

Improving JHA in Electrical Construction: A Workers' Perspective

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CPWR – The Center for Construction Research and Training
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CPWR's Project Team

CPWR – The Center for Construction Research and Training



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Project AIMS

Project: “Prevention through Augmented Pre-task Planning” – Funded by NIOSH.



AIMS: Enhance the quality of JHA and Pre-task Planning, particularly in electrical construction:

- Partner with electrical contractors of various sizes, unions, and associations
- Develop ready-for-impact “Electrical Task Challenges & Solutions” documents informed by workers’ input
- Disseminate findings and make them publicly available through CPWR’s R2P and Communications channels

Today's Presentation

- **Step 1:** Job Hazard Analysis (JHA) challenges – preliminary findings
- **Step 2:** High-risk electrical tasks and contributing work factors from practitioners' perspective
- **Step 3:** Work factors and project attributes increasing workers' task difficulties and impacting overall performance
- **Step 4:** Develop and disseminate ready-for-impact resources

Industry Advisory Group & Partners

Electrical Contractors

- Rosendin Electric (Marty Rouse, Shayne Stevens, Derek Morgan, and Josh Johnson)
- MC Dean Building Intelligence (John Bennett and Aaron Schoemaker)
- Contemporary Electric (Blake Downer)
- Freestate Electric (Ron Michael and Dean Speelman)
- Valley Electric (Jamie Stuart)



Unions & Associations

- NECA (Jerry Rivera, Wes Wheeler, and Justin Thayer)
- IBEW (David Mullen)



General Contractors

- Clark Construction (Keena Myers)
- Penta Group (Rodd Webber and Elias Brooks)



Job Hazard Analysis (JHA)

Job Hazard Analysis (JHA):

- To identify potential hazards associated with tasks.
- To recommend controls to proactively address hazards.

The gap in the JHA process:

- Mainly from a compliance perspective.
- Minimal opportunity for workers' input.
- Lack of information on human performance and human factors.
- Lack of workers' engagement in site safety planning.
- Lack of task-specific content.
- Inconsistency between JHA content and task requirements.
- Lack of comprehensive guidelines.
- Confusion and conflicts on jobsites.

Preliminary Findings

JHA Challenges	Recommendations & Strategies
Optimizing content <ul style="list-style-type: none">▪ Long and wordy documents▪ Inconsistency between JHA and task requirements▪ Lack of management presence on jobsites▪ Minimal opportunity for workers' input	<ul style="list-style-type: none">▪ Provide task-specific information▪ Use one-page summaries/"mini-JHA" pocketbooks▪ Replace text with visual aids when possible (photos, videos)▪ Frequent site visits by management▪ Perform post-job review/debrief
Buy-in <ul style="list-style-type: none">▪ Pencil-whipping▪ Resistance to change	<ul style="list-style-type: none">▪ Personalize the JHA process▪ Incorporate real-life incidents and near-misses▪ Designate workers to serve as liaison with management▪ Actively solicit worker feedback
Communication & Coordination <ul style="list-style-type: none">▪ Lack of consistency in communicating jobsite changes▪ Lack of mentorship▪ Language barrier▪ Absenteeism	<ul style="list-style-type: none">▪ Perform site audits regularly▪ Engage all stakeholders equally in site safety planning▪ Recognize hazards from adjacent crews▪ Pair non-English speaking workers with bilingual coworkers▪ Brief workers who were absent on current site condition

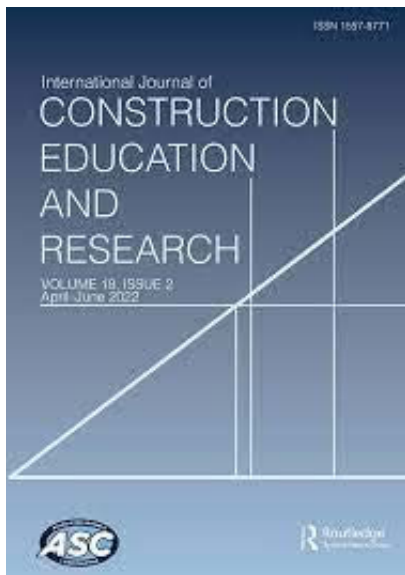
JHA Article

Obstacles and Solutions to Implementing Job Hazard Analysis in Construction: A Case Study

Babak Memarian, Sara B. Brooks, and Jean Christophe Le.

