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Design and Analysis of Spider Web Slab

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Abstract : Earthquake is the most damaging and most frequently occurring disaster among all. So, it is necessary to mitigate such kind of risk. To reduce the effect of earthquake forces in slab it should able to absorb more vibration. So the spider web system is adopted in slab rather than conventional slab. In the present study, the circular slab is taken for analysis. In this the conventional circular slab with normal two way reinforcement is compared with the circular slab with reinforcement in spider web system is and going to found which one is more effective to absorb vibration. For the analysis, ANSYS software is used because of finite element modeling.
Key words : Circular Slab, Spider Web System, ANSYS, Vibration, Normal Two Way Reinforcement.

1.0 Introduction

1.1 General

There are several different types of web - the sheet web, orb web, tangle web, funnel web, tubular web and dome or tent web. The most common type of web mainly viewed around the home is the orb web, because of its circular shape and it is resembling like a giant wheel[1,2] .Orb webs are normally a planar structures which are distinct into conical shapes at the time of insect impact and they are mainly classified into 4 quadrants, each quadrants covering 90° angle.

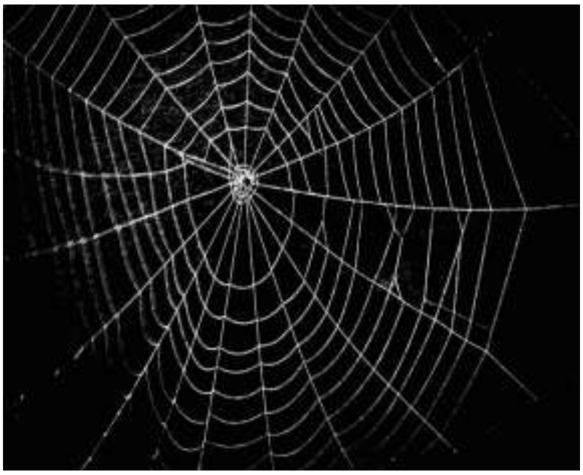

Fig 1 Orb Type Spider Web

1.2 Objective of the Study

- It is highly economical compared to using a two way slab for circular sections.
- It is highly adequate to absorb more vibration such that it is able to withstand seismic force when compared to conventional slab.

2.0 Methodology

2.1 ANSYS Software

The slab is modeled by using ANSYS Software for the following given below.

a. Conventional two way circular slab with normal reinforcement.
b. Circular slab using spider web system reinforcement.

In these normally linear static analysis is preferred for analysis.

For meshing condition , fine meshing is used for entire slab system.

2.1.1 Building the Model

The each element modeled by using the following element type in ANSYS.

Table 1Element type in ANSYS

Element	**Element type in ANSYS**
Concrete	Solid-187
Steel Reinforcement	Link-18

2.1.2 Define Material Property

The material property of concrete and steel is already predefined in ANSYS. The properties are given below in Table 2.

Table 2Properties of Material

Material properties	Steel	Concrete
Youngs Modulus (MPa)	$2 \text{ X } 10^5$	30000
Bulk Modulus (MPa)	$1.67 \text{ X } 10^5$	15625
Shear Modulus (MPa)	76923	12712
Poison's Ratio	0.3	0.18
Ultimate Tensile Strength (MPa)	250	5

2.1.3 Loading

An Uniformly Distributed Load of 4KN/m is applied at the top of the slab.

2.1.4 Solution

By doing salvation process in ANSYS the following solutions were found.

