

Status of Occupational Health and Safety in Bridge Construction

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Abstract

This paper discusses the status of Occupational Health and Safety in the construction sector particularly in bridge construction works. It highlights the safety guidelines and checklists developed by Japanese experts in collaboration with Bridge Division, Department of Roads. The content of the safety control checklist has been comprehensively elaborated. A comparative case study with regard to standard of OHS administered, between Wangchu Zam construction in Thimphu (carried out by CDCL) and Dangdung and Yurmung bridge construction in Trongsa (carried out by Lamnekha Construction Pvt. Ltd.) has been presented. The study was conducted based on observations made against the requirements specified in the safety control guidelines.

Introduction



Diwash Subba is an engineer currently working at Bridge Division, Department of Roads, Ministry of Works and Human Settlement, Thimphu. In his 4 years plus of experience in the department, he has carried out detailed design of bridges across Bhutan and also worked closely with Japanese experts in the field of Occupational Health and Safety (Safety Control) pertaining to bridge construction works.

Occupational Health and Safety (OHS) is a fairly new territory embarked upon by the Bhutanese engineering community. Since it is at its early stage, OHS is taken synonymous with safety helmets and boots and is therefore, mostly overlooked during execution of any construction project. In doing so, the executing bodies miss out a considerable amount of other safety practices that are otherwise mandated by OHS regulations. The labourers, both Bhutanese and Indian, are so alienated to the concept that they show reluctance to wear their protective equipment due to associated discomforts and uneasiness.

The Labour and Employment Act was enacted by MoLHR in 2007 following which, OHS regulations were created in 2009 and then revised in 2012. Despite the initiative, OHS regulation has not been implemented thoroughly due to poor linkages with the implementing institutions. Although the law exists, it has not been imposed properly in the actual fields, where works are conducted in the same old hazard-prone manner as before.

Background

Department of Roads currently has an on-going technical cooperation project with assistance from JICA. The CAMBRIDGE project aims to produce Bridge Management System (BMS) which stores the inventory data of bridges along with reports on structural health of the infrastructures. This system will help in prioritizing budget allocation for maintenance of the bridges across the Bhutanese road network. Along with BMS, the project has also produced

guidelines for monitoring of occupational health and safety particularly at bridge construction sites. These guidelines are supplemented by field checklists which help in thorough evaluation of whether or not the construction works have been carried out as per the minimum standards set by the guidelines.

To ensure that the construction activities are carried out in accordance with the OHS regulations, the project engineer from employer's side should visit the site, before the commencement of an activity and inspect as per the checklist. For this, he will need to take a copy of the relevant checklist and enquire the site engineer of the status of each requirement, which should subsequently, be verified through actual inspection. Only when the requirements are fulfilled and the project engineer approves of the activity, can the contractor proceed further.

For demonstration and familiarization for DoR engineers, the project experts from CAMBRIDGE carried out seminars and workshops at Wangchu Zam construction site in Chubachu, Thimphu and Dangdung and Yurmung bridge construction sites in Trongsa. The observations and comparisons between the two projects with regard to implementation of OHS regulations will be duly discussed and presented in the later section. The content of the checklist has been discussed in the following sections.

Types of accidents

The work-related accidents that occur in a construction site can be classified as:

a. Fall accident

This type of accident involves the workers falling from heights and succumbing to injuries or fatality. Improper scaffolding, absence of hand rails at high heights, uncovered openings or working without safety harnesses are seen to be some of the causes for such accidents.

b. Falling objects

These are caused by construction materials which fall due to improper securing when lifted. It can also occur due to improper operations of cranes or other lifting machineries. If machines are kept at heights without proper staging, they can fall and cause injuries to workers.

c. Construction machinery

Mistakes during operations of construction machineries can cause fatal accidents at sites. Lack of communication between the site workers and operators can also lead to such problems. The machines should be inspected before working and the operators' licenses checked. Deploying signal men to coordinate the works can reduce accidents arising from poor communication.

d. Structural failure

Some structures such as retaining walls, scaffolding, formworks, etc. which are made prior to the main construction can fail due to design faults or poor quality of materials used. Landslides may come over excavated slopes due to steep gradients. These can cause large scale injuries to the workers and have adverse cost and time implications on the project.

e. Public accidents

At sites which are not provided with proper barricades, information boards or signal men, there are high chances of general public getting in close proximity of the construction works and causing unnecessary hindrances and accidents.

