Hand Fracture and Laceration

Incident Date	May 30, 2024
Incident Location	ABC Company, Houston, TX
Date of Report	June 6, 2024

Cause Mapping®

1. Problem
2. Analysis
3. Solutions

Contents Page

Event Summary 2

1. Problem Definition 3

Diagrams 4 - 5

Photos 6

2. Cause-and-Effect Analysis (5-, 6-, 12-, 23-Why) 7 - 10, 12

Bull Rigging Process Map 11

Summary Cause Map with Solutions 13

3. Solutions 14

Matrix 15

Evidence 16

Bull Rigging JSA 17

Job Safety Analysis (JSA) 18 - 19

ThinkReliability

Prepared by: ThinkReliability Staff

Event Summary

On May 30th, 2024, during the installation of a plate for modifications in the reactor area, an employee suffered a serious hand injury when their fingers were pinched between the plate and the wall.

The plate had to be rotated into place, which resulted in a shift in its center of mass. The employees handling the installation used a manual lifting and rigging (often called bull rigging), threading steel cables through small holes in the plate to lift it into position. A lifting jig that was used for the first installation of the plate stopped being used due to the modifications required to the walls, and the amount of time required for the rework.

The method of rigging led to a small support area, leading to instability when moving the plate. As the plate was being maneuvered, it swung and shifted, moving toward the wall. The employee's hand was placed in close proximity to the wall and was pinched between the plate and the wall as the piece moved.

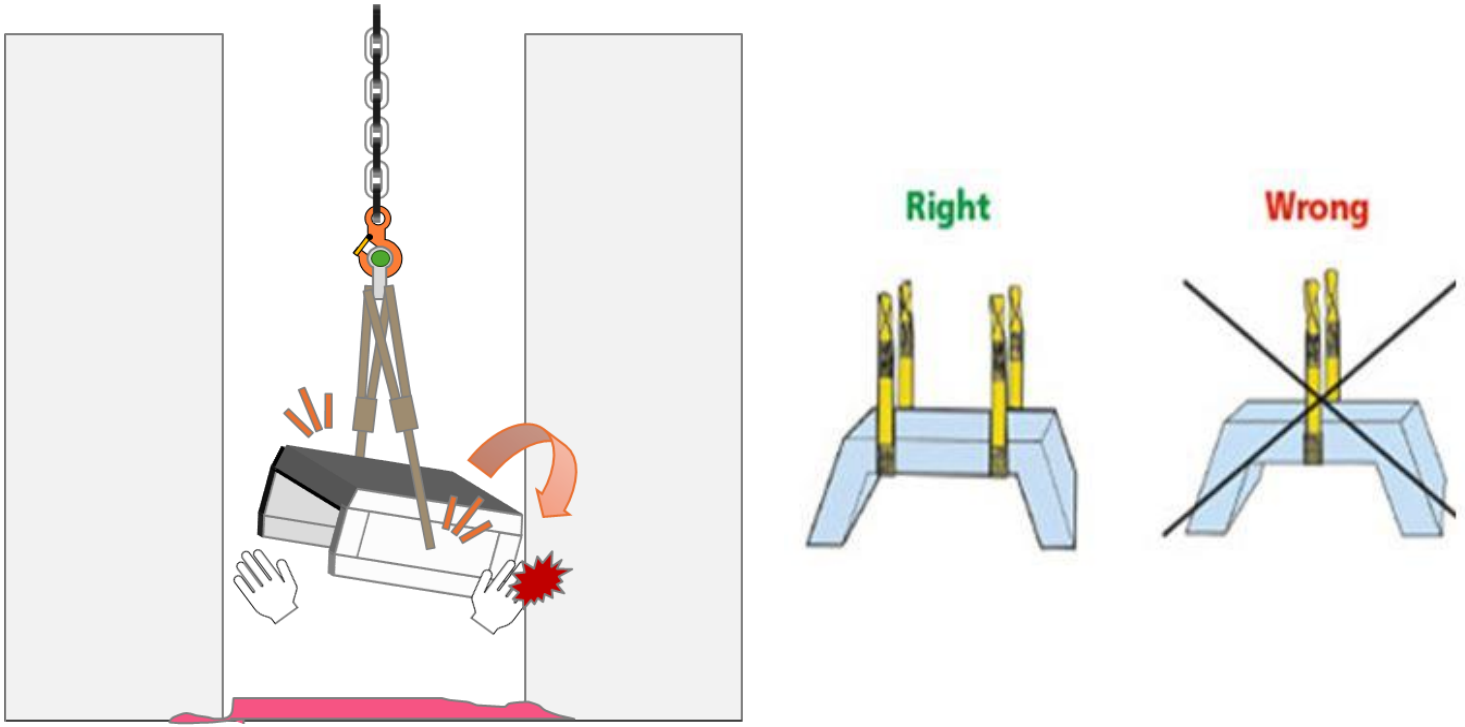


Diagram 1: Depiction of plate pinching employees hand and recommended practices for rigging up a plate similar to the one used in this incident

