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Review Paper on Static Analysis and Design of Retaining Wall with and without Shelve using Software

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***Abstract:** This paper presents the results of Static analysis and Design of retaining wall with and without shelves. 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 a R.C.C retaining wall reduces the total earth pressure on the wall, which results in a reduced thickness of the wall and ultimately i0n an economic design of a cantilever wall. The conclusions in this thesis drawn based on the discussion and results obtained analytically and using Staad-Pro. model study. The pressure distribution diagram changes much due to addition of shelves. The pressure relief shelves have been extend up to the failure plane to achieve the stability of the structure. In practice, there is limitation of using more number of shelves, but up to three shelve may be used economically for high retaining walls. It is also observed that, the average saving in cost of construction is 15% to 25% by the provision of relief shelves over the conventional cantilever retaining wall. Analytical results of active earth pressure, nodal reactions, and bending moments with pressure relief shelves have been close agreement with the Staad-Pro. Software result.*
***Keywords:** Special retaining wall, Relief shelves, Earth pressure, Stability of wall, Bearing pressure, Overturning moment and bending moment.*

I. INTRODUCTION

This Retaining walls are generally built to hold back soil mass. Retaining walls are structures that are constructed to retain suc h materials which are unable to stand vertically by themselves. They are also provided to maintain the grounds at two different levels. The study in this thesis is carried out mainly for improvisation of the 'retaining structure' as it is an indispensab le features of civil construction projects, especially all types of bridges, high walls in hilly terrain, etc. with suitable type, proper design and reasonable estimation. A retaining wall with pressure relief shelve is uncommon type of retaining wall. The pressure relief shelf towards the backfill side of retaining wall reduces the total earth pressure on the stem wall which results in increasing the overall stability of wall. The less material goes into the stem wall due to provision of shelves to the retaining wall and some material acts vertically on the pressure relieving shelves and ultimately this result into the economical design.

A. Objective of Case Study

1) To analyze and design the modal retaining wall with and without shelf by Conventional Method.
2) To compare the results obtained from analysis and design of retaining wall with and without shelf and discuss the results.
3) To analyze of modal retaining wall with and without shelf using Software. Cost comparison between retaining wall with and without shelf.
4) To make the retaining wall stable so that soil bearing pressure gives equal pressure distribution on both sides.

II. LITERATURE REVIEW

MIKIO FUTAKI, OSAMU SAKAGUCHII (1992) [1]:This paper concerned with the experimental study on a real scale cantilever retaining wall for seismic loadings. In this paper, Soil-Structure Interaction has been done by model test. The present paper intends to investigate the safety and to evaluate the force acting on the wall for the seismic loadings.

RAJESH D. PADHYE, PRABHULING B. ULAGADDI (2010) [2]: The active earth pressure and lever arm are reduced due to provision of shelf and there by archive versa considerable reduction the moment about the base slab

DR. D. N. SHINDE, MR, ROHAN R. WATVE(2015) [3]:This paper concerned with the analysis of cantilever retaining wall using Finite Element method. The retaining wall with and without shelves is analysed by using Stadd-pro model and results for various parameters are to be compared in this paper.

SCOTTO DI SANTOLO, A. PENNNA, A. EVANGELISTA G.E. MYLONAKIS, S. BHATTACHARYA , C.A. TAYLOR (2012) [4]: Reinforced concrete cantilever retaining walls represent a popular type of retaining system. It is extensively considered as advantageous over conventional gravity walls as it gives economy and ease in construction and installation.

III. METHODOLOGY

A. Analysis and Design of cantilever Retaining wall without Shelves

This chapter concerned with stability of the cantilever retaining wall without shelves. The stability check for cantilever retaining wall without shelves is very important to study. The principle of design of cantilever retaining wall without shelves, various forces are acting on structure and the stability of cantilever retaining wall should be checked for sliding, overturning, bearing capacity failure, and tension has been explained below,

1) *No Sliding:* The retaining wall must be safe against sliding. The factor of safety against sliding must be greater than 1.5. In other words, μ Rv > Rh, where Rv and Rh are vertical and horizontal component of R respectively & μ is friction factor between wall base and foundation soil.
2) *No Overturning:* The retaining wall must be safe against overturning about toe. The factor of safety against overturning must be greater than 2.
3) *No Bearing Capacity Failure:* The pressure caused by Rv at the toe of the wall must not exceed the allowable bearing capacity of the soil. The pressure distribution at base is assumed to be linear.
4) *No Tension:* There should be no tension at the base of the wall. When the eccentricity (e) is greater than B/6, tension develops at the heel.

