OPTIMUM DESIGN OF RCC FOLDED PLATE ROOF WITH DIFFERENT ANGLE OF INCLINATION

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ABSTRACT- The Folded plates structures are type of roofing which are used widely they have many advantages in Architectural and structural point of view. They are also called as Prismatic shells. This dissertation work give analysis of reinforced concrete folded plate roofs for economic and optimized design of folded plates. The different single and multi-span folded plates are analyzed with different angle of inclination. The results show the parameters like stresses, shear & moments. The lesser the value of above parameter with comparative analysis provides the economic design. The Single bay, Double bay & Triple bay folded plate rcc roofs are analyzed and results are compared as single span & multi span with 6m,9m,12m with Angle of inclination 15, 30, 45 degrees. Various bays of rcc folded roofs are analyzed with varying angle of inclination to understand behavior of folded plates and with results we will do comparisons and conclude which is having optimum sections**.**

Keywords: Folded plates, Single bay, Double bay, Triple bay, Spans, Angle of inclinations, Stresses, Moments, Optimum sections

I. INTRODUCTION

Folded plates are assembly of flat plates. Folded plates are connected together rigidly alongside their edges in that way the structural members in system are able to carrythe loads without having any supplementary beams to support along their mutual edges.The series of rectangular plates connected together are called folded plates. They are inclined to each other but monolithically joined along their edges longitudinally. These folded plates are made in various types of shapes. Most widely used shapes are V type, trough type, trapezoidal type and north light type folded plates. V Shaped folded plate are most simplest but the area provided for concrete is less on the compression side and other than that it might not able to provide sufficient area for reinforcement which is needed to be accommodated on the side of tension. But due to its simplified nature V shaped folded plates are used. And most common type is trough type. Z shaped folded plates are used to provide the idea of north light roofs in some factories.

Types of folded plates:Based on shapes V shaped, trough shape, trapezoidal type,North light type or Z type, Based on geometric form folded structures can be divided into: Surface structures, Frame structures, spatial structures. Based on the material they are made up of Reinforced concrete, Metal, Wood, Glass, Plastic materials and combination of different materials. The shape of folded structures affects the transmission of load and direction of relying of folded structures. Based on these parameters we can do the division be Linear, Radial, Spatial folded plate.

Advantages of folded plates: The folded plates are prepared for large spans, they are less costly than cylindrical shells because of their easiness in formwork, the folded plates will give aesthetically good appearance, and folded plates are very lighter form of structures. For 30 m span shell thickness 60mm.Concrete can be used as a building material which reduces the cost of materials construction, we can provide longer span with column free are,we can give Flat shapes by choosing arched shapes, Esthetically it looks great compared to other type of construction, Good from visual point of view, The material utilization is relatively less in this form, Form work will be able to remove as early as possible, Large column free areas can be covered which look good, Form work essential is comparatively simpler. Movable form work can be used, Its design is not complicated it involves easier calculations.

Applications of folded plates: Folded structures was originate and its usage is high in the applications of architectural buildings and engineering structures, According to the applications and the arrangement in architectural structure, this form of construction can be divided into the floor, roof and folded wall constructions, According to the theory of folded structures great number of engineering structures are constructed like bridges and retaining walls and various others. By the introduction of

folded form the theory of greater stiffness of being productive element has found purpose in many user products, the largest number of roof structures is the folded structures, the necessity for acquire the larger variety and cost effectual structure led to the emergence of this folded structure, the rapid advance of spatial structures leads to the incomparable solutions which influenced the appearance and illustration identity of the structures, it is essential to design the construction that will meet all the definite conditions of stability and deformation especially in cases of design of the bridges with longer spans**.**

II. LITERATURE REVIEW

'Studies on V-Type R.C.C Folded Plate Roofs'-international journal of innovative research in science, engineering and technology volume.5, issue 3, march 2016-S.muthukeerthana, v.preetha.Folded plates are series of thin plates, usually rectangular joined monolithically along their common edges and supported on diaphragms. They are also known as hipped plates. It is ideally suited for variety of structures such as factory buildings, assembly halls, go downs, auditoriums and gymnasia, requiring large column free area. Folded plates were first used for large coal bunkers by G.Ehlers of Germany in 1924-25. The various types of folded plates available are Prismoidal, Prismatic, Pyramidal and the commonly used shapes of folded plates are V-type, Trough type, Polygonal type, Combination of V and Trough type, Butterfly type and North light. Some of the applications are Factory buildings, Assembly halls, God owns Auditoriums, Gymnasia.

