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Analysis of Connections for Precast Sections of Cut and Cover Tunnel Sections by Using Finite Element Method for Regular Traffic and Metro

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Abstract: *Understanding of the precast cut and cover tunnels and different types of connection are to be used and suitable option to be evaluated for the purpose of design after analysing. Structural analysis is a process to analyse a structural system in order to predict the responses of the real structure under the action of expected loading and external environment during the service life of the structure. The present work reflects on the analysis and design of cut and cover tunnel (Precast Panel's) which are the main source of transportation to human life where there is no connectivity which helps to travel from place to place. The modelling and analysis of precast panel's for cut and cover tunnel construction is carried out by using the software Staad-pro software. Different design loads are taken into consideration mainly for metro and regular traffic loading are considered. The design loads are considered as per IRC 6. Cut and cover panels is designed by using Staad-pro and results are compared manually.*

Keywords: Pre-cast panels, cut and cover tunnels, cushion loading, earth pressure, structural design, theoretical calculation, staad pro etc.

I. INTRODUCTION

The "cut and cover" and the "cover and cut" are two techniques for tunnel construction in highway engineering. The "Cut and Cover" method has been used for a long time in urban subway construction but also in interurban transportation projects, in the construction of relatively short and shallow highway and railway tunnels. Lately, the method has been adequately adapted to facilitate construction of tunnel portals. Construction of cut & cover tunnels have gained the speed due to construction and proposal of national highways, expressways and metros. Now a day's proposals of these highways/expressways and metros are done with accepting major challenges. Challenges like construction of underground tunnels with conventional method of construction (cast in situ). This construction method comes with various difficulties like uncontrolled ground water in underground construction and landslide in cut & cover sections in hills (where slope protection system needs to be designed).

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The "cut and cover" technique is a simple construction method widely applied in both urban and rural tunnelling projects. Introduction of pre-casting sections in the construction of cut & cover tunnels can minimize the risk, time and cost. In this research we have considered the cut & cover tunnel of arch shape superstructure and straight raft foundation with precast abutments. Analysis and design of precast sections is to be done as per the IRC method as normal concrete sections. But, analysis of connections of this precast section is the major part of this research. Different types of the connections/joints are to be studied and analysed for the capacity by finite element analysis.

II. REVIEW OF LITERATURE

[1]. David Ward, Design and Construction of Tunnels, This article follows the geo technical arc of typical tunnel project from exploration to testing to engineering analysis supporting the section of tunnel etc.

[2]. Benjamin Celada Z.T. Bieniawski, Ground Characterization and Structural Analyses for Tunnel Design, in this article tunnel and their stability to opening is considered. In tunneling, most often the ground actively participates in providing stability to the opening. Therefore, the design procedure for tunnels, as compared to aboveground structures, is much more dependent on such factors as the site situation, the ground characteristics, and the excavation and support methods used. Recommendations on tunnel design

[3]. Sylvain Plumey, Aurelio Muttoni, Laurent Vulliet, Considerations on the design of cut-and-cover tunnels,had study Soil-structure interaction in the field of cut-and-cover tunnels can be studied by an uncoupled approach by independently determining the characteristic curves of the soil and of the structure, and then by graphically finding the position of equilibrium of the system based on a kinematical compatibility criterion.

[4]. James L. Wilton , Cut-and-Cover Tunnel Structures, In this chapter, discussions or characterizations of usual practice in the design and construction of cut-and-cover tunnel structures refer generally to practice in the United States. The design and construction of these structures in Canada, Mexico, Europe, Asia, and elsewhere abroad is similar in many respects, but it can differ in many respects as well.

[5]. A. Mouratidis Professor of Highway Engineering, the "Cut-and-Cover" and "Cover and-Cut" Techniques in Highway Engineering", The main concept of the method consists of full-length or sequential excavation along the road segment and subsequent construction of the tunnel bore. Following drainage and waterproofing measures, backfilling requires a well-monitored construction process, adequately defined in terms of equipment and quality control. Environmental issues, such as planting and seeding, constitute the final stage, complemented, eventually, by reconstruction of the secondary road network upslope.

[6]. Federal Highway Administration Offices of Research & Development Washington, D.C., Construction Methods, Design, and Activity Variations for Cut and Cover Tunneling", It is the aim of this study to provide these men with a model of varying site and construction conditions which are used to determine the most advantageous methods of performing each construction activity for optimum efficiency of the entire design-construct operation.

[7]. American Concrete Institute , Guide for Precast Concrete Tunnel Segments, This document provides analysis, design, and construction guidelines exclusively for one-pass precast segmental lining that is installed almost instantaneously with excavation inside TBM shields only a few yards behind the TBM cutterhead.

[8]. G. Lunardi, M. Gatti, Arched Shaped cut and cover tunnels on the new Pedemontana Lombarda moterway, An innovative prefabrication method has been successfully employed for the construction of arch-shaped cut and cover tunnels on the new "Pedelombarda" motorway. The tunnels consist of prefabricated components resting on a cast-in-place invert. This solution has been employed with span widths varying from 14 m to 19 m and overburdens from a minimum of 1 m up to 8-9 m. Particular attention was paid to the backfilling stages, in order to define the geotechnical properties of the soil used for lateral and top backfilling. The high percentage of prefabrication in the solution adopted allowed high production rates to be maintained and also the use of high visual quality prefabricated concrete. After a detailed description of the construction system, this paper looks at the analyses performed in the design stage and the results of monitoring conducted during the testing of the works compared to design predictions.

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III. OBJECTIVE

1. To carry out literature survey regarding above mentioned topics and with all the references carry out analysis accordingly.
2. To study feasibility of precast system for cut & cover tunnels.
3. To study capacity of connections of precast panels for various loadings on underground tunnels by using Finite Element Method.
4. To compare and find the best suitable connections for precast sections.

IV. PURPOSES

1. To study the effect of cushion over structure
2. To analyze cut and cover structure and know type of loading and loading combination are taken into consideration.
3. They easily accommodate both railway and vehicular traffic.
4. To understand and see different types of connections that can be used in precast panels of cut and cover construction.
5. To study the effect of loading in providing arch shaped cut and cover tunnels.

V. METHODOLOGY

1. Literature Survey of cut and cover Tunnels and all the related topics.
2. To study all the critical loadings and combinations acting on tunnel section and analyze those loading on panels and connections are to be provided.
3. Design of conventional RC cut & cover tunnel section.
4. Study of various possible connections.
5. Finite element modelling on ANSYS/ABAQUS.
6. Verification of Design by Manual method.
7. Observations.

VI. REFERENCES

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[6]. James L. Wilton "Cut-and-Cover Tunnel Structures"
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