

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 {N11, N22, N12, M11, M22, M12}. In this example, N11=N22=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

Material Properties

Isotropic Orthotropic Anisotropic

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

Add  Exit 

Fig. 2

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

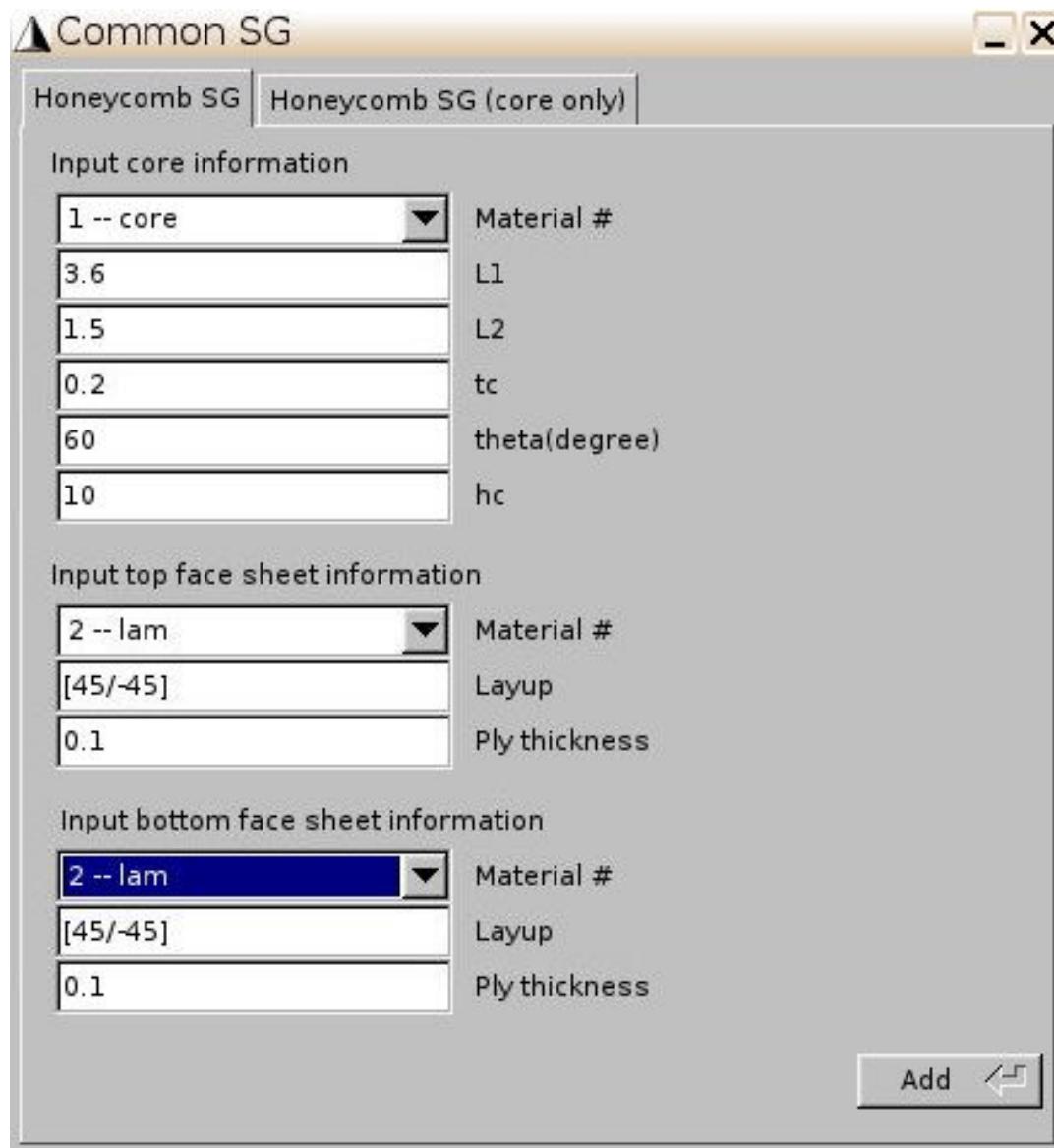


Fig. 3

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

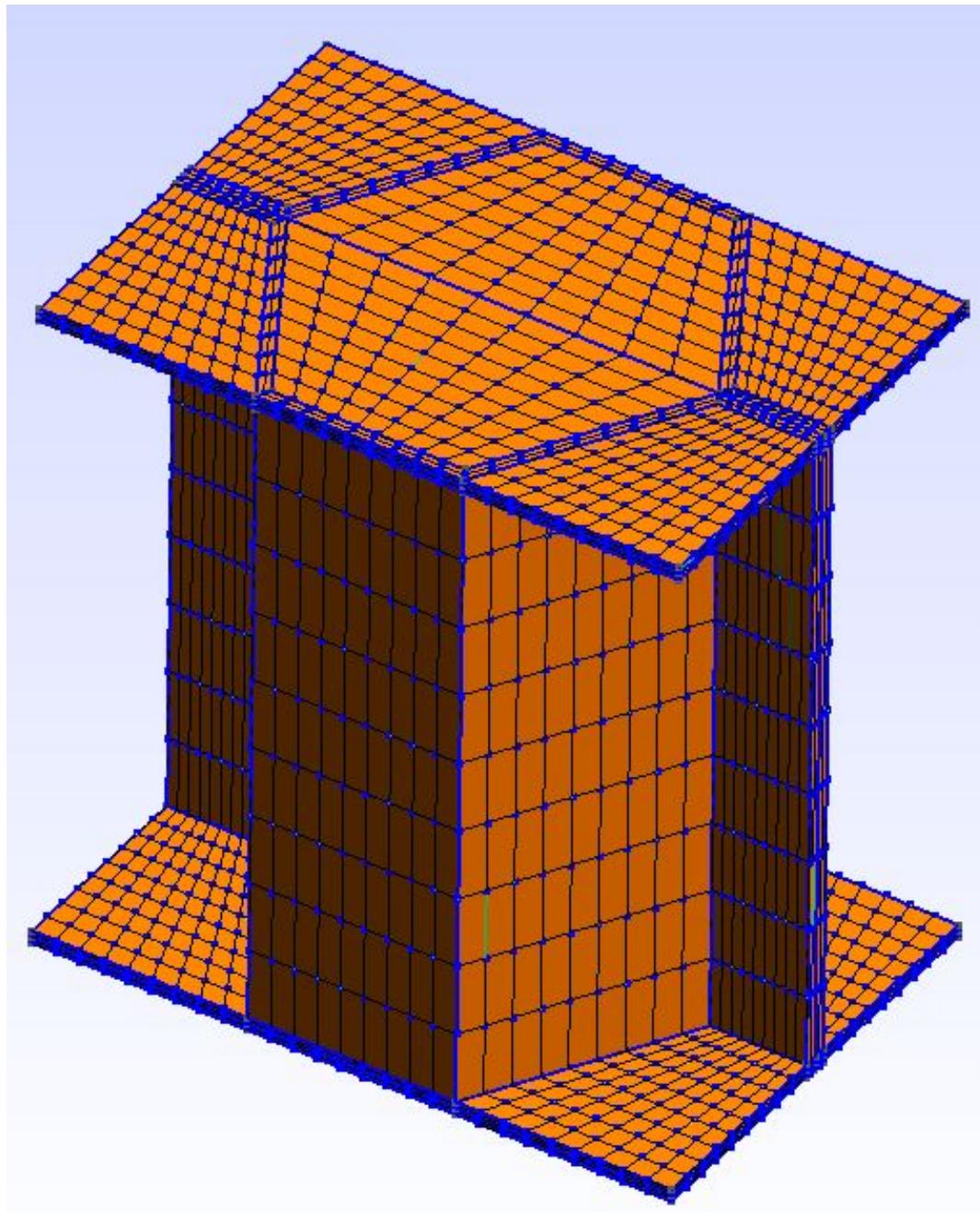


Fig. 4

* 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					
1.40055000E+004	1.49207500E+004	1.02584470E+003	1.06504440E+010	-0.30959500E+011	2.20023000E+000
1.49207500E+004	1.40055000E+004	1.02584470E+003	1.06504440E+010	-0.30959500E+011	2.20023000E+000
1.02584470E+003	1.02584470E+003	1.44037000E+004	1.47127000E+004	-2.20533400E+011	-0.09950100E+011
1.06504440E+010	1.06504440E+010	1.47127000E+004	1.44037000E+004	-2.20533400E+011	-0.09950100E+011
-0.30959500E+011	-0.30959500E+011	-2.20533400E+011	-2.20533400E+011	1.00000000E+000	1.00000000E+000
2.20023000E+000	2.20023000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000