Details of checklist

The checklist identifies three areas to be looked into for the OHS administration.

Preparatory item

This section is concerned with checking whether a Safety Plan specific to the site is prepared by the contractor or not. Safety Plan is a document that sets out rules and procedures to be implemented during the execution of a project with the aim to protect the workers from any of the identified work hazards. Along with prevention of work accidents, the document also outlines the procedures for responding to a safety incident, providing emergency medical treatments and following up with post-incident reporting.

A safety plan should consist of the following:

a. Assignment of responsibilities

It should specify who should be responsible for looking after the safety aspect of a construction project at the site. It should also specify who should replace the responsible person during his absence.

b. Frequency of inspection

The frequency at which the safety inspection to be carried out at site should be mentioned. It should also designate the person responsible for carrying out the inspection.

c. Medical facilities

The type of medical facilities that should be available during the working hours at the site should be mentioned along with how the emergency responses should be fetched when accidents occur.

d. Safety equipment

The list of Personal Protective Equipment (PPE) to be provided to the workers should be provided. It should also specify at what frequency should these equipment be replaced.

e. Dissemination of information

The workers should be made aware of all the safety protocols that should be followed at the site. Additionally, morning meeting should be conducted daily before the works commence so that the workers fully understand about the activities. The document should mention as to who should be responsible for dissemination of such information.

f. Organization and hygiene

The document should state the type of regular tasks that should be carried out for maintenance of hygiene at the site. Along with that the person responsible should also look after proper storage of tools and equipment at the end of the working hour.

g. Post-incident reporting

This part specifies the type of reporting that should be documented after the accidents occur at the site.

b. Contract management

This section describes as to how the contractor will ensure that the safety plans will be carried out and followed at the construction site.

Daily works

This section inspects the safety standards in the daily regular works that are performed at the site. The section looks into 3 key areas as given below:

a. Morning meeting

The safety inspector (usually project engineer from employer's side) has to visit the site and see whether morning meetings are conducted every day before the commencing of the daily works. The inspector has to assure that during such meetings, attendance of the workers is confirmed seen if any one of them is under the influence of alcohol. Additionally, it should be confirmed that none of the workers are sick. The workers should then be informed of work schedule for the day and notified about the identified safety risks likely to occur.

b. Safety sign board

Here, the inspector has to inspect and confirm that the construction site is provided with at least one safety sign board with the message "Safety First". The minimum size of the sign board should be 30cm x 100cm and it should be erected at a point from which it is readily visible across the site.

c. Personal Protective Equipment (PPE)

The safety inspector has to check whether the workers are equipped with safety gadgets such as safety helmet, boots, working uniform, gloves, safety harnesses (if appropriate), goggles, etc.

Specific works

This section deals with inspection of safety standards in specific works that a particular project will carry out depending on the nature of construction. These have been discussed as:

a. Scaffoldings

The material used for scaffolding should be strong and of good quality. All the openings should be covered with footboards which should be tied at the ends to strong parts of the scaffolding. At places where the working height is more than 2m, railings of 85cm height should be provided. Safety nets should be fixed at hazardous locations as fall prevention measures. Proper ladders should be provided for vertical movement along the scaffolding. They should be tied at the top and provided with slip stoppers at the bottom. Any unnecessary hindrance in the working platform should be removed. When the scaffolding is dismantled, it should be ensured that they are systematically removed in step-wise manner.

b. Earthworks

The specifications and conditions of machines (such as backhoe, bulldozer, dump trucks, payloader, etc.) that will be deployed for the earth works should be checked along with their operators' licenses. Signal men should be properly deployed so that the work is not hindered by general public. The working ground for the machines should be checked so that they do not get into precarious positions during operation.