International Journal of Construction Education and Research (January 2022)

<https://doi.org/10.1080/15578771.2022.2027053>




INTERNATIONAL JOURNAL OF CONSTRUCTION EDUCATION AND RESEARCH
<https://doi.org/10.1080/15578771.2022.2027053>

 **Routledge**
Taylor & Francis Group

 Check for updates

Obstacles and Solutions to Implementing Job Hazard Analysis in Construction: A Case Study

Babak Memarian , Sara B. Brooks, and Jean Christophe Le

CPWR – The Center for Construction Research and Training, Silver Spring, Maryland, USA

ABSTRACT

Construction workers experience a disproportionately high rate of work-related injuries. However, if hazards are properly recognized and addressed, most of these incidents are preventable. Job hazard analysis (JHA) is a method for identifying and mitigating workplace hazards that emphasizes proactive risk control. Despite its importance, the construction industry currently lacks comprehensive guidelines on how to effectively design and implement JHA on a consistent basis. To fill this gap, this case study pursued two objectives: (1) to explore challenges and shortcomings of current practices in developing and implementing JHA in construction and (2) to identify effective practices and interventions employed by contractors to address these challenges. To this end, 30 sample JHA documents were analyzed, and 23 semi-structured interviews were conducted with construction safety professionals representing 17 companies. Findings of this study identified a lack of worker involvement in the process, lack of buy-in, management absence, complacency, and inadequate coordination and communication as major issues. Solutions explored to address these challenges included incorporating visual aids, rotating JHA meeting leaders, and continuously updating JHA information to reflect the current work conditions. The practical implications of these findings and the path forward for further research are discussed.

KEYWORDS

Job hazard analysis;
job safety analysis; JHA;
construction safety;
pre-task planning

Electrical Construction



Jerry Rivera, MEng, GSP

Safety Director, The National Electrical Contractors Association (NECA)
Washington, DC, Chapter
Project Advisor

Electrical Construction



Electrical construction; a high-risk trade.

The Problem

- Most controls and practices are from a compliance perspective
- Minimal room for workers' perspective and input

The Need

- Improve the quality of pre-task planning and JHA in electrical work
- Provide task-specific content from electrical workers' perspective
- Incorporate workers' input in redesigning the work process and task

High-risk Electrical Tasks & Contributing Work Factors

Identified high-risk electrical tasks and contributing work factors based on input from 14 electrical contractors.

- Demolition/removal of electrical equipment
- Site work, layout, and logistics
- Prepare ground for underground electrical installations
- Pull cables and wires
- Lock Out/Tag Out (LOTO)
- Operate trucks with boom lifts or stand-alone lifts
- Produce openings for conduit and electrical lines
- Installation of new electrical equipment
- Preventive maintenance on electrical equipment
- Energize electrical equipment

Findings Snapshot

Pull Cables & Wires

- Improper ergonomic techniques and awkward posture due to tight workspaces
- Not using mechanical aids to move reels
- Improper use of the tugger
- Sharp edges (e.g., HVAC ductwork)
- Long distance pull operations



Findings Snapshot

Energized Electrical Equipment

- Incomplete, incorrect, or mislabeled installations
- Failure to follow the LOTO procedures
- Using conductive tools
- Improper control of downstream devices
- Circuit breaker failure causing arc flashes and igniting combustible dust



