

Analysis and Design of Retaining Wall with and without Shelf using SAP 2000

¹Dishakumari Ajitbhai Lad, ²Asst.prof Hitesh K. Dhameliya
¹Student, ²Assistant professor
 Chhotubhai Gopalbhai Patel Institute of Technology, Bardoli

Abstract - Cantilever retaining wall with pressure relief shelves is considered as a special type of retaining wall. The concept of providing pressure relief shelves on the backfill side of an R.C.C retaining wall reduces the total earth pressure on the wall and increases overall stability of retaining wall, which results in a reduced thickness of the wall and ultimately in economic design of a cantilever wall. This paper shows effect of pressure relief shelf in cantilever and counter fort retaining wall.

keywords - Retaining wall, Retaining wall with shelf, Earth pressure, Stability of wall, Overturning moment.

I. INTRODUCTION

A retaining wall is a structure used to retain earth or other materials and to maintain ground surface at different elevations at either side of it. Retaining walls are used to retain earth or other materials which have the tendency to slide and repose at a particular inclination. They provide lateral support to the backfill, embankment or in order to hold them in a vertical position.

Retaining walls with pressure relief shelf is one of the special types of retaining walls. High R. C. C. retaining walls may be used economically by providing relief shelves on the backfill side of the wall. Such walls may be termed as the Retaining Wall with Pressure Relief Shelf. Providing one or more relief platforms or shelves, extending them to the rupture surface, can considerably increase the stability of retaining wall. The relief shelves have the advantage of decreasing the overall lateral earth pressure on the wall and increasing the overall stability of the structure. This results in an economical design because less material goes into the wall as compared to a massive structure of cantilever or even counter fort retaining walls without the shelves.

The study of retaining wall with a pressure relief shelf is somewhat an un-noticed area in the field of Geotechnical Engineering. Very few studies have been carried out so far on this topic. It is also observed that rarely such retaining wall structures are constructed. The study of this type of retaining wall is therefore important to see the performance of such a wall. The analytical and practical solutions regarding reduction in earth pressure is interesting to observe.

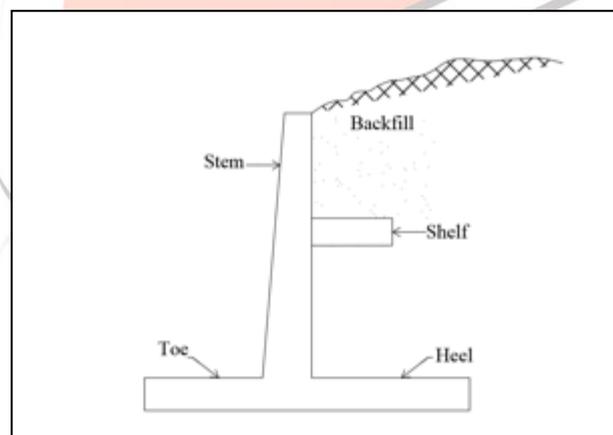


Fig.1 Retaining wall with pressure relief shelves

II. SAP 2000 SOFTWARE

SAP 2000 is one of the finite element software helpful in modeling and analysis for a civil engineering structural system. The analysis engine integrated to the SAP 2000, converts the object based model in to a finite element model by meshing the material domain in to a network of quadrilaterals and triangles. SAP 2000 contains effective engineering features for those engineers who engage in state of art practical with linear, non-linear and dynamic loading considerations.

III. LITERATURE REVIEW

Prachi S Bhojar, Dr. G. D. Awachat presents the results of static analysis and design of retaining wall with and without shelves. The conclusions in this thesis drawn based on the discussion and results obtained analytically and using a staad-pro model study. The pressure distribution diagram changes substantially due to the addition of shelves. The overturning moment gets reduced due to provision of relief shelves. It is also observed that the saving in cost of construction is 15% to 25% by the provision of relief shelves over the conventional cantilever retaining wall. There is 35% saving in concrete and 11% saving in steel.

Prof. Shilpi Bhuniyan, Ms. Bhagyashree Girme, Mr. Bilal Lambe and Mr. Aditya Agrawal This paper concerned with comparison of structural analysis of cantilever retaining wall along with different position of relief shelf are studied in details

such as compare load on shelf and displacement on nodes of retaining wall with relief shelves using STAAD-PRO. The retaining wall with a relief shelf is proved to be advantageous over the cantilever and counter fort retaining wall. The best location for the single shelf is observed to be between 0.4h to 0.5h for the maximum reduction in earth pressure, less bending moment and less deflection.