The Effective Compliance Matrix					
1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000
1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000
1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000
1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000
1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000
1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000	1.00000000E+000

Cross-Plane Properties					
E1 = 2.10890000E+002	E2 = 6.74730000E+000	E3 = 1.02584470E+003	G12 = 1.20171000E+010	G13 = 1.06504440E+010	G23 = 1.00000000E+000
E2 = 6.74730000E+000	E1 = 2.10890000E+002	E3 = 1.02584470E+003	G12 = 1.20171000E+010	G13 = 1.06504440E+010	G23 = 1.00000000E+000
E3 = 1.02584470E+003	E1 = 2.10890000E+002	E2 = 6.74730000E+000	G12 = 1.20171000E+010	G13 = 1.06504440E+010	G23 = 1.00000000E+000
G12 = 1.20171000E+010	E1 = 2.10890000E+002	E2 = 6.74730000E+000	E3 = 1.02584470E+003	G13 = 1.06504440E+010	G23 = 1.00000000E+000
G13 = 1.06504440E+010	E1 = 2.10890000E+002	E2 = 6.74730000E+000	E3 = 1.02584470E+003	E3 = 1.02584470E+003	G23 = 1.00000000E+000
G23 = 1.00000000E+000	E1 = 2.10890000E+002	E2 = 6.74730000E+000	E3 = 1.02584470E+003	E3 = 1.02584470E+003	E3 = 1.00000000E+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.

