

Predict failure index and strength ratio of a honeycomb sandwich plate

Problem Description

The failure index and strength ratio of a honeycomb sandwich plate under the biaxial loading condition are predicted using the MSG plate model. For a plate structural analysis, the loads are usually expressed in terms of plate stress resultants $\{N_{11}, N_{22}, N_{12}, M_{11}, M_{22}, M_{12}\}$. In this example, $N_{11}=N_{22}=10$ N is assumed.

Software Used

[Gmsh4SC 2.0](#)

Solution Procedure

Below describes the step-by-step procedure you followed to solve the problem.

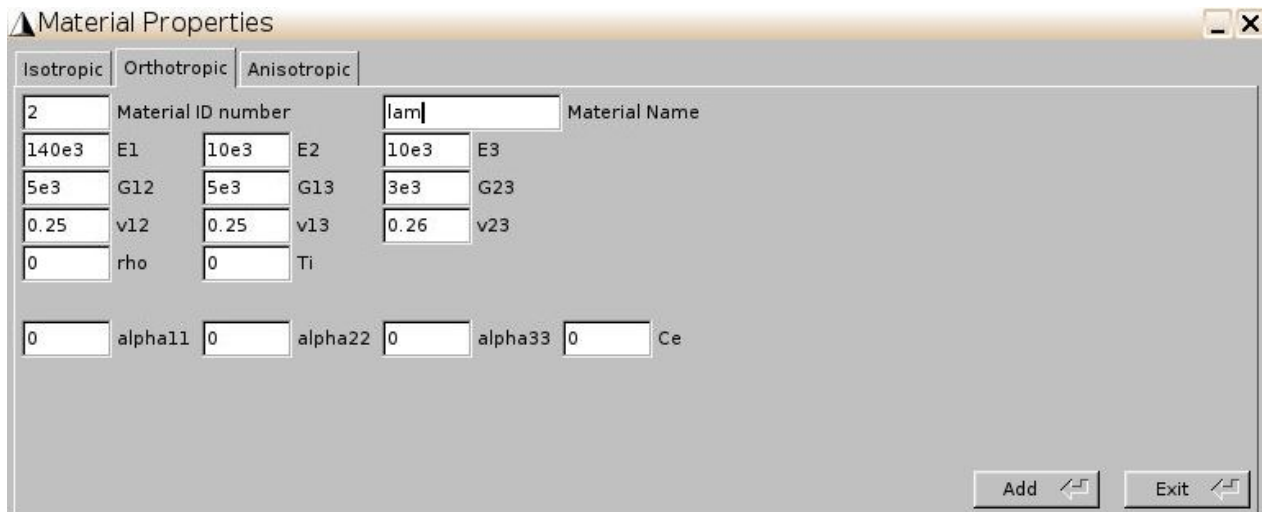
1. step 1

- Open Gmsh4SC and create a new model (Change the default name). Click Material->Thermoelastic and input the matrix and fiber properties as shown in Fig. 1 and Fig. 2.



Fig. 1

PREDICT FAILURE INDEX AND STRENGTH RATIO OF A HONEYCOMB SANDWICH PLATE



The image shows a software dialog box titled "Material Properties". It has three tabs: "Isotropic", "Orthotropic", and "Anisotropic". The "Orthotropic" tab is selected. The dialog contains several input fields for material properties. The "Material ID number" is set to 2, and the "Material Name" is "lam". The properties are arranged in a grid-like format:

Property	Value
Material ID number	2
Material Name	lam
E1	140e3
E2	10e3
E3	10e3
G12	5e3
G13	5e3
G23	3e3
v12	0.25
v13	0.25
v23	0.26
rho	0
Ti	0
alpha11	0
alpha22	0
alpha33	0
Ce	0

At the bottom right, there are two buttons: "Add" and "Exit".

Fig. 2

* Click Geometry->Common SG-> 3D SG->Honeycomb. Select the materials for core and skim as shown in Fig. 3.

