

PRESENTED FOR WORKPLACE SAFETY NORTH - MINING HEALTH AND SAFETY CONFERENCE

# Development of DOSE & MOSAIC Databases

*Better Data, Safer Work.*

PRESENTER

**Dr. Amin Yazdani**

President, CISWP



INSTITUTIONAL PILLAR

# Strategic Intent & Impact

01

OUR VISION

*"A future where every Canadian worker thrives in **safe, healthy, and high-performing** workplaces, strengthening the resilience and competitiveness of businesses across the country."*

Stitch - Design with AI



**BETTER  
DATA.  
SAFER  
WORK.**



OUR MISSION

# Leading innovation through evidence-informed practice.

To lead innovation in workplace safety, wellness, and performance in Canada by integrating **applied research**, workforce development, advanced technology, and evidence-informed practices in collaboration with partners to deliver measurable, real-world impact.



# What are the actual benefits of using exoskeletons in construction?

Grant Cameron October 28, 2022



Angela Gismondi September 9, 2024

## New standard focuses on work disability management for paramedics across Canada

February 22, 2022

Back Twitter Facebook LinkedIn Send Save Print

The Canadian Institute for Safety, Wellness & Performance (CISWP) at Conestoga, in collaboration with CSA Group, the Centre for Research on Work Disability Policy (CRWDP), Paramedic Association of Canada (PAC), and the County of Renfrew, led the research and development behind a new standard recently released by the CSA Group. This latest project is one of several applied research initiatives led by CISWP to support paramedics across Canada.



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NEWS, ONTARIO, SKILLED TRADES

# New research labs at focus on workplace in

RENEW CANADA / SEPTEMBER 17, 2024

CANADIAN OCCUPATIONAL SAFETY NEWS TOI

Topics Safety and PPE

## Canada's first 4D body scanner will help create better PPE for women

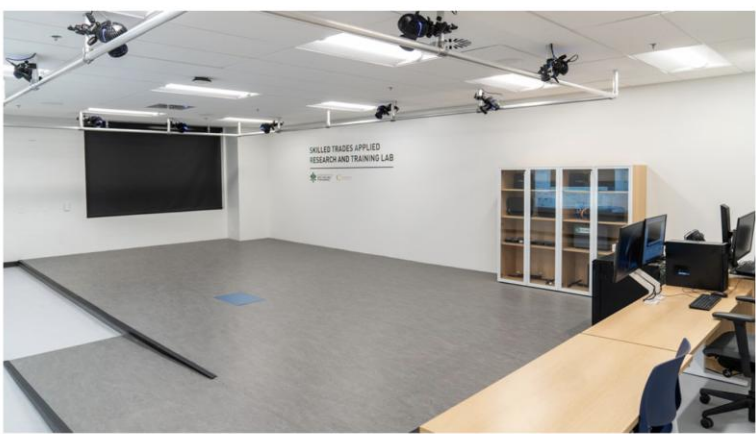
Technology is part of two new safety research labs at Conestoga College



### LATEST NEWS

- U.S. study reveals surprising sectors for non-fatal injuries
- Island Health's fatigue management policy raises concerns
- How York Regional Police slashed recruit injuries
- Pacific Rim Industrial fined \$210,000 After worker dies in...

FREE NEWSLETTER



CONESTOGA COLLEGE - At the new Skilled Trades Applied Research and Training lab at Conestoga College, researchers will conduct studies to understand the cause of injuries and develop and evaluate targeted solutions.

BETTER DATA. SAFER WORK.




**2025 – 2028**

**Phase 1: Construction and Paramedics**

# MOBILE LABORATORIES



## Launch of DOSE and MOSAIC Mobile Labs


 **Workplace Safety and Insurance Board (WSIB)**  
85,595 followers  
1mo • 🌐

Today we had the pleasure of attending a special event with the [Canadian Institute for Safety, Wellness, and Performance \(CISWP\)](#) and [David Piccini](#), Minister of [Labour, Immigration, Training and Skills / Travail, Immigra...](#) ...more



 **David Piccini**  • 1st  
Ontario's Minister of Labour, Immigration, Training and Skills Development & MPP...  
1mo • 🌐

Incredible work that will change the landscape of construction and improve health & safety on job sites!


 **Canadian Institute for Safety, Wellness, and Performance (...)**  
1,658 followers  
1mo • 🌐


CISWP, in partnership with [Workplace Safety and Insurance Board \(WSIB\)](#), and surrounded by partners from across the [#Construction](#) and [#Paramedicine](#) sectors, was thrilled to present and officially launch our [#MobileLabs](#) ye: ...more



 **David Piccini**  • 1st  
Ontario's Minister of Labour, Immigration, Training and Skills Development & MPP...  
2w • Edited • 🌐

In partnership with the [Workplace Safety and Insurance Board \(WSIB\)](#), [Canadian Institute for Safety, Wellness, and Performance \(CISWP\)](#)'s new mobile research labs are bringing cutting-edge safety training and real-time insights straight to ...more

 **Mobile labs take injury-prevention research directly to Ontario worksites**  
thesafetymag.com

 **Labour, Immigration, Training and Skills / Travail, Immigra...**  
74,966 followers  
1w • 🌐

Protecting Ontario workers starts with safe, productive workplaces.

WSIB funded mobile research labs are now rolling onto job sites — ...more



# PARTNERSHIPS

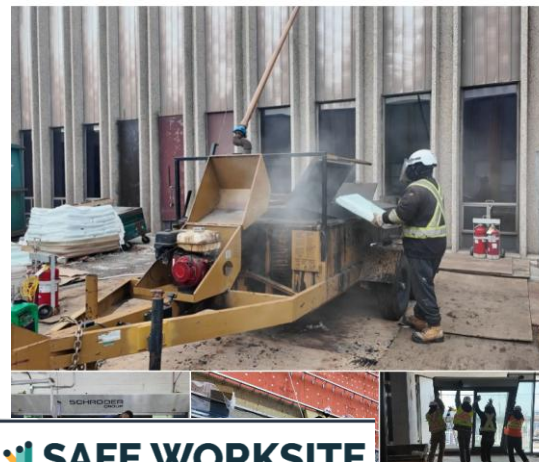


- Partnership development strategies
  - Businesses across Ontario
  - Diversified partners
  - Multiple occupations



Canadian Institute for Safety, Wellness, and Performanc...  
 1,658 followers  
 1mo •

CISWP #FieldResearchers were out with Flynn across multiple sites in Ontario for 9 weeks, collecting data about #OccupationSpecificExposures for #roofers, #waterproofers, #sheetmetal workers, #fabricators, #glaziers, ...more



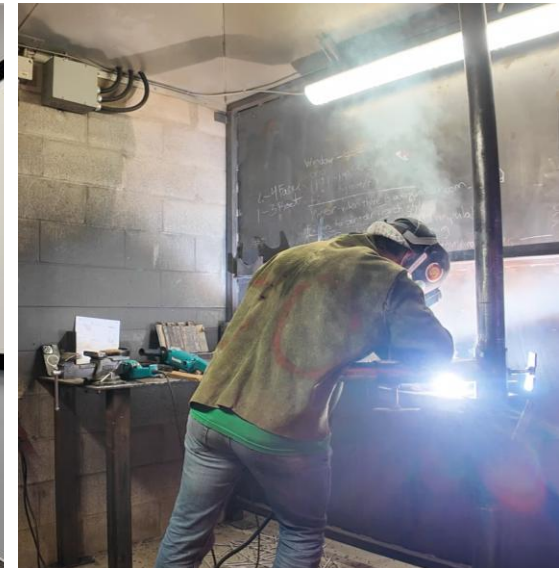
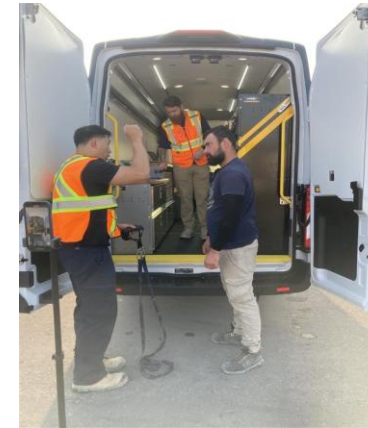
Kyle Brohman • 1st  
 If I had wheels, I'd be a wagon  
 4mo •

At Conestogo Electric Inc., the safety and wellbeing of our electricians is always front and center. That's why we're honoured to be a participant in the Safe WorkSITE study led by the Canadian Institute for Safety, Wellness, and ...more



Source of workplace exposure data using **wearable sensors** of workers while performing their jobs at their worksites to identify and understand the factors related to workplace injuries and performance deficits.

**Assign exposure to EACH task performed under EACH NOC code.**



METHODOLOGY OVERVIEW

# Actual Worksites. Actual Workers. Actual Conditions.

The CISWP Equilibrium project moves beyond the sterile environment of a university laboratory. Our research takes place where the work happens, capturing the nuanced physical and psychological demands of real-world labor.

## Mobile Research Labs

State-of-the-art diagnostic units deployed directly to industrial sites, enabling immediate data processing and high-fidelity collection.

## Objective Biometrics

Utilization of non-intrusive wearable sensors to monitor musculoskeletal load and cardiovascular strain during standard 8-hour shifts.



### Direct Observation

Integration of video kinesthetics and force-plate measurements into standard workflows without disrupting production timelines.



### Real-Time Data

Immediate synchronization of physiological data with workplace environmental metrics like heat index, noise levels, and vibration.

# What...

is required  
to do my  
job?

are the  
injuries  
common to  
my job?

BETTER  
DATA.  
SAFER  
WORK.

# Why ...

do injuries and accidents happen frequently?

how can we control the risk of an injury??