The gradient of the excavated slope should be checked and reconfirmed prior to the excavation. To prevent the workers from falling rocks, proper barricade should be made and safety helmets provided. If groundwater is found to be present, a proper drainage channel should be provided to flush out the water. In order to haul the excavated matter, a proper access road should be made beforehand.

c. Concrete works

The inspector should see if the concrete pouring method adopted (manual, chute, concrete pump, etc.) is appropriate for the site. The ground or staging for concrete mixer or transit mixer should have adequate bearing strength so that they do not topple or lose footing during operation. In case of a transit mixer, a signal man should be deployed so that it reaches the site in timely manner and does not get disturbances from general public. The scaffolding used for concreting should be of sound material and have adequate strength.

d. Formworks

The formworks should be prepared in a yard which is spacious and clean. The inspector should check whether or not the formworks conform to their structural design calculations. The materials used should be of sound quality and free from any defects. The scaffolding for the formworks should be of adequate strength to take on the load that comes on them once the concrete is placed. When the formworks have to be placed at higher heights, proper care should be taken when lifting them up. In case footboards cannot be placed along the scaffolding, the workers should be provided with safety harnesses to prevent fall accidents.

e. Lifting works

The size of the tension wires used for lifting should be of adequate diameter and strength. They should be free of defects. Proper slinging method should be employed so that the

lifted object does not swing excessively during lifting. Signal men should be deployed so that he can effectively transfer the message to the operator through visual signals. It should be made sure that the operators and signal men are thorough with various signals that will be used. No workers should be allowed to come under the lifted load.

f. Construction site

The inspector should make sure that the construction area is properly barricaded so as to prevent the entry of general public or other nuisances. The site should be clean with the equipment and material properly organized. Access roads, if any, should be provided with guiding ropes at the edges. There should be construction information boards at appropriate locations so the general public or visitors are aware of the on-going activities.

g. Acetylene and oxygen gas cylinders

These cylinders should be kept standing in storage and provided with fall preventive mechanism. The storage should be able to provide shade to the cylinders (temperature should be less than 40 C). The inspector should make sure that the cylinders are kept standing even during the actual use. Any fire related items should be used at least 5m away from the cylinder storage.

h. Power supply

Power distribution panel boards should be provided and the transmission wires used should be of appropriate specifications. The connections made should be proper and should be away from wet areas. Proper earthing should be made.

i. Crane and heavy machineries

The capacities of such machines should be checked and ensured that they are adequate for the site requirements. The inspector should also check whether or not the machines are regularly inspected and maintained along with checking of the operators' licenses. Signal men should be deployed when such machines are operating.

These are some of the specific works that the checklist covers. The inspecting engineer should visit the site and inspect all of these requirements before approving the activity. In case the contractor fails to meet any of the stipulated requirements in the checklist, the inspector will be expected to report on his observations and halt the work until the recommended changes are implemented.

Case Study

The standards of safety regulations implemented at Wangchu Zam construction project executed by CDCL and Dangdung and Yurmung Bridge construction projects executed by Lamnekha Construction Pvt. Ltd. were studied and compared to understand the existing status of OHS in the country. The projects are similar in terms of nature of construction, cost incurred and project duration.

