Segment Lining Design of the Long Tunnel for Transferring Water at Sardasht Dam Considering Segment Joints Effects

H. Bakhshandeh Amnieh¹; S. Taei Semiromi²; M. Rahimi Dizadjí³
1- Assistant Professor; Department of Mining Engineering; Faculty of Engineering; University of Kashan
2- MSc Student; Department of Mining Engineering; Faculty of Engineering; University of Kashan
3- PhD Candidate; Faculty of Mining & Metallurgy; Amirkabir University of Technology; Sepasad Engineering Co.

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In this research, the axial and shear force and bending moments in the segment lining of Sardasht dam water transfer tunnel are studied using both analytical and an explicit finite difference method, aiming to design a safe and stable lining. Segment joints and their characteristics such as stiffness and distribution pattern were considered as the principal modeling factors. The results indicate that the existing thickness of the tunnel lining is safe and provides the appropriate load and moment bearing capacity.

Introduction

Segment joints of the lining should be capable of withstanding a certain amount of bending moment, and axial and shear forces. Considering that the force-displacement correlation may behave linearly within a certain range of the applied loads, the bending moment applied on the lining might be reduced. Hence, the lining thickness could be reduced once smaller internal forces are involved. In the structural analysis of the lining segment, joints could be modeled as elastic tubes and their stiffness could be expressed in terms of rigidity.

Methodology and Approaches

In this article, considering the rigidity of the lining segments, the lining joints are modeled as elastic tubes with constant rigidity. Analytical methods for analysis of the lining joints are based on the ratio of horizontal to vertical stresses, soil strength coefficient, the influence of joint stiffness, number and distribution of joints. Bending moment, axial force and the lining displacements due to the internal forces applied on the lining are calculated. Axial force and bending moment applied on the lining have been evaluated using the FLAC software program. Hence the graph of axial force versus bending moment of the lining is plotted considering that the bending moment and axial forces applied on the lining are evaluated using both analytical and numerical methods.

Results and Conclusions

In the numerical method, all combinations of bending moments and axial forces applied to the lining segment at Sardasht long tunnel were transferred to the reciprocating effect diagram, to evaluate its safe application. The safety factor for both continuous and segmental lining was found to be 2.22 and 3.14, respectively. Hence all selected linings were found to be safe. In the numerical method, the axial force and bending moment applied to the tunnel lining were determined at three different ratios of (horizontal stress/vertical stress) and they were found to be 0.7, 1.0 and 1.3. Their combinations were found to be within the acceptable regions in the reciprocating effect diagram. Hence, one can conclude that a 30cm thickness for the segment lining is stable and safe within the limits considered.