October 17,2023
ICRI 2023 Fall Convention

Hard Hats to Helmets

Scott Greenhaus
Structural Technologies

Agenda

- History of hard hats
- What are TBIs?
- What technical and performance standards do these helmets meet?
- How are the helmets different than hard hats?
- What about comfort, maintenance and accessories for the helmets?
- What about future technology improvements?
- H2H Website
- Case Study
- Questions

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Looking At The Past

1919

Bullard for mining and then Navy ship building. Made from steamed canvas, leather brim, black paint and glue

1930's

Hard hats evolved and were made from metals

1940's

MSA Skullguard fiberglass

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1969
MSA in Space
MORE INFO

1960s
International
MORE INFO

1961
New Helmets Introduced

In 1961, the Topgard® Helmet was introduced, which was the first polycarbonate hardhat. Polycarbonate is an extremely durable plastic that is very difficult to crack or break. A year later in 1962, the V-Gard® Helmet launched. Today, both helme are part of the family of "best-selling helmets."

1960s
Gas Masks for the military
MORE INFO

1960 - 19

VIEW ALL EVENTS THIS

20s 1930s 1940s 1950s 1960s 1970s 1980s

- **Part Number:** 1926
- **Part Title:** Safety and Health Regulations for Construction
- **Subpart:** E
- **Subpart Title:** Personal Protective and Life Saving Equipment
- **Standard Number:** 1926.100
- **Title:** Head protection.
- **Applicable Standards:** 1910.135
- **GPO Source:** e-CFR

1926.100(a)

Employees working in areas where there is a possible danger of head injury from impact, or from falling or flying objects, or from electrical shock and burns, shall be protected by protective helmets.

1926.100(b)

Criteria for head protection.

1926.100(b)(1)

The employer must provide each employee with head protection that meets the specifications contained in any of the following consensus standards:

1926.100(b)(1)(i)

American National Standards Institute (ANSI) Z89.1-2009, "American National Standard for Industrial Head Protection," incorporated by reference in §1926.6;

1926.100(b)(1)(ii)

American National Standards Institute (ANSI) Z89.1-2003, "American National Standard for Industrial Head Protection," incorporated by reference in §1926.6; or

1926.100(b)(1)(iii)

American National Standards Institute (ANSI) Z89.1-1997, "American National Standard for Personnel Protection-Protective Headwear for Industrial Workers-Requirements," incorporated by reference in §1926.6.

1926.100(b)(2)

The employer must ensure that the head protection provided for each employee exposed to high-voltage electric shock and burns also meets the specifications contained in Section 9.7 ("Electrical Insulation") of any of the consensus standards identified in paragraph (b)(1) of this section.

1926.100(b)(3)

OSHA will deem any head protection device that the employer demonstrates is at least as effective as a head protection device constructed in accordance with one of the consensus standards identified in paragraph (b)(1) of this section to be in compliance with the requirements of this section.

[77 FR 37600, June 22, 2012; 77 FR 42988, July 23, 2012]

In Short: Provide ANSI Z89.1 *OR*
Prove Equivalent effectiveness

OSHA Requirements

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Safety+Health
The Official Magazine of the NSC Congress & Expo

From 2003 to 2010, 2,210 fatal TBIs occurred in construction at a rate of 2.6 per 100,00 FTE workers.

Home

NIOSH: Construction workers at high risk for traumatic brain injuries

March 29, 2016

Morgantown, WV – Construction workers sustain more traumatic brain injuries than emplo other type of workplace in the United States, according to a recent report from NIOSH.

Safety interventions must be emphasized in the construction industry, in which more than 2 workers died of a traumatic brain injury from 2003 to 2010, researchers said.

Traumatic brain injuries represented one-quarter of all construction fatalities during the eig study period, according to the report. More than half of fatal work-related traumatic injuries result of falls – particularly from roofs, ladders and scaffolds. Workers 65 and older were n more likely to sustain a fatal traumatic brain injury than workers 25 to 34 years old. Meanw workers at organizations with fewer than 20 employees were more than 2.5 times more lik from a traumatic brain injury than those who worked for organizations with more than 100

Srinivas Konda addressed the findings in a March 21 NIOSH blog post. Konda is an assoc fellow in the NIOSH Division of Safety Research

AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 59:212–220 (2016)

Fatal Traumatic Brain Injuries in the Construction Industry, 2003–2010

Srinivas Konda, MPH,* Hope M. Tiesman, PhD, and Audrey A. Reichard, MPH

Background *Research on fatal work-related traumatic brain injuries (TBIs) is limited. This study describes fatal TBIs in the US construction industry.*
Methods *Fatal TBIs were extracted from the Bureau of Labor Statistics Census of Fatal Occupational Injuries.*
Results *From 2003 to 2010, 2,210 fatal TBIs occurred in construction at a rate of 2.6 per 100,000 full-time equivalent (FTE) workers. Workers aged 65 years and older had the highest fatal TBI rates among all workers (7.9 per 100,000 FTE workers). Falls were the most frequent injury event (n = 1,269, 57%). Structural iron and steel workers and roofers had the highest fatal TBI rate per 100,000 FTE workers (13.7 and 11.2, respectively). Fall-related TBIs were the leading cause of death in these occupations.*
Conclusions *A large percentage of TBIs in the construction industry were due to falls. Emphasis on safety interventions is needed to reduce these fall-related TBIs, especially among vulnerable workers.* Am. J. Ind. Med. 59:212–220, 2016. Published 2016. This article is a U.S. Government work and is in the public domain in the USA.

Breakdown Of The NIOSH Study

TABLE III. Number and Rate of Fatal TBIs per 100,000 FTE Workers in the Construction Industry by Age and Event Type—US, 2003–2010

	Contact with objects and equipment		Falls		Transportation incidents		Other[a]	
Age group (in years)	n (%)	Rate	n (%)	Rate	n (%)	Rate	n (%)	Rate
16–19	—	0.9	38 (51)	2.3	20 (27)	1.2	—	0.1
20–24	46 (24)	0.6	99 (52)	1.3	39 (20)	0.5	8 (4)	0.1
25–34	95 (21)	0.4	247 (54)	1.1	107 (23)	0.5	11 (2)	0.1
35–44	92 (18)	0.4	299 (58)	1.3	101 (20)	0.4	22 (4)	0.1
45–54	62 (12)	0.3	315 (59)	1.6	114 (21)	0.6	47 (9)	0.2
55–64	40 (14)	0.5	183 (62)	2.1	57 (19)	0.7	16 (5)	0.2
65 and older	—	0.8	88 (65)	5.2	25 (19)	1.5	—	0.5
Total	363 (16)	0.4	1269 (57)	1.5	463 (21)	0.6	115 (5)	0.1

1269 (57%) Fatalities from FALLS!

