

Scientific Journal of Impact Factor (SJIF): 3.134

E-ISSN (O): 2348-4470 P-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 2,Issue 12,December -2015

Comparative Study of Cantilever and Counter fort Retaining wall

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Abstract— In this paper the study of the behavior and optimal design of two types of reinforced concrete walls of varying heights namely cantilever retaining wall, counter fort retaining wall. Cost against each optimal design of wall for particular height is calculated by using the volume of concrete and the amount of steel. Amidst the cost estimates of all the two optimal designs for particular height, a comparative study is carried out and the alternative with the least cost estimate is chosen as the best design solution.

Keywords- Cantilever wall, counter fort wall, optimization.

I. INTRODUCTION

A retaining wall is one of the most important types of soil retaining structures. The primary purpose of retaining wall is to retain earth or other material at or near vertical position. It is extensively used in variety of situations such as highway engineering, railway engineering, bridge engineering, dock and harbour engineering, irrigation engineering, land reclamation and coastal engineering etc. Reinforced concrete retaining walls have a vertical or inclined stem cast monolithic with a base slab. These are considered suitable up to a height of 6m.

It resists the lateral earth pressure by cantilever action of the stem, toe slab and heel slab.

Necessary reinforcements are provided to take care of the flexural stresses. The tendency of the wall to slide forward due to lateral earth pressure should be investigated and if a factor of safety is insufficient, a shear key should be designed to prevent lateral movement of the structure.

Besides the self-weight, the main predominant force for analysis and design of the retaining wall is lateral earth pressure. The lateral earth pressure behind the wall depends on the angle of internal friction and the cohesive strength of the retained material, as well as the direction and magnitude of movement of the stems.

Whenever we need to have a major vertical discontinuity in the terrain, with soil at two elevations, we need to support the vertical face of the soil and this support is provided by retaining walls.

Ground surface is stable so long as it is generally horizontal or is characterized by gentle slopes. As soil slope becomes stepper, stability diminishes, although some quiet steep slopes in soil can be stable. With the dawn of new ideas and materials, technology has found better methods to retain large masses of soil. Gravity walls, cantilever walls and counter fort walls are referred as rigid retaining structures.

II. LITERATURE REVIEW

A. DR. S.S PATIL [1], REPORTED THE ANALYSIS AND DESIGN OF STEPPED CANTILEVER RETAINING WALL. " INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) VOLUME, NO 4 ISSUE 02, FEBRUARY-2015.

DR. S.S PATIL, "In this study, Cantilever retaining walls are found best up to a height of 6m.For greater heights earth pressure due to retained fill will be higher due to lever arm effect, higher moments are produced at base, which leads to higher section for stability design as well as structural design.

This proves to be an uneconomical design. As an alternative to this, one may go for counter fort retaining wall, which demands greater base area as well as steel. As a solution to this difficulty, a new approach that is to minimize effect of forces coming from retained fill, short reinforced concrete members in the form of cantilever steps are cast along the stem on the retaining face. Addition of these steps would counterbalance the locally appearing forces and will result into lesser moment and shear forces along the stem. Also it will reduce the bending action that is pressure below the base.

International Journal of Advance Engineering and Research Development (IJAERD) Volume 2,Issue 12,December -2015,e-ISSN: 2348 - 4470 , print-ISSN:2348-6406

Wall HEIGHT.	COUNTERFORT WALL	STEEPED CANTILEVER WALL
6	29100	29500
8	51170	70000
10	86280	129050
12	143360	122470
15	269770	248240

Table -1 cost comparison

Cost comparison shall be carried out for these three different alternatives to give most economical retaining wall type.



Figure 1 final cost comparison

B. PROF. SARITA SINGLA AND ER. SAKSHI GUPTA, "INVESTIGATED THE OPTIMIZATION OF REINFORCED CONCRETE RETAINING WALLS OF VARYING HEIGHTS USING RELIEVING PLATFORMS." INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) VOLUME ,NO 4 ISSUE 06, JUNE-2015,

PROF. SARITA SINGLA AND 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. Amidst the cost estimates of all the three optimal designs for particular height, a comparative study is carried out and the alternative with the least cost estimate is chosen as the best design solution.



