

Detailed Design

MEC-E1060



Aalto University
School of Engineering

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12.10.2020

Selection of Machine Components

Use calculation programs and product catalogues provided by manufactures

- Power, forces and angular velocities as input values



Selection of Machine Components

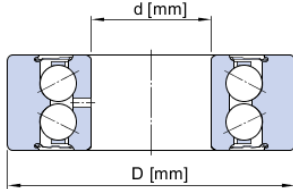
Select bearing

By designation

Designation Starts with

By bearing type

Bearing type [Select from list](#)

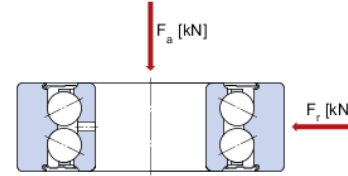


Outer diameter min mm Outer diameter max mm

Bore diameter min mm Bore diameter max mm

Note: The drawing displayed is only for general representation and may not be identical to the selected bearing variant.

Enter input parameters



Note: The drawing displayed is only for general representation and may not be identical to the selected bearing variant.

Bearing life

F_r
Radial load kN

F_a
Axial load kN

n_i
Rotational speed of the inner ring r/min

Operating temperature
Bearing outer ring °C

n_c specification method
Select from list

Viscosity calculation input type
Select from list

Viscosity at 40 °C
 mm²/s

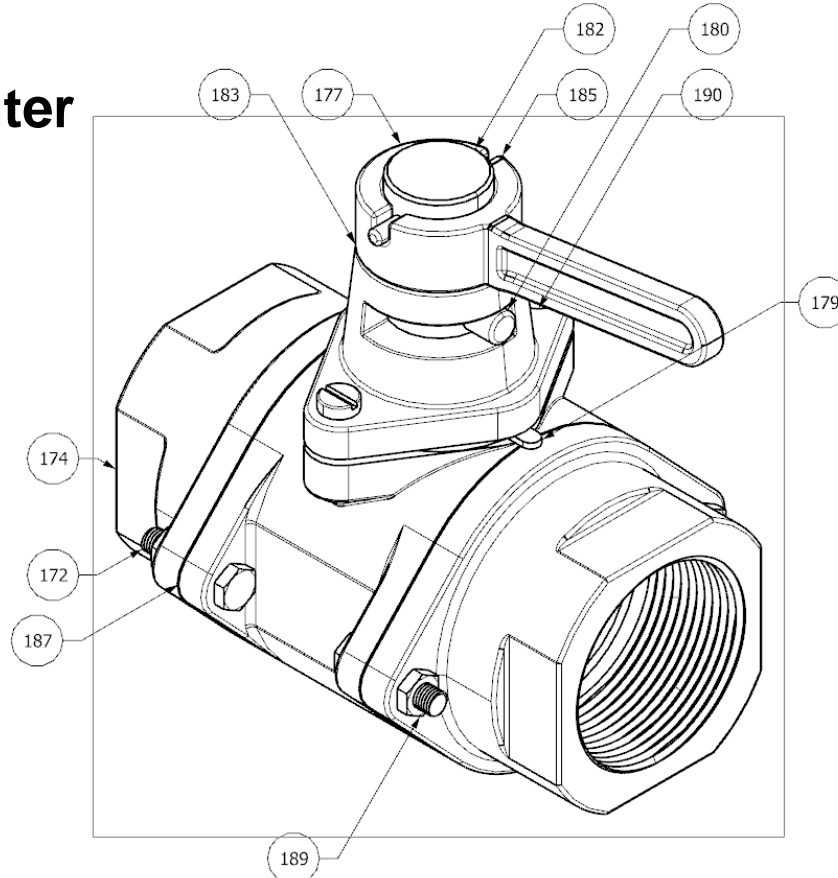
Bill of Materials (BOM)

Bill of Materials

An example

Values from Teamcenter

- ID as balloons
- Name as name



| | | |
|------------|---------------------|-----|
| 187 | Frame | 1 |
| 173 | Frame Sealing | 2 |
| 174 | Frame Side | 2 |
| 183 | Upper Frame | 1 |
| 177 | Handle | 1 |
| 182 | Shaft | 1 |
| 179 | Upper Frame Sealing | 1 |
| 175 | Ball | 1 |
| 185 | Shaft Pin | 1 |
| 180 | Pin | 1 |
| 190 | Screw Upper Frame | 2 |
| 172 | Screw Frame | 4 |
| 189 | Nut | 4 |
| DB PART NO | DB PART NAME | QTY |

Drawing Mode

When main assembly open

- New → Item

The 'New Item' dialog box is shown with the 'Drawing' tab selected. The 'Templates' section displays a table of drawing templates. The 'Name and Attributes' section shows a table with fields for ID, Revision, Name, and Dataset Name. The 'Reference Part' section includes input fields for Number, Revision, and Name, along with a 'Browse...' button.

| Name | Type | Units | Relationship | Owner |
|-----------|---------|-------------|---------------|--------------|
| A0 - Size | Drawing | Millimeters | specification | teamcente... |
| A1 - Size | Drawing | Millimeters | specification | teamcente... |
| A2 - Size | Drawing | Millimeters | specification | teamcente... |
| A3 - Size | Drawing | Millimeters | specification | teamcente... |
| A4 - Size | Drawing | Millimeters | specification | teamcente... |
| A0 - Size | Drawing | Millimeters | master | teamcente... |

| Name | Value |
|----------------|---------------|
| 1 ID | 000188 |
| 2 Revision | A |
| 3 Name | Ball Valve |
| 4 Dataset Name | 000188-A-dwg3 |

Reference Part

Number: 000188 Revision: A Name: 000188-A Browse...

