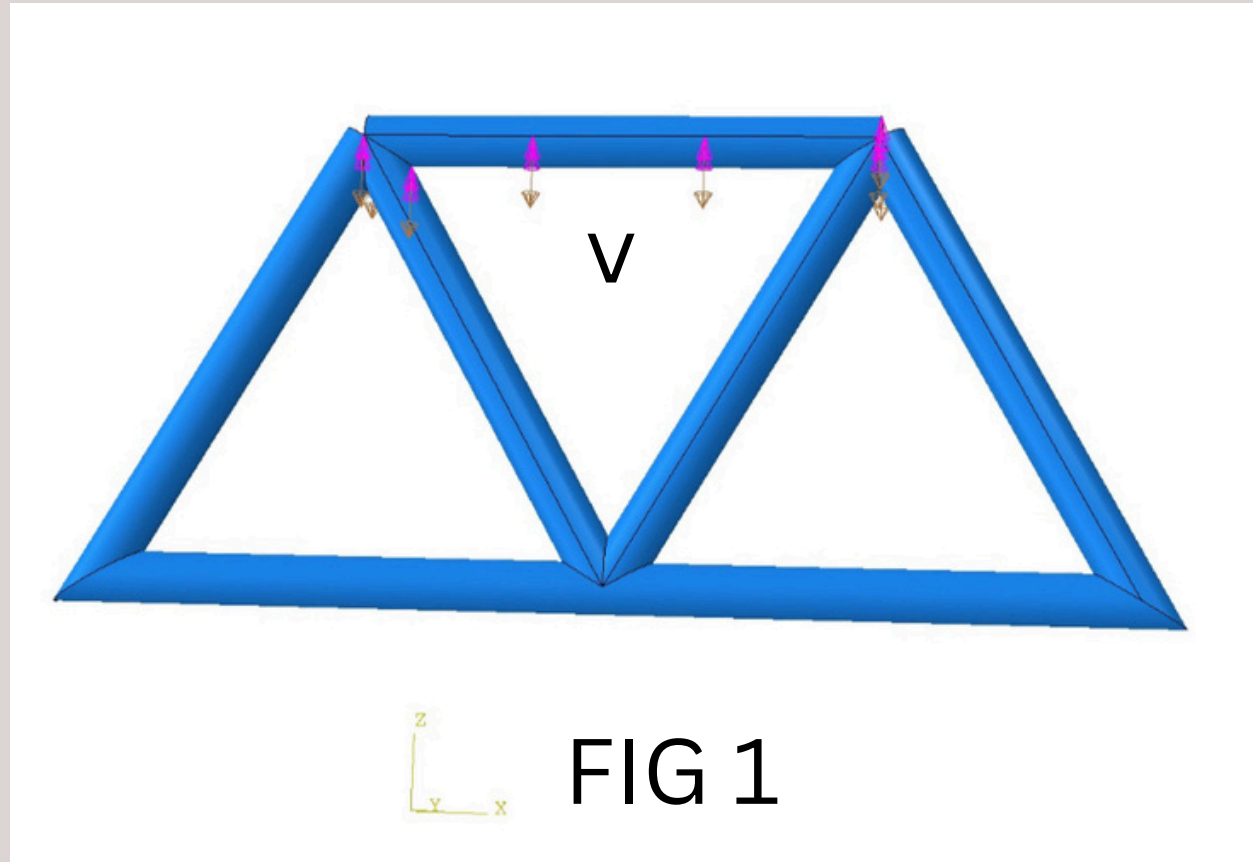


# Solid Beam Analysis

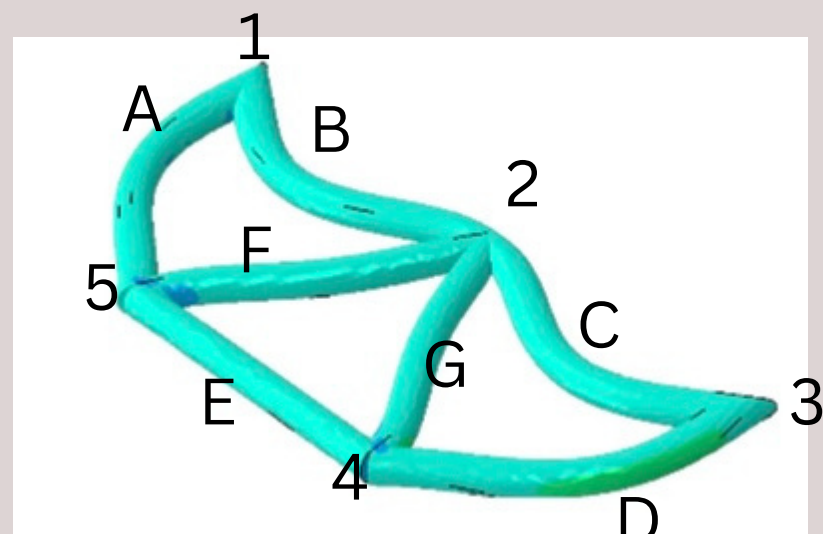
## Problem 1:



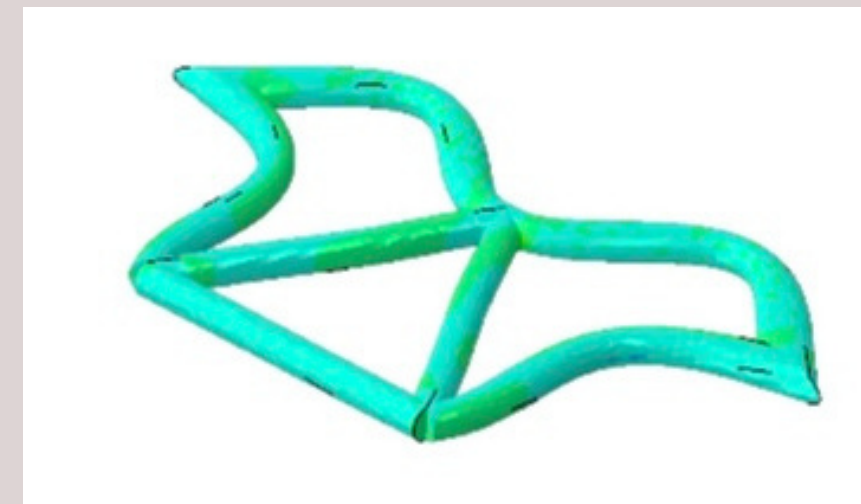
Length of each cylindrical rod = 50m  
Radius of each cylinder = 5m  
young's modulus of material used = 200GPa  
Poisson's ratio = 0.3

Case 1: ( $V = 500\text{m/s}$ )

Observation: ( Deformation modes)



Mode -1



Mode -2

Mode 1 occurs at  $t = 0.1\text{s}$ ,  $0.2767\text{s}$ ,  $0.4221\text{s}$ ,  $0.6358\text{s}$ ,  $0.8\text{s}$  in a time gap from  $0\text{s}$  to  $1\text{s}$ .

Mode 2 occurs at  $t = 0.19\text{s}$ ,  $0.3779\text{s}$ ,  $0.5368\text{s}$ ,  $0.7\text{s}$ ,  $1.0\text{s}$  in a time gap from  $0\text{s}$  to  $1\text{s}$ .

### **At $t = 0.1\text{s}$ :**

S11 is maximum at point 2 and has a value of  $4.037\text{e}+10\text{ Pa}$

S22 is maximum at points 4,5 and has a value of  $1.633\text{e}+10\text{Pa}$

S33 is maximum at rod G and has a value of  $6.470\text{e}+09\text{Pa}$

### **At $t=0.19\text{s}$ :**

S11 is maximum at point 2 and has a value of  $3.83\text{e}+10\text{Pa}$

S22 is maximum at point 2 and has a value of  $1.79\text{e}+10\text{Pa}$

S33 is maximum at pint 2 and at mid region of rods A and D and has a value of  $3.78\text{e}+10\text{ Pa}$

### **At $t = 0.2767\text{s}$ :**

S11 is maximum at the mid region of rods B and C and at point 2 and has a value of  $5.6167\text{e}+10\text{ Pa}$

S22 is maximum at points 4,5 and has a value of  $2.2\text{e}+10\text{ Pa}$

S33 is maximum at points 4,5 and at rod G,A and has a value of  $3.397\text{e}+10\text{ Pa}$

### **At $t = 0.3779\text{s}$ :**

S11 is maximum at point 2 and rod B,C and has a value of  $1.912\text{e}+10\text{ Pa}$

S22 is maximum at points 2,4,5 and has a value of  $1.09\text{e}+10\text{Pa}$

S33 is maximum at point 2 and has a value Of  $2.598\text{e}+10\text{ Pa}$

### **At $t = 0.4221\text{s}$ :**

S11 is maximum at pooint 2 and at mid region of rod B,C and has a value of  $5.17\text{e}+10\text{ Pa}$

S22 is maximum at points 4,5 and has a value of  $2.026\text{e}+10\text{ Pa}$

S33 is maximum at points 4,5 and at rod G,A and has a value of  $2.578\text{e}+10\text{ Pa}$

### **At $t = 0.5368s$ :**

S11 is maximum at points 2,4,5 and at rod B,C,A,D and has a value of  $1.751e+10Pa$

S22 is almost uniform for entire boy and has a value of  $2.78e+10 Pa$

S33 is maximum at points 4,5 and has a value of  $1.272e+10 Pa$

### **At $t = 0.6358s$ :**

S11 is maximum at point 2 and at mid region of rods B,C and has a value of  $3.596e+10 Pa$

S22 is maximum at points 4,5 and has a value of  $5.549e+09 Pa$

S33 is maximum at rod G,A and has a value of  $1.674e+10 Pa$

### **At $t = 0.7s$ :**

S11 is maximum at point 2 and mid region of rod B,C and has a value of  $7.37e+10 Pa$

S22 is maximum at point 2 and has a value of  $2.384e+10 Pa$

S33 is maximum at point 2 and has a value of  $5.318e+10 Pa$

### **At $t = 0.8s$ :**

S11 is maximum at point 2 and mid region of rod B,C and has a value of  $3.260e+10 Pa$

