

# ANALYSIS OF COMPOSITE PLATES WITH CUT-OUT OPENINGS

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**Abstract** -Panel is a thin composite plate made with a cement-based mortar matrix in reinforced with closely spaced layer of small diameter wire mesh is used. Layers of plates are bonded together to form laminated composites. Hence analysis of plates remains a major part in design. The study has incorporated the effects of boundary conditions, cutout and shape. It is used for construction of walls, roof, for supportive material for fluid transmission and various cut out purposes. In our project comparison between sawdust replaced panel without cutout and sawdust replaced panel with cut out are analyzed. We used sawdust as a composite material. The deformation values are analyzed using ANSYS Workbench software and compared. The sawdust replaced with 5%,10%,15% are analyzed in cutout panel and also in panel without cutout. The load carrying capacity of panel were also determined. Thus, we able to find a panel with more load carrying capacity

**Key Words:** Composite plates, Sawdust, ANSYS Workbench, cut-out panels, Deformation, Panels

## 1. INTRODUCTION

Concrete is the most widely used construction material all over the world, with innovations in science and technology in construction industry, the scope of concrete as construction material has widened. Concrete has strong compression but is weak in tension and flexure. The utilization of concrete is increasing at a higher rate due to development in infrastructure and construction activities all around the world. River sand has been used most commonly as fine aggregate in concrete in the past, but over use of material has led to environmental concerns. Generation of wood wastes in sawmill is an unavoidable environmental pollution and hence great efforts are made in utilization of such waste

Composite concrete plates with are presented for structural applications in construction instead of steel plates in some of its uses, such as retaining walls, floor and roof slabs, irrigation gates, open channels and flood protection panels. The plates are lighter in weight with high strength, cracking resistance, better deformation characteristics and high ductility and energy absorption properties which are very useful for dynamic applications compared with conventional concrete plates.

Sawdust is also known as wood dust. It is the by-product of cutting, drilling wood with a saw or any other tool; it is composed of fine particles of wood. Certain animals, birds and insects which live in wood, such as the carpenter ant are also responsible for producing the saw dust. Sawdust's are produced as a small discontinuous chips or small fragments of wood during sawing of logs of timber into different sizes. The chips flow from the cutting edges of the saw blade to the floor during sawing operation.

## 1.1 OBJECTIVES

- To find load carrying capacity of panel.
- To find deformation value of panel with cut out panel.
- Comparison of load carrying capacity of panel with and without replacement of sawdust.

## 2. MATERIALS

**Cement;** A cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel together. Cement mixed with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete

**Sand;** Sand is in very commonly used in construction, often providing bulk, strength and stability to other materials such as asphalt, concrete, mortar, render, cement, and screed. Sand is used in liquid form to manufacture glass, and is also used for moulding metal casting.

**Sawdust;** sawdust we may prepare the mortar which is made by mixing the sawdust with sand and cement at certain ratio. According to the ratio of adding Dry Sawdust, the strength of the mortar will be varied. The concrete which is made by addition of sawdust is called sawdust concrete.

**Wiremesh;** wire mesh offers a variety of solutions for building—from reinforcing concrete in slab on grade foundations to ventilating attics with soffit screens.

### 2.1 MATERIAL PROPERTIES

PROPERTY	RESULT
Specific gravity	3.15
Fineness	94%
Initial setting time	30 min
Final setting time	10 hrs

**Table 1:** Physical Properties of Cement

PROPERTY	RESULT
Specific gravity	2.3
Sieve Analysis	100% passing

**Table 2:** Physical Properties of Sand

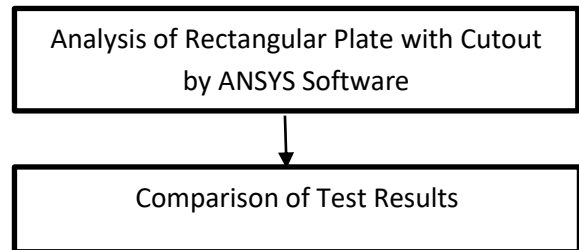
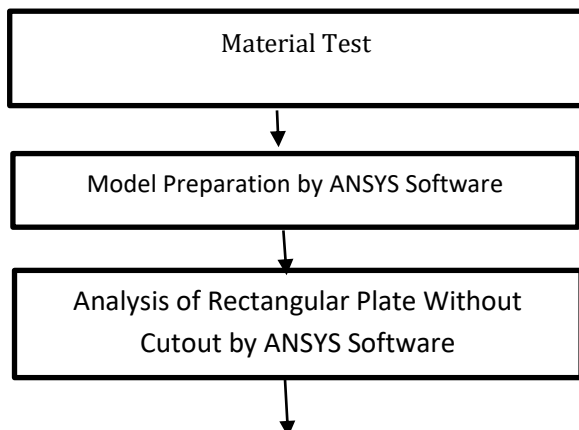
PROPERTY	RESULT
Specific Gravity	2.34
Sieve Analysis	99.6 % passing