Drawing Mode

View Creation Wizard guides thru visibility settings

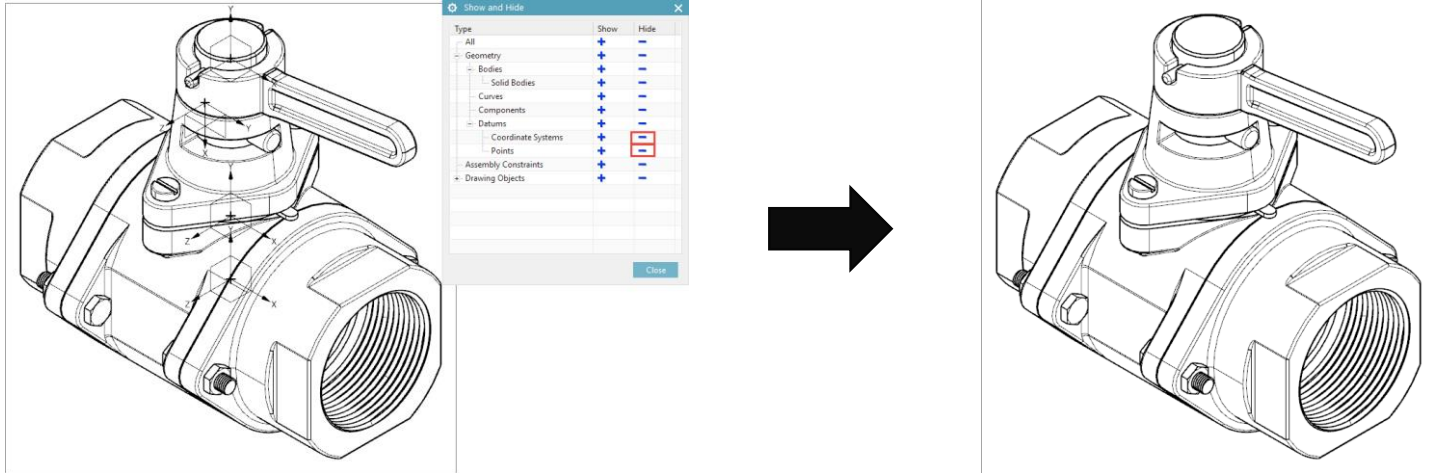
- Options → Preview style to Hidden Wireframe
- Orientation (Isometric if possible)



Show and Hide

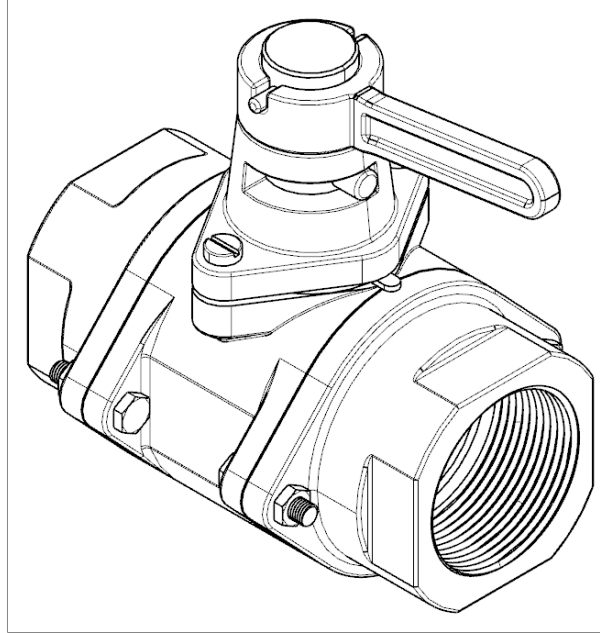
In View tab

Allows showing/hiding of different entities



Parts List

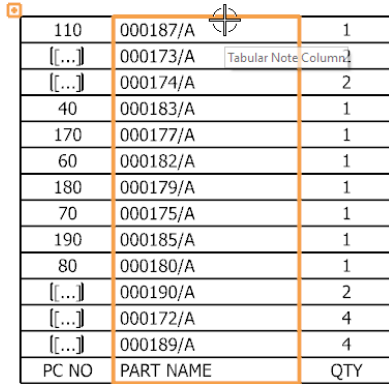
By default, part's ID is shown



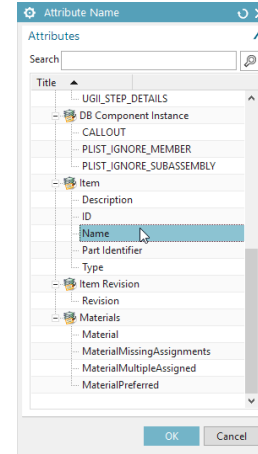
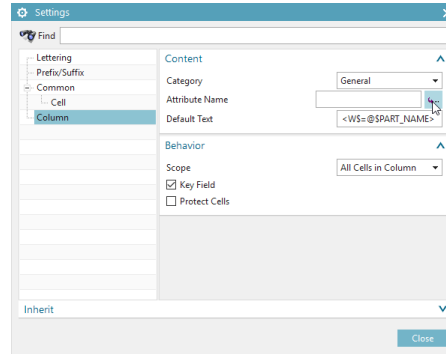
| | | |
|-------|-----------|-----|
| 110 | 000187/A | 1 |
| [...] | 000173/A | 2 |
| [...] | 000174/A | 2 |
| 40 | 000183/A | 1 |
| 170 | 000177/A | 1 |
| 60 | 000182/A | 1 |
| 180 | 000179/A | 1 |
| 70 | 000175/A | 1 |
| 190 | 000185/A | 1 |
| 80 | 000180/A | 1 |
| [...] | 000190/A | 2 |
| [...] | 000172/A | 4 |
| [...] | 000189/A | 4 |
| PC NO | PART NAME | QTY |

