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Hard Hats to Helmets

Advances in Helmet Designs and Standards

Katie Aune

May 20, 2026

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  - US state, Canadian provincial/territory or other country requirements may be different.
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Katie Aune, CSP
Global Application Engineering Specialist

- 14 years at 3M
  - Head, Eye, and Face Protection Portfolios
  - Extensive experience with high visibility garments
- 25+ years of experience helping to keep workers healthy and safe
- Involved in ISEA committees for several ANSI standards including ANS/ISEA Z89.1
- Certified Safety Professional with a degree in Environmental Health & Safety

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Topics

- Differences in Hard Hat & Helmet Types
- Changes in ANSI/ISEA Z89.1-202X
- OSHA Requirements
- Virginia Tech Star Ratings
- Evolution of Designs
- Selection Considerations

Differences in Hard Hat & Helmet Types

Myth or Fact?

Climbing style head protection is better and safer than traditional hard hats.

MYTH

- When choosing appropriate head protection:

Complete a hazard assessment: consider all hazards and job requirements.

No single style of head protection is “best” or ‘safest’.

Don’t judge a helmet by its looks… read the label

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Hard Hats vs Climbing Style Helmets

HARD HAT
- Traditional style & suspension
- Could fall off with head movements or wind
- Type I and Type II

CLIMBING HELMET
- Updated design & suspension
- Additional security with the chin strap
- Type I, Type II and EN 12492

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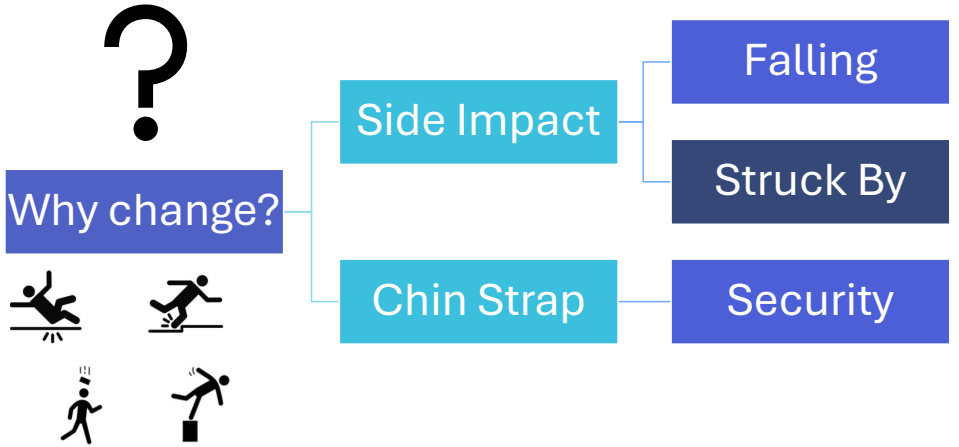

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Polling Question 2:
How confident are you in knowing the differences between Type I and Type II helmets?