# How...

**do I prevent injuries, specific to my job, before they occur?**

**do I measure or assess the risk of injury, specific to my job?**

**do I ensure employees can return to work effectively?**

# Where...

**can I find job-specific, practical resources to prevent and manage injuries and illnesses ?**

**can I find the expertise to solve my specific health and safety challenges?**



**BETTER  
DATA.  
SAFER  
WORK.**

Meilleure sécurité au travail.



## Body Posture

Evaluate body movement (repetition, duration, awkward postures)



## Muscle Activity

Measuring muscular effort and fatigue



## Heart Rate Monitor

Frequency, Heart Rate Variability



## CORE Sensor

Body core temperature, heat stress



## Dust Monitoring

Capable of collecting exposure data for silica exposure



## Air Quality and Aerosol Monitoring

Measuring particle mass concentration, particle concentration, temperature, relative humidity. Measuring dust, smoke, fumes, and mists.



## Eye Tracking

Situational awareness, quality, precision, performance, safety



## Noise Dosimeter

Measuring noise exposure



## Vibration System

Measuring exposure to vibration from tools and equipment and vehicles.



## Stress Monitoring

Mental workload, Stress, Respiration, Motion, Cardiac impedance, Heart rate variability



## ActiGraph

Activity, sleep, mobility, heart rate and variability, oxygen saturation, and skin temperature



## Pressure Sensors

Pressure mapping gloves and for seats

# “Taking Research **into** the Field”



**Eye Tracking**  
*Situational awareness,  
quality, precision,  
performance, safety*



# DOSE DATA PROCESSING

**Assign exposure data to job duties, tasks, and sub-tasks.**

Observational Coding/Task Analysis →

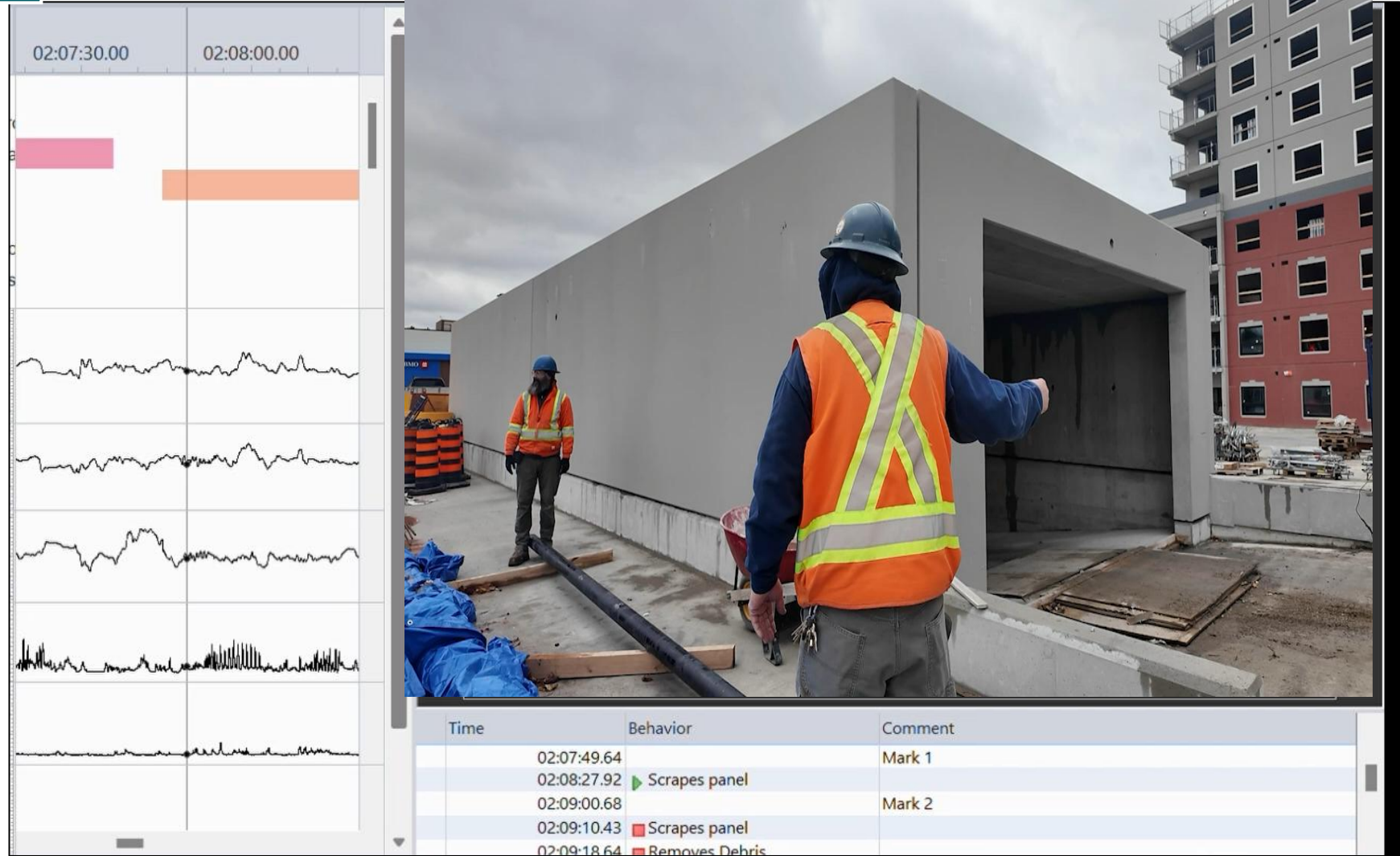
Posture Evaluation: Trunk →

Posture Evaluation: Left Shoulder →

Posture Evaluation: Right Shoulder →

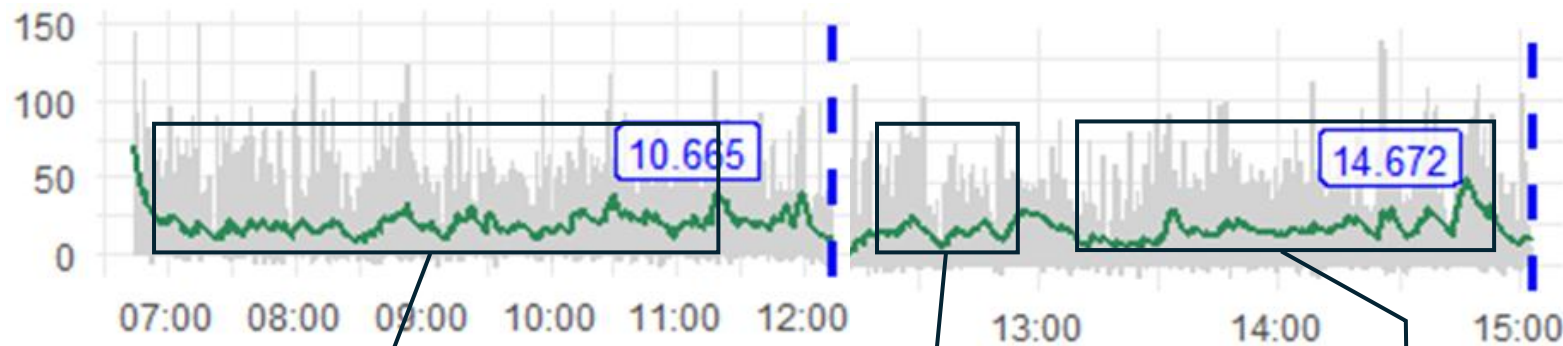
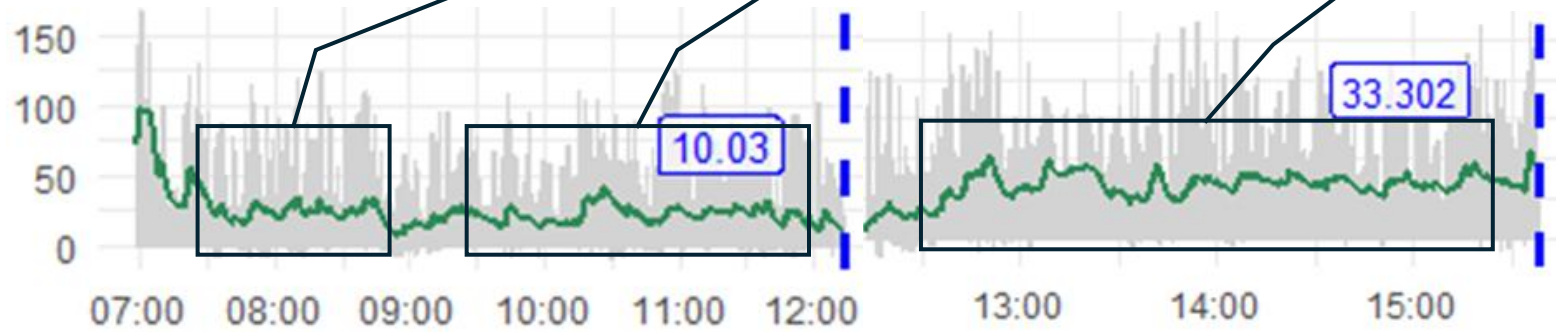
Muscle Activity: Right Arm →

Muscle Activity: Right Shoulder →



*\*8-hour full shift continuous recording*

# DOSE DATA PROCESSING

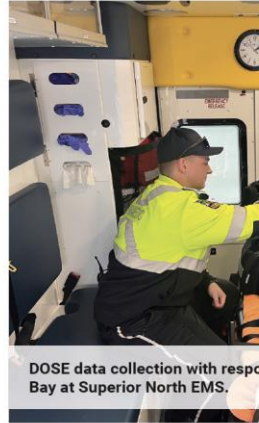


# DOSE Data Collection

Canada's First Database of Occupation-Specific Exposures (DOSE)

CISWP wants to understand how injuries occur and how to prevent these injuries to improve the health and safety of workers in Canada. The data is collected using wearable sensors that include many factors that influence injury. The findings contribute to the development of Canada's only Database of Occupation-Specific Exposures (DOSE). The results of this study will support the development of resources that will inform the prevention of injuries and protect workers health and safety.