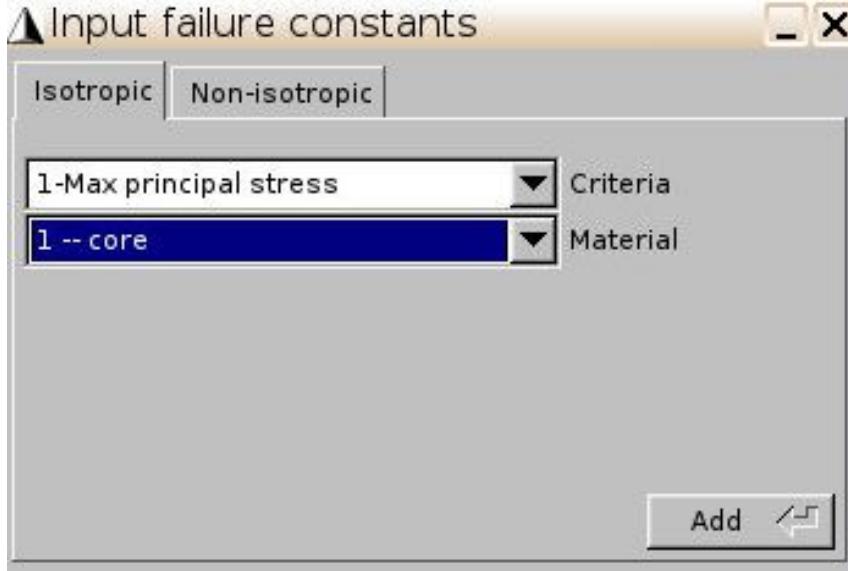


Fig. 6

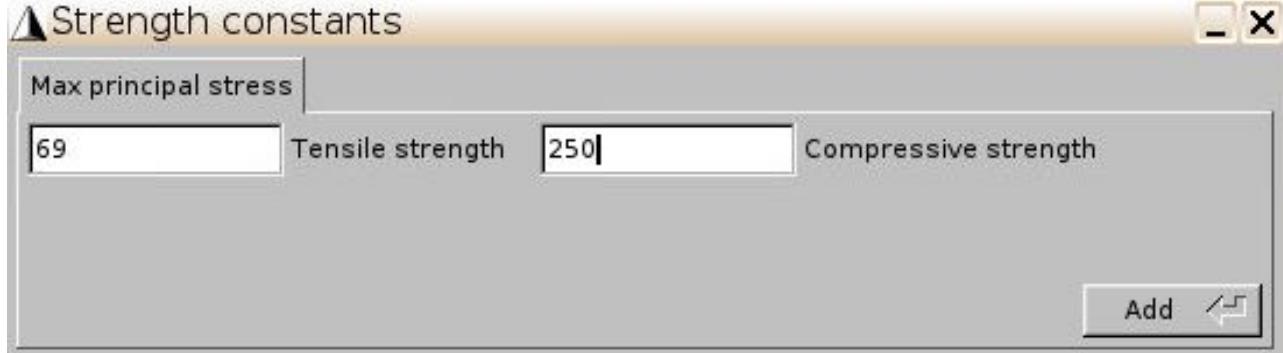


Fig. 7

PREDICT FAILURE INDEX AND STRENGTH RATIO OF A HONEYCOMB SANDWICH PLATE

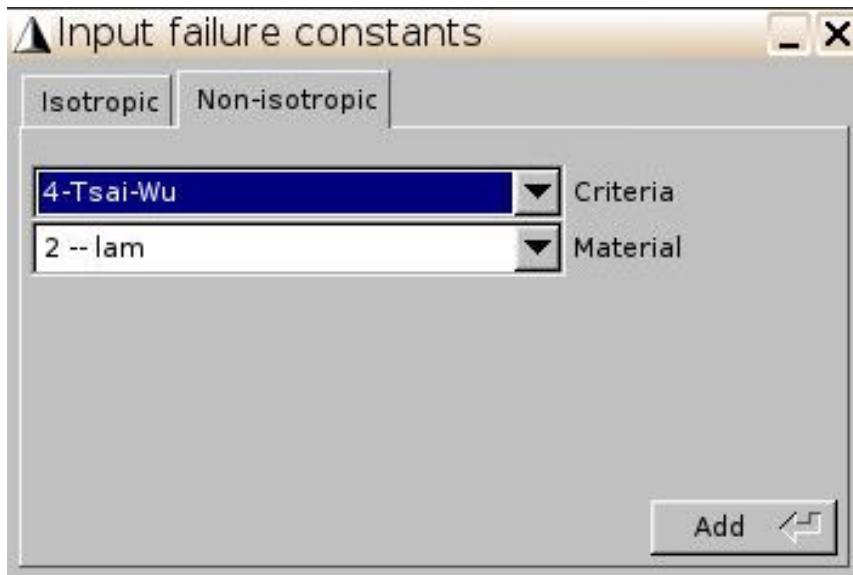


Fig. 8

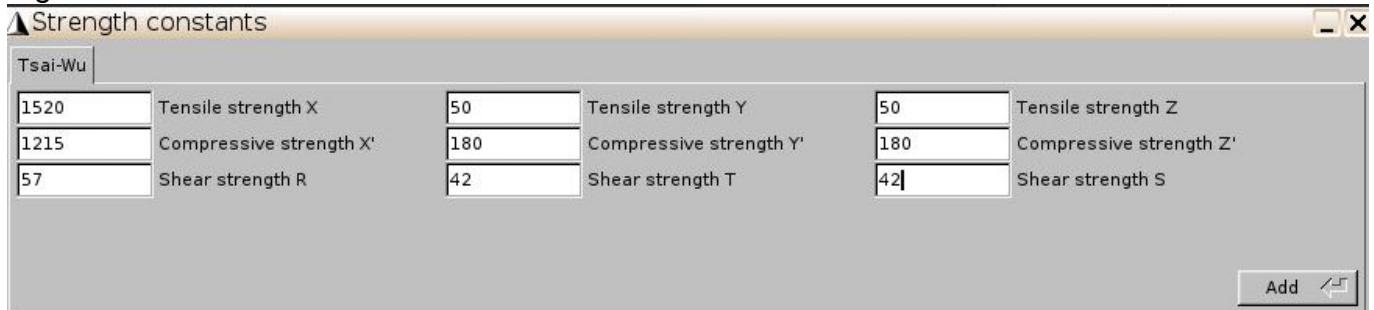


Fig. 9

* 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.