Findings Snapshot

Prepare ground for underground electrical installations

- Striking unground live lines/energized feeders
- Trench preparation and excavation
- Hazardous atmospheres (e.g., manholes and duct banks)
- Tight workspace
- Procedure violation - using stronger chipping guns to accelerate progress
- Poor quality inspection due to dirt obscuring wire coatings



Findings Snapshot

Preventive maintenance on electrical equipment

- Complex LOTO procedure due to multiple switchgear and unaccounted feeds
- Failure to follow LOTO procedures
- Contact with energized parts (e.g., conductors and bus bars)
- Overloading load bank
- Faulty load banks and cables
- Improper connection to load bank



Article: High-risk Electrical Tasks & Contributing Work Factors



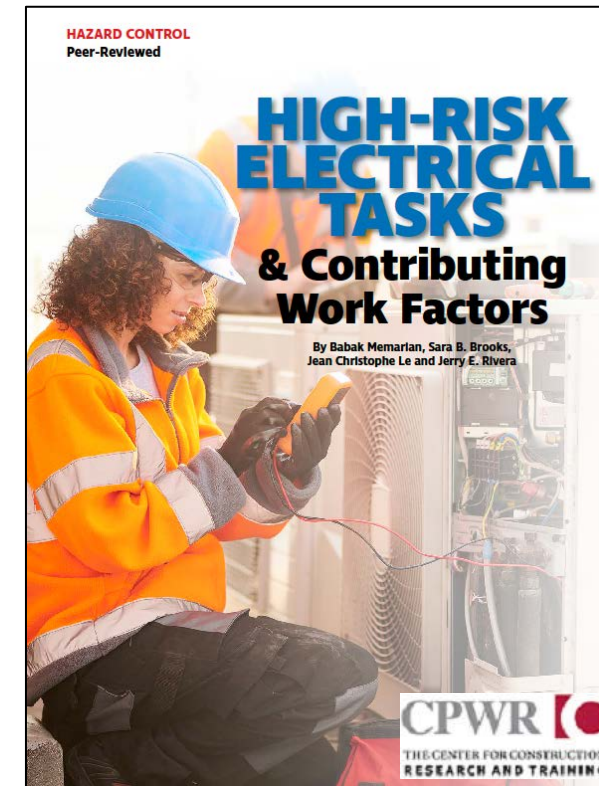
- A peer-reviewed article published by the Professional Safety Journal (ASSP).

High-risk Electrical Tasks and Contributing Work Factors

Babak Memarian, Sara B. Brooks, Jean Christophe Le, and Jerry E. Rivera

Professional Safety Journal (August 2022)

https://www.assp.org/docs/default-source/psj-articles/f1mem_0822.pdf?sfvrsn=d8b99447_0



Let's think beyond just compliance!

What else should be included in JHA?

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What else should be included in JHA?