Parts List

Column show options can be changed by selecting the column



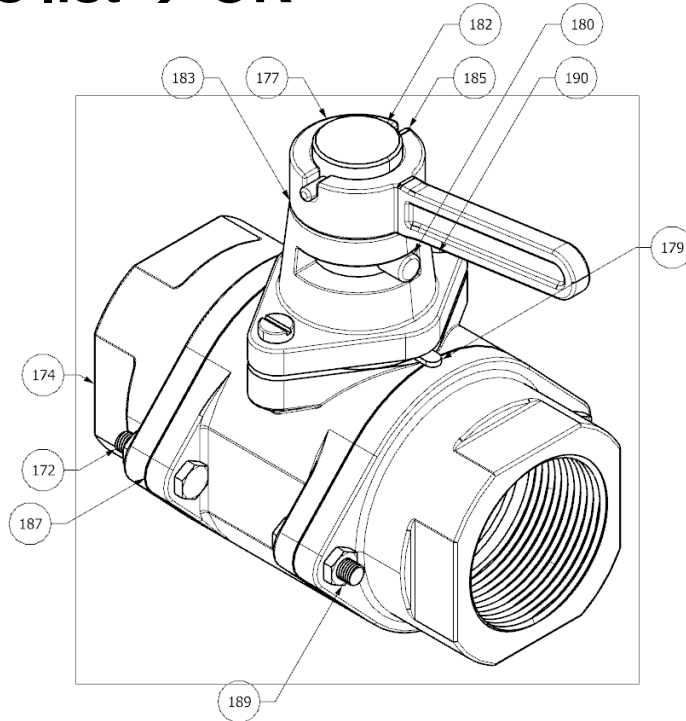
| | | |
|-------|-----------|-----|
| 110 | 000187/A | 1 |
| [...] | 000173/A | 2 |
| [...] | 000174/A | 2 |
| 40 | 000183/A | 1 |
| 170 | 000177/A | 1 |
| 60 | 000182/A | 1 |
| 180 | 000179/A | 1 |
| 70 | 000175/A | 1 |
| 190 | 000185/A | 1 |
| 80 | 000180/A | 1 |
| [...] | 000190/A | 2 |
| [...] | 000172/A | 4 |
| [...] | 000189/A | 4 |
| PC NO | PART NAME | QTY |



| | | |
|-------|---------------------|-----|
| 110 | Frame | 1 |
| [...] | Frame Sealing | 2 |
| [...] | Frame Side | 2 |
| 40 | Upper Frame | 1 |
| 170 | Handle | 1 |
| 60 | Shaft | 1 |
| 180 | Upper Frame Sealing | 1 |
| 70 | Ball | 1 |
| 190 | Shaft Pin | 1 |
| 80 | Pin | 1 |
| [...] | Screw Upper Frame | 2 |
| [...] | Screw Frame | 4 |
| [...] | Nut | 4 |
| PC NO | DB PART NAME | QTY |

Balloons

Auto Balloon → Select Parts list → OK



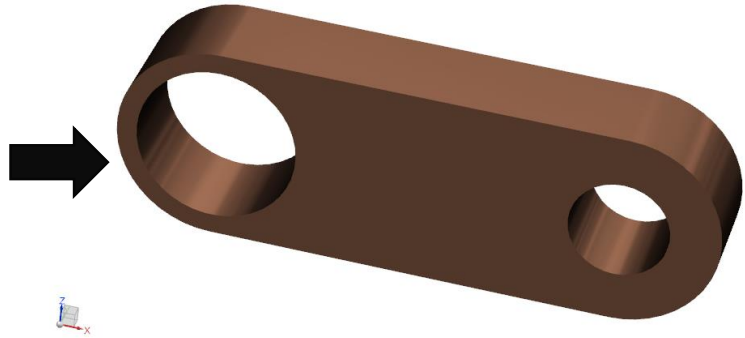
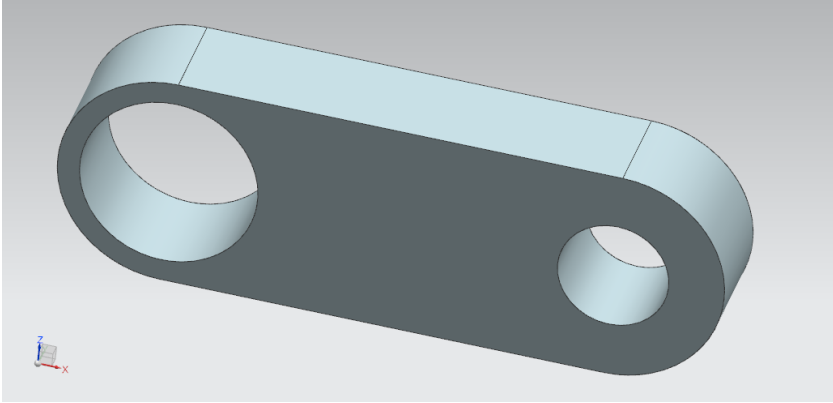
| | | |
|------------|---------------------|-----|
| 187 | Frame | 1 |
| 173 | Frame Sealing | 2 |
| 174 | Frame Side | 2 |
| 183 | Upper Frame | 1 |
| 177 | Handle | 1 |
| 182 | Shaft | 1 |
| 179 | Upper Frame Sealing | 1 |
| 175 | Ball | 1 |
| 185 | Shaft Pin | 1 |
| 180 | Pin | 1 |
| 190 | Screw Upper Frame | 2 |
| 172 | Screw Frame | 4 |
| 189 | Nut | 4 |
| DB PART NO | DB PART NAME | QTY |

