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Analytical Study of Solid Slab with Different Types of Cavity

Mrs. Kavita Golghate[1], Pratish Awasthi[2]

[1]Assistant Professor, Dept. of Civil Engineering, SDBCE, Indore, Madhya Pradesh, India
[2]Student M. Tech (Structure Engineering), Dept. of Civil Engineering, SDBCE, Indore, Madhya Pradesh, India

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Abstract - *Population of every country is increasing day by day and for this population requires low cost houses this houses consume more concrete and in the production of that concrete plenty amount of CO_2 will produces. This CO2 production is covers 40% of total production of CO2 on this planet. If we reduce the few amount in that then we save our environment or reduction in the ozone layer.*

Our lower income group population wants the houses which can be built with low cost so to build the low cost house we have to reduce the uses of concrete from the structure because it is the most expansive material used in the building.

To overcome from above mentioned problems the slab should be lighter and economical for that a slab of dimension 1000 X 1000 X 150 mm is modeled and use the recycled plastic cavity in the shape of sphere, egg and elliptical which is placed in the middle of the cross section of the slab and the cavity is fixed at the joint of the reinforcement. The pressure of 15000 Pa is applied on the top face of the slab and keep the all four side faces fixed to get the edge condition. Analysis of this slab was carried out by using ANSYS WORKBENCH 14.0.

Key Words: Solid Slab, Cavity Slab, modelling, Ansys 14.0

1. INTRODUCTION

Concrete is the most important material for the building construction and it is second most usable material after water. We cannot assume a structure without concrete. In the manufacturing of the concrete huge amount of carbon die oxide and other gases and by product come into the atmosphere and this amount of carbon and other by product disturbed the cycle of the atmosphere and by the result of which our environment is getting warm day by day and the carbon die oxide is the biggest reason behind the decaying of the ozone layer of earth which reduces the radiation comes on the earth surface.

If we prepare 1 tons of concrete than total emission of CO_2 is 410 kg/m^3. The production of cement which is the primary material for the concrete is increasing with rate of 2.5% per year so the emission of carbon is also increases to reduce that many work done in this field and they get batter result.

In order to reduce the uses of carbon construction company uses the cavity in the slab or in other structural parts of building this uses of cavity reduces the use of concrete by which the emission of carbon is reduces.

This analysis investigates of compares the 6 perimeter of solid slab, sphere cavity slab, egg cavity slab and elliptical cavity slab

1.1 Types of Cavity1

Cobiax:-

Cobiax is the elliptical plastic boll which is made from recycled plastic. Cobiax founded in Switzerland and after some year it is manufactured in Cobiax components are currently manufactured in many factories distributed over worldwide. In early, Switzerland is considered as headquarter for the start of manufacturing, marketing and exporting of Cobiax to other countries. Recently, these countries have held the partnership with Switzerland and have manufactured the void formers with steel cages for its cities that use this system. Among these countries are Germany, Singapore, France, Greece, Iran, Turkey, Middle East and many other countries around the world.

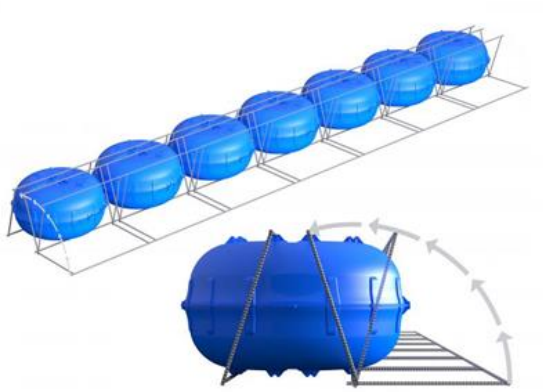


Figure. 1 Cobiax Cavity

U-Boot:-

It is invented in 2001 by the Italian engineer this type of cavity reduces the transportation problem by which CO2 is comes in to the environment on very large scale. This type of cavity has two parts top and bottom which is separated and we can join them on site and placed on roof shuttering. It reduces the concrete more than cobiax and the bubble deck slab system.

Figure. 2: U-Boot

Bubble Deck:-

In the 90s Bubble deck system was invented by jorgan Breuning for reducing weight of the slab with more than 30% and also it has longer span between supports and this slab is known as bubble deck slab. The name of this slab is due to the shape of the cavity fix in the slab. The manufacturer of this type of cavity take the patent for that. It generally used in between the upper and the bottom layer of the reinforcement which gives almost same property as given by the solid slab used material is HDPE.

