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(Option 2)Research on the Risk weight setting method for NATM Tunnel Project Construction Risk assessment

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1. Introduction

For NATM (New Austrian Tunneling Method) tunnel projects, various site Condition affects the success of the project. This includes geographical, climatic, geological characteristics, etc., and there are various difficulty of predictable, resulting in risks. Until now, risk management has been presented and managed by a general risk list, and the possibility of risk is different depending on the Site Condition, but it does not reflect it. There is a lot of interest in risk management, but there are difficulties in the lack of experts (Hong, 2003) and unclear lists for risk management. Therefore, this study intends to predict the occurrence of risks according to the Site Condition. It is intended to be solved by giving weight by using the possibility and influence of risks depending on the Site Condition. In addition, by providing approaches that are not equipped with existing risk management methodologies, it will help to develop a system that can cope with various risk elements.

2. Risk weight setting method

In order to set the risk weight of this study, when the user selects the Site Condition, the risk according to each condition is taken from the DB, and each risk has a probability and effect. First, organize a list of risks according to the Site Condition. It was categorized by reference to the attributes of the collected risks and the construction Safety Management Intergrated Information. Site Condition consists of natural phenomena, ground conditions, distance from the field, design, and specialty, complaints, repair, environment, and obstacles.

1st Class	2st Class	3st Class
Ground condition	Geology	Fault
		Fractured zone
		Fold
	Rock	Weathered
		Joint
		RQD

Table 1. Site Condition sample

The following <Table 1.> is an example of site condition, and you can check the corresponding risk when selecting the list.As construction projects depend on unique site conditions, risks also occur depending on site conditions, so the probability and impact value of each risk in each list were determined as weights. Risk probability and impact scores use qualitative figures obtained through expert advisory meetings. For evaluation purposes, this study requires the user to select a site condition. Afterwards, the weight is set based on the probability and impact of the risk derived according to the site condition classification of each category and the AHP technique. The AHP technique is a type of decision-making technique and a theory that makes consistent evaluations by reflecting experience or intuition (Lee, 2007). The process was applied to find optimal decision-making after a pairwise comparison of the importance of each item and use it to identify key management risks.This method combines AHP weighting and direct risk assessment, and the risk weight setting method according to site condition is summarized below.

1. Site Condition Scores are awarded for each category. Ex) Large (5 points), Medium (2 points), Small (7 points)

2. After arranging the Site Condition classification into a hierarchical framework, compute priority weights and make a pairwise comparison matrix. Priority Weight for Site Condition (0.193, 0.083, 0.724)

	1st Class	2st Class	3st Class
1st Class	**0.1589**	0.273	0.149
2st Class	0.053	0.091	0.106
3st Class	0.789	0.636	0.745

Table 2. Apply AHP technique to site conditions

3. Combining probability and impact for each risk

4. Apply the site condition weight to each risk. Ex) 24 (risk score) × 0.193 (weight for Site Condition 1) = 4.632

5.Derive an overall score that reflects the sum of risk weights in site condition.

6.Normalize aggregated scores to compare risks on a common scale.

	SCORE	RANK	New SCORE	RANK
RISK1	**24**	1	24(24×(0.193+0.083+0.724))	1
RISK2	25	2	4.825(25×(0.193+0.083))	4
RISK3	30	3	8.28(30×0.193)	2
RISK4	36	4	6.948(36×(0.193+0.083))	3

Table 3. Risk ranking that varies depending on site conditions

Through this, risks subject to intensive management can be identified and managed. This method can also be applied to other construction types beyond the tunnel project.

3. Conclusion

This study can identify risks subject to intensive management by creating a site condition list, confirming the value through the probability and impact scores of risks, and assigning weights. This approach will be an important driving force in identifying various risks that may occur during the tunnel design and planning stages and establishing strategies to respond to them. However, its scope is limited to NATM tunnels, and there are limitations in the difficulty of differential access during differentiation, management, visualization, and management.

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REFERENCES

[1]Hong, S.W., Kim. H.I., and Ahn. Y.S. (2003). “A Study on Development and Real Situation Analysis for the Risk Management of Domestic Construction Companies.”

Journal of the Architectural Institute of Korea Structure& Construction, 19(5), pp. 153-160.

[2]LEE, K.K. (2007) "Examination of Value Engineering for Bridge Superstructures Using AHP method." Master's thesis, Ajou University.

[3] Ihm, M.H. (2022). Geologic Structure and Rocks as Geotechnical Risk Factors at Intermediate depth Tunneling in Korea. The Journal of the Convergence on Culture Technology (JCCT), 8(3), pp.551~557.

[4]Kim, H.B. (2023). Construction project risk database establishment and classification system development, Master's thesis, Kyungpook National University.