A. I'm an expert
B. Somewhat confident
C. Somewhat not confident
D. I would like to learn more

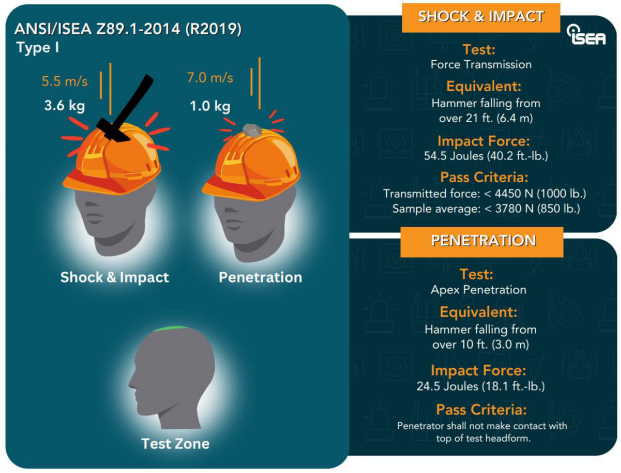
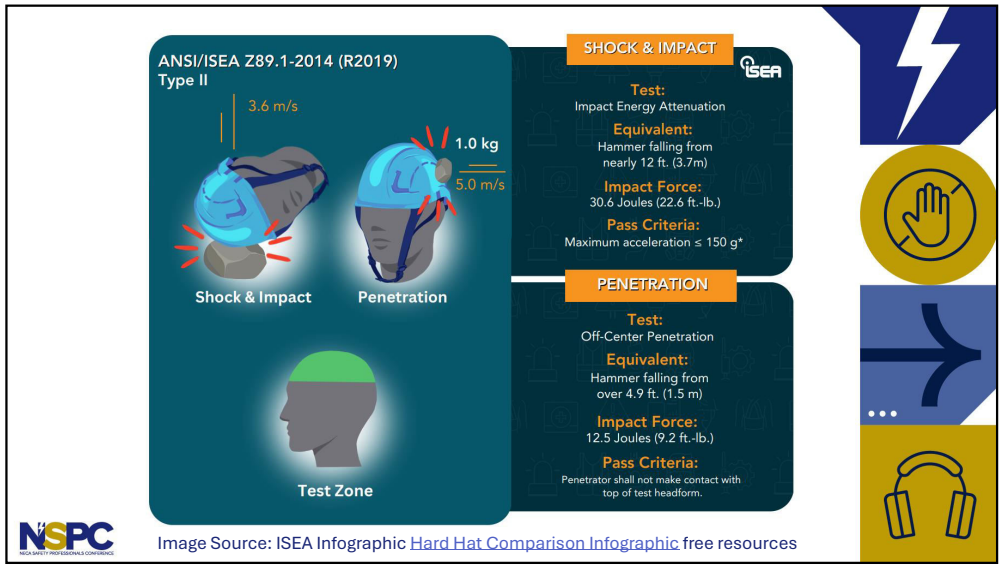


Image Source: ISEA Infographic Hard Hat Comparison Infographic free resources



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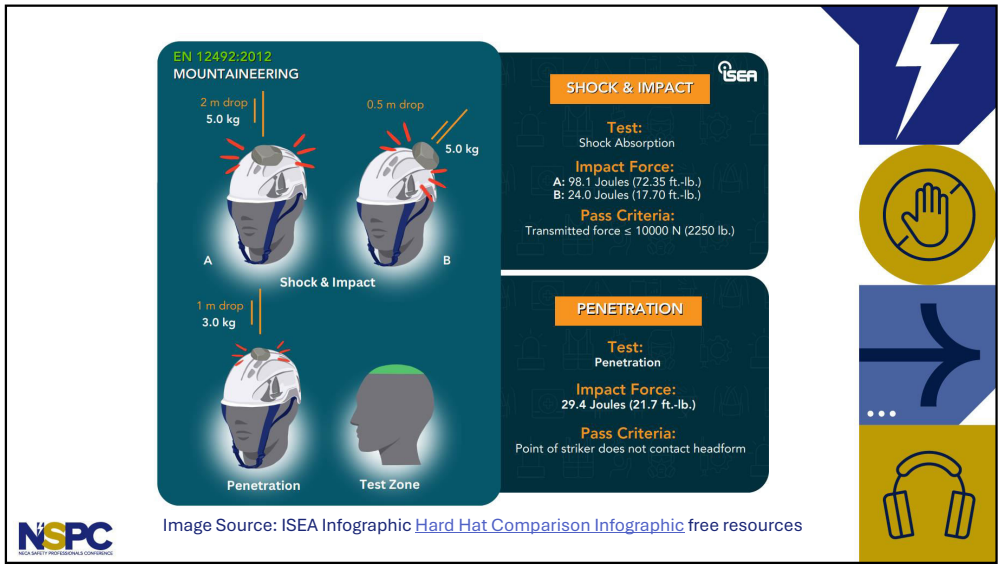

Image Source: ISEA Infographic Hard Hat Comparison Infographic free resources

Protection Options in the Market

Type I

- Top force transmission/ Impact testing
- Penetration testing

Type I EN 12492

- Top force transmission/ Impact testing
- Penetration testing
- EN 12492 tests
  - Shock absorption and penetration at 30° angle

Type II

- Top force transmission/ Impact testing
- Penetration testing
- Side impact energy
- Side penetration

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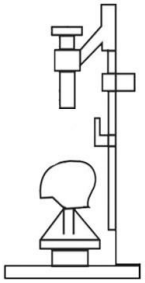
Differences between standards

