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"A Parametric Study Of Skewed Parabolic Cylindrical shell at 0^0 And 30^0 By Staad Pro Software"

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ABSTRACT:

Because there are no internal supports within the thin, reinforced concrete shell, the interior of the shell constructions is open. In industry, domes and flat plates are the most commonly utilized shell shapes; however, spherical, parabolic, or cylindrical portions can also be used. Storage facilities and sports facilities are typical concrete shell constructions. In industry, domes and flat plates are the most commonly utilized shell shapes; however, spherical, parabolic, or cylindrical portions can also be used. Storage facilities and sports facilities are typical concrete shell constructions. The main goal of this work is to do a parametric analysis of numerous cylindrical shell designs with different lengths. Two distinct cylindrical shell lengths were used for the analysis, and the radius and thickness were adjusted. Compare the behavior of the shell for several models based on these alterations for the same chord width, length, and material.However, because the exact form required for structural stability changes depending on the material, shell size, internal or external loads, and other pertinent elements, they can be difficult to design. The following results have been found out by three cases. Case1:Effect of variation in skew angle: Case2:Effect of variation in rise Case3:Effect of variation in thicknesses:

Keywords: cylindrical shells, Analysis, Parameters,Rise,shear stress,moment.

I. INTRODUCTION :

From architectural and functional points of view, shells have their applicability as roofing units in many of the public buildings. Thin shells offer many of the attributes that architects and engineers are looking for in an ideal structure. Shells, only a few centimeters thick, can cover very large spans and their geometrical forms, singly and in combination, are practically numberless. Shells are thin because they are curved in such a fashion as to keep bending stresses to a minimum. The extent of their acceptance will depend upon, among other things, economics and value of aesthetic effects, suitably to functional requirement and how their structural behavior is understood. The performance and behavior of shell structures, when subjected to seismic loads, suggests that the requirement of establishing a methodology for studying the response of shell structure to earthquake loads has become essential. This will move us toward implementing performance based design by using time history analysis.

2. OBJECTIVES OF THE PRESENT STUDY

As mentioned above the study of skewed cylindrical shell roofs with varying parameters has been under taken for present study

The main objectives of the present work:

To conduct parametric studies on such parabolic cylindrical shell roofs at 0^o having different rises, thicknesses and Skew Angle of shells.

Plotting the graphs and tables on the behavior of shell (moment and stress), which will provide the ready to use data for practicing engineers planning to use such type of shells.

3. LITERATURE REVIEW :

- **Hut and Schnobrich (1990)** Plane stress constitutive models are proposed for the nonlinear finite element analysis of reinforced concrete structures under monotonic loading. An elastic strain hardening plastic stress-strain relationship with a non associated flow rule is used to model concrete in the compression dominating region and an elastic brittle fracture behavior is assumed for concrete in the tension dominating area. After cracking takes place, the smeared cracked approach together with the rotating crack concept is employed. The steel is modeled by an idealized bilinear curve identical in tension and compressions. Via a layered approach, these material models are further extended to model the flexural behavior of reinforced concrete plates and shells. These material models have been tested against experimental data and good agreement has been obtained.

- **Zhang et al. (2000**) The vibration analysis of cylindrical shells using wave propagation method is presented. Results obtained using the methods have been evaluated against those available in the literature. Comparison of the results by the present method and numerical finite element method is also carried out. It is possible to conclude through the comparisons that the present method is convenient, elective and accurate. The method can be easily extended to complex boundary conditions and loaded shell structures.
- **Singh and Shen (2005)** A variation full-field method is presented in this paper for the free vibration analysis of open circular cylindrical laminated shells supported at discrete points. A differential equation in matrix form is developed using the first-order shear deformable theory of shells, and rotary inertia is included. A large number of preselected nodal points on the reference surface of the shell. Each nodal point has 5 degrees of freedom, three displacement components, and two components of the rotation of the normal to the reference surface. The values of the natural frequency obtained from the present method show good agreement with published data in the literature.
- **Elhegazy (2020)** This studies goals to introduce the overview of the researches that included the blessings of making use of the cost engineering with inside the creation enterprise in particular the multi-tale homes. Multi-tale homes are a part of a distinctly specialized subject of layout and creation projects. They deal now no longer simplest with a building's layout and advent however additionally with its ongoing operation and maintenance. Because a massive part of the time and money expended via way of means of each the private and non-private sectors is used for creation, specifically multi-tale homes, it's miles vital for proprietors and developers to consider the way to optimize the stability among value and feature as they make important choices approximately multi-tale homes. The idea of cost engineering has advanced notably and has been extended over the years; today, several requirements and associated manuals exist. Various engineering databases, worldwide journals, and convention lawsuits had been searched. International journals had been looked for applicable studies papers. This paper affords views on cost engineering with in side the modern-day structural engineering context with a view to body the breadth and a couple of dimensions it encompasses, to summarize latest sports on decided on applicable topics, and to spotlight viable destiny guidelines in studies and implementations.
- **Palli (2021)** Transient dynamic evaluation (from time to time referred to as time-records evaluation)is a method used to decide the dynamic reaction of ash a pe below the motion of Any fashionable time-established loads. The time scale of the loading is such that the inertia or damping results are taken into consideration to be important. Present paintings is centered on appearing the time records evaluation of a normal locomotive teach the use of finite detail evaluation in Indian railroad conditions. Track floor irregularity within side the shape of an ellipsoidal bump is modeled with assumptions that the car passes over the bump in 0.one hundred forty four seconds, variant in displacement at distinct key places of the truck and automobile frame fashions is plotted in opposition to time below preferred loading conditions. The reaction sample of the the front and rear quantities of the locomotive truck and automobile frame suggest that those places are greater liable to wheel excitations in comparison to that of the centre quantities of it as they may be far from the centre of gravity of the car because of unbalanced mass distribution.
- **Jahanbazi et al. (2024)** The subject of current investigation is the free vibration response of laminated composite shells reinforced by graphene platelets. The shell takes the shape of a skew cylinder; particular examples include cylindrical shells and rectangular and skew plates. A functionally graded pattern of reinforcements is produced when a varying amount of graphene platelets are added to each layer of the shell. First order shear deformation shell theory is used to derive the fundamental shell governing equations. It is better to utilize an oblique coordinate system to implement the boundary conditions. As a result, an oblique coordinate system is used to define strains and stresses. The shell's total kinetic and strain energy are then determined. The motion equations of the shell associated with free vibrations are established according to the Ritz technique, where the fundamental shape functions are Chebyshev polynomials. The present study's novel numerical results are then presented to explore the effects of skew angle, opening angle, shallowness, side to thickness ratio, boundary conditions, graphene platelet weight fraction, and profile. The results of this research are compared with the data that is currently available in the open literature. It is demonstrated that each of these elements has a significant impact on how the structure responds to free vibration.

