ENG-A2001

Period II – Mechanical Engineering

Aalto University
School of Engineering

Kaur Jaakma

1.11.2021

Content

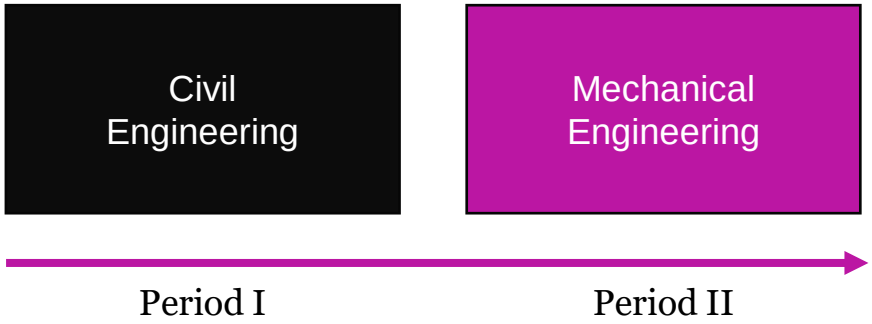
Practical arrangements of Mechanical Engineering module

CAD in Mechanical Engineering

Course structure

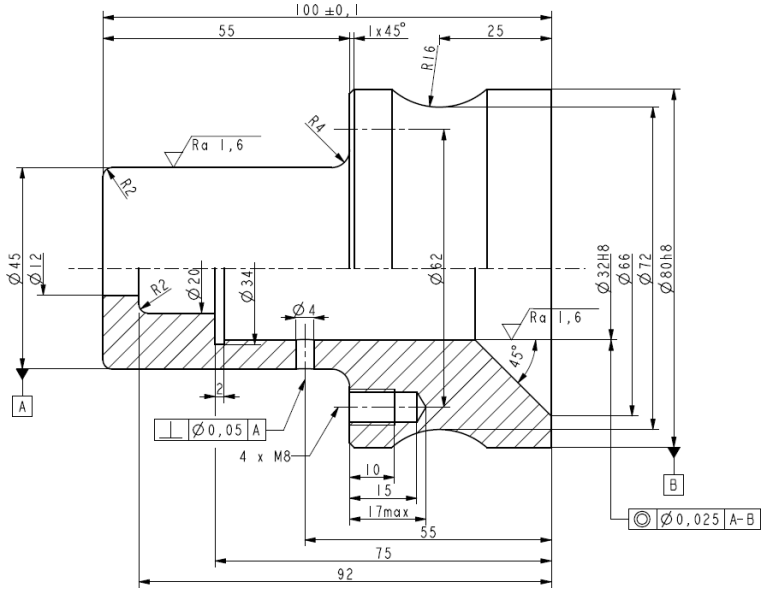
Two modules

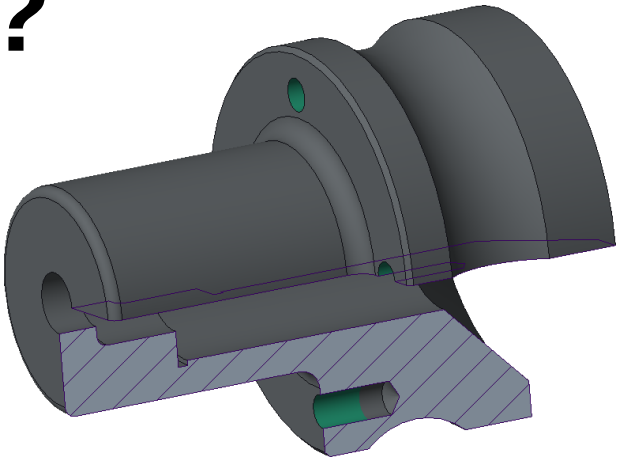
- CAD/CAE tools in Civil Engineering
- CAD/CAE tools in Mechanical Engineering
- Both obligatory and needed to be completed during the same semester

