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INFLUENCE OF WIDTH AND STRIP LOAD LOCATION ON HORIZONTAL STRESS OF NON-YIELDING WALL

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Abstract

In this paper, an analysis is discussed to bring out the the effect of strip load location and its width on the non yielding wall. In the analysis, the location of strip load from the non yielding wall is considered at 1m, 2m, 3m 4m and 5m and the usual range 1m, 2m and 3m width of strip load is considered. The Boussinsq's expression for horizontal stress due to strip load is used for the analysis. The horizontal stresses are analysed up to a depth 0f 10m at 1m intervals. The analysis revealed that as the location of strip load increases from the wall, the horizontal stress is decreaing up to about 1m depth and thereafter there is marginal increase in the horizontal stress. The maximum horizontal stress is noticed at about 1.0m depth from the ground surface irrespective of strip width and its position.

1.0 Introduction

Retaining walls near the coal handling plants usually experience surcharge loads due to coal carrying heavy vehicles. Surcharge loads acting on retaining wall are additional vertical loads that used to the backfill soil above the top of the wall. Live load surcharge is considered when vehicular actions act on the surface of backfill soil at a distance which equal or less than the wall height from the wall back face. A surcharge load is any load such as spoil embankments, streets or highways, construction machinery and coal carrying vehicles, which is imposed upon the surface of the soil close enough or distance to the excavation/or wall. This load causes a lateral pressure to act on the system in addition to the basic earth pressure. One of the most famous methods is Boussinesq strip method. After many considerations on adjacent surcharge, it was found that the distribution of lateral surcharge had not accuracy, and the shape and also the magnitude of the lateral pressure were not correct [1]. In the compacted backfill soil, the lateral earth pressure measured near the top of the wall is almost identical to the passive earth pressure

estimated by the Rankin theory [2]. Stress history of backfill soil influences the coefficient of at rest earth pressure. Mayne and Kulhawy [3] provide an excellent summary of the effects of stress history on K_o. With regard to the K_o values obtained through statistical analysis, the Jaky's formula agrees very well with the test data for normally consolidated soils. Studies of many researchers have shown that the compaction of soil increases the lateral earth pressure exerted on non-yielding structures. It was proved that compaction has a larger impact on near surface residual lateral earth pressure and as the depth is increased, this effect is diminished [4].

2.0 Boussinesq's Horizontal Stress Expression for Strip Load

The Boussinsq's expression for horizontal stress due to strip load is considered. The nomenclature and parameters are shown in the Fig.1. The expression for horizontal stress due to strip load is shown in equation below. A surcharge load q = 100 kPa is considered in the analysis. The width of strip load 'B' is varied from 1m to 3m. The horizontal distance of center of strip load 'x' is varied from 1m to 5m.