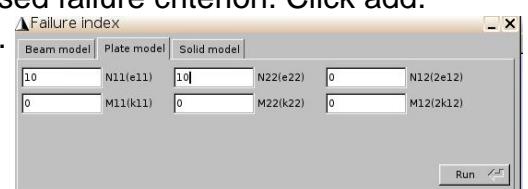


Fig. 10

* 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.

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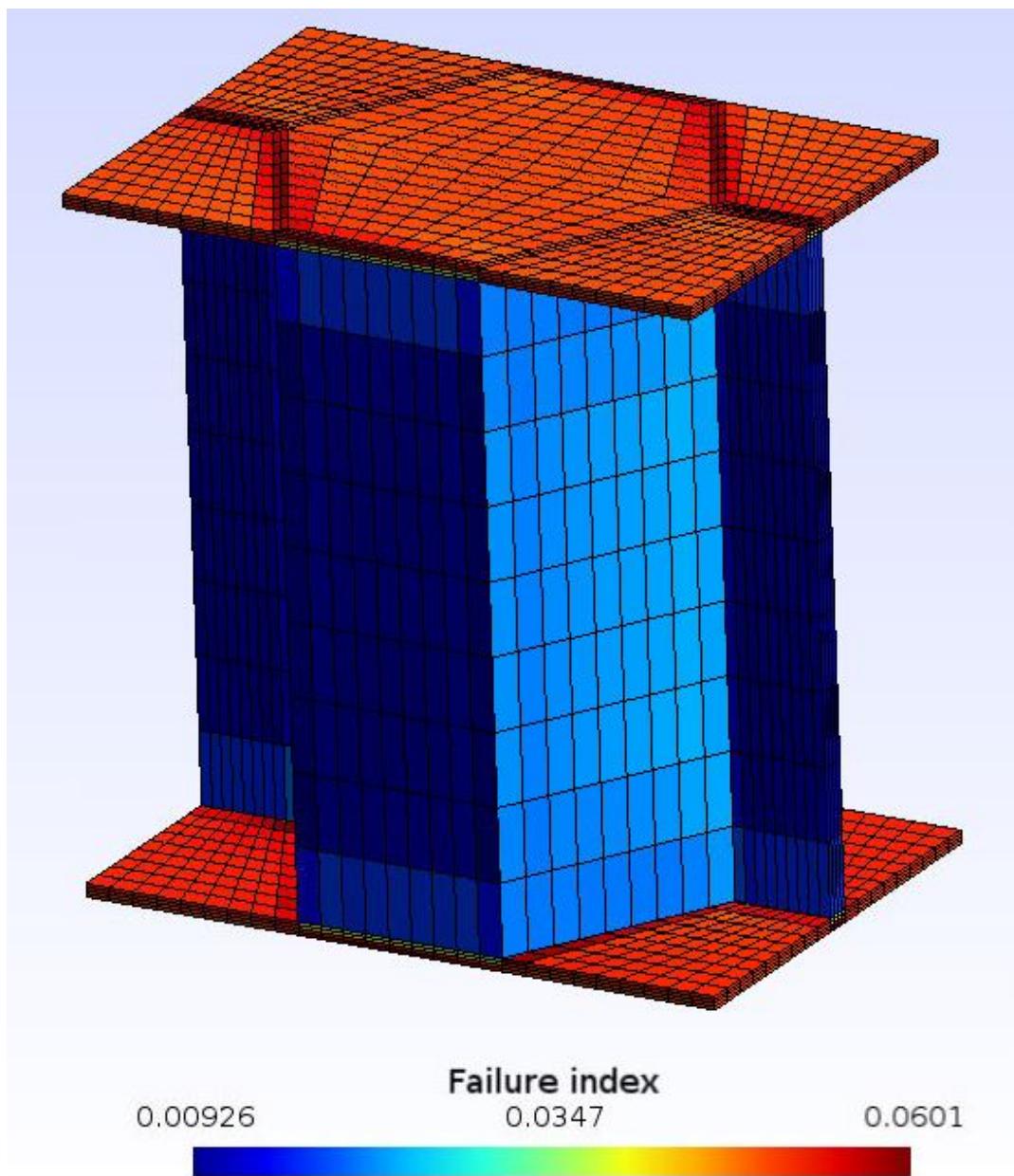