Print → Select a PDF printer



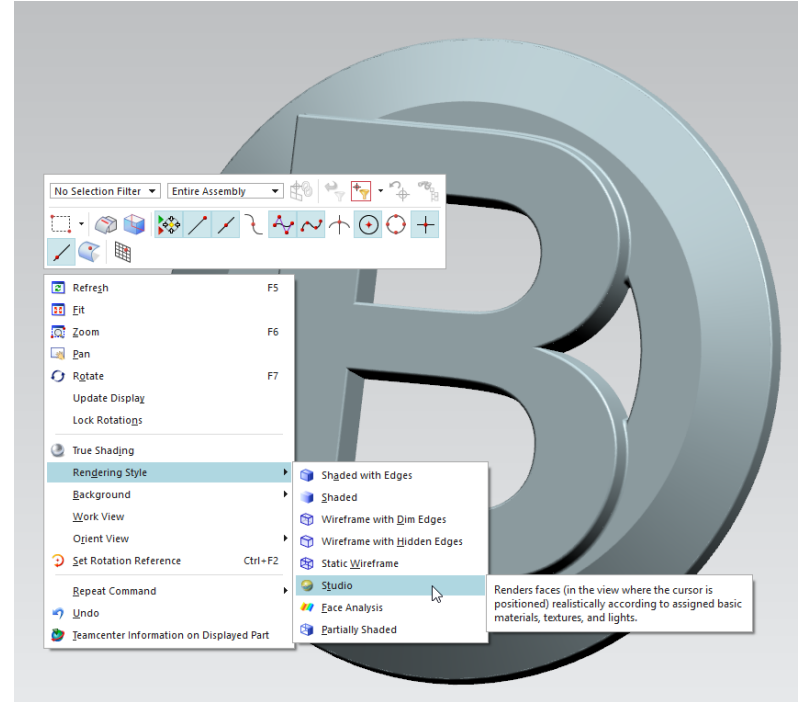
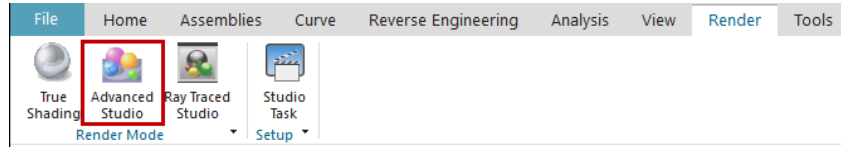
Rendering

Rendering



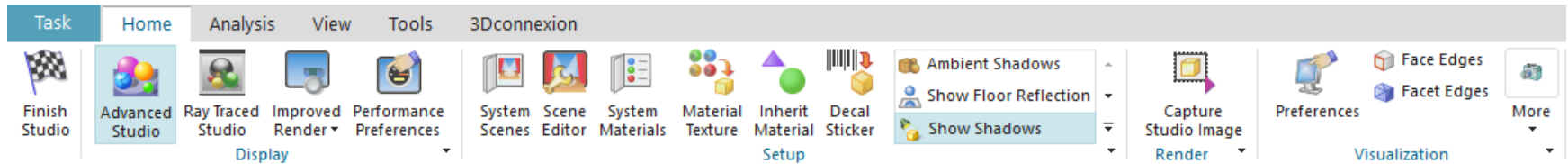
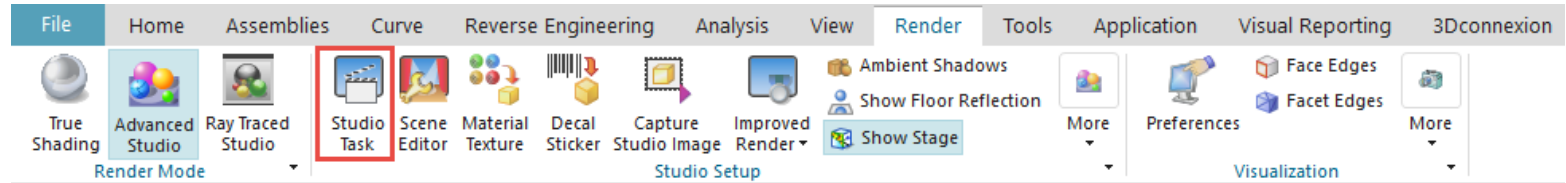
Rendering

Rendering tools integrated in NX



Rendering

Studio Task

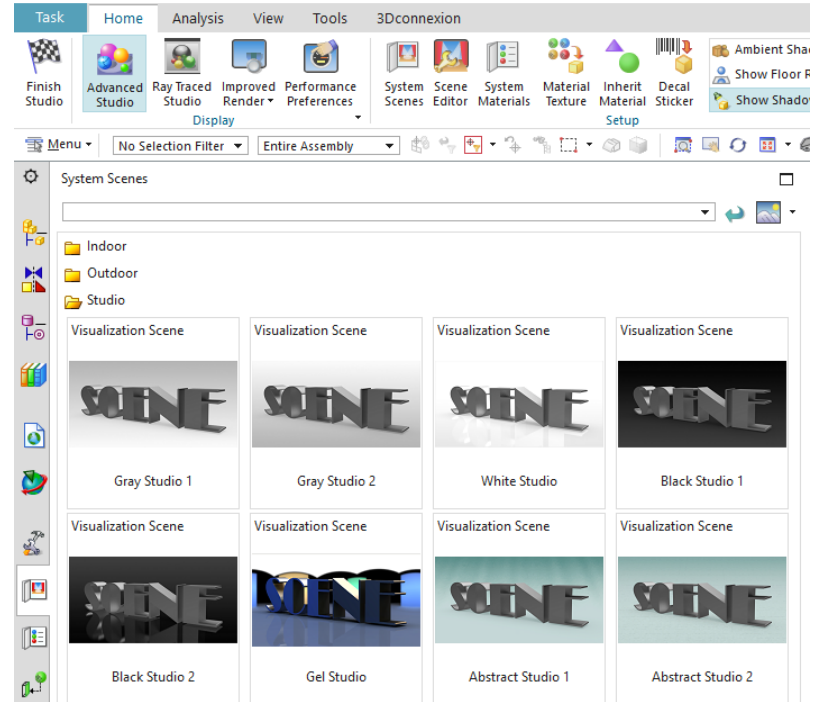


Rendering

System Scenes

Predefined sets of settings

- Lights, background, reflections, shadows etc.