This initiative is funded by: 



DOSE data collection with respiratory paramedics at Superior North EMS.



DOSE data collection with Logistics Paramedics at Halton Paramedics



A DOSE Mobile Lab.



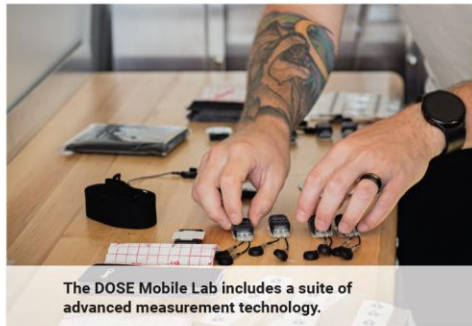
DOSE Data collection participant wearing sensors.



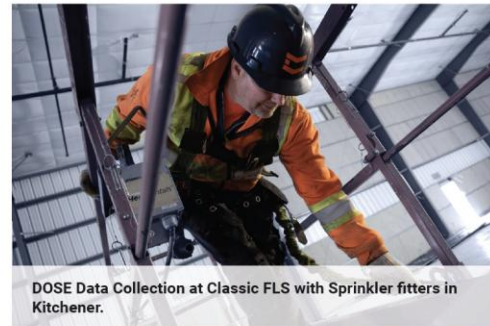
DOSE Data Collection at Bruce Power with technicians in Tiverton.



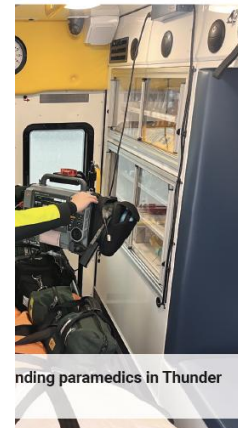
DOSE Data Collection at Flynn Group included roofers, sheetmetal workers, glaziers, and others across several locations throughout Ontario.



The DOSE Mobile Lab includes a suite of advanced measurement technology.



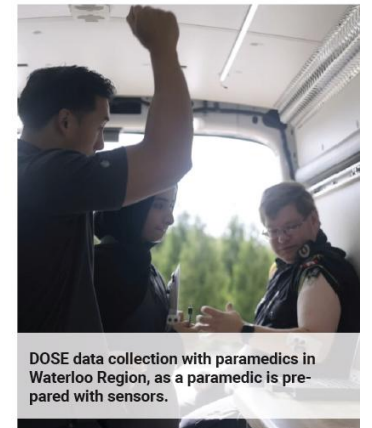
DOSE Data Collection at Classic FLS with Sprinkler fitters in Kitchener.



DOSE data collection with paramedics in Thunder Bay



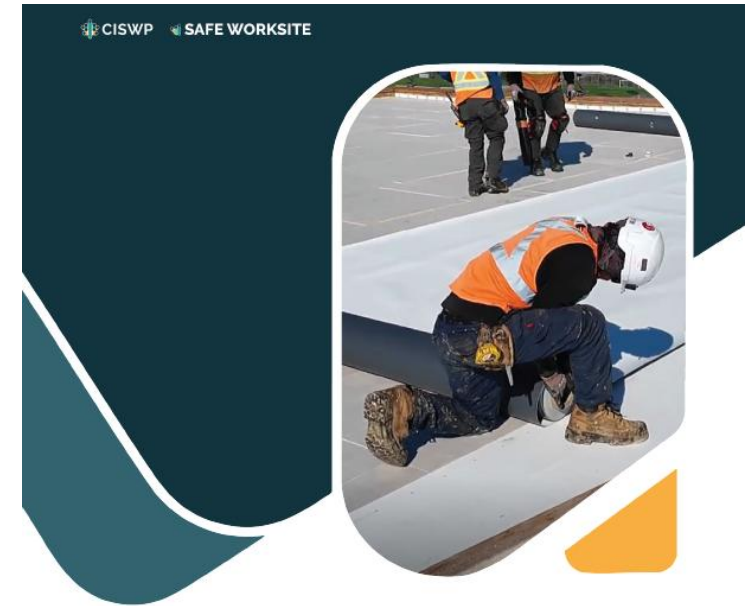
DOSE data collection produces several body exertion and other metrics, such as EMG, informing the understanding of real-world work.



DOSE data collection with paramedics in Waterloo Region, as a paramedic is prepared with sensors.

## **Safe WorkSITE (Solutions, Innovations, and Technology Evaluation)**

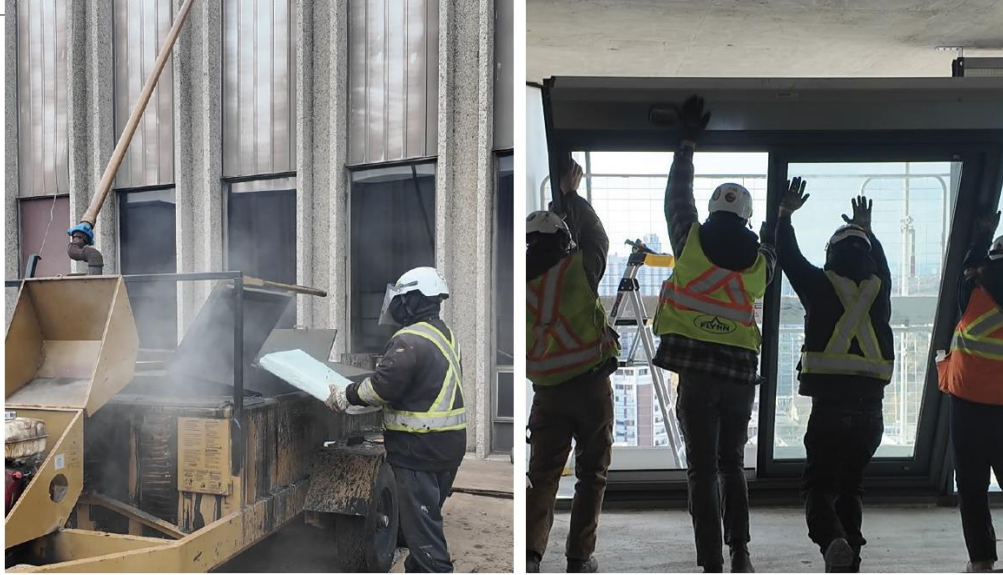
While collecting data for DOSE, CISWP will provide **immediate impact to businesses of all sizes** through accessible, practical, and effective **resources and tools** that addresses their specific health and safety challenges.



Safe WorkSITE Report:  
Roofers and Shinglers (NOC73110)

Canadian Institute for Safety, Wellness &  
Performance (CISWP)

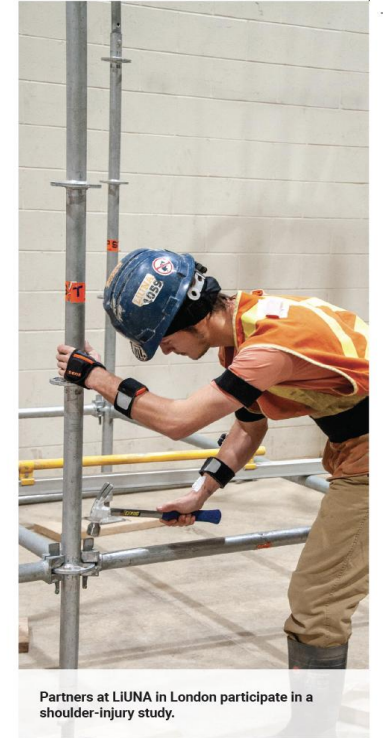
# SAFE WORKSITE



DOSE Data Collection at Flynn Companies included locations in Grimsby, Milton, and Toronto



The START lab contributes to several key initiatives, including Safe WorkSITE data collection.



Partners at LIUNA in London participate in a shoulder-injury study.

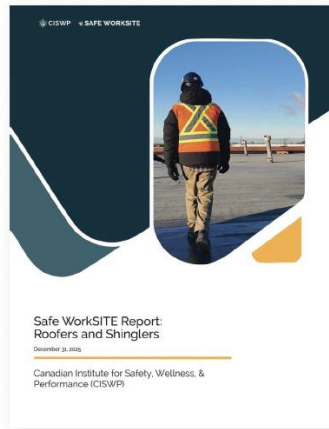


## Safe WorkSITE

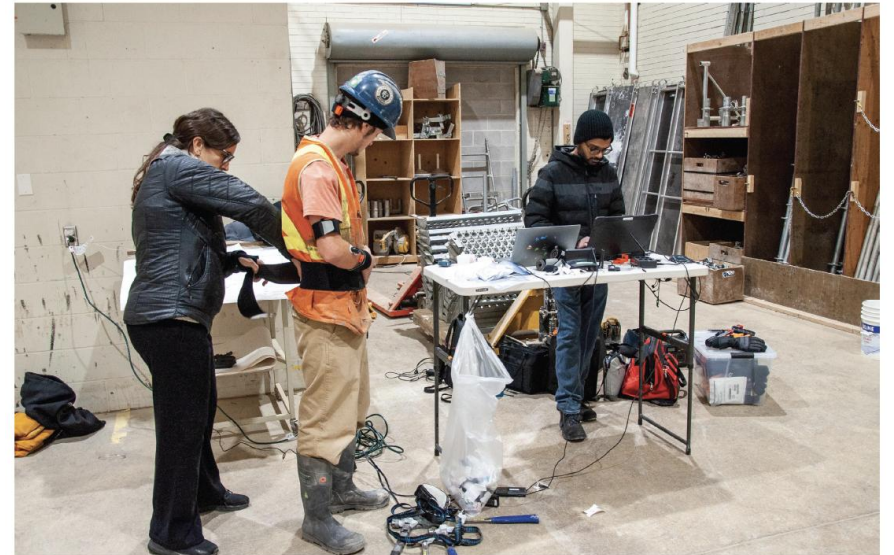
A Safe Work Solutions, Innovations & Technology Evaluation (Safe WorkSITE)

A Safe Work Solutions, Innovations & Technology Evaluation (Safe WorkSITE) Report is a targeted, company-specific report that outlines the key tasks that workers do on your worksites and compiles our researcher's expert recommendations for completing that work in safer and more productive ways.