Problem Outline

		Hand Fracture and Laceration
What	Problem(s)	Employee Injured, Rigging practice, method, hand placement, uneven loading on rigging
When	Date	May 30, 2024
	Time	5:40 AM
	Different, unusual, changed	3rd plate that was bull rigged, end of shift
Where	Facility, location	ABC Company, Houston, TX
	Unit, area	Unit 3, Reactor area
	Equipment, tools	Chain falls, rigging equipment
	Task, operation being done	Installing plate to wall

Impact to Goals

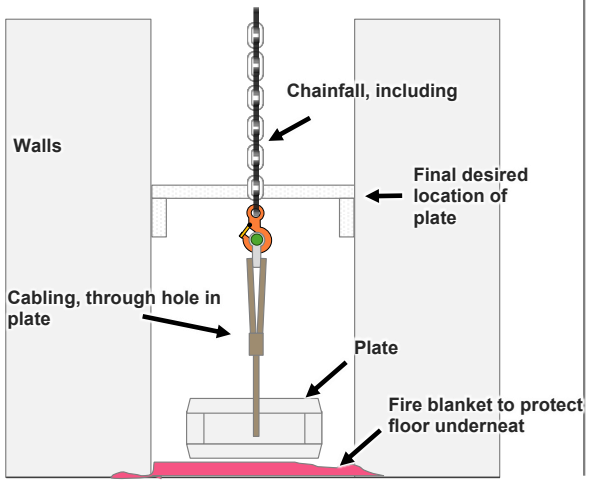
Safety	Finger laceration and fractures to 4th and 5th finger on right hand		
Environmental	None		
Customer	None		
Production, Schedule	None		
Property, Equipment	None		
Labor, Time	None		
		This incident	$0
Frequency	First time employee injured during installation, 4th plate to be installed		
		Annualized cost	$0

Timeline

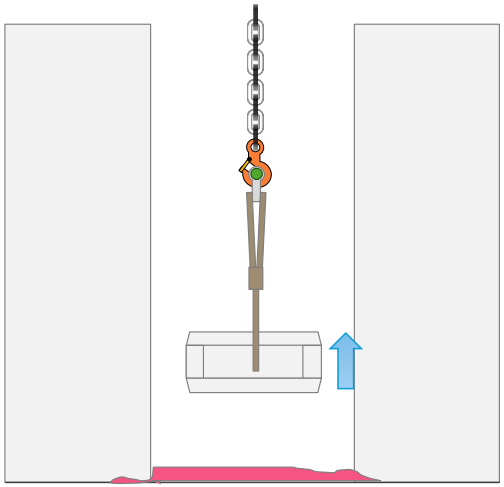
Date	Time	Description	Source, Notes
June 26, 2022		Employee hired by company	HR, employee file
July 2, 2022		Employee went through training, including JSA and bull rigging training	HR, employee file
May 26, 2024	2:10 PM	Walls modified to accommodate plate installation	Job Scope, Interviews
	5:30 PM	First plate tacked into place	Interview
	9:22 PM	Plate passed inspection and cleared for wall modification	Inspection Report
	10:00 PM	Wall repairs began	Interview
May 28, 2024	3:05 PM	Wall repairs complete, 31 hours of modification required to utilize jig	Interview
May 29, 2024	6:00 PM	Meeting to discuss plate installation process	Interviews by multiple
		Scope change to bull rig (by hand) instead of using jig to install plates to wall	Interviews by multiple
	11:30 PM	First plate that was bull rigged was successfully installed	Interview
May 30, 2024	2:30 AM	Plate rigged with chainfall to lift plate to wall	Interview
	5:40 AM	**Plate shifts in rigging, pinches hand between plate and wall, fracturing two fingers**	Interview
		Job stopped, employee rushed to medical	Interview
		Employee sent to hospital for incident response	Medical records
	6:00 AM	Job shut down for day, meeting to discuss path forward	Interviews by multiple

Diagrams

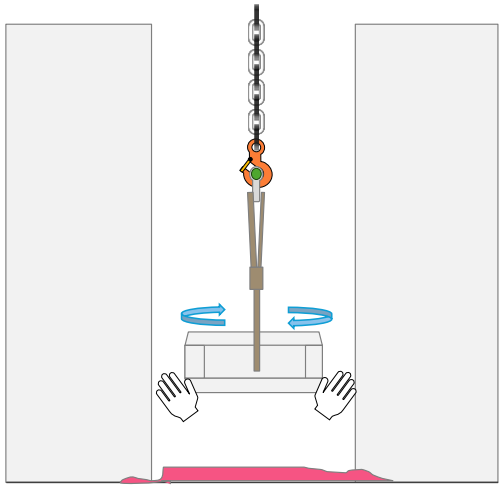
1 Employee rigged plate (600 lbs) on ground to lift into place for welding. Rigging was done on the two ends using a chain fall and cabling



