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Risk Assessment Tunnel Construction with Prevention

Abhijit Dinkar, Omkar Mahajan, Pooja Sokande, Rohit Mishra, Prof. Manisha Bambade
Department of Civil, VOGCE, Mumbai University, Aghai, Thane, Maharashtra, India

ABSTRACT

Construction projects are often faced with complex challenges; all of which lead to difficult decisions and possibly disputes regarding liability of the parties. This research investigates the risks associated with tunnelling construction and uses the information to create a simplified risk register. The risk register may be used as areference guide of responsible and proactive project planning that reflects industry standards, lessons learned and the currency of understanding of the owners and contractors. Additionally, a checklist was created to simplify risk assessment during each phase of construction by identifying possible hazards for each critical task of the project. By openly acknowledging and discussing risks in the contract, the author believes that the tone of the project will be set towards mutually beneficial progress and co-operation and the lessons learned on each project will also be easier to recreate and utilize on future projects.

Keywords : FEM Analysis, TBM, AS/NZS

I. INTRODUCTION

Construction projects are often faced with complex challenges such as differing conditions, underestimated productivity, environmental or safety violations for example, all of which lead to difficult decisions and possibly disputes and litigation. The key to success on any construction project is to, therefore, have a competent and prepared team ready to mitigate as many risks as possible, as quickly as possible. Proactive construction companies even go as far as to include forecasting, analyzing and planning for risks that lie on the margin of or just outside the scope of the project. But even the most prepared construction team is still in harm's way if the forecasted risks are not accounted for and assigned to the stakeholders best suited to handle them. Through a thorough literature search of current tunnelling practices this research aims to create an improved tunnelling construction checklist designed to account for hypothesized risks on the project's critical path. The checklist and risk register developed in this research are intended to serve as guidelines for tunnelling risk management; therefore, they are intended to be updated regularly as processes develop and adapted to suite different project conditions.

II. LITERATURE REVIEW

Kimoya Lee Giel- Tucker, Managing tunneling construction risk:

This research could be developed into the co-production research study of the total risks associated with tunneling construction. The important of risk management throughout the project life cycle and involved singular investigation into the contractor designer and other involved parties.

M.S.Rahul,(2014), Case Study on Design and Construction of Tunnel:

Case study of water tunnel for Pranahitha Chevella tank as described in this letter. The design and various steps during construction activities are enlightened in this paper. Concrete Lining is provided depending upon the rock class encountered during the excavation which described in paper.

S. Abdel Salam & Alaa Ata,(2015), Modeling of TBM Tunnel Construction for the Greater Cairo Metro Line:

Ground services due to construction of tunnel by slurry shield tunnel boring machines are predicted in this paper. The construction stage and design are analysis by FEM analysis and simulated the condition of a section along the route of proposed site.

Hideki Shimada, Saeid Khazaei & Kikuo Matsui, (2004), Small diameter tunnel excavation method using slurry pipe-jacking,:

The study of a small diameter pipe pushing construction, design and various aspects studied in this paper. The mud slurry is formed around the pipe in order to stabilize the concerned soil. This paper also discusses the effect, shape on the stability of concerned soil by means of numerical analysis.

III. METHODOLOGY

Hazard and risk assessment

The risk assessment methodology applies the principles and guidelines of AS/NZS ISO 31000: 2009. The assessment includes the following components: hazard and receptor identification risk analysis risk evaluation risk treatment. A hazard is something with the potential to cause harm. Risk is the likelihood that the harm will occur from exposure to the hazard. There must be a hazard and a receptor present for a risk to exist (Brecher 1997). Hazard and receptor identification Hazard identification was undertaken to identify potential hazards during both the construction and operation phases of the Project. The type and magnitude of exposures relating to these hazards were then identified. For the quantification of an exposure, all potential receptors need to be identified and characterized. Receptors are not restricted to human individuals or communities but can include sensitive environments, including natural habitat, flora and fauna.