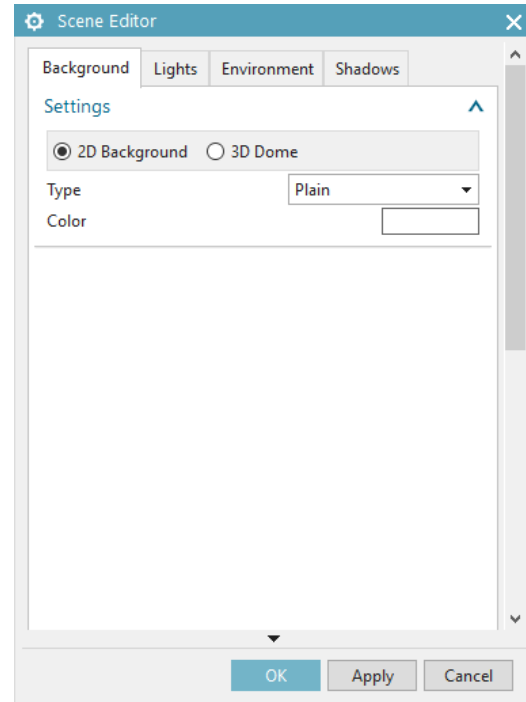


Rendering

Scene Editor

Create your of scene

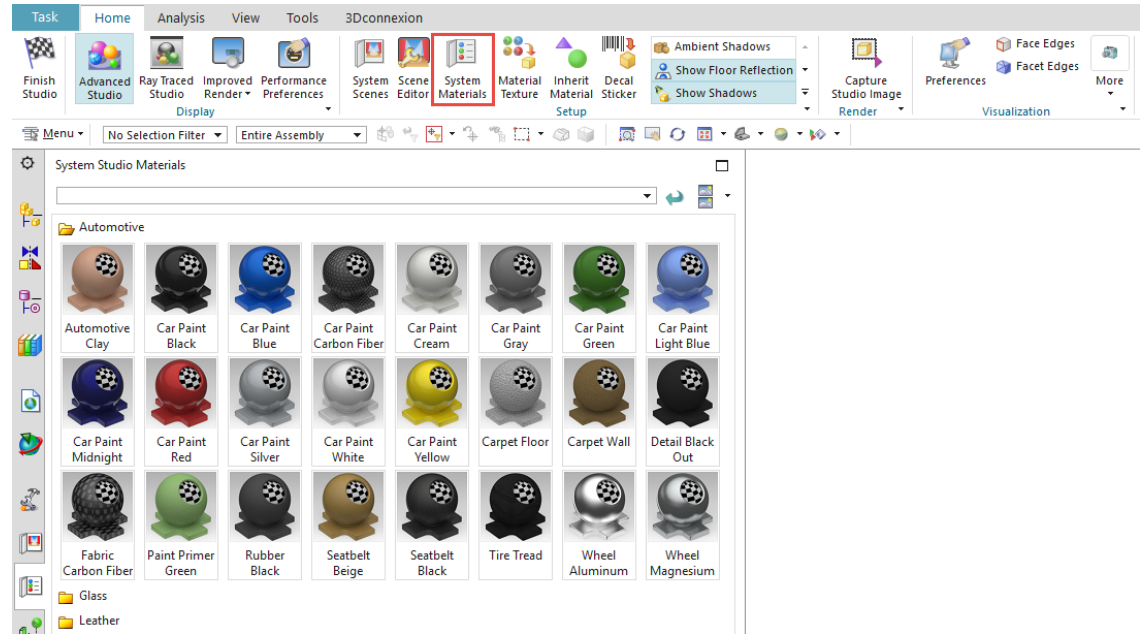
- Background
- Lights
- Environment
- Shadows



