**Discipline: MS Civil Engineering**

**Course Title: Risk and Disaster Management in Construction**

**Submitted By: Engr. Kamran Khan**

**ID: 15162**

**Q1. Considering the Bus Rapid transit (BRT) Peshawar, what were the risk involved during construction associated with technical aspect of the project? Support your answer with logical and factual arguments along with references. State how we could counter the risks associated with the technical aspects.**

The contractors and designers involved in the tunnel construction in United Kingdom were prosecuted under the *Health and Safety Act* in England because they did not provide adequate measures for masons, labor and the common public to prevent from ‘risk’. The report further stated, “*Risk assessment should be a fundamental step in the procedures adopted by all parties (of construction): it is inappropriate wholly to leave the control of risk to contractors.*” The Bus Rapid transit (BRT) Peshawar is a unique project initially initiated to improve the transportation system of Peshawar city, however, it has variety of shortcomings with respect to technical as well as the social aspect. Herein, we would throw light on various risks associated with construction of this mega project. Following is the succinct list of aforementioned risks;

1. **Extended duration of construction**

The lack of experience of the concerned government organization led to an extended duration, which had been allocated initially for this project. Peshawar city experiences different types of related hazards that include intensive rainfall, extreme temperature changes, hailstorms and strong winds. One such example could be quoted i.e. Diyala Bridge which was located in Iraq where flood washed away the formwork for the below the deck slab. It led to delaying the project that resulted in huge loss. Other than this, there were also many other factors contributing to the occurrence of failure. Furthermore, in case of BRT, the extended duration resulted in experiencing more amount of rainfall that choked the sub-surface drains thereby increasing the surface runoff on roadways. It resulted in deterioration of pavement surfaces along with many fatal accidents that took lives of half a dozen. Such a discrepancy caused immense trouble to public and hindered the process of construction in the congested region of Peshawar city. Measures must have been taken to synchronize with weather department and observe speedy construction by implementing fast track working to avoid any delay.

1. **Technical complexity and innovation in design requiring new methods of construction and/or erection:**

In case of relatively new design, material or construction method, what is desirable is detailed and in-depth communication between the designer, contractor or any other expert involved in the construction process. In the case of BRT, proposal of new cycle track and employing sharp curves along with side drains was troublesome for the contractors. It was because those curves had to be redesigned after demolishing the built structure a number of times and at several locations. Such sharp turns were in fact not possible for the large-sized buses that would run on those tracks. In addition, several issues have been faced by the contractors working on BRT because the nature of project is complex as well as there exists large communication gaps between the executing parties. This can be addressed by maintaining close liaison between the designer and execution parties, so that any probable mishap in future is avoided.

1. **Defective design**

Defective or copy paste design is a major problem of various projects in Pakistan. As already mentioned, the design flaws in BRT were recorded at numerous instances. For instance, drains, piles and walkways were improperly designed and no heed was given to designing curves at prescribed location due to which turning was not possible for buses. Such a perplexity has caused chaotic unrest among public amid constructing one section of the track and then breaking it because of fault in design or workmanship. In the United Kingdom, a walkway was collapsed which resulted in killing six people and the contractor was held responsible by the court of law for the design and construction of the walkway. However, it was also reported that the cause of the accident was associated with design of the steel structure. Similarly, the BRT has witnessed a number of local failures, fault in designs and malpractice, however, the project is not discussed critically in the court of law in order to reach out to the actual causes, which has impeded the constructional activities.

1. **Defective design, workmanship, material and quality control**

The main risk associated after proper design is the quality of material and workmanship. In addition to aforementioned risks, this is a major contributor in delaying and compromising the intended quality of the Peshawar BRT project. It can also be related with a prominent incident in past wherein the main distillation column of a new oil refinery hit an accident while being erected that caused total loss. It was revealed that, a weld in the cross-strut in the top section of the jib of the 250 tonne crane had failed due to which the ultimate failure had taken place. In yet another example, during the construction of the rail-link from London’s Paddington Station to Heathrow Airport, the Heathrow Express line, three partly built station tunnels caved in (October 1994) and continued to collapse in few days. It was revealed that the failure was initiated at the base of the main shaft at the connection to the down-platform. A problem of similar kind has also been reported in BRT when a precast concrete girder near University town area was lifted using cranes, which cost the company a loss of $ 0.15 million. Such pivotal risks can be vilified by ensuring proper check and balance, inspection of machinery and material before usage via preset national standards protocol, which we currently lack. Moreover, close supervision from consultant firms and adequate, reliable and proper testing of construction material at each stage should be ensured to achieve quality in the field of construction.

1. **Inadequate site management**

In the BRT project, utility lines were damaged during excavation at various locations but due to proper site management, the affected area was cordoned and recovered immediately in matter of hours. In an incident in the UK where fire broke out, the fire brigades from the neighborhood quickly reached the site and hardly had it taken an hour to extinguish the fire. If adequate fire-fighting equipment (manual fire extinguishers) had been available, there will be minimum losses to the owner. This leads to the conclusion that site management is a must-to-do aspect and which significantly affect the construction quality, duration and the benefit to cost ratio.