- 388 (24%) fell from roofs
- 301 (24%) fell from ladders
- 212 (17%) fell from scaffolds/staging
- 25 employees fell and died from the same walking/working surface
- Small contractors(<20), foreign born, older workers > risk

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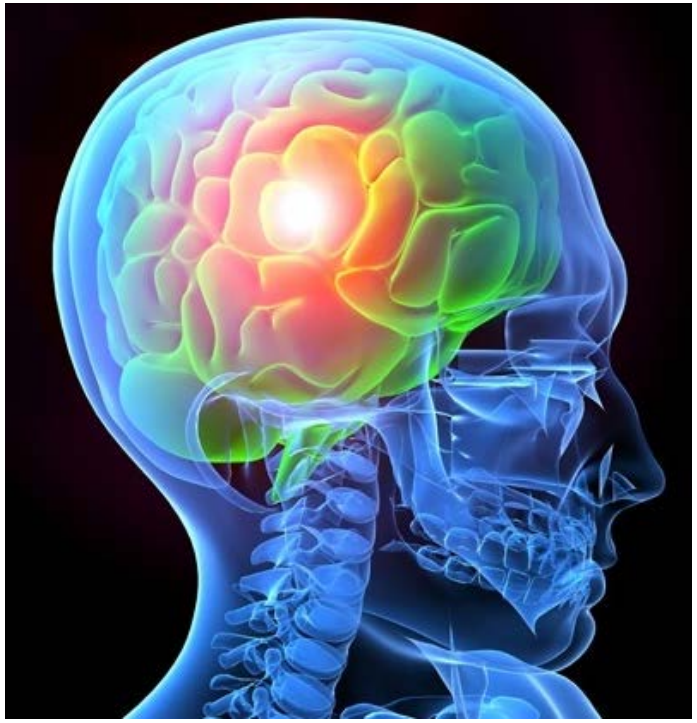
Traumatic Brain Injury (TBI)

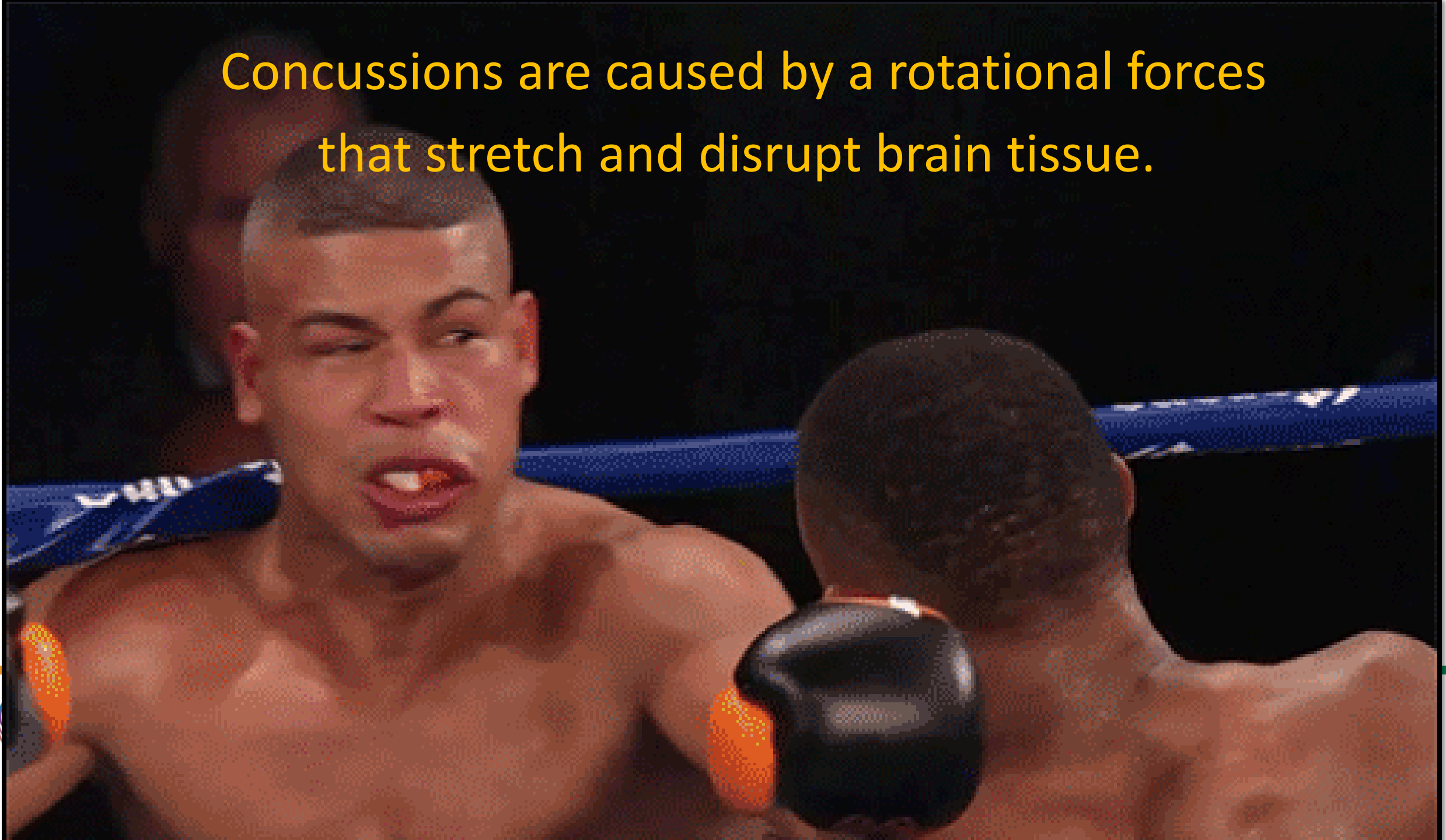
TBI claims average $150,000 ++
LTA claims average $ 50,000

17% of claims between $3 million and $5 million. 30% of claims costing more than $10 million.

- CDC defines TBI as:
  - Blow or jolt to the head or penetrating head injury that disrupts the normal function of the brain
  - Ranges from “mild” i.e., a brief change in mental status or consciousness to “severe” i.e., an extended period of unconsciousness or amnesia after the injury. Potentially fatal.