Wangchu Zam is an on-going bridge construction project, expected to complete by June 2019. The project duration is 27 months and cost is around Nu. 108 million. The bridge is reinforced concrete arch type of 96m span. Dangdung and Yurmung bridges were completed in 18 months and 12 months respectively. The total cost of the two projects is a little over Nu. 110 million. Both the bridges are 50m long and are of steel truss girder type with concrete decking. The differences between the OHS regulations are as tabulated below:

Table 1: Comparison of Wangchu Zam and Dangdung & Yurmung Zam constructions

Sl.	OSH Aspect	Wangchu Zam	Dangdung and Yurmung Bridges
1	Safety Plan	Not submitted	Not submitted
2	Daily meeting	Conducted where the activities for the day are informed of and attendance taken.	Not conducted
3	Safety sign boards	Safety sign board with visible message was provided at a point which was visible across most of the site.	No safety sign boards were provided.
4	Uniform and PPE	Project Manager, Project Engineer and workers wear appropriate site uniforms along with PPEs such as safety helmets, boots, harnesses, etc.	Although the workers were provided with safety helmets and boots, there were not any site uniforms for them. So, the workers worked in their casual clothes.
5	Scaffoldings	Although sound materials were used for making scaffoldings, they were not designed and checked for safety. Footboards were only provided at certain locations and some openings were left uncovered. Hand rails were not provided at places where the height exceeded 2m. Ladders used for vertical movement along the scaffolding were awkward to walk on.	Similar case.
6	Earthworks	Before the excavation, access route was created so the dump trucks could reach the point of excavation and take away the excavated matter. The excavated matters were properly dumped at designated area.	Proper cut slopes were not maintained. The excavated materials appeared to have been dumped on the downstream side of river.
7	Formworks	Formworks used were clean and of strong material. However, they were not designed and checked for safety.	Similar case.
8	Construction site	The construction site is thoroughly barricaded with CGI sheets to prevent entry to the general public and cause unnecessary hindrance to the work. This also protects public from work accidents that are likely to occur at the site. Construction information boards are provided near the entrance for awareness of the public and visitors alike. However, no such information boards are fixed on the other side of the river, where, owing to their absence, people are often seen driving till the site and going back.	The construction sites were open with no barricades at all. There were no project information boards at the site. The site engineer reasoned that the site was far away from public centers and the adjoining roads were not yet opened to traffic. At Yurmung bridge site, a narrow wooden plank had been laid across the stream as a means of river crossing for the workers. The plank was not properly fixed at the ends and did not have any hand rails as side supports.
9	Acetylene and oxygen gas cylinders	Although the cylinders were stored in shaded areas, they were not kept upright but rested in sideways manner. Even during the actual use, they were kept rested and not upright.	Similar case.

10	Power supply	Proper power distribution panel boards were used along and electric wires used were of appropriate specifications.	Similar case.
11	Shoring works	For shoring works, 4 temporary concrete frames were built on the river bed. Wooden planks were placed across these frames and shoring metal poles raised upon them. Designed shoring arrangement was used with proper metal clamps. Walking platforms were provided by laying wooden plans across the openings. Workers used safety harnesses while working on the structure. However, when dismantling, it was observed that the workers threw the shoring poles carelessly from where they were detached into the flowing water below.	During the launching of steel truss girders, no shoring structure was built to support the girders. Instead, tension steel wires were stretched over the steel towers at each abutment and anchored to heavy weights. The girders were then suspended by means of wires and launched across after fixing the connections. During the launching, the workers were seen without safety helmets and safety harnesses.



(a)



(b)

Figure 1: Comparison of working conditions between Dangdung Bridge and Wangchu Bridge. (a) Workers at launching of steel girders without safety belt and PPEs. (b) Quality check/audit at Wangchu Bridge with workers in proper PPEs

Discussion

Occupational Health and Safety Administration failed to gain momentum in the past decade despite the enactment of Labour and Employment Act in 2007 by MOLHR and subsequent formulation of OHS Regulations in 2009 and 2012. Lack of expertise specialized in the field and lack of cross-institutional linkages (between the law enactors and implementing agencies) can be pointed out as the foremost hindering factors among various other factors such contractor's reluctance, public unawareness, lack of researches, etc.

Today, none of the contract documents used as guiding entity for construction works in the country has any definite clause persisting on proper administration of OHS and imposing relevant penalties upon failing to do so. Although some contracts spell out the use of PPEs by the workers at site, the absence of any legal implications on the failure of its adoption has led to its negligence in most cases.