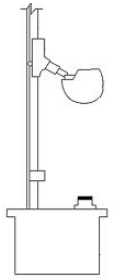
Impact Testing



- ANSI/ISEA Z89.1-2014 Type I

Dropped from a height to achieve a specified impact velocity

EN 12492:2012 Similar set-up, but specifies drop height



CSA Z94.1-2015
ANSI/ISEA Z89.1-2014 Type II

Dropped from a height to achieve a specified impact energy or velocity

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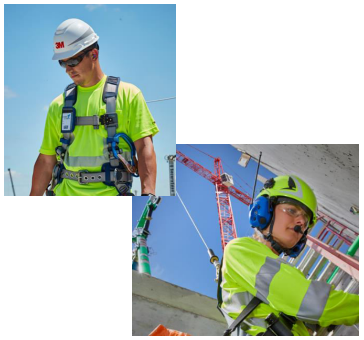
Differences in Standards



Impact Energy (Joule)

Standards	Top/Crown Testing Type I	Front, Back, &/or Side Testing Type II
ANSI/ISEA Z89.1-2014	54.5	33.5 *top also
CSA Z94.1-2015	55	30
EN 12492	98.1	24.5
EN 812 Bump Cap	12.5	12.5

US Head Protection Standard: ANSI/ISEA Z89.1-2014 (R2019)

Electrical Classes (contact)
- C: Not rated
- G: 2,200 V
- E: 20,000 V

Marking
- Reverse Donning
- LT: Lower Temperature
- HT: Higher Temperature
- HV: High Visibility

Impact Types
- Type I: Top Impact
- Type II: Top and Side Impact

Types of Head Protection

- Type I - Top Impact
- Type II - Top/Side Impact

Inside view of a Type I

Inside view of a Type I EN12492

Need new pic here???

Inside view of a Type II

Electrical Classes

Conductive – 0 Volts
- Provides no electrical protection
- 3M™ vented hard hats

General – 2200 Volts
- Intended to reduces the danger of contact with low voltage conductors
- 3M™ non-vented hard hats

Electrical – 20,000 Volts
- Intended to reduce the danger of contact with higher voltage conductors
- 3M™ non-vented hard hats

*Applies for both ANSI Z87.1 and CSA Z94.1 standards

Types of Head Protection

Bump Caps

- Designed to help when your head bumps an object.
- No applicable standards in Canada, ANSI100 not widely used in US

Hard Hats

- Designed to provided limited head protection from impact
- Requires ANSI Z89.1 or CSA Z94.1

Climbing Helmets

- Designed to provided limited head protection from impact with the security of a chinstrap
- Requires ANSI Z89.1

Changes in ANSI/ISEA Z89.1-202X

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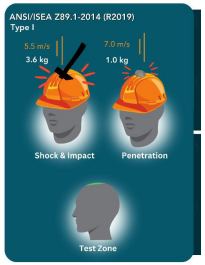
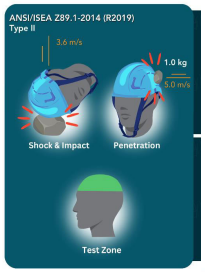
Current ANSI/ISEA Z89.1 Standard





Current Z89.1-2014 (R2019) Protection

Type I:
- Shock & Impact (TOP)
- Penetration (TOP)

Type II:
- Shock & Impact (TOP & LATERAL)
- Penetration (TOP & LATERAL)
- Chin strap is optional

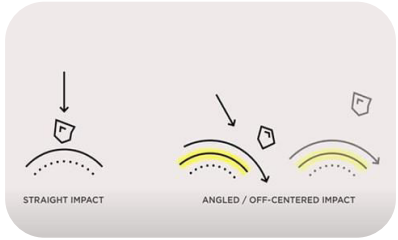
Classes for both Type I & II:
- C (Conductive)
- G (General) up to 2,200 volts
- E (Electrical) up to 20,000 volts

Revision ANSI/ISEA Z89.1 – Key Updates

Not final until ANSI approval

- **Type I+** – Additional protection identified by a plus (**+**) marking **ADDS** the following:
  - Shock & Impact (LATERAL)
  - Chin Strap **mandatory**
  - Retention System Effectiveness (Roll Off)
- **Type II+** – Additional protection identified by a plus (**+**) marking **ADDS** the following:
  - Chin Strap **mandatory**
  - Retention System Effectiveness (Roll Off)