3.0 Results and Discussions

3.1 Spider web model

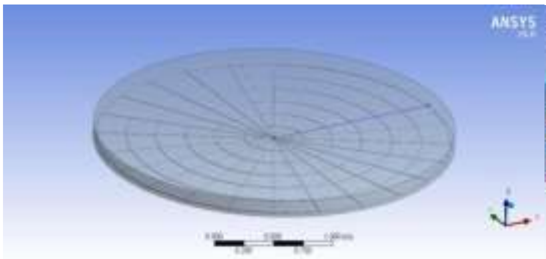

Fig 2 Typical view of spider web model

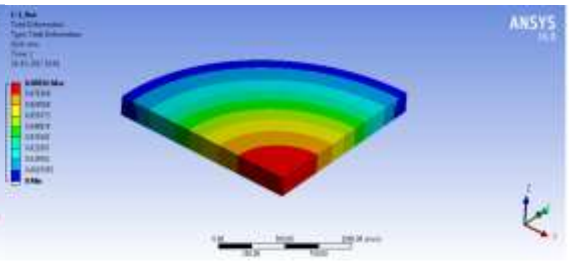

Fig 3 Typical view of total deformation

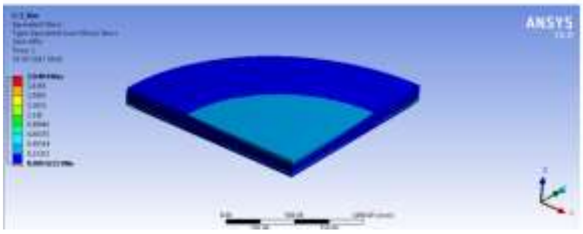

Fig 4 Typical view of equivalent von mises stress 1

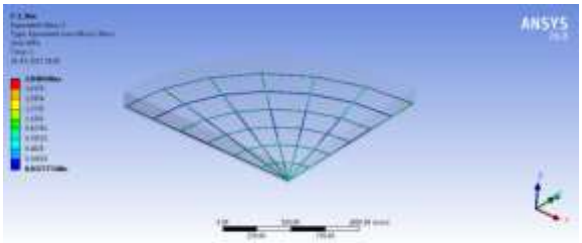

Fig 5 Typical view of equivalent von mises stress 2

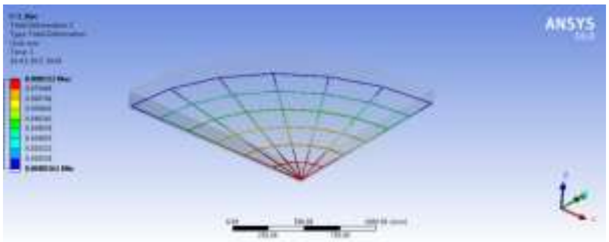

Fig 6 Typical view of total deformation

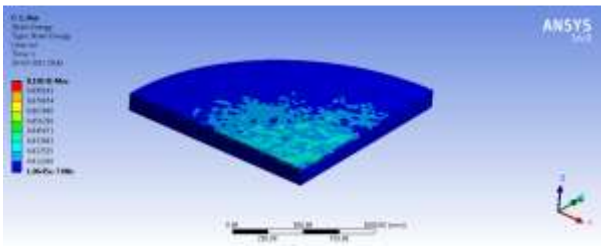

Fig 7 Typical view of strain energy

Properties	Result
Total Deformation 1[mm]	.08816
Equivalent von mises stress 1[mpa]	2.0404
Equivalent von mises stress 2[mpa]	2.0404
Total deformation 2[mm]	.088152
Strain energy[mj]	.10141