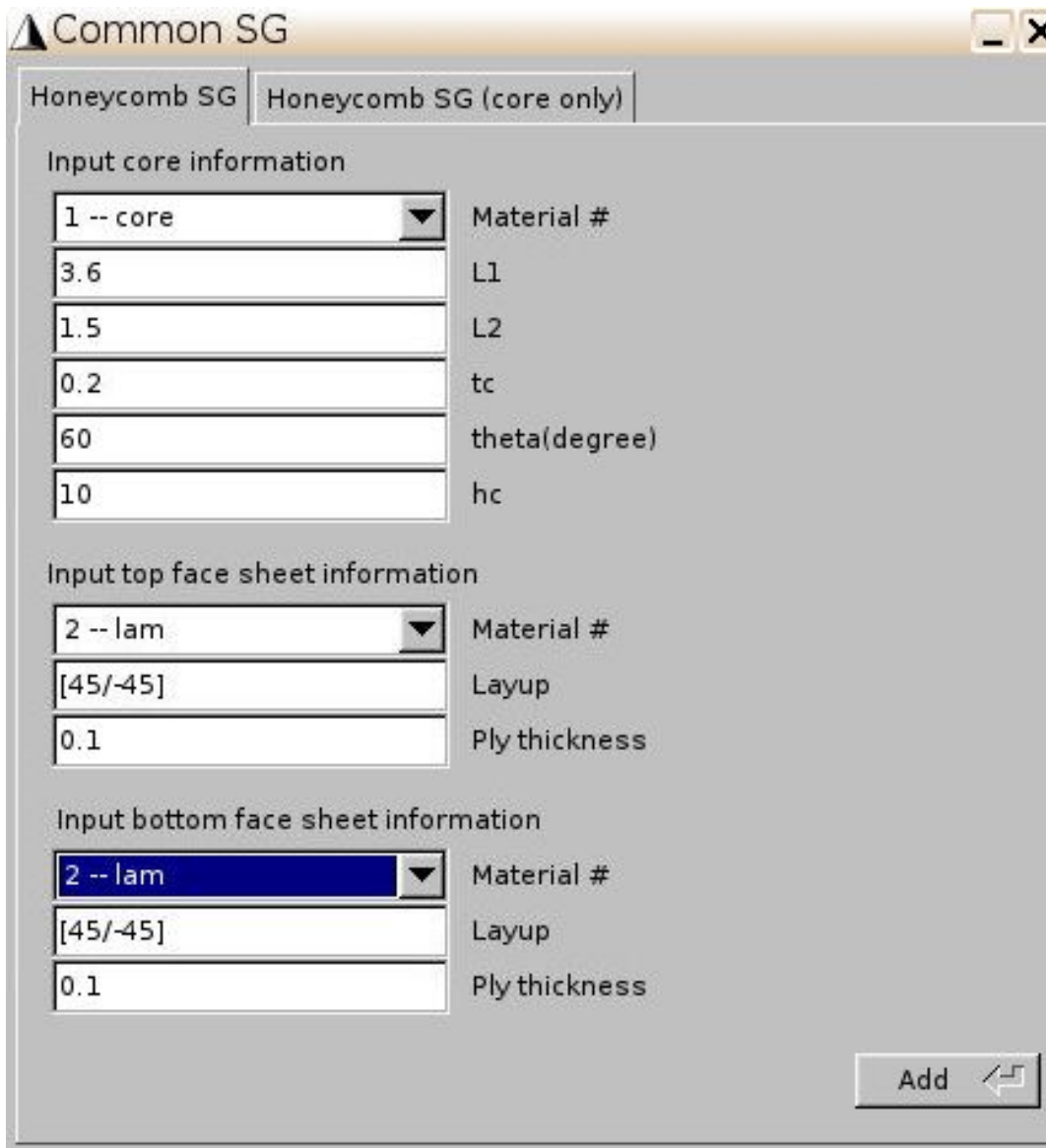


Fig. 3

* Click Mesh->Generate 3D mesh->Generate (Fig. 4.).