Concussions are caused by a rotational forces that stretch and disrupt brain tissue.



brain injuries
≠
skull fracture

Munoz-Sanchez, et al., Brain Inj. 23:1, 2009

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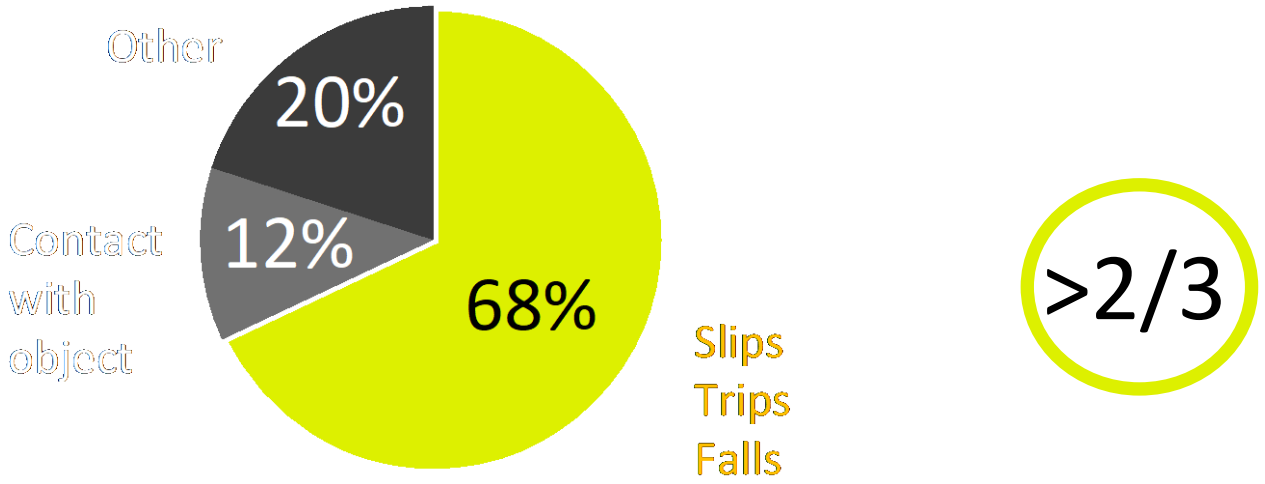
Brain Injury in the USA

- 54,272 work-related brain injuries / year in USA (OSHA Report)
- Construction: highest % of work-related TBIs of any industry (25%)[1]
- Over 2/3 of brain injuries occur from slips, trips, or falls, typically from ground level or less than 6’ height. [2]



1. Tiesman HM, et al. Am J Prev Med 2011; 41(1):61-67.
2. OSHA Severe Injury Reports. US Department of Labor; 2021.

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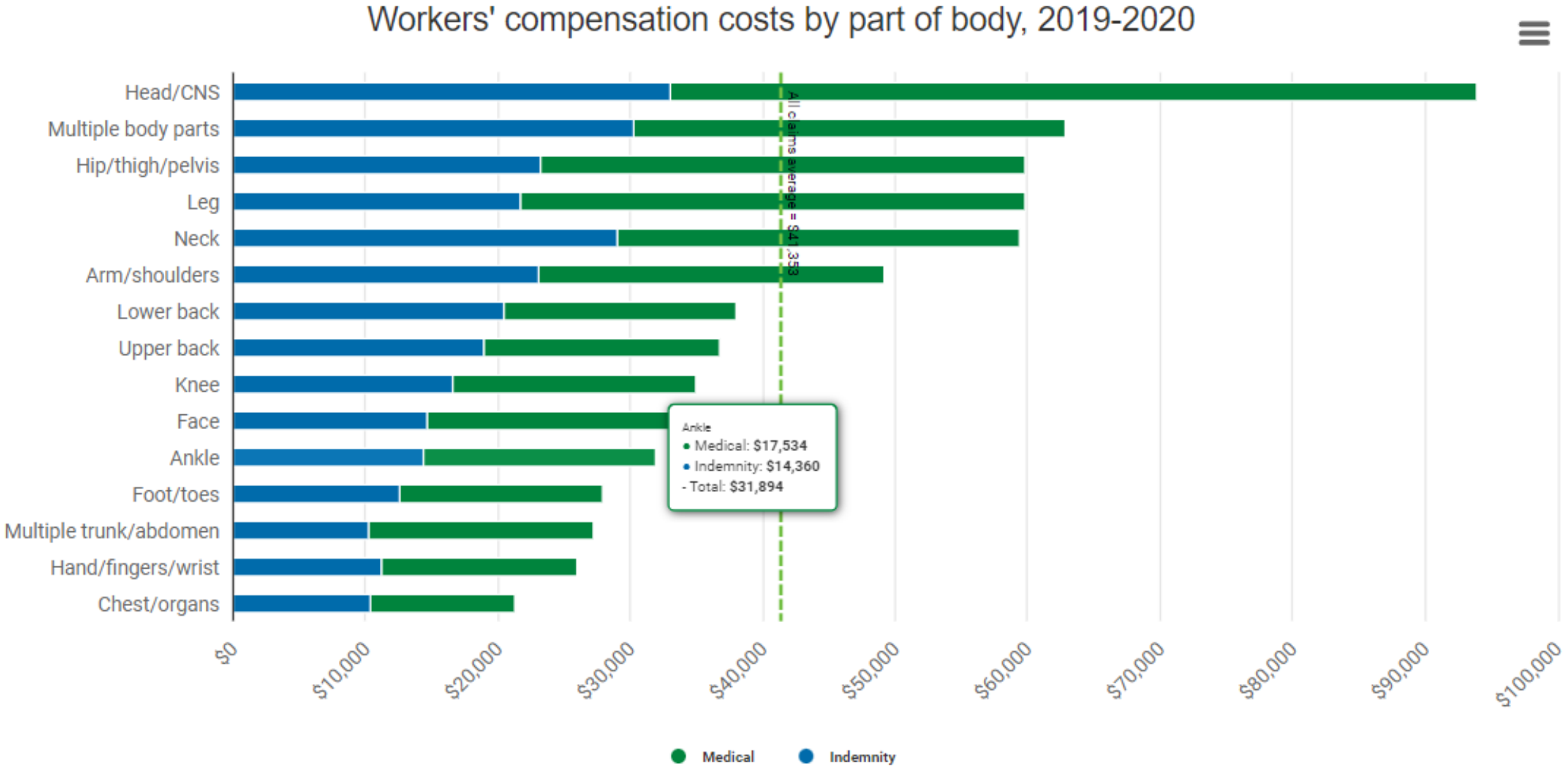

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Innovation In Fall Protection

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Isn’t There Something Better?