Rendering

System Materials

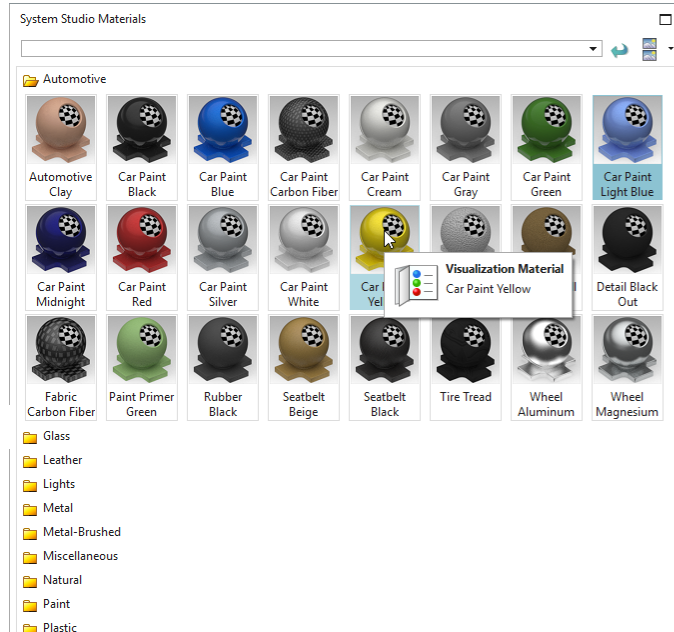
Set of predefined materials



Rendering

System Materials

First part/surface, then material

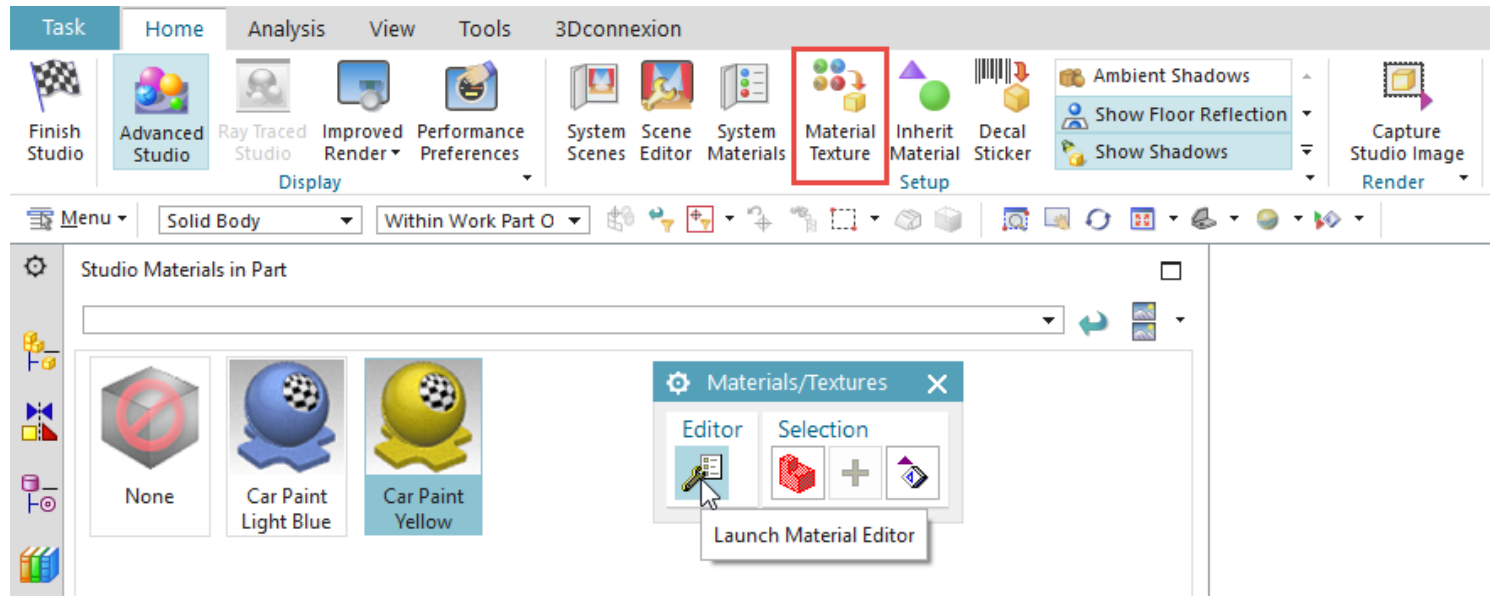


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Rendering

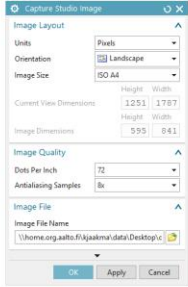
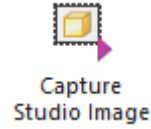
Material Texture

Allows modifying materials in the scene



Rendering

Capture Studio Image



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Flexible Multi-Body Analyzes

Bonus

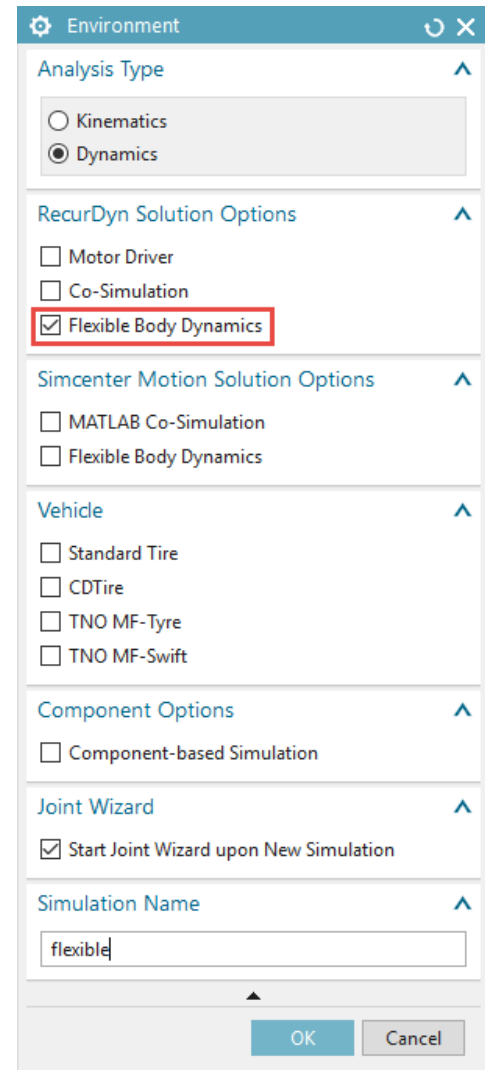
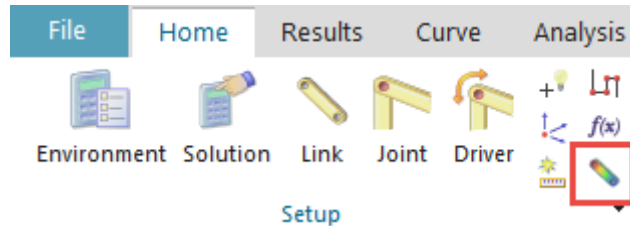


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NX Environment

Flexible option must be selected beforehand

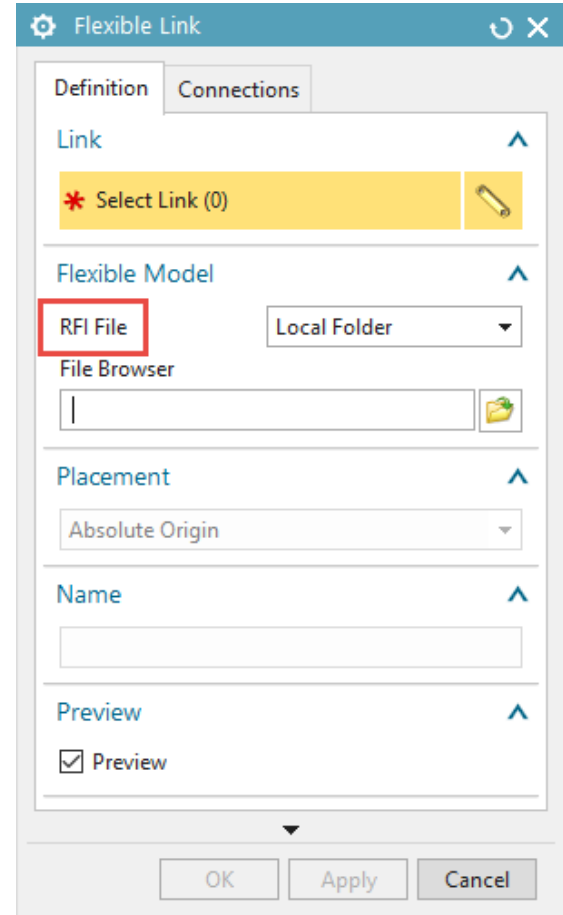
- Otherwise normal MBS model
- New button for flexible link