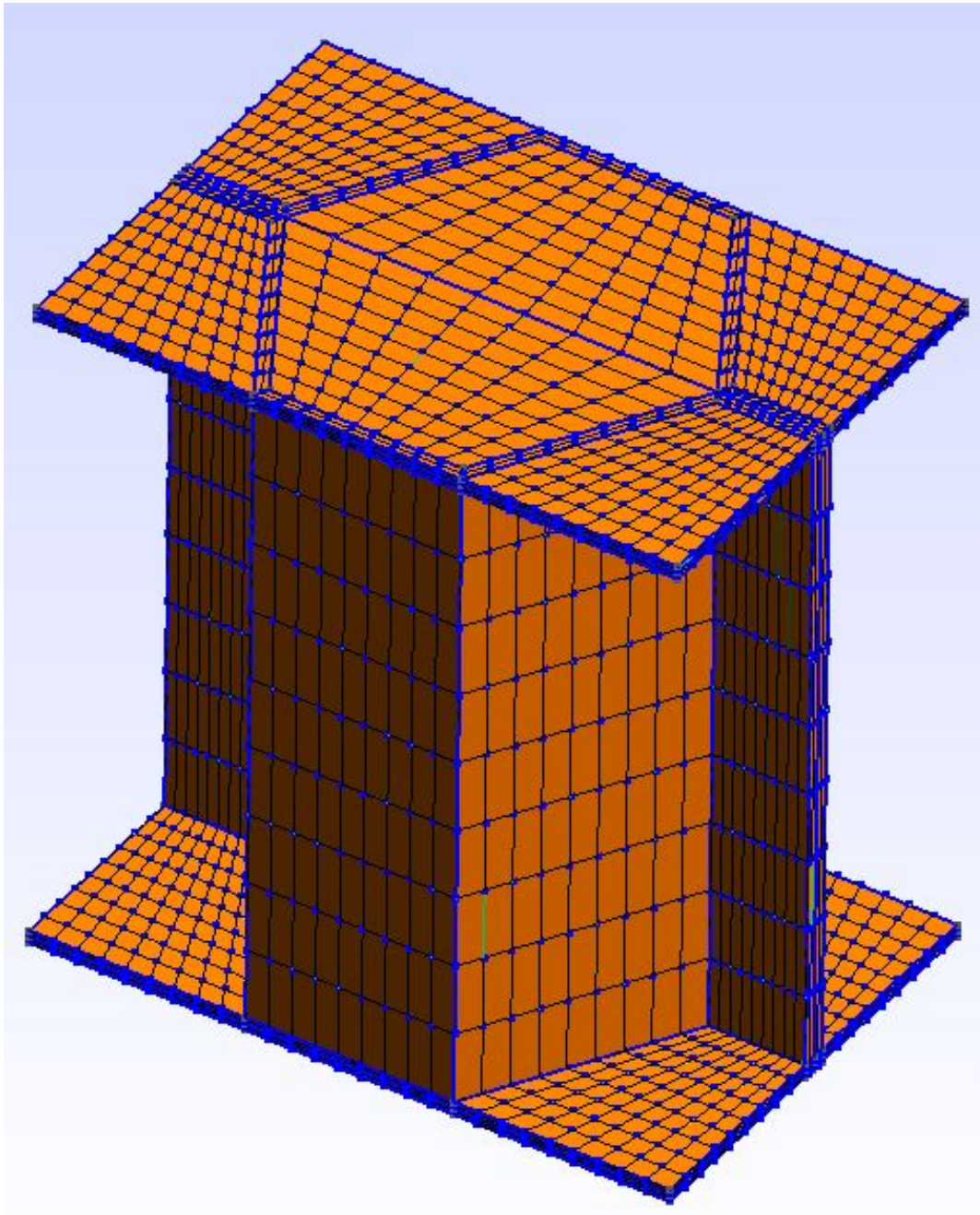


Fig. 4

* Click [SwiftComp](#)->Homogenization->Plate model. Keep the default parameters and click save and run. The homogenization results will automatically pop up (Fig. 5.).

