RISK ASSESSMENT AND SAFETY ISSUES AT CONSTRUCTION PROJECTS IN BANGLADESH: A CASE STUDY FROM A BRIDGE PROJECT

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ABSTRACT

Bangladesh Institute of Labour reported that construction is the most dangerous industry in terms of health and safety at work. Safety issues have a large impact on the budget, schedule, and project's quality. The ILO estimated that the construction sector in industrialized countries employs between 6% to 10% of the workforce but accounts for between 25% to 40% of work-related deaths. Since the safe work procedures are not integrated, safety concerns are almost entirely ignored in construction projects both in public and private sector. Only projects funded by international financial authorities, such as the World Bank, ADB, JICA, and others, have effective requirements or guidelines regarding safety. In this study a particular task of Jamuna Railway Bridge Construction is considered as the case study to assess the risk and effect of prevention measures on it. In the project, due to an accident during Pier construction, the authority carried out underwater MS plate installation and welding work in the damaged steel cofferdam. Prior to repair activities, method of statement was prepared with risk assessment and its control measures for comparatively safe work. The Hazards and severity of each component were identified and Risk assessments were performed. Based on the well-established methodology, the probability and severity levels are determined to calculate the Risk Factor. It is observed that for the reported activities the probability scores are varied from 2 to 4, whereas the severity varies from 3 to 5 (5 for most of the activities). Thus, the calculated risk score was found to be varied from 9 to 20, which is under the category of high -risk level. Severity of hazard can not be changed but probability can be minimized imposing the prevention measures. Therefore, before implementing the work, precaution measures are imposed, and its reflection in minimizing the Risk Factor are calculated. It is found that the probability scores are reduced to 1 for most of the cases with a highest value of 2 in some. Therefore, the risk scores were reduced and found to be varied from 2 to 6 (only one activity still has a score of 10), which is under the category of low risk level. Workers may not be aware of potential hazards or may not have the skills necessary to effectively mitigate risks if they are not properly trained or if training is not updated on a regular basis. Therefore, Construction projects must be designed with proper risk management plan quantifying the probable hazard and severity for each of the activities and implement accordingly.

Keywords: *Health and Safety, Risk Assessment, Hazard, Severity*

1. INTRODUCTION

Bangladesh's GDP is growing at a rapid rate of 7.9%. With 7.67% of GDP growth in 2016 coming from the construction sector, Bangladesh's construction industry plays a significant role in the country's GDP (Ahmed, Sobuz & Haque, 2018). The availability of both inexpensive skilled and unskilled labour has made the growth of the construction industry possible. A major measure of individuals, the labour force survey conducted by the Bangladesh Bureau of Statistics (BBS) revealed that about two million workers are currently employed in the development business (Shourav, Shahid & Yahya, 2015). It's unfortunate that there isn't much Foreign Direct Investment (FDI) in the construction sector, even though construction and related activities make up about 80% of all investments made in Bangladesh (Mondal, 2003). One of the well-known elements that can help a developing nation like Bangladesh's economy grow is foreign direct investment (FDI). According to Ahmed and Islam (2014), there are two primary barriers in the construction industry that prevent large-scale projects from drawing in foreign investment: environmental hostility and a high death and injury rate on construction sites. But in contrast to developed nations, the situation regarding occupational health and safety at work in the Least Developed Countries (LDC) is distinct. Bangladesh was on the list of Least Developed Countries (LDC) in the past decades, per Tabassum and Ahmed (2014).

After meeting all of their basic needs, LDC and developing nations always struggle to save up enough money to invest in capital projects. This demonstrates unequivocally how important it is to raise the FID rate in the construction industry. Therefore, it is now crucial to control fatalities and deaths at construction sites. Even though the construction sector is essential to the nation's economic expansion, worker occupational health and safety standards are among the lowest in the industry. Based on data from the Occupational Safety, Health and Environment (OSHE) statistics, construction-related accidents claimed the lives of 147 people in 2016. According to a different report of Bangladesh Institute of Labour Studies (BILS) report, the construction industry saw 1,196 deaths overall between 2005 and 2016 (or at least 100 deaths annually). According to a BILS report, there are about 100 injuries reported annually. Electrocution and falls from heights are the two main causes of injuries and fatalities. It has grown difficult to monitor and enforce safety in the construction industry, even with laws in place for construction sites (Daily Star, 2017). In this case, adequate research is necessary to reduce incidents and fatalities at Bangladeshi construction sites.

