

# Identification and Elimination of Hazards in Steel Industries by Hierarchy Control Method

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**Abstract-** The aim of this study is to Identification of hazards in various machineries in the steel industry and solution based on the hierarchy of controls. This will minimize the occupational health hazards of the workers. Hazard Identification and Risk Assessment (HIRA) is a process that involves examining what could cause harm to people in black bar to bright bar process workplace and evaluating whether the necessary precautions are in place. The goal is to ensure that no one becomes ill or gets hurt. Based on the risk assessment tool will Identify hazards, assess exposure, evaluate potential risks, and take precautions and to ensure that your workplace is safe and then decide what type of control measures shall be taken to control the employees are protected from harm by using the risk matrix to assist with the process.

**Index Terms-** Severity, Probability, Frequency rate, Exposure limit

## I. INTRODUCTION

Hazard Identification and Risk Assessment (HIRA) in fabrication and erection work involves systematically identifying potential dangers like falls from heights, struck-by incidents, electrical hazards, and exposure to harmful substances during the fabrication and assembly of structures, then evaluating the likelihood and severity of each hazard to determine the level of risk and implement appropriate control measures to minimize them.

## II. PROCEDURE

The risk management process is a systematic way to identify, evaluate, and reduce risks that could impact an organization. The process can help protect assets, improve decision making, and save time and money

Essential Steps of a Risk Management Process: 1. Identify the Risk, 2. Analyze the risk, 3. Evaluate the risk, 4. Treat the risk, 5. Monitor and review the risk



Hierarchy of control: 1. Elimination, 2. Substitution, 3. Engineering controls, 4. Administrative controls, 5. Personal protective equipment



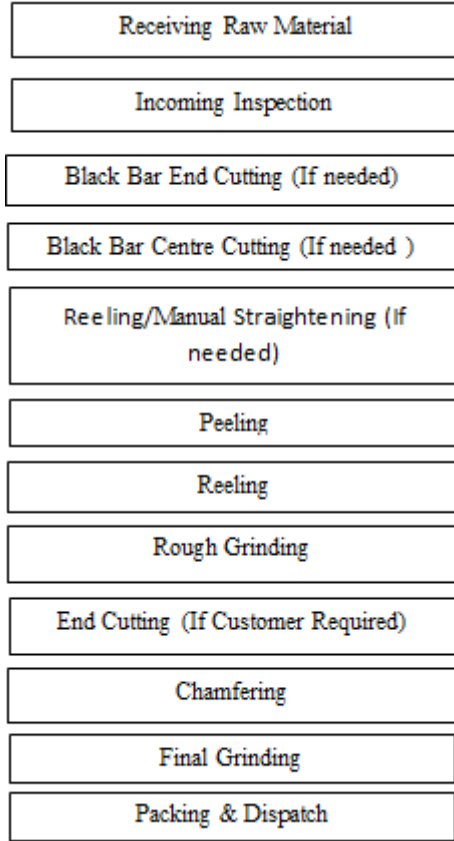
Risk Assessment Matrix				
Severity				
	Catastrophic - 4	Critical - 3	Marginal - 2	Negligible - 1
Frequent - 4	High (16)	High (12)	Serious (8)	Medium (4)
Probable - 3	High (12)	Serious (9)	Serious (6)	Medium (3)
Remote - 2	Serious (8)	Serious (6)	Medium (4)	Low (2)
Improbable - 1	Medium (4)	Medium (3)	Low (2)	Low (1)

## III. DEFINITION AND PROCESS FLOW

In a steel plant, a "black bar" refers to a rough, hot-rolled steel bar that has just been formed through the initial rolling process, while a "bar" typically refers to a more refined steel

bar that has undergone additional finishing processes, like cold rolling, to achieve tighter tolerances and a smoother surface, often called a "bright bar".

**Process Flow**



**IV. RISK ASSESSMENT AND CONTROL MEASURES**

**1. Lifting Equipments**

The steel industry uses a variety of lifting equipment, including hoists, jib cranes, and other heavy machinery: Hoists - Mechanical devices that use pulleys, chains, or ropes to lift and lower objects. Hoists can be manual, electric, or pneumatic.