4. METHODOLOGY :

The purpose of the present work is to study, the behavior of non-skewed parabolic cylindrical shell roof and skewed parabolic cylindrical shell roof with varying parameter under dynamic loads. For this purpose following details are used:

Table 1 Parameter selected for analysis

S. No.	Description	Parameter
1	Span in x-direction	18m
2	Span in y-direction	10m
3	Live load	0.6kN/m^2
4	Grade of concrete	M-25
5	Type of steel	Fe-415
6	Column Size	0.5mx 0.3m

7	Column height	6m
8	Column longitudinal reinforcement	2%ofarea
9	Column transverse reinforcement	10d@150mmc/c
10	Beam Size	0.8mx 0.3m
11	Beam reinforcement	0.0037m^{2}bothside(Top &Bottom)
12	Shell reinforcement	10d@200mmc/c in both faces in both ways
13	Diaphragm thickness	0.2m,0.15m&0.1m
14	Radius of shell	10m
15	Thickness of shell	0.20m,1.5m&0.1m
16	Skewed angle	0^o,30^o
17	Roll down angle	30^o
18	Rise	2.68m

In order to achieve the objectives of the study, the following methodology is proposed. In this attempt, we prepared twenty seven models with variation in skew angle, rise and thickness. With those variation models are as follows:-

Non-skewed Parabolic Cylindrical Shell Roof

1. Size10m*18mspan18mandchordlength10mrise1.5mRolldownangle30^{0}radius10m thickness of shell 200mm.
2. Size10m*18mspan18mandchordlength10mrise1.5mRolldownangle30^{0}radius10m thickness of shell 150mm.
3. Size10m*18mspan18mandchordlength10mrise1.5mRolldownangle30^{0}radius10m thickness of shell 100mm.
4. Size10m*18mspan18mandchordlength10m rise2.25mRolldownangle30^{0}radius10m thickness of shell 200mm.Size10m*18mspan18mandchordlength10m rise2.25mRolldownangle30^{0}radius 10m thickness of shell 150mm.
5. Size10m*18mspan18mandchordlength10m rise2.25mRolldownangle30^{0}radius 10m thickness of shell 100mm.
6. Size10m*18mspan18mandchordlength10m rise3mRolldownangle30^{0}radius 10m thickness of shell 200mm.
7. Size10m*18mspan18mandchordlength10mrise3mRolldownangle30^{0}radius10m thickness of shell 150mm.
8. Size10m*18mspan18mandchordlength10mrise3mRolldownangle30^{0}radius10m thickness of shell 100mm.

Skewed Parabolic Cylindrical Shell Roof(skewedby30^0)

1. Size10m*18m span18 m and chord length10m rise1.5mRolldownangle30^0 radius 10m thickness of shell 200mm.
2. Size10m*18mspan18mandchordlength10m rise1.5m Rolldownangle 30^0 radius 10m thickness of shell 150mm.
3. Size10m*18mspan18mandchordlength10m rise1.5mRolldownangle30^{0}radius 10m thickness of shell 100mm.
4. Size10m*18mspan18mandchordlength10m rise2.25mRolldownangle30^{0}radius 10m thickness of shell 200mm.
5. Size10m*18mspan18mandchordlength10m rise2.25mRolldownangle30^{0}radius 10m thickness of shell 150mm.
6. Size10m*18mspan18mandchordlength10m rise2.25mRolldownangle30^{0}radius 10m thickness of shell 100mm.
7. Size10m*18mspan18mandchordlength10m rise3mRolldownangle30^{0}radius 10m thickness of shell 200mm.
8. Size10m*18mspan18mandchordlength10m rise3mRolldownangle30^{0}radius 10m thickness of shell 150mm.
9. Size10m*18mspan18mandchordlength10m rise3mRolldownangle30^{0}radius 10m thickness of shell 100mm.