This research aims to identify the safety standards and Occupational Health and Safety Management System (OHSMS) of the construction industry in Bangladesh, as well as to present a case study to reduce the risk factor through risk assessment.

2. METHODOLOGY

2.1 Study Area

Bangladesh is divided approximately into halves by Jamuna River. Prior to the opening of the existing Bangabandhu Bridge in 1998, the only way to cross the mighty Jamuna River is by ferry which took several hours and gets worsen by adverse tidal change. The existing Bangabandhu Bridge is a 4-lane highway traffic and dual gauge single track with restricted load and currently can run 38 trains per day with limited speed at 20 km/h. Double tracking construction project can make line capacity jump up to 88 slots per day. Although this railway line has a great potential for heavy traffic especially freight transport with neighbouring countries, it has been limited due to bottleneck caused by such restrictions. Therefore, in order to meet increasing national and sub-regional traffic demand, Government of Bangladesh (GOB) recognizes the urgent need to construct a new and dedicated railway bridge parallel to existing Bangabandhu Bridge with the provision of dual gauge double track. This new railway bridge, “The Bangabandhu Sheikh Mujib Railway Bridge” will improve the capacity and safety of railway transportation in Bangladesh and contribute to efficient logistic network within the country and with neighbouring countries in South Asia. As the Bangabandhu Sheikh Mujib Railway Bridge will be an important link in the planned Trans Asia Railway, this railway bridge is considered as an important part of national and future regional international

railway transport networks. This bridge is 4.8 km long and 12.6 m width, total pier number 50. The Bangabandhu Sheikh Mujib Railway Construction Project is one of the biggest bride construction projects in Bangladesh and is currently employing over 2,000 people. It was funded by JICA. Every workforce member, including managers, engineers, steel fixers, carpenters, operators, and drivers, has received a safety induction and is receiving the required training from a dedicated trainer.
In this study a particular task of Jamuna Railway Bridge Construction is considered as the case study to assess the risk and effect of precaution measures on it. In the project, due to an accident during Pier construction, the authority carried out underwater MS plate installation and welding work in the damaged steel cofferdam. Prior to repair activities, method of statement was prepared with risk assessment and its control measures for comparatively safe work. The Hazards and severity of each component were identification and Risk assessments were performed.

2.2 Methodology for Risk Assessment

Effective operations management for the majority of firms depends on having a tool to graphically depict a risk assessment. Apart from assigning an objective rating to risks according to their likelihood of occurring and impact, a 5x5 risk matrix also serves as a simple manual for future risk rating procedures that involve the identification of new hazards. Using a 5x5 risk matrix is quite helpful in situations like ISO 45001:2018, an international standard addressing best practices toward employee safety amidst workplace threats. The management can then employ risk assessment tools, like a 5×5 risk matrix, to aid in decision-making to minimize or eliminate workplace hazards, since this standard intends to help reduce work-related risk for workers. Using tools like a 5×5 risk matrix is the most effective way to evaluate risks during the risk analysis stage of an organization's comprehensive quality risk management system. This can subsequently lead to a quantifiable statement of risk, where the risk assessment's output is expressed as a numerical value or a qualitative description of the risk level.

One kind of risk matrix that is shown graphically as a table or grid is the 5x5 risk matrix. On a scale from low to high, it has five categories for each of the two variables: probability (along the X axis) and impact (along the Y axis). A 5x5 risk matrix is a comprehensive tool that businesses use to identify the likelihood and consequences of worker injuries and risk exposure related to workplace hazards. It is used during the risk assessment stage of project planning, operations management, or job hazard analysis. Moreover, it can function as an additional instrument for assessing the potential harm or disturbance caused by hazards.