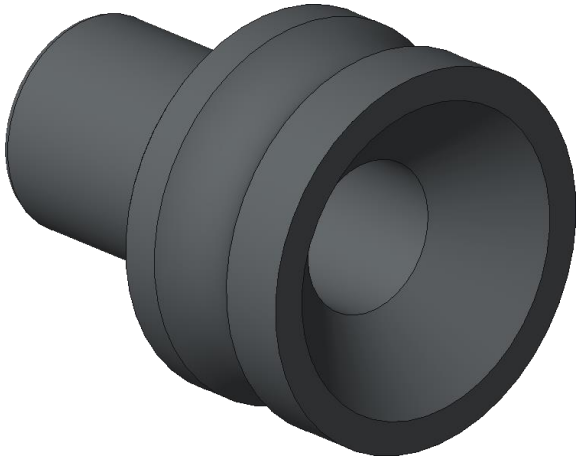


Why We Need 3D CAD?

To communicate

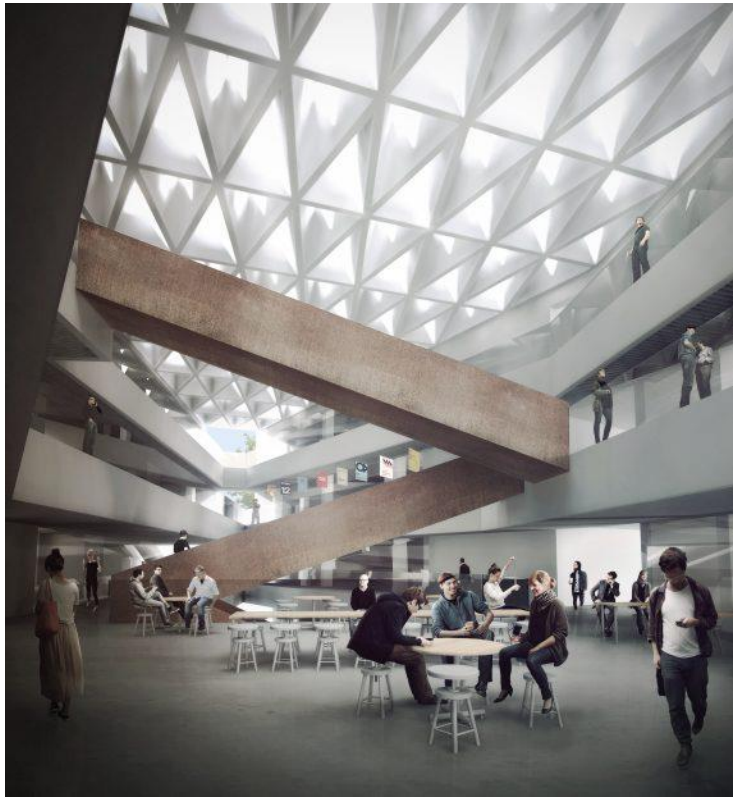






Why CAD?

To visualize



Why CAD?

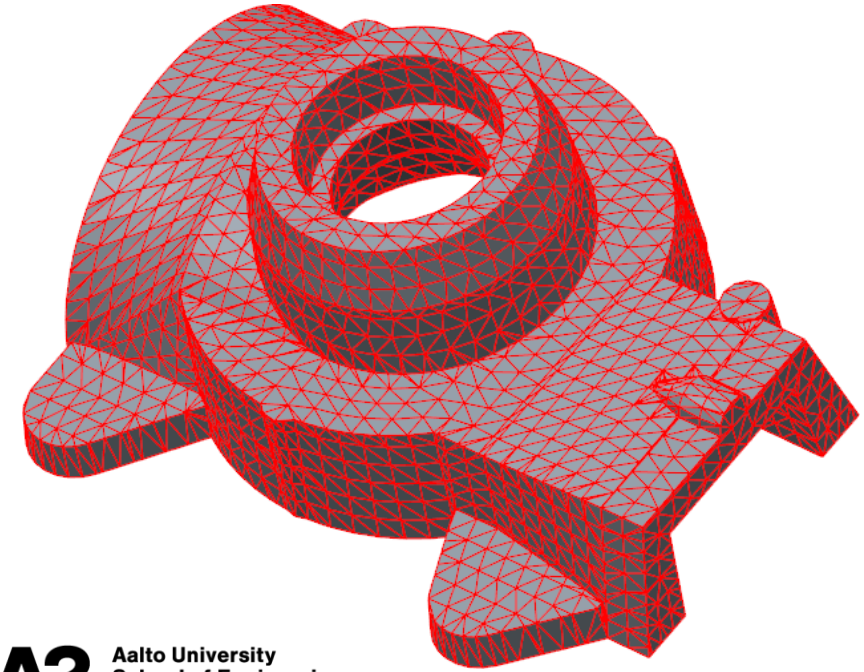
To visualize

Why CAD?