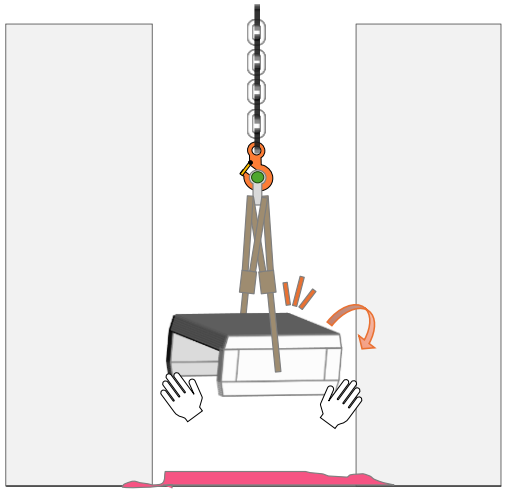
2 Employees began lifting plate, using chain hoist, from grade, up to approximate location where the plate would be welded



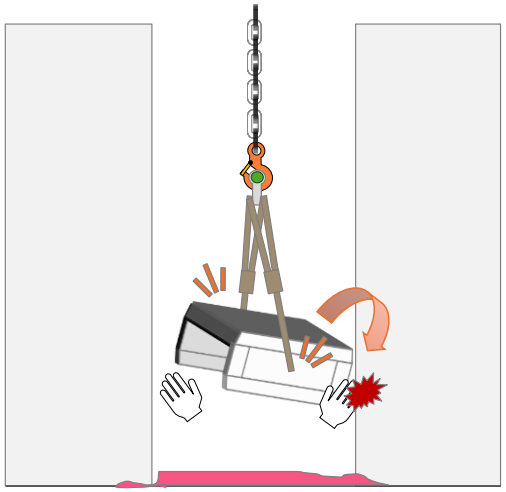
3 Injured employee began to rotate plate into place to prepare the fit up into location



4 As employee was rotating the plate into place, the plate began to rotate laterally in an unintended manner



5 The plate continued to rotate, the employee reacts instinctively, pinching the employee's finger between the plate and the wall, lacerating and fracturing the 4th and 5th finger on their right hand



Recommended best practices for bull rigging using plates of this method. Recommended having multiple slings that are not crossing each other in a basket hitch to prevent slippage and to control the load.

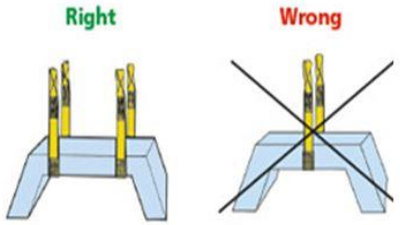


Diagram 1: Sequence of events for incident involving hand laceration.

Photos

Redacted for Privacy Purposes



Photo 1: Bull rigging set up for plate to be installed

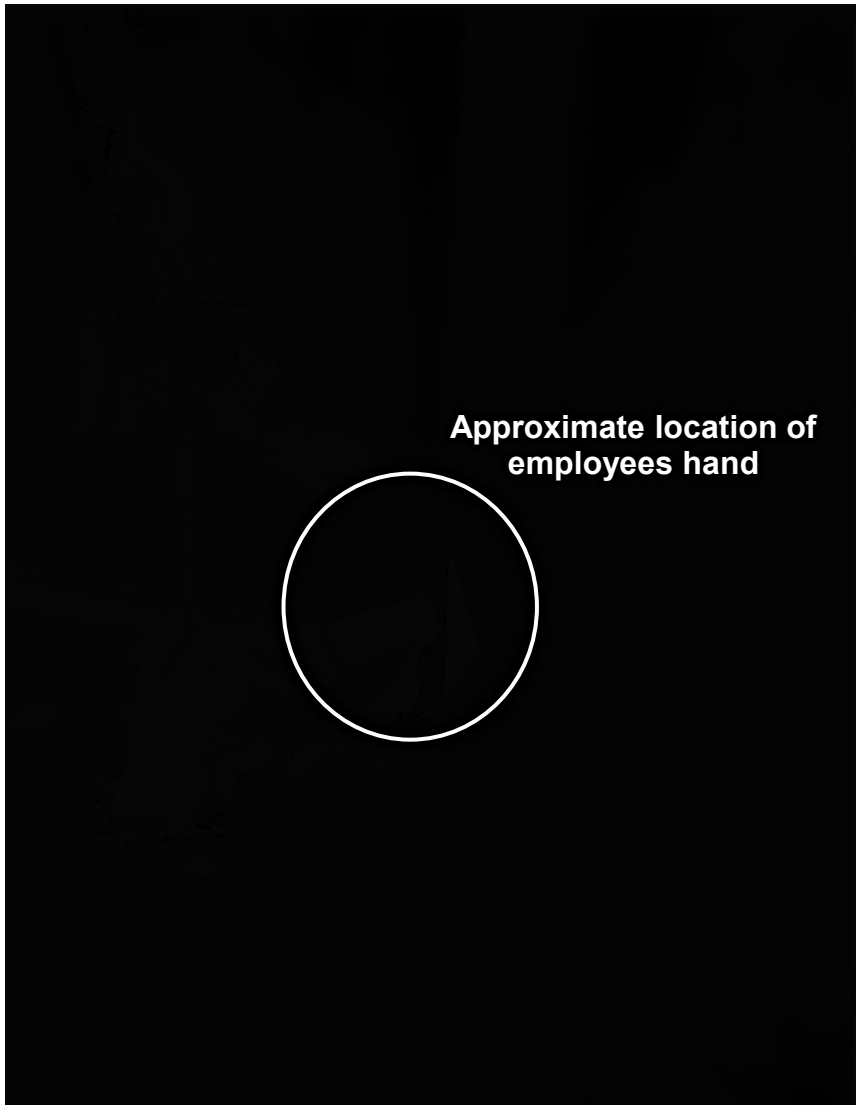
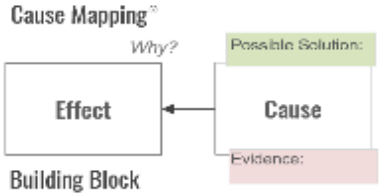
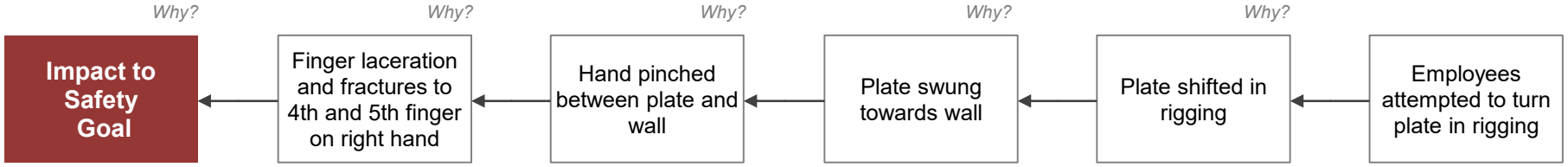


