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RESEARCH ARTICLE

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USE OF FOLDED PLATE FOR ANALYSIS & DESIGN OF RETAINING WALL

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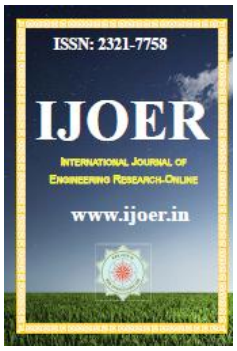

ABSTRACT

Folded plate structures have gained popularity and are used very extensively in Europe and America. Folded plate structures are finding increasing applications in the present day to building practice for covering large column free areas. The economy in covering large column free areas, and consumption of materials, aesthetic views and ease of construction are all in favor of such structures. The behavior of such structures is divided into a transverse slab action and longitudinal plate action. The structural behavior of folded plate is generally 3-dimensional. In this study, Folded plate connected in triangular pattern is used as a retaining wall and the analysis is carried out on the same structures also design of retaining wall by using software is compared with the design by using conventional method by using IS 14458 Part: 2. The thickness and angle of inclination of the plates are taken as 0.15m and 45^0 respectively. The aim of this study is to understand the effect of the triangular shape of the folded plate used as a retaining wall to carry the loads. In this parametric study cost comparison between conventional retaining wall and folded plate as a retaining wall was studied. This study shows that there is 26.40 % reduction in the steel when folded plate is used as a retaining wall.

Key Words— Folded plate, Retaining wall, ETAB.

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INTRODUCTION

Back ground

The thin reinforced-concrete folded plates and shells, as we know today, had its beginnings in Germany in the 1920s. Two German engineers, walder and Dischinger were the first to develop a theoretical analysis applicable to reinforced – concrete cylindrical shells around the year 1930 [8]. In this early simplified treatment, the plates were regarded as hinged to each other along their junctions so that longitudinal sliding between them is prevented. The transverse moments at the joints were ignored. Most of the methods developed in Europe were based on the theory of elasticity and led to differential and algebraic equations. Starting from 1947, American engineers have done much to simplify the analysis of folded plates by the development of numerical distribution procedures which are very suitable for use in the design office.

Concept of folded plate roof

Folded plate structures are now very popular and are used very extensively in many places. The economy in materials, especially where relatively large spans are needed, and the aesthetic advantages are all in favor of such structures. Other advantages are the ability of hipped plate structures to handle large concentrated loads, or to accommodate openings of appreciable size, and others. Folded plate structures are finding increasing applications in the present day building

practice for covering large column free areas. The economy in covering large column free areas, and consumption of materials, aesthetic views and ease of construction are all in favor of such structures. The behavior of such structures is divided into a transverse slab action and longitudinal plate action. The structural behavior of folded plate is generally 3-dimensional.

Fig. 1 Folded plate roof type 1

Fig. 2 Folded plate roof type 2

Aims & Objectives

1. First objective of this paper is cost comparative study on conventional retaining wall and folded plate used as a retaining wall which will very helpful to achieve economy of the structure.
2. Utilizing the concept of folded plate for the construction of retaining wall structure.
3. Analysis of different shapes of folded plates in retaining wall.
4. To study the effect of internal angle on the load carrying capacity of retaining wall.

II. PROBLEM STATEMENT

This study investigates the effects of triangular shaped retaining wall on the load carrying capacity of the retaining wall. Here, to find the effectiveness of triangular shaped folded plate used as a retaining wall, design is done by using conventional method as per IS 14458 Part:2 and Also by using ETABS software.

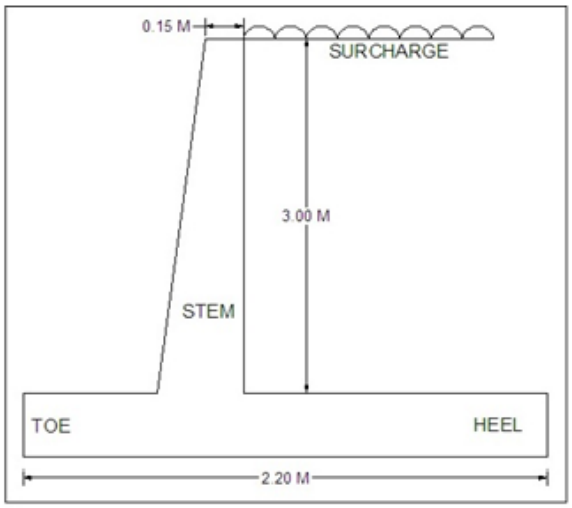

Fig. 3 Retaining wall details

Model of retaining wall for manual calculation as per 14458 Part: 2 (Refer Table 1)

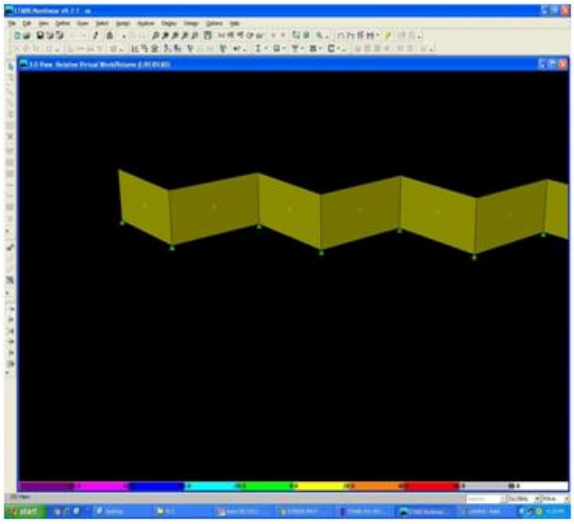

Fig. 4 Diagram of Model of retaining wall in ETABS software

III. METHODOLOGY

In the present study cantilever type of retaining wall is designed by using conventional method as per IS 14458 Part:2 having height 3 m and subjected to the uniform surcharge of 10 KN/m and check it for overturning, sliding and bearing pressure. Then found the percentage of steel for the various types of steels i.e. main steel as well as distribution steel for Toe, Heel and Stem portions. Then same load is applied on triangular shaped retaining wall and analysis and design of retaining

wall was done in ETABS software. Details of the design by using conventional method as per IS 14458 Part:2 is as follows