S22 is maximum at points 4,5 and has a value of  $8.245e+10 Pa$

S33 is maximum at rod G,A and point 2 and has a value of  $7.809e+10 Pa$

### **At $t = 1.0s$ :**

S11 is maximum at points 2,4,5 and has a value of  $2.616e+10 Pa$

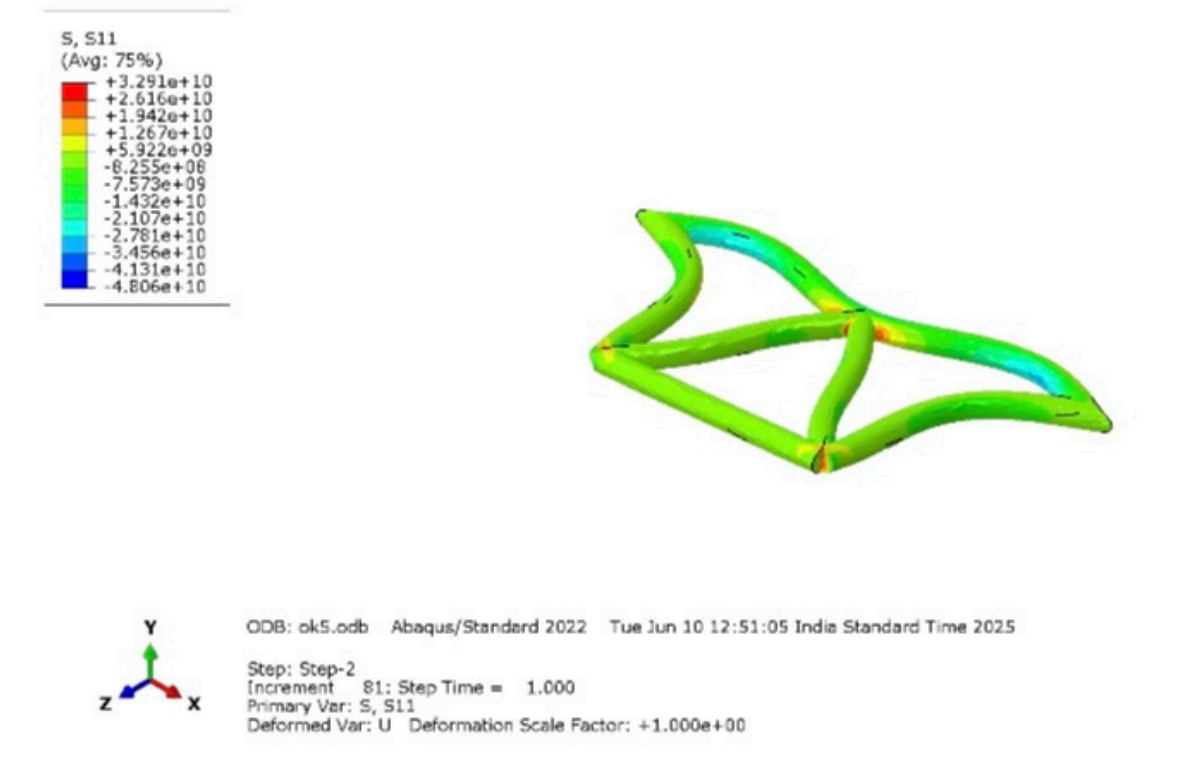
S22 is maximum at point 2 and has a value of  $1.028e+10 Pa$

S33 is maximum at points 4,5 and has a value of  $2.960e+10 Pa$

**The areas where the axial stresses are high are more prone to fracture.**

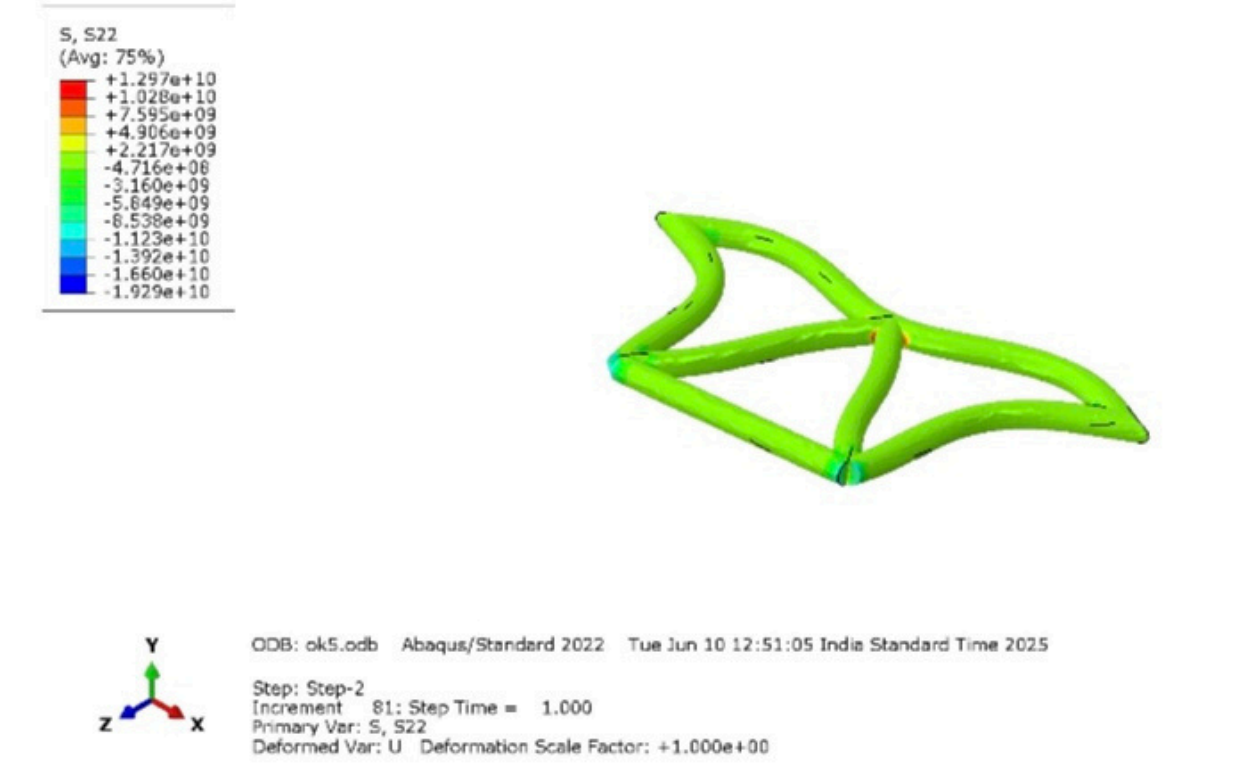


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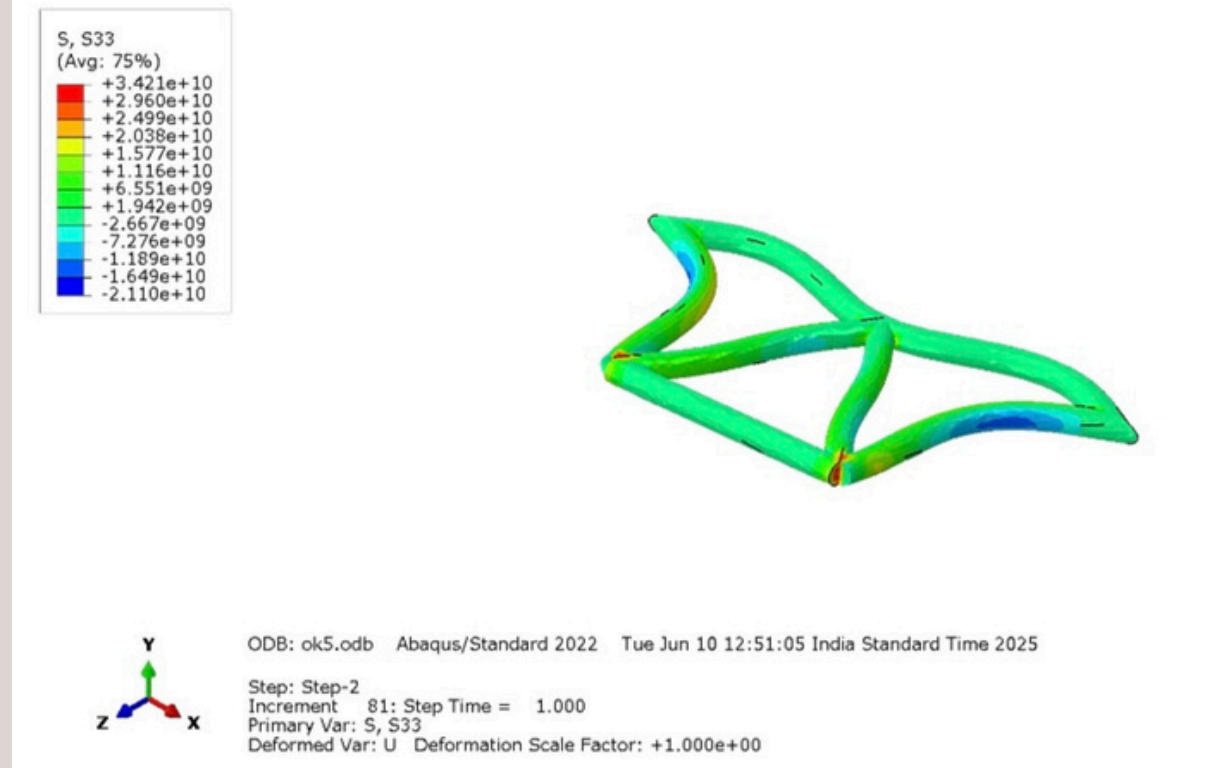
S11

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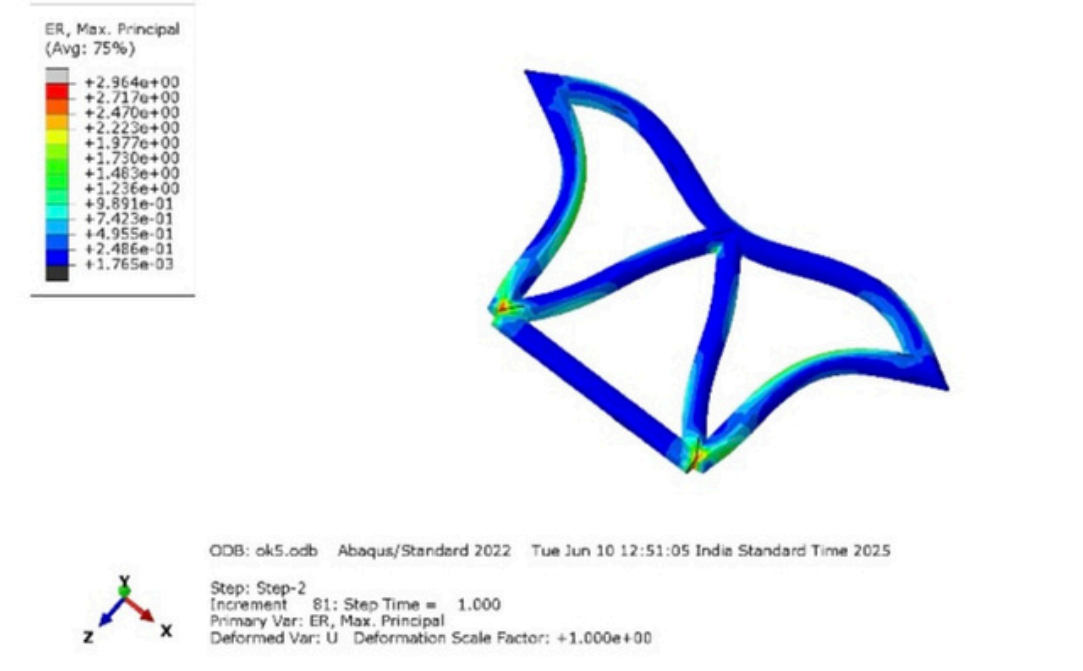
S22

