

FEM Mesh preparation and quality inspection



EURO

SLING

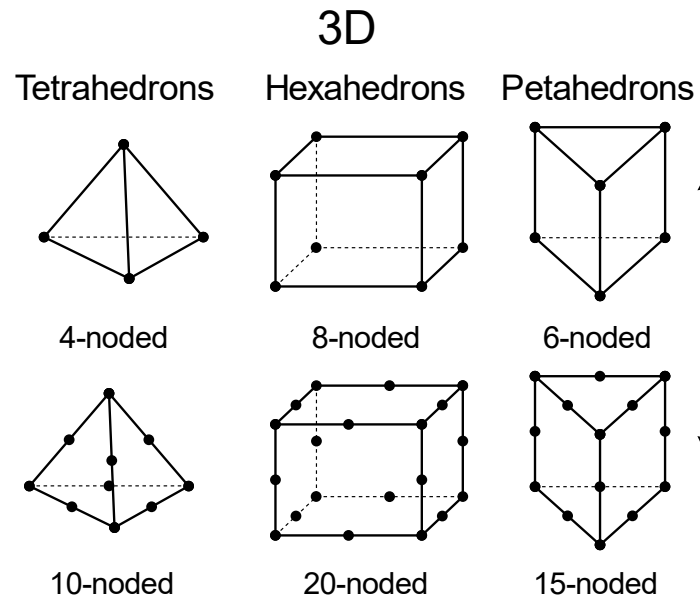
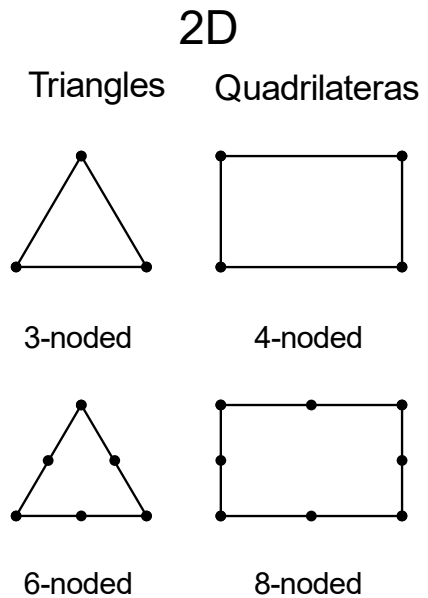
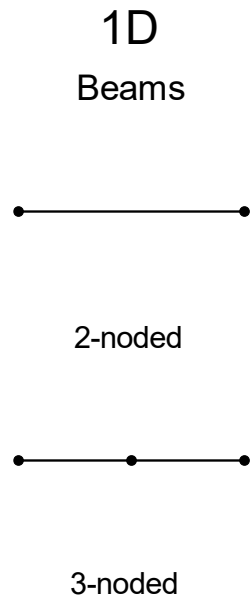
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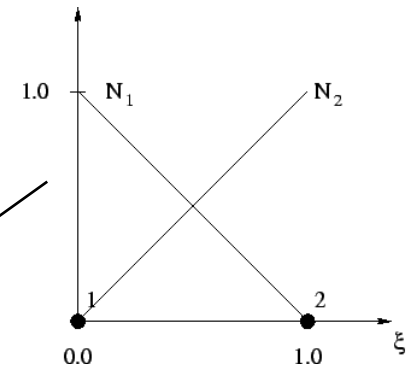
FE Mesh preparation and quality



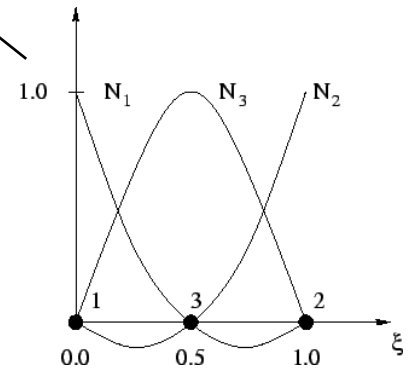
Finite element (FE) types



Linear shape functions (SF):