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The effective stiffness matrix
.....
1.4051030E-004 1.4521749E-004 1.0254470E-003 1.9556412E-012 -8.3099595E-011 -2.3602992E-11
1.4051030E-004 1.4521749E-004 1.0254470E-003 1.9556412E-012 -8.3099595E-011 -2.3602992E-11
1.0156470E-001 1.4440739E-002 1.4712740E-004 2.2051346E-011 -5.0870108E-011 1.0817130E-10
1.9096400E-011 1.1245100E-011 2.0021310E-011 1.9126340E-009 1.9051040E-009 6.3142620E-009
2.9092690E-011 2.9092690E-011 1.0881100E-011 1.0881100E-011 6.3623680E-009 -6.3623680E-009
.....
The effective compliance matrix
.....
1.4051030E-004 1.4521749E-004 1.0254470E-003 1.9556412E-012 -8.3099595E-011 -2.3602992E-11
1.4051030E-004 1.4521749E-004 1.0254470E-003 1.9556412E-012 -8.3099595E-011 -2.3602992E-11
1.0156470E-001 1.4440739E-002 1.4712740E-004 2.2051346E-011 -5.0870108E-011 1.0817130E-10
1.9096400E-011 1.1245100E-011 2.0021310E-011 1.9126340E-009 1.9051040E-009 6.3142620E-009
2.9092690E-011 2.9092690E-011 1.0881100E-011 1.0881100E-011 6.3623680E-009 -6.3623680E-009
.....
Isotropic Properties
E1 = 1.1200000E+000
E2 = 2.2000000E+000
E3 = 1.4000000E+000
nu12 = 0.2000000E+000
nu13 = 0.2000000E+000
nu23 = 0.7000000E+000
.....
Material Properties
E1 = 2.0000000E+000
E2 = 4.0000000E+000
E3 = 4.0000000E+000
nu12 = 0.0000000E+000
nu13 = 0.0000000E+000
nu23 = 0.0000000E+000
.....
    
