inputs in HERE:  
<https://www.regulations.gov/document/COE-2019-0015-0002>



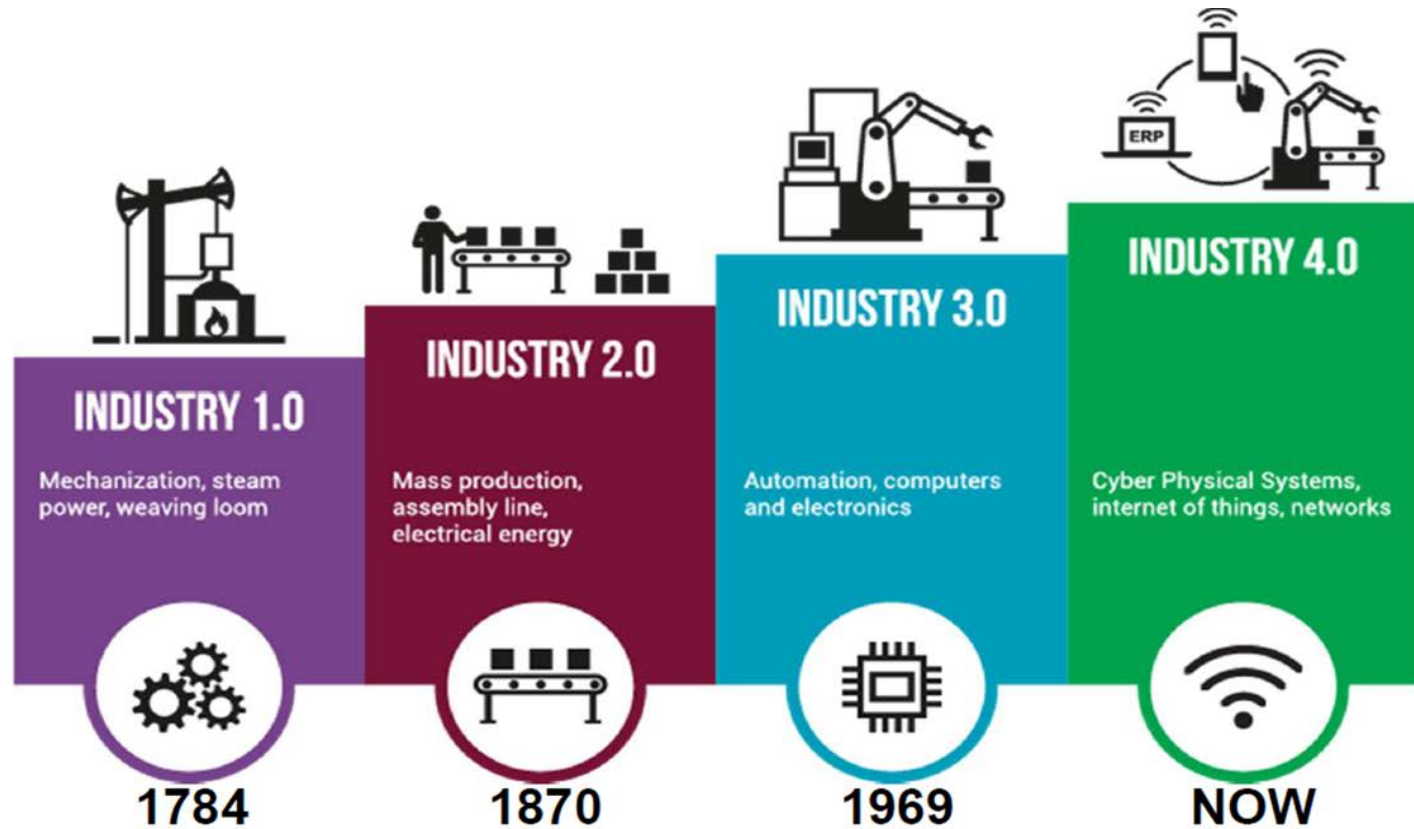
- The NIOSH Prevention through Design program is part of the new Emerging Technologies Branch (ETB), with Dr. Jay Vietas as Chief.
- What is the Emerging Technologies Branch?