Quadratic SF:



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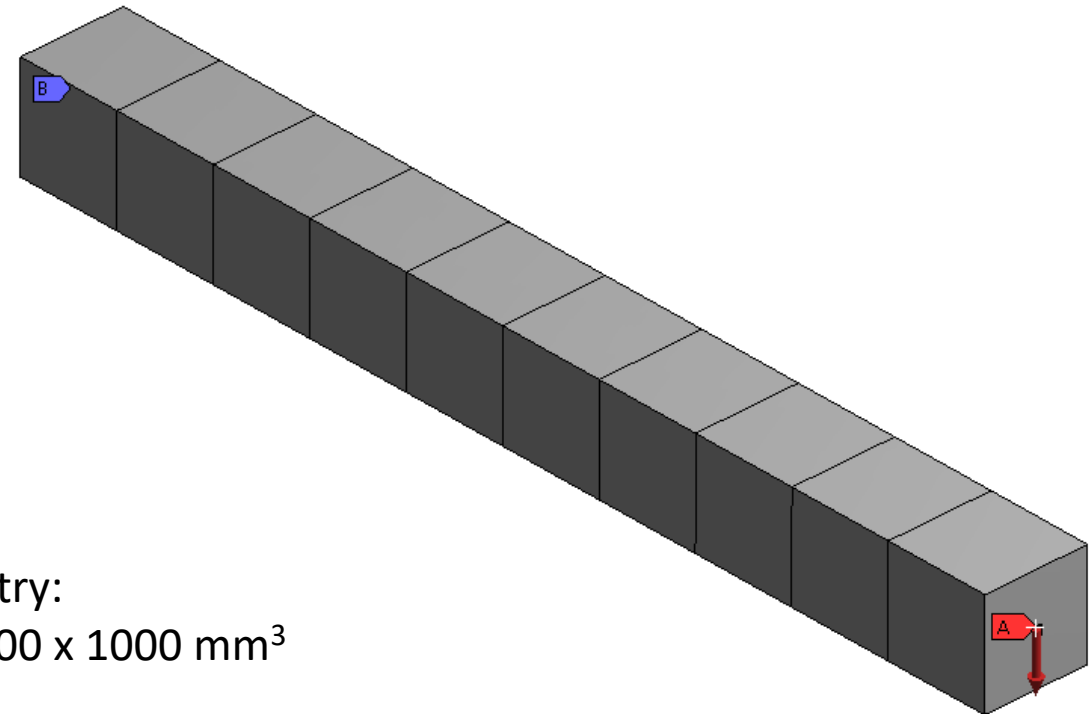
Case 1: 1D FEs in 3D space

Details View	
Details of Point2	
Point	Point2
Type	Construction Point
Definition	Manual Input
# Points generated	1
Point Group 1 (RMB)	
<input type="checkbox"/> FD8, X Coordinate	1 m
<input type="checkbox"/> FD9, Y Coordinate	0 m
<input type="checkbox"/> FD10, Z Coordinate	0 m

Details of "Rect1"	
Definition	
Type	RECT
Import Type	Imported
Dimensions	
<input type="checkbox"/> B	100. mm
<input type="checkbox"/> H	100. mm
Physical Properties	
Beam Section	Rect1
A	10000 mm ²
Iyy	8.3333e+006 mm ² .mm ²
Izz	8.3333e+006 mm ² .mm ²

A: beam 1D
Static Structural
Time: 1. s
24. 06. 2021 10:32

A Force: 300. N
B Fixed Support



Geometry:
100 x 100 x 1000 mm³

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Case 2: 3D FEs (quadratic element order) in 3D space