This initiative is funded by:  WSIB Ontario



Companies that participate in DOSE data collection receive a customized report with observations and recommendations.



Labourers at LIUNA in London contribute to a scaffolding assembly study to assess shoulder risk.

## Example: Roofers and Shinglers (NOC: 73110)

| i   | Date                             | Task  | Neck and Upper Back |         |        |                               |   |   | Shoulder       |         |          |                               |
|-----|----------------------------------|---|---------------------|---------|--------|-------------------------------|---|---|----------------|---------|----------|-------------------------------|
|     |                                  |   | Frequency (Hz)      |         |        | Duration (seconds)            |   |   | Frequency (Hz) |         | Duration |                               |
|     |                                  |   | Minimum             | Average | Peak   | % of Sample (g-force Posture) | Average of Highs in Posture (g-force Posture) | Average of Highs in Posture (g-force Posture) | Minimum        | Average | Peak     | % of Sample (g-force Posture) |
| f   | Apply bolt-up roofing components | Installation of insulation                  | 0.00%               | 0.11%   | 24.00% | 0.00%                         | 1.00min                                       | 22.0°   | 1.00%          | 1.00%   | 21.00%   | 0.21%                         |
|     |                                  | Installation of protection board            | 0.00%               | 0.00%   | 24.00% | 1.27%                         | 1.40min                                       | 28.0°   | 1.00%          | 1.00%   | 21.00%   | 0.88%                         |
|     |                                  | Apply solvent proofcoating surface          | 1.00%               | 4.00%   | 24.11% | 0.88%                         | 0.00min                                       | 20.1°   | 0.00%          | 1.44%   | 21.00%   | 0.20%                         |
|     |                                  | Apply vapor barriers and air barriers       | 1.18%               | 4.20%   | 24.80% | 0.82%                         | 0.00min                                       | 20.2°   | 1.00%          | 1.68%   | 24.21%   | 0.20%                         |
| j   | Apply membranes                  | Installation of drains, vents, rooflet caps | 1.00%               | 4.00%   | 24.11% | 0.88%                         | 0.00min                                       | 21.0°   | 0.00%          | 0.00%   | 21.00%   | 0.20%                         |
|     |                                  | Apply cold-laid membranes                   | 1.00%               | 0.00%   | 20.00% | 0.88%                         | 0.00min                                       | 20.4°   | 1.00%          | 1.45%   | 24.00%   | 0.82%                         |
|     |                                  | Apply membranes using hot process           | 1.00%               | 0.00%   | 24.00% | 0.88%                         | 0.71min                                       | 21.0°   | 1.00%          | 1.00%   | 21.00%   | 0.20%                         |
|     |                                  | Installation of membrane flashing           | 0.54%               | 0.04%   | 21.00% | 1.82%                         | 1.10min                                       | 20.2°   | 0.10%          | 23.04%  | 20.00%   | 0.88%                         |
| k   | Prepare concrete                 | Prepare rebar in form                       | 1.00%               | 1.00%   | 24.00% | 0.80%                         | 0.81min                                       | 20.2°   | 2.00%          | 3.00%   | 28.00%   | 0.88%                         |
|     |                                  | Hot air welding                             | 0.00%               | 1.00%   | 24.00% | 0.88%                         | 0.00min                                       | 21.0°   | 1.00%          | 1.41%   | 24.00%   | 0.20%                         |
|     |                                  | Prepare concrete                            | 0.18%               | 4.40%   | 24.00% | 2.80%                         | 1.10min                                       | 20.1°   | 1.14%          | 1.75%   | 20.00%   | 0.20%                         |
| ... | ...                              | ...   | ...                 | ...     | ...    | ...                           | ...   | ...   | ...            | ...     | ...      |                               |
| 20  | Roofers                          | Assemble/Disassemble gable ends             | 0.70%               | 1.00%   | 24.00% | 1.87%                         | 1.40min                                       | 23.0°   | 0.00%          | 21.70%  | 24.00%   | 0.28%                         |
| 20  | Shingling                        | Shingling and re-roofing roof metal job     | 1.00%               | 4.71%   | 24.00% | 0.88%                         | 0.70min                                       | 20.2°   | 1.00%          | 3.00%   | 28.00%   | 0.88%                         |



| Task                              | MSD Risk <sup>a</sup> |          |          |          | Whole-body Fatigue Risk <sup>b</sup> | Thermal Risk <sup>c</sup> |
|-----------------------------------|-----------------------|----------|----------|----------|--------------------------------------|---------------------------|
|                                   | Neck and upper back   | Shoulder | Low back | Hand-arm |                                      |                           |
| Installation of membrane flashing | Green                 | Green    | Yellow   | Yellow   | Yellow                               | Green                     |
| Installation of insulation        | Green                 | Green    | Yellow   | Green    | Yellow                               | Green                     |
| Apply membranes using hot process | Green                 | Green    | Yellow   | Yellow   | Yellow                               | Green                     |
| Prepare concrete                  | Green                 | Green    | Yellow   | Green    | Yellow                               | Yellow                    |
| Installation of protection board  | Green                 | Green    | Yellow   | Yellow   | Yellow                               | Green                     |

Green indicates "low" risk, yellow indicates "moderate" risk, and orange indicates "high" risk (no high risks were observed).

## Analyzing Data By TASK

### Installing Membrane Flashings



#### Task Description

##### Overview:

Roofers install or repair membrane flashings on low-slope roofs to create watertight seals. Two processes were observed: roof completion with TPO membranes and roof repair with modified bitumen (Mod. Bit.).

##### Subtasks:

- Measure, cut, and install plywood flashing bases.
- Drill and fasten bases to the roof deck.
- Measure, cut, and apply membrane sheets (TPO or Mod. Bit.).
- Weld seams using a hot-air welder.
- Apply sealant to membrane edges.

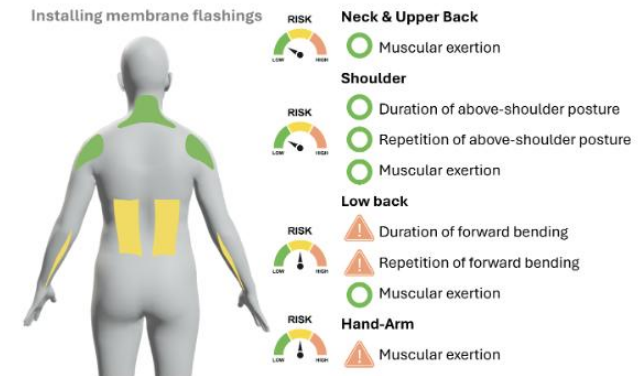
##### Key Materials & Equipment:

TPO, Mod. Bit., 1/2-inch plywood, adhesive, sealant, tape measure, knife, saw, drill, hot-air welder.

##### PPE:

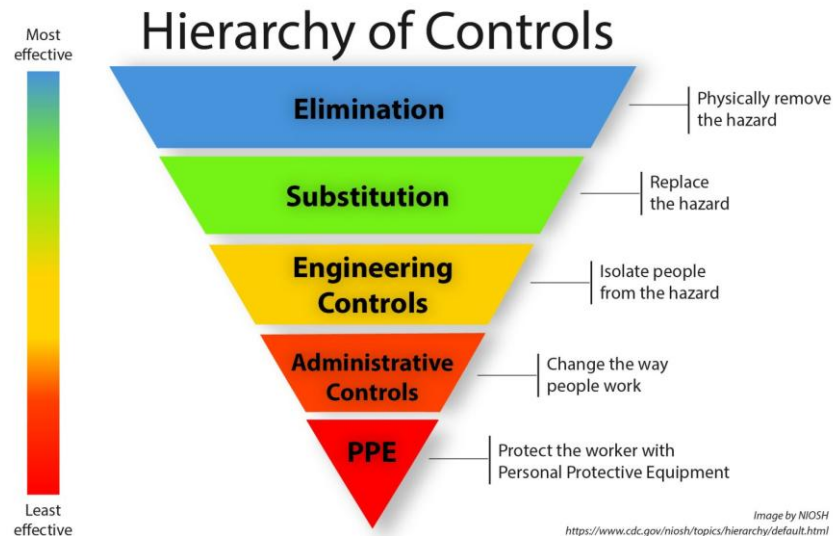
Gloves, safety boots, eye protection, and long sleeves for burn and cut protection.

