

MODELING A COMPONENT WITH A PARAMETERIZED DEFORMATION

Application Note

Objectives:

- Create an Akselos component with twisting deformation parameters. Refer to the “Geometric parameters for solid elements” application note to learn how to create mapping functions in the Component Editor.
- Define materials, loads and boundary conditions.
- Prepare the model.
- Visualize analysis results.

Model Description:

The model below is a finite element representation of a beam system. Dimensions of this beam are shown in Figure 1 and Table 1. In this case, we clamp one side and solve the beam with *Self Weight* only.

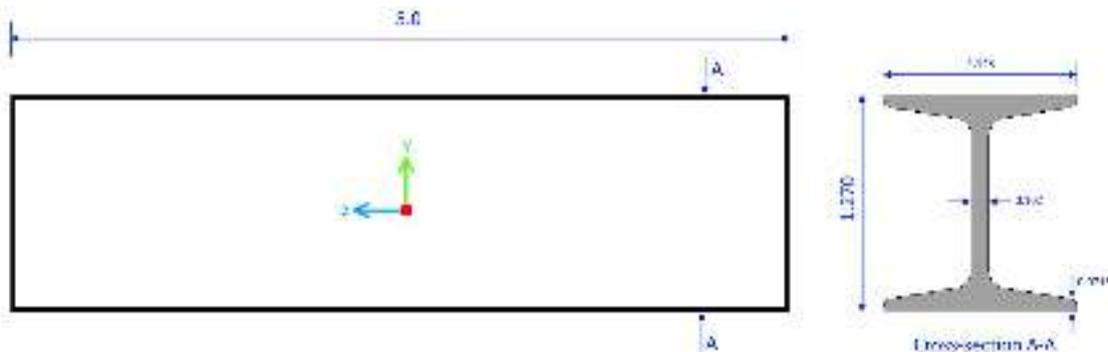


Figure 1: Model dimensions

Elastic Modulus	200 GPa
Poisson Ratio	0.30
Density	7850 kg/m ³

Table 1: Model Properties

In this application note we want to show how you can change the twisting angle shown in Figure 2. When we change the twisting angle, all elements in z0 plan will not rotate, while all elements in z2 plan will rotate with the defined twisting angle. All element in any plan between z0 and z2 (z1 for example) will rotate with γ angle given by the equation below:

$$\gamma = \frac{(z_1 - z_0) \times \text{twist}}{z_2 - z_0}$$

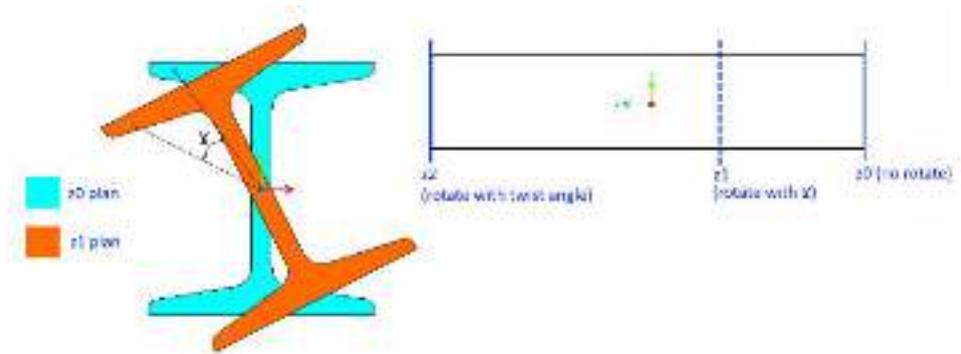


Figure 2: Basic idea of twisting parameter

Suggested Exercise Steps:

- Create a Cantilever beam component in Akselos Modeler. (Refer to the Component Editor tutorials in the Akselos User Manuals to learn how to create components in the Component Editor.)
- Define material properties and mapping functions. (Refer to the “Geometric parameters for solid elements” application note to learn how to create components with mapping functions.)
- Apply boundary conditions and loads (clamped at both side and using self-weight)
- Upload the model to Akselos Dashboard.
- Solve model with FEA and RB-FEA solver types.
- Review the results.

Create new Parameters - Depth

Changing the value of this parameter changes the twisting angle of the component. Specify the discrete values as 0, 15, 30, 45, 60, 75 and 90 degrees.

