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A Review on Designing of Loft Retaining Wall & Comparison with other Types of Retaining Walls

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A B S T R A C T

Retaining wall structures are used for holding back earth material. The various reasons are for constructing the retaining walls, like preventing erosion, aesthetic purposes. The main purpose of a retaining wall is to separate two different levels of soil or ground when there is a need for a change in elevation. Retaining walls plays an important role in protecting the structures from collapsing and natural problems such as soil erosion. Earth retaining structures include cantilever retaining wall, sheet pilings, bulkheads, basement walls, and special types of retaining wall. The special types of walls include counter fort retaining wall, buttress retaining wall, and retaining wall that rest on piles etc. Loft retaining wall can be considered as a special type of retaining wall. A loft retaining wall is an uncommon type of retaining wall. The pressure relief shelf towards the backfill side of retaining wall helps to decrease the total earth pressure on the stem which results in increasing the overall stability of the wall. Lofts are horizontal platforms, which are constructed monolithically with the stem of wall, and extend into the backfill at right angles, throughout the length of the retaining wall. A number of such shelves is constructed at regular spacing along the height of the wall. The concept of providing loft on the backfill side of retaining wall reduces the total earth pressure on the wall, due to which it reduces the thickness of the wall and ultimately gives more economical design. The parametric study is carried out to find the effect of number of lofts, width of lofts, loft position and variation in the length of loft, etc.

Keywords: Retaining wall, Loft retaining wall, Total earth pressure, backfill. Economical design.

Introduction

Concrete is the crucial respectful building fabric. Holding dividers for supporting the earth-fills / backfills have been in utilize since past for long period. These incorporate unbending, bulky, gravity sort dividers which have restrictions withCrespect to backfill tallness on account of bulky divider area and expanding development taken a toll. Strengthened cement concrete (R.C.C.) cantilever dividers, buttressed dividers and counter-fort dividers are in utilize for more stature of backfill and higher earth-pressure extents. In later past few decades geosynthetic strengthened holding structures have come up in hone and have obtained notoriety. Huge number of such fortified soil dividers are being developed and utilized these day.

Fig 1 Roadside Retaining Wall

However, the utilize of routine R.C.C. holding dividers is unavoidable in numerous circumstances. A ceaseless examination and consider is going on the different sorts of holding dividers for accomplishing ideal economy, creating expedient and simple development forms, lessening area of divider components and eventually to get the divider of most extreme quality and solidness. This is conceivable as it were by diminishing the soil weight behind the divider. Different strategies have been created for decreasing the soil weight behind wall.

Fig 2 Retaining Wall with Loft / Relief Panel

Wall at Location : Dhayari Pune

Retaining Dividers with Lofts can too be considered as a uncommon sort of holding divider and moreover a useful arrangement to unsteady and incline territory. The lofts have the preferences of diminishing the acting sidelong soil weight and expanding the generally solidness of the holding divider as appeared in Fig. . One elective to handle such issues is to diminish the horizontal pushed on the divider. There are numerous methods accessible to decrease the soil weight, such as utilize of light weight backfill. An endeavor has been made to get it the behavior of cantilever holding divider with lofts and thus to investigate the viability of lofts to decrease the soil weight and the twisting minute on the wall.
The utilize of hang has been considered for soothing the greatness of earth- pressure itself at the back of holding divider and for making strides the figure of security against sliding as well as toppling. In the display ponder an endeavor has been made to investigate the lessening in amounts of development materials (support steel & concrete) with utilize of hang at the back of holding divider. This would influence the by and large lessening in the taken a toll of holding loft.

Construction Features Of Relief-Shelf Wall

The length of the alleviation rack divider seem be expanded as long as conceivable (given the stature of the divider remains more prominent than almost 6 to 8m at each cross area). Note that the stature of a holding divider is measured from ground level on inactive side/lower side till the best of divider or the ground level on higher side (i.e., the inserted profundity is not checked as successful tallness). Wherever stature is lesser, at that point customary sort of dividers can be given in that parcel. Along length of alleviation rack divider, a limit development joints (around 10 mm wide) at each 30 m interims are prescribed over full heigh.