Project*

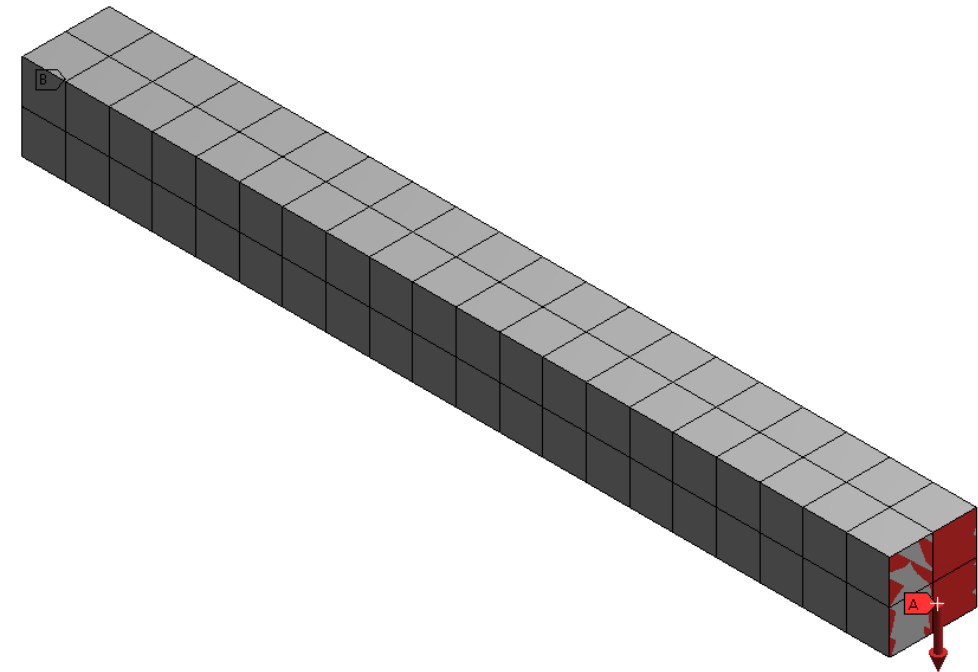
- Model (B4)
 - Geometry
 - Materials
 - Coordinate Systems
 - Mesh
 - Static Structural (B5)
 - Analysis Settings
 - Remote Displacement
 - Force
 - Solution (B6)
 - Solution Information
 - Equivalent Stress

Details of "Mesh"

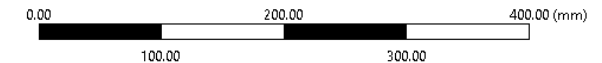
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Quadratic
<input type="checkbox"/> Element Size	Default
Sizing	
Quality	
Inflation	
Advanced	
Statistics	

B: beam 3d
Static Structural
Time: 1. s
24. 06. 2021 10:37

A Force: 300. N
B Remote Displacement



Geometry:
100 x 100 x 1000 mm³



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Case 3: 2D FEs in 2D space (plane stress and plane strain)

Project

- Model (D4)
 - Geometry
 - SYS-4\Surface
 - Materials
 - Coordinate Systems
 - Mesh
 - Static Structural (D5)
 - Analysis Settings
 - Pressure
 - Fixed Support
 - Solution (D6)
 - Solution Information
 - Directional Deformation

Details of "Geometry"

Definition	
Source	E:\Projekti\2021_Erasmus_plu...
Type	SpaceClaim
Length Unit	Meters
Element Control	Program Controlled
2D Behavior	Plane Stress
Display Style	Body Color