With five rating levels for every component to ensure a more accurate analysis, this tool helps Environment, Health, and Safety (EHS) experts to conduct comprehensive risk assessments. As the 5x5 risk matrix explains, when compared to other variants such as 3x3 and 4x4, the 5x5 version offers a more comprehensive method of assigning a 5-point rating to dangers. A 5×5 risk assessment matrix must be color-coded in order to show the combined level of likelihood and impact of the hazards that have been identified. It is necessary, therefore, to indicate low hazards in green, moderate risks in yellow (amber), and severe dangers in red. Other closely comparable colours, including orange, light red, and light green, can then be used by organizations, EHS specialists, and project managers to distinguish between the various risk levels. The Probability, also called likelihood, (x-axis) pertains to the extent of how likely it is for the risk to occur. The 5 risk rating levels under this component are as follows:
Rare – unlikely to happen and/or have minor or negligible consequences
Unlikely – possible to happen and/or to have moderate consequences
Moderate – likely to happen and/or to have serious consequences
Likely – almost sure to happen and/or to have major consequences
Almost certain – sure to happen and/or have major consequences

The impact, also called severity or consequences, the Impact (y-axis) aims to determine the level of effects that the hazard can cause to workplace health and safety. While a 5×5 risk matrix can be tailored to the needs of an organization, the following represent the general terms used to describe the 5 levels to determine the risk's impact:
Insignificant – won't cause serious injuries or illnesses
Minor – can cause injuries or illnesses, only to a mild extent
Significant – can cause injuries or illnesses that may require medical attention but limited treatment
Major – can cause irreversible injuries or illnesses that require constant medical attention
Severe – can result in fatality

Based on certain levels of impact and probability, each risk box shows the rating assigned to it. The 5×5 risk matrix typically employs numerical values to more accurately depict the risk levels. Risk levels are defined as, Risk Level = Probability x Impact.

For calculating risk, the first stage is to give each category under Probability and Impact a numerical number between 1 and 5, with 1 being the lowest. Next, the Risk Level is calculated by multiplying the Probability value by the Impact value using the algorithm. To better understand how the various levels indicate the Probability and Impact, following is the guide on the numeric values and their representation as a result of the analysis used in this study:
1-6: Acceptable – no further action may be needed and maintaining control measures is encouraged
8-12: Tolerable – must be reviewed in a timely manner to carry out improvement strategies
15-25: Unacceptable – must implement cease in activities and endorse for immediate action
With these, one can improve his existing risk control measures as needed, and recommend further actions that the EHS and quality managers can reinforce toward a proactive safety culture.

PROBABILITY						
	Very Likely-5	5	10	15	20	25
	Likely-4	4	8	12	18	20
	Probable-3	3	6	9	12	15
	Unlikely-2	2	4	6	8	10
	Very Unlikely-1	1	2	3	4	5
		1	2	3	4	5
		Negligible	Slight	Moderate	High	Very High
			SEVERITY			

RISK	RISK LEVEL	ACTION
1 to 6	Low Risk	May be acceptable but review task to see if risk can be reduced
8 to 12	Medium Risk	Task should only be undertaken with appropriate management authorization after consultation with specialist personnel
15 to 25	High Risk	Task must not proceed. It should be redefined or further control measures should be put in place to reduce risk. The control should be in place

Figure 1: Risk Matrix

3. RESULTS AND DISCUSSIONS

3.1 OHS in Global and Regional Scales

According to Burton (2010:7), the ILO estimates that illnesses and accidents related to the workplace claim the lives of two million men and women annually. According to WHO estimates, there are 160 million new cases of work-related disorders worldwide each year. It also states that workplace circumstances are responsible for almost 33% of back pain, 16% of hearing loss, nearly 10% of lung cancer, and 8% of depression cases. In the European Union, a person passes away from work-related reasons every three and a half minutes. This indicates that occupational diseases (159,500) or work-related accidents (7,500) account for about 167,000 deaths annually in Europe alone. An accident involving a worker in the EU results in at least three working days of recuperation time for that worker every 45 seconds. There are about 7 million workplace accidents annually that result in three or more days of absence from work. According to a recent ILO report, there are an estimated 2 million occupational fatalities worldwide each year. The leading causes of these deaths include diseases that are contracted at work, such as cardiovascular and cerebrovascular disorders, various infectious diseases, and malignancies. According to estimates from Hämäläinen, Takala, and Saarela (2006), there are 270 million occupational accidents annually, including deadly and non-fatal. Approximately two-thirds of the 160 million workers who suffer from work-related illnesses miss four or more working days of work as a result. Accidental occupational injuries are fourth among the leading causes of work-related mortality, after circulatory disorders, certain infectious diseases, and cancers related to the job. According to recent data from the WHO and ILO, overall rates of occupational illness and accidents are rising or staying the same in developing and industrializing nations but are gradually dropping in the majority of industrialized nations (Alli, 2008: 3).