Revising ANSI/ISEA Z89.1 – Not Included



Rotational Force

- **Current State**
  - Rotational force *may* increase risk of TBI
  - No standardized test method available currently
  - Therefore, current draft revision of Z89.1 **does not include requirements for rotational force**
- **Future State**
  - ISEA working with industry to identify and/or develop an appropriate test method
  - That test method will be considered for inclusion in the next Z89.1 revision

FAQ's

- Will the new ANSI/ISEA Z89.1 revision make current Z89.1 helmets obsolete?
- Should we delay helmet purchases until the new standard is released?
- If I need Type I+, why not just buy Type II?
- What happens if workers won't wear the chin strap?
- How does EN12492 compare to ANSI/ISEA Z89.1?

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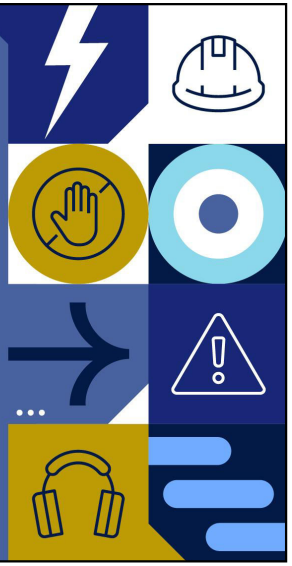
OSHA Requirements



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Myth or Fact:

OSHA will cite you for not wearing a climbing style helmet

MYTH

- OSHA Head Protection Standards requires head protection which meets or exceeds ANSI/ISEA Z89.1-2014
- Type I or Type II hard hats or helmets can be worn

What OSHA Currently References

- **OSHA regulations** = mandatory
- Guidance / alerts / internal policy **are not** regulation
- OSHA references **older ANSI/ISEA Z89.1 editions**
- OSHA has not mandated Type II for all workers. **Internal OSHA helmet policy applies to OSHA staff**, not automatically to all employers

- ✓ **OSHA sets the floor**
- ✓ **Consensus standards define performance**
- ✓ **Employers may choose to meet or exceed the minimum based on hazard assessment**

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US Head Protection Regulations and Standards

OSHA Regulates the Wearer:

- 29 CFR 1910.135 – Head Protection
- Required when possible danger of head injury from impact, or from falling or flying objects, or from electrical shock and burns.

ANSI Regulates the manufacturer

- ANSI Z89.1-2014 (R2019) – Industrial Head Protection
- General minimum performance and label requirements

Hazards:

- Impact type, penetration, electrical, and high visibility in occupational & educational environments.

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OSHA Head Protection Bulletin

Applies to OSHA inspectors

Some Scenarios to Consider Helmets:

- Construction Sites
- Working from Heights
- Specialized Work Environments
- Low-Risk environments

Source: Head Protection: Safety Helmets in the Workplace OSHA, Head Protection: Safety Helmets in the Workplace Safety and Health Information Bulletin, SHIB 3-6-2024

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Virginia Tech STAR Rating System

STAR Rating website: vt.edu/helmet

Simulation
Tests for the
Analysis of
Risk

- Virginia Tech Helmet Lab
  - Comprehensive Injury Biomechanics Lab
  - Developed STAR Rating for football helmets in 2011
    - Nine-year study
  - Continue to expand into other sport helmets

How VT developed STAR Rating for Construction Helmets

- Study real-world data on fall injuries from OSHA
  - Injury outcomes
  - Fall height
  - Surface impacted
- Developed lab testing based on fall scenarios
  - Fall height as it relates to skull fracture risk
  - Head impact speed and acceleration of head
  - Other body parts slow down the head impact speed

How VT developed STAR Rating for Construction Helmets

- What is needed to reconstruction in the lab
  - Head impact angle
  - Head impact location
  - Head impact velocity
- Final
  - 2 velocities
  - 3 head angles
  - Predict head injuries
    - Concussion
    - Skull fractures

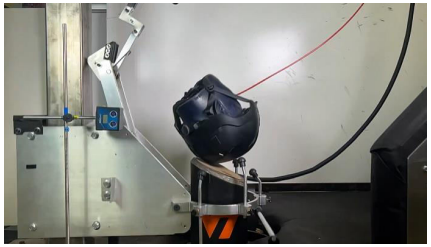

Photo credit: vt.edu/helmet

Score and STAR Rating

- Lower score is BETTER
  - Predicting the number of head injuries if exposed to 100 such impacts
- Higher number of stars is BETTER
  - VT Tech recommend 4 or 5 star for these types of fall hazards
  - Falls are sited frequently by OSHA
    - Hard to determine how many falls studied by VT were preventable if proper fall protection had been worn
- Type II will typically perform better than Type I

How does STAR rating compare to ANSI/ISEA Z89.1-2014?