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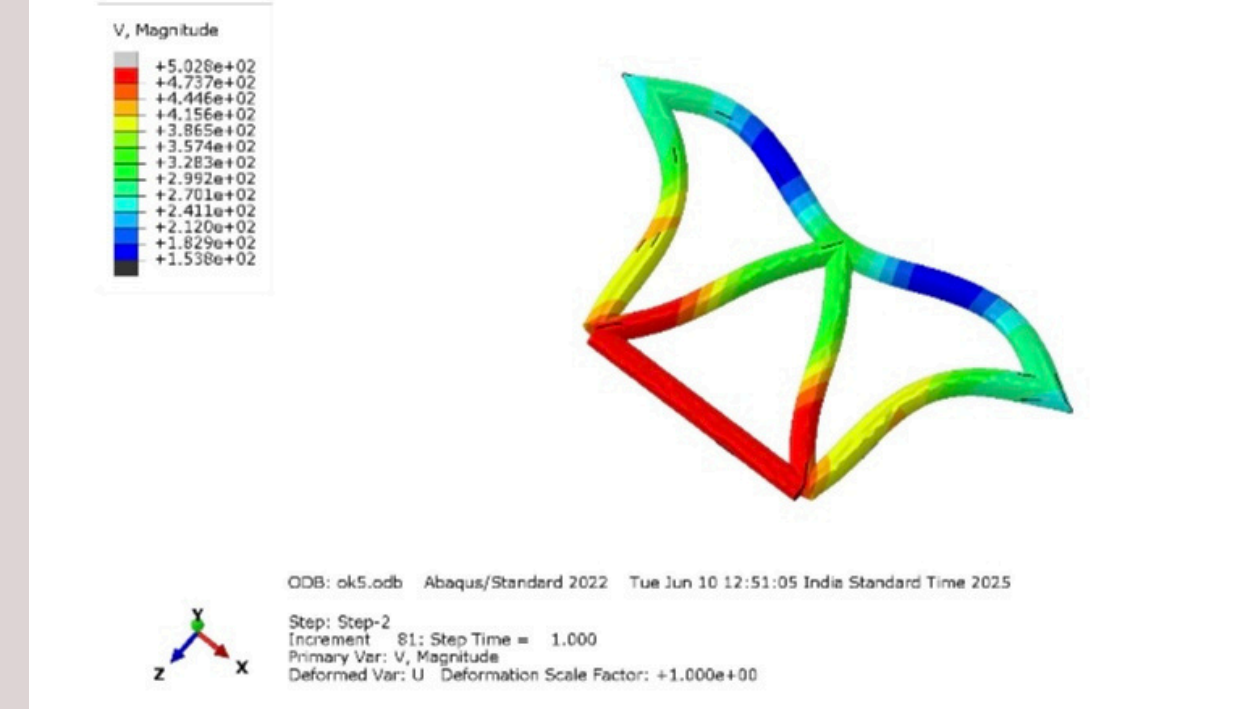
S33

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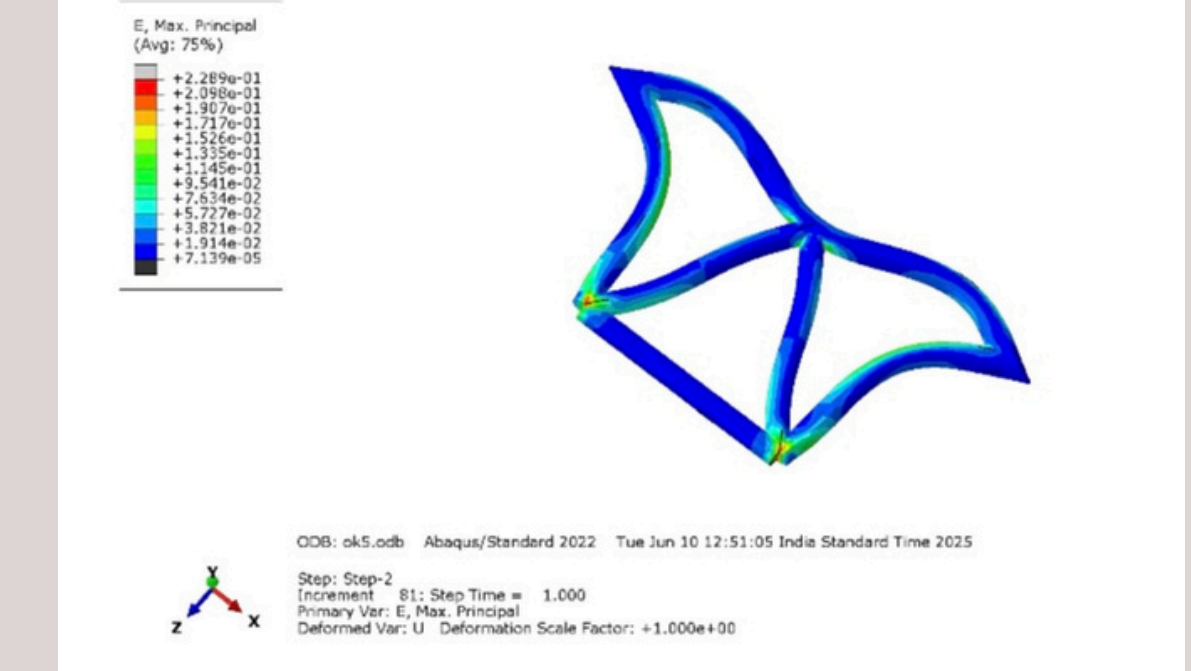
Strain rate

Printed using Abaqus/CAE on: Wed Jun 11 17:42:25 India Standard Time 2025



velocity

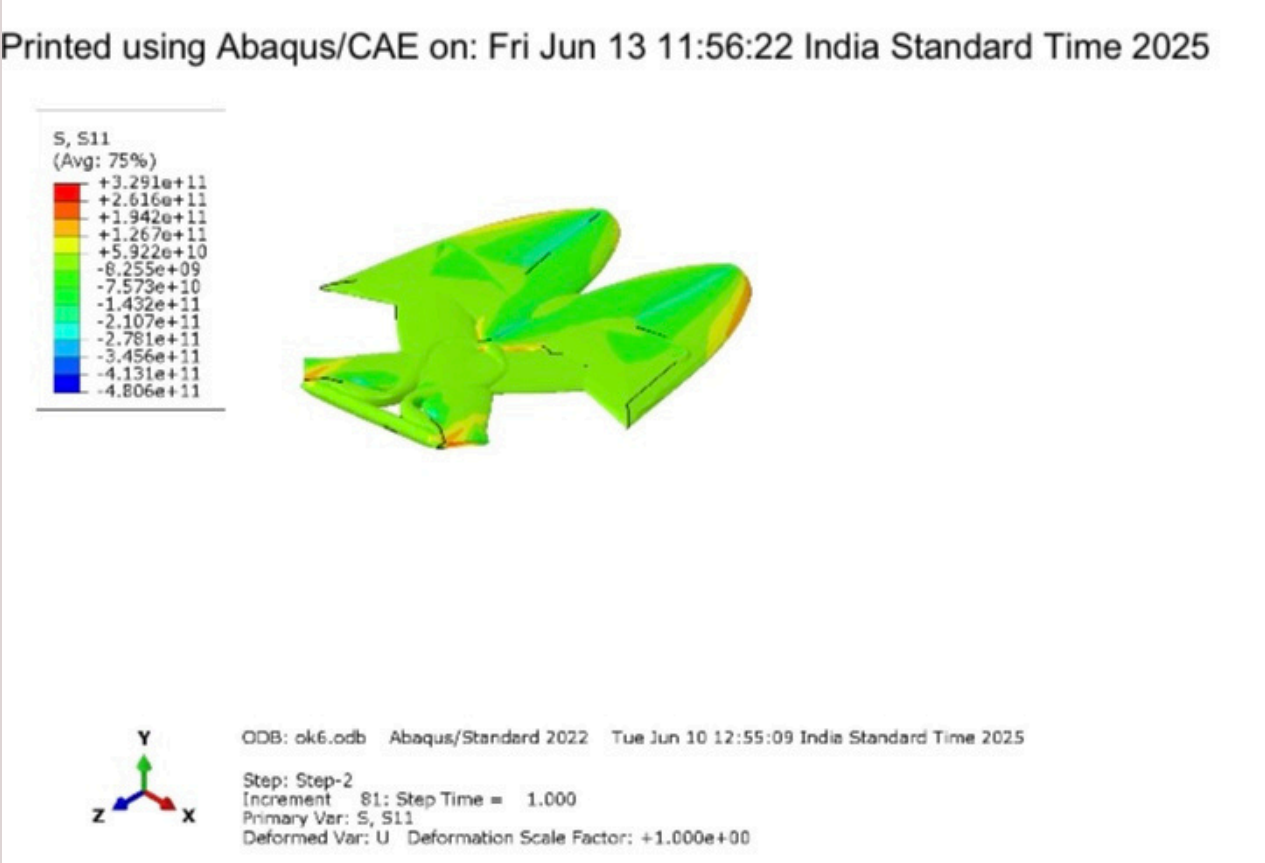
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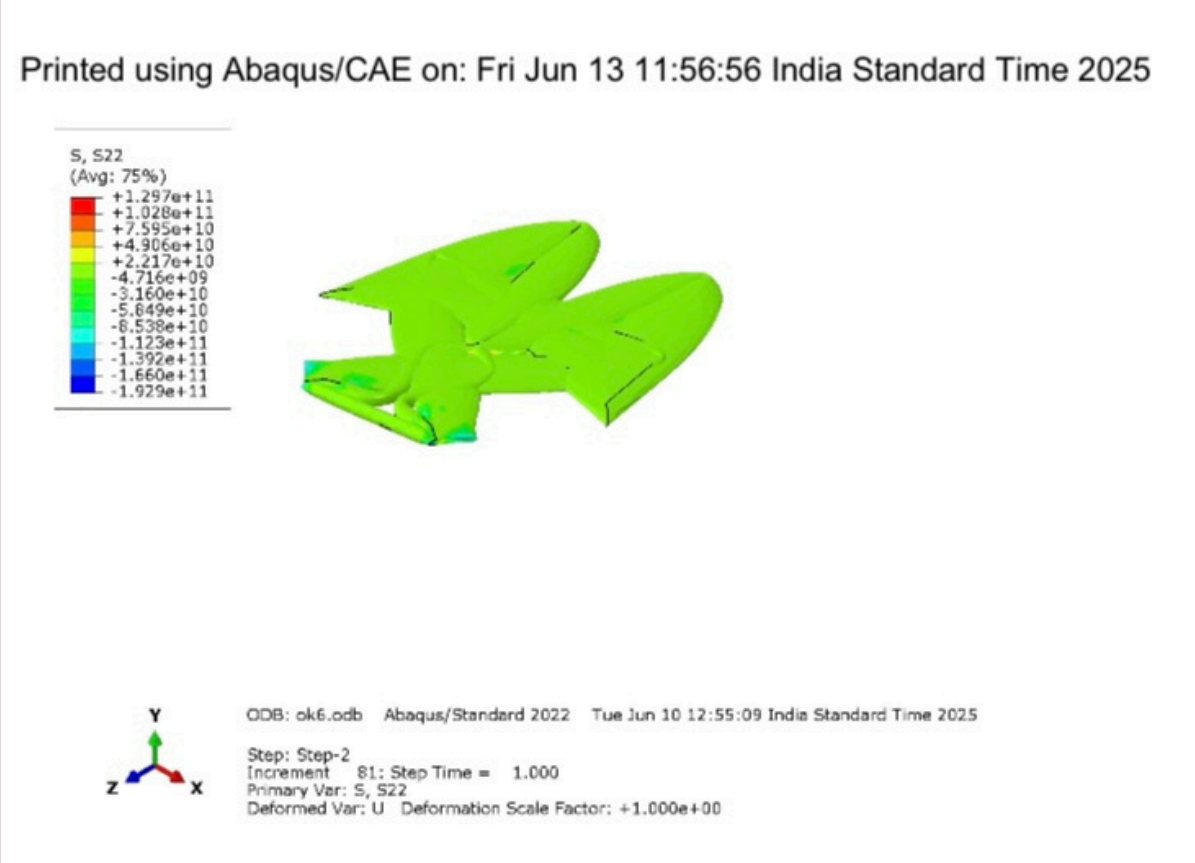
Strain

