# Heat Stress Exposure of Construction Workers: A Case Study on the Construction of an Academic Building in Southwest Florida

**Kenneth S. Sands II, Ph.D.[1], Craig D. Capano, Ph.D.[2], CPC, Kamau Lawson**

Department of Construction Management, Florida Gulf Coast University

kesands@fgcu.edu[1], ccapano@fgcu.edu[2]

## Introduction & Need

*A significant stressor for construction workers is the potential exposure to heat stress related illnesses. Workers in southwest Florida are especially susceptible to incidents of heat stress due to climatic conditions that include high temperatures combined with high relative humidity. Working in hot conditions induces a physiological strain on workers and extreme variations from the internal body temperature interferes with body functions and normal homeostasis. Workers who are exposed to extreme heat or who work in hot conditions can be exposed to heat stress which can result in heat stroke, heat exhaustion, heat cramps, or heat rashes. There are a number of studies regarding heat related illnesses in the construction industry; however, there are limited case studies on the conditions of heat exposure experienced by construction workers.*

## Research Objectives

- *Provide a case study for academic literature to describe the heat stress related conditions experienced by construction workers while working on an academic building in southwest Florida.*
- *Identify and document key issues pertaining to worker heat stress conditions through OSHA's Heat Hazard Assessments.*
- *Observe and describe any mitigation strategies employed by the project management team (PMT) to reduce heat stress exposure of workers via this case study.*

## Research Impact

- *Provides a work-in-progress case study on the heat stress conditions of construction workers in southwest Florida with a focus on providing decision-makers insight into proper heat stress safety protocols and mitigation strategies used by a PMT.*
- *Provides the severity of heat stress conditions which southwest Florida construction workers are exposed to help PMTs understand the importance of task planning and heat stress mitigation for worker safety.*

## Design & Methods

*As a case study, observations of worker heat stress conditions were observed on an active construction site of an academic building in southwest Florida by performing heat hazard assessments from August 2020 (start of labor work) through October 2020, a period of heavy activity for sitework and concrete workers. The primary protocol for data collection is the OSHA Heat Hazard Assessment which involves four steps.*

Fig. 1. Kestrel 5400 Heat Stress Tracker Setup

***Step 1:** We determined the daily wet bulb globe temperature (WBGT) using the Kestrel 5400 WBGT Heat Stress Tracker*

| Clothing Worn | CAF |
|---|---|
| Work clothes (long sleeves and pants). Examples: Standard cotton shirt/pants. | 0 |
| Coveralls (w/only underwear underneath). Examples: Cotton or light polyester material. | 0 |
| Double-layer woven clothing. | 3 |
| SMS Polypropylene Coveralls | 0.5 |
| Polyolefin coveralls. Examples: Micro-porous fabric (e.g., Tyvek™). | 1 |
| Limited-use vapor-barrier coveralls. Examples: Encapsulating suits, whole-body chemical protective suites, firefighter turn-out gear. | 11 |

Fig. 2. Clothing Adjustment Factors (OSHA 2020)

***Step 2:** We considered the addition of the clothing adjustment factor to determine the WBGT effective – observations of worker attire were documented.*

***Step 3:** determine the metabolic work rate based on the worker activity.*

| Work Category | Metabolic Rate (Watts) | Examples |
|---|---|---|
| Rest | 115 | Sitting |
| Light | 180 | Sitting, standing, light arm/hand work and occasional walking |
| Moderate | 300 | Normal walking, moderate lifting |
| Heavy | 415 | Heavy material handling, walking at a fast pace |
| Very Heavy | 520 | Pick and shovel work |

Fig. 3. Metabolic Work Rates (OSHA 2020)

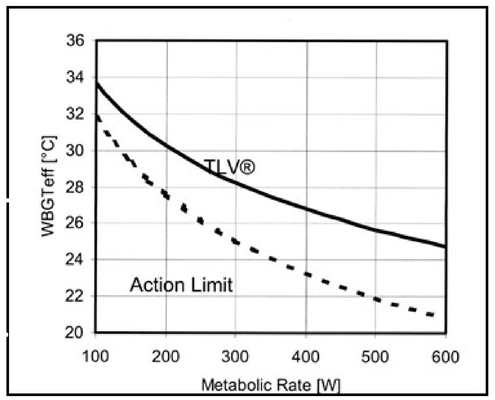


Fig. 4. ACGIH TLV & Action Limit (OSHA 2020)

***Step 4:** We determined the threshold limit value (TLV) or action limit (AL) using the American Conference of Governmental Industrial Hygienists (ACGIH) table to screen workers for heat stress exposure.*

**Additionally, site conditions and mitigation strategies of the PMT are observed. The work is expected to continue from April 2021 through October 2021*

## Preliminary Results

*Preliminary results indicate that workers regularly experienced heat stress conditions for the types of activities being performed. Even though the attire of workers were long-sleeved shirts, long denim pants, boots, face-masks, gloves and hard hats, it didn't warrant an addition of the clothing adjustment factor (CAF).*

*Based on the ACGIH, there were a significant number of hours with excessive WGBT values that would warrant a 50/50 work-rest cycle and physiological monitoring which are suggested under these conditions. Mitigation strategies employed by the PMT included the provision of regular breaks, filtered water systems and an outdoor cold wall merchandiser with ice. The study is expected to be completed during the month of October 2021 during which further data analysis will be conducted and more conclusive results will be discussed.*

## References

*American Conference of Governmental Industrial Hygienists (ACGIH) (2017). "Heat Stress and Strain: TLV® Physical Agents 7th Edition Documentation (2017)". TLVs and BEIs with 7th Edition Documentation, CD-ROM. Cincinnati, OH, 2017.*

*Occupational Safety and Health Administration (OSHA) (2020). "Heat Stress" <https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_4.html> (November 20, 2020)*