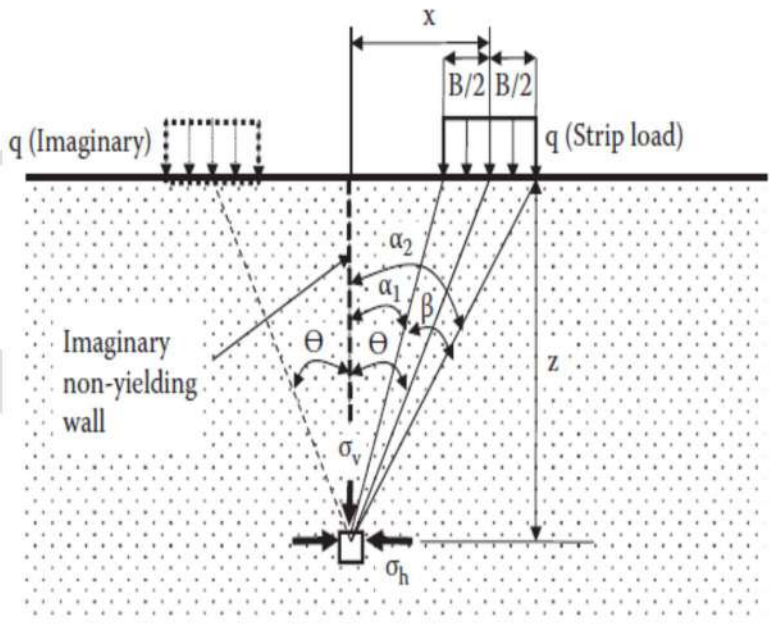

Fig.1 Strip load and physical parameters for horizontal stress

$$\sigma_h = \frac{2q}{\pi}[\beta - sin\beta\cos(2\theta)]$$

From the geometry in Fig.1, the expressions for associated physical parameters are as follows: $\theta = \tan^{-1}(x/z)$, $\alpha_1 = \tan^{-1}[(x - B/2)/z]$, $\alpha_2 = \tan^{-1}[(x + B/2)/z]$ and $\beta = \alpha_2 - \alpha_1$.

3.0 Variation of Horizontal Stress due to Strip Load Position

The variation of horizontal stress with depth due to strip load is presented in Figs.2 to 4.

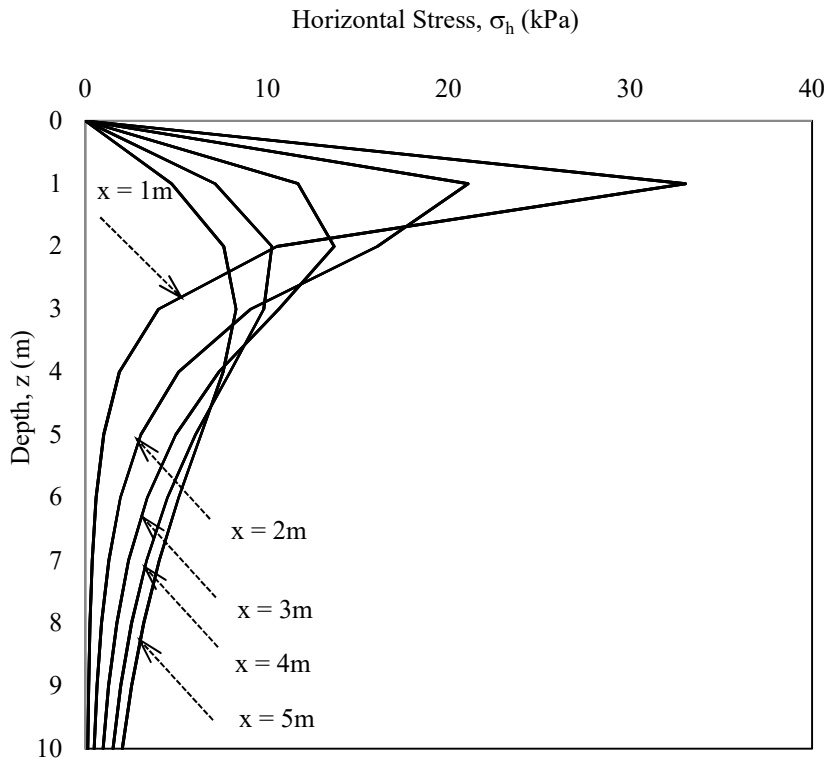

Fig.2 Horizontal stress variation with depth for strip load width, B = 1m

Figs.2 to 4 presents the variation of horizontal stress with depth due to varied strip load widths of 1m, 2.0m and 3.0m respectively. And also in these figures, the effect of strip load position, i.e., x = 1m, 2m, 3m, 4m and 5m from the non yielding wall on horizontal stress is shown further. The maximum horizontal stress is varying from 33 kPa to 105 kPa as width of strip load increases from 1m to 3m for surcharge load 100 kPa and for strip position from wall x = 1m. Irrespective of strip width and strip position, the maximum horizontal stress is occurring at 1m depth from the ground surface where strip load is placed.