Bounding Box

Properties

Statistics

Update Options

Basic Geometry Options

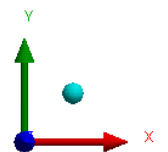
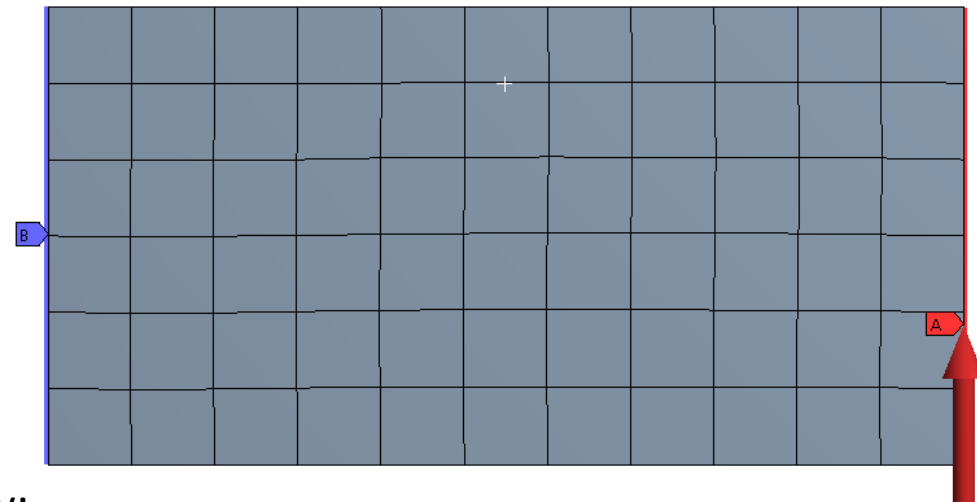
Advanced Geometry Options

CAD Attributes

Model Assembly Output Version	1
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D: plate - 2D plane stress
Static Structural
Time: 1. s
24. 06. 2021 10:42

A Pressure: 0.1 MPa
B Fixed Support



Geometry:
 $200 \times 120 \times 5 \text{ mm}^3$

*Key setting: WB Properties > Analysis Type: 2D

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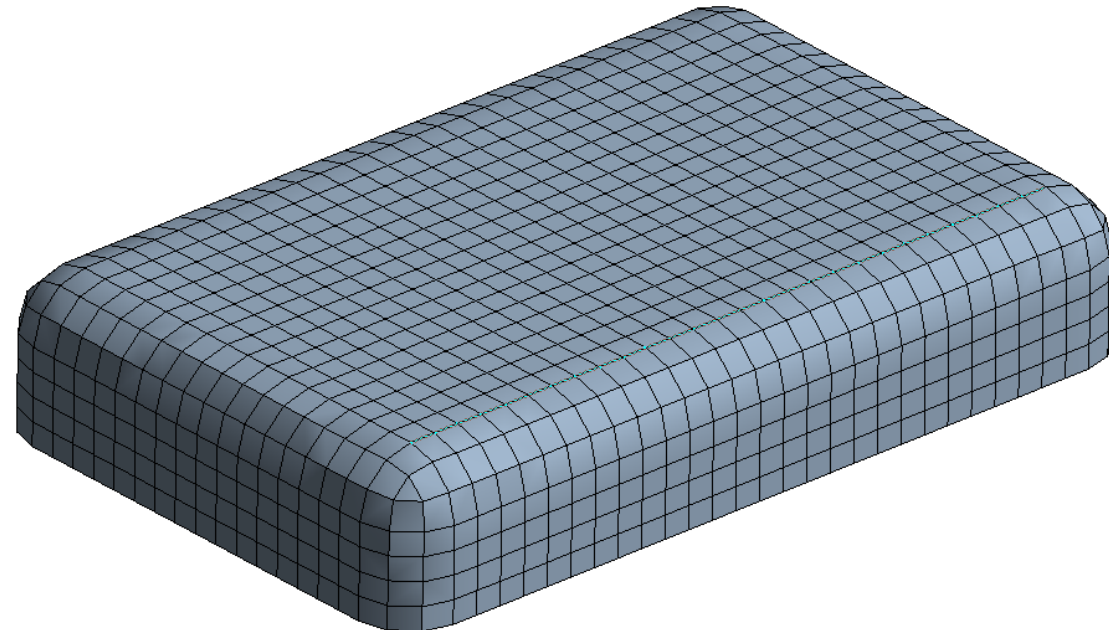
Case 4: Housing - 2D shell FEs in 3D space

Project*

- Model (C4)
 - Geometry
 - SYS-3\Surface
 - Materials
 - Structural Steel
 - Coordinate Systems
 - Global Coordinate System
 - Mesh
 - Static Structural (C5)
 - Analysis Settings
 - Fixed Support
 - Pressure
 - Solution (C6)
 - Solution Information
 - Directional Deformation

