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"Analysis and Comparative Study of Trapezoidal Shaped Retaining Wall with Varying Geometric Parameters"

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ABSTRACT

This project work deals with the study of retaining wall using trapezoidal plates with various geometric properties such as angle of inclination and widths of plates. While doing this other remaining geometric properties and material properties are kept constant. Here in this study the trapezoidal shaped folded plate is formed with the angle of inclination of plates is varying from 10 degree to 90 degree (i.e. 10 degree, 20 degree, 30 degree, etc.) with 10 degree constant interval, similarly the width of the plates is varying from 0.5 m to 2.5 m (i.e. 0.5m, 1m, 1.5m, etc.) with 0.5 m constant interval and horizontal plates of 0.5m in between two inclined plates. The other constant geometric parameters are height of retaining wall 5.5m and thickness of plate is 0.2m throughout the project, also the material properties are always remain same for entire work. Concrete is the material for analysis. Several models were created in the software using the above parameters to analyze the effects of the width and inclination angle by observing the results such as Deflections. These results of deflections of plates are plotted against the inclination of plate for every different width of plates. From these plotted graphs we can determine the critical angle for each specified plate width. In these work the only static loads are considered for analysis purpose dynamic loads are not considered.

Keywords: Folded plate, Trapezoidal shaped retaining wall, Study of folded plate as retaining wall.

I.INTRODUCTION

1.1. Background

Folded plates are assemblies of at plates rigidly connected together so as to make structural system capable of carrying loads. They provide an economical and aesthetically pleasing design. This project describes how to proceed in the folded plate analysis by using computer software well known to most engineers. Although a folded plate is indeed a three-dimensional problem, we will see how to do it in a two-dimensional Manner and without differential equations or calculus, just with the help of simple computer software. While it is quite true that there are a myriad of computer programs available to solve any folded plate condition and the only requirement for the user is to input a few design descriptive characteristics. The classical methods such as whitneys method and simpsons method are the approximate method of analysis. Most analysis procedure of reinforced concrete and folded plate are based on elastic theory when subjected to large forces, however folded plate deforms beyond elastic range and the study of their behaviour and performance required non-linear analysis. So, that the STAAD Pro. Software is used for the analysis of the folded plates. There is requirement of study the behaviour of parameters for achieving economy in constructions. This project aims at studying the

behaviour of folded plate structure, analysis of folded plate structure by using computer software STAAD pro. , Also, the comparative study of the folded plates with the varying geometric parameters. The results obtained are then analyzed in detail and the critical sections are decided for different geometric parameters.

1.2. Statement of problem

Analysis and Comparative Study of Trapezoidal Shaped folded plates as Retaining Wall with Varying Geometric Parameters.

1.3. Why this project is chosen?

The need for new techniques in the designing of retaining wall is the increased intent for being conservative. Generally the simple concrete cantilever retaining wall structures are used in practice. But, the behaviour of a concrete cantilever structure is often governed by the thickness and height of the structure. In this project the attempt is made to study the behavior of trapezoidal shaped folded plates as retaining wall with the varying geometric parameters. The deflections and stress distribution at various points are observed.

II.OBJECTIVES

- The objective of the project is to study a systematic performance of the trapezoidal shaped plate as a retaining wall structure through variations in width and angle of inclination of plate by conducting analysis in computer programs. Finite element analysis is used to perform and to interpret the results and further understanding the behaviour of the trapezoidal shaped folded plate as retaining wall structure. The contents of objectives are as follows;
- To study the current work through literature survey.
- Development of the models in STAAD pro.
- Determination of relative joint displacements for each folded plate structure.
- Comparison of the several models on the basis of results obtained.
- Determination of critical dimensions for folded plate retaining wall structure.

III.PRESENTED WORK

3.1. Standard field conditions

For the entire project following geometric parameters and field properties are used. These are kept constant throughout the project. Other parameters which are variable are mentioned in the model development step.