Case I: Effect of skew angles

For this Study, Variation in skew angle has been done keeping rise &thickness constant. The following models are therefore selected for the study:

1. For 1.5 m rise and 200 mm thickness model no.1,10 and19.
2. For1.5mriseand150mmthicknessmodelno.2,11and 20.
3. For1.5mriseand100mmthicknessmodelno.3,12 and 21
4. For2.25mriseand200mmthicknessmodelno4,13 and 22.
5. For2.25mriseand150mmthicknessmodelno.5,14 and 23.
6. For2.25mriseand100mmthicknessmodelno.6,15 and 24.
7. For3mriseand200mmthicknessmodelno.7,16 and25.For3mriseand150mmthicknessmodelno.8,17 and 26.
8. For3mriseand100mmthicknessmodelno.9,18 and27.

Case II: Effect of rises

For this Study, Variation in rise has been done keeping skew angle & thickness constant. The following models are therefore selected for the study:

1. Forskewangle0^{0}and200mmthicknessmodelno.1,4 and7.
2. Forskewangle0^{0}and150mmthicknessmodelno.2,5 and 8.
3. Forskewangle0^{0}and100mmthicknessmodelno.3,6 and9
4. Forskewangle30^{0}and200mmthicknessmodelno.10,13 and16.
5. Forskewangle30^{0}and150mmthicknessmodelno.11, 14 and17.
6. Forskewangle30^{0}and100mmthicknessmodelno.12, 15 and18.

Case III: Effect of thicknesses

For this Study, Variation in thickness has been done keeping skew angle and rise constant. The following models are therefore selected for the study:

1. Forskewangle0^{0}and1.5mrisemodelno.1,2and3.
2. Forskewangle0^{0}and2.25mrisemodelno.4,5 and6.
3. Forskewangle0^{0}and3mrisemodelno.7,8 and9.
4. Forskewangle30^{0}and1.5mrisemodelno.10,11 and12.
5. Forskewangle30^{0}and2.25mrisemodelno.13,14 and15.
6. Forskewangle30^{0}and3mrisemodelno.16,17 and18.