# Case 2: ( V = 5000m/s)

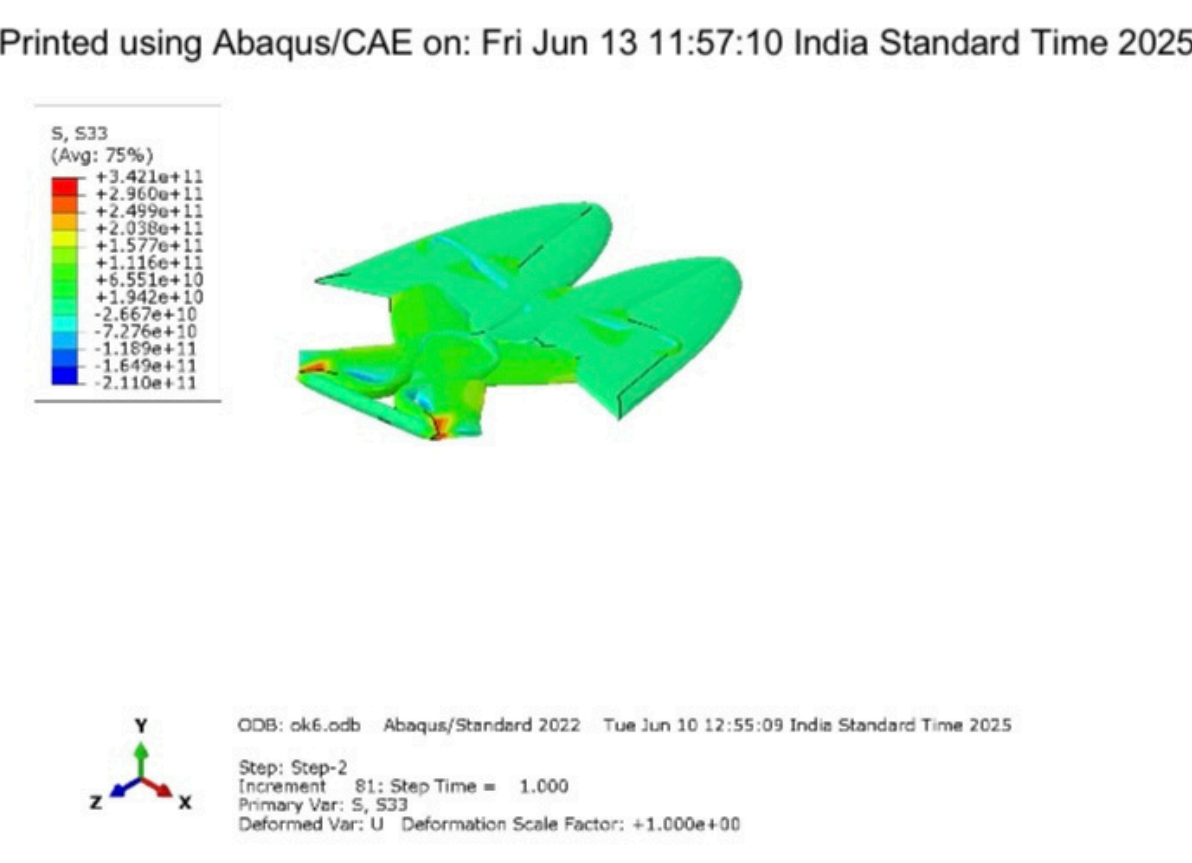
No deformation nodes observed



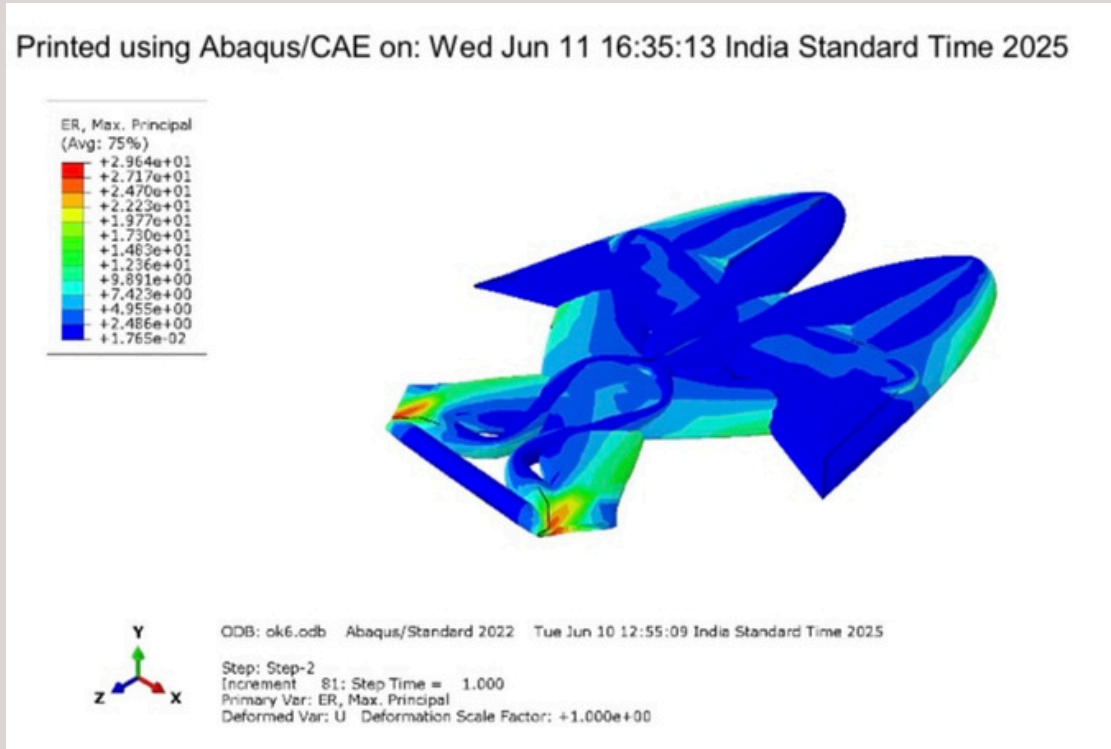
S11



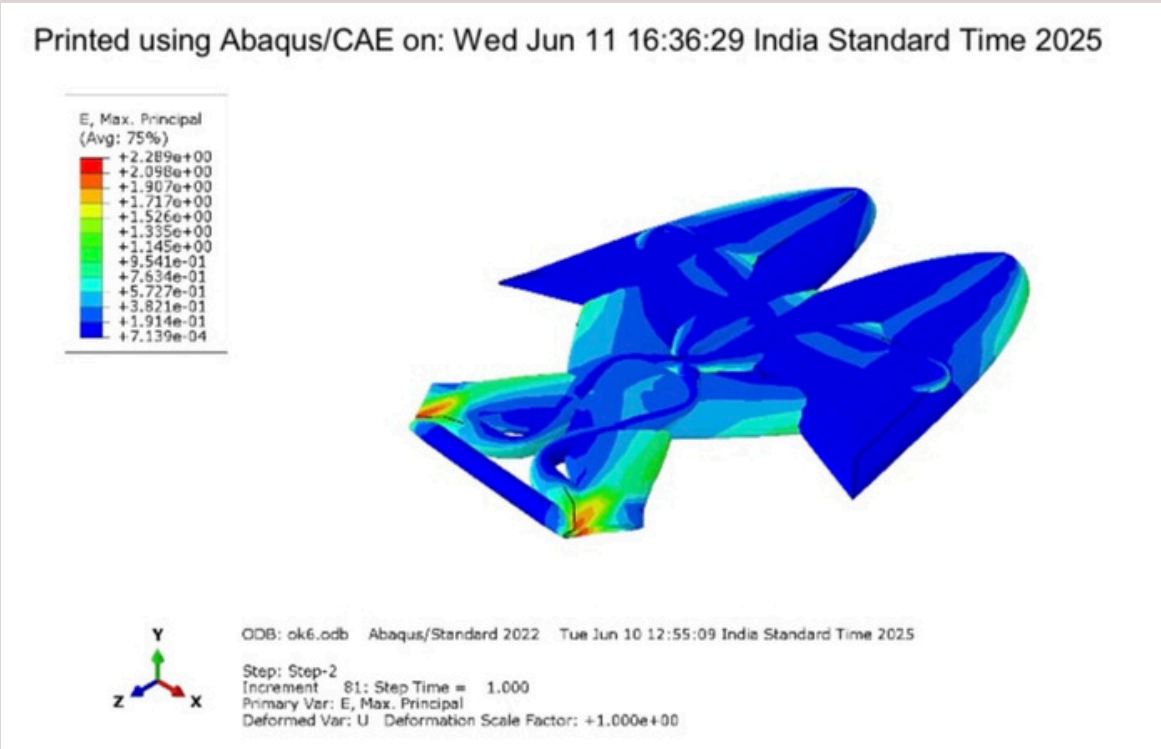
S22



S33



Strain Rate



Stress



## Problem 2:

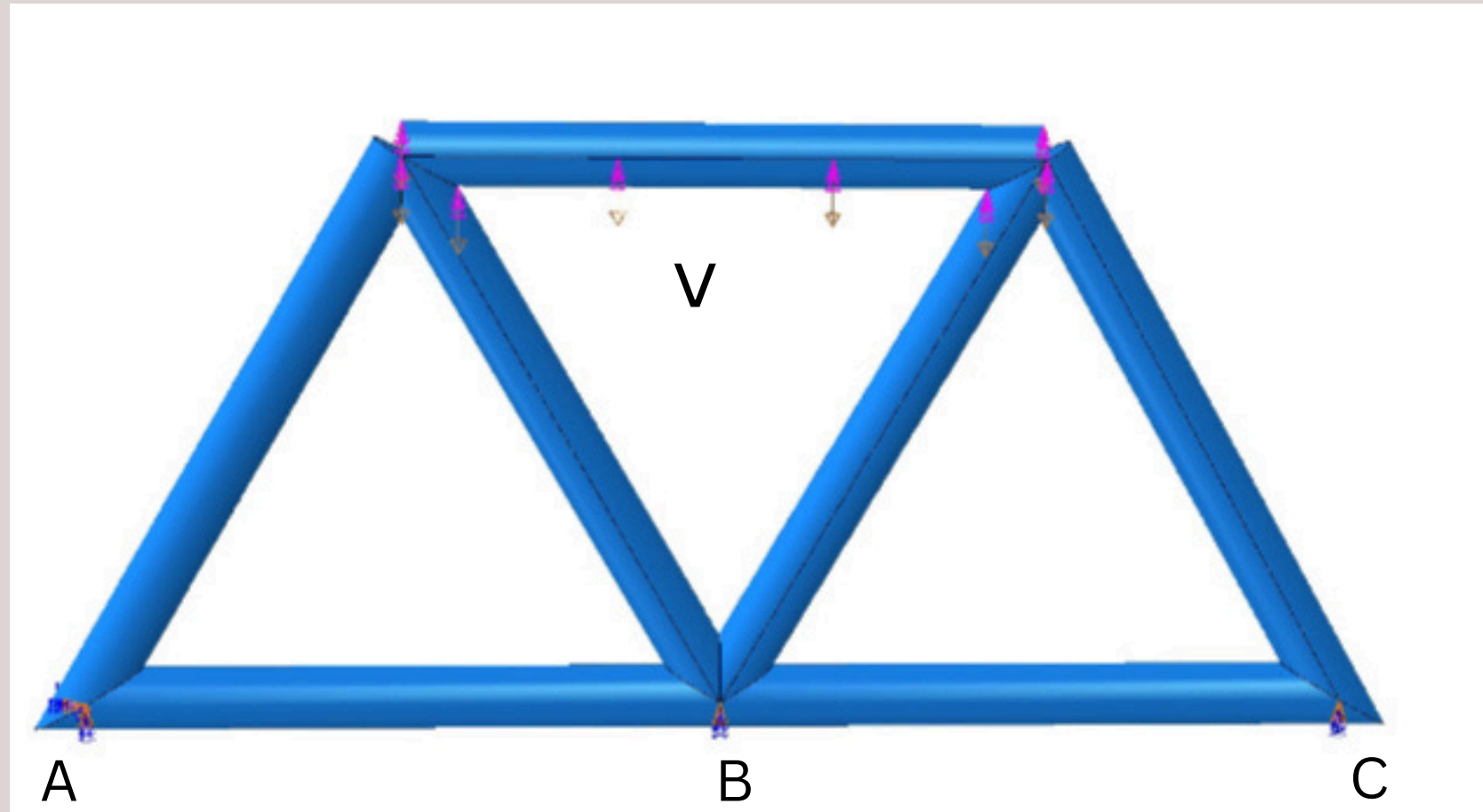


FIG2

Here A is a fixed joint and B,C are rolling joints

Length of each cylindrical rod= 50m

Radius of each cylinder = 5m

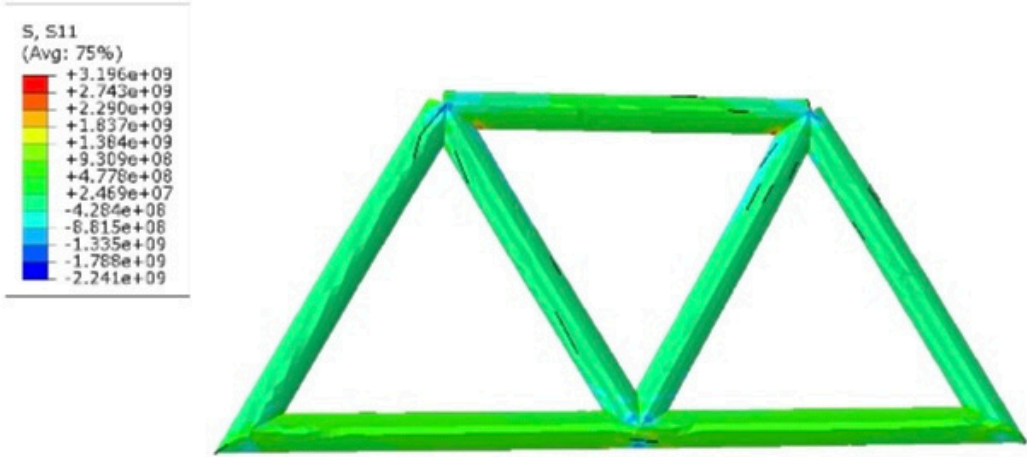
young's modulus of material used = 200GPa

Poisson's ratio = 0.3

# Case 1 :(V= 0.5 m/s)

No deformation modes observed

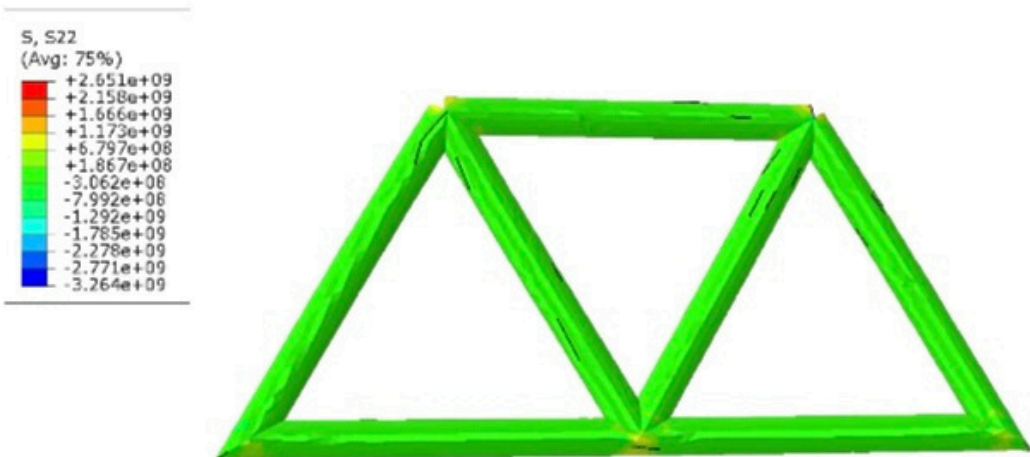
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ODB: case3.odb Abaqus/Explicit 2022 Tue Jun 10 17:22:29 India Standard Time 2025  