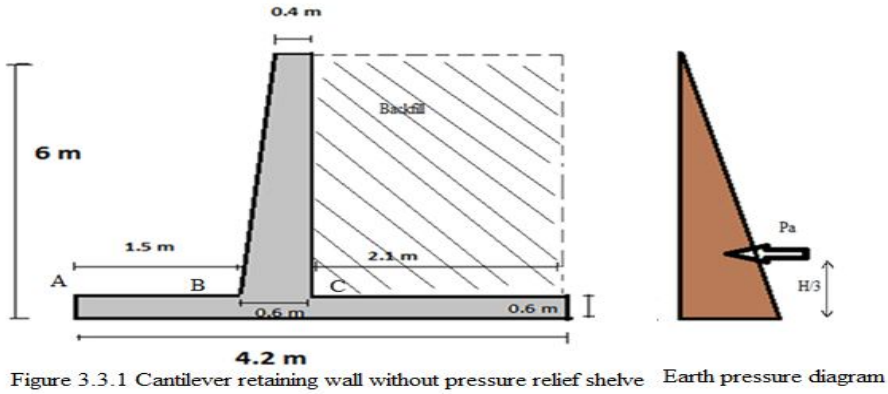

Figure 3.3.1 Cantilever retaining wall without pressure relief shelve Earth pressure diagram

B. Analysis and Design of Cantilever Retaining Wall with Shelves: (Reducing its Dimension up to some Extent)

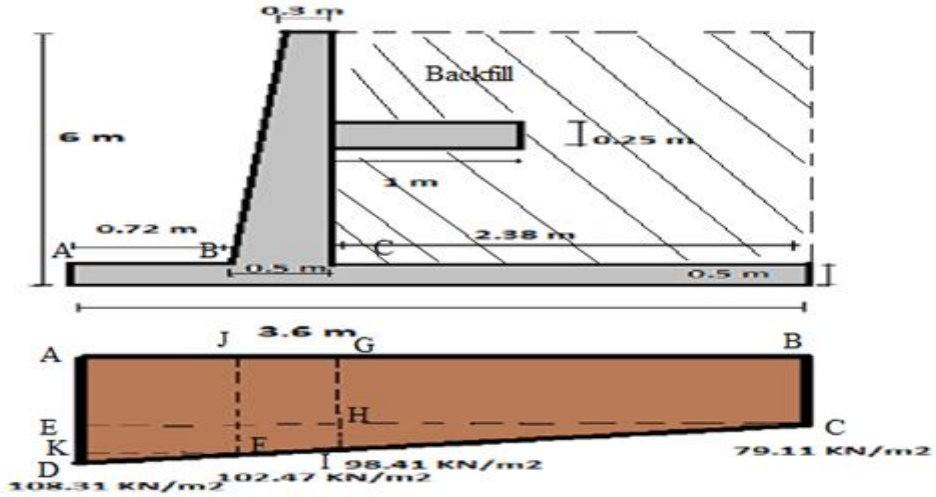

Figure 4.1.2 Retaining wall with base slab pressure diagram

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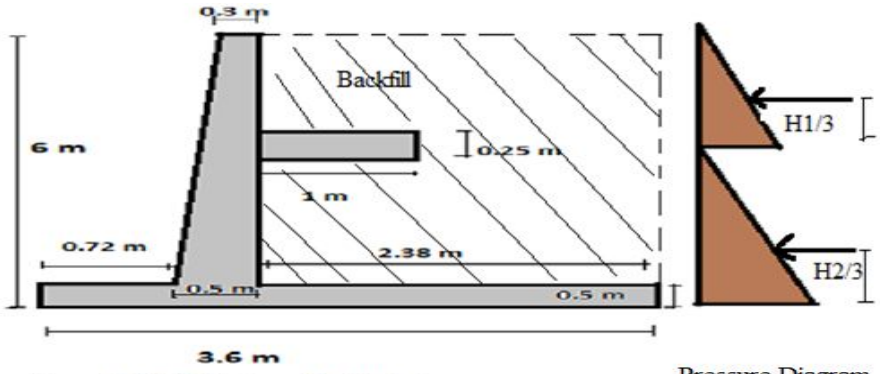