5. RESULTS for rise variation

Graphs for stresses

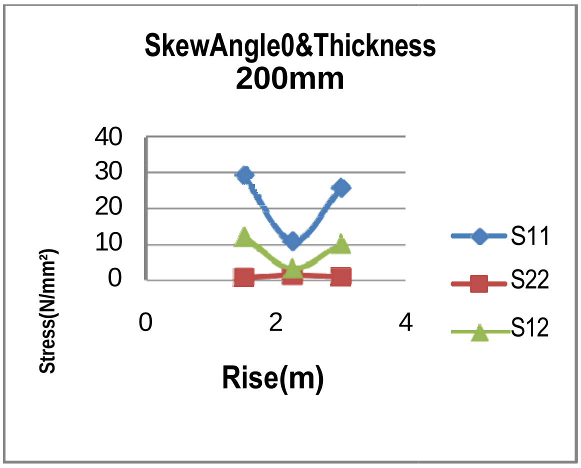

Fig.1

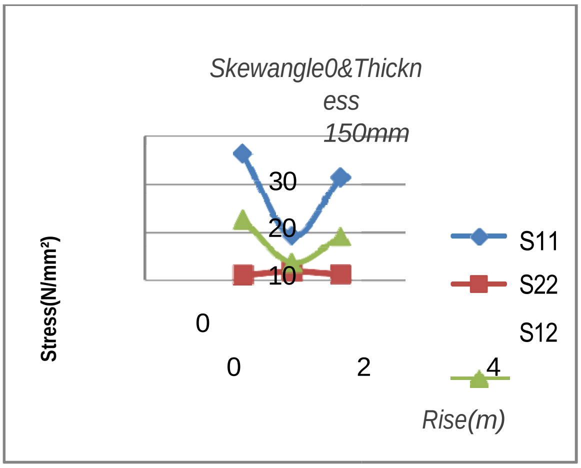

Fig.2

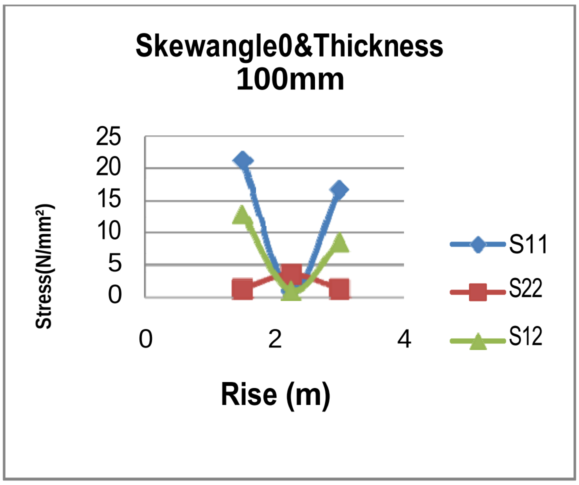

Fig.3

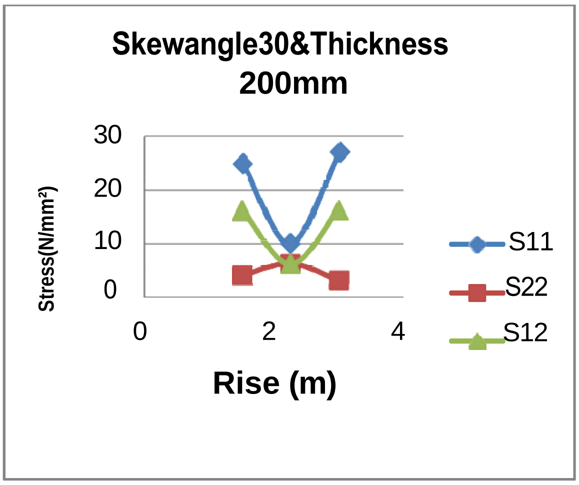

Fig.4

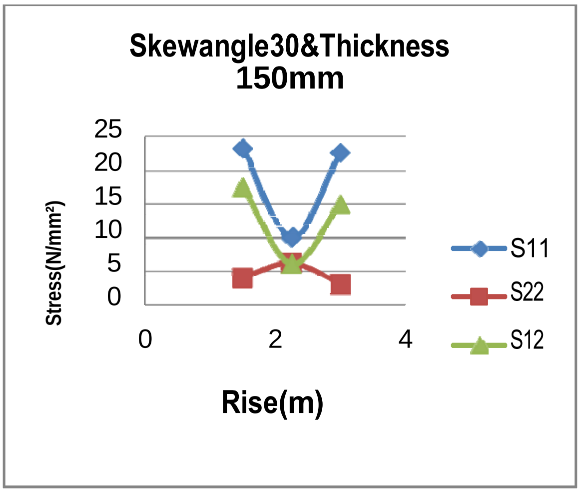

Fig.5

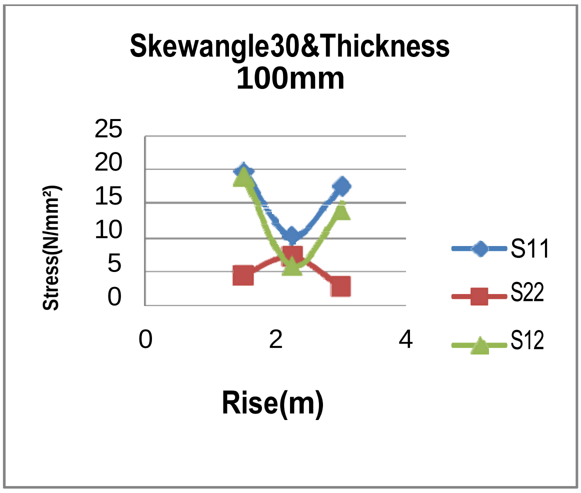

Fig.6

Graphs for Moments

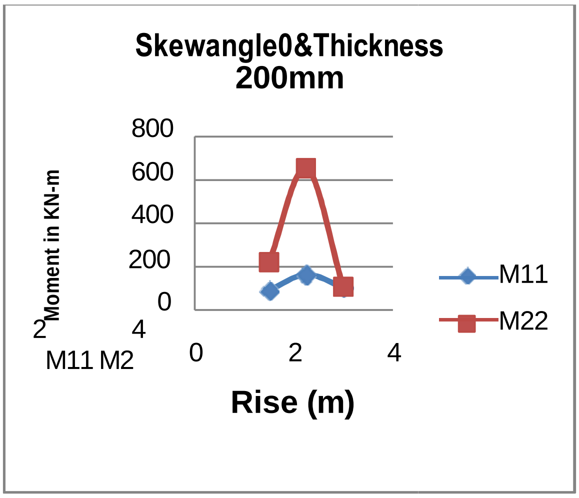

Fig.7

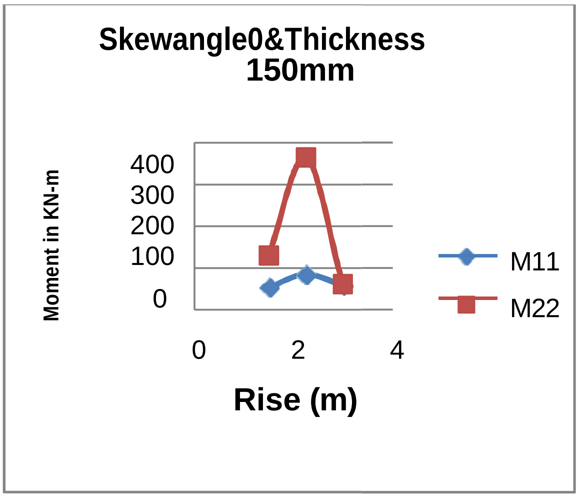

Fig.8

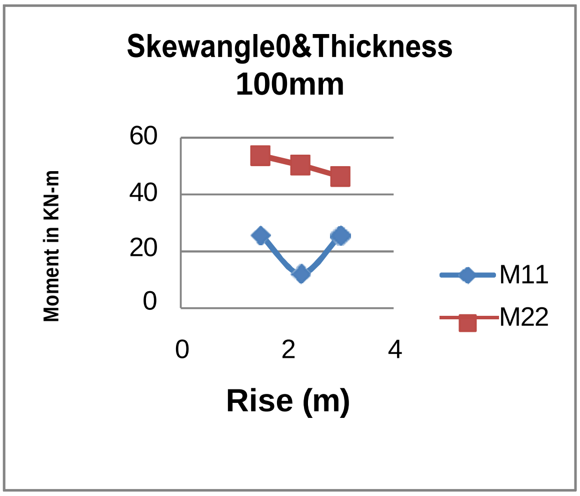

Fig.9

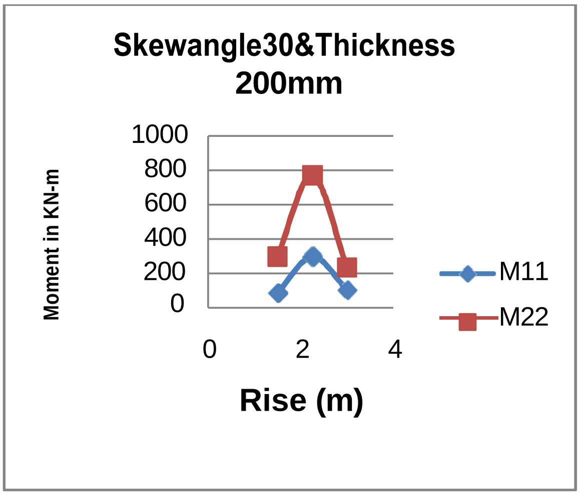

Fig.10

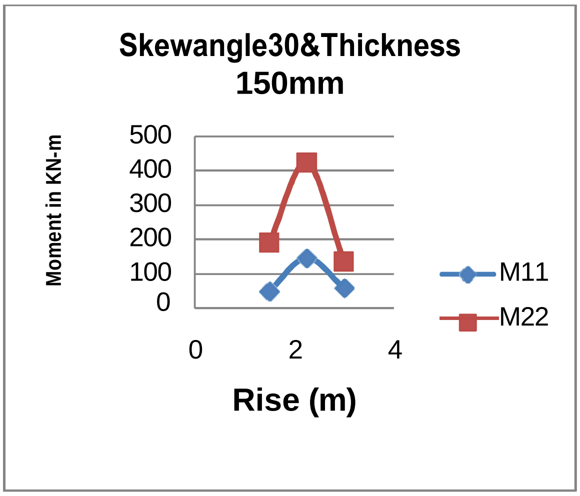

Fig.10

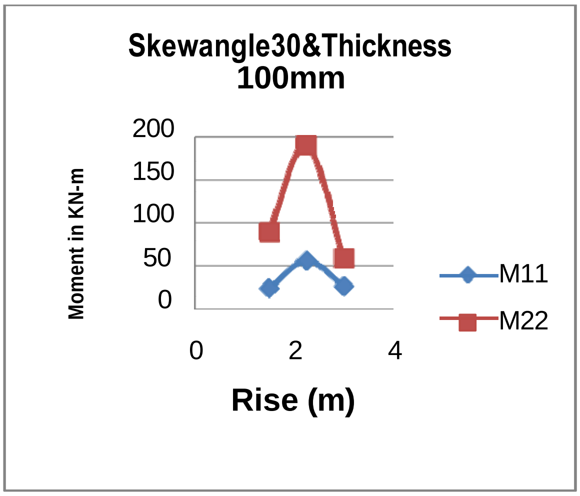

Fig.11

Graph for Stresses

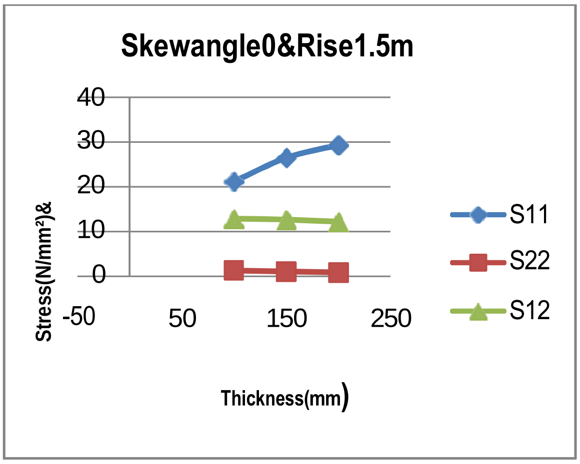

Fig.13

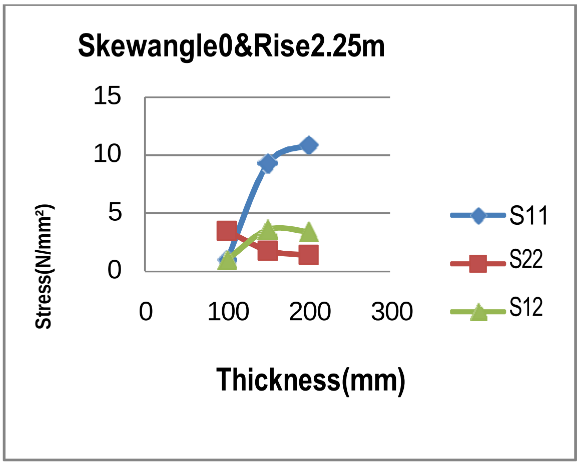

Fig.14

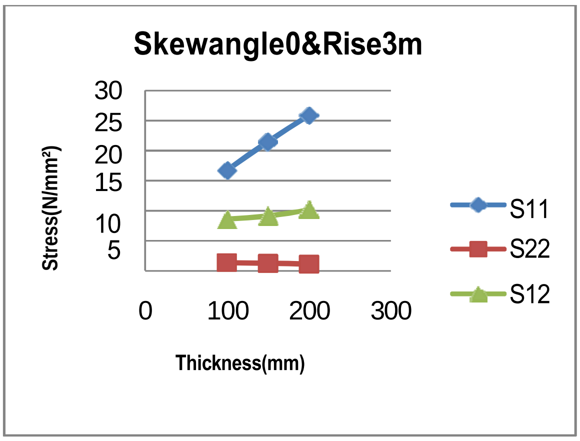

Fig.15

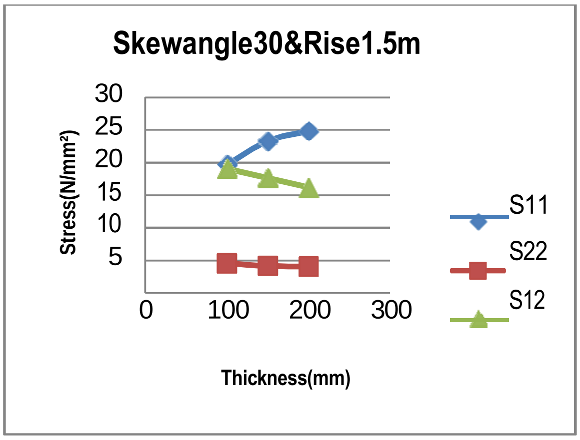

Fig.16

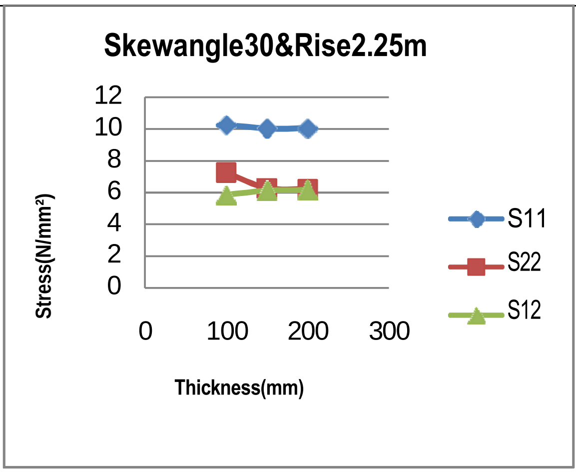

Fig.17

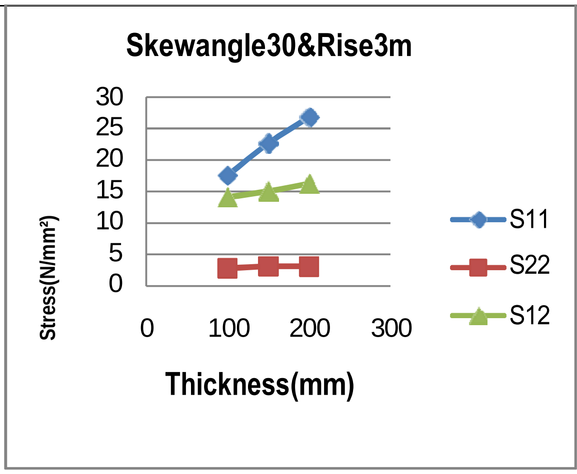

Fig.18

Graphs for Moments

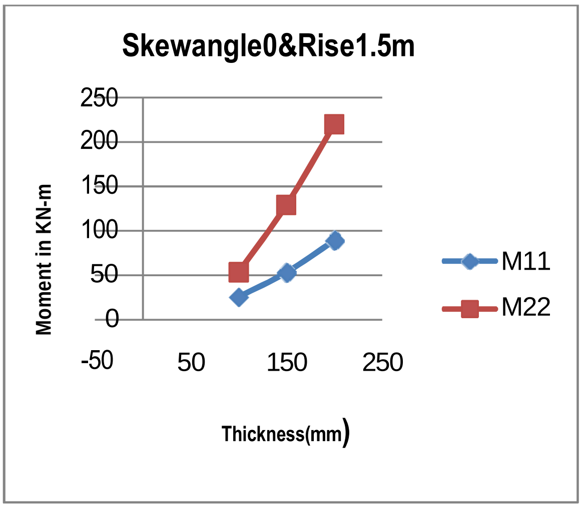

Fig.19

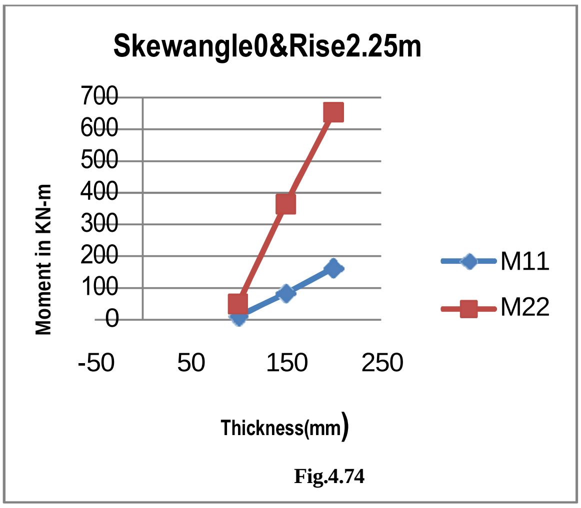

Fig.20

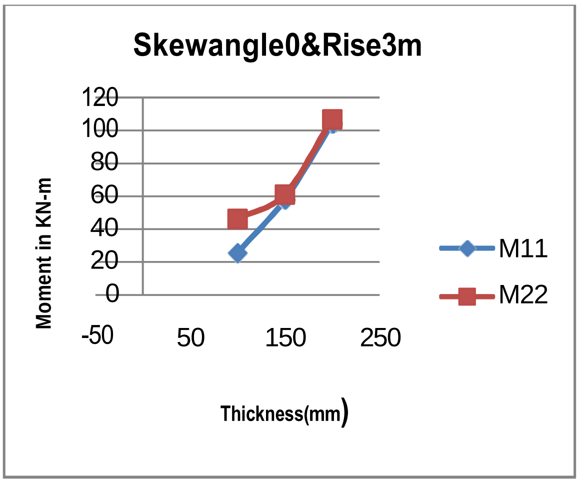

Fig.21

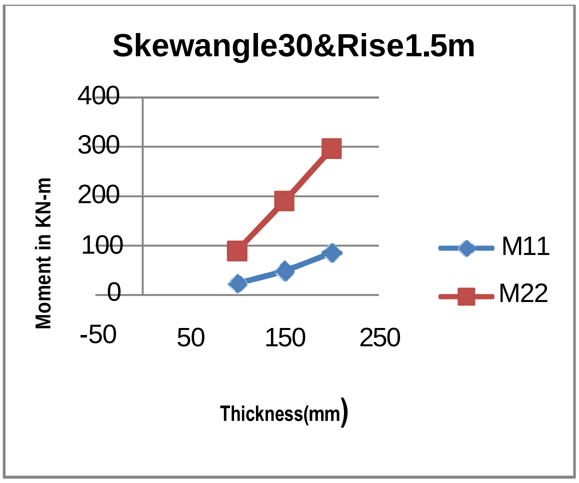

Fig.22