As seen in the case study, in both construction projects, no safety plan documents were submitted prior to the start of work. There were no safety inspectors deployed by employer to scrutinize the standard of safety regulations implemented at the sites. The construction works carried out at Trongsa exhibited high level of working hazards which were totally ignored. The construction areas were not barricaded and no information boards were provided for public awareness. Workers worked in their casual clothes which are actually not suitable to work in. Safety helmets and boots were reportedly provided but its use during the work was not strictly imposed and as a result many workers could be seen without their safety gadgets during site visits. Even during the launching of the huge steel girders across the river, workers could be seen walking on the suspended girders without any safety harness. The gradient of cut slope was dangerously steep and even the scaffoldings were seen to be erected on weak soils. The practice of conducting morning meetings with the workers before starting the day's work was completely absent.

Compared to them, the Wangchhu Zam construction project in Thimphu does significantly better with regard to administration of OHS. The work yard is barricaded and appropriate information boards are provided. A "Safety First" sign board is also fixed at the site to indicate that safety of the workers is the first priority. Morning meetings are conducted every day before the commencement of the day's work. The workers work in their proper site uniforms fully equipped with relevant PPEs. These practices are laudable and should be strengthened upon in times to come.

Some of the shortcomings were also observed at Wangchu Zam site and they should not be overlooked. For instance, the scaffoldings and formworks should be designed and checked for safety as stipulated in the safety control guideline. The gas cylinders were kept at inappropriate positions in storage as well as during operations. Hand rails were not provided at places where the fall height exceeded 2m. The ladders used for vertical movements were not properly made and posed every risk of work accident. Dismantling of scaffoldings were not monitored well and workers were seen disposing the detached poles carelessly into the river.

OHS administration should be thorough and encompass all the working hazards that are likely to occur during the course of a work. Even a minor hazard will have the potential to cause high negative impact on the workers. An injury or a death at a site, resulting from a working hazard can lead to impedance of the progress due to post-incident processes. Moreover, such negligence can lead to premature failing of structures even at construction stage and cause injuries and deaths on large scale. This will have huge undesired financial implications on the cost of the project. Therefore, OHS administration should be thoroughly comprehensive and encompassing in order to provide a safe working environment for the workers involved.

Conclusion

The administration of OHS has a long way to go from where it stands today. After an unremarkable decade marked with failure to gain momentum despite enactment of law and framing of regulations, it is high time that the relevant agencies collaborate and formulate rules to be implemented across the concerned sectors such as construction and manufacturing sectors. Proper designation of responsibilities to the agencies and framing clear cut policies and

regulations can help streamline the administration and also eliminate unnecessary duplication of works.

The resulting rules should have legal binding provisions that will encourage strict implementation by the executing entities. For instance, in the construction sector, the contract documents should have appropriate clauses calling for thorough administration of OHS at work site to promote a safe working environment not just for the workers but also for the general public who may get involved indirectly with the work. The clause can also specify the list of penalties to be imposed upon the contractor when he fails to uphold the clause and performs an activity under hazardous conditions.

Besides the rules and regulations, expertise in the OHS should be developed by providing opportunities for specialization in the field and training in relevant programs. Data collection associated with working hazards should be taken up by a related agency and researches conducted to develop a more specific measures and regulations appropriate for the country. Public awareness is another prominent area to be looked into for promoting a more effective OHS administration. For this, public awareness facilities such as media, newspapers, radios and social media can be capitalized upon.

References

CAMBRIDGE. (2018). A field checklist on the basic items on safety control for bridge construction. Thimphu.

CAMBRIDGE. (2018). Guideline for a field checklist on the basic items on quality control for bridge construction. Thimphu.

CAMBRIDGE. (2018). Guideline for a field checklist on the basic items on safety control for bridge construction. Thimphu.