Figure 4.1.1 Retaining wall with shelves
(Reducing its dimensions up to some extent)

C. Analysis and Design of cantilever Retaining wall with Shelves: (Reducing its Dimension up to Maximum Value)

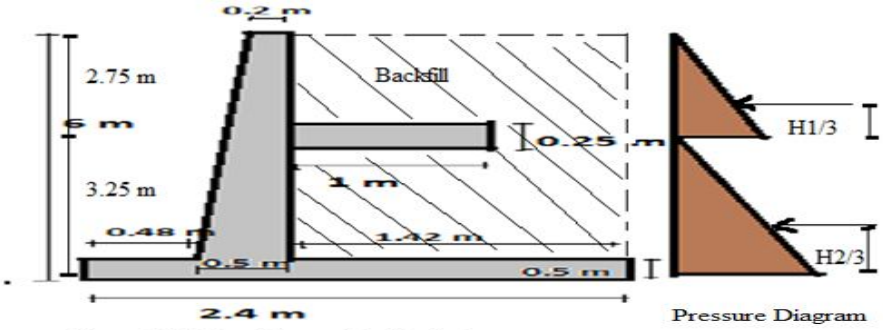

Figure 4.2.1 Retaining wall with shelves
(Reducing its diamensions up to maximum value)

D. Analysis and Design of cantilever Retaining wall with two Shelves

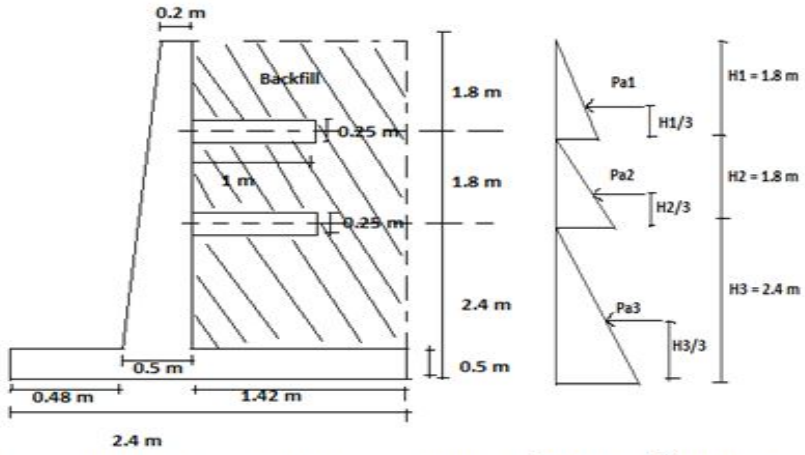

Figure 4.4.1 Retaining wall with two shelves

IV. ANALYSIS OF RETAINING WALL WITH AND WITHOUT SHELVE USING STAAD-PRO SOFTWARE

In this chapter, the retaining wall with and without shelves are analysed using Staad-Pro. structural software in which retaining wall is prepared using plate element. Staad-Pro gives better and accurate results for analysis of retaining wall with and without shelves. The loading conditions are acted on retaining wall such as lateral load of soil on stem wall, vertical l Load on heel slab and shelve, vertically acted soil bearing pressure etc. are shown in model. Fixed support condition has been given to the junction of stem wall and base slab. The results of analysis of retaining wall with and without shelve in Staad-Pro. gives nodal reactions, plate stresses and bending moment.