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What technical and performance standards do helmets meet?

Head Protection Standards Worldwide

EUROPE
EN 397 / EN 12492 / EN 14052

USA / CANADA
ANSI Z89.1 / CSA Z94.1

AUSTRALIA / NZ
AS/NZS 1801

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ANSI Z89.1 TYPE I and TYPE II

- **ANSI Z89.1 TYPE I** helmets are tested for:
  - Top impact absorption
  - Penetration resistance
  - Flame resistance
  - Electrical classification requirements (Conductive, General, Electrical)

- **ANSI Z89.1 TYPE II** helmets pass Type I tests **and** additional tests for:
  - Lateral impact
  - Lateral penetration
  - Chin strap requirements (if applicable*), and
  - Low/high temperature operating range

- It is important to note that an ANSI Type II helmet can be sold without a chin strap.
  A chin strap could be added as an accessory after purchase and not be subjected to any testing.

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Helmet Design and Testing

Expanded Polystyrene (EPS)

- First Law of thermodynamics (Law of Conservation of Energy) states that energy can neither be created nor destroyed; energy can only be transferred or changed from one form to another.
- Energy from impact involving EPS is absorbed during the crushing of foam creating heat and limiting energy from reaching the head/brain.

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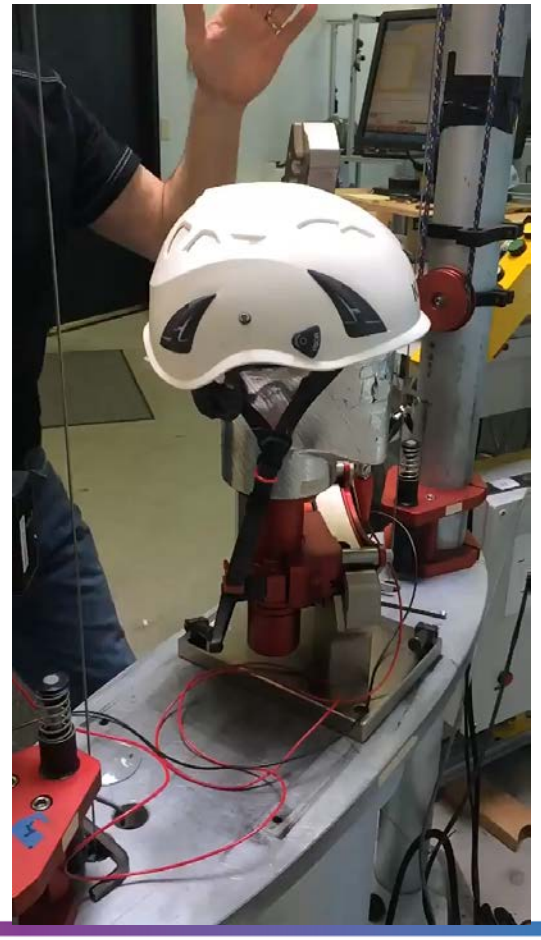
Helmet Testing

Force Transmission

Apex Penetration



Impact Attenuation

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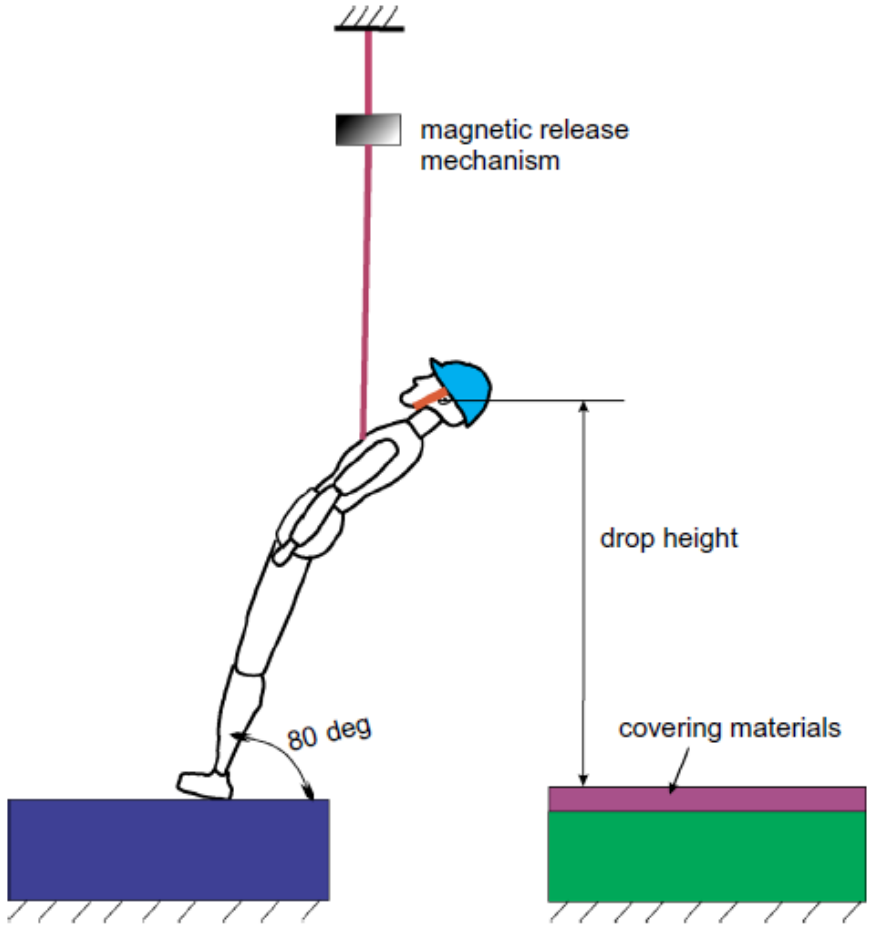
Helmet Effectiveness

- Evaluation of the Fall Protection of Type I Industrial Helmets[1]
  - Without a hard hat or helmet – 100% probability of serious head injury
  - With a traditional hard hat ~ 65% probability of a serious head injury
  - With a helmet ~ 25% probability of a serious head injury