Figure. 3: Bubble Deck

1.2 DETAIL OF CAVITY USED

Sphere cavity:

Diameter		
Internal	=	74.00 mm
External	=	80.00 mm
Thickness	=	6.0 mm
Volume	=	EXT. – INT
	=	$2.68 \times 10^{-4} - 2.122 \times 10^{-4}$
	=	5.58×10^{-5} m^2
Weight	=	62 Gram

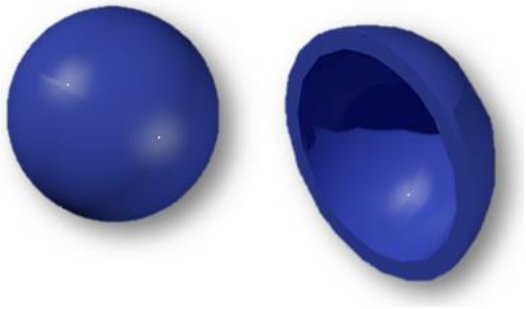


Figure. 4: Sphere Cavity

Elliptical Cavity

Diameter Dx	EXT.	=	80.00 mm
	INT.	=	74.00 mm
Dy	EXT.	=	40.00 mm
	INT.	=	34.00 mm
Dz	EXT.	=	80.00 mm
	INT.	=	74.00 mm
Thickness		=	6.0 mm
Volume		=	2.90×10^{-04} m^3
Weight		=	300 Gram

Figure.5: Elliptical Cavity

Egg Cavity

Diameter Dx	EXT.	=	61.00 mm
	INT.	=	55.00 mm
Dy	EXT.	=	80.00 mm
	INT.	=	74.00 mm
Dz	EXT.	=	61.00 mm
	INT.	=	55.00 mm
Thickness		=	6.0 mm
Volume		=	6.2×10^{-05}
Weight		=	60 Gram

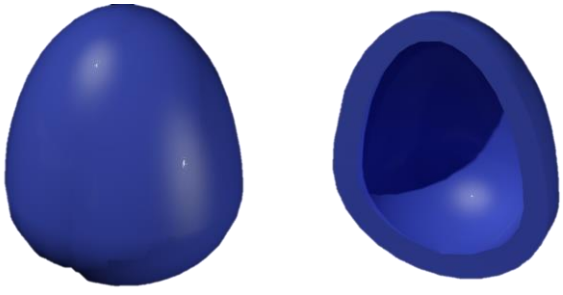


Figure.6: Egg Cavtiy

2. MEHODOLOGY & PROBLEM FORMULATION

ANSYS software work on its own created model it can also work on the model which is created in the third party software like AutoCAD or catia in that work i created my all the model in Auto-cad and export it in the .iegs format which is supported by the ANSYS 14.0.

In that process first of all model is prepared in the AutoCAD and then it is exported in .iegs format and after that it is imported in Ansys 14.0 static analysis and then it is meshed with the course relevance and default size of element after meshing of slab load is applied on slab and fixed it's all four side faces and analyse it for total deformation, Von-misses stress, Von-misses strain, strain energy, principle stress, principle strain, Shear strain, Shear stress Etc.

In that process four type of slab is modeled which is solid slab, Sphere cavity slab, Egg cavity slab, Elliptical cavity slab the general arrangement of slab is shown in figure given below.

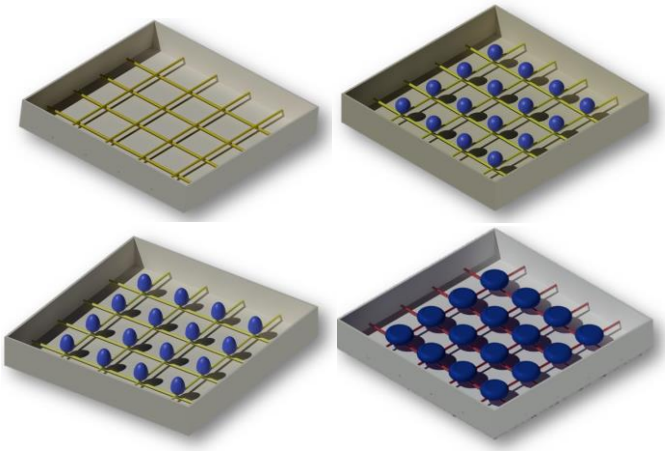


Figure.7: Arrangement of Cavity in Slab

Table -1: Material Used

Material Used			
Material	Density Kg/m^3	Poisson ratio	Young's Modulus (mPa)
Concrete	2400	0.18	27386
Reinforcement	7850	0.3	2.0 X 10^5
Recycled Plastic	1100	0.35	4000

3. RESULTS & DISCUSSION

The result is based on the 4 properties which is total deformation, Von-misses stress, Von-misses strain, Shear strain, Shear stress.