Indian Projects

This framework has been utilized in India nearly since the past 15 a long time, for divider statures extending from 6 m to 30 m. Indian railroads, PWD Maharashtra, NHAI, MIDC, CIDCO, Godrej, Mahindra and Mahindra, JSW, Puranik builders, LODHA builders, Larsen and Toubro and a couple of more prominent organizations have viably received this framework at a few of their locales. To increment the appropriateness of relief-shelve framework in one of the ventures, one framework supplier utilized geotextile layers in the held soil which upgraded the soundness to fill to a more prominent degree and assist decreased the genuine drive applied on the divider to nearly half.

Fig 3 Retaining Wall

Relief-shelve wall on ROB approaches, at Dist. Dhule, Maharashtra (Yr. 2004-05)

Literature Review

Specialized papers of different diaries from India and other nations are examined to get it the significance and need of this investigate. It too appears comparative think about such as fetched, economy, bowing minute, steadiness against upsetting & sliding between both the holding divider. The comparative ponder is carried out along with the taken a toll and ideal or slightest fetched gauge is chosen as the best choice. In this paper it is moreover appeared that the soothing stage holding divider is conservative, so require not stress as the real behavior is affirmed by most of the inquire about specialists through physical scaled demonstrate as well as modern FEA models, clarified afterward. In India couple of companies have procured licenses towards this framework of plan and give it beneath names such as 'Graviloft system' and 'Introjected Wall' etc., which are all the same adaptations of relief-shelve dividers. By and large, relief-shelve divider demonstrates to be temperate for statures more noteworthy that 6 to 8m or so. There are distinctive sorts of holding dividers exists with distinctive tallness, reasonableness, etc. The hang holding divider is the prudent and diminishes horizontal soil weight, increments the holding divider solidness. In this manner, it is fundamental to ponder on holding divider with loft.

- **Jumikis [1964]** the provision of one or more relief shelves and extending them to the rupture surface, can considerably increase the stability of retaining wall. The relief shelves have an advantage of decreasing the overall lateral earth pressure on the wall and increasing the stability of the structure. This results in an economical design because less material goes into the wall as compared to massive structure of cantilever or even counterfort retaiing walls without shelves.
- **Patil and Wagh [2008**] have demonstrated the use of loft for relieving the magnitude of earth-pressure itself at the back of retaining wall and improving the factor of safety against sliding as well as overturning. In the present study an attempt has been made to explore the possible reduction in quantities of construction materials (Reinforcement Steel and Concrete) with use of loft / lofts at the back of cantilever retaining wall. Details about the cases analyzed, the designed sections for cantilever retaining wall with and without loft are presented in this paper. Factors of safety, reinforcement steel and concrete quantities for these sections of cantilever retaining wall are presented in this paper. This data indicates reduction in quantities of these materials due to provision of loft at back of retaining wall. This in tern would result in less construction cost.
- **Khural R. [2013]** to achieve required formation width and to stabilize disturbed hill slopes number of retaining structures are constructed in hilly terrain, its construction cost is near about 20% to 30 %of hill roads project cost.
- Gravity retaining walls are designed by considering its shape and size. Its stability is depending on its dimensions. Design of gravity retaining wall is not based on type of material used for construction.
- **Ray Chaudhuri [1973]** had concluded that when height of earth mass to be retained is less than 6 m cantilever retaining wall is generally preferred. Above 6 m height counterfort retaining wall is used to achieve economy in construction. Cantilever retaining wall with relief shelf is alternative to counterfort retaining wall which is found out easy to construct and more economic. As total active earth pressure on retaining wall with relief shelf is lower in magnitude than that of conventional type, keying at the base may not be necessary to prevent sliding in certain cases.
- **Dhamdhere [2018]** have worked for optimal solution. He has chosen optimal cost as best solution. He fixed base width and other dimensions of retaining wall then performed stability check and determined minimum and maximum bearing pressure and then accordingly designed all portions of retaining wall. He has taken reliving platform length equal to heel slab length and reliving platform's length is considered one fourth of base slab thickness. At mid height of retaining wall, location of reliving platform considered. Also checked for stability of retaining wall by calculation, Such as Eccentricity of the resultant reaction force was between 0 and the base width/6. Factor of safety against sliding and overturning were taken more than 1.5. Minimum bearing pressure is more than zero and maximum bearing pressure is and less than soil bearing capacity. Then after design and analysis he estimated quantity and worked out costing. He compared the costing of cantilever retaining wall and retaining wall with reliving platform.
- **Anjali Diwalkar, [2020]** selected various retaining wall's shape by performing preliminary calculations. As conducted finite element Analysis, for that he used PLAXIS and considered two ways of construction first one is Backfilling after the wall construction and other is backfilling parallel to wall construction. She selected three different shapes with constant height and cross-sectional area. She used trial method to adopt stable section as per BS 8002. She estimated exerted force on retaining wall first by using Coulomb's method of analyze and wedge method.
- **Patil S.M [2010]** says that by providing relief shelf in cantilever retaining wall it is found that factor of safety against overturning and sliding is improved. Due to provision of relief shelf earth pressure reduces which results in reduction in section. As section of retaining wall is less, requirement of construction material is also less which results reduction in cost. He had found that reduction in volume of concrete and steel is 35 % and 18% respectively. For height in the vicinity of 10 m cantilever retaining wall with single relief shelf is economical than conventional counterfort retaining wall but further economy is achieved by providing relief shelf in counterfort.
- **Dr. D. N. Shinde, Mr. Rohan R. Watve [2015]** concerned with the analysis of cantilever retaining wall using Finite Element method. The retaining wall with and without shelves is analyzed by using Staad-pro model and results for various parameters was compared and found satisfactory.
- **D. R. Dhamdhere1, Dr. V. R. Rathi, Dr. P. K. Kolase** paper consist of analysis and design of cantilever and relieving platform retaining wall with varying height from 3m to 10m and SBC 160KN/m2. It also shows comparative study such as cost, economy,