ANSI/ISEA Z89.1-2014

- Consensus standard required by OSHA
  - Self-certify
- Based on lab tests used for decades
- Written/maintained by manufacturers (ISEA members)
- Cons – based on lab tests and pass/fail

STAR Rating by Virgina Tech

- Study that can be used as a tool for product selection
- Studied severe, but survivable, fall events
- Based calculations on concussion and skull fracture probabilities
- Study done with no input from manufacturers or ISEA members
- Cons – Hard to determine how many falls studied by VT were preventable if proper fall protection had been worn

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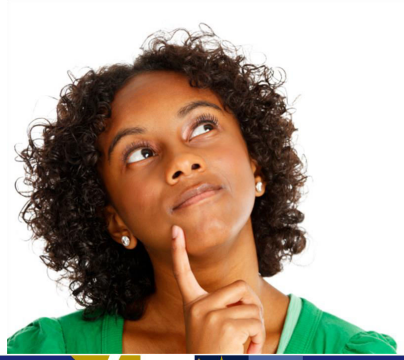
Using VT Helmet Ratings



- Great tool if the hazards studied are hazards you need to consider for your workers.
- Can help you look closer at a ‘passing’ helmet to determine

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Evolution of Designs

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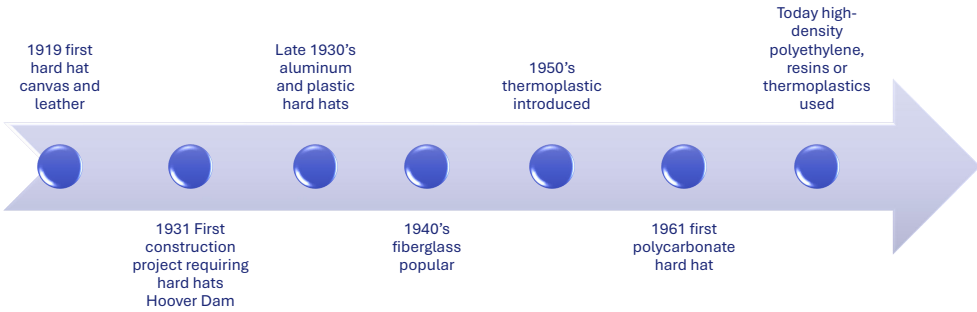
History of Designs

- 1919 First hard hat was made of canvas and leather for mining
- 1931 Hoover Dam build was first time hard hats were required

Photo credit: Bureau of Reclamation

History of Hard Hat Materials



https://www.certifymeonline.net/blog/history-hard-hats/

Traumatic Brain Injury (TBI)

An injury* that affects how the brain works.

Potential causes:
- Bump, blow, or jolt to the head
- Penetrating injury

There are three main types of TBI:
- Mild TBI or concussion
- Moderate TBI
- Severe TBI

Source: *"Facts About TBI" Centers for Disease Control, Facts About TBI | Traumatic Brain Injury & Concussion | CDC

Traumatic Brain Injuries

Source: Construction Helmets and Work-related Traumatic Brain Injury | Blogs | CDC

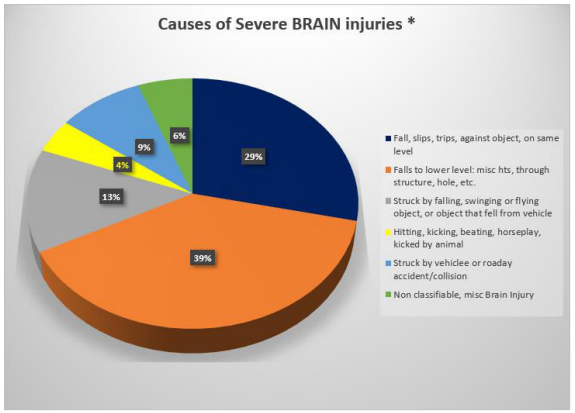
Severe Brain Injuries

- Severe injuries - 79,350
- 3.6% were brain injuries

- Top Causes
- 39% Falling to a lower level

- 29% Fall, slips & trips same level

- 13% Struck by object



Data from https://www.osha.gov/severeinjury January 2015-December 2022

Continual Evolution

- Transition from Type I to Type II

- More options to address impact
  - Managing impact forces with foam
  - Adding in shock absorbers
  - Addressing rotational forces/impact