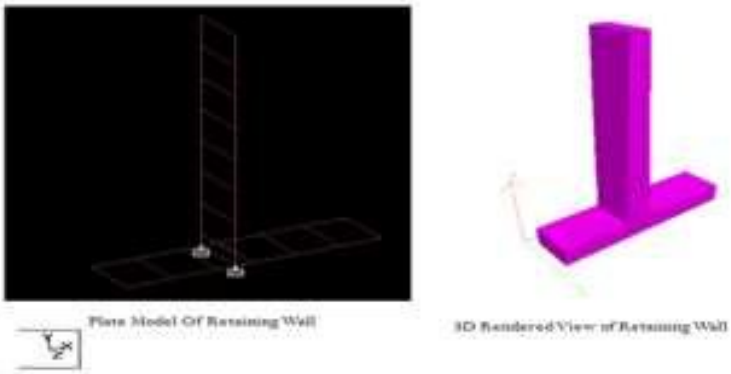

Figure 7.1.2 Plate model and 3-D rendered view of retaining wall

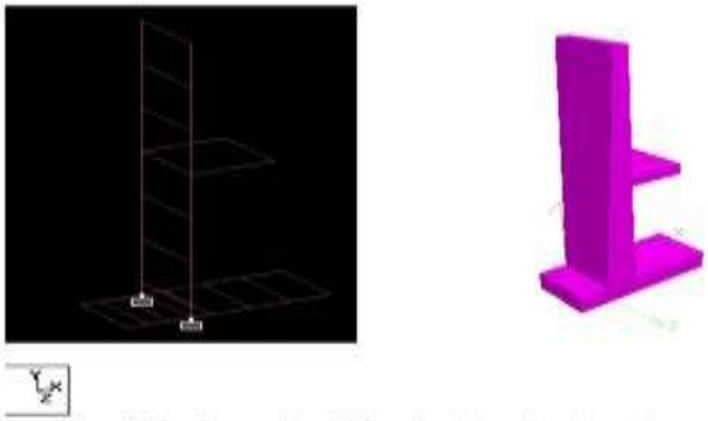

Figure 7.2.2 Plate model and 3-D rendered view of retaining wall

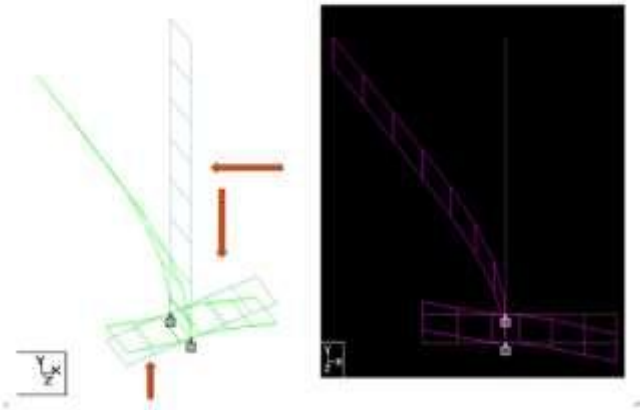

Figure 7.1.4 Deflected shape of retaining wall

V. ANALYSIS AND DESIGN OF RETAINING WALL USING EXCELL SPREADSHEETS

In this chapter, the basic calculations of analysis and design of retaining wall with and without shelve, and retaining wall with two shelves has been performed using Excel formulation.

Primary values such as height of retaining wall, unit weight of soil, unit weight of concrete, coefficient of friction, angle of internal friction, safe bearing capacity of soil etc. shall be put in Excel Spreadsheets and results for analysis and design of retaining wall shall be calculated.

A. Analysis of retaining wall.

F	G	H
1) Ka=	0.333409377	
2) Active Earth Pressure =	12.00273758	24.00547517
3) Horizontal Force Per Unit Length =	12.00273758	48.01095034
4) Total Horizontal Force =	60.01368792	
LOAD CALCULATIONS		
1) Weight Of Wall (Wa) =	27.5	
2) Weight Of Wall (Wb) =	20.625	
3) Weight Of Base =	30	
4) Weight Of Soil =	136.08	
5) Weight Of Shelf =	6.25	
Total Weight =	220.455	
Friction Force =	110.2275	
Factor Of Safety Against Sliding=	1.836705989	Safe In Sliding
1) Overturning Moment =	56.01277539	64.01460045
2) Total Overturning Moments =	120.0273758	
3) Restoring Moments =	313.4502	
Factor Of Safety Against Overturning=	2.611489236	Safe In Overturning