At the corporate, governmental, and international levels, the financial consequences of these accidents and fatalities are enormous. Estimates of these losses, taking into account missed wages, medical costs, training and retraining, production disruption, lost working time, and other factors, are regularly placed at about 4% of the world's gross national product annually, and probably considerably more. A total of US$122 billion was estimated to have been spent on compensation for a group of OECD countries in 1997 alone, with 500 million working days missed due to illnesses or accidents (Alli, 2008: 4). Work-related mortality in some developed countries are presented Figure 2. Here Morality Index= (Number of work -related death/Total workforce) x 100,000.

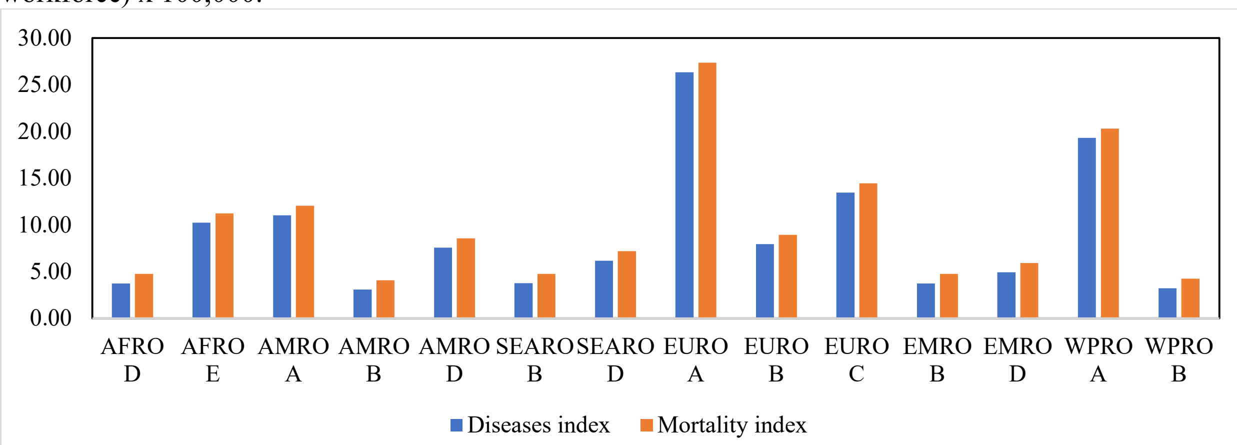

Figure 2: Work-related mortality in some developed countries (as per ILO, 2023)

Table 1: Work-related mortality in some developing countries

Country	Economically active population	Fatal accident 2003	Accident causing at least 4 days' absence Average 2003	Work-related diseases	Work-related mortality	Deaths caused by dangerous substances
Bangladesh	46,325,000	9,652	9,074,601	34,831	44,483	11,662
Bhutan	1,270,174	405	380,776	955	1,360	320
India	473,300,000	46,928	44,120,055	355,863	402,791	119,153
Koria, Democratic of	9,600,000	1,956	1,838,523	7,218	9,174	2,417
Maldives	88,000	13	11,810	66	79	22
Myanmar (Burma)	27,010,000	7,069	6,645,868	20,308	27,377	6,800
Nepal	11,700,000	3,372	3,170,090	8,797	12,169	2,945

Timor-Leste	400,000	117	109,793	301	418	101
Total	569,693,174	69,510	65,351,517	428,339	497,849	143,420

According to ILO report, it is observed that

- The European Statistics on Accidents at Work (ESAW) estimates that, in the 15 EU member states prior to the 2004 and 2007 enlargements, approximately 5,000 workers lost their lives in workplace accidents, and approximately 5 million workers suffered injuries that required more than three days away from work (EU, 2004).
- The rates of occupational accidents and fatalities in China and India are comparable, at 8,700 and 8,028 accidents and 10.4 and 10.5 per 100,000 for fatalities, respectively.
- In sub-Saharan Africa, there are 16,000 accidents and 21 fatalities per 100,000 workers. This indicates that 42 million job-related accidents resulting in at least three days of missed work occur year, and 54,000 worker deaths occur.
- Every year, 22.6 million occupational accidents in Latin America and the Caribbean result in at least three days of missed work, and around 30,000 fatalities occur in this region (Alli, 2008: 4).