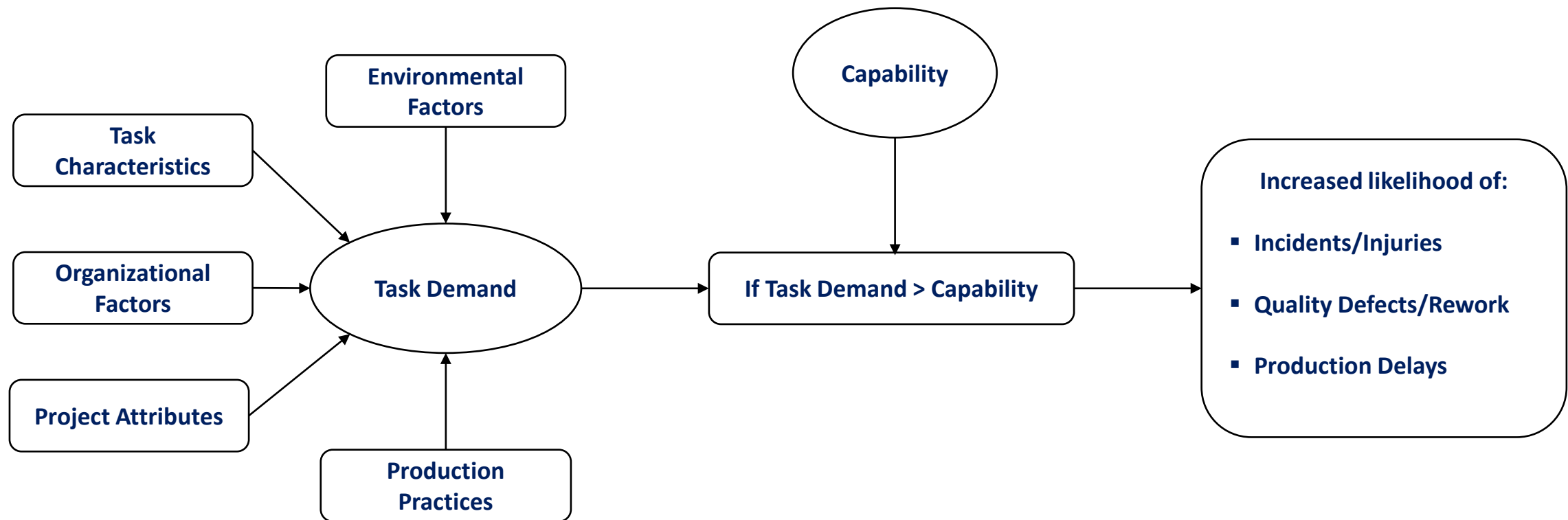
“Learn and incorporate what workers say about the task.”

Human Performance & Workplace Safety

- In line with the NFPA 70E “Human Performance and Workplace Electrical Safety”
 - **Error Precursors; Task Demands**; time pressure, high workload, repetitive actions, multi-tasking, unclear goals, unclear standards, etc. (NFPA Q 6.1, Table Q5)
 - **Human performance tools**; pre-job briefing/planning, post-job review, jobsite review, etc.

“Learn and incorporate what workers say about the task.”

Task Demands in Construction



Enhanced JHA & Pre-task Planning in Electrical Construction

- Interviews with electrical workers to assess task difficulties and explore contributing work factors:
 - Physical loads
 - Mental loads
 - Time pressure
 - Environmental factors
 - Frustration
 - Other

First; measure physical, mental, temporal (time), and frustration (1= very low and 10=very high).

Second; identify contributing factors – what makes your task challenging.

Third; what tips and tricks do you suggest to simplify the task?

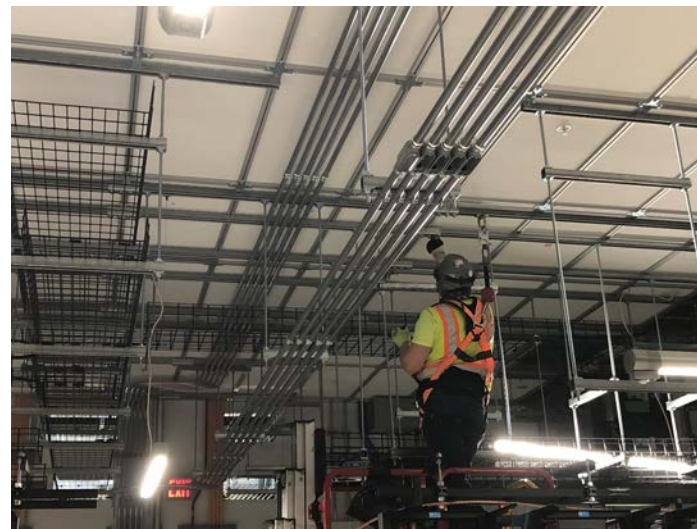
- To date; conducted 90 in-person onsite interviews with electrical workers.