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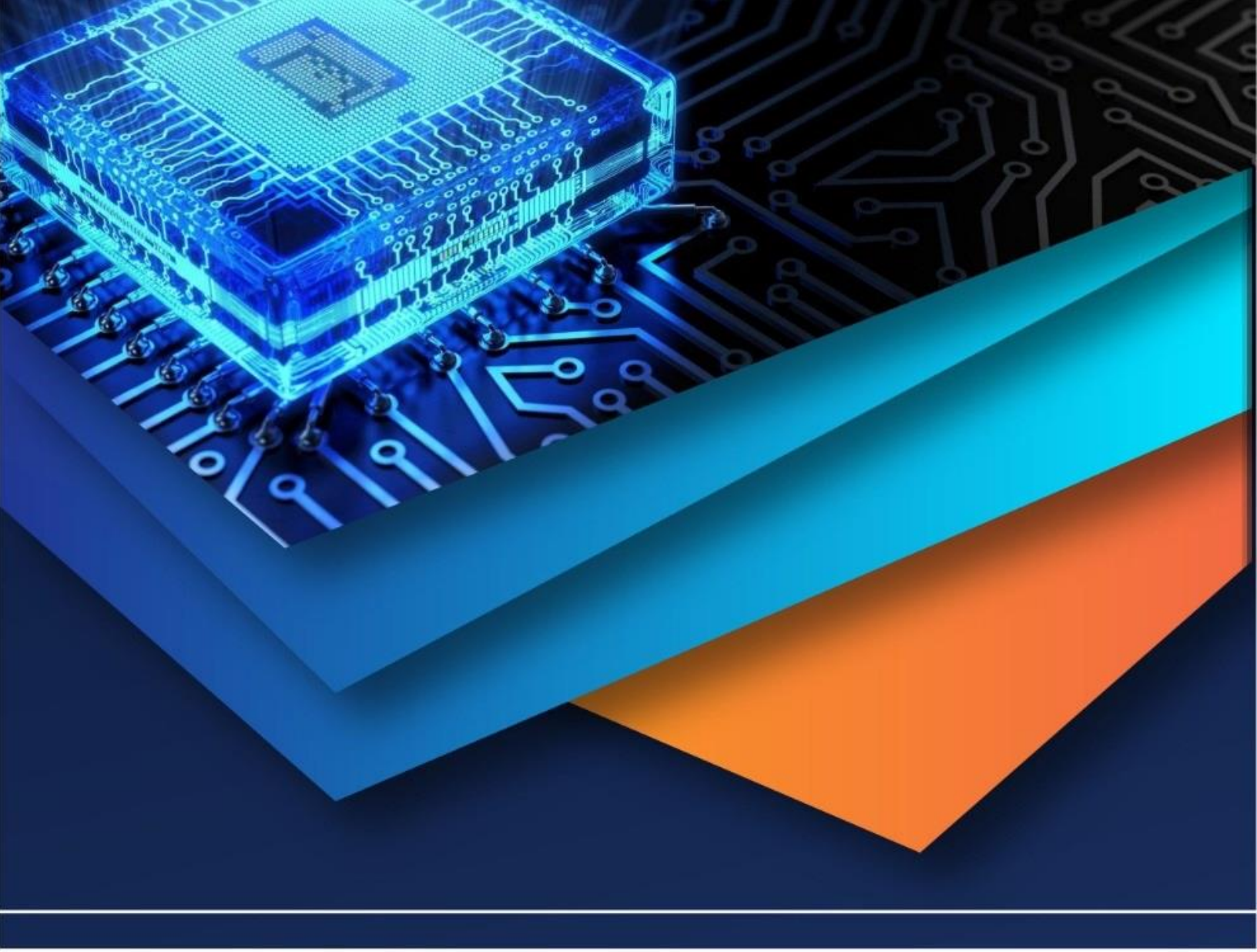

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