Table 2 shows the OHS statistics for some developing countries according to ILO. Work-related mortality in are also presented Figure 3. It is observed that the mortality index in Bangladesh is 4.61 which is about half of the case for India. Except India and Maldives, other countries have less mortality and disease index compared to Bangladesh.

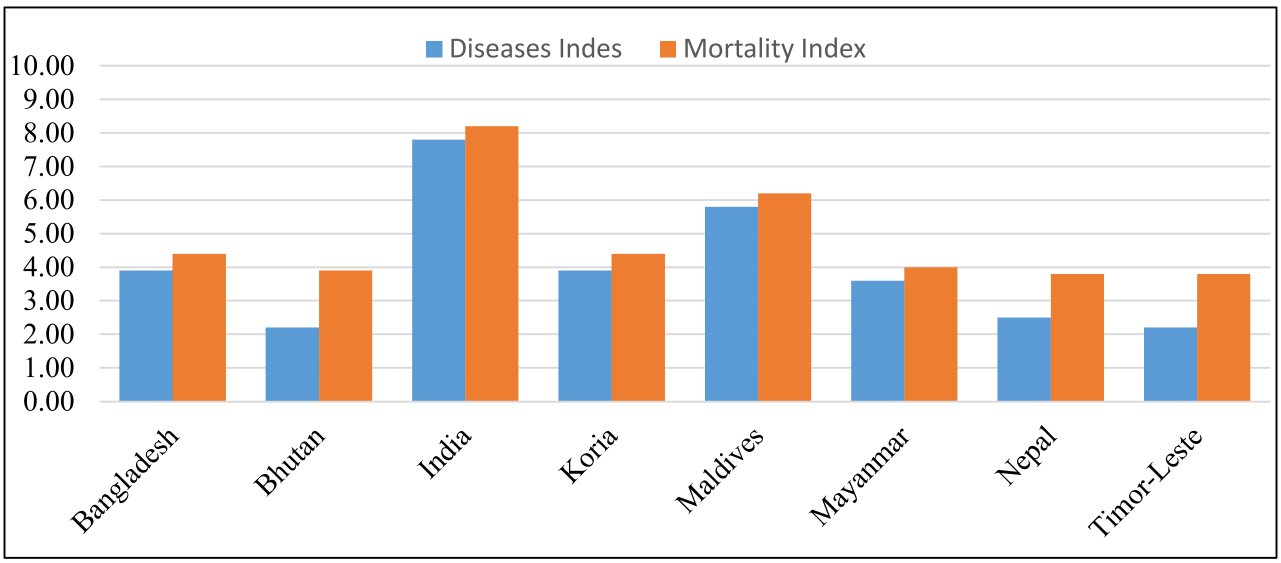

Figure 3: Work-related mortality in some developing countries (Source: ILO, 2023)

Some key aspects of health and safety practices in Bangladesh are explained below:

Occupational Health and Safety laws: One important piece of legislation governing occupational health and safety in Bangladesh is the Factories Act, 1965. It describes a number of regulations pertaining to safety precautions, work hours, and working conditions in industrial settings. The enforcement and implementation of occupational safety and health regulations in Bangladesh are under the jurisdiction of the Directorate of Inspection for Factories and Establishments (DIFE). Inspections are carried out by DIFE to make sure that rules are being followed.

Safety Standards in the Workplace: Hazardous processes and substances must be properly managed and controlled to minimize risks to workers. Employers are required to maintain safe working conditions, provide necessary safety equipment, and implement measures to prevent accidents and injuries in the workplace.

Worker Training and Awareness: Employees should be aware of potential hazards at work and know how to report unsafe conditions. Employers are expected to train staff members on safety procedures, emergency protocols, and the correct use of safety equipment.
Child Labor and Forced Labor: Child labour and forced labour are prohibited by Bangladeshi labour laws. Employers must make sure that these kinds of behaviours don't occur at work.
Fire Safety: The prevention of fires is vital, particularly in the apparel and textile sectors. The 2013 Rana Plaza tragedy, in which a structure housing apparel factory collapsed, brought attention to the need for stronger fire and building safety regulations.
Healthcare Facilities: Basic healthcare facilities are supposed to be provided by employers to their staff; larger establishments might have on-site medical facilities.
Social Compliance and International Standards: A large number of Bangladeshi industries, especially those engaged in exporting goods, follow international standards for social compliance. These standards frequently contain clauses pertaining to safety, health, and labour rights.

