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# Buckling Analysis of different composite (Smart-PZT) beams by ABAQUS for aviation strength

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***Abstract*:** *In this modelling, design phenomena of smart beams are a crucial factor. By designing we have analyse buckling analysis of smart beam under different loads. In the recent past, some good works appeared in various journals and conferences proceeding on designing analysis of beams. In this project we do designing buckling analysis of smart beam and spatial displacement with different boundary condition*

***Keyword:*** **Buckling Analysis; Smart Material; Abaqus; Elemental Analysis**

## I. INTRODUCTION

A smart composite beam is a construction element typically consisting of a reinforced concreted slab attached to and supported by profiled steel beams. Composite beams are stronger than the sum of their constituent parts and exhibit favourable combination of the strength characteristics of both materials. This means steel and concrete composite beams will posses both the compressive strength of concrete and the tensile strength of steel. There are several other types of composite beams used in the construction industry which combine various grades of concrete with plastic composites and timber. The steel and reinforced concrete composite beam is, however, the most commonly used. But we use modern smart beams without steel and contains only the metal and their alloys. Here we are using the hybrid beam having composition (al-cu-al).

## LITERATURE SURVEY

Are views of the recent development of the finite element analysis for laminated composite plates from 1990 till date is presented by Zhang and Yang. The literature review is devoted to the recently developed finite element models based on the various laminated plate theories for the free vibration and dynamics, buckling and post buckling analysis, The geometric non linearity large deformation analysis, failure and damage analysis of composite laminated plates are also presented.

The present nine-node assumed strain shell element is implemented in the extended version of the FEAP (Zienkiewicz and Taylor, 1989 and Zienkiewicz and Taylor, 2000). In order to validate this present shell element, several numerical examples are solved to test the performance of the shell element in static analysis. Examples are anisotropic composite materials for the comparisons and further developments. Before proceeding with the following study, the influence of the finite element mesh is quantified

## WHY SMART?

Smart are formed by combining materials together to form an overall structure that is better than the individual components having uniform composition throughout its surface.

The biggest advantage of modern Smart materials is that they are light in weight as well as strong. By choosing an appropriate combination of matrix and reinforcement material, a new material can be made that exactly meets the requirements of a particular application. Smarts also provide design flexibility because many of them can be molded into complex shapes. The downside is often the cost. Although the resulting product is more efficient, the raw materials are

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often expensive.

## EQUATION USED

**The Potential Energy Approach**

The generalexpressionforthe potentialenergyis:

$$W_p = \frac{1}{2}\int_e \sigma^T \epsilon A\, dx - \int_i u^T f\, A\, dx - \int_i u^T T\, dx - \sum_i u_i p_i$$

**Assembly of the Global Stiffness Matrix and Load Vector**

We noted earlier that the total potential energy written in the form earlier can be written in the form

$$W_p = \frac{1}{2} Q^T K Q - Q^T F$$

**Element Stiffness Matrix**

Considerthe strain energyterm

$$-U_e = (1/2) \int \sigma^T \epsilon A\, dx$$

## APPLICATIONS

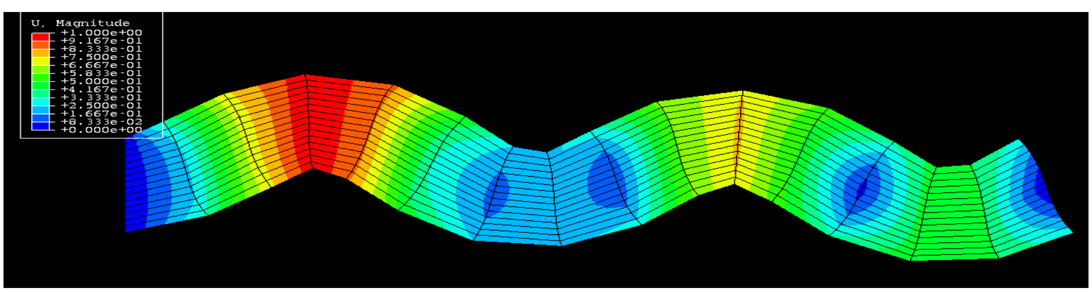
Smart Composite materials are generally used for buildings, bridges and structures such as boathulls, swimming pool panels, race car bodies, shower stalls, bathtubs, and storage tanks, imitation granite and cultured marble sinks and counter tops. The most advanced examples perform routinely on spacecraft in demanding environments.