III. ANALYSIS AND MODELING

Optimum design of rcc folded plate roof with different angle of inclination. The term optimum design in statistical point of view involves modeling of structure in software, data collection from results and summarizing results in the form of tables and comparative analysis is done to understand the variation of results and conclusions are finalized.

The ETABS software is utilized to create 3D models and carryout analysis. The Roofs are modeled as a series of load resisting elements; the lateral loads to be applied on the buildings are based on the Indian standards. The study is performed for seismic zone 2 as per IS 1893-2002. The folded plate roof adopted of reinforced concrete elements. The frames are assumed to be firmly fixed at the bottom and soil structure interaction is neglected. The models are subjected to loads like dead load, live load and also lateral loads this folded plate roof structure is analyzed by following models.

BAYS, SPANS & ANGLE OF INCLINATIONS: Each span with different angle of inclination (15, 30, 45) were analyzed with Single bay, Double bay & Triple bay.

- 6mx6m span- 15 degrees angle of inclination
- 6mx6m span- 30 degrees angle of inclination
- 6mx6m span- 45 degrees angle of inclination
- 9mx9m span- 15 degrees angle of inclination
- 9mx9m span- 30 degree angle of inclination
- 9mx9m span- 45 degree angle of inclination
- 12mx12m span- 15 degree angle of inclination
- 12mx12m span- 30 degree angle of inclination
- 12mx12m span- 45 degree angle of inclination.

BASIC DATA OF THE STRUCTURE

Structure	SMRF
No. of stories	Single storey
Storey height	3.00
Type of building use	Industrial
Foundation type	Isolated footing
Seismic zone	2
Young's modulus of elasticity of concrete, E	25000N/mm2

MATERIAL PROPERTIES

Grade of concrete	M25
Grade of steel	HYSD 500
Young's modulus of steel	2 x 10^5 N/mm2
Density of reinforced concrete	25 KN/M^3

MEMBER PROPERTIES

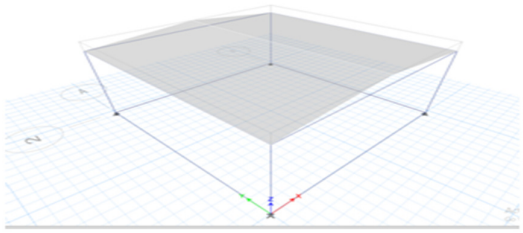
Column size	230x450mm
Beam size	230x420mm
Plinth beam size	230x300mm
Slab thickness	125mm

LOADS CONSIDERED:

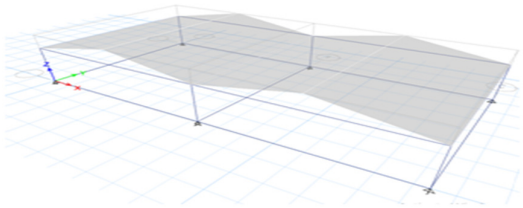
Loads	Multiplying factors
Dead load	1
Live load	1
Wind load +x	1
Wind load-x	1
Wind load +y	1
Wind load-y	1
Earthquake load-x	1
Earthquake load-y	1

LOAD COMBINATIONS:

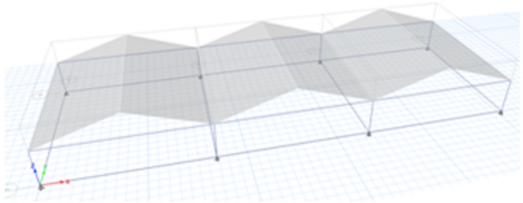
Combination 1	1(DL+LL)
Combination 2	1.2(DL+LL+WLX)
Combination 3	1.2((DL+LL+WL-X)
Combination 4	1.2(DL+LL+WLY)
Combination 5	1.2(DL+LL+WL-Y)



Model Shows a single bay rcc folded plate roof of 6m span having 15 degree angle of inclination.