Jib cranes - A type of light hoisting equipment that's well-suited for short-distance, frequent use. Jib cranes are known for being efficient, energy-saving, and easy to operate and maintain. Other types of lifting equipment include: overhead cranes, forklifts, jacks, building cradles, passenger lifts, chains, hooks, and rope. Lifting equipment helps to lift, move, and position heavy loads in a variety of applications. Risk assessment for lifting equipment's:

Equipment / Assessment	Process / Activity	HAZARD	CONSEQUENCE / HARM	Parts of the body likely to be affected	Before Control		SxPI (Severity * Probability)	Type of Risk	To be taken the control measures
					S	P			
Forklift / Stacker/ Crane	Lifting of material	Fall of material	Injury/ Property Damage	Human / Property Damage	4	3	12	Medium	<b>Signage/warnings/administrative control:</b> To provide the Barrica Tape. Isolate the work area and to display the SOP.  <b>PPE:</b> To provide the Safety Helmet, Belt & Safety Shoe
	Operation Failure	Breakage of motor bearing	Injury/ Property Damage	Human / Property Damage	4	3	12	Medium	<b>Signage/warnings/administrative control:</b> Maintain daily Checklis Carried out the External inspection.
		Failure of Horn, Light, reverse horn	Injury/ Property Damage	Human / Property Damage	4	3	12	Medium	<b>Signage/warnings/administrative control:</b> Maintain daily Checklis Carried out the External inspection.
		Failure of brake shoe	Injury/ Property Damage	Human / Property Damage	4	3	12	Medium	<b>Signage/warnings/administrative control:</b> Maintain daily Checklis Carried out the External inspection.
		Breakage of fork	Injury/ Property Damage	Human / Property Damage	4	3	12	Medium	<b>Signage/warnings/administrative control:</b> Maintain daily Checklis Carried out the External inspection.
		Leakage of Brake gear oil	Injury/ Property Damage	Human / Property Damage	4	3	12	Medium	<b>Signage/warnings/administrative control:</b> Maintain daily Checklis Carried out the External inspection.
		Material loading/unloading by Forklift / stacker	Material falls due to improper Loading / unloading.	Injury/ Property Damage	Human / Property Damage	4	3	12	Medium
	Failure of lifting equipment due to over weight		Injury/ Property Damage	Human / Property Damage	4	3	12	Medium	<b>Signage/warnings/administrative control:</b> Authorized person to be handle and inspect tools only use and to display SOP.  <b>PPE:</b> Safety Shoe, Helmet, safety Belt
	Failure of operation forklift due to inadequate maintenance		Injury/ Property Damage	Human / Property Damage	4	3	12	Medium	<b>Signage/warnings/administrative control:</b> Authorized person to be handle

**2. Inspection Process**

Steel material inspection is a systematic process that verifies the quality, integrity, and suitability of steel materials by using Micrometer, Lobbing Micrometer, Measuring Tape.

**Risk Assessment for Inspection**

Equipment / Assessment	Process / Activity	HAZARD	CONSEQUENCE / HARM	Parts of the body likely to be affected	Before	SxPI (Severity * Probability)	Type of Risk	To be taken the control measures
Prolonged sitting / standing	Repetitive motion	Ergonomic issues	Body, Leg, & Hand	2	4	8	Medium	<b>Signage/warnings/administrative control :</b> To provide the Periodic Brake /Rest/ Job change provide training on material handling and proper lifting techniques
Eye strain or fatigue from reading detailed inspection for extended periods.	Repetitive motion	Ergonomic issues	Body, Leg, & Hand	2	4	8	Medium	<b>Signage/warnings/administrative control :</b> To provide the Periodic Brake /Rest/ Job change provide training on material handling and proper lifting techniques

### 3. Cutting Process

It works on the principle of hydraulic pressure. In this hydraulic energy is converted into mechanical energy.

This pressure is given from the source called hydraulic power pack. The tool (cutter) is welded to piston of cylinder.

Risk assessment for cutting process:

Process / Activity	HAZARD	CONSEQUENCE / HARM	Parts of the body likely to be affected	Before Control		S1xP1 (Severity * Probability)	Type of Risk	To be taken the control measures
				S1	P1			
Machine operation	Contact with sparks/ Contact with rotating parts	Burn/ cut injury	Body/ finger	4	3	12	Medium	<b>Engineering control</b> To provide the safety guard <b>Signage/warnings/administrative control</b> Authorized person to be handle / To display the warning signage and to display the SOP.
Material Loading & Unloading	Prolonged standing / awkward posture	Ergonomic issues	Body, Leg, Neck & Hand	2	4	8	Medium	<b>Signage/warnings/administrative control</b> Authorized person to be handle / To display the warning signage and to display the SOP.
Material Loading	Waste removal from the machine	Muscular skeletal disorder (MSD)	back pain	2	1	2	Low	<b>Signage/warnings/administrative control</b> To provide the Periodic Brake / Rest/ Job change / provide training on material handling and proper lifting techniques
awkward posture / Lifting the material	Repetitive motion	Ergonomic issues	Body, Leg, Neck, back & Hand	3	4	12	Medium	<b>Signage/warnings/administrative control</b> To provide the Periodic Brake / Rest/ Job change / provide training on material handling and proper lifting techniques
Metal cutting process	Dust /spark exposure & Noise exposure	Health	Respiratory problem/ eye problem/ body	4	3	12	Medium	<b>Signage/warnings/administrative control</b> Authorized person to be handle / To display the warning signage and to display the SOP. <b>PPE:</b> To provide the Jean apron, Ear plug, Dust mask, goggles, Safety shoe.
Non metal cutting process	Dust exposure & Noise exposure	Health	Respiratory problem/ eye problem/ body	4	3	12	Medium	<b>PPE:</b> To provide the Jean apron, Ear plug, Dust mask, goggles, Safety shoe.
Wrong connection of electrical wires/ Utilization of inappropriate wire rating / Failure of RCCB / Improper insulation of wires/cables / Short circuit, Overload.	Exposure of electric shock	Electrocution / Burn Injury/ Fatal	Body	5	3	15	High	<b>Engineering control</b> To provide the Circuit breaker / grounding/ Proper connection. Proper wire color coding / Provide the RCCB/ Proper connection <b>Signage/warnings/administrative control</b> Authorized person only handling the process and instruct to follow the LOTO procedure wherever applicable or else isolate the power before start the maintenance activity
Contact with cutting blade	Contact with sharp edges	Cut injury	Finger	4	3	12	Medium	<b>Signage/warnings/administrative control</b> Authorized person to be handle / To display the warning signage and to display the SOP.

### 4. Peeling and Reeling Process

The peeling process is a heavy machining process that removes the outer layer of hot rolled steel bars to produce a smooth, bright surface.

The process can be used on a variety of materials, including carbon steels, stainless steels, and nickel-based alloys. In the steel manufacturing process, "reeling" refers to the final step where a hot rolled steel bar is fed through a set of contoured rolls to straighten it out, essentially removing any bends or curvature, often done after rolling or heat treatment, to prepare the bar for further processing like cutting, grinding, or turning; it's essentially a straightening process for round steel bars,

sometimes also called "bar reeling" or "round bar straightening."

### Risk assessment for peeling and reeling process:

Equipment / Assessment	Process / Activity	HAZARD	CONSEQUENCE / HARM	Parts of the body likely to be affected	Before		S1xP1 (Severity * Probability)	Type of Risk	To be taken the control measures
					S1	P1			
Material Loading & Unloading	Material lifting by Manual	Repetitive motion	Ergonomic issues	Body, Leg, & Hand	2	4	8	Medium	<b>Signage/warnings/administrative control</b> To provide the Periodic Brake / Rest/ Job change / provide training on material handling proper lifting techniques
Material Loading & Unloading	Prolonged standing / awkward posture	Repetitive motion	Ergonomic issues	Body, Leg, Neck & Hand	2	4	8	Medium	<b>Signage/warnings/administrative control</b> To provide the Periodic Brake / Rest/ Job change / provide training on Ergonomics
Material Loading	Waste removal from the machine	Repetitive motion	Muscular skeletal disorder (MSD)	back pain	2	1	2	Low	<b>Signage/warnings/administrative control</b> To provide ergonomics awareness training
Material Loading	Uneven surface Handling	Contact with sharp Edge	Injury	hand	4	3	12	Medium	<b>PPE:</b> To provide the Gloves, Safe Shoe, Mask, Safety Harness, Helmet
Handling of Machine	Machine Fall Down	Building collapse	Property / fatal	Property / loss of life	4	3	12	Medium	<b>Signage/warnings/administrative control</b> Periodic maintenance / stability tests/ ensure the all parts in condition

### 5. Rough and Chamfering Grinding Process

"Rough grinding" in steel manufacturing refers to a grinding process that rapidly removes large amounts of material from a steel work piece using a coarse abrasive wheel, typically to shape the piece, remove large weld seams, or deburr edges, resulting in a relatively rough surface finish with a high material removal rate, as opposed to a finer finish achieved in finishing grinding stages; it often utilizes a coarser grit grinding wheel to achieve this rapid stock removal.

"Chamfering grinding" in steel refers to the machining process where a specific angled cut, called a chamfer, is created on the edges of a steel work piece using a grinding wheel, essentially removing sharp edges and creating a smooth, sloped transition on the corners, often done for improved functionality and to prevent damage during assembly or usage.