Photo 2: Plate after shifted while in rigging, approximate positioning of employee's hand shown with white circle above

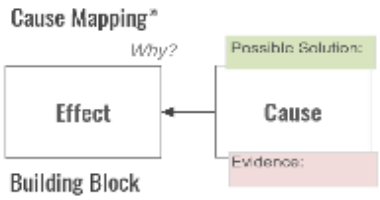
Hand Fracture and Laceration



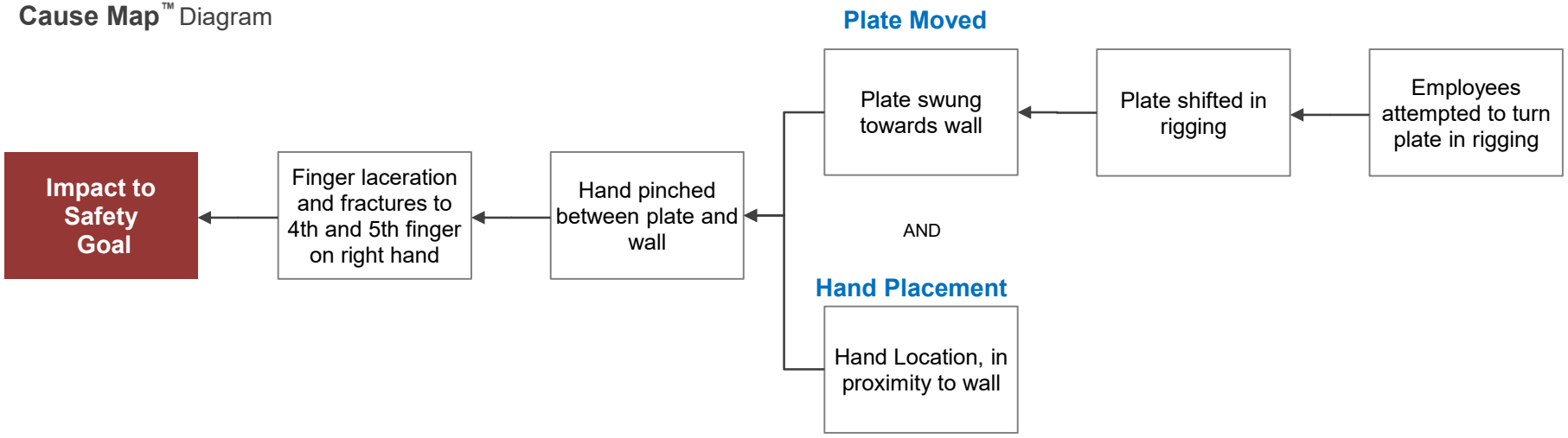
Cause Map™ Diagram



Hand Fracture and Laceration



Cause Map™ Diagram



Hand Fracture and Laceration



Cause Map™ Diagram

Impact to Safety Goal

Finger laceration and fractures to 4th and 5th finger on right hand

Hand pinched between plate and wall

AND

Plate Moved

Plate swung towards wall

plate shifted in rigging

Evidence:
Statement made by injured employee

Employees attempted to turn plate in rigging

Hand Placement

Hand Location, in proximity to wall

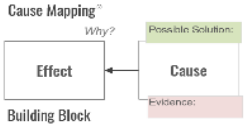
Evidence:
Hand placement put between plate and wall as hand had large injury

Learning #1:

The employee had his hand on the plate given the tight proximity of the wall. The employee put his hand in an pinch point.