Model Shows a double bay rcc folded plate roof of 9m span having 30 degree angle of inclination.

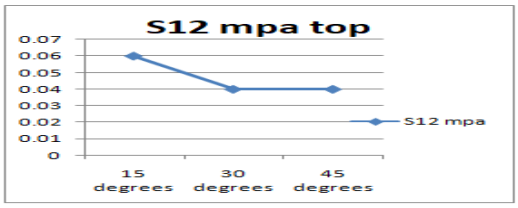


Model Shows a triple bay rcc folded plate roof of 12m span having 45 degree angle of inclination.

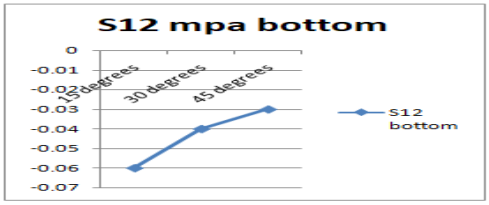
CHAPTER-IV
RESULTS & DISCUSSION:

After comparative analysis The results obtained from the analysis of the folded plate roof of 27 cases are shown in above tables as single bay, double bay, triple bay folded plate rcc roofs with 15,30,45 angle of inclinations and 6,9,12m spans. The stresses, moments are obtained after analysis shown as parameters S22, S12, M11, M22, and M12 and tables are made to show the variation of stresses and moments the lowest stress level will be optimum behavior of the folded plate structures and in this unit we will do comparative analysis of results and show the effect of changing angles and changing the spans of structure for understanding the behavior of folded plate roof.

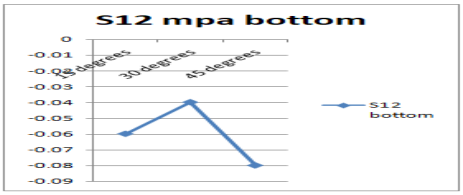
Graph showing variation of Shear stress S12 of folded plate with 6m span and with different angles at end span of the Single bay folded roof.



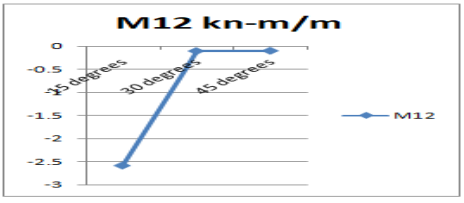
Graph showing variation of Shear stress S12 of folded plate with 6m span and with different angles at end span of the Single bay roof.



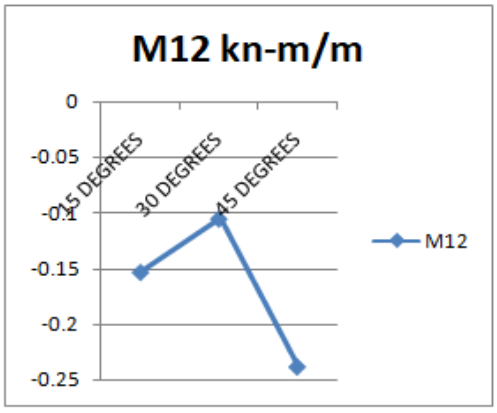
Graph showing variation of Shear stress S12 of folded plate with 6m span and with different angles at end span of the triple bay roof.



Graph showing variation of twisting moment M12 of folded plate with 6m span and with different angles at end span of the double bay roof.



Graph showing variation of twisting moment M12 of folded plate with 6m span and with different angles at end span of the triple bay roof



CHAPTER-V
CONCLUSIONS

With this study of the dissertation work we can conclude the optimum behavior of three different types of rcc folded plate roofs i ,e single bay, double bay, triple bay we has taken three different angle of inclinations 15,30,45 degrees and three spans of 6m,9m,12m.

1) For single bay folded plate roof the most optimum and favorable sections after comparisons we should provide 6m span-45 degrees, 9m span-15 degrees, 12m span-15 degrees.

2) For the double bay folded plate roof the most optimum and favorable sections after comparisons we should provide 6m span-45 degrees, 9m span-30 degrees, 12m span-30 degrees.

3) For the triple bay folded plate roof the most optimum and favorable sections after comparisons we should provide 6m span-30 degrees, 9m span-45, 12m span-45 degrees

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