Risk analysis

The risk analysis identifies the likelihood of a hazard occurring, ie probability or frequency, and the consequence if the hazard occurs. Risk criteria were developed for the Project, enabling the assessment of the potential likelihood and resulting consequence if each hazard were to occur.

Risk evaluation

The ratings of the risk elements, consequence and likelihood, allows the development of an overall risk rating of the hazard.

Risk treatment

the resulting risk rating identified during risk evaluation determines the treatment/management level that needs to be applied to the risk. The risk ratings include:

extreme high medium low.

The general management principles for each risk rating are:

Extreme – excessive risk to people and property. Significant and urgent actions required to reduce the risk.

High and medium – implement mitigation measures to reduce the risk to as low as practicable **Low** – monitor and manage the risk to the extent necessary.

After undertaking the preliminary risk assessment, the risk evaluation is then repeated taking into account the mitigation measure/s applied to the risk with the objective of yielding a reduced risk rating. This residual risk is derived on the assumption that all identified mitigation measures would be effectively implemented.

Hazard and receptor identification

Hazardous activities or events Potentially hazardous activities or events which may occur during the construction and operations phases of the Project and which present a risk to people and property are listed below:

Construction

Operation of vehicles and construction equipment on site including in a confined tunnel space the storage of dangerous goods, including oils and fuels, in relatively compact construction worksites the use of oils, fuels and other dangerous goods including explosives, and their transport to construction areas transportation of excavated soil to spoil placement areas offsite working with electricity and in close proximity to electricity in the operations rail corridors and facilities working within operating rail environments construction failures or incidents resulting in tunnel or underground collapse or subsidence, flooding or inundation changes to surface road and services networks.

Operations train incidents both aboveground and in the tunnel maintenance works on the rail line, tunnel and and/or ancillary infrastructure acts of terrorism or vandalism, such as acts leading to fires and/or explosions collapse, subsidence or failure of tunnel and other structural components flooding and inundation from both surface and groundwater sources.

Health and safety

This section summarises the values of the existing environment and the potential for impacts from the Project related to health and safety and public health. This preliminary health assessment considers environmental factors that have the potential to affect human health, public safety and quality of life, such as air pollutants, odour, worksite lighting, impacts to amenity, dust, noise, vibration and water quality.

Project construction workforce

The health and safety values of the construction workforce are associated with their exposure to and use of safe construction practices. Safe construction practices are critical when the workforce is required to work under the following conditions: at heights in the vicinity of or operating heavy equipment within confined spaces within operating rail and road corridors with electricity with chemicals/dangerous goods manual labour, including the use of tools and heavy lifting.

Project operations workforce

The health and safety values of the operations workforce are related to safe working environments and the safe and efficient operation of the Project. As identified in the risk assessment the main risks to people during operation of the Project are associated with: collision on the line due to maintenance activity or unknown track obstruction an act of terrorism or vandalism infrastructure malfunction emergency situations, including natural disasters.

Community and stakeholder values

An indication of the existing health and safety values of the community and stakeholders has been identified through the Project community consultation process. These values are listed below and have been categorised according to the primary environmental aspect of the health and safety values identified.

- ✓ air quality
- ✓ vibration
- ✓ noise
- ✓ access
- ✓ amenity/quality of life
- ✓ human and public health.

IV. CONCLUSION

Risk is most commonly defined as the combination of the likelihood of a harmful occurrence and the severity of such an occurrence. The greatest severity in construction materializes on the critical path of the project and identifying and tabulating the critical path's most likely harmful occurrences and outlining mitigation strategies will reduce their impacts. The premise is that the risks that materialize outside of the critical path minimizes will have less damage on the overall project. This thesis provides access to the risks associated with tunnelling and incorporates best practices and prevention mechanisms into a risk register and a checklist. The risk register is a

simplified and thorough compilation of risk mitigation strategies while the risk checklist provides a concise reiteration of the risks associated with tunnelling construction. The checklist works with the risk register, which draws attention to the common risks encountered on tunnelling construction projects, thus ensuring that they have been or are being considered and addressed.

V. REFERENCES

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