Step: Step-1  
Increment 33165: Step Time = 1.000  
Primary Var: S, S11  
Deformed Var: U Deformation Scale Factor: +1.000e+00

S11

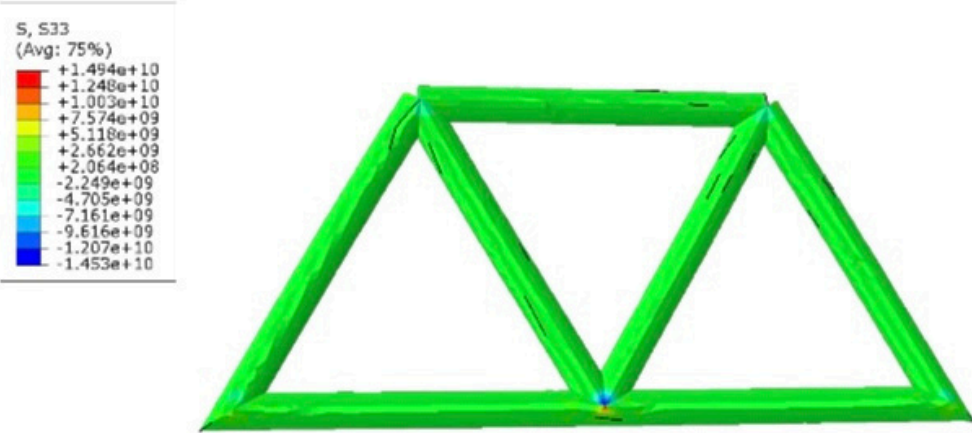
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ODB: case3.odb Abaqus/Explicit 2022 Tue Jun 10 17:22:29 India Standard Time 2025  
Step: Step-1  
Increment 33165: Step Time = 1.000  
Primary Var: S, S22  
Deformed Var: U Deformation Scale Factor: +1.000e+00

S22

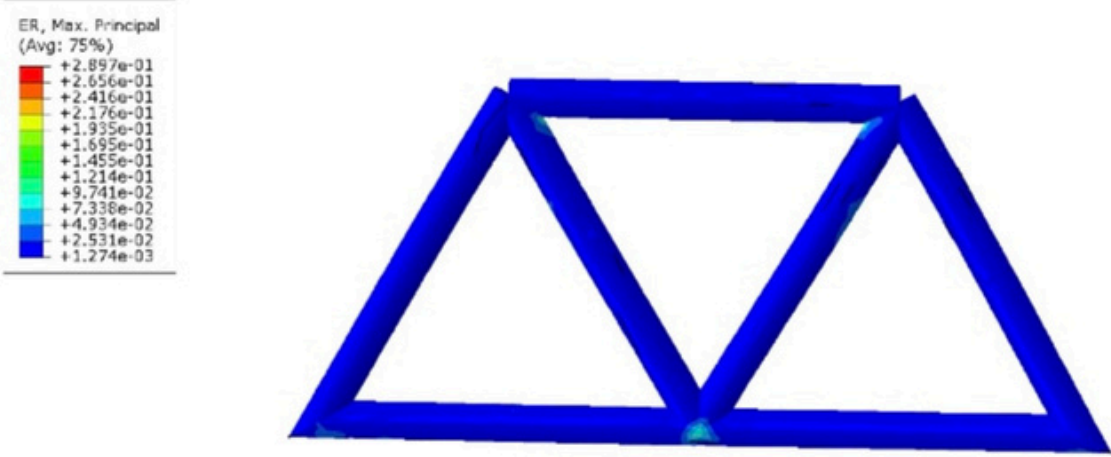
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Step: Step-1  
Increment 33165: Step Time = 1.000  
Primary Var: S, S33  
Deformed Var: U Deformation Scale Factor: +1.000e+00