### Task Risk Assessment Summary for Installing Membrane Flashings



| Body Region  | Force   | Duration   | Posture  | Repetition   | MSD Risk     |
|--|---|--|--|--|--------------|
| Neck and upper back  | <input type="checkbox"/> High: Muscle exertion > 14%<br><input type="checkbox"/> Moderate: Muscle exertion 10-14%<br><input checked="" type="checkbox"/> Low: Muscle exertion < 10% |  |  |  | Low          |
| Shoulder   | <input type="checkbox"/> High: Muscle exertion > 15%<br><input checked="" type="checkbox"/> Low: Muscle exertion ≤ 15%  | <input type="checkbox"/> High: > 10% of task time in above-shoulder posture<br><input checked="" type="checkbox"/> Low: ≤ 10% of task time in above-shoulder posture | <input type="checkbox"/> High: Above-shoulder posture repetition > 1 count/min<br><input checked="" type="checkbox"/> Low: Above-shoulder posture repetition ≤ 1 count/min |  | Low          |
| Low back   | <input type="checkbox"/> High: Muscle exertion > 15%<br><input checked="" type="checkbox"/> Low: Muscle exertion ≤ 15%  | <input checked="" type="checkbox"/> High: > 10% of task time in forward bending<br><input type="checkbox"/> Low: ≤ 10% of task time in forward bending               | <input checked="" type="checkbox"/> High: Forward bending repetition > 0.5 counts/min<br><input type="checkbox"/> Low: Forward bending repetition ≤ 0.5 counts/min         |  | Moderate     |
| Hand-arm   | <input type="checkbox"/> High: Muscle exertion > 30%<br><input checked="" type="checkbox"/> Moderate: Muscle exertion 10-30%<br><input type="checkbox"/> Low: Muscle exertion < 10% |  |  |  | Moderate     |
| <b>Heart Rate</b>  |   |  |  |  | Fatigue Risk |
| <input type="checkbox"/> High: Cardiovascular effort > 30% for > 90% of task time<br><input checked="" type="checkbox"/> Moderate: Cardiovascular effort > 30% for 50-90% of task time<br><input type="checkbox"/> Low: Cardiovascular effort > 30% for < 50% of task time |   |  |  |  | Moderate     |
| <b>Core Body Temperature</b>   |   | <b>Temperature Gradient</b>  |  | <b>Heart Rate</b>  | Thermal Risk |
| <input type="checkbox"/> High: Core body temperature > 38°C<br><input checked="" type="checkbox"/> Low: Core body temperature ≤ 38°C   |   | <input type="checkbox"/> High: Temperature gradient < 3.3°C<br><input checked="" type="checkbox"/> Low: Temperature gradient ≥ 3.3°C                                 |  | <input type="checkbox"/> High: Heart rate > 110 bpm<br><input checked="" type="checkbox"/> Low: Heart rate ≤ 110 bpm | Low          |

## Providing Data-Driven Recommendations By TASK



Safe WorkSITE Report:  
Roofers and Shinglers

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**Risks and Recommendations for Installing Membrane Flashings**

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**Injury Risk: LOW – No Recommendations**

LOW MSD risk | Neck and upper back  
The MSD risk at the neck and upper back was **low** based on average muscle exertion (average = 7% of maximum effort), which was below the threshold of 10% of maximum effort.

LOW MSD risk | Shoulder  
The MSD risk at the shoulder was **low** based on duration and frequency of above shoulder postures and muscle exertion. The average duration of above shoulder postures was minimal (0.06% of task duration, < 10%), infrequent (0.05 counts/minute, < 1 count/min), and average muscle exertion did not exceed the risk threshold (2% of maximum effort, < 15%).

LOW thermal risk  
The thermal risk during this task was **low** based on core body temperature, core-skin temperature gradient, and heart rate. The average core body temperature during this task was below the risk threshold for heat strain (37°C, < 38°C). The temperature gradient between core and skin temperature was normal (4°C, > 3.3°C), suggesting effective heat dissipation. The average heart rate was below risk thresholds (104 bpm, < 110 bpm), confirming that thermal load was low.

**Injury Risk: Moderate**

MODERATE MSD risk | Low back  
The MSD risk at the low back was **moderate** based on duration and frequency of forward bending. This task frequently required prolonged (40% of task duration, > 10%) and repeated forward bending (3 counts/min, > 1 count/min).

**Engineering Controls**

- **Consider using a tool handle extender when applying adhesive** to minimize extended reaches and static forward bending postures.

**Administrative Controls**

- **Consider using task rotation to avoid frequent or static forward bending.** The most effective task rotation scheme alternates between body regions and muscle groups, to provide rest periods and reduce overall muscle exertion and overload. For instance, alternating between lifting and gripping may reduce muscle exertion of the shoulders, neck, and back but not for the hand-arm.
- **Avoid twisting when bending at the waist.** Twisting is a hazardous activity, placing undue stress on the low back. When possible, position the body in front of the work and avoid awkward positions. Ensure there is no debris or other equipment that may get in the way.

Safe WorkSITE Report:  
Roofers and Shinglers

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**MODERATE MSD risk | Hand-arm**  
The MSD risk for the hand-arm region was **moderate** based on muscle exertion. The average measured muscle exertion was 12% of maximum effort (30% maximum effort > task effort > 10% maximum effort).

**Engineering Controls**

- **Consider tool selection to promote maximal force application and minimize awkward hand and wrist postures.** For tasks where force is applied perpendicular to the straightened forearm and wrist, or when forces are applied vertically, a straight handle tool is ideal. For tasks where force is exerted in a straight line in the same direction as the straightened forearm and wrist, or when forces are applied horizontally, a bent/angled pistol grip tool is ideal. Select tool handles that are cylindrical or oval. Larger diameter handles help with maximal torque and non-slip handle material will reduce effort and improve comfort.

**Administrative Controls**

- **Ensure tools are regularly maintained.** Tools that are worn, blunt, or out of alignment will vibrate more. Regularly inspect heat welders to minimize tool-related injuries and uneven bonding for consistent membrane adhesion quality.

**Personal protective equipment**

- **Consider anti-vibration dampening material on handles** to reduce the effects of hand-arm vibration. Vibration affects manual dexterity, requiring greater grip strength than necessary.

**MODERATE whole body fatigue risk**  
The risk for physical fatigue was **moderate**. The average cardiovascular effort for this task was above the recommended threshold considered sustainable for an 8-hour workday 67% of the time.

**Administrative Controls**

- **Consider using task rotation to balance physically demanding tasks with those that are less demanding to avoid fatigue.** The most effective task rotation scheme alternates between body regions and muscle groups, to provide rest periods and reduce overall muscle exertion and overload. For instance, alternating between lifting and gripping may reduce muscle exertion of the shoulders, neck, and back but not for the hand-arm.
- **Take rest breaks to avoid overexertion and overload.** Rest breaks interrupt or decrease long periods of repetitive or monotonous workloads.
- **Consider balancing work pace,** where too quick a pace reduces the effectiveness of rest breaks and increases the chance of mistakes and poor technique.

## Analyzing Data By JOB

| Task | Calculated Risk Level (R)<br>(Low=1, Moderate=2, High=3) | Observed Duration (D) | Time Weighted Average (TWA)<br>$\frac{R_1 D_1 + R_2 D_2 \dots R_5 D_5}{\sum D}$ | Overall Risk Score (Low: $TWA \leq 1$ ,<br>Moderate: $1 < TWA \leq 2$ ; High: $TWA > 2$ ) |
|------|--|-----------------------|---|---|
| 1    | R <sub>1</sub>   | D <sub>1</sub>        | TWA   | Low/Moderate/High   |
| 2    | R <sub>2</sub>   | D <sub>2</sub>        |   |   |
| 3    | R <sub>3</sub>   | D <sub>3</sub>        |   |   |
| 4    | R <sub>4</sub>   | D <sub>4</sub>        |   |   |
| 5    | R <sub>5</sub>   | D <sub>5</sub>        |   |   |