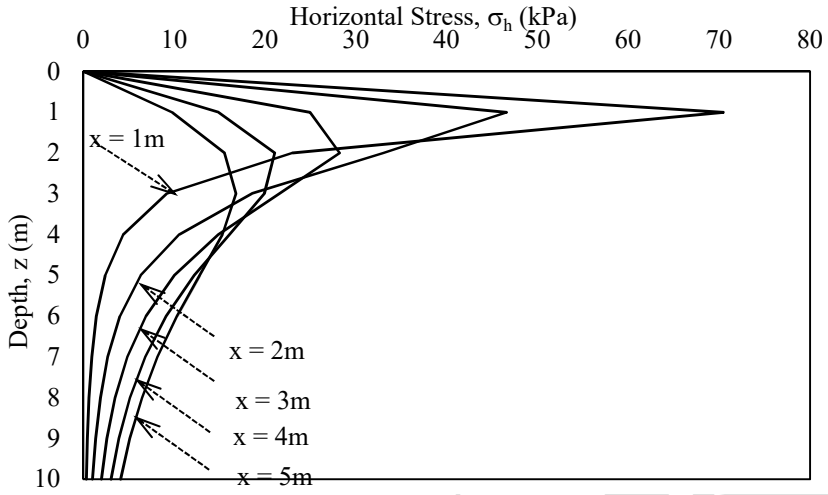

Fig.3 Horizontal stress variation with depth for strip load width, B = 2.0m

Further it is noticed that as the location of strip increases from the non yielding wall, the horizontal stress is decreasing in the shallow depth and it is increasing marginally at deeper depth. From the figures further it is noticed that the increase in horizontal stress when location of strip changes from x = 5m to 1m towards non yielding wall, and for various widths of strip 1m, 2m and 3m and at z =1m are 6.96, 7.21 and 6.85 times respectively.

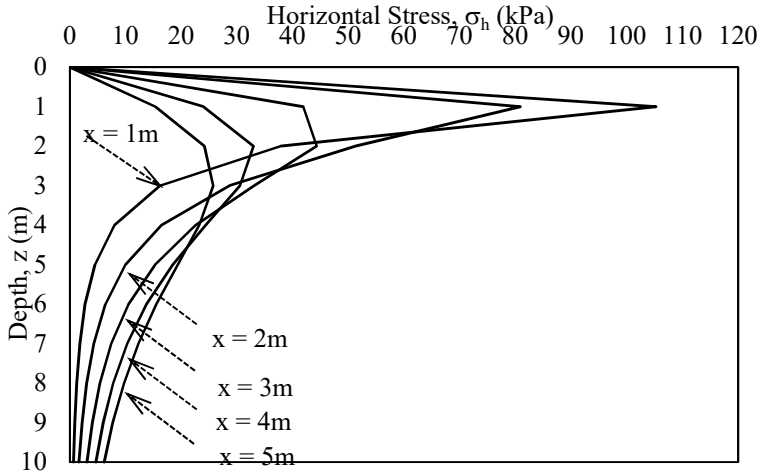

Fig.4 Horizontal stress variation with depth for strip load width, B = 3m

Also at z = 5m, the analysis showed that the horizontal stress is increasing marginally as location of strip moves from wall to away i.e., from x = 1m to 5m. This increase at z = 5m depth for the

above conditions is 7.6, 5.36 and 6.85 times. Comparatively, the horizontal stresses at depth z=5m are very low than z=1m. These stresses at z=1m when strip is at x = 1m are 33, 29.5, 23.54 times than the stresses at z =5m for strip widths 1m, 2.0m and 3.0m respectively. Similarly, when strip is at x =5m, the stresses at z =5m are 1.60, 1.31 and 1.26 respectively than at z = 1m.

Conclusions

From the above analysis and discussion, it is observed that the horizontal stresses due to strip load surcharges are important while designing the non yielding retaining walls towards achieving the stability requirements. Strip width and strip location both will influence the additional horizontal stresses apart from the soil stresses on the wall. The stresses will increase if width of strip load increases and also the stresses are high when strip load is near to the wall. The stresses developed due to strip load are marginal at deeper depths beyond z = 1m. Hence soil which is there at shallow depth will be stressed more and in turn cause more horizontal stress on the wall.

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