bending moment, stability against overturning &sliding between both the retaining wall. The comparative study is carried out along with the cost and optimum or least cost estimate is chosen as the best option. In this paper it is also shown that the relieving platform retaining wall is economical, more stable than cantilever retaining wall and it also relives the bending moment of heel portion.

- **Chauhan, V. B. [2021]** studied an in-depth understanding of the stability aspect of the retaining wall with relief shelves under static surcharge loading with the consideration of various geometrical parameters of the relief shelves and their effects on the performance of wall using the numerical modeling, and further portray the recommendations for a safer and efficient design of such walls.

3. Advantage And Disadvantage

Advantage

The lofts have the focal points of diminishing the acting horizontal soil weight and provision of one or more lofts and expanding them to the crack surface, can
impressively increment the steadiness of holding wall.
The loft altogether diminishes the most extreme bowing minute and the beat development of the wall.
Due to arrangement of hang soil weight diminishes which comes about in diminishment in section.
The holding divider with a help rack is demonstrated to be beneficial over the cantilever and counter post holding wall.
In holding divider with racks, as the stature of the divider increments, the rate sparing of fabric increases.
providing hang in cantilever holding divider it is found that figure of security against toppling and sliding is improve

Disadvantage

Retaining dividers, counting hang plans, may require continuous upkeep such as review for breaks, disintegration control, and periodic repairs.
Loft holding walls can take up space in property, decreasing usable zones for arranging or other purposes.
Relief racks make focuses of push concentration, which may possibly lead to breaking or disappointment, particularly if not appropriately outlined or constructed

4. Conclusion

From literature review, and above study we concluded that:
Proper selection, number, location, and dimensions of loft can considerably reduce the total contact pressure below the base slab and making the retaining wall much safer in bearing capacity failure mode.
Lofts are susceptible to modify the wall movement of the retaining wall depending upon its width and location along the height of the wall.
The provision of the loft to the wall can lead to significant improvement in the stability of the retaining wall to carry the static surcharge loading on the backfill surface compared to a wall without a loft.
Designing of economical loft retaining wall for reducing lateral earth pressure and to increase the stability of retaining wall.
Each counterfort retaining wall of height 8 m, 12 m, 16 m & 20 m are compared without loft & with loft on the basis of number of lofts, thickness of loft, earth pressure & cost.
The provision of 2 number of loft results in reduced earth pressure, base width and cost of retaining wall as compared to the provision of 1 loft.
The counterfort retaining wall with loft is economical as compared to counterfort retaining wall without loft.

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