1. Thickness of base slab = 0.3 m
2. Total depth of wall = 3.3 m
3. Base width = 2.2 m
4. Top width = 0.15 m
5. Bottom width = 0.3 m
6. Resisting force and resisting moment Table .

TABLE 1: Resisting force and resisting moment table

Parts	Area	Weight	Perpendicular Distance	Moment
	$\frac{1}{2}\times 0.15\times 3=0.225$	$0.225\times 25=5.625$	$0.6+2\frac{0.15}{3}=0.70$	$5.625\times 0.70=3.937$
	$0.15\times 3=0.45$	$0.45\times 25=11.25$	$0.6+0.15+\frac{0.15}{2}=0.825$	$11.25\times 0.825=9.281$
Base slab	$2.2\times 0.3=0.66$	$0.66\times 25=16.5$	$\frac{2.2}{2}=1.1$	$16.5\times 1.1=18.15$
Back fill	$1.3\times 3=3.9$	$3.9\times 18.5=72.15$	$0.6+0.15+0.15+\frac{1.3}{2}=1.55$	$72.15\times 1.55=111.83$
Surcharge	10KN/m	$10\times 1.3=13$	$0.6+0.15+0.15+\frac{1.3}{2}=1.55$	$13\times 1.55=20.15$

IV. RESULTS

The results of the both methods are tabulated below:

TABLE 2: Results by using manual method

Parts	Main Steel	%	Distribution Steel	%	Total %
Toe	ø 10 mm bars @ 200 mm c/c	0.13	ø 8 mm bars @ 120 mm c/c	0.139	0.27
Heel	ø 10 mm bars @ 200 mm c/c	0.13	ø 8 mm bars @ 120 mm c/c	0.139	0.27
Stem	ø 10 mm bars @ 180mm c/c	0.19	ø 8 mm bars @ 160 mm c/c	0.139	0.329

TABLE 3: Results by using software method

Parts	Main Steel	Distribution Steel	Total Percentage
Toe	0.105	0.105	0.21
Heel	0.105	0.105	0.21
Stem	0.125	0.125	0.25

Comparison of results between two methods:

TABLE 4: Average reduction in steel by using software

Parts	% steel in conventional retaining wall	% steel in folded plate retaining wall	% reduction in steel
Toe	0.27	0.21	22.22
Heel	0.27	0.21	22.22
Stem	0.329	0.25	21.87
Average Reduction			22.1

V. CONCLUSION

A parametric study to find the effectiveness of triangular shaped folded plate used as a retaining wall was done, design is done by using conventional method as per IS 14458 Part:2 and Also by using ETABS software.

From the results it can be observed that, there is 22.10 % reduction in the steel reinforcement is found when triangular shaped folded plate was used as a retaining wall. From this study we can say that folded plate can be economically used as a retaining wall.

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VII. REFERENCES

[1]. J. A. Puckett and D. L. Wiseman (1991), "compound strip method for folded plates with connecting elements" Vol.117, No. 1, January, 1991. ©ASCE, ISSN 0733-9445/91/0001-0255/$1.00 + $.15 per page. Paper No. 25453.

[2]. T. Subramani1, K. Bharathi Devi2, M.S.Saravanan3, C.T.Sivakumar4 (December 2014) "Cost Comparative Study On Steel Frame Folded Plate Roofing System Vs Conventional Truss Roofing System" T. Subramani et al. Int. Journal of Engineering Research and Applications www.ijera.com ISSN : 2248-9622, Vol. 4, Issue 12(Part 4), December 2014, pp.139-144 .

[3]. HasmukhVitlialbhai Trivedi, Sachchidanand Sinha, and KavetiSeetharamulu(1983) "Nonprismatic Folded Plates: Tests" This paper is part of theJournal of Structural Engineering, Vol. 109, No. 10, October, 1983. ©ASCE, ISSN 0733-9445/83/0010-2463/$01.00. Paper No. 18325.

[4]. Lakshmy, T.K., Optimum design of trough type folded plate roofs, Computers and structures 57 (1) 1995, 125-130. [2] Bandyopadhyay J.N. (1989),

[5]. Comparative analysis of folded plate structures, Computers and structures, 36 (2), 1989, 291-296. [3] Peng L.X,,

[6]. Bending analysis of folded plates by the FSDT meshless method, Thin walled structures 44, 2006, 1138-1160.

[7]. Joseph E. Bowles 'foundation analysis and design' McGraw hill education (India) private limited 2013.

[8]. G.S.Ramaswamy 'design and construction of concrete shell roofs'2007.

[9]. Binoy Kumar Chatterjee 'Theory and design of concrete shells'

[10]. WWW.ASCE.ORG(Date 20/11/2015)