Employee stated that would be tough to position plate without utilizing hands, this should have created a "stop job" for Company to investigate better ways to move plates into position

Hand Fracture and Laceration



Cause Map™ Diagram

Impact to Safety Goal

Finger laceration and fractures to 4th and 5th finger on right hand

Hand pinched between plate and wall

AND

Plate Moved

Plate swung towards wall

Plate shifted in rigging

Evidence: Statement made by injured employee

Center of mass outside area of support

Center of mass shifted

AND

Plate Rotated

Employees attempted to turn plate in rigging

Evidence: Statement made by injured employee

Plate required to be rotated in place

Plate Design

Uneven weight distribution in rigging

Design of Plate

Hand Placement

Hand Location, in proximity to wall

Evidence: Hand placement put between plate and wall as hand had large injury

Hand Placement

Learning #1:

The employee had his hand on the plate given the tight proximity of the wall. The employee put his hand in an pinch point.

Employee stated that would be tough to position plate without utilizing hands, this should have created a stop job for Company to investigate better ways to move plates into position.

Plate Design and Installation

Learning #2:

To position the plate, the employee had to rotate it within the rigging.

This rotation, necessary due to tight space constraints, caused the plate's center of mass to shift. The shift was also affected by uneven weight distribution in the rigging, due to the plate's design.

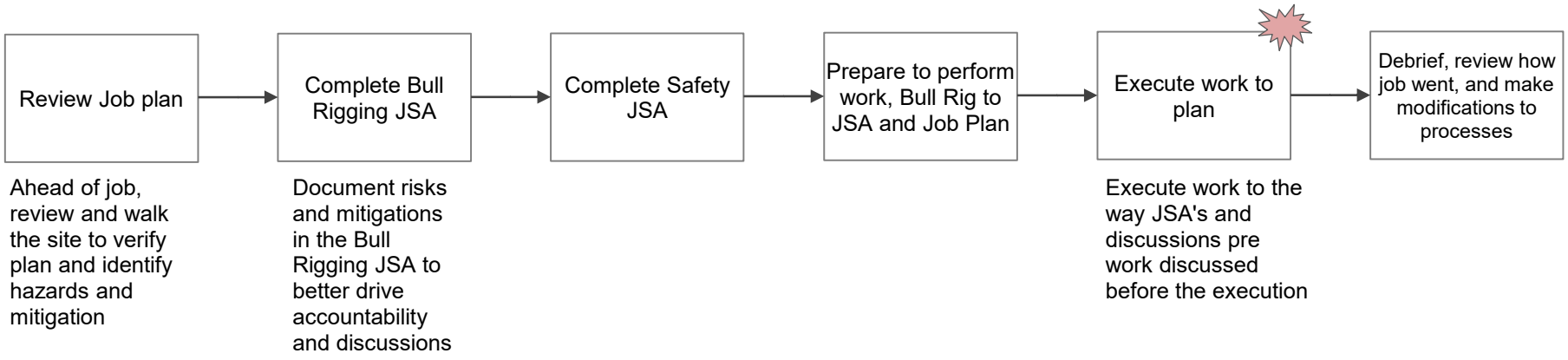
Process Map

Bull Rigging Process

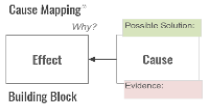
The process map below identifies the steps needed to accomplish this job. Starting at the point at which the team reviews the job plan and then executes the work.

The process map is read from left to right by saying "then" between each box. This gives the readers, the front line, and the mangers the same information for how the work gets done. The process map is utilized through investigation methods to better document and align the organization by how tasks are accomplished in any organization.

Process Map



Hand Fracture and Laceration



Cause Map™ Diagram

Impact to Safety Goal

Finger laceration and fractures to 4th and 5th finger on right hand

Hand pinched between plate and wall

AND

Plate Moved

Plate swung towards wall

Plate shifted in rigging

Evidence: Statement made by injured employee

Center of mass outside area of support

AND

Plate Design and Installation

Plate Rotated

Center of mass shifted

Employees attempted to turn plate in rigging

Evidence: Statement made by injured employee

Plate required to be rotated in place

AND

Plate Design

Uneven weight distribution in rigging

Design of Plate

Learning #2:
To position the plate, the employee had to rotate it within the rigging.

This rotation, necessary due to tight space constraints, caused the plate's center of mass to shift. The shift was also affected by uneven weight distribution in the rigging, due to the plate's design.

Hand Placement

Hand Placement

Hand Location, in proximity to wall

Evidence: Hand placement put between plate and wall as hand had large injury

Learning #1:
The employee had his hand on the plate given the tight proximity of the wall. The employee put his hand in a pinch point.

Employee stated that would be tough to position plate without utilizing hands, this should have created a stop job for Company to investigate better ways to move plates into position.

Bull Rigging, Jig Use

Bull Rigging

Base of support small, through holes

Rigging performed with steel cabling through holes in plate

Evidence: See picture 1 - showing how rigging configuration on plate

Jig Unavailable

Jig was labor intensive

Evidence: First plate was installed with the jig, ABC company had to make modifications to the walls in order to use the jig, in subsequent plate installations, ABC Company did not want to modify the walls due to the time required for rework of the walls

Modification to wall was undesirable

Evidence: Before incident, utilizing the jig required modification to the wall / close out face, after incident, modifications for jig utilization have been allowed

Requires more hours for repairing of the wall

AND

Utilization of jig required modification to wall

AND

Bull Rigging Approved

ABC Company approved bull rigging plate into place

Evidence: ABC Company reviewed bull rigging JSA and plan before execution

Employees believed bull rigging through holes was only way

Evidence: Statement made by injured employee

No other rigging options apparent

Evidence: Statement made by injured employee

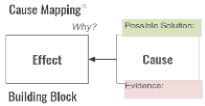
AND

ABC Company misidentified risk with bull rigging plate

Safety processes (Bull rigging JSA) ineffective

Learning #3:
The first plate was installed using a lifting jig, but required modifications to the walls to be able to use the jig.

