INFLUENCE OF LININGS ON STRESS AND DEFORMATION IN ROCK AROUND ELLIPTICAL TUNNELS

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE DEGREE OF MASTER OF ENGINEERING

IMIYA RALALAGE PRIYANTHA GUNATILAKA

DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY OF MORATUWA
SRI LANKA

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DECLARATION

The work included in the thesis in part or whole, has not been submitted for any other academic qualification at any institution.

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Signature of the Candidate

Certified

UOM Verified Signature

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Dr. U.G.A.Puswewala
Supervisor

ABSTRACT

Stress and deformation behavior in rock surrounding elliptical tunnels with concrete liners is investigated by finite element analysis. The loading condition is limited to hydrostatic pressure applied inside the tunnel and it is assumed that the constitutive behaviors of both rock and concrete are according to isotropic linear elasticity. Plain strain conditions are assumed to prevail for the tunnels, which is the case when tunnels with straight axis in uniform rock media are considered.

Three elliptical tunnel geometries with major to minor axis ratios of 1.156, 1.358 and 1.500 are considered for the study. Each problem geometry was analysed for liner thickness varying from 0.0 m (unlined case) to 1.0 m in steps of 0.2 m, assuming that the Young's Modulus for rock is $1/10^{th}$ of that of concrete. The result for stress and deformation are presented for the rock domain, both in tabular and graphical forms. These numerical results illustrate the effect of concrete liner thickness and tunnel geometry on stress and deformation in rock.

A limited parametric study is conducted by varying the Young's Modulus of rock for a selected tunnel geometry with a concrete liner thickness of 0.2 m.

The present research makes a significant contribution to tunnel engineers, providing numerical tools to arrive at an optimum tunnel geometry and liner thickness, by striking a balance between cost and efficiency.

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ABBREVIATIONS

eg - exempli gratia (example)

etc - et ceteri or cetera (and the others)

hr - hour

i.e. - id est (that is)

kN - kilo Newton

m - metre

m^2 - square metre

mm - millimetre

N - Newton

N/m^2 - Newton per square metre

N/mm^2 - Newton per square millimetre

No - Number

Pa - Pascal

% - Percentage

< - Less than

> - Greater than

^{0} - Degree

ν - Poisson's ratio

ρ - Density of soil

τ - Stress in tangential direction

σ_H - Stress in horizontal direction

σ_v - Stress in vertical direction