Figure 2comparison of optimal cost

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C. A. J. KHAN AND M. SIKDER, "INVESTIGATED THE DESIGN BASIS AND ECONOMIC ASPECTS OF DIFFERENT TYPES OF RETAINING WALLS", JOURNAL OF CIVIL ENGINEERING (IEB), 32 (1) (2004).

A. J. KHAN AND M. SIKDER, "This paper presents step-by step design procedures for externally stabilized walls and internally stabilized walls as suggested by different codes/ researchers. Typical design examples of some of the externally stabilized and internally stabilized walls, i.e. design of reinforced concrete cantilever retaining walls, metal strip reinforced walls, Geotextile reinforced walls and anchored earth walls of different heights have been provided for the purpose of cost comparison. The major reason may be the anticipation that such walls would be more expensive compared to the conventional externally stabilized walls, and also that the design procedures involved might be too cumbersome. The analyses reveal that the internally stabilized walls are significantly more economical compared to the externally stabilized wall considered in this study, and this economic benefit increases with increasing height of the walls."

D. ANCY JOSEPH AND MERCY JOSEPH," CONDUCTED A COMPARATIVE STUDY OF GABION WALLS AND REINFORCED EARTH RETAINING WALLS." VOL.3, ISSUE 2, FEBRUARY 2015.

ANCY JOSEPH AND MERCY JOSEPH, "In their research for better results man has tried many methods to retain large masses of soil starting from bamboo, wood and other materials to random rubble masonry. As time progressed concrete retaining wall has become the most commonly sought after solution With the advent of new ideas and materials, technology has found better methods to retain large masses of soil. The advance of modern technology and research for more greener materials has lead to new soil retaining techniques such as reinforced earth retaining walls and gabion walls. Here the paper focuses on the study of reinforced earth retaining walls as a more economical solution as well as environmental friendly as compared to concrete retaining walls."

E. PROF. DR. D.N.SHINDE AND MR.ROHAN R. WATVE," REPORTED OPTIMUM STATIC ANALYSIS OF RETAINING WALL WITH & WITHOUT SHELF /SHELVE AT DIFFERENT LEVEL USING FINITE ELEMENT ANALYSIS.

PROF. DR. D.N.SHINDE AND MR.ROHAN R. WATVE, "Retaining wall with pressure relief shelves is one of the special types of retaining wall. High reinforced concrete retaining walls may be used economically by providing relief shelves on the back fill side of wall. Such walls may be termed as the retaining wall with relief shelf. lateral earth pressure on wall and increasing overall 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 counter fort retaining walls without the shelves."

III. DISCUSSION

Based on various literature reviews, it is observed that cantilever and counter fort retaining wall is very important retaining structures. Cantilever retaining walls are economically suited for wall heights up to 6.0 M and hence for height up to 6.0 M, no other alternative is necessary. Counter fort retaining walls are suitable for retaining wall heights 8.0 M to 10.0 M for standard site conditions assumed. The other types of wall may also be tried for different site conditions

IV. CONCLUSION

The following conclusions are made from the present study:

1. The retaining wall with relieving platform is proved to be most cost effective and advantageous over the cantilever and counter fort retaining wall.

2. Due to discontinuous lateral earth pressure diagram in case of retaining wall with relieving platform, there is better stability in the retaining wall.

3. Reduction in cross-sectional in retaining wall with relieving platforms area reduces the requirement of the construction material like volume of concrete and amount of steel thus reducing overall cost.

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International Journal of Advance Engineering and Research Development (IJAERD) Volume 2,Issue 12,December -2015,e-ISSN: 2348 - 4470, print-ISSN:2348-6406

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