Details of "SYS-3\Surface"

Graphics Properties	
Definition	
<input type="checkbox"/> Suppressed	No
Dimension	3D
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
<input type="checkbox"/> Thickness	5. mm
Thickness Mode	Manual
Offset Type	Middle
Treatment	None



Geometry:
200 x 120 x 5 mm³

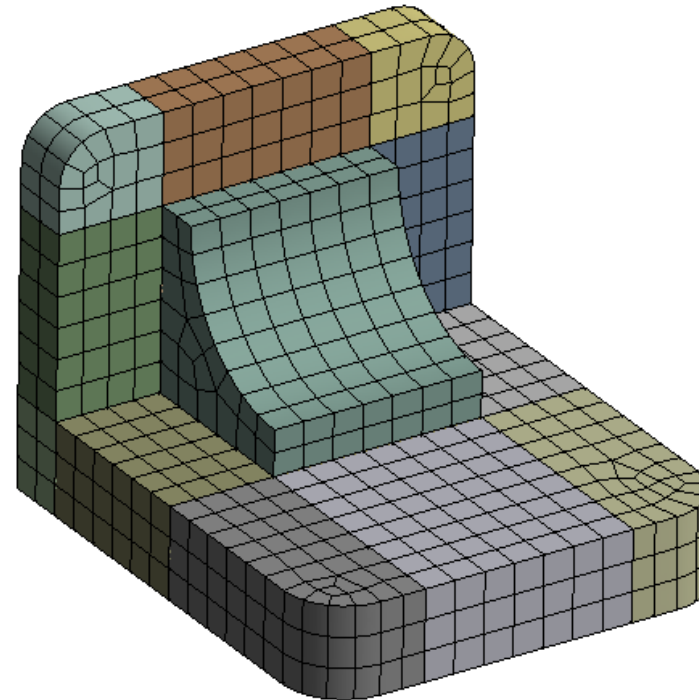
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Case 5: Structured 3D FE mesh

The screenshot shows a software interface with a project tree on the left and a details panel on the right. The project tree is expanded to show the 'Mesh' object under the 'Static Structural (E5)' analysis type. The details panel for 'Mesh' is open, showing various settings.

Details of "Mesh"	
Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
<input type="checkbox"/> Element Size	10.0 mm
Sizing	
Quality	
Inflation	
Advanced	
Statistics	



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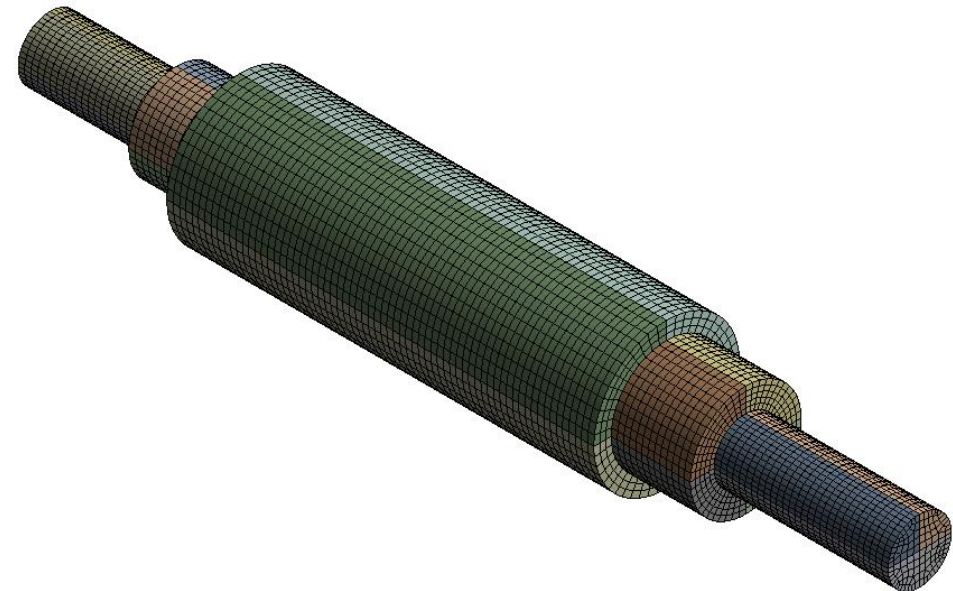
Case 6: Structured 3D FE mesh (cylindrical bodies)