### Risk Assessment for rough and chamfering grinding process

Equipment / Assessment	Process / Activity	HAZARD	CONSEQUENCE / HARM	Parts of the body likely to be affected	Before Control		S1xP1 (Severity * Probability)	Type of Risk	To be taken the control measures
					S	P			
Drilling Machine	Machine operation	Contact with rotating parts	Cut injury	Finger	4	3	12	Medium	<b>Engineering control:</b> To provide the safety guard <b>Signage/warnings/administrative control:</b> Authorized person to be handle / To display the warning signage/ To display the SOP.
	Awkward posture / Lifting the material	Repetitive motion	Ergonomic issues	Body, Leg, Neck, back & Hand	3	4	12	Medium	<b>Signage/warnings/administrative control:</b> To provide the Periodic Brake / Rest / Job change / provide training on mater handling and proper lifting techniques
	Bench drilling	Dust exposure	Health	eye problem	4	3	12	Medium	<b>PPE:</b> To provide the goggles, Safety shoe, PU thin coat gloves.
	Hand drilling	Dust exposure	Health	eye problem	4	3	12	Medium	<b>PPE:</b> To provide the goggles, Safety shoe
	Contact with drill bit	Contact with sharp edges	Cut injury	Finger	4	3	12	Medium	<b>Signage/warnings/administrative control:</b> Authorized person to be handle / To display the warning signage/ To display the SOP. <b>PPE:</b> To provide the Gloves, Safety Shoe, Mask, Ear P
	Rotating parts	Nip point	Cut injury	Finger	4	2	8	Medium	<b>Engineering control:</b> To provide the safety guard <b>PPE:</b> To provide the Gloves, Safety Shoe, Mask, Ear P
	Entanglement of finger between machine equipments	Hand contact with drill bit	Crush injury	Finger	4	3	12	Medium	<b>Signage/warnings/administrative control:</b> Authorized person to be handle / To display the warning signage/ To display the SOP. <b>PPE:</b> To provide the Gloves, Safety Shoe, Mask, Ear P
Wrong connection of electrical wires/ Utilization of inappropriate wiring/ Failure of RCCB / Improper insulation of	Exposure of electric shock	Electrocution / Burn Injury/ Fatal	Body	5	3	15	High	<b>Engineering control:</b> To provide the Circuit breaker / grounding / Proper connection, Proper wire color coding / Provide the RCCB/ Proper connection <b>Signage/warnings/administrative control:</b> Authorized person only handling the process and instructs to follow the LOTO procedure where applicable or else isolate	

## V. CONCLUSION

Hazard Identification and Risk Assessment (HIRA) study made on the various equipment's and its process. Based on the risk factor, Prevention and control measures provided to avoid the occurrence of such hazards as a recommendation. Implementation of control measures will help to eliminate and reduce the risk and also prevent the accident happen.

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## 6. Strapping Machine Process

A steel strapping machine process involves feeding a continuous steel strap around a bundle of steel products, applying tension to tightly secure the load, and then sealing the strap using a specialized mechanism, typically through heat sealing or crimping, to ensure the bundle remains stable during storage and transportation; this is primarily used in industries where heavy-duty bundling is required, like steel mills or construction sites

### Risk Assessment for Strapping Machine process

Equipment / Assessment	Process / Activity	HAZARD	CONSEQUENCE / HARM	Parts of the body likely to be affected	Before Control		S1xP1 (Severity * Probability)	Type of Risk	To be taken the control measure
					S	P			
Material Loading & Unloading	Material lifting by Manual	Repetitive motion	Ergonomic issues	Body, Leg, & Hand	2	4	8	Medium	<b>Signage/warnings/administrative control:</b> To provide the Periodic Brake / Rest / Job change / provide training on mater handling and proper lifting techniques
	Prolonged standing / awkward posture	Repetitive motion	Ergonomic issues	Body, Leg, Neck & Hand	2	4	8	Medium	<b>Signage/warnings/administrative control:</b> To provide the Periodic Brake / Rest / Job change / provide training on Ergonomics
	Waste remove from the machine	Repetitive motion	Muscular skeletal disorder (MSD)	back pain	2	1	2	Low	<b>Signage/warnings/administrative control:</b> To provide ergonomics awareness training
Material Loading	uneven surface Handling	Contact with sharp Edge	Injury	hand	4	3	12	Medium	<b>PPE:</b> To provide the Glove Safety Shoe, Mask, Safety Harness, Helmet <b>Signage/warnings/administrative control:</b> Periodic maintenance stability test/ ensure the all parts in tight condition
Handling of Machine	Machine Fall Down	Building collapse	Property / fatal	Property / loss of life	4	3	12	Medium	

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