## ABOUT ABAQUS

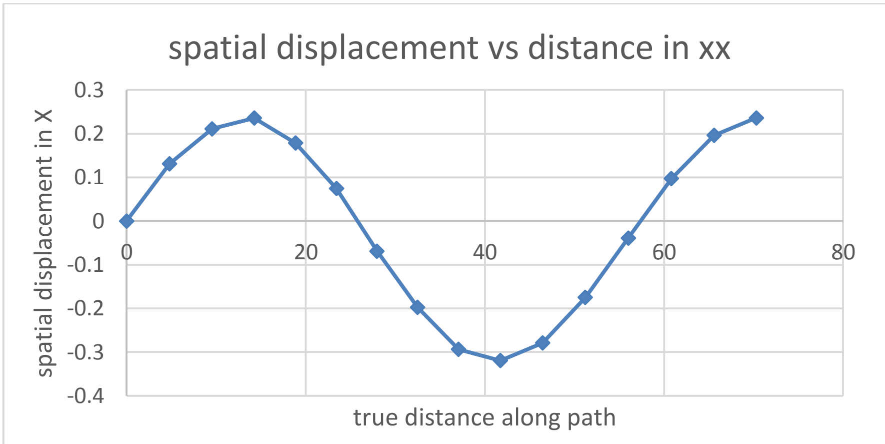
ABAQUS FEA (formerly ABAQUS) is a software suite for finite element analysis and computer-aided engineering, originally released in 1978. The name and logo of this software are based on the abacus calculation tool. Abaqus/CAE is capable of pre-processing, post-processing, and monitoring the processing stage of the solver; however, the first stage can also be done by other compatible CAD software, or even a text editor. Abaqus/Standard, Abaqus/Explicit or Abaqus/CFD are capable of accomplishing the processing stage. Dassault Systems also produces *Abaqus for CATIA* for adding advanced processing and post processing stages to a pre-processor like CATIA.

## RESULTS

| |
|---|
| **ALUMINIUM** |
| **COPPER** |
| **ALUMINIUM** |




**BUCKLING OF SMART BEAM**


spatial displacement vs distance in xx
spatial displacement in X
true distance along path
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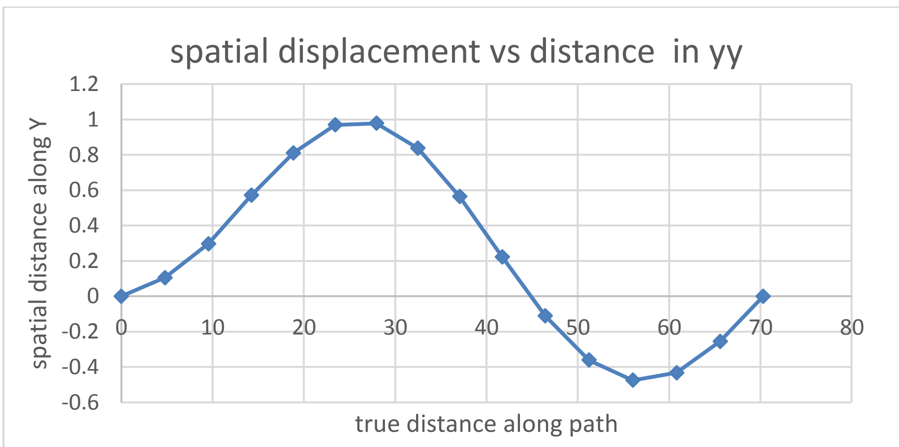
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
0
20
40
60
80