Flexible Link

Flexible link needs RFI file

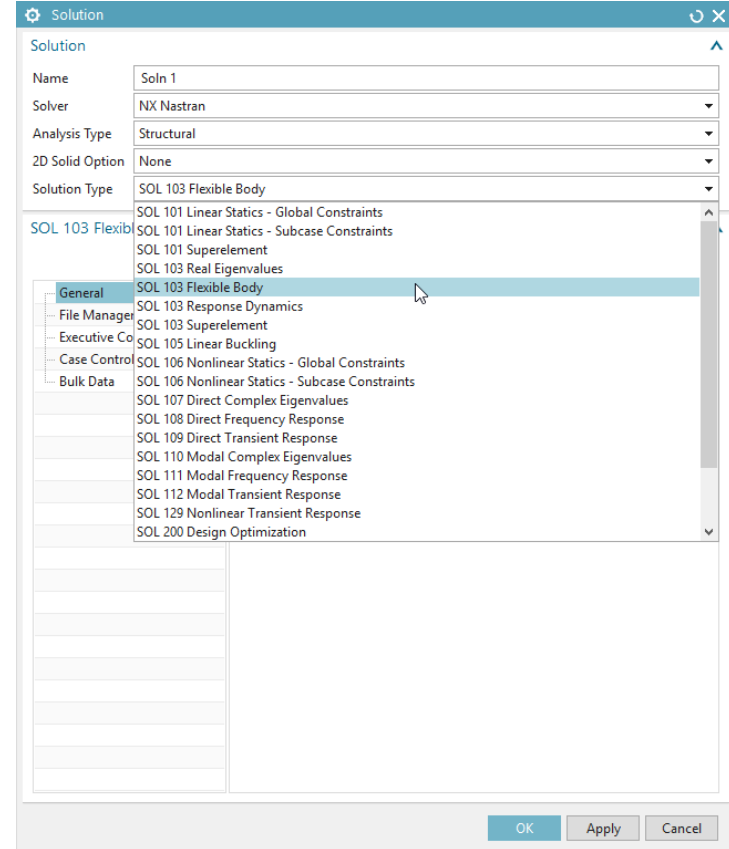
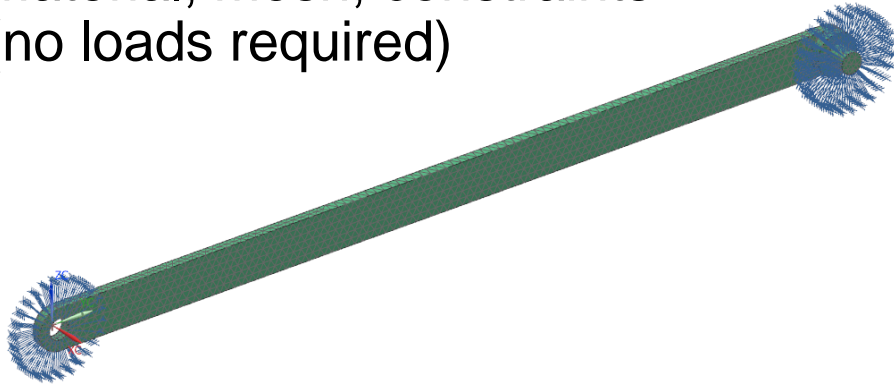
- Can be created in NX Nastran
- Basically a FEM mesh



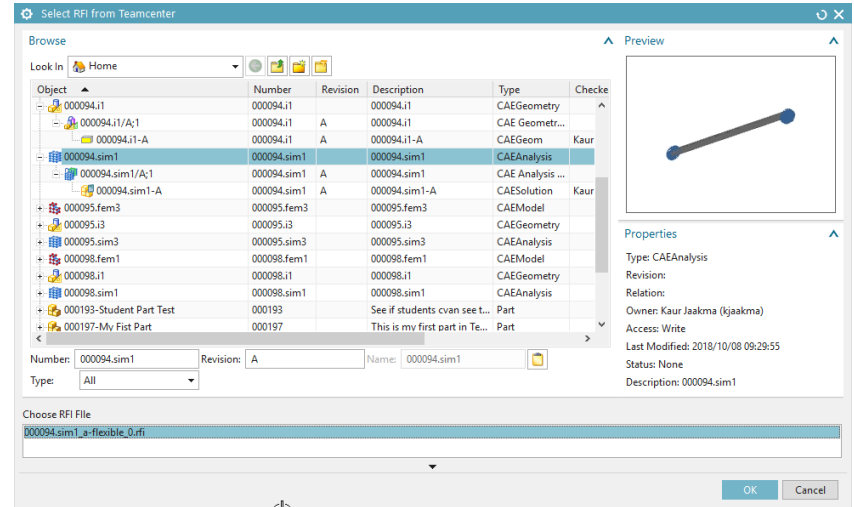
RFI File

NX Nastran solver

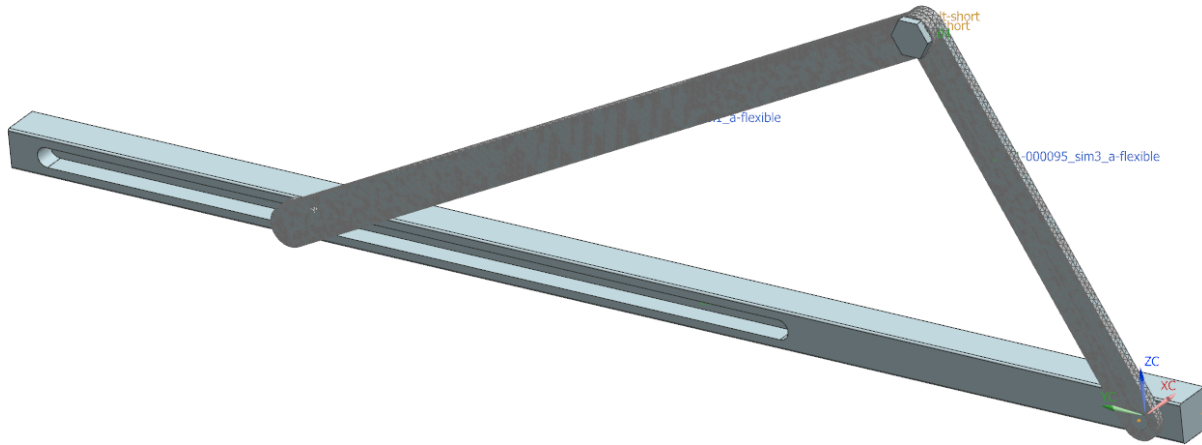
- SOL 103 Flexible Body as Solution (modal analysis)
- Material, mesh, constraints (no loads required)