3.1.1. Geometric parameters

- Height of retaining wall – 5.5m
- Thickness of plates – 0.2m
- Central horizontal part in trapezoidal retaining wall – 0.5m
- Extreme horizontal part in trapezoidal retaining wall – 0.25m

3.1.2. Soil and field properties

- Top surface - Horizontal
- Angle of repose (Ø) – 30 degree

- Unit weight of soil – 16.5 KN/m^3
- Material below the wall base is same with safe bearing capacity – 160 KN/m^2
- The coefficient of friction between base and soil is – 0.55

3.2. Analysis of structure using software

- For the analysis the STAAD pro software is used.
- The square gridding for stems are 0.25m side is made for analysis.

3.2.1. The loading is given as shown below

- All loads are acted globally.
- Weight of soil (Dead load of soil) on footing

The dead load exerted by the soil on the footing of the structure

On heel side = 93.5 KN/m^2

On toe side = 14.025 KN/m^2

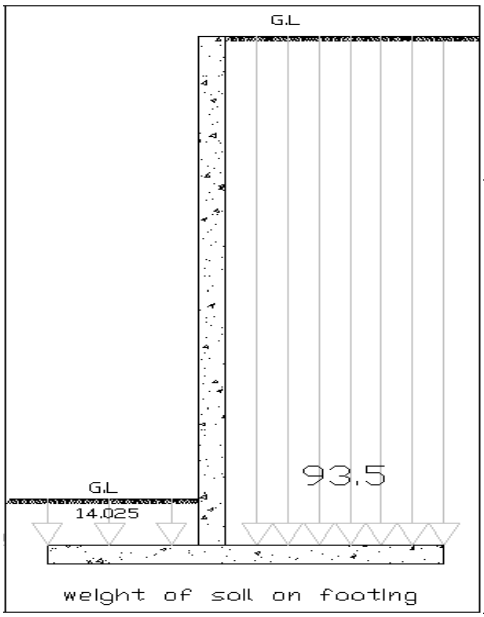

Fig. 3.1 Weight of Soil on Footing

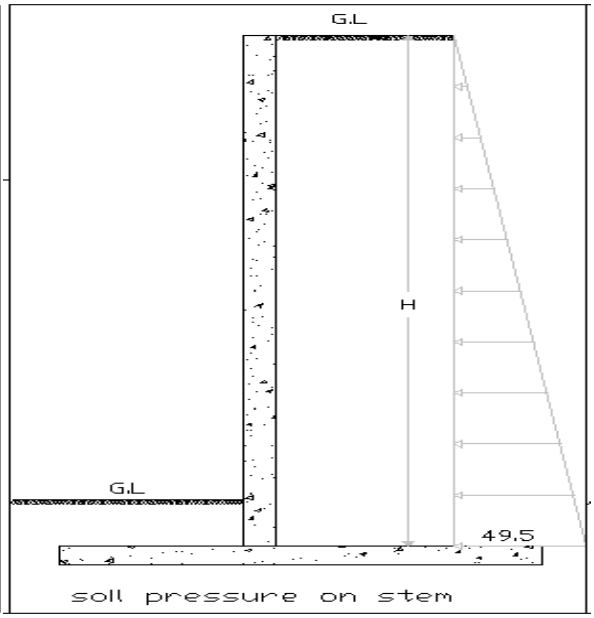

Fig. 3.2 Soil Pressure on Stem

- Pressure exerted by soil on stem

It is the soil pressure exerted on the stem of retaining wall. This pressure is uniformly varying pressure with 0 KN/m^2 at the top of retaining wall and 49.5 KN/m^2 at the base of the retaining wall.

- Self weight or dead load

It takes the self weight of the entire structure.

3.2.2. The load combinations are as shown below

- For bearing = 1.25 dead load + 1.35 soil weight on footing + 1.5 soil pressure on stem
- For sliding = 0.9 dead load + 1 soil weight on footing + 1.5 soil pressure on stem
- For service limit = 1 dead load + 1 soil weight on footing + 1 soil pressure on stem

3.2.3. The supports specifications are as below

- Type of support – Elastic mat

- Direction of support – Y direction
- Soil Subgrade modulus – 9600 KN/m^2/m

IV.RESULTS

The analysis done for all the models the results of the various absolute displacements for the central cycle of the structure is done. For the sample case, the results for 2m width are as given below the graph is angle of inclination on X axis and nodal displacements on Y axis.