  - Note: In the automotive industry < 50% is the generally accepted permissible limit



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Hard Hat vs. Safety Helmet

HARD HAT

- Standard hard hats are 60-year-old technology
- Complying with ANSI Z89.1 (top impact and top penetration)
- When falling, a hard hat will fall off your head.
- **Designed just for falling objects**
- **5 years shelf life**
- No chinstrap and no additional lining
- Overall fit hinders movements
- Few and limited accessories
- Warranty: 1 year

SAFETY HELMET

- **EPS foam all over the shell absorbs and dissipates the impact**
- **Complying with ANSI Z89.1/2015** (top impact and top penetration) **AND additional side, rear and front impact** according to mountaineering standard EN 12492 or ANSI TYPE II (with strap)
- **Stays on your head during a slip, trip, or fall.**
- **Designed for Fall Protection & Heavy Impact**
- **10 years shelf life**
- Wide collection of accessories
- Warranty: 3-5 years

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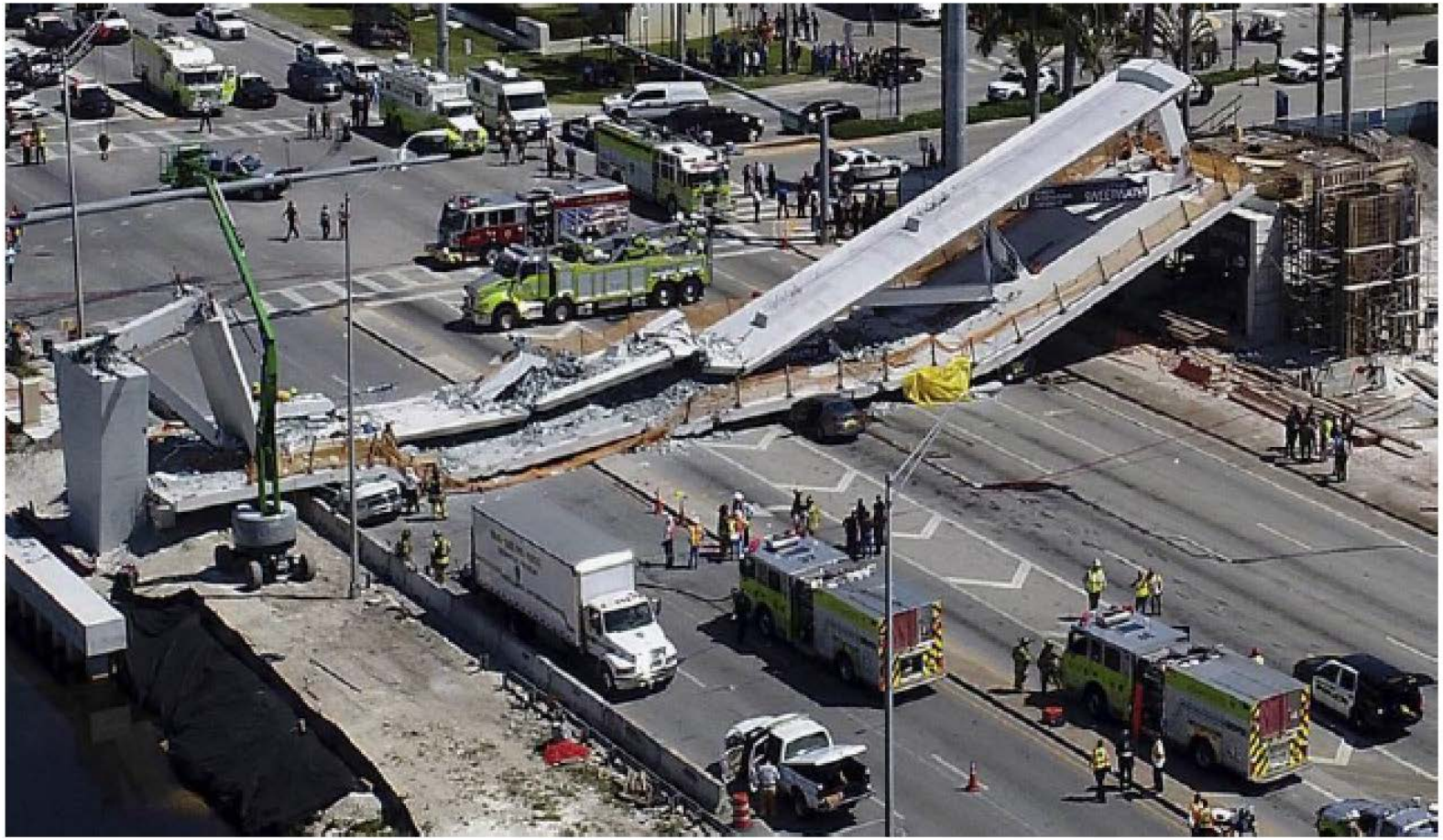
Hard Hats to Helmets

Why should I make the change?

Our Call to Action- Structural



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Safety Helmet Initiative: Objectives

For **ICRI, Structural,** and for our Industry:

- This is about **saving lives**.
- We’re trying to connect all the different pieces of a solution to provide the industry a **much better** solution.
- We want to share our vision, and hope you feel passionate about being part of this.

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Safety Helmet Initiative: Objectives

1. *Ensure a significantly lower cost solution available in the U.S. Market.*
   - Meets ANSI Type I requirements
   - Meets performance requirements of EN 12492, ANSI Type II
   - $30-$40 target- Current market range $60-$100+
2. *Start saving lives*: Work with manufacturers to ensure there is supply to all interested parties. Target industry organizations, industrial clients, and major general contractors to create a trickle-down affect to their specialty contractors.
3. *Lobby for Change*: With lower cost solutions, we can push for change to Standards and OSHA requirements without a negative impact to the industry.
4. *Watch the Market Adapt*: With growing interest and changing requirements, other manufactures will bring solutions to the table. Product innovation and cost reduction will follow.

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Safety Helmet Transition

- Traditional hard hats only protect the wearer from falling objects. Safety helmets are available that can protect the wearer's entire head.
- OSHA has determined as a "best practice", the use of advanced safety technology can better protect our staff and demonstrate OSHA's commitment to the safety of workers as a safety and health leader.

OSHA Occupational Safety and Health Administration

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What about comfort, maintenance and accessories for the helmets?