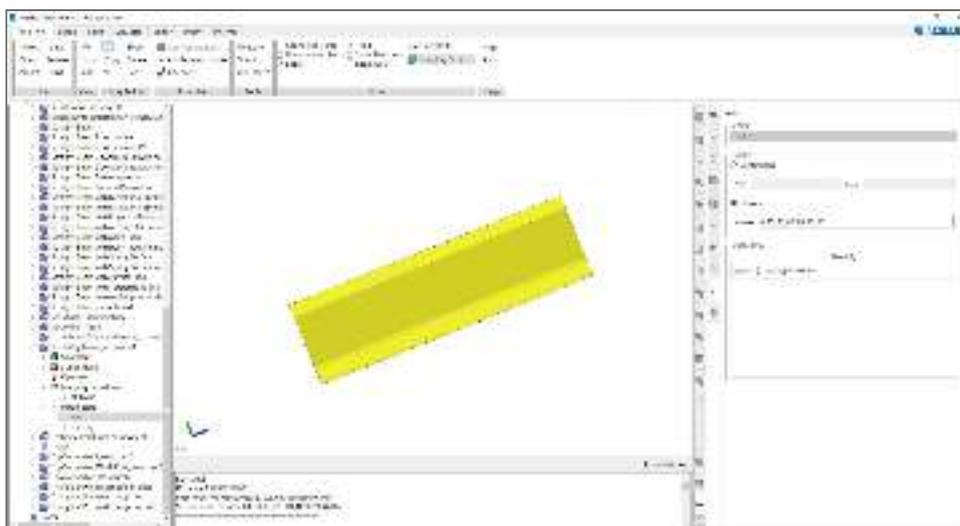


Figure 3: Parameter and its values

Create Mapping functions

We have only one subdomain in this case. Therefore, we will have just 1 mapping function.

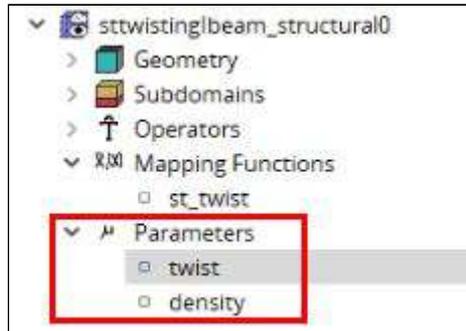


Figure 4: Create mapping function

Mapping function formula:

```
alpha:=pi*twist/180; h:=5.0; r:=(z+h/2.0)/h;  
xp := ((x*cos(r*alpha))-(y*sin(r*alpha)));  
yp := ((y*cos(r*alpha))+x*sin(r*alpha));  
zp := z;
```

h is the length of the beam. This function rotates all elements in the component to create the twisting effect. When “**twist**” changes, the beam will become twisted.

Results:

Remember that the beam is clamped at the side that is not rotated, the other side is free. We solve it with Self-weight load only for multi-values of twisting angles. Note that in Akselos Modeler, Self-Weight is recognized in the (-z) direction only. Therefore, you should move the component to reach the right positions.

When we change the *twist* parameter:

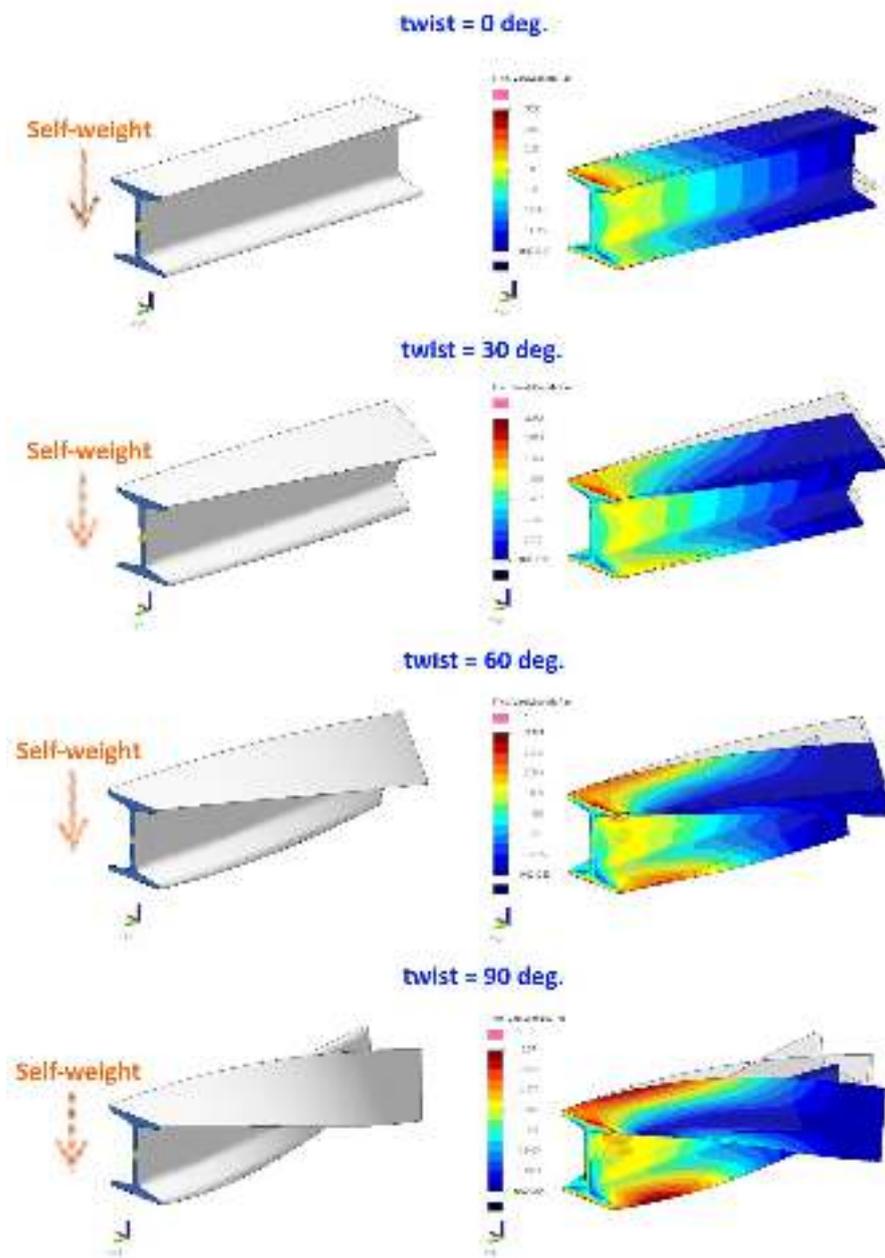


Figure 5: Difference between four “twist” values (left)
Results at Von Mises stress field with original position (right)

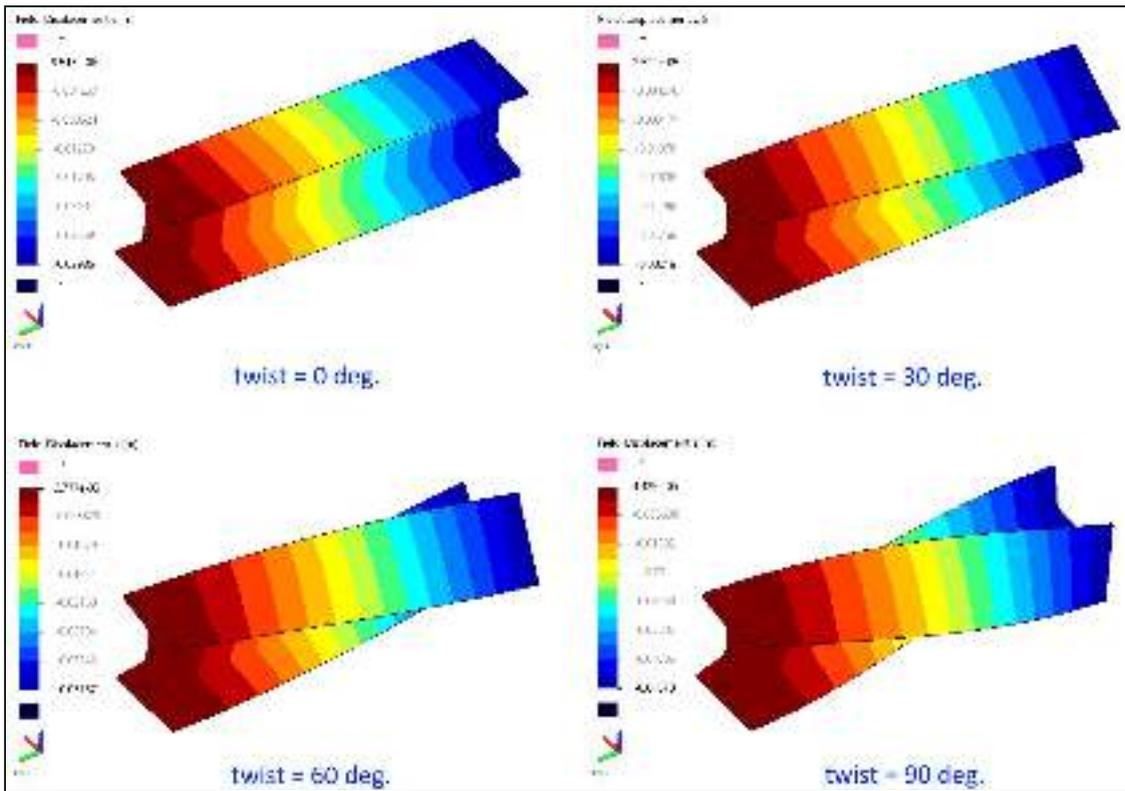


Figure 6: Simulation results in displacement field at z-direction

About Akselos

Akselos is a digital technology company headquartered in Switzerland, with operations in Europe, the USA and South East Asia. The company has created the world's most advanced engineering modeling, and fastest simulation technology, to protect the world's critical infrastructure today and tomorrow. The technology has the power to revolutionize how we build and manage our critical infrastructure, and pushes the boundaries of what modern engineering and data analytics can achieve. Developed by some of the world's best minds, the MIT-licensed technology builds something far beyond the capability of a conventional digital twin – a digital guardian that allows operators to not only monitor an asset's condition in real time, but helps them to see the future.



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