Table 4.1 Values of Nodal Displacements for 2m Width Plates

FOR 2m										
HT	NODE	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
0	31	14.586	17.606	18.282	18.645	19.588	20.279	22.143	27.463	42.719
.5	153	18.152	19.987	19.818	19.638	20.399	21.051	22.963	28.57	44.808
1	275	28.5	26.881	24.258	22.503	22.677	23.178	25.187	31.548	50.417
1.5	397	42.068	35.994	30.33	26.58	25.989	26.291	28.457	35.914	58.531
2	519	56.884	46.01	37.246	31.417	30.016	30.108	32.478	41.249	68.282
2.5	641	72.213	56.452	44.631	36.729	34.517	34.4	37.011	47.23	79.072
3	763	87.752	67.121	52.291	42.339	39.33	39.012	41.89	53.641	90.53
3.5	885	103.367	77.919	60.116	48.141	44.352	43.841	47.007	60.344	102.431
4	1007	118.997	88.789	68.046	54.07	49.518	48.823	52.291	67.253	114.636
4.5	1129	134.618	99.704	76.044	60.087	54.785	53.913	57.696	74.308	127.058
5	1251	150.228	110.647	84.09	66.168	60.129	59.085	63.191	81.473	139.639
5.5	1373	165.835	121.606	92.167	72.292	65.526	64.317	68.755	88.721	152.34

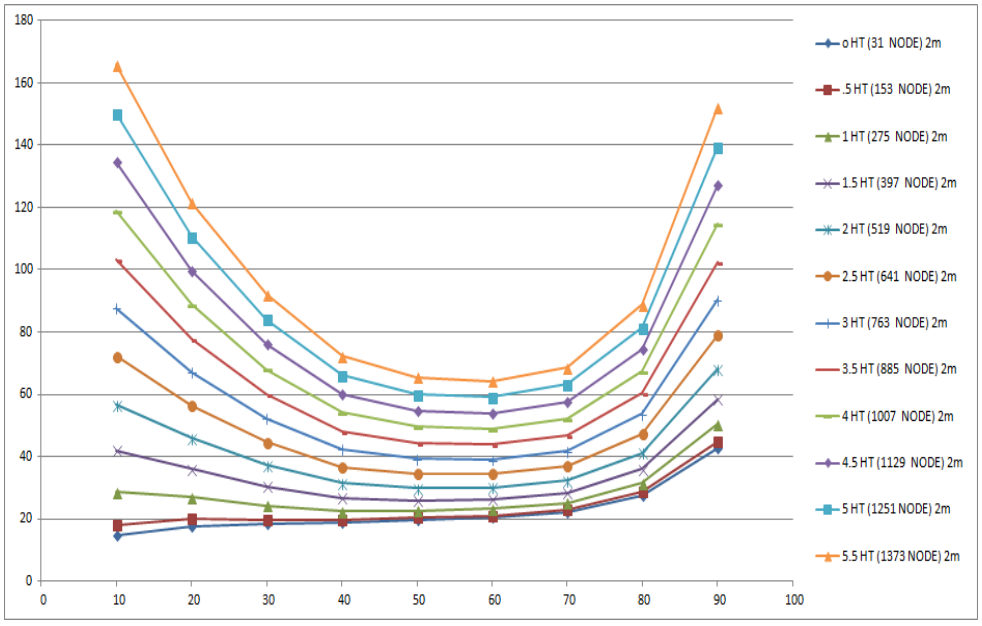

Fig. 4.1 Graphs of nodal displacements for 2m widths plates

V. CONCLUSION

The proposed analysis of trapezoidal folded plates yields satisfactory results. Form the study it is observed that the maximum absolute nodal displacements are changes with change in dimensions when the angle increased the displacement get reduced up to certain angle and then further increase in angle results in increase in displacement. Generally the angles 50 degree, 60 degree and 70 degree are observed as critical angles i.e. the angles at which the absolute nodal displacements are minimum. Further it concludes that the values of displacements are not only depending upon angles but also on the width of the trapezoidal folded plate. Finally the combination of angle of inclination and width of folded plate s also calculated as shown in present work.

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