Conversations at ABC Company took place, where the company indicated that the plates could be bull rigged and manually lifted in place without the jig. The risk assessment performed by ABC Company was ineffective, leading ABC Company to utilize bull rigging for the plate.



Cause Map™ Diagram

Impact to Safety Goal

Finger laceration and fractures to 4th and 5th finger on right hand

Hand pinched between plate and wall

AND

Plate moved

Plate swang towards wall

Plate shifted in rigging

Evidence: Statement made by injured employee

Center of mass outside area of support

AND

Center of mass shifted

Plate rotated

Employees attempted to turn plate in rigging

Evidence: Statement made by injured employee

Plate required to be rotated in place

AND

Uneven weight distribution in rigging

Plate design

1. Possible Solution: **Modify plate design to make easier to install and rig**

Design of Plate

Plate Design and Installation

Learning #2:

To position the plate, the employee had to rotate it within the rigging.

This rotation, necessary due to tight space constraints, caused the plate's center of mass to shift. The shift was also affected by uneven weight distribution in the rigging, due to the plate's design.

Hand Placement

Hand Placement

4. Possible Solution: **Look at hand placement with job, investigate sticks to move plates when bull rigged, consider tag lines, push poles, etc...**

5. Possible Solution: **Modify new employee training to include this incident as an example for hand placement**

Hand Location, in proximity to wall

Evidence: Hand placement put between plate and wall as hand had large injury

Learning #1:

The employee had his hand on the plate given the tight proximity of the wall. The employee put his hand in an pinch point.

Employee stated that would be tough to position plate without utilizing hands, this should have created a stop job for Company to investigate better ways to move plates into position.

Bull Rigging, Jig Use

Base of support small, through holes

Bull Rigging

Rigging performed with steel cabling through holes in plate

Evidence: See picture 1 - showing how rigging configuration on plate

Jig Unavailable

2. Possible Solution: **Utilize Jig for all future plates to install remainding plates**

Jig was labor intensive

Evidence: First plate was installed with the jig, ABC company had to make modifications to the walls in order to use the jig, in subsequent plate installations, ABC Company did not want to modify the walls due to the time required for rework of the walls

Modification to wall was undesireable

Evidence: Before incident, utilizing the jig required modification to the wall / close out face, after incident, modifications for jig utilization have been allowed

Requires more hours for repairing of the wall

AND

Utilization of jig required modification to wall

AND

Bull Rigging Approved

ABC Company approved bull rigging plate into place

Evidence: ABC Company reviewed bull rigging JSA and plan before execution

Employees believed bull rigging through holes was only way

Evidence: Statement made by injured employee

No other rigging options apparent

Evidence: Statement made by injured employee

AND

3. Possible Solution: **Modify bull rigging training / checklist / JSA to include detailed rigging steps vs. high level statements**

ABC Company misidentified risk with bull rigging plate

Safety processes (Bull rigging JSA) ineffective

Learning #3:

The first plate was installed using a lifting jig, but required modifications to the walls to be able to use the jig.

Conversations at ABC Company took place, where the company indicated that the plates could be bull rigged and manually lifted in place without the jig. The risk assessment performed by ABC Company was ineffective, leading ABC Company to utilize bull rigging for the plate.