S33

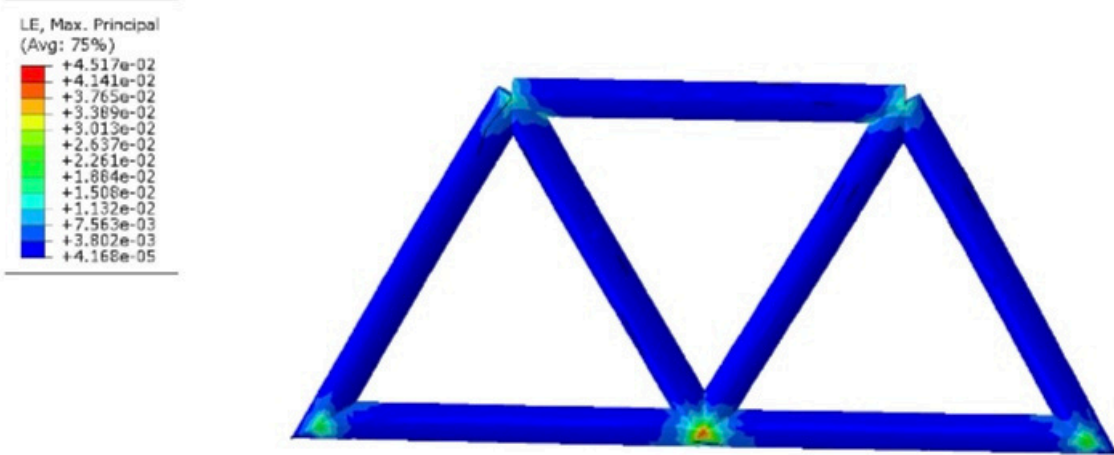
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ODB: case3.odb Abaqus/Explicit 2022 Tue Jun 10 17:22:29 India Standard Time 2025  
Step: Step-1  
Increment 33165: Step Time = 1.000  
Primary Var: ER, Max. Principal  
Deformed Var: U Deformation Scale Factor: +1.000e+00

Strain rate

Printed using Abaqus/CAE on: Wed Jun 11 16:15:35 India Standard Time 2025



ODB: case3.odb Abaqus/Explicit 2022 Tue Jun 10 17:22:29 India Standard Time 2025  
Step: Step-1  
Increment 33165: Step Time = 1.000  
Primary Var: LE, Max. Principal  
Deformed Var: U Deformation Scale Factor: +1.000e+00

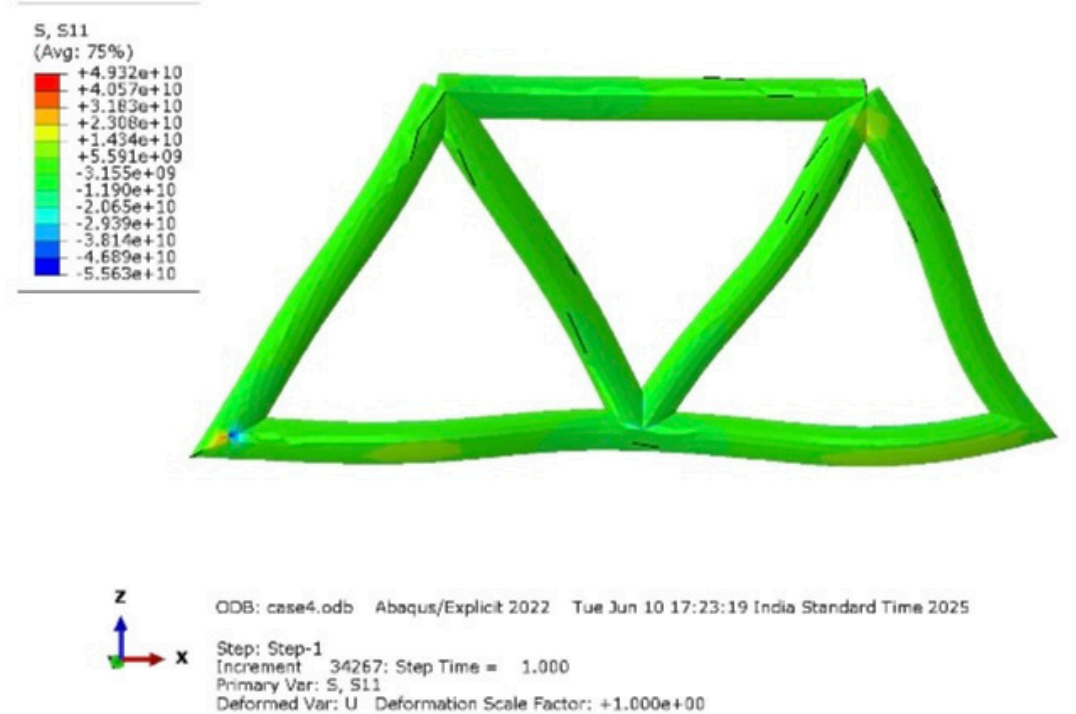
Logarithmic strain



# Case 2: ( V = 5m/s)

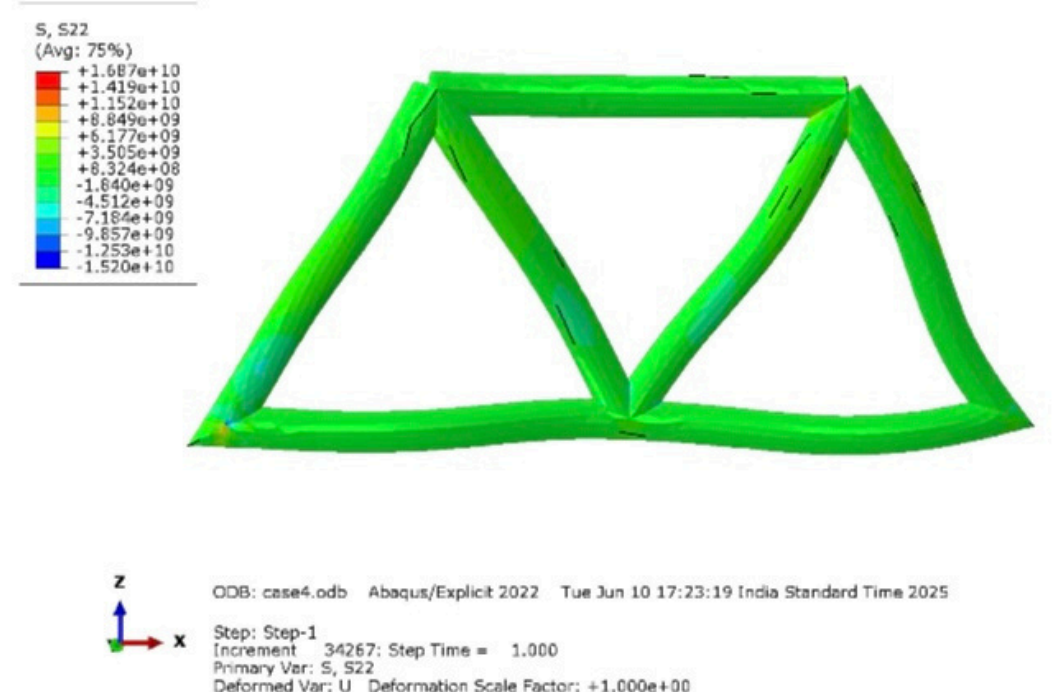
No deformation modes observed

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S11

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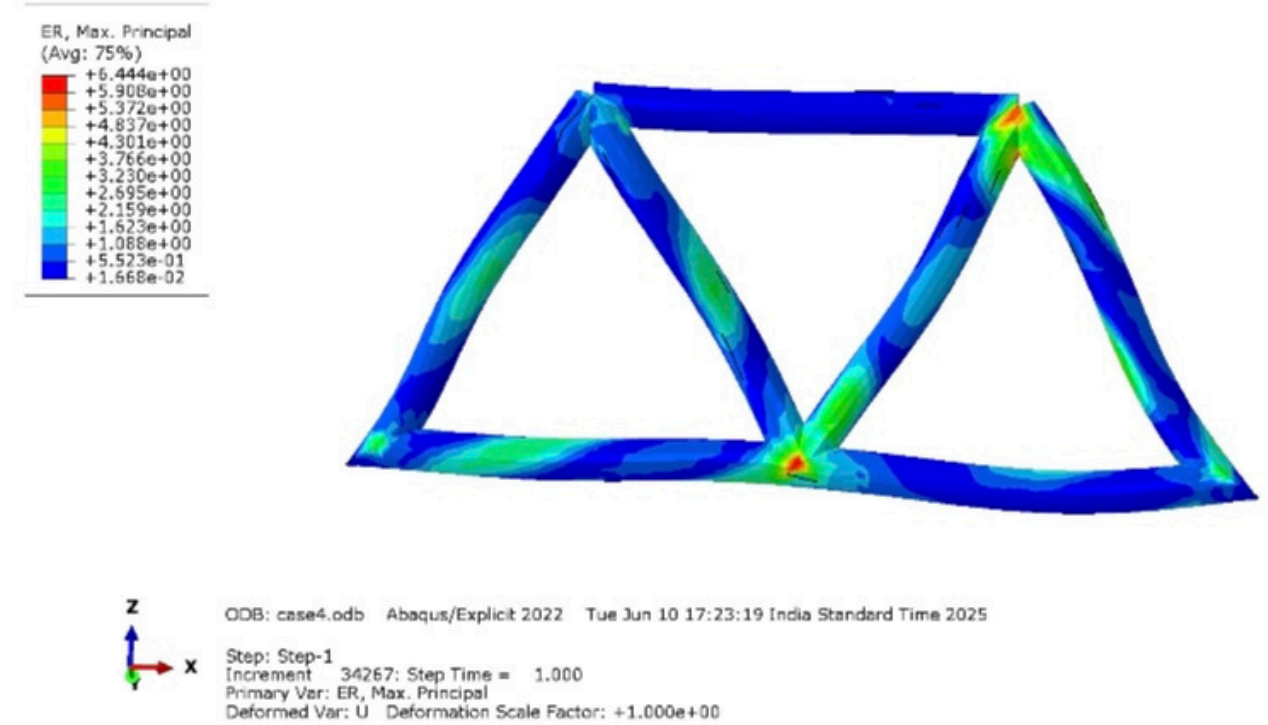
S22