Rotational Impacts

- Not all impacts are linear
- Many impacts include rotational motion of the head
- Concussions can occur with either or BOTH

Top of head impact may induce ONLY linear (straight line) motion

Most impacts, such as "Oblique" or off-center, induce linear AND rotational motion

Rotational Protection

- Need low friction layer between worker and helmet
  - Helmet rotates
  - Could decrease head rotation
  - Helps disperse impact force
  - Needs to absorb energy
    - webbing, foam, etc
  - Chin straps
- Many predictive models exist
  - Hard to predict individual reactions, recovery
  - Potential biases
- Needs are evolving fast, data needs to keep up

Selection Considerations

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ISEA reports 4 Challenges

1. Getting employees to wear it correctly
2. Enforcement
3. Comfort & Fit
4. Heat related concerns

Source ISEA/ Keller Study, Head Protection Study

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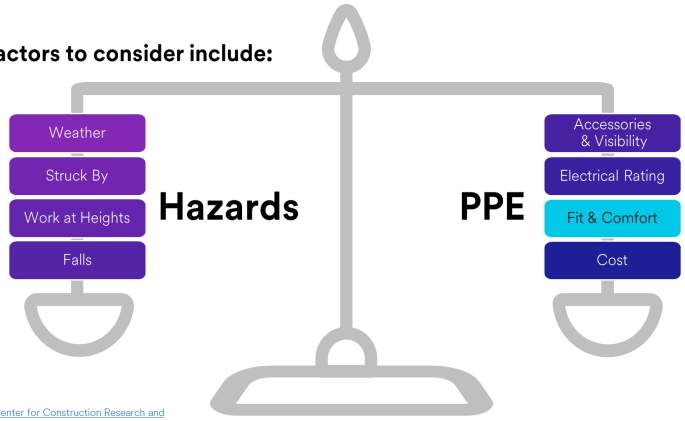
CPWR Selection Considerations

Some factors to consider include:



Source: CPWR, Center for Construction Research and Training. Source: Head-Protection-The-Basics-Webinar.pdf

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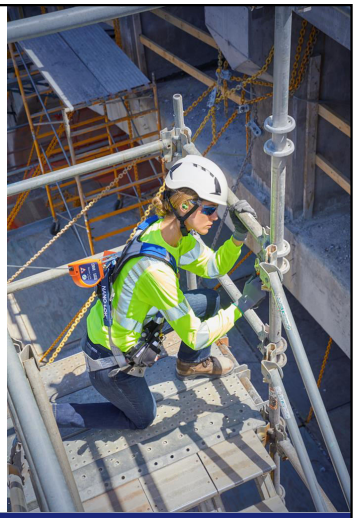
Consider all the information

- Hazard Assessment
  - Hard Hat or Safety Helmet
  - Type I vs Type II
  - Class C, E and or G
  - STAR rating
  - Comfort/fit for worker
    - Options to fit the workers' individual comfort
  - Integrated protection options



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Considerations

Type II
- Side impact protection
  - Leading cause of traumatic brain injuries
- Chin strap for stability

Type I or Type II
- Integrated protection options
  - When multiple hazards exist that need eye/face protection
- Comfort for daily use

https://www.oshaeducationcenter.com/types-of-safety-helmets/

Comparison

Hard Hat
- Top impact risk only
  - Warehouses
  - Short-term projects

Safety Helmet
- Top, side, front, and back impact risks
  - Work at heights
  - Impacts from equipment
  - Slips, trips or falls
  - Multiple hazards
  - Forestry operations
  - Confined space rescue
  - Disaster clean up

https://www.osha.gov/sites/default/files/publications/SAFETY_HELMET_SHIB.pdf

Questions?