### MSD Risks

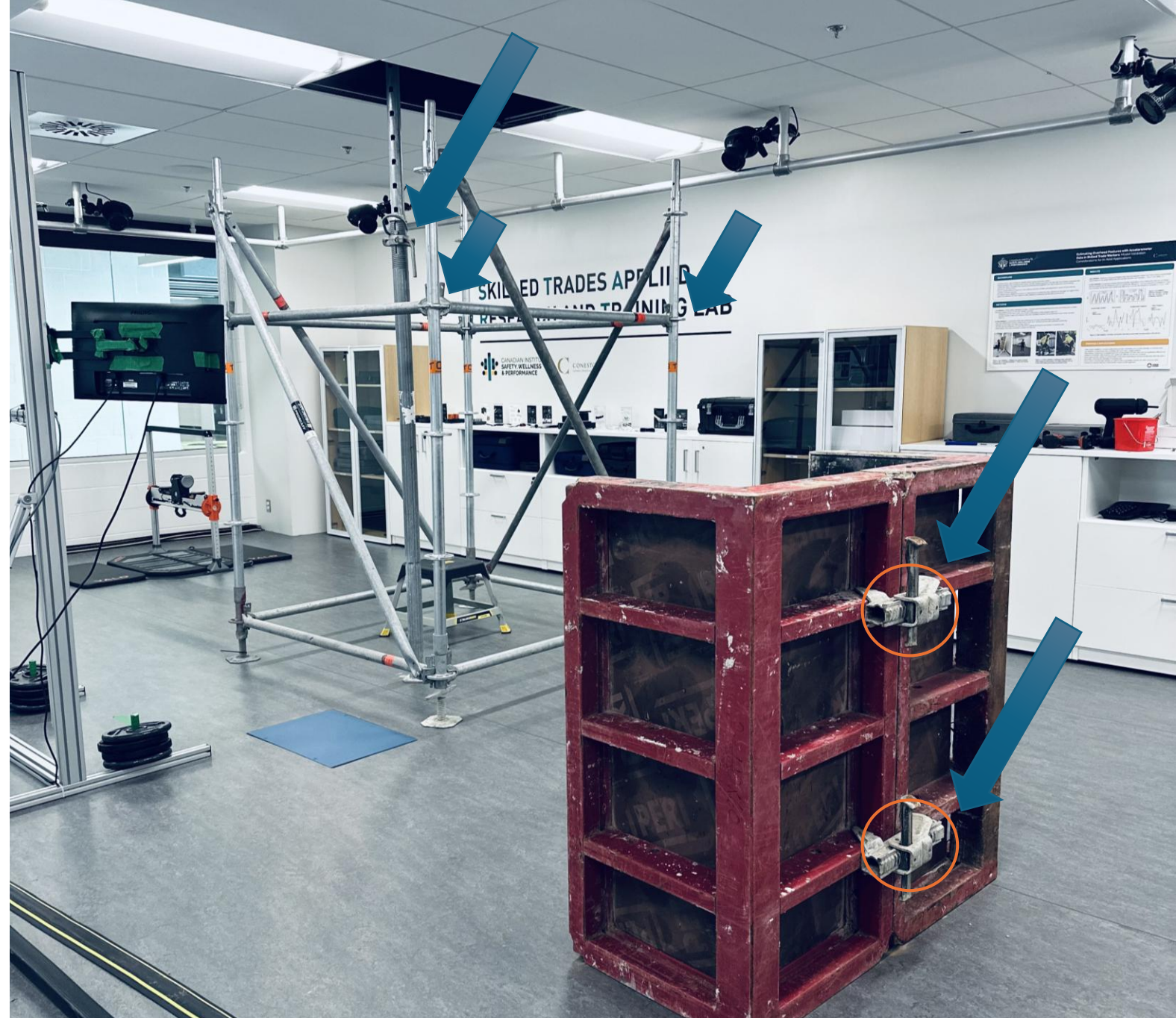
|                                | Neck and upper back | Hand-arm | Shoulder | Low back | Whole-body fatigue | Thermal  |
|--------------------------------|---------------------|----------|----------|----------|--------------------|----------|
| <b>Roofers<br/>(NOC 73110)</b> | Low                 | Moderate | Low      | Moderate | Moderate           | Moderate |

## SAFE WORKSITE PROJECTS

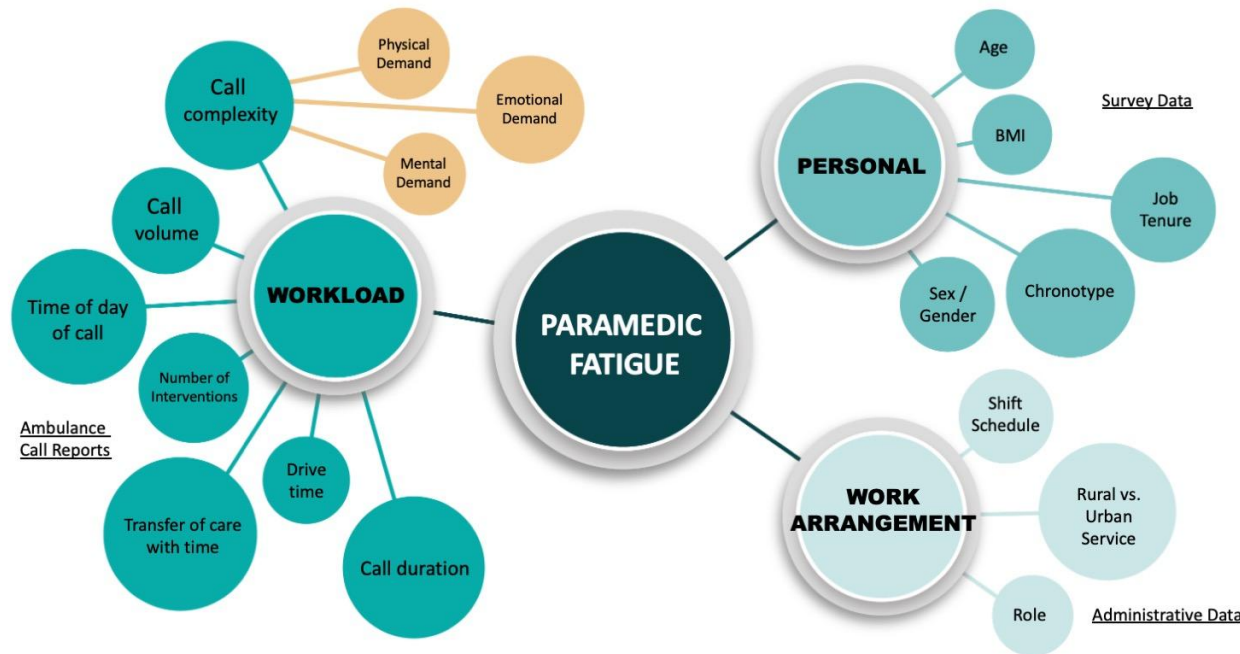
### PROJECT: HAMMER DESIGN

- **Objective:**  
To identify the most effective hammer design for scaffold and formwork wall assembly.

..... More Details on the  
Lab Tour



## PROJECT 2: PARAMEDIC FATIGUE RISK MANAGEMENT TOOL



### Fatigue is linked to:

- Increased medical errors and poor patient care quality
- Paramedic injuries, including accidents and risk of musculoskeletal disorders and burnout.
- An impact on services, having to deal with significant sick leaves, compensation costs, and a growing labour shortage.

### What did we do?

- A multi-year longitudinal cohort study with several services
- Actigraph watches worn for 90 days over 3 phases
- Conducted logistical regression to identify main factors related to paramedic fatigue.
- Developed a data-driven fatigue prediction calculator and management dashboard based on daily workload and administrative data using machine learning models.

## Paramedic Fatigue Management System Dashboard (FMSD)

Predict poor sleep risk based on occupational and ACR metrics The app will estimate the probability of poor sleep for the shift data entered based on trained model data.

Full Name  Date

[Personal Info](#) [ACR Info](#)

Sex  Age

Height (cm)  Weight (kg)

Occupational Title  Job Tenure (years)

Total shift hours  Shift Type

**No prediction yet**

**Risk Level**  
No risk computed yet.

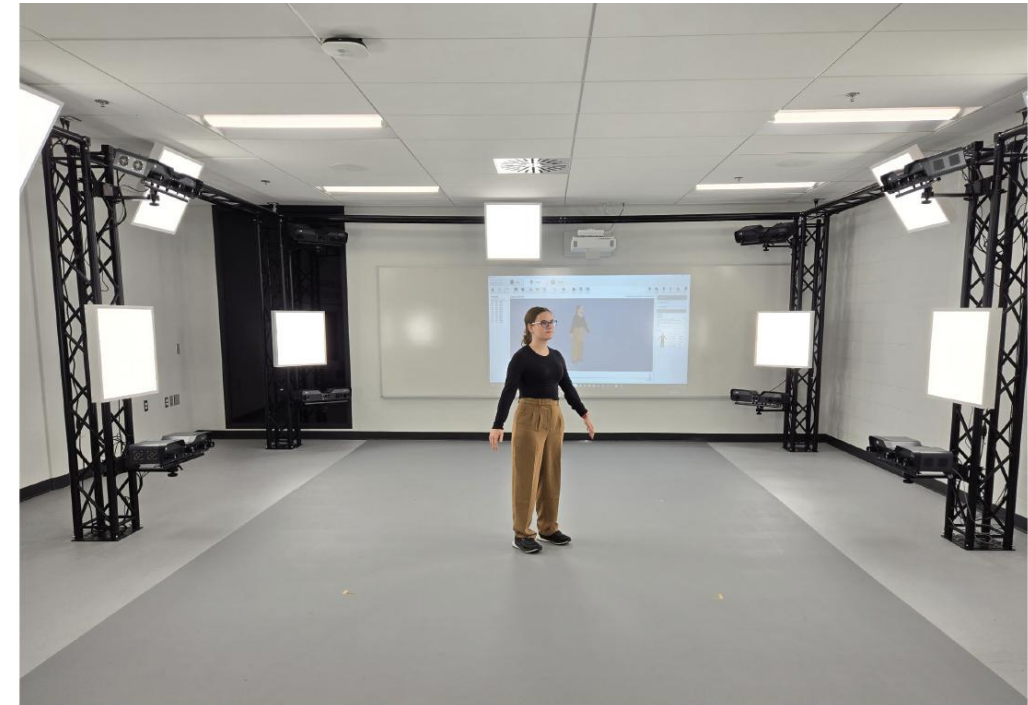
| Probability Estimate | Status                        |
|----------------------|-------------------------------|
| —                    | Run prediction to see status. |

**Recommendation**  
Click 'Predict' after entering the details to see the risk assessment.



## MOSAIC (Multivariate Occupation-Specific Anthropometric Database)

Develop Canada's only multivariate anthropometry database to make work **more inclusive, safer, and health equitable** through **better design** of **PPE, tools, and equipment**, reflective of the many body shapes and capabilities of Canada's diverse workforce.