Result Sheet				
	Solid Slab	Sphere Cavity	Egg Cavity	Elliptical Cavity
Total Deformation (m)	3.1440 E-06	3.2291 E-06	3.1949 E-06	3.8299 E-06
Von-Misses Strain (m/m)	9.3408 E-06	0.00001042	9.2411 E-06	9.5124 E-06
Von-Misses Stress (Pa)	7.94 E+05	9.53 E+05	1.00 E+06	6.78 E+04
Shear Strain (m/m)	4.3746 E-06	4.0903 E-06	6.9906 E-06	6.954 E-06
Shear Stress (Pa)	325500	311960	260410	276160

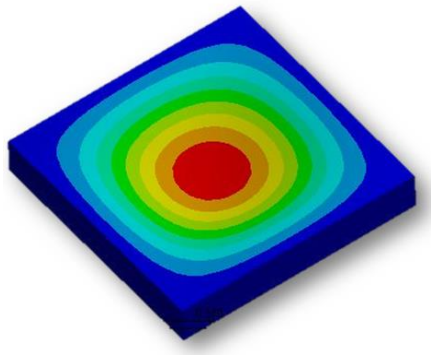
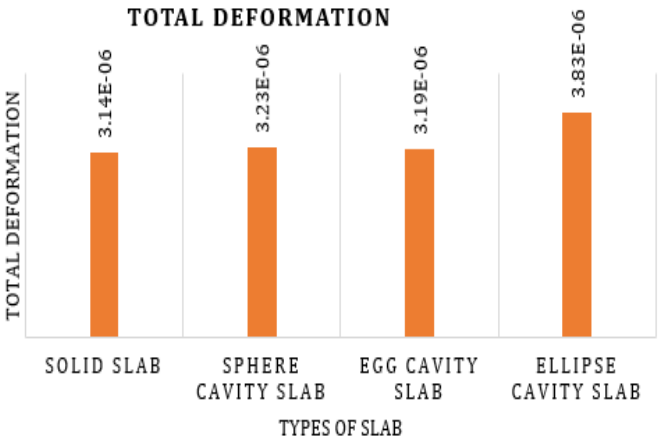