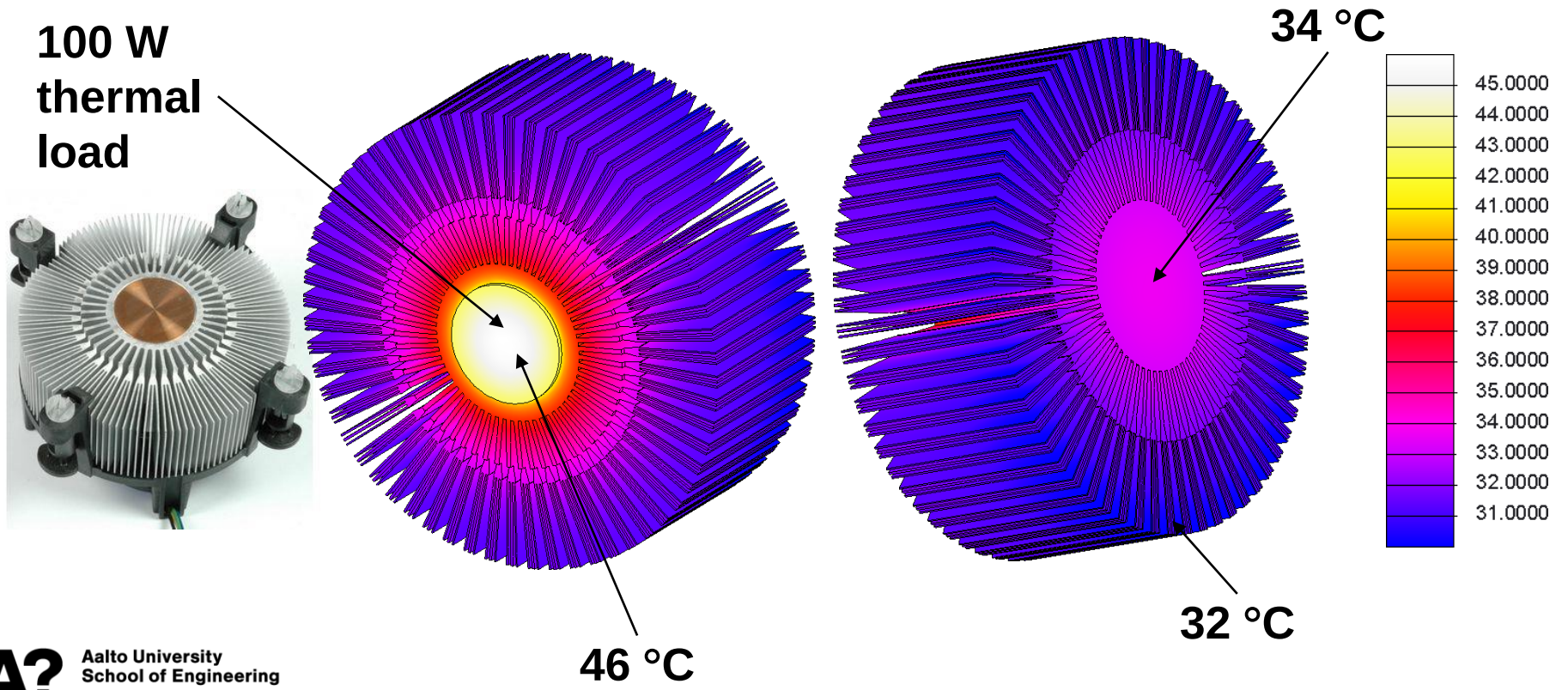
Augment/Virtual Reality (AR/VR)

Why CAD?