# What is measured?



## Static and dynamic 4D body scan

Full morphological digital mapping



## Muscle strength and capacity

Isometric and functional testing



Foot scan



Hand scan



Body composition



Demographics



## Pain and discomfort mapping

Self-reported musculoskeletal data

# Participants

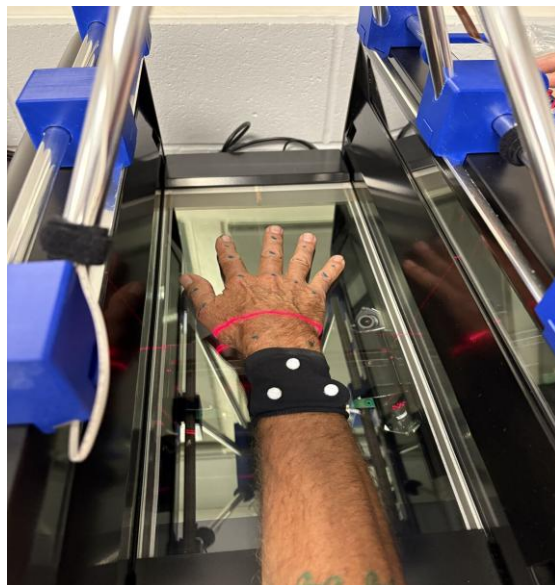
**CANADIAN WORKERS**

**JOB-SPECIFIC DATABASE**

The MOSAIC study is developing Canada's first comprehensive anthropometric database to revolutionize workplace ergonomics and safety standards across all major industrial sectors.

# MOSAIC DATA COLLECTION





Name: 002.001 (ID:). Gender: Male.

| Measure                              | Left foot | Right foot |
|--------------------------------------|-----------|------------|
| Foot length (mm)                     | 276.1     | 278.6      |
| Toes position (mm)                   | 229.7     | 232.1      |
| Toes angle (degrees)                 | 22.7°     | 24.0°      |
| Toes Girth (mm)                      | 255       | 255        |
| Toes Height (mm)                     | 24.1      | 22.8       |
| Toes Width (mm)                      | 115.6     | 116.0      |
| Position of 1st metatarsal head (mm) | 202.9     | 205.2      |
| Position of 5th metatarsal head (mm) | 178.7     | 182.2      |
| Ball position (mm)                   | 190.1     | 193.0      |
| Ball angle (degrees)                 | 14.6°     | 13.5°      |
| Ball girth (mm)                      | 268.1     | 268.5      |
| Ball height (mm)                     | 43.1      | 41.3       |
| Medial ball height (mm)              | 34.6      | 32.4       |
| Lateral ball height (mm)             | 25.0      | 24.0       |
| Ball width (mm)                      | 111.5     | 112.3      |
| Instep girth (mm)                    | 264       | 265        |
| Instep height (mm)                   | 66.3      | 65.1       |
| Instep width (mm)                    | 99.8      | 100.7      |
| Navicular position (mm)              | 105.5     | 103.6      |
| Navicular height (mm)                | 41.1      | 40.6       |
| Heel Width (mm)                      | 68.1      | 67.1       |
| Instep to heel girth (mm)            | 362       | 365        |
| Arch Area                            | 2485      | 3235       |
| Foot breadth (mm)                    | 107.9     | 109.2      |



Move 4D

Data
Subject
Dynamics
Settings

Object
Mode
Projection
N.Views
View
Background
Elements
Synchron.
Clean
Measurem.
Copy
Save
Video

Export
Exit

Modules:

| Name | Points |
|------|--------|
|      |        |

Capture: A-POSE Frequency: 90 fps; Frames: 4; Date: 23/07/25

Subject file

Project: MOSAIC\_002

Subject: 002\_062

Measurement wizard

Measurem. Settings

| View                     | Measurement       | Value (mm) |
|--------------------------|-------------------|------------|
| <input type="checkbox"/> | Height            | 1802.0     |
| <input type="checkbox"/> | Back neck ht      | 1547.0     |
| <input type="checkbox"/> | Back neck-hip ht  | 618.1      |
| <input type="checkbox"/> | Torso ht          | 746.1      |
| <input type="checkbox"/> | Cervicale-knee ht | 1049.7     |
| <input type="checkbox"/> | Back neck-knee    | 1079.2     |
| <input type="checkbox"/> | Waist-knee ht     | 625.5      |
| <input type="checkbox"/> | Waist ht          | 1122.8     |
| <input type="checkbox"/> | High waist ht     | 1158.2     |
| <input type="checkbox"/> | Hip ht            | 928.8      |
| <input type="checkbox"/> | Max hip girth ht  | 894.9      |
| <input type="checkbox"/> | Inside leg ht     | 800.9      |
| <input type="checkbox"/> | Knee ht l         | 498.3      |

**Waist height**

Vertical distance from the waist level to the ground (virtual anthropometer). Waist level (ISO 8559-1:2017 3.1.22) is the midway level between the lowest rib point and the highest point of the hip bone at the side of the body. Lowest rib point (ISO 8559-1:2017 3.1.15) is the inferior point of the bottom of the rib cage (tenth rib) projected horizontally, 45 degrees from the mid-sagittal plane, to the surface of the skin. The highest point of the hip bone (ISO 8559-1:2017 3.1.16) is the highest point at the side of the upper border of the iliac crest.

⏪
⏩
⏴
⏵
✂
🗑

● x1
○ :2
○ :4
○ :8
○ :16

Frame: 0

Time: 00:00.000 00:00.000 00:00.033

Move 4D

Data
Subject
Dynamics
Settings

Object
Mode
Projection

N.Views
View
Background
Elements

Compute

Capture: GAIT
Frequency: 90 fps; Frames: 180; Date: 23/07/25

Drag any dynamic measurement to see its graphical representation

⏮
⏪
⏩
⏭

○ x1
●
○ :2
○ :4
○ :8
○ :16

Frame: 0  
Time: 00:00.000

Subject file

Project:

Subject:

Measurement wizard

| View                                | Measurement            |
|-------------------------------------|------------------------|
| <input type="checkbox"/>            | 7CV to waist contoured |
| <input checked="" type="checkbox"/> | Maximum thigh girth R  |
| <input checked="" type="checkbox"/> | Maximum thigh girth L  |
| <input type="checkbox"/>            | Mid thigh girth R      |
| <input type="checkbox"/>            | Mid thigh girth L      |
| <input type="checkbox"/>            | Low thigh girth R      |
| <input type="checkbox"/>            | Low thigh girth L      |
| <input type="checkbox"/>            | Total crotch length    |
| <input type="checkbox"/>            | Front crotch length    |
| <input type="checkbox"/>            | Back crotch length     |
| <input type="checkbox"/>            | Waist girth            |
| <input type="checkbox"/>            | Upper-arm girth L      |
| <input type="checkbox"/>            | Upper-arm girth R      |
| <input type="checkbox"/>            | Outer arm length L     |
| <input type="checkbox"/>            | Outer arm length R     |
| <input type="checkbox"/>            | Upper-arm length L     |
| <input type="checkbox"/>            | Upper-arm length R     |

**Maximum thigh girth left**  
 Mean of the maximum horizontal girth of the left thigh below the gluteal fold. Extended interpretation made by IBV of the static measurement described in ISO 8559-1:2017 5.3.3.20 (similar to ISO 7250-1:2017 6.4.13 and ASTM D5219-15 Thigh girth) that can be generalized to any posture and movement.

Move 4D

Data

Subject

Dynamics

Settings

Object

Mode

Projection

N.Views

View

Background

Elements

Compute

Capture: REACH
Frequency: 90 fps; Frames: 180; Date: 23/07/25

Drag any dynamic measurement to see its graphical representation

⏮

▶

⏭

x1
  :2
  :4
  :8
  :16

Frame: 0

Time: 00:00:00

00:00.000 00:00.111 00:00.222 00:00.333 00:00.444 00:00.555 00:00.666 00:00.777 00:00.888 00:01.000 00:01.111 00:01.222 00:01.333 00:01.444 00:01.555 00:01.666 00:01.777 00:01.888 00:01.988

Subject file

Project

Subject

Measurement wizard

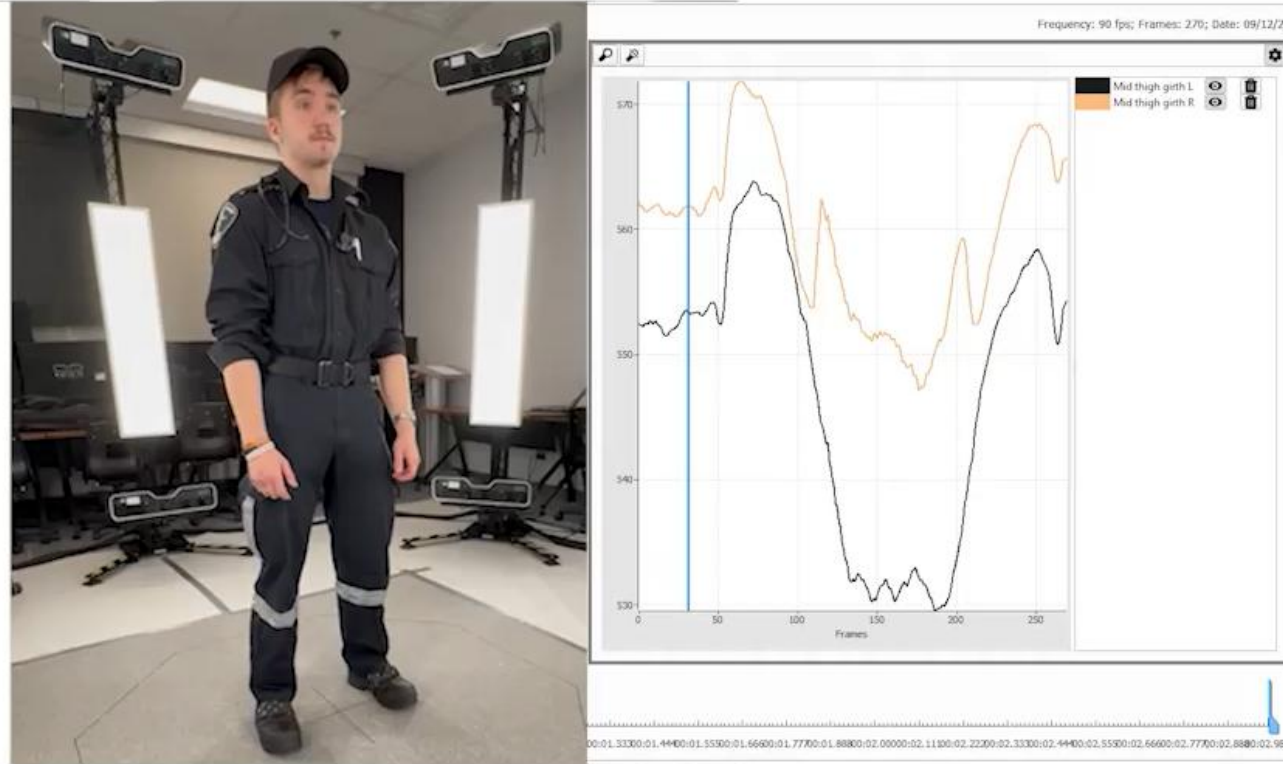
Measurem.