```

Fig. 5

2. step 2

* Click [SwiftComp](#)->Static failure->Input failure constants. Assign failure criterion (max-stress) to the core first (Fig. 6.) and input the failure constants (Fig. 7.). Repeat this step to define the fiber failure constants as shown in Fig. 8 and 9. Note that the lam is non-isotropic material and we will use Tsai-Wu failure criterion in this example.

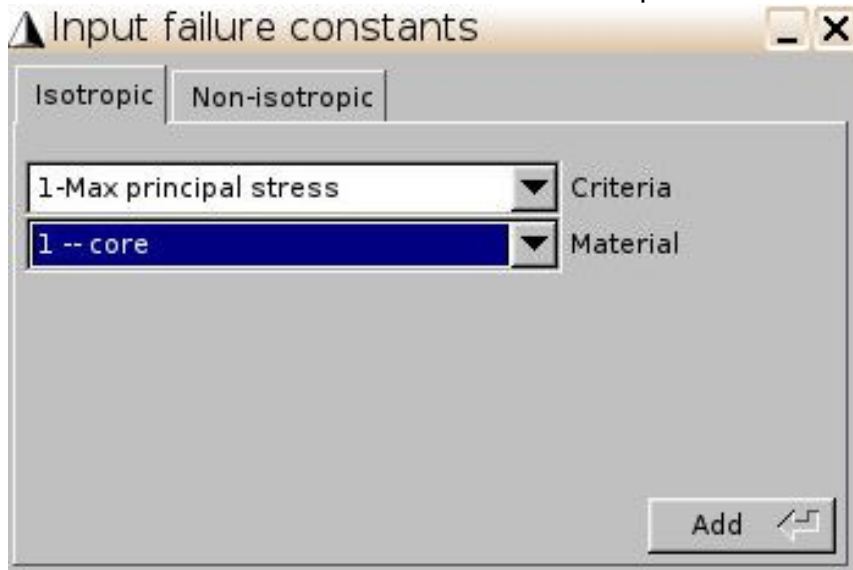


Fig. 6

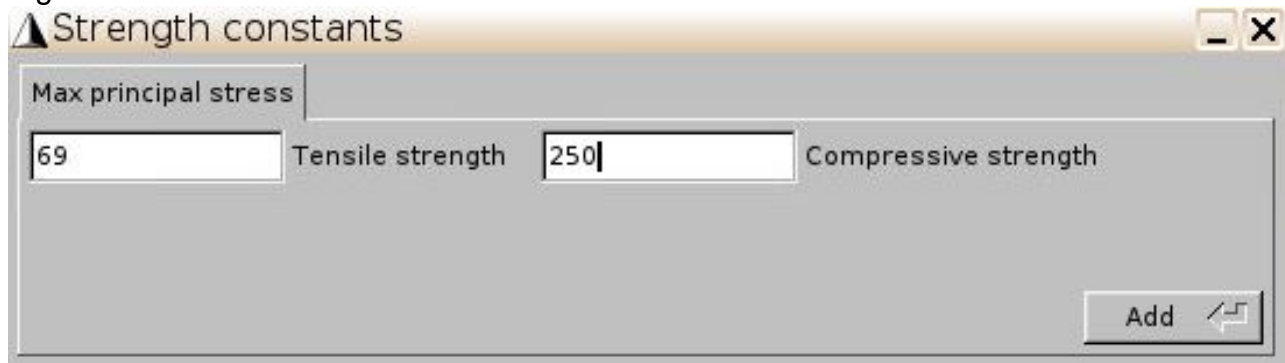


Fig. 7

PREDICT FAILURE INDEX AND STRENGTH RATIO OF A HONEYCOMB SANDWICH PLATE

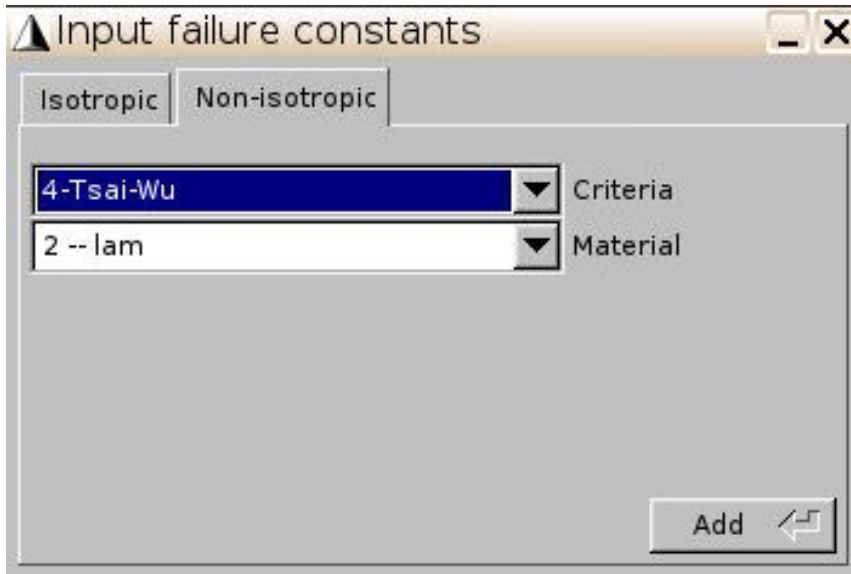


Fig. 8

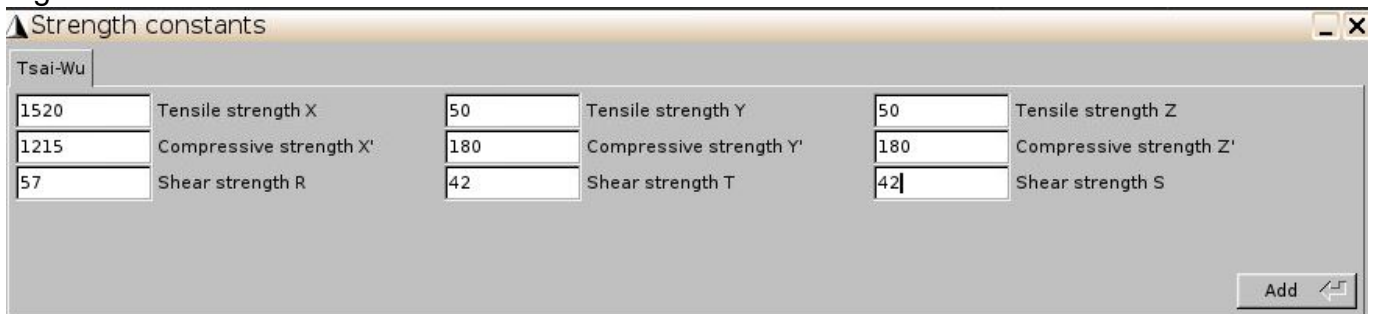


Fig. 9

* Click Failure index and strength ratio and select stress-based failure