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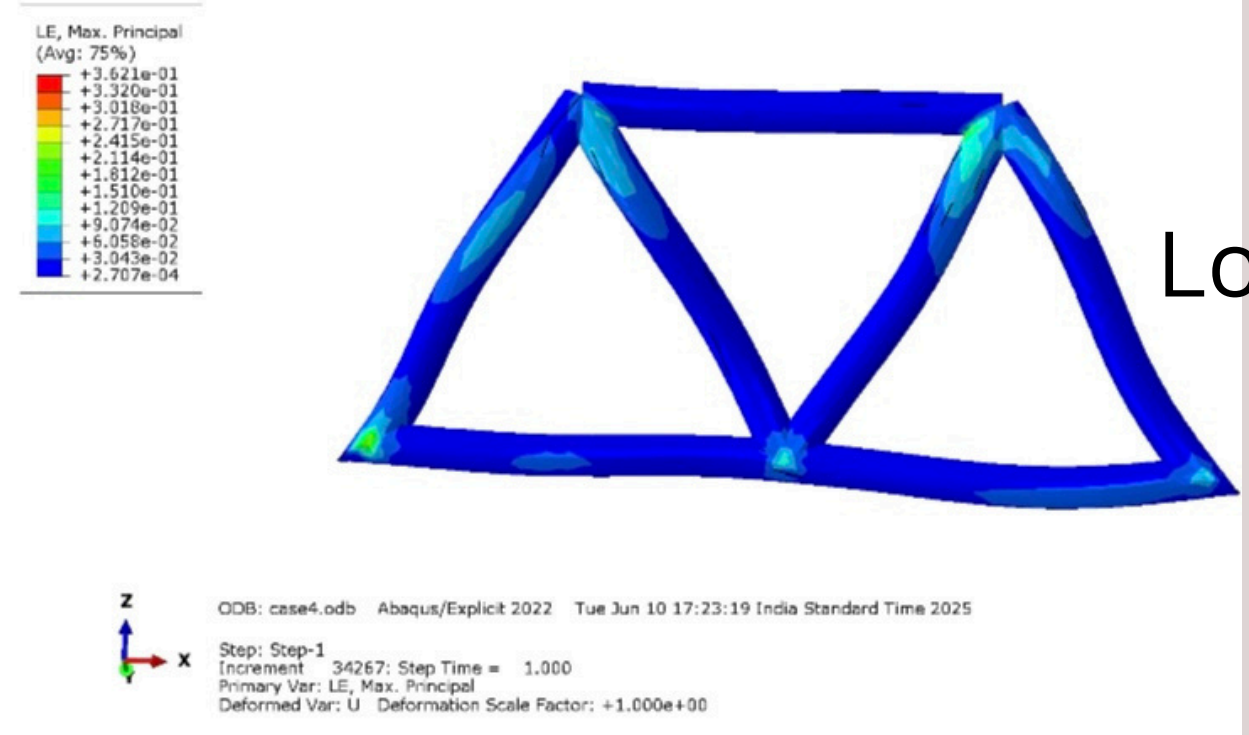
S33

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Strain rate

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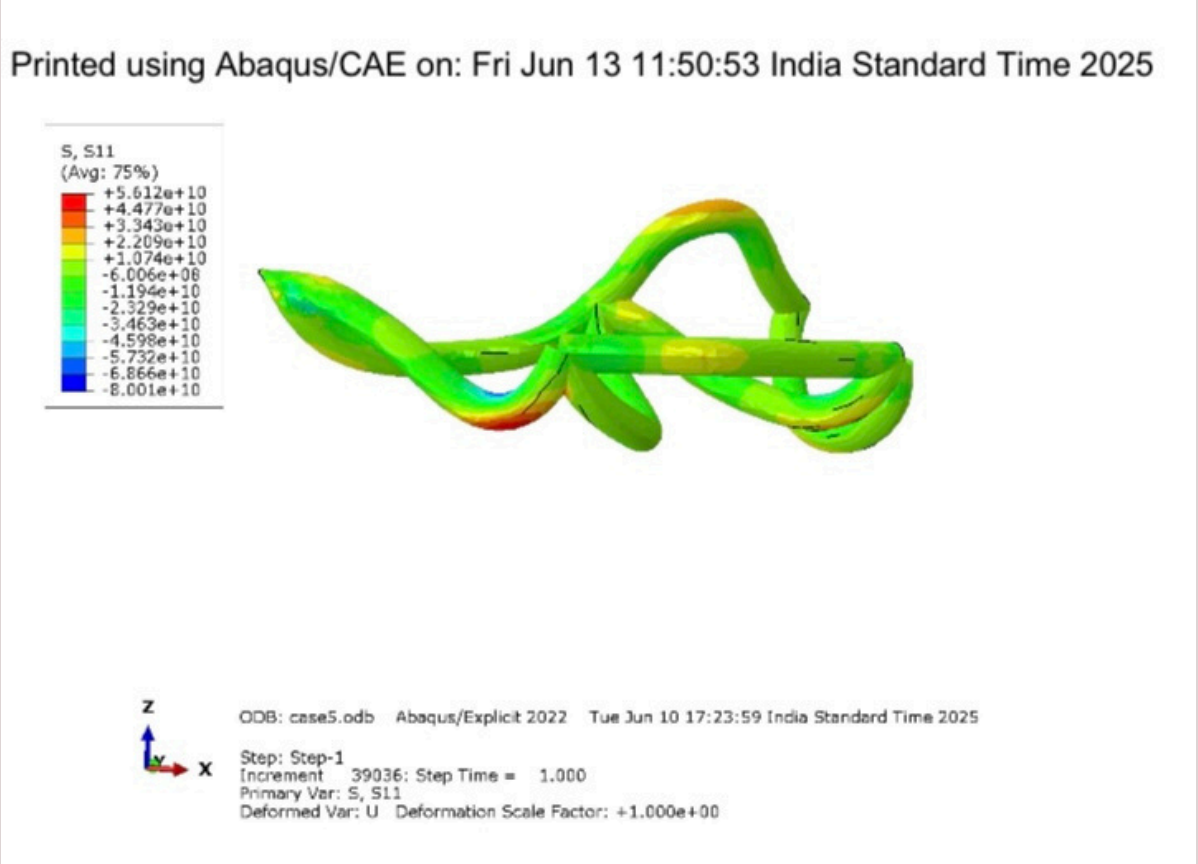