Fig. 11

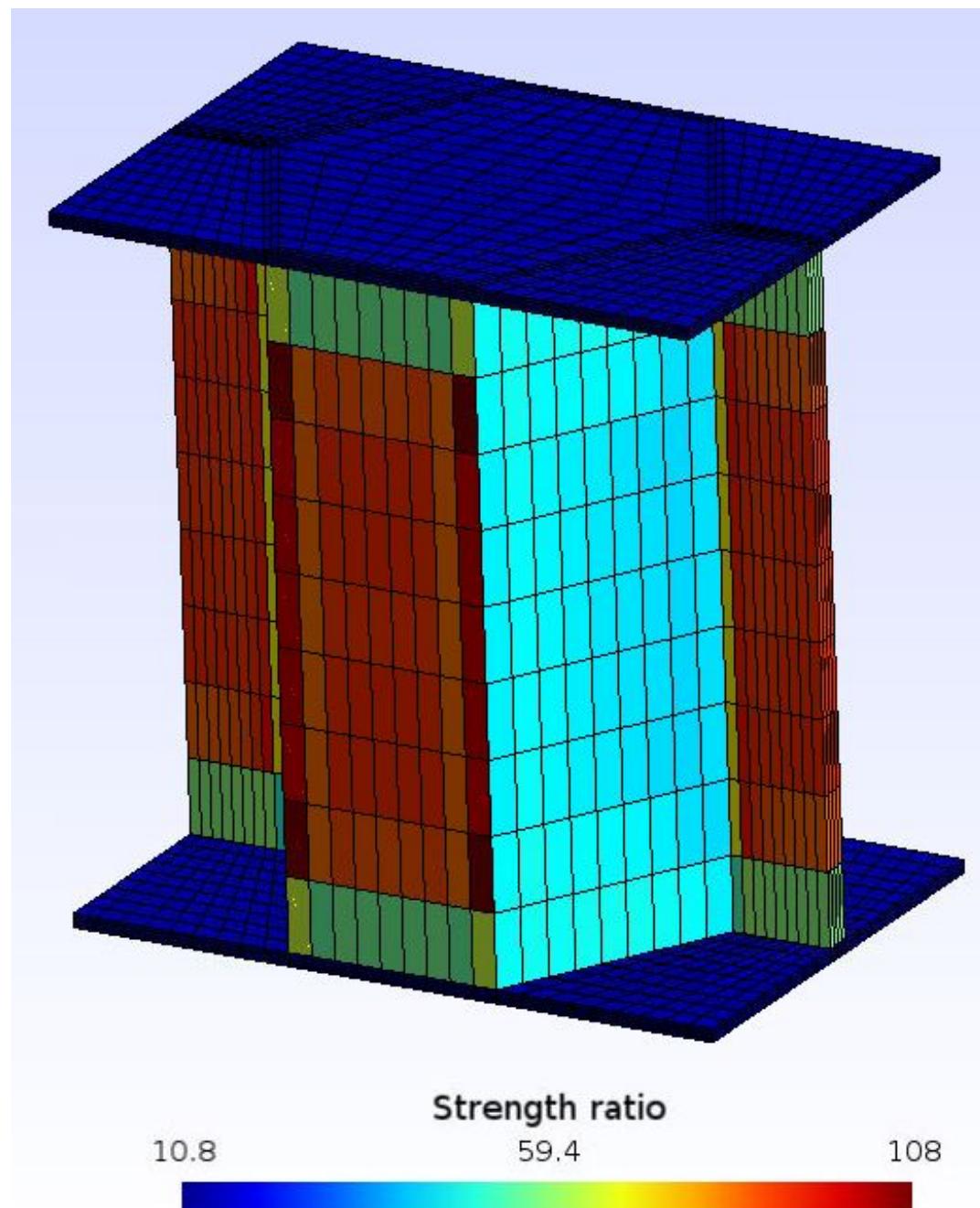


Fig. 12