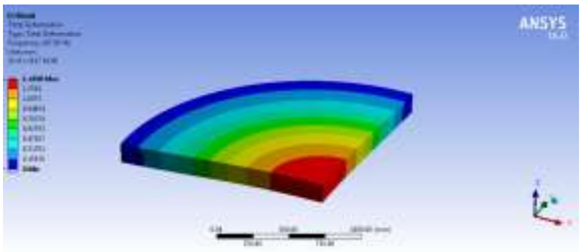

Fig 8 Total deformation 1

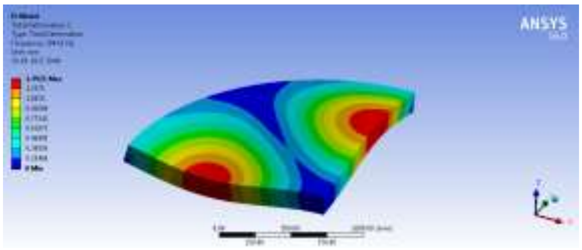

Fig 8 Total deformation 2

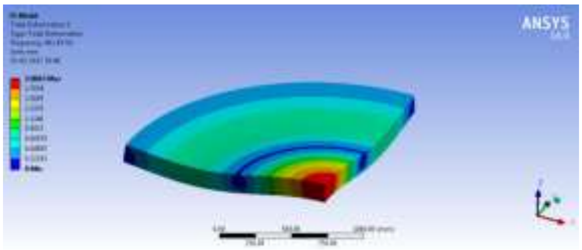

Fig 9 Total deformation 3

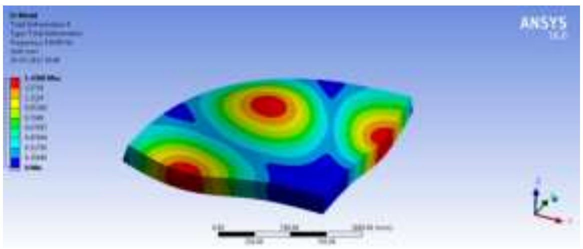

Fig 10 Total deformation 4

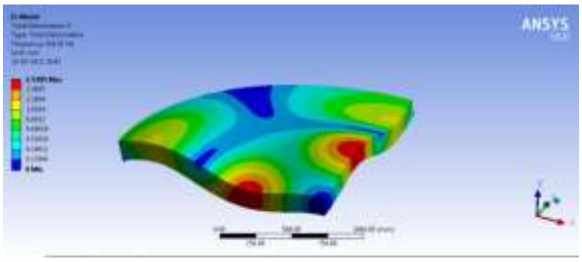

Fig 11 Total deformation 5

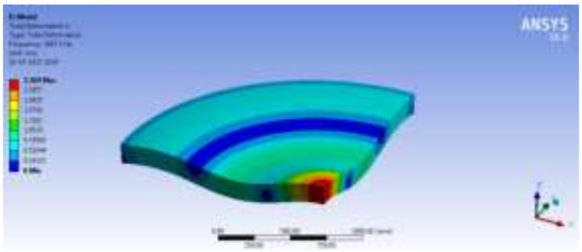

Fig 12 Total deformation 6

3.2 Normal Circular Slab

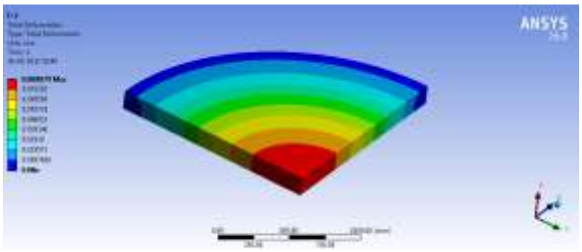

Fig 13 Total Deformation

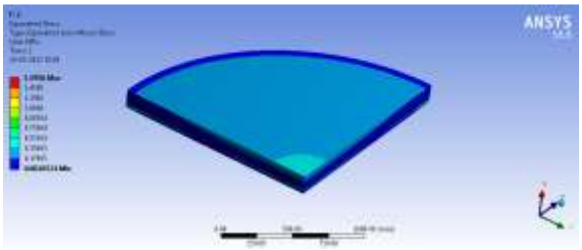

Fig 14 Equivalent Stress

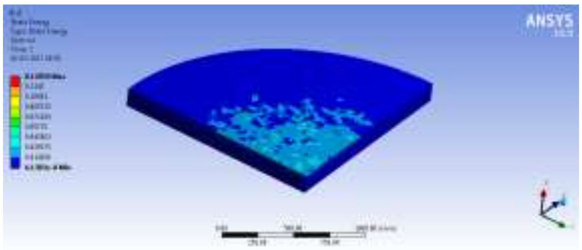

Fig 15 Strain Energy

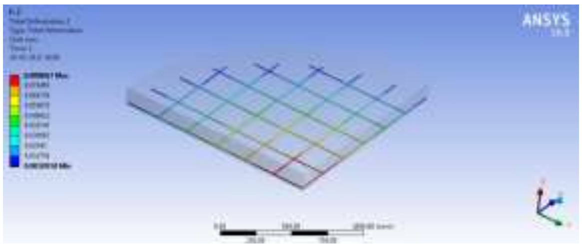

Fig 16 Total Deformation 2

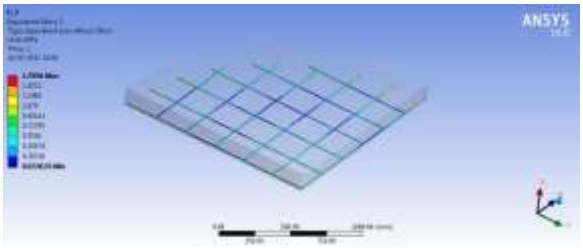

Fig 17 Equivalent Stress 2

Properties	Result
Total Deformation 1 [mm]	.088079
Equivalent von mises stress 1[mpa]	1.5956
Equivalent von mises stress 2[mpa]	1.5956
Total deformation 2[mm]	.088067
Strain energy[mj]	0.12859

4.0 Conclusion

On comparing the spider web slab and a conventional circular slab it can be inferred that the Von-Mises stress in spider web slab is higher in comparison to circular slab. The deformations in both circular and spider web slab are almost similar. The strain energy in spider web slab is lesser than the strain energy in circular slab[3,4,5].

4.1 Future Study

In Spider web slab further study can be done by analyzing it by using the properties of spider web silk instead of the properties of reinforcing steel in it. Further analysis of spider web slab in terms of its behavior to impact loading can be done.

5.0 References

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