Figure.8: Demonstration of Total Deformation Result



Char5 -1: Total Deformation

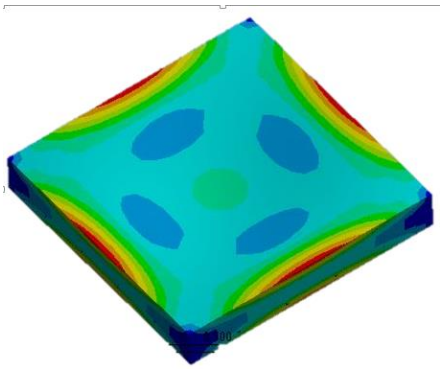


Figure.9: Demonstration of Von-Misses Strain Result

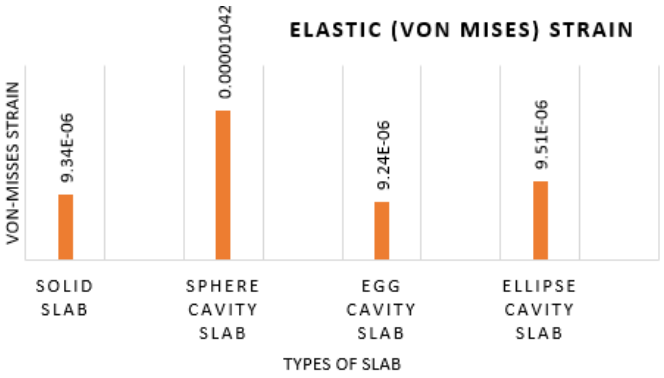


Chart -2: Von-Misses Strain

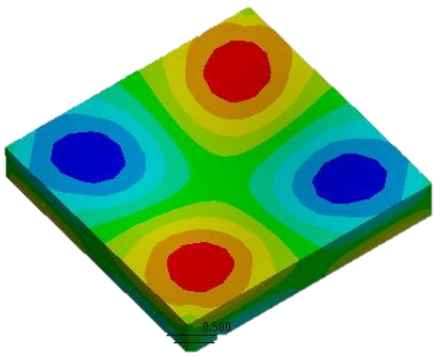


Figure.10: Demonstration of Shear Strain Result

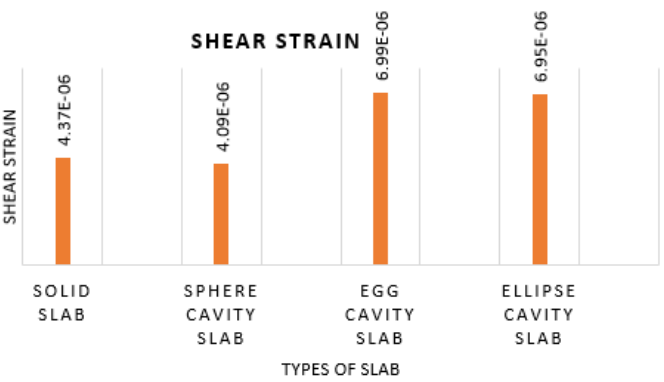


Chart -3: Shear Strain

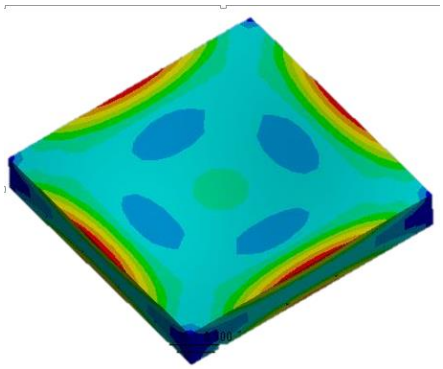


Figure.11: Demonstration of Von-Misses Strain Result

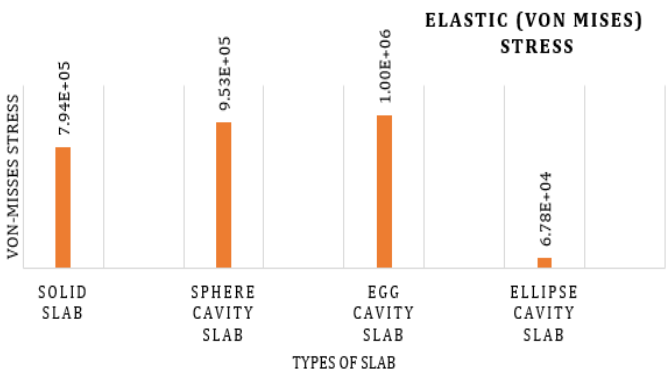


Chart -4: Von-Misses Stress

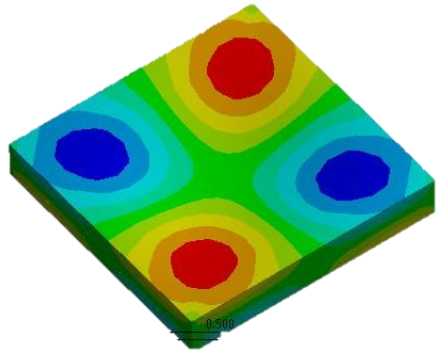


Figure.12: Demonstration of Shear Strain Result

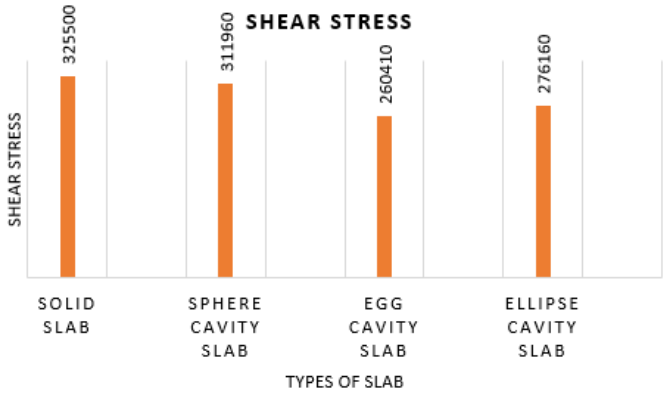


Chart -5: Shear Stress

4. CONCLUSIONS

1. Many of the time the cavity slab behaves better than the solid slab.

2. Total deformation values of the cavity slab & Solid slab is approximating same.

3. The Behavior of egg elliptical & solid slab is same in case of Von-Misses Strain.

4. The behavior of sphere cavity slab is better than all other slabs in case of shear stress.

5. The behavior of sphere cavity slab is better than all other slabs in case of Von-Misses Stress.

6. The behavior of Elliptical cavity slab is better than all other slabs in case of shear stress.

7. If we talk of the economy, then sphere cavity slab saves 6% concrete, Egg cavity saves 4% concrete and Elliptical cavity saves 15% concrete.

5. Future Scope

1. It is also felt that study of seismic performance on the basis of experimental investigation in Indian environment is required. For analysis and design of precast concrete structure in the country, seismic performance of structure must be investigated experimentally.

2. Study of seismic performance of emulative precast structure can be performed on ANSYS workbench.

3. Study of thermal performance of the slab structure can be performed on ANSYS Workbench.

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