| View                                | Measurement            |
|-------------------------------------|------------------------|
| <input type="checkbox"/>            | 7CV to waist contoured |
| <input type="checkbox"/>            | Maximum thigh girth R  |
| <input type="checkbox"/>            | Maximum thigh girth L  |
| <input type="checkbox"/>            | Mid thigh girth R      |
| <input type="checkbox"/>            | Mid thigh girth L      |
| <input type="checkbox"/>            | Low thigh girth R      |
| <input type="checkbox"/>            | Low thigh girth L      |
| <input type="checkbox"/>            | Total crotch length    |
| <input type="checkbox"/>            | Front crotch length    |
| <input type="checkbox"/>            | Back crotch length     |
| <input type="checkbox"/>            | Waist girth            |
| <input type="checkbox"/>            | Upper-arm girth L      |
| <input type="checkbox"/>            | Upper-arm girth R      |
| <input type="checkbox"/>            | Outer arm length L     |
| <input checked="" type="checkbox"/> | Outer arm length R     |
| <input type="checkbox"/>            | Upper arm length L     |
| <input type="checkbox"/>            | Upper arm length R     |

**Outer arm length right**

Distance from right shoulder point to right elbow point, then the right elbow point to the right wrist point. Extended interpretation made by IBV of the static measurement described in ISO 8559-1:2017 5.7.8, ASTM D5219-15, ISO 18825-2:2016 2.2.10 Arm length, that can be generalized to any posture and movement.

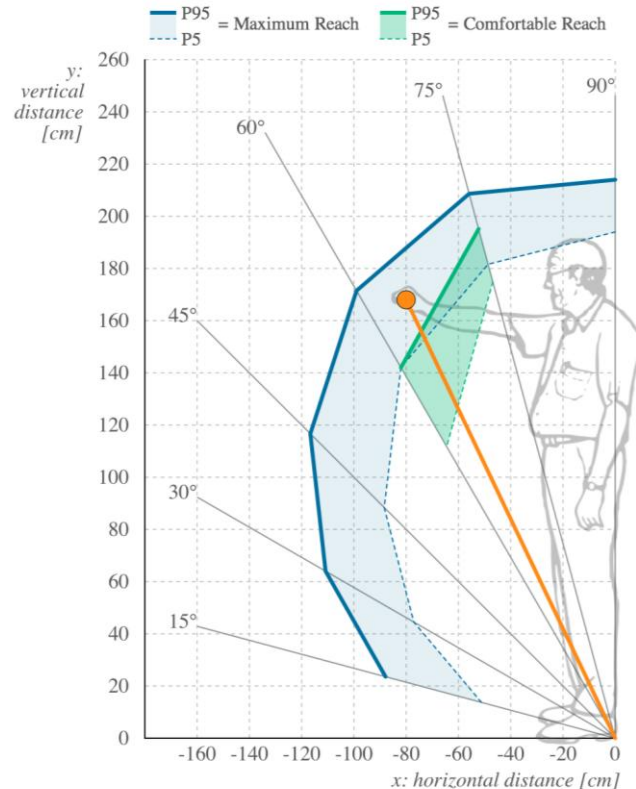
## 4-DIMENSIONAL DYNAMIC BODY ANALYSIS: GARMENT DESIGN



In addition, we are developing a catalog of 4D dynamic body scans of occupation-specific simulated work tasks. These simulations can be utilized to analyze the **CHANGE** in body dimensions during movement which must be accommodated in design (ex. Fabric stretch).

## 4-DIMENSIONAL DYNAMIC BODY ANALYSIS: TOOLS AND WORKSTATION DESIGN

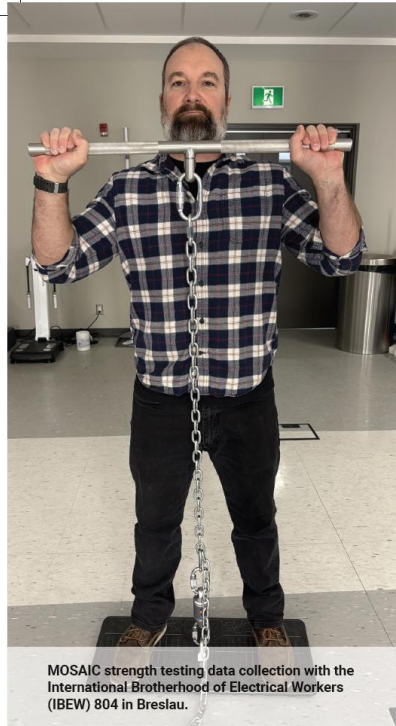
### Existing Geometric Tools



### 4D Dynamic MOSAIC Tool



The 4D dynamic body scan database may also be utilized to develop ergonomic tools such as reach envelope analyses which offer increased sensitivity to individual demographics and anthropometrics.



MOSAIC strength testing data collection with the International Brotherhood of Electrical Workers (IBEW) 804 in Breslau.



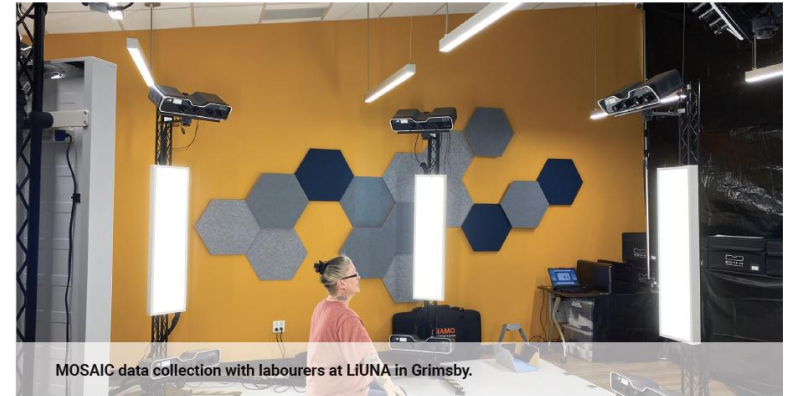
MOSAIC data collection with paramedics at Halton Paramedics.



MOSAIC body scanning data collection with IBEW 804 in Breslau.



MOSAIC data collection with apprentices at the Ontario Masonry Training Centre in Mississauga.



MOSAIC data collection with labourers at LiUNA in Grimsby.



## MOSAIC Data Collection

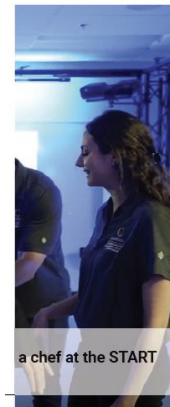
Canada's Innovative Multivariate Occupation-Specific Anthropometric Database

MOSAIC utilizes state of the art anthropometric (body dimension measuring) and strength capacity equipment to calculate the body measurements and capabilities of the workforce. CISWP is taking our mobile data collection equipment to various worksites across Ontario to collect data to build the databases required by product manufacturers to design more inclusive and better fitting tools, equipment, and personal protective equipment (PPE). MOSAIC will help make work more inclusive, safer, and health equitable for all of the diverse Canadian workforce through the better design of tools, equipment, and PPE to meet their needs.

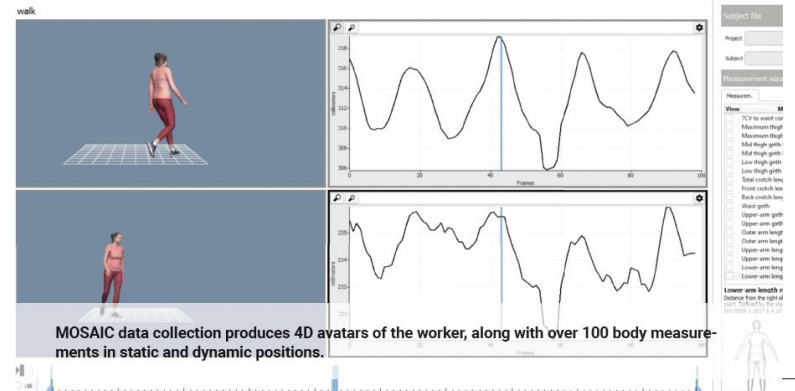
This initiative is funded by: WSIB Ontario



MOSAIC Data collection with a chef at the Lab in Cambridge.



a chef at the START



MOSAIC data collection produces 4D avatars of the worker, along with over 100 body measurements in static and dynamic positions.



# Thank You!

Contact Us:  
[info@ciswp.ca](mailto:info@ciswp.ca)



CISWP 2030 VISION:

**BETTER  
DATA.  
SAFER  
WORK.**



**BETTER  
DATA.  
SAFER  
WORK.**