Project

- Model (H4)
 - Geometry
 - Materials
 - Coordinate Systems
 - Connections
 - Mesh
- Static Structural (H5)
 - Analysis Settings
 - Solution (H6)
 - Solution Information

Details of "Mesh"

Display	
Display Style	Use Geometry Setting
Defaults	
Physics Preference	Mechanical
Element Order	Program Controlled
<input type="checkbox"/> Element Size	2.0 mm
Sizing	
Quality	
Inflation	
Advanced	
Statistics	



Individual work case 1: Structured 3D FE mesh (wheel)

- Static structural module: Wheel - 3D - Individual Example
- In Design Modeler upload geometry from file *Wheel_Meshing_defeatured.x_t*
- Try to reach at least 80 % element quality using (predominantly) hexagonal FEs
- Hint – use either
 - Geometry slicing or
 - Mesh method – Hex dominant or
 - Both methods combined

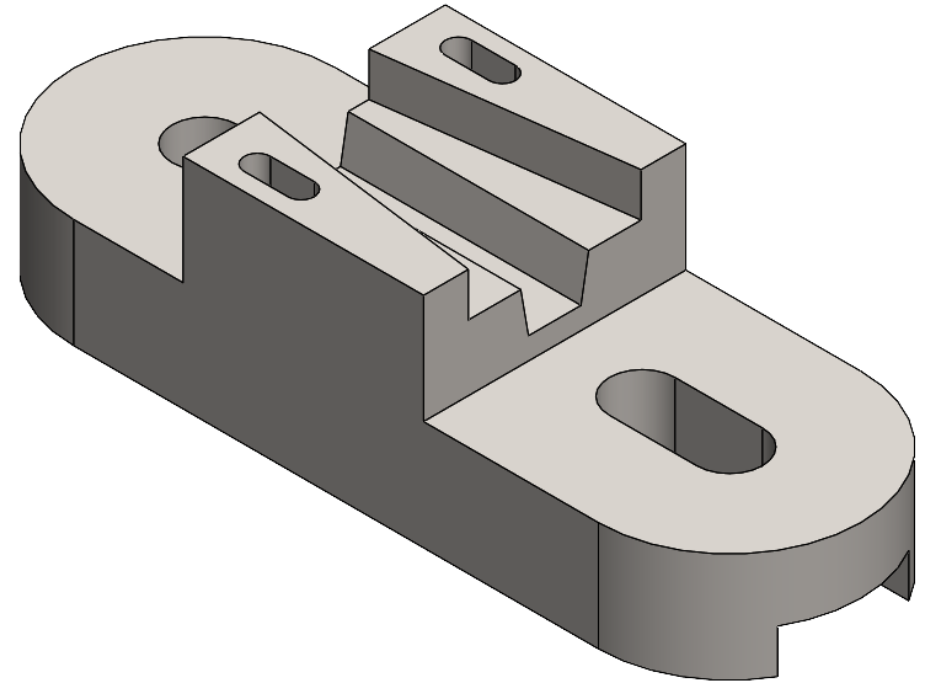


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Individual work case 1: Structured 3D FE mesh (3D body)

- Static structural module: Block 2 - 3D - Individual Example
- In Design Modeler upload geometry from file *Meshing_block_2.x_t*
- Try to reach at least 80 % element quality using (predominantly) hexagonal FEs
- Hint – use either
 - Geometry slicing or
 - Mesh method – Hex dominant or
 - Both methods combined



Thank you for your attention!

Contact:



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