Helmet Accessories

Bracket and visors

Earmuffs

Straps and clips
for headlamps

Reflective Strips

Winter padding

Neck shade

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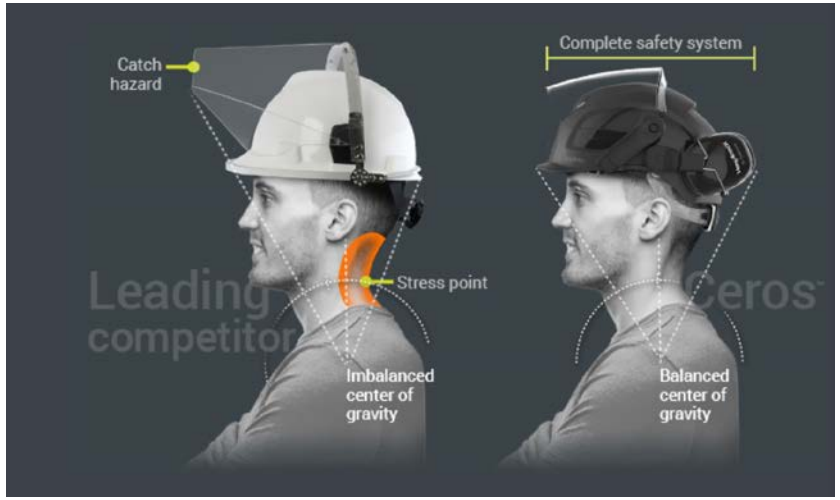
Helmet comfort and fit

Weight – hard hat 14 oz ~400 grams

Helmets ~450-500 grams



"I love it! It's much more comfortable than the old hard hat" – Dave

"It feels a lot lighter on your head" – Steve

"The upgraded suspension really feels secure, and I really like how it adjusts to my head" – Ross

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Aren’t helmets hotter than hard hats?

Head Protection Temperature Study

Georgia Tech Enterprise Innovation Institute: Safety, Health and Environmental Services Group

Testing Protocol

- Six Quest Temp 34 Heat Stress monitors (WBGT)
- Six different head protection models
  - 4 helmets
  - 2 hard hats
  - Sponge saturated with 50 mL of water to simulate perspiration and water loss was measured at the end of each testing cycle.
- Internal and external temp. measured over 3-day period

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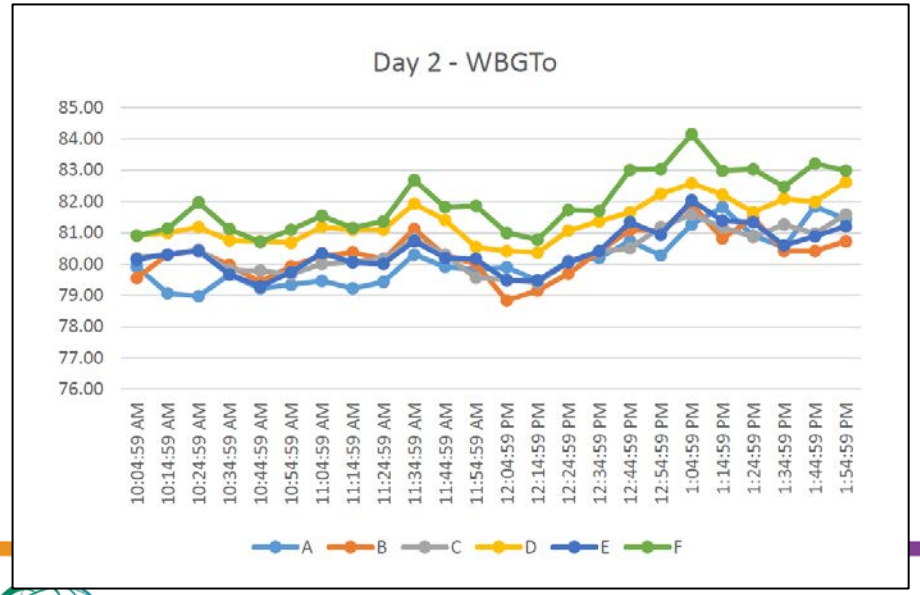
Head Protection Temperature Study

Georgia Tech Enterprise Innovation Institute: Safety, Health and Environmental Services Group

Average Ambient WBGTo - Control	Average External Surface of HH/Helmets	Average Globe – Under HH/Helmets	Average Dry - Under HH/Helmets	Average WBGTo - Under HH/Helmets	Average Grams Water Loss
86.3 °F – 87 °F	89.9 °F – 94.7 °F	89.2 °F – 93.4 °F	87.6 °F – 89.4 °F	79.8 °F – 81.6 °F	20.8 g - 32.8 g

Results



	Average external Surface	AverageGlobe internal	Average Dry Internal	Average WBGTo Internal
A	94.7	91.3	87.6	79.8
B	91.4	90.7	88.7	79.9
C	92.7	89.2	88.3	79.9
D	92.9	91.9	89.4	80.8
E	92.7	90.9	88.3	80.0
F	89.8	93.4	88.0	81.6

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New Technology

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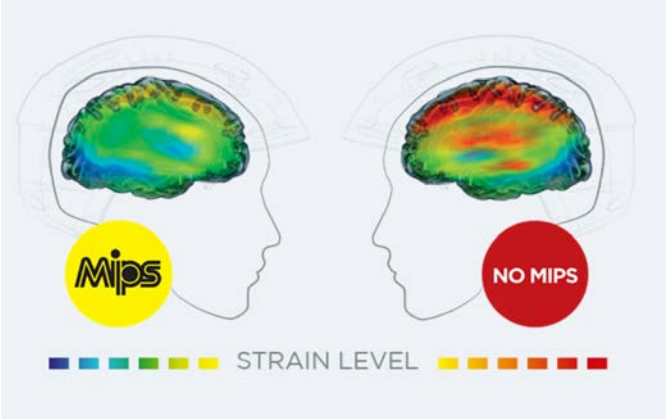
MIPS Technology

- **M**ulti-Directional **I**mpact **P**rotection **S**ystem
  - Reduces rotational forces caused by angled impacts to the head.
  - A helmet's shell and liner are separated by a low friction layer which allows the helmet to slide, noticeably reducing trauma to the brain in the case of oblique impacts.
  - MIPS layer is located between the liner and the user's head.