Solutions

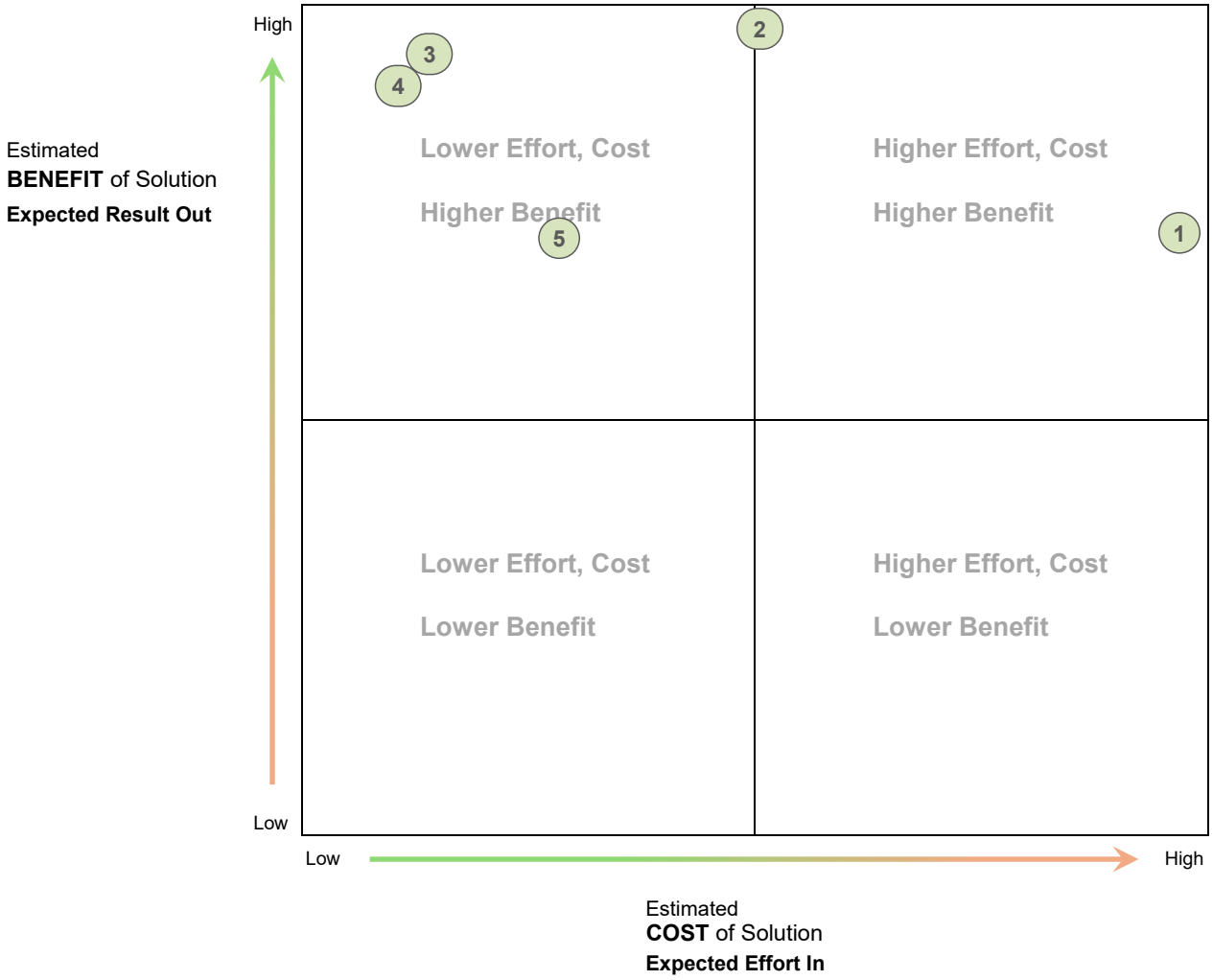
The solutions identified below are solutions that the investigation team came up with that would work best for their organization. When reviewing action items, it's important to remember that each organization has its own risk philosophy including risk profile. Your solutions that fit best for your organization, may not work at others and vice versa.

Ref.	Possible Solution	Cause	Work Process, Task	Owner	Due Date	Status
1	Consider modification plate on the wall to give more clearance for installation	Design of plate	Plate Installation, Design			
2	Utilize Jig for all future plates to install remaining plates	Jig was labor intensive	Plate Installation, Design			
3	Modify bull rigging training / checklist / JSA to include detailed rigging steps vs. high level statements	Safety processes (Bull rigging JSA) ineffective	Bull Rigging JSA	Information redacted for privacy purposes		
4	Look at hand placement with job, investigate sticks to move plates when bull rigged, consider tag lines, push poles, etc…	Hand Location, in proximity to wall	Plate Installation, Design			
5	Modify new employee training to include this incident as an example for hand placement	Hand Location, in proximity to wall	Hand placement, safety training			

Solutions Matrix

The Solutions Matrix on this page qualitatively assesses the effectiveness of solutions identified in the Cause Map. Recommended solutions are evaluated using two key factors: **benefit** (the extent of risk reduction and impact on affected goals) and **cost** (including financial expense, implementation time, and business impact).

When reviewing the matrix, look for solutions that provide the highest benefit with the lowest cost. High-benefit, low-cost solutions are typically prioritized, while high-cost solutions may require further justification. This comparison helps ensure that the most effective and feasible solutions are implemented.