3.2 Risk Assessment: A Case Study

An incident occurred on 25 June 2023 at Bangabandhu Sheikh Mujib railway Bridge Construction Project (WD2). Due to increasing the seasonal water level, the contractor has suspended River Training work and temporarily demobilize all RTW-related equipment. On 24 June 2023. during the demobilization of a flat barge, due to its high speed (3.2 m/s), the barge lost control and flowing downstream due to a strong current and collided with the Pier–5 of Jamuna bridge, which was under construction. After hitting Pier 5 of the existing bridge, the flat barge proceeded downstream and immediate control or recovery was made by the tugboat's towing machinery. After dewatering the cofferdam, it was noticed that the water level returned to its original level because of seepage. A survey was conducted and discovered that the interlock pipe was broken; therefore, rectification is required.
The authority decided that Diving and underwater MS plate installation and welding work will be done will need to be carried out in accordance with standard operating procedure. All personnel will wear appropriate Personal Protective Equipment (PPE). The general workflow as following:

- MS plate will be dived by two-part, 6,000 mm x 600 mm and 4,500 mm x 600 mm.
- Plate will be lifted from barge to cofferdam by 70t Crawler Crane.
- A 5t Chain Block will be set in the 3rd Ring Beam at elevation of MSL +7.00.
- Once lower down in position, Diver will go to under water for checking the position.
- Two-way radio communication system will be established between shore crew and underwater diver.
- 1st Plate will be set in the actual location and qualified underwater welder will fix it with tag weld.
- A video survey of the fixed plate will be carried out to confirm the position as per design.
- After confirmation of position and installation, welder will start welding from top elevation to bottom elevation direction.
- Underwater welding work will be monitor from shore via video camera.
- During the welding always two-way communication set will be maintained from shore crew and welder.
- The prescribed work will be proceeded in day and night shift.
- For the night work additional safety measure will be taken i.e. adequate lighting, safety surveillance, emergency response team, etc.
- After completion of 1st Plate installation and welding, 2nd plate will be installed as following the above process.
- Upon completion of both plate installation and welding, a further video survey and physical checking by diver will be carried out.

- Final testing and checking of leakage will be conducted by discharging water. 1st part of steel plate will be lower down by chain block in the fitting location

Prior to proceed in activities, method of statement was prepared with risk assessment and its control measure for comparatively safe work. Table 3 shows the Hazard identification and Risk assessment for under water welding work. For each of the activities, the hazards are identified and severity of risks are reported. Based on the methodology described in section 2.2, the probability and severity levels are determined to calculate the Risk Factor. It is observed that for the reported activities the probability scores are varied from 2 to 4, whereas the severity varies from 3 to 5 (5 for most of the activities). Finally, the risk score was found to be varied from 9 to 20, which is under the category of moderate to high-risk level.

Severity of hazard can not be changed but probability can me minimized imposing the precaution measures. Table 4 represents the imposed precaution measures, and its reflection in minimizing the Risk Factor are calculated. It is found that the probability scores are reduced to 1 for most of the cases with a highest value of 2 in some. Therefore, the risk score was reduced and found to be varied from 2 to 6 (Only one activity still has a score of 10), which is under the category of low risk level.

Table 2: Hazard identification and Risk assessment for under water welding work

Item	Description of Job	Hazards	Risks	Initial Risk Rating Probab. x Severity		Risk Factor
Safety Precaution for general activity				P	S	RF
1A	Deployment of workforces	-Work patterns/unskilled workman -Physical hazard du to mistakes occurring because of poor awareness & training	Damage/Injury /Fatality	3	5	15
1B	Selection of tools & Tackles	Select defective/improper tools leading to equipment damage & accident	Damage/Injury /Fatality	4	5	20
	Temporary power connection from DB	Electrocution, spark & fire	Property damage/burn injuries/fatality	3	5	15
	Movement of heavy machinima around the site & lifting operations	Miscommunication of signal	Injured of people/worker	3	3	9
1C	Working over water	Potential to fall in river	Injury/fatality	3	5	15
2A	Before entering Confined space	- Gasses - Lack of or excess oxygen - Slip, Trip, Fall	Nausea, Fire explosion, injuries	3	4	12
2B	Entry to Confined space	Fall from man basket, slip, trip, fall	Serious Injury/ Fatality	3	5	15
2C	Working in Confined space	-Restricted access/egress - Contaminants - Carbon monoxide - Struck by objects falling into confined space - Temperature - Slip, Trip, Falls	Serious Injury/ Fatality	3	5	15
2E	Return to Service of Confined Space	Person left in confined Space	Lack of oxygen is a leading damage the brain or cause fatality	4	5	20
3A	Clan up on Completion	Trip hazards, Rubbish	Sprains of streams, Back injury, minor or	4	3	12