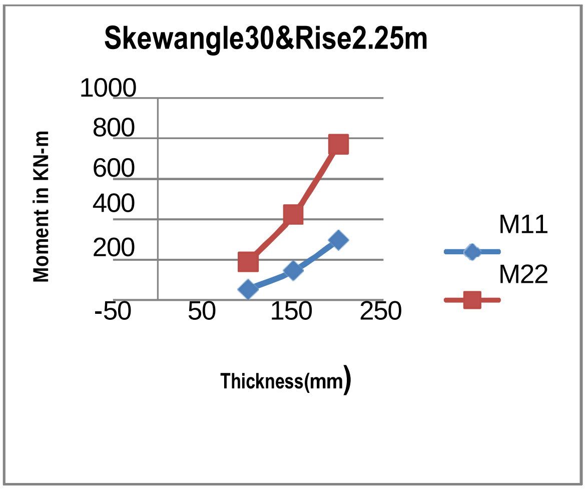

Fig.23

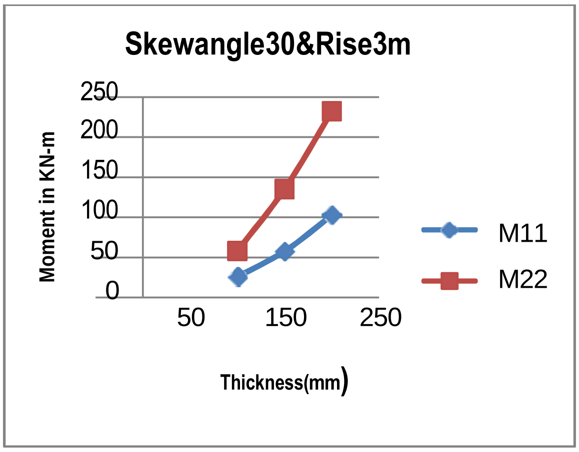

Fig.24

7.DISCUSSION ON RESULTS :

Case1:effect of variation in skew angle

- **Effect on longitudinal stress S_{11} (Nx)**: for rise1.5 meter longitudinal stress decreases in first mode by 40% and by 41% in second mode at 30° skew angle . It increases in first mode by 44% and decreases in second mode by 16%. The value of stress in third mode at 30° skew angle decreases by 11% .In fourth mode the value of stress is high as compared to first mode. The value of the stress at 30°decreasesby2%. For rise 2.25 meter longitudinal stress increase in first mode by two times and 4% in second mode at 30° skew angle in first mode by 50% and two time in second mode. The value of stress in third mode at 30° increase by 18% . In fourth mode the value of stress is high as compare to first mode, the value of the stress at 30°decreasesby77% .For rise 3.0 meter longitudinal stress increase by 97% in first mode at 30° in second mode increment at 30° is 11% .In third mode stress is high as compare to first and second mode, stress increase by 5% at 30° fourth mode stress is very high as compare to first and second mode at 30° skew angle stress decreases by 10% .