Logarithmic strain

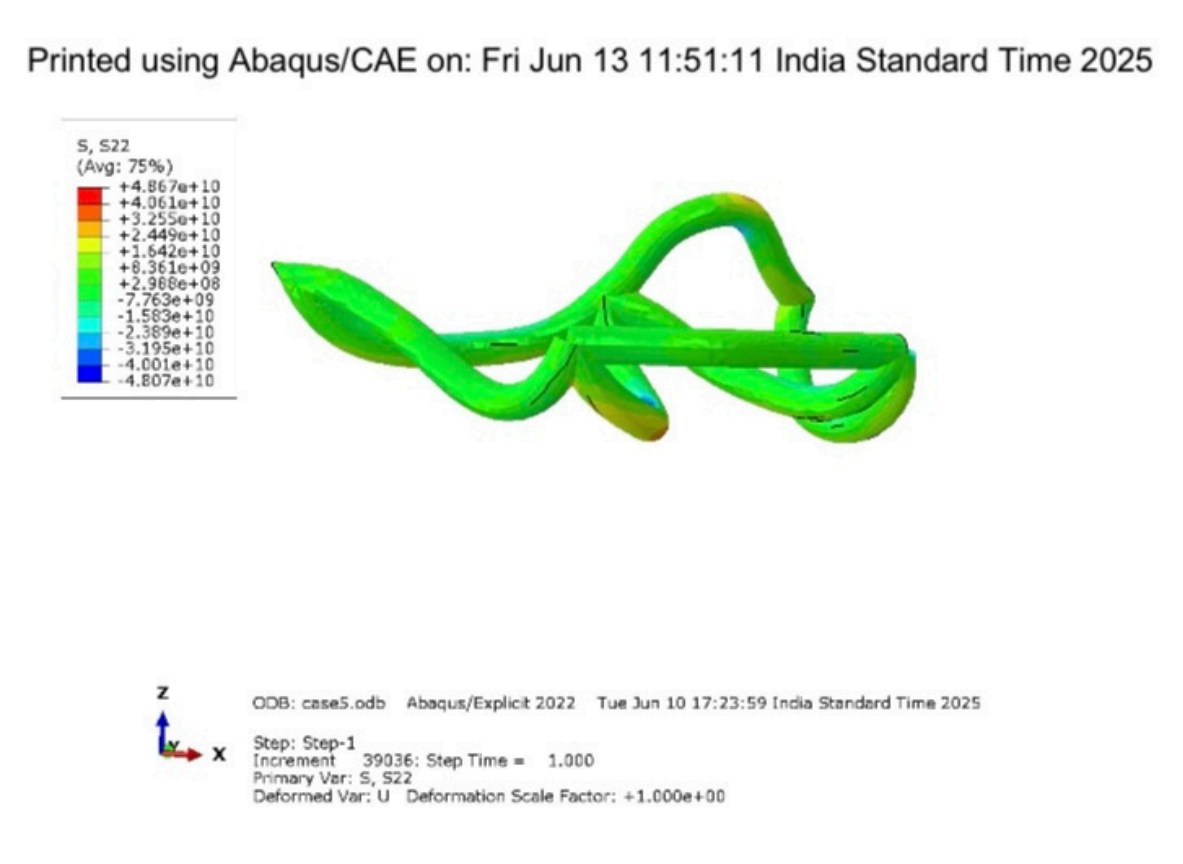


# Case 3: (V = 50m/s)

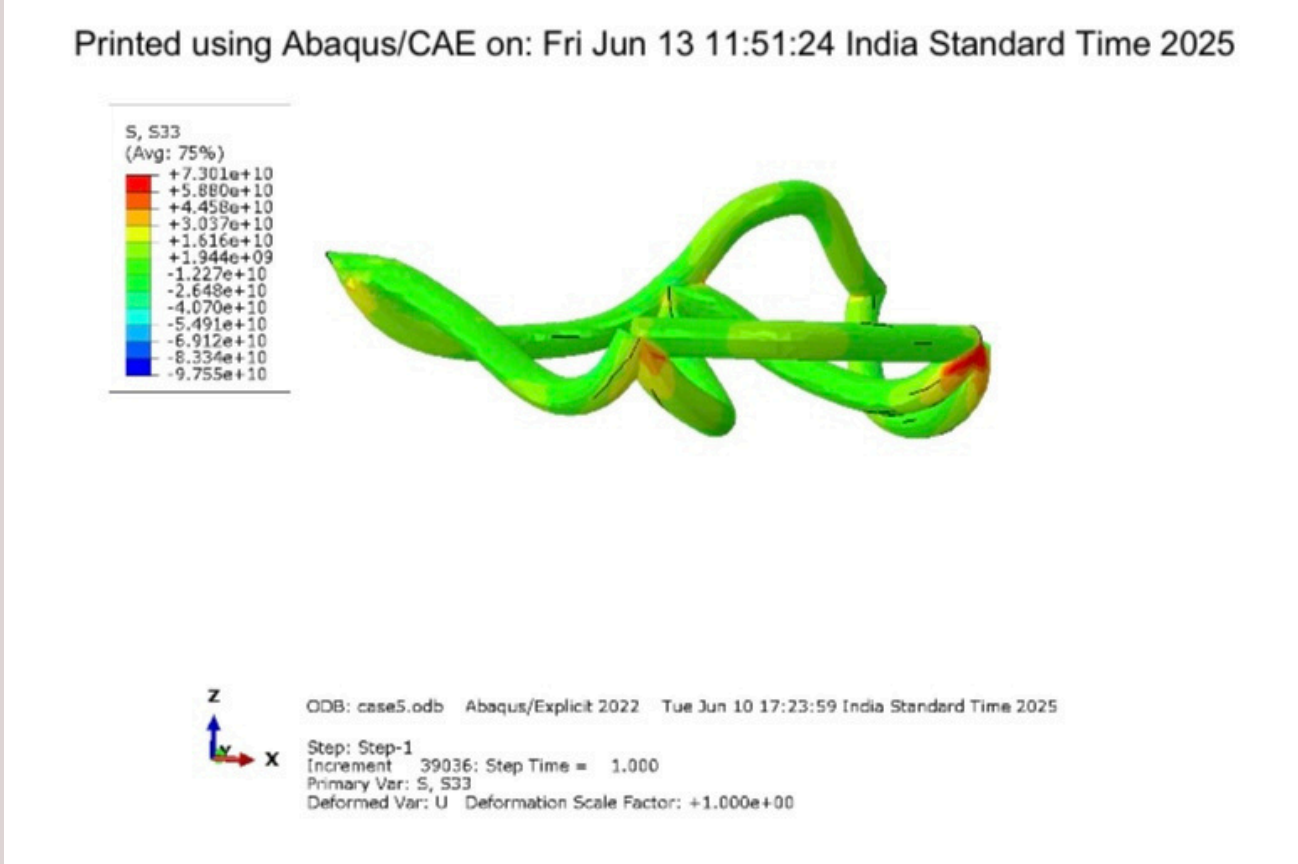
No deformation modes observed



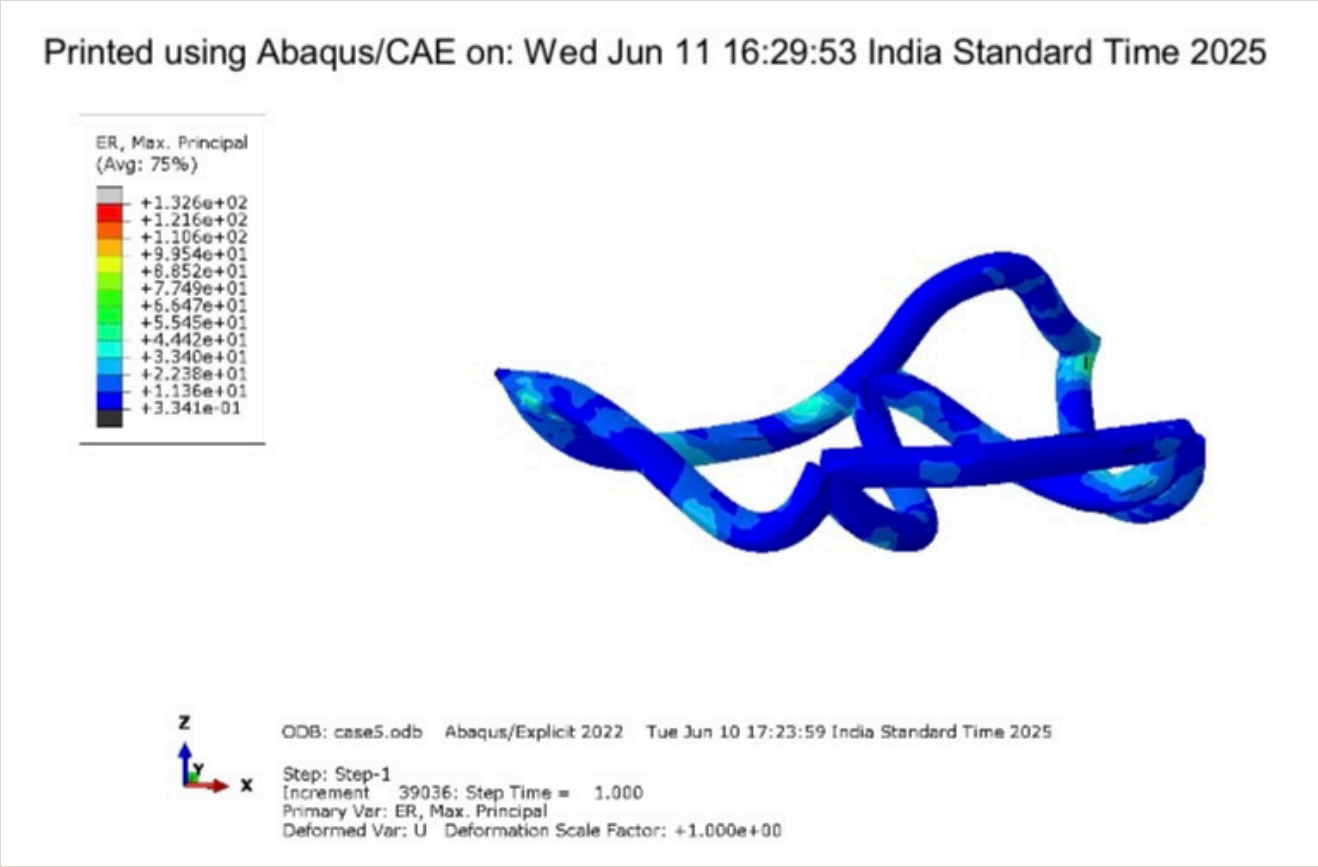
S11



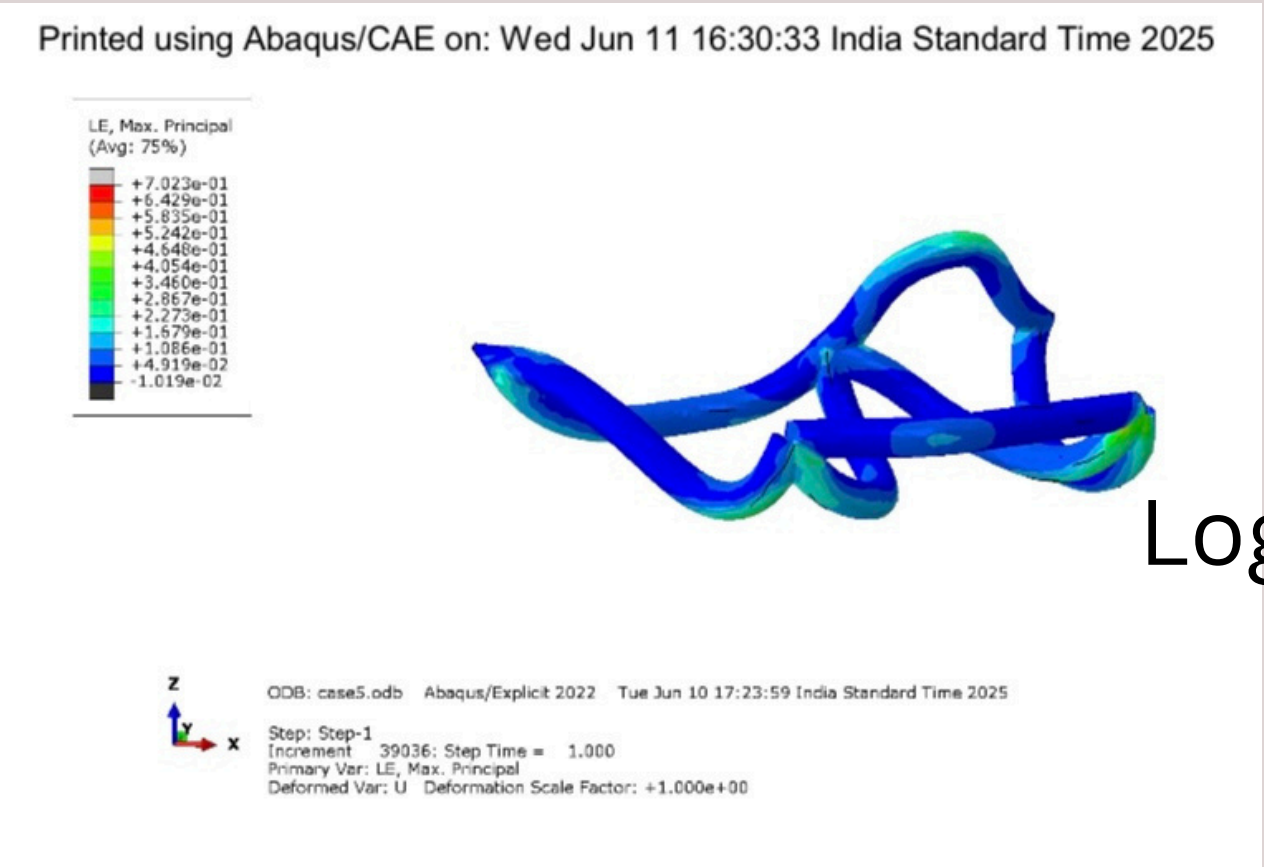
S22



S33



Strain rate



Logarithmic strain

## Observation:

As observed in Fig. 2, the deformation pattern is consistent across all cases where point A is fixed and points B and C are subjected to rolling constraints. The solid cylindrical beam exhibits the same deformation shape as the wireframe model when identical boundary conditions and loading are applied. However, the stress and strain values differ significantly between the two models due to differences in geometry and material distribution

Furthermore, upon decreasing the mesh size, the overall deformation remains nearly unchanged, indicating mesh convergence in terms of displacement results. This suggests that the current mesh is sufficiently refined to capture deformation accurately, though local stress/strain values may still vary with further refinement.