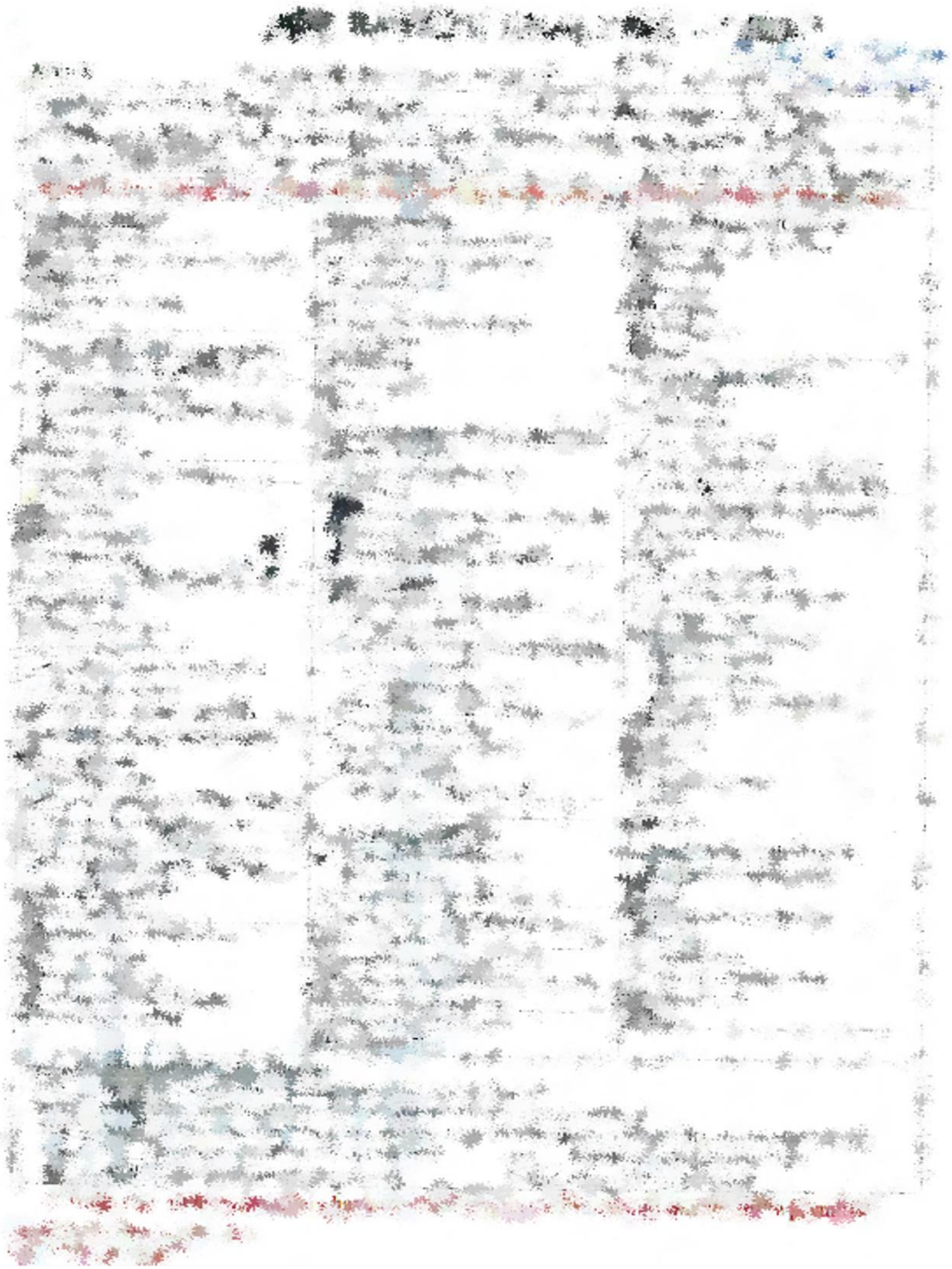
Ref.	Possible Solution
1	Consider modification plate on the wall to give more clearance for installation
2	Utilize Jig for all future plates to install remaining plates
3	Modify bull rigging training / checklist / JSA to include detailed rigging steps vs. high level statements
4	Look at hand placement with job, investigate sticks to move plates when bull rigged, consider tag lines, push poles, etc…
5	Modify new employee training to include this incident as an example for hand placement

Appendix: Supporting Information

This page intentionally left blank

THESE STEPS INCLUDE AREA HAZARDS WHICH ARE REQUIRED TO BE COMMUNICATED WITH OTHER WORK GROUPS

Basic Steps	Potential Risks	Preventive Measures / Safe Job Procedures	Tools / Equipment Needed
1) gather tools and	1) pinch and crush points	1) Be aware of	1) Chain fall / Tem
2) equipment for	2) from tight spots.	2) Surroundings	2) Come along 1.5 Tem
3) bull rigging up hard	3) heavy loads	3) Know your weight	3) Come along 1.5 Tem
4) Steps	4) failed rigging	4) proper Inspection	4) Power Tools
5) Install rigging and	5) poor communication	5) good open line of com	5) hand Tools
6) hoist lifting eyes	6) Body position	6) good body mech	6)
7) Bull rig up hard	7) line of site	7) Keep eyes on work	7)
8) steps	8) crew in area	8) No work below	8)



STEP 2

PROPER SEQUENCE OF JOB STEPS & TOOLS USED	POTENTIAL HAZARDS	CONTROLS AND RECOMMENDED ACTIONS
	Pinch points from heavy Pieces moving equipment, tarted rigging Pieces	Practice good lifting techniques get help with loads, inspect all rigging before use
	Back and body Strains and sprains from heavy lifting awkward body Position while working Hand Steps one Heavy Crush Hazard present Tool kick back due to tight Spots Guard loose and rotates Non-Permit confined Space with limited access and egress points Poor lighting tripping hazard	Maintain good body mechanics while working in areas that are tight Harness wear cut/impact Gloves obtain Permit, use as intended Use Secondary Steps to assist Materials Sign all Paperwork continue to Monitor air through full Shift install lights watch your Step
	Leaks from hoses if damaged fire hazard while performing hot work	Clean all hot work PPE per Policy do not look at arc Protect all hoses inspect hoses for damage, remove all flammable hazards fir