Item	Description of Job	Hazards	Risks	Initial Risk Rating Probab. x Severity		Risk Factor
			major cuts			
3B	Emergency preparedness during the execution of the Underwater Welding Works	Physical injuries (Minor, Serious, Fatal)	-Incident/Accident from Human suffering Human injury -Potential of Fatal Accident -Occupational illness -Incident related to Underwater welding activities	4	5	20

Table 3: Preventive measures and its reflection in minimizing the Risk Factor

Item	Description of Job and Hazards	Precaution/ Prevention Measure	Initial Risk Rating Probab. x Severity		Risk Factor
		Safety Precaution for general activity	P	S	RF
1A	**Deployment of workforces :** 1.Work patterns/unskilled workman 2.Physical hazard du to mistakes occurring because of poor awareness & training	1.Deploy skilled workers for high-risk activities like working at height. 2.Checking the workforce competency level. 3.Only skilled person will appoint for works. 4.Identified hazards and control measures shall be explained to team /work men through toolbox talks every day in the morning before the start of the activity till the completion of job. 5.Working area to be condoned off with barrier to avoid entry of unauthorized persons 6. Ensuring all personnel are adequately trained and certified in underwater welding and safety protocols. Safety induction prior to start the activities	1	5	5
1B	**Selection of tools & Tackles:** Select defective/improper tools leading to equipment damage & accident	1.Remove damaged or faulty tools & tackles from site 2.select third party certified tools & tackles only. 3.On site regular inspection of tools & tackles 4.Using of master list of good tools & tackles 5.Daily physical verification of all the tools to be verified by site site Engineer.	1	5	5
	Temporary power connection from DB: Electrocution, spark & fire	1.All electrical equipment should be checked as per checklist 2.Powr cable to be checked properly and it should be used through RCCB (30mA) 3.All electrical connection should be carried out authorized electrician.	1	5	5

Item	Description of Job and Hazards	Precaution/ Prevention Measure	Initial Risk Rating Probab.	x Severity	Risk Factor
		4.All power cable to be kept in proper routine and not laid on access. 5.Cable joint should be properly with cable connection. 6.Fire extinguisher to be kept at near working area 7.Proper earthling to be provided in DB and electrical equipment			
	Movement of heavy machinima around the site & lifting operations: Miscommunication of signal	1.Only one person should be appointed for signaling work 2.All signals should be known to all staff and workers 3.Signalman should stay where machine operator can see his signal.	1	3	3
1C	**Working over water:** Potential to fall in river	1/ Life ring and life jacket shall be provided 2.Unauthorized people or machinery are prohibited to enter working area. 3.Clear information and instructions about activities in working area. 4.safety awareness training. 5.Check the weather condition before starting work. 6.Conduct working over water safety awareness training for all involving employee	1	5	5
2A	**Before entering Confined space:** 1.Gasses 2.lack of or excess oxygen 3.Slip, Trip, Fall	1.Ensure all people are confined space trained. 2.Develop the job specific confined space induction including emergency rescue procedure, for all people work in or around the confined space. 3.Complete the confined space Entry Permit. 4.Check the possible gases an oxygen level by the gas tester. 5.Isolate all equipment, materials, services and energy sources possibly dangerous to people working in or near the confined space. 6.Determine the need for cleaning and purging. 7. Maintain an acceptable atmosphere by ventilation. 8.Provide appropriate PPE, ensure all rescue equipment is available. 9.Keep a person hole watcher and maintain the log entry/exit log sheet	1	4	4
2B	**Entry to Confined space :** Fall from man basket, slip, trip, fall	1.Mas basket must be inspected by competent person. 2.Full body harness must be worn and hook up with the auxiliary hook 3.The crane operator and signal man must be competent. 4. Before starting the activity check the weather condition	1	5	5
2C	**Working in Confined space:** 1.Restricted access/egress 2.Contaminnts 3.Carbon monoxide 4.Struck by objects falling into confined space 5.Temperature 6. Slip, Trip, Falls	1.Appropriate signs/Barricades 2.Regular atmospheric monitoring 3.Wear Hearing and/or dust masks to be worn when necessary 4.Use pinch bars as much as possible to minimize noise and dust from hammers. 5.Keep generators away from entrance of pit to keep exhaust fume away. 6.Keep clear around entrance area	1	5	5