Electrical Tasks Studied to Date

18 electrical tasks studied to date:

- Overhead Conduit Installation
- Installing Lighting Tracks & Supports
- Site Preparation and Layout
- Pulling Wire
- Terminations
- Electrical Demolition
- Cable Tray Installation
- Grounding
- Busway Installation
- Material Handling/Logistics
- Wiring AC Units
- Connecting Building-to-Building Conduit
- Access Card Readers Installation
- Fire Alarm Components Installation
- Receptacles Installation
- Branch Circuits Installation
- Pre-fabricated Components
- QA/QC



“Electrical Task Challenges & Solutions” Documents

- Organized based on Task and Project Type
- Applicable for JHA, Pre-Task Planning, and Training
- Contains task-specific challenges raised by workers
- Visualizes the situation using images
- Recommends solutions
- Easy to download and use in PDF and MS Word format
- Customizable for specific project needs
- 33 ready-for-impact task-specific documents under various project types
- Publicly available free of charge

TASK: _____ PROJECT TYPE: _____

Summary: _____

Location: _____

The following page(s) list the challenges that workers identified while performing this task and recommendations for improvement.

Challenges are organized into the following categories:

Physical/Ergonomic challenges pertain to musculoskeletal activity required to perform a task such as pushing, pulling, turning, controlling. Moreover, it gauges the biomechanical complexity versus simplicity in performing a task.

Mental/Frustration challenges pertain to mental and perceptual activity required to perform a task such as thinking, deciding, calculating, remembering, looking, searching. Moreover, it gauges worker discouragement, irritation, stress and annoyance versus security, gratification, contentment, and comfort.

Type	Workers' Challenge	Recommendations and Suggestions
Physical/Ergonomic		
Mental/Frustration		
Mental/Frustration and Physical/Ergonomic		

“Electrical Task Challenges & Solutions” Documents (cont.)

TASK: Overhead Conduit Installation

PROJECT TYPE: Commercial Building Renovation

TASK: Overhead Conduit Installation PROJECT TYPE: Commercial Building Renovation

Summary: Overhead conduit and component installation took place in a partially closed public museum undergoing renovation and expansion in winter. Work was performed in the presence of fragile, unmovable historic artifacts.

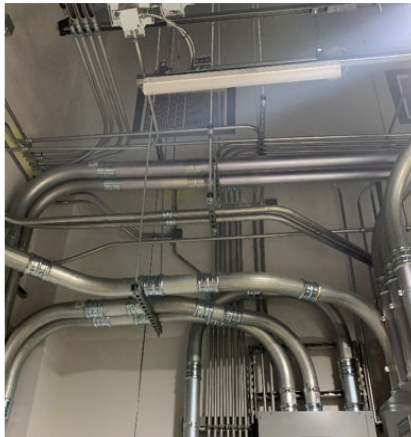

Location: Urban center in US Mid-Atlantic region.

The following page(s) list the challenges that workers identified while performing this task and recommendations for improvement.

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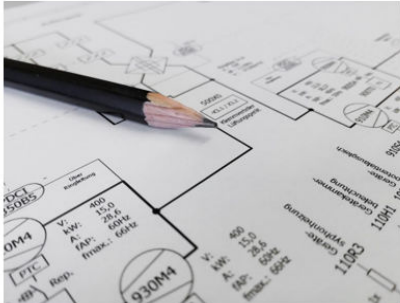
Mental/Frustration challenges pertain to mental and perceptual activity required to perform a task such as thinking, deciding, calculating, remembering, looking, searching. Moreover, it gauges worker discouragement, irritation, stress and annoyance versus security, gratification, contentment, and comfort.



Type	Workers' Challenge	Recommendations and Suggestions
Physical/Ergonomic	<p>Tight space: Assembling conduit in tight spaces requires awkward postures.</p> 	<p>Substitution:</p> <ul style="list-style-type: none"> Use manageable prefabricated components if feasible <p>Administrative Control:</p> <ul style="list-style-type: none"> Conduct daily pre-task planning with crew at beginning of work shift
	<p>Manual wire pulling: Cannot use tuggers for wire size 8 or smaller, or for larger wire when it is shorter than 300 ft.</p> 	<p>Engineering Control:</p> <ul style="list-style-type: none"> Use wire-dispensing cart <p>Administrative Control:</p> <ul style="list-style-type: none"> Conduct daily pre-task planning with crew at beginning of work shift Pull with a partner Rotate workers if feasible Plan for breaks <p>Personal Protective Equipment:</p> <ul style="list-style-type: none"> Use proper gloves for pulling

“Electrical Task Challenges & Solutions” Documents (cont.)