1. **Explosion and fire**

Inflammable construction materials such as timber, shuttering, packing material, plastic foils, fuel, paints and other hazardous material are generally found on site. A project concentrated in one location can be threatened in its entirety by fire and the risk involved increases with the progress of construction. Welding can also be one major cause in this regard. It is to mention here that, an amusement park under construction within a hotel and shopping complex was destroyed by fire. Due to excessive welding, the inflammable materials openly dumped and lack of fire-resistance measures, the probability of fire damage in case of BRT increases to several degrees. For example, welding caused problems to people living nearby and thus causing the retinas to damage which could lead to reticupathy i.e. permanent blindness.

1. **Collapse of temporary works**

It was thought that the launching truss failed causing the incomplete span to collapse and to over-load the two preceding spans, causing their collapse. It was fortunate that no one was killed or injured in the collapse.

1. **Ground movement**

Ground movement resulting from a number of causes, including landslides, frost heave, earth slips and ground pressure leading to collapse. Example 1: Due to heavy rainfall the earth on the slope above the building site of sewerage plant slipped down 10 m. The sewer had already been completed and was ready for use but then became filled with mud along a length of 2500 m. In case of BRT same condition happened due to heavy rain all mud come along side of the drain resulting in collapse.

**Risk Identification**

Now that we’ve discussed some of the risks common on construction projects, it’s time to identify the risks unique to your project. This should be done as early as possible during the preconstruction phase of the project. Remember, if you fail to identify and manage a potential risk you are basically accepting it, should it present itself during your project.

Hold brainstorming sessions with the project team and stakeholders to identify risks. At this point, you aren’t looking to solve any problems. The goal here is to identify as many possible scenarios that could negatively impact the project. Be sure to rely on the expertise, experience and knowledge base of your team. Review past projects with similar size, scope, and location you’ve completed to better understand the risks your current project is facing.

A good way to prevent risks from sneaking up on you as the project progresses is to hold regular meetings with your project team and stakeholders. In addition to reviewing your current risk management efforts, you can also use that time to identify any other issues that may pop up in the foreseeable future.

**Managing Risks**

High impact, high probability risks should be handled first, while risks with a low probability and low impact can be tackled last. Factor in the amount of time, money, and work each risk will require to effectively manage. Now that you’ve ranked each risk, carefully review each one and determine if you can avoid, eliminate, reduce, transfer, or accept each risk.

**Avoid the risks.**This may mean turning down a project or negotiating the contract to remove the risks. There’s no shame in walking away from a project if the risks outweigh the potential rewards.

**Transfer the risks.**Your company might not be the right fit to manage a particular risk. Work with the other stakeholders to determine who on the project team is best suited to assume each risk.Discuss with the client what risks they will assume and which ones you will be responsible for managing. Work with your insurance provider to determine which risks are covered under your current policies along with other options for protecting your company against risks.

**Mitigate the risks.**Eliminating, reducing and accepting risks takes careful planning. Break down each risk into actionable items. Don’t overcommit your resources to handling multiple risks. You may need to bring in additional resources, such as hiring more workers or renting additional equipment, to manage all your risks effectively.

**Accept the risks.**Agreeing to accept a risk is a decision that shouldn’t be taken lightly. It might be fine to accept a few low probability, low impact risks. Agreeing to accept a high probability, high impact risk without any type of management or mitigation could be detrimental to the project and your bottom line.

Good risk management requires a high level of collaboration and communication with all parties involved. Keeping everyone on the same page and working together will allow you to identify and manage risks before they become a problem. Remember, risks can lead to great rewards when effectively managed.

**Q2:**

Annual probability of hazard = ID/6585200= 15162/6585200=0.00230

By using Table 2.1 values

0.0023 falls in category C, which shows **“Very Unlikely”**

As the Cost is given, now by using Table 2.2

The values fall in category IV, which shows **“Significant Loss”**

Now By Using given Risk Matrix,

Matching of values of probability as category C and consequences (cost) as serial IV, the level of the Risk comes out to be **Low (L)** in this case. Once you’ve identified the potential risks to your project, you now need to sit down and assess each risk based on the probability of becoming reality and the impact they will have on the project if they occur. Rank the impact and probability of each risk as high, medium, or low.

High impact, high probability risks should be handled first, while risks with a low probability and low impact can be tackled last. Factor in the amount of time, money, and work each risk will require to effectively manage. Now that you’ve ranked each risk, carefully review each one and determine if you can avoid, eliminate, reduce, transfer, or accept each risk.

 In this case as the probability is very low and chances of occurrence of this particular risk is almost nil, nevertheless the loss to occurrence of this risk is too much high. Hence by using Risk Matrix the impact of the risk come out to be Low (L). Hence the risk may be either accepted or eliminated depending on it nature.