**Table 3:** Physical Properties of sawdust

MATERIAL	STANDARD PANEL (Kg)	5% SAWDUST REPLACE D (Kg)	10% SAWDUST REPLACE D (Kg)	15% SAWDUST REPLACED (Kg)
Cement	8.3	8.3	8.3	8.3
Sand	16.6	15.073	14.806	13.709
Sawdust	-	0.89	1.794	2.691
Water	4.2 L	4.37 L	4.54 L	4.71 L

**Table 4:** Mix Design

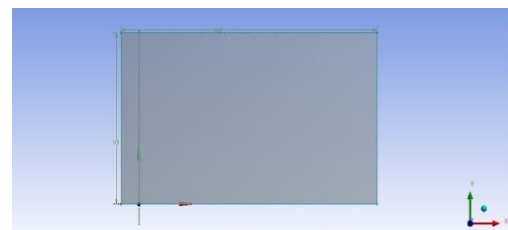
### 3.METHODOLOGY



### 4. ANALYSIS USING ANSYS

A rectangular panel with 600mm length, 450mm height and 50mm thickness is modeled for the analysis. The analysis is carried out in static structural. The mix proportion taken is 1:2, in which sand is replaced by 5%, 10% and 15%. 4\*4mm wire mesh is used. The analysis is carried out in composite panel with and without cutout. Meshing provided after modeling is 30mm in size and is quadrilateral type.

Element of Solid 65 for concrete is used for modeling the composite panel. A convergence of results is obtained when an adequate number of elements are used in a model. A finer mesh typically gives more accurate results, but at the cost of higher computational requirements. In this study, set all the elements to be square and size of the mesh is 30 mm



**Fig 1:** Model of Composite Panel



**Fig 2:** Meshed Structure of Composite Panel

A nonlinear structural analysis was performed to study the nonlinear material behavior of panel. In nonlinear analysis, the load applied to a finite element model is divided into a series of load increments called load step. Here, the displacement is applied in 15 steps. At the completion of each displacement increment, the stiffness matrix of the model is adjusted to reflect the nonlinear changes in the structural stiffness before proceeding to the

next displacement increment. The problem is now defined and ready to be solved. All the panels are initially analyzed without providing cutouts

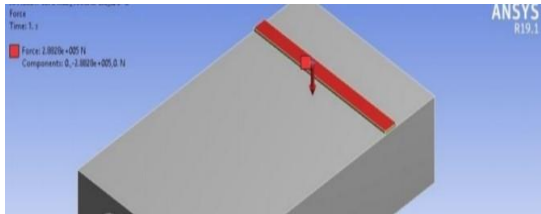


Fig 3: Loading and Boundary Conditions

Once the loading conditions are applied, deformation results are found out.

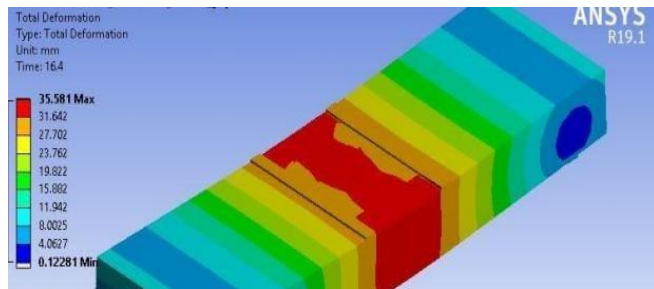


Fig 4: Deformation in panel without sawdust

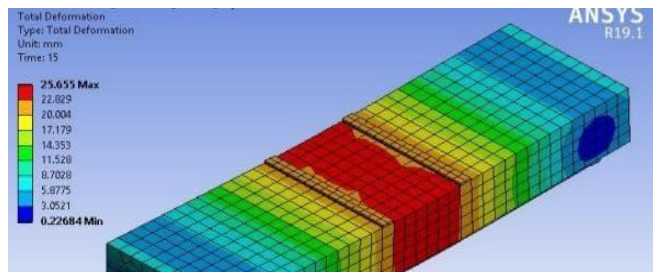


Fig 5: Deformation in 5% sawdust replaced panel

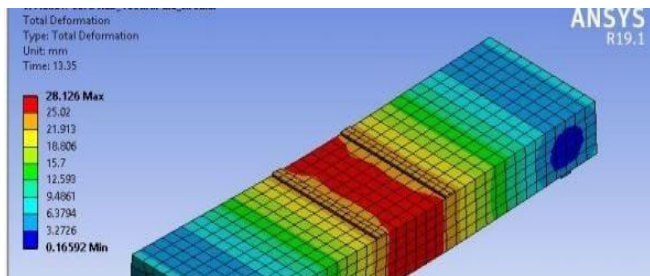


Fig 6: Deformation in 10% sawdust replaced panel

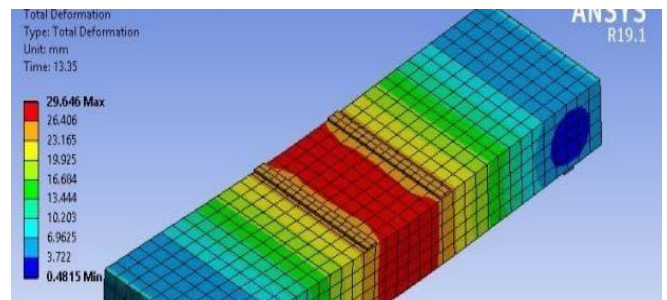


Fig 7: Deformation in 15% sawdust replaced panel

Now, all the panels are provided with cutouts and are analyzed.