- **Effect on transverse stress S_{22} (Nx):** for rise 1.5 meter transverse stress decreases by 19% in first mode at30°. In second mode stress increment at30° is 6% . In third mode stress is high as compared to first and second mode, stress increases by four time at 30° . In fourth mode stress is very high as compare to first and second mode at 30° skew angle stress increase by 51% .For rise 2.25 meter transverse stress increase by 52% in first mode at 30° . In second mode stress increment at 30° is 65% . In third mode stress is high as compare to first and second mode, stress increase by three times at 30° .In fourth mode stress is very high as compare to first and second mode at 30° skew angle stress decreases by36% .For rise 3.0 meter transverse stress increases by one and half time in first mode at 30° . In second mode stress at 30° increases by 37% .In third mode stress is high as compare to first and second mode, stress increase by two time at 30° . In fourth mode. Stress is very high as compared to first and second mode. In forth mode at 30° skew angle stress increase by 37% .
- **Effect on shear stress S_{12} (Nx):** for rise 1.5 meter shear stress decreases by 11% in first mode at 30° . In second mode stress increases at 30° by10% . In third mode, stress is high as compare to first and second mode, stress increase by 19% at 30° .In fourth mode, stress is very high as compared to first and second mode, at 30° skew angle stress increase by 89% .For rise2.25 meter shear stress increase by80% in first mode at 30° .In second mode stress increases at 30° by 92% .In third mode, stress is high as compared to first and second mode, stress increase by 69% at 30° .In fourth mode, stress is very high as compared to first and second mode at 30° skew angle stress increase by 54% .For rise 3.0 meter shear stress increase by two times in first mode at 30° . In second mode stress increases at 30° by 68% a. In third mode, stress is high as compare to first and second mode, stress increase by 66% at 30° a. In fourth mode at 30°skew angle stress increase by 34% .
- **Effect on longitudinal moment M_{11} (Mx):** for rise 1.5 meter moment stress decreases by 34% in first mode at 30° In second mode stress decreases at 30° . In third mode stress decreases by8% at 30° . In fourth mode, stress is very high as compare to first and second mode, at 30° skew angle stress decreases by 13% .