A. C. Chougule, Prof. J. P. Patankar, P. A. Chougule This paper conducts a thorough analysis of the design measure taken of reinforced concrete cantilever retaining walls with single, double and without shelves. Manual and software analysis is done. Software analysis is done by using STAAD Pro V8i software. Retaining walls with shelves are economical compared to conventional retaining walls without shelves. In retaining wall with shelves, as the height of the wall increases, the percentage saving of material increases. Cantilever retaining walls with two shelves are economical as compared to cantilever walls with single shelf.

Hany F. Shehata This paper presents a Finite Element analysis of retaining wall using PLAXIS2D-AE.01. The reduced total active earth pressure due to the provisioning of shelves is depicted. It was found that the shelves had a significant effect on the resulting earth pressure distribution. This decrease enables the retaining structures to become more stable and to exhibit lower bending moments. The shelves significantly decrease the maximum bending moment and the top movement of the wall. This decrease in the lateral pressure increases the retaining structure stability.

Liu Minnan, Liu Fuchen In this article, the discriminate for long and short relieving platforms is deduced and the earth pressure calculation models for different relieving platforms are established. The relieving platform is put in the middle position of retaining wall, the pressure relief effect is the best; under the condition of ensuring that the relieving platform length exceeds the sliding plane.

V. B. Chauhan, S. M. Dasaka Present study attempts to investigate the possible reasons behind the failure of a cantilever retaining wall with relief shelves, which is located in the heart of Hyderabad city, India. In the present analysis, rigid retaining walls with five relief shelves provided at different heights of wall having equal widths are analyzed with FLAC3D. It is found that the use of a larger width of relief shelves has significantly increased bending stress in relief shelf as well as on the faces of stem of wall just the relief shelves. This unanticipated stresses might have been neglected in the designs, resulting in failure of retaining wall.

Prof. Sarita Singla, Er. Sakshi Gupta In this paper the study of the behavior and optimal design of three types of reinforced concrete walls of varying heights namely cantilever retaining wall, counter fort retaining wall and retaining wall with relieving platforms is done. The retaining wall with a relieving platform is proved to be most cost-effective and advantageous over the cantilever and counter fort retaining wall. Due to discontinuous lateral earth pressure diagram in case of retaining wall with relieving platform, there is better stability in the retaining wall.

Umit Gokkus, Yesim Tuskan In this study the magnitude of reduction in total active earth pressure, overturning moments at the bottom of the wall and its distribution due to the response of a relief shelf in a retaining wall is presented with cantilever type retaining wall on cohesion less soil. A numerical study is conducted to investigate the effect of the number of shelves; shelf and wall stem rigidity and shelf horizontal location on the resulted lateral earth pressure distribution. Pressure quantity, the maximum acting bending moment and shear force on the wall are also discussed to perform the retaining design.

Hitesh Rathi, Dr. G. N. Ronghe In the present study an attempt is made to analyze the cantilever retaining wall with a pressure relief shelf by using finite element package (SAP-2000). The maximum moment on the pressure relief shelf increases linearly with the increase in depth ratio. The optimized position of pressure relief shelf for least top wall displacement and appropriate bending moment on the wall and pressure relief shelf is found to be at depth ratio (h/H) of 0.3.

Dharshan K, Keerthi Gowda B S In the present study a cantilever earth retaining wall of 4m height is considered to analysis for its optimum parameters. Here an attempt is made to analyze cantilever earth retaining wall with and without pressure relief shelf by using commercially available finite element packages (SAP-2000). The moments developed in the cantilever earth retaining walls with pressure relief shelves are always less compared to conventional retaining walls. 22 %, 33.46 % and 41.53 % of reduction of moments are recorded when there is adoption of relief shelves at H/3, H/2 and 2H/3 positions of stem in comparison to the moments of cantilever retaining wall without pressure relief shelf.

Karthik Babu, Keerthi Gowda In the present study a counter fort earth retaining wall of 8 m height is considered for the analysis by soft computing technique in comparison with conventional ones. In the present study comparison of conventional counter fort earth retaining wall with pressure relief shelf attached counter fort earth retaining wall is studied. 33%, 50.5% and 61.53% of reduction of moments are recorded when there is adoption of relief shelves at H/3, H/2 and 2H/3 positions of the stem in comparison to the moments of counter fort earth retaining wall without the pressure relief shelf.

IV. SUMMARY

The retaining wall with pressure relief shelf is a special type of retaining wall which is prove to be very advantageous than the retaining wall without pressure relief shelf. The retaining wall with pressure relief shelf is very unnoticed area in the field of construction so it is very important to study about the retaining wall with pressure relief shelf.

V. CONCLUSION

After studying the various literature review it can be conclude that, the retaining wall with pressure relief shelf is economical than the conventional retaining wall. Due to the provision of relief shelf at the backfill side of retaining wall it reduce the active earth pressure and overturning moment. Also provide stability to the retaining wall.

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