NIOSH PtD  
has a new  
home

# The Emerging Technology Branch

Dr. Jay Vietas, PhD, CIH, CSP

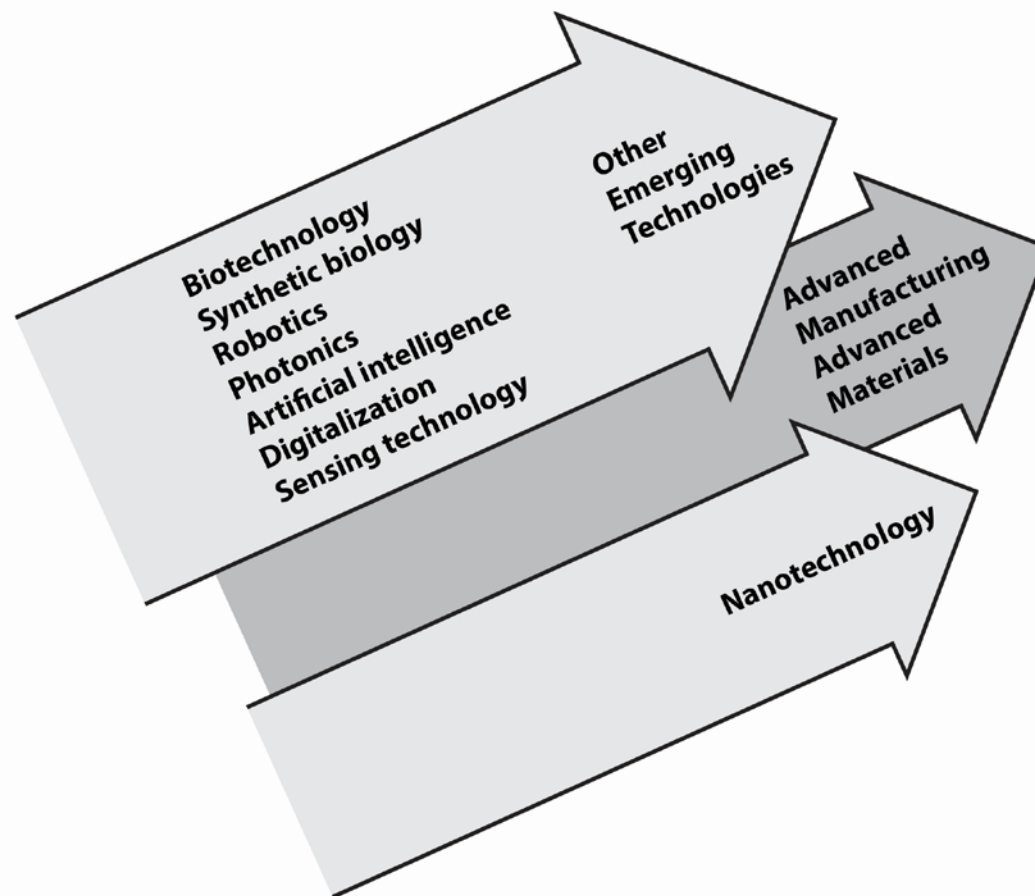
Chief of ETB



## Emerging/Innovative Technologies

- Advanced Materials
- Advanced Manufacturing
- Biomanufacturing
- Industrial Internet of Things
- Smart Sensors
- AI/AR/VR
- Wearable Technology
- Digital Supply Chain
- Robotics
- Big Data Analytics
- Blockchain & Worker Data

## Focus for Occupational Safety and Health (OSH)



# Emerging Technologies Post-Pandemic

- Investment in science and technology
  - Develop resilience/preparation for next pandemic
  - Issues associated with climate change
- Address domestic production and supply chain issues
  - Flexible and redundant manufacturing
- Remote work and reliance on technology to connect
  - Definition of work, workplace, and workforce



**Today's workers still face many hazards from work: some traditional, some new, some yet unknown.**





For more information, contact CDC  
1-800-CDC-INFO (232-4636)  
TTY: 1-888-232-6348 [www.cdc.gov](http://www.cdc.gov)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