  For rise 2.25 meter moment stress increase by 28% in first mode at 30° . In second mode stress decrement at 30° is 2% . In third mode stress increase by 74% at 30° .In fourth mode at 30° skew angle stress increase by 84% For rise 3.0 meter moment stress decreases by 4% in first mode at 30°.In second mode stress decreases at 30° by 3% .In third mode stress increases by 2% at 30° . In fourth mode stress is very high as compare to first and second mode at 30° skew angle stress decreases by 7% .
- **Effect on transverse moment M_{22} (Mx):** for rise 1.5 meter transverse moment decreases by 46% in first mode at 30° .In second mode stress increases at 30° by 42% . In third mode stress is high as compare to first and second mode, stress increase by 47% at 30° .In fourth mode stress is very high as compare to first and second mode at 30° skew angle stress decreases by 17% .For rise 2.25 meter transverse moment increase by 25% in first mode at 30° . In second mode stress increases at 30° by 51% . In third mode stress increase by three times at 30° . In fourth mode, stress is very high as compare to first and second mode, at 30° skew angle stress increase by 66% .For rise 3.0 meter

transverse moment increases by 2% in first mode at 30° . In second mode stress increases at 30° by two times In third mode stress increase by two times at 30° . In fourth mode stress is very high as compare to first and second mode at 30° skew angle stress increase by 37% .

Case2:effect of variation in rise

- **Effect in non-skew parabolic cylindrical shell:** In non skew shells the longitudinal stress S11 (Nx) decreases by 64% at 2.25 meter rise and at 3 meter rise it decreases by18%.The transverse stress S22 (Nx) increases at 2.25 meter rise by 72% and at 3meter by14%.Further the in plane shear stress decreases at 2.25 meter by 71% and at 3 meter rise by 23% .The longitudinal moment M11 (Mx), increases with the increase in rise, at 2.25 meter rise increase by 83% and at 3 meter rise it increase by 17%.The transverse moment M22 (MX) is increases at 2.25 meter rise by two times and at3 meter rise it decreases by51% .

Case3:Effect of variation in thicknesses:

- **Effect in non-skew parabolic cylindrical shell:** In non skew shells the longitudinal stress S11 (Nx) decreases by 14% at 150 mm thickness and at 100 mm thickness it decreases by 90%. The transverse stress S22 (Nx) increases at 150 mm thickness by 27% and at 100 mm by two and half times. Further the in plane shears stress increases at150 mm thickness by 5% and at 100mm thickness it decreases by 71%.The longitudinal moment M11(Mx), decreases with the decrease in thickness,at150mm thickness decrease by 40% and at 100 mm thickness it decrease by71%.The transverse moment M22 (Mx) is decreases at 150 mm thickness by 41%and at 100 mm thickness it decreases by 75% .

CONCLUSION

Effect of skewed angle:

The longitudinal stress(Nx) decreases as the skew angle increases, transverse stress(Nx) increases as the skew angle increases .The in plane shear stress (Nx) almost remained constant, therefore it can be concluded that the role of resistance to load shifts from longitudinal stress(Nx) to transverse stress (Nx) as skew angle increases.

Longitudinal Moment (Mx) does not vary much with skew angle, but the transverse moment (Mx) increases with skew angle but more for 45°.Further the transverse moment (Mx) is more than double than Longitudinal Moment (Mx) in all cases, which shows transverse moment (Mx) plays the major role in resisting the load.

Effect of rise:

The stresses are minimum for 2.25m rise as compared to other two rise. Thus for shallow and deep shell, the loads are resisted by stresses as compared to intermediate rise, which is reflected by their higher values. In shells with intermediate rise, the moment plays major role. In plane shear stress (Nx) played negligible part in loads resistance.

Effect of thickness:

The longitudinal stress (Nx) increases with increase in thickness, while transverse stress (Nx) either decreases or remains constant. Further the value of longitudinal stress (Nx) is much larger ascompared to transverse stress (N□). The magnitude of in plane shear (Nx) lies in between the other two stresses and it is observed to decrease with thickness. Thus it appears that longitudinal stress (Nx) plays major role in resisting the loads as compared to other two stresses. Both the moments, longitudinal Moment (Mx) and transverse moment (Mx), are increasing with thickness. Transverse moment (Mx) increases more in comparison of longitudinal Moment (Mx).

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