criterion. Click add. Select plate model and input and loads as shown in Fig. 10.

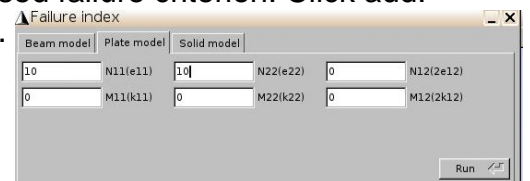


Fig. 10

* Click Run. The contour plots of the failure index and strength ratio under this loading condition is given as shown in Fig. 11 and 12.

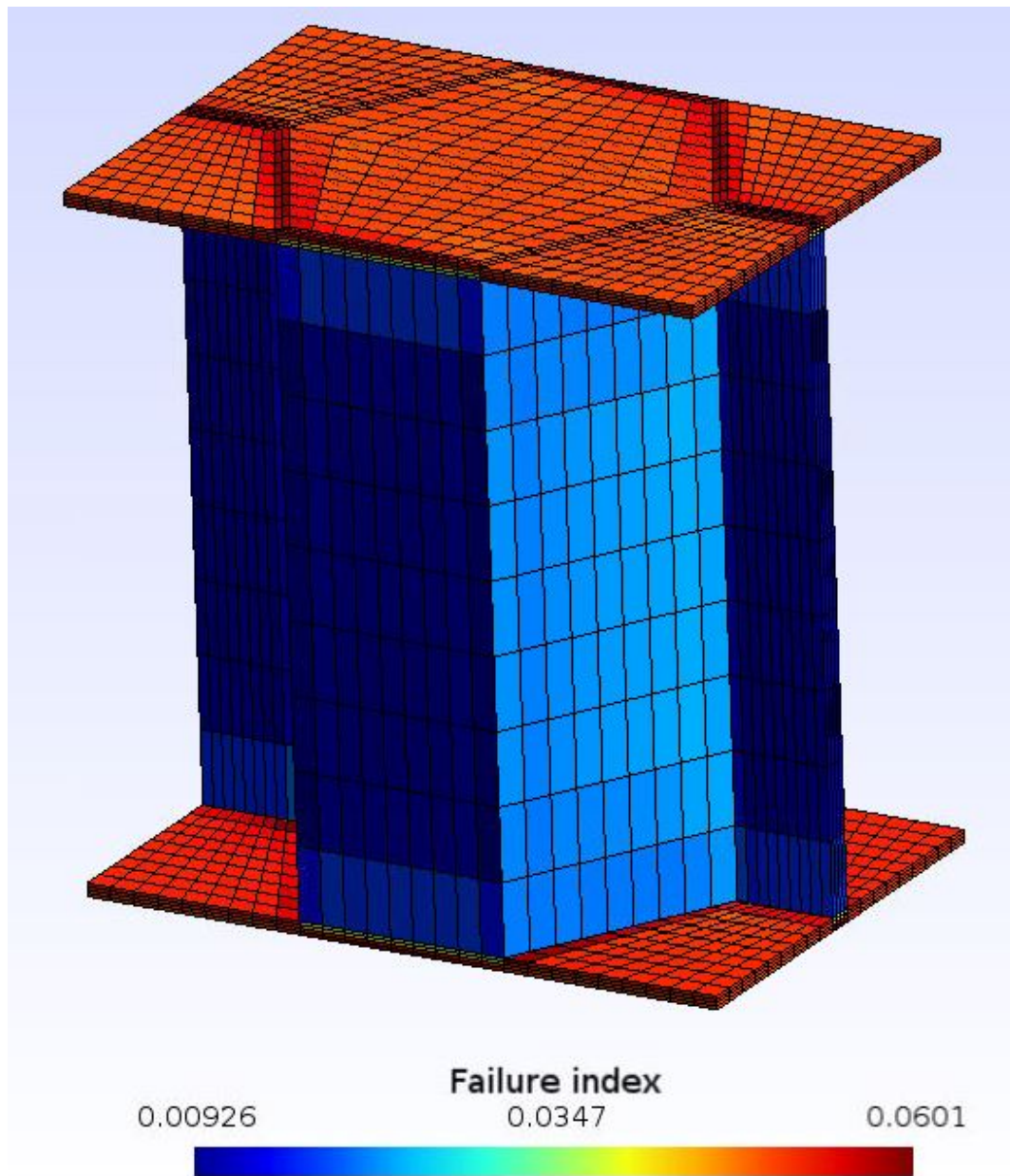


Fig. 11

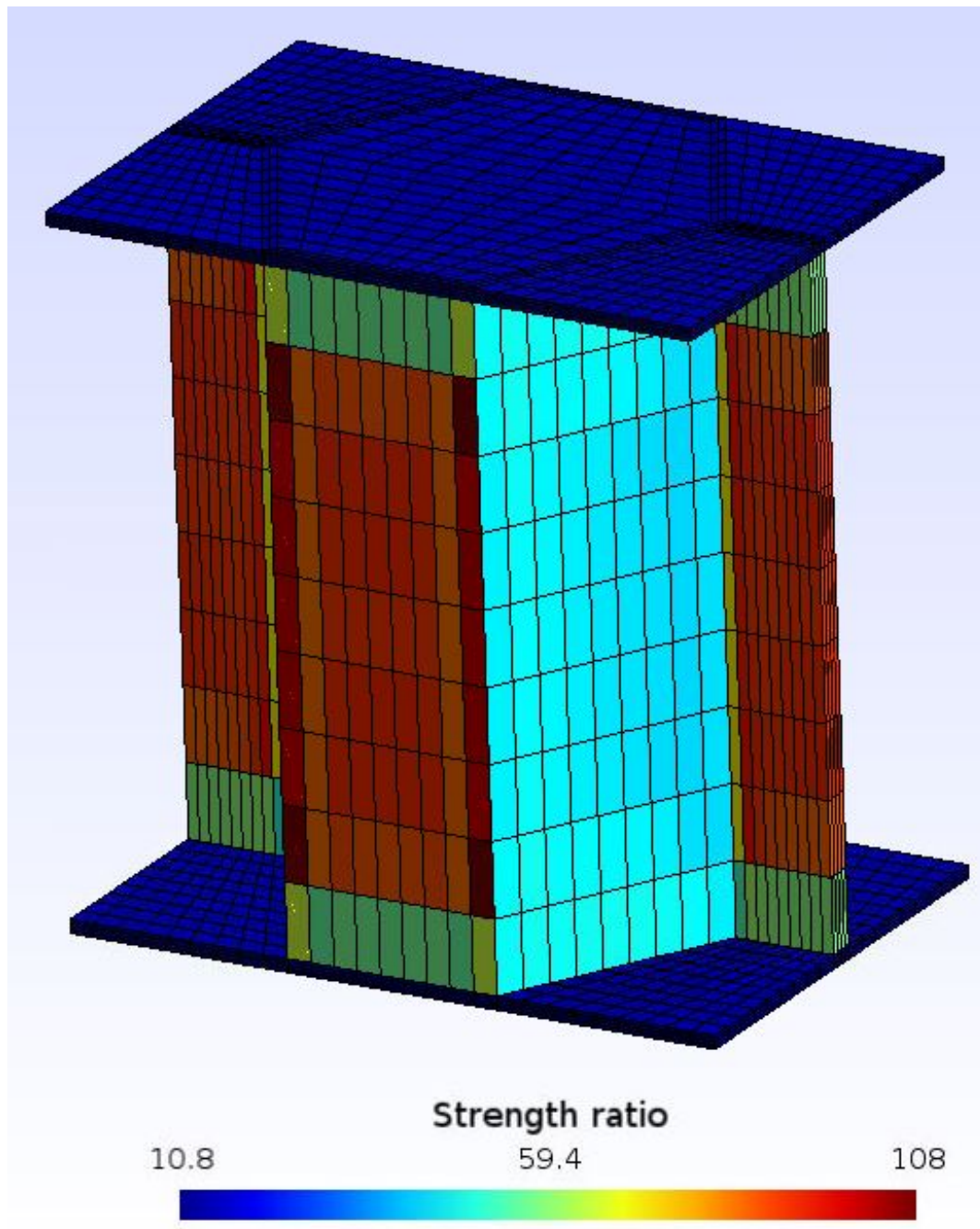


Fig. 12