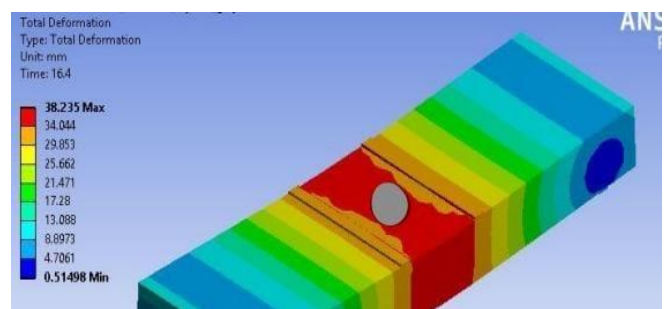


Fig 8: Deformation in panel without sawdust with circular cutting

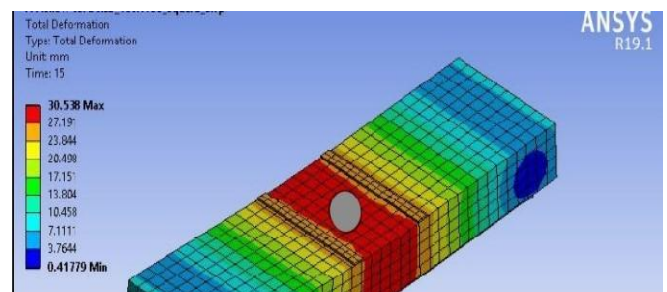


Fig 9: Deformation in 5% sawdust replaced panel with circular cutting

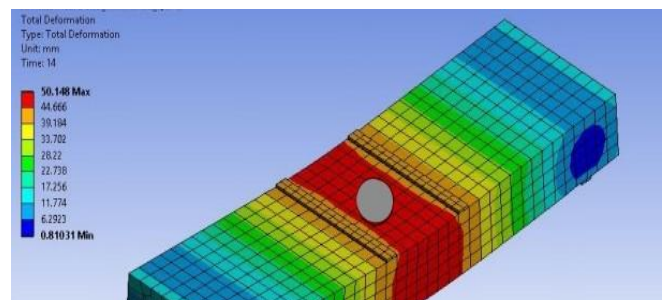


Fig 10: Deformation in 10% sawdust replaced panel with circular cutting

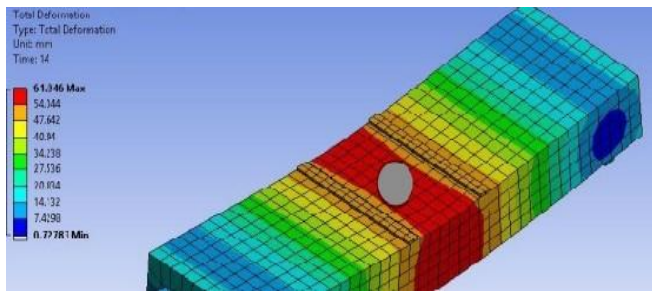


Fig 11: Deformation in 15% sawdust replaced panel with circular cutting

**5. RESULTS AND DISCUSSION**

PANELS	WITHOUT SAWDUST	5% SAWDUST	10% SAWDUST	15% SAWDUST
WITHOUT CUTOUT	35.581 mm	25.655 mm	28.126 mm	29.646 mm
WITH CUTOUT	38.235 mm	30.538 mm	50.148 mm	61.046 mm

Table 5: Deformation Values From ANSYS

**6. CONCLUSIONS**

When the panels without circular cutout were analyzed,

- Deformation of panel with no replacement is found to be 35.581 mm under axial load.
- Deformation of panel with 5% replacement of sawdust is found to be 25.655 mm under axial load.
- Deformation of panel with 10% replacement of sawdust is found to be 28.126 mm under axial load.
- Deformation of panel with 15% replacement of sawdust is found to be 29.646 mm under axial load.

When the panels with circular cutout were analyzed,

- Deformation of panel with no replacement is found to be 38.235 mm under axial load.
- Deformation of panel with 5% replacement of sawdust is found to be 30.538 mm under axial load.
- Deformation of panel with 10% replacement of sawdust is found to be 50.148 mm under axial load.
- Deformation of panel with 15% replacement of sawdust is found to be 61.046 mm under axial load.

From the deformation values obtained, panel with 5% replacement proved to have more load carrying capacity

**7. REFERENCES**

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