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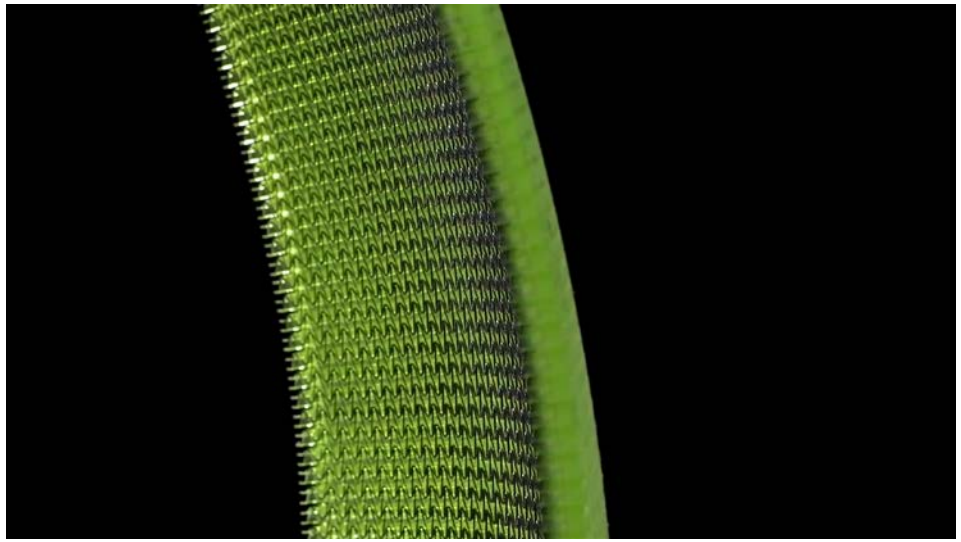
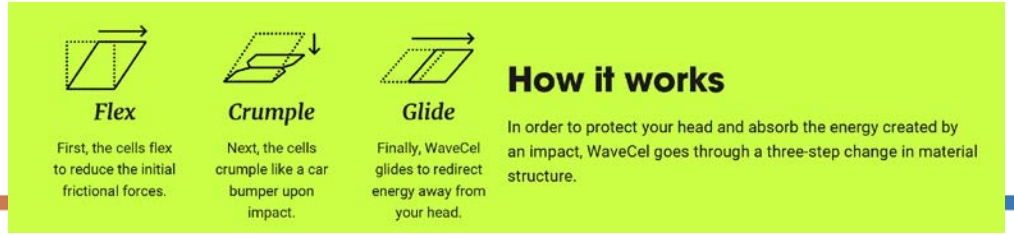
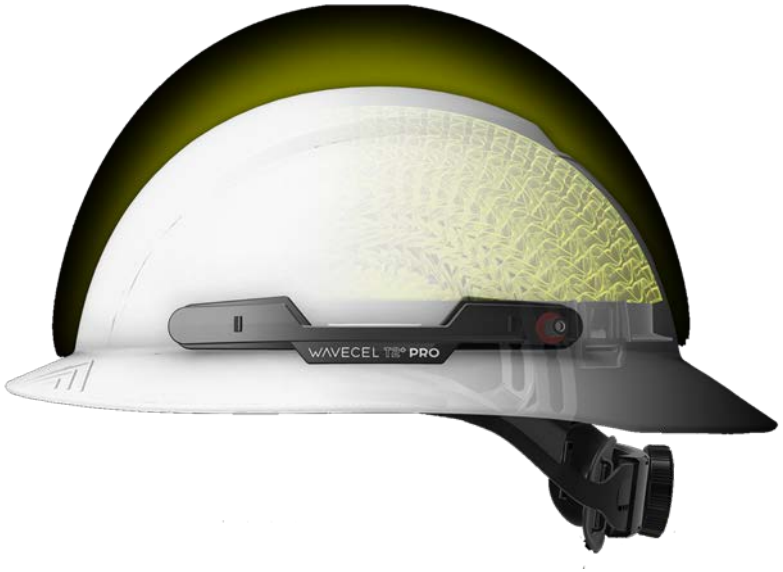
Energy Absorbing Cell Technology

- A collapsible cellular structure that lines the inside of a helmet.
- It works like a crumple zone that absorbs the force of an impact before it reaches your head







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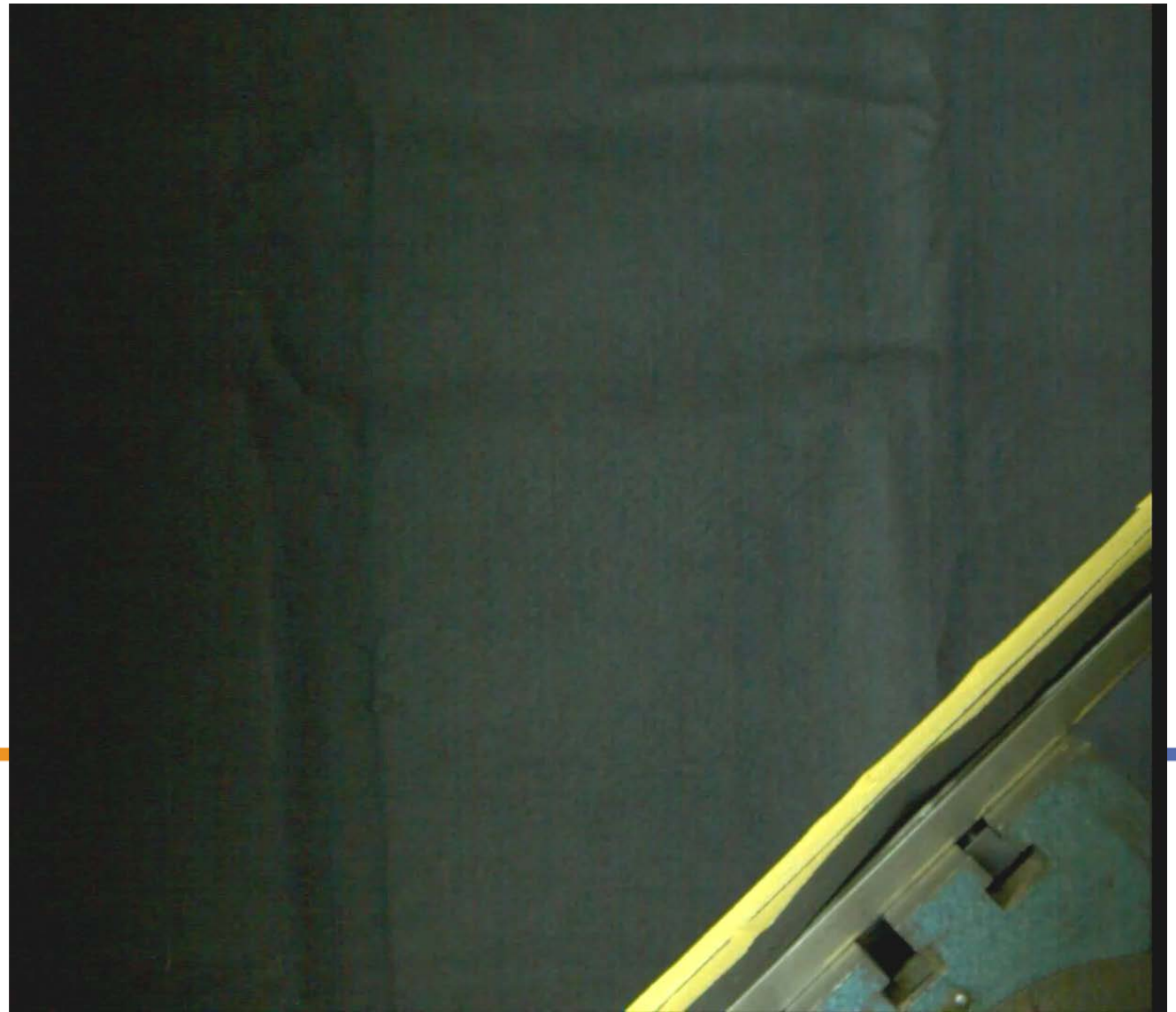
Standard Helmet