spatial displacement vs distance in yy
spatial distance along Y
true distance along path
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1
0.8
0.6
0.4
0.2
0
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-0.6
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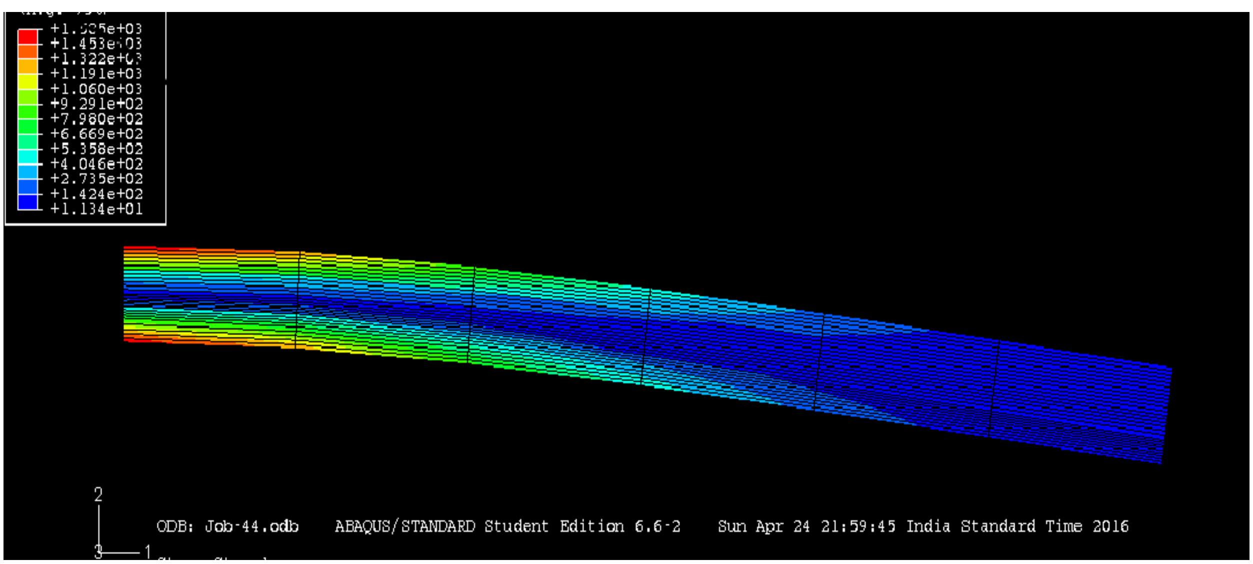
50
60
70
80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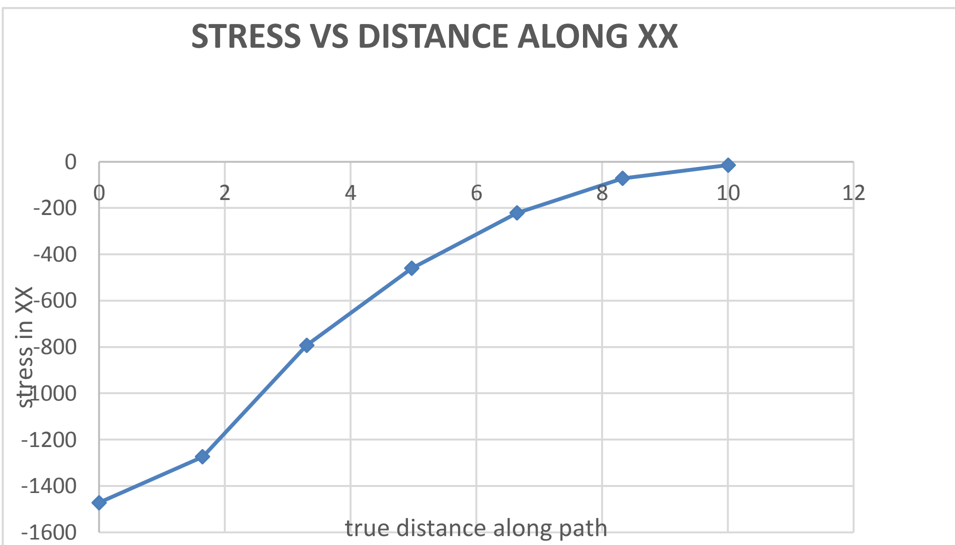
+1.060e+03
+9.291e+02
+7.980e+02
+6.669e+02
+5.358e+02
+4.046e+02
+2.735e+02
+1.424e+02
+1.134e+01
2
3
1
ODB: Job-44.odb ABAQUS/STANDARD Student Edition 6.6-2 Sun Apr 24 21:59:45 India Standard Time 2016

**DEFLECTION OF CANTILIVER COMPOSITE BEAM**

| Beam Deflection | Stress Component $\sigma_{xx}$ | Stress Component $\sigma_{yy}$ | Stress Component $\tau_{xy}$ | Strain Component $\epsilon_{xx}$ | Strain Component $\epsilon_{yy}$ | Strain Component $\gamma_{xy}$ |
|---|---|---|---|---|---|---|
| +5.589e+03 | +4.166e+03 | +2.723e+02 | -1.749e-09 | +5.870e-08 | +2.616e-08 | +4.390e-09 |
| +5.123e+03 | +3.349e+03 | +2.353e+02 | -1.718e+01 | +4.713e-08 | +2.236e-08 | +2.659e-09 |
| +4.657e+03 | +2.531e+03 | +1.982e+02 | -3.435e+01 | +3.556e-08 | +1.857e-08 | +1.001e-09 |
| +4.191e+03 | +1.713e+03 | +1.611e+02 | -5.153e+01 | +2.399e-08 | +1.477e-08 | +6.935e-10 |
| +3.749e+03 | +8.952e+02 | +1.240e+02 | -6.870e+01 | +1.242e-08 | +1.098e-08 | -2.387e-09 |




## CONCLUSION

In this paper we have analyzed in the hybrid beam stress concentration at various distance. So we finally comes out with various data showing the beam behaviour under different loading and boundary conditions. After this analysis we are able to do stress analysis of any beam with different loading conditions.

In this project we applied different boundary conditions on beams and we get different stress value at different node. We get different stress intensity at different node by applying point load on the beams. We done analysis on two hybrid beams one having composition al-cu-al and we applied different conditions i.e. cantilever, simply

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supported, clamped and on analysis we get results that on how particular beam the distribution of stress occur.And now with this analysis we have different results of different beams and any combination can be used according to its application and be easy to choose the beam as it shows stress intensity at different point. We done analysis on hybrid beams because, the biggest advantage of modern hybrid materials is that they are light in weight as well as strong. By choosing an appropriate combination of matrix and reinforcement material, a new material can be made that exactly meets the requirements of a particular application. In this paper we applied mechanical force on the beams and we analyze deflection of the beam at different condition.

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