TASK: Overhead Conduit Installation

PROJECT TYPE: Commercial Building Renovation

Type	Workers' Challenge	Recommendations and Suggestions
Mental/Frustration	<p>Information retention: Remembering circuits installed and conduits run months earlier.</p> 	<p>Administrative Control:</p> <ul style="list-style-type: none"> Provide Toolbox Talks on Workplace Stress

Type	Workers' Challenge	Recommendations and Suggestions
Mental/Frustration and Physical/Ergonomic	<p>Working at heights: Typing off and pulling wire on ladders at heights and in tight spaces.</p> 	<p>Engineering Control:</p> <ul style="list-style-type: none"> Use scissor lift if feasible Use a tool harness or build a temporary table/shelf or beam clamp to hold material if feasible Install improved lighting <p>Administrative Control:</p> <ul style="list-style-type: none"> Conduct daily pre-task planning with crew at beginning of work shift Use signage to inform others worker of current location Use the buddy system Provide ladder, fall protection, and ergonomics training, including visual aids and recent incidents Plan ahead to avoid multiple trips up/down the ladder
	<p>Obstacle obstruction: Multiple measurements required to bend materials to accommodate existing racks and ducts.</p> 	<p>Administrative Control:</p> <ul style="list-style-type: none"> Use Building Information Modeling to pre-plan Conduct daily pre-task planning with crew at beginning of work shift Involve all project stakeholders (subs, GC, engineers, architects) during pre-planning meetings <p>Use a unified communication platform to coordinate information among all stakeholders</p>

Another Example

TASK: Material Handling/Logistics

PROJECT TYPE: Data Center-New Construction

Summary: Manual material handling took place in a new data center under construction. Work involved unloading, moving, distributing, and staging materials.


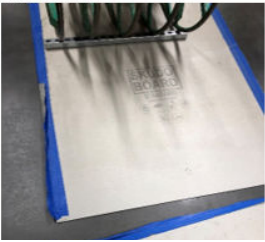

Location: US Mid-Atlantic region.

The following page(s) list the challenges that workers identified while performing this task and recommendations for improvement.

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TASK: Material Handling/Logistics		PROJECT TYPE: Data Center-New Construction
Type	Workers' Challenge	Recommendations and Suggestions
Physical/Ergonomic	<p>Pushing, pulling, and lifting heavy material: Including with a manual pallet jack.</p> 	<ul style="list-style-type: none"> • Use electric pallet jack • Use forklift • Training on proper material handling techniques • Stretch and flex • Buddy system
	<p>Maneuvering on SkudoBoards: Floor protection pads can come loose or buckle, causing a tripping hazard and impeding electric pallet jack movement.</p> 	<ul style="list-style-type: none"> • Use manual pallet jacks in areas where <u>SkudoBoard</u> is present. • Leave floors bare and buff out scratches when work is completed. • Use 'Masonite' board.
Mental/Frustration and Physical/Ergonomic	<p>Unclear/undecided material staging location: Need to stage and move materials to different locations multiple times due to undecided staging location.</p> 	<ul style="list-style-type: none"> • Designate dedicated staging areas during pre-task planning. • Take a picture of the material and send it to the foreman. Move material to the correct work area after verification.

Next Steps

- Conduct more interviews with electrical workers on various tasks
- Disseminate the “Electrical Task Challenges & Solutions” documents
- Conduct workshops in collaboration with contractors and local unions
- Need more information or want to participate in this study? Please contact:

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Thanks!