Cell Type Helmet

Hard Hats to Helmets- GCs

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H2H Website

HARD HATS TO HELMETS

HOME ABOUT WHY HELMETS? HELMET STORIES RESOURCES

Hard Hats to Helmets

Traumatic Brain Injuries are responsible for 25% of all construction fatalities, and many life-altering injuries. It's time to make the transition.

WATCH HOW HELMETS SAVE LIVES

REGULATORY REQUIREMENTS AND TECHNICAL SPECIFICATIONS
RESEARCH AND DEVELOPMENT
CONSTRUCTION INDUSTRY ADOPTION
VENDOR INFORMATION

HELMET TESTING

H2H is pleased to present helmet testing videos produced by Milwaukee Tool. These videos provide an overview of the pertinent ANSI Z89.1 and EN 12492 helmet testing requirements. Thanks to Milwaukee for their educational videos and support of H2H!

Watch Videos

ICRI CONCRETE REPAIR Restore | Repurpose | Renew 35th YEAR ANNIVERSARY

www.hardhatstohelmets.org

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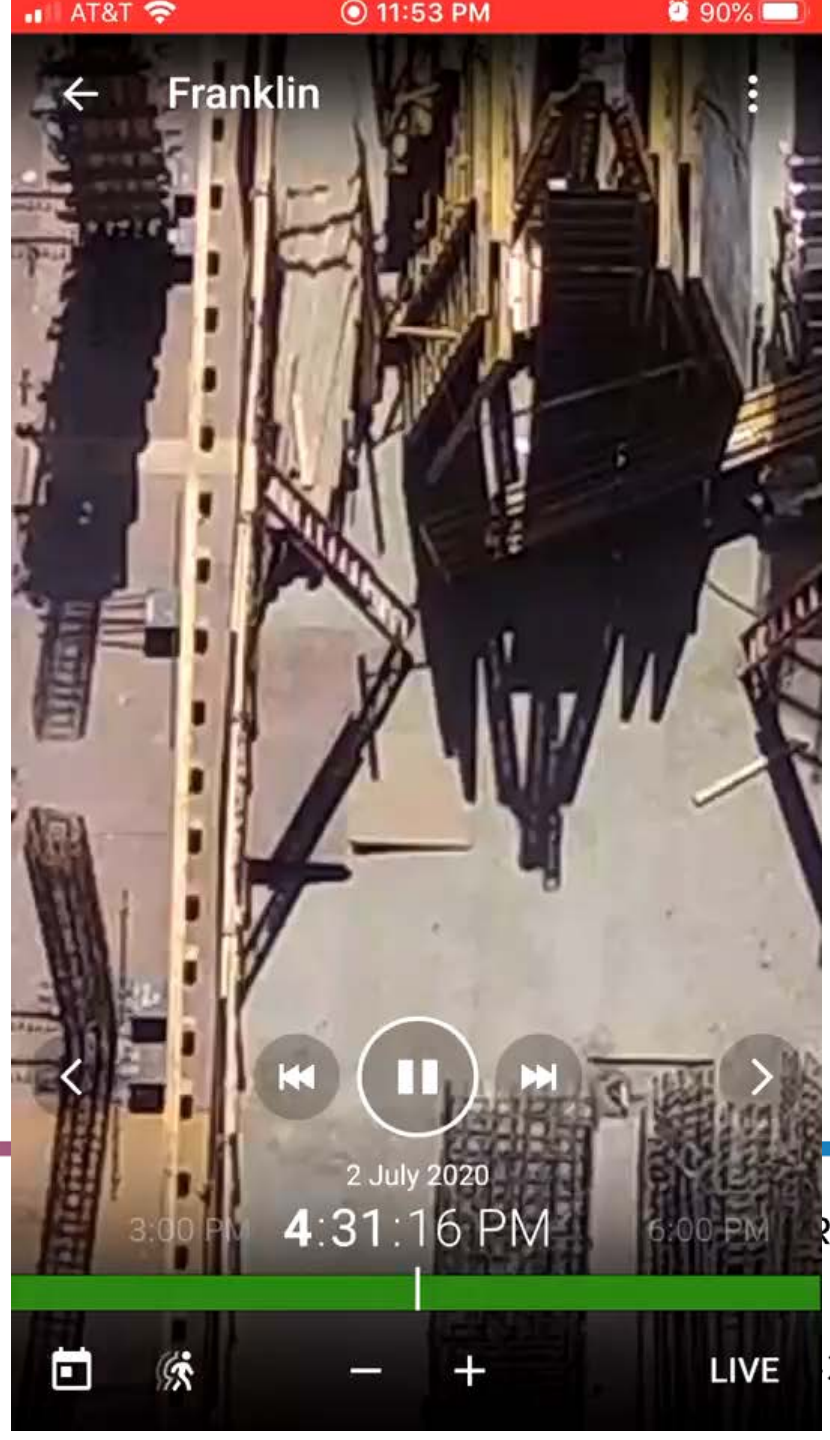

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Case Study

Questions?

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