RFI File



Solution



Solution

Solution Option

Solution Type: **Flexible Body**

Analysis Type: Kinematics/Dynamics

Time: 10 sec

Steps: 60

☐ Skip Steps

☐ Include Static Analysis

☐ Solve with OK

Gravity

Specify Direction

Gravity: 9806.65 mm/sec²

Settings

Name: Solution_1

Solver Parameters

Dynamics/Kinematics

Initial Step Size: 1e-006

Error Tolerance: 0.001

Maximum Step Size: 0.01

Numerical Damping: 1

Maximum Iterations: 50

Statics

Integrator: Robust N-R

Error Tolerance: 0.001

Maximum Iterations: 100

Initial Step Size: 1e-006

Maximum Step Size: 1

Redundant Constraint Violation

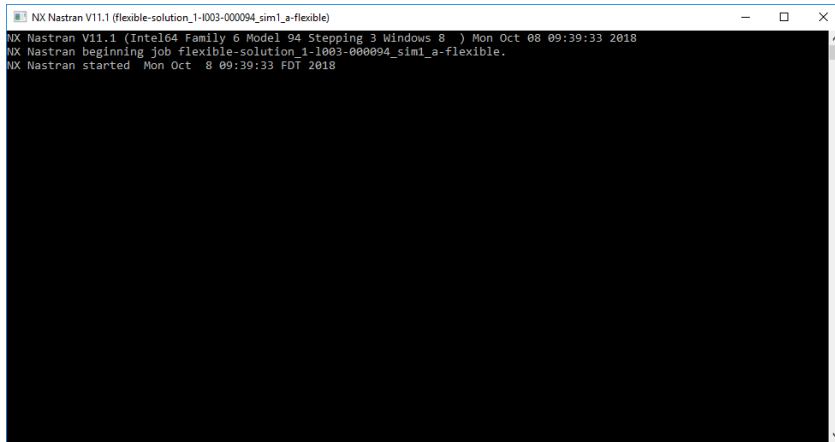
Length Tolerance: 0.005 mm

Angle Tolerance: 0.1 deg

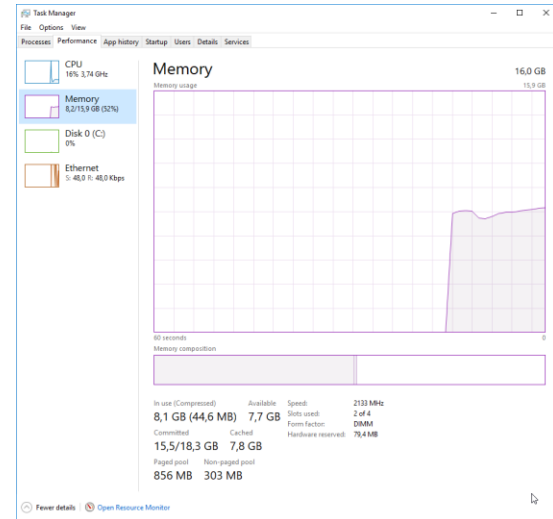
OK Apply Cancel

Own Solver

When all command windows are gone, simulation is ready



```
NX Nastran V11.1 (flexible-solution_1-1003-000094_sim1_a-flexible)
NX Nastran V11.1 (Intel64 Family 6 Model 94 Stepping 3 Windows 8 ) Mon Oct 08 09:39:33 2018
NX Nastran beginning job flexible-solution_1-1003-000094_sim1_a-flexible.
NX Nastran started Mon Oct 8 09:39:33 FDT 2018
```

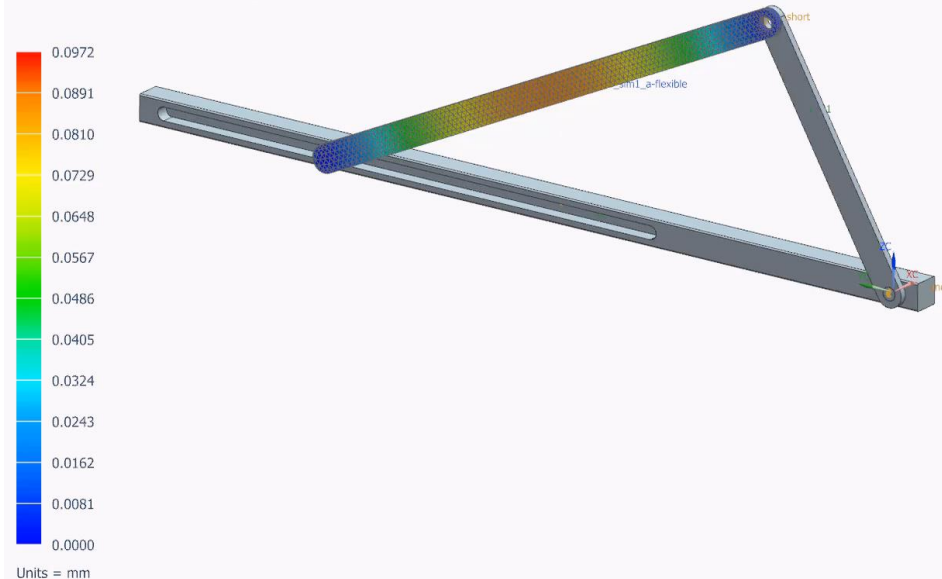


Result Movie

In Teams FAQ channel file folder

Imported Result : flexible-solution_1-l003-000094_sim1_a-flexible
Load Case 1, Increment 61, 10 sec
Translational Deformation - Nodal, Magnitude
Min : 0.0000, Max : 0.0863, Units = mm
Deformation : Displacement - Nodal Magnitude

Time 10.000000
Step 60



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