Item	Description of Job and Hazards	Precaution/ Prevention Measure	Initial Risk Rating Probab. x Severity		Risk Factor
		7.Care when passing material out of confined space. 8.Mechanical Ventilation (fans) 9.Adequate lighting 10. All light, fans, generator and lead to be tested and tagged as per Bechtel procedures 11. Leads to be elevated keep work area tidy. Small items to be removed immediately or stacked neatly.			
2E	**Return to Service of Confined Space:** Person left in confined Space	1.All persons involved have left the confined space 2.Stand-by-person to confirm all personnel are out of the confined and accounted for information to be recorded by sign off on the entry/exit register. 3.The trained person doing the work to confirm all work is complete, equipment is removed and the area is ready to be put back into service by removal of applicable isolation. 4.Confined Space Risk Assessment, Confined Space Entry Permit, Air Quality Register and Entry/exit Register returned to the Bechtel Work Supervisor. 5.Bechtel work supervisor to arrange for isolation removal. Inform PWCS that the work in the confined space has been completed	2	5	10
3A	**Clan up on Completion:** Trip hazards, Rubbish	All possible due diligence to be exercised to ensure zero slips, nips and falls. All rubbish to be disposed of in bins provided.	2	2	4
3B	**Emergency preparedness during the execution of the Underwater Welding Works:** Physical injuries (Minor, Serious, Fatal)	Emergency vehicle to standby all the time at site vicinity The injured person should be given First aid immediately. First aid box shall be made available with required medicines in adequate quantity and Certified First Aider available at work location. Employees shall be explained about the provisions of first aid, assembly point and contact numbers etc. Emergency assembly area, emergency siren should be available Emergency shower & eye wash facility should be available Tie up with hospital in case of medical facility. Emergency Protocols: Establishing clear emergency procedures to swiftly respond to any electrical hazards or accidents that may occur during underwater welding operations. Emergency Preparedness: Have plans in place for contingencies like equipment failure, diver emergencies, or foreseen situations. Commination: Maintain clear commutation between the dive team, face support, and any other involved patties throughout the operation. Standby ambulance and rescue boat	2	3	6

4. CONCLUSION

The construction sector is one of the riskiest in the world, with a major injury risk that is 2.5 times higher than in other sectors. Bangladesh, a least developed nation, lacks an appropriate OHSMS for construction sites, as evidenced by statistics report. Fewer accidents and injuries equal fewer disruptions and downtime in a safe and healthy work environment. Workforces always face challenges due to pattern of job and lack of competency, taking precautions mainly selecting suitable tools & tackles and necessary training. This study shows that risk factor can be reduced by implementing proper management/mitigation measures, which could be acceptable to the stakeholder. For example, Power is mandatory for operating the machineries/tools and its use should always be in controlled with built in system like proper earthing and proper insulation & good cable management. In case of Working over water, workforces should be used to swimming in the tidal river for his/her confidence. Using life jacket, he/she can survive in the event of emergency. To work inside Confined space workforce should be experienced and physically fit, frequently gas testing & close monitoring with emergency preparedness is mandatory here.

In this study a particular task of Jamuna Railway Bridge Construction is considered as the case study to assess the risk and effect of precaution measures on it. In the project, due to an accident during Pier construction, the authority carried out underwater MS plate installation and welding work in the damaged steel cofferdam. Prior to repair activities, method of statement was prepared with risk assessment and its control measures for comparatively safe work. The Hazards and severity of each component were identification and Risk assessments were performed. Based on the well-established methodology, the probability and severity levels are determined to calculate the Risk Factor. It is observed that for the reported activities the risk scores can be reduced significantly (2 to 6 in a scale of 25) from its initial risk score (upto 20) after implementing the proper mitigation measures. Long-term cost savings are a possible outcome of investing in health and safety practices. Reduced medical costs, insurance premiums, project delays, and legal liabilities are all lowered when there are fewer accidents. Prioritising health and safety create a positive work environment that increases employee engagement and morale. When employees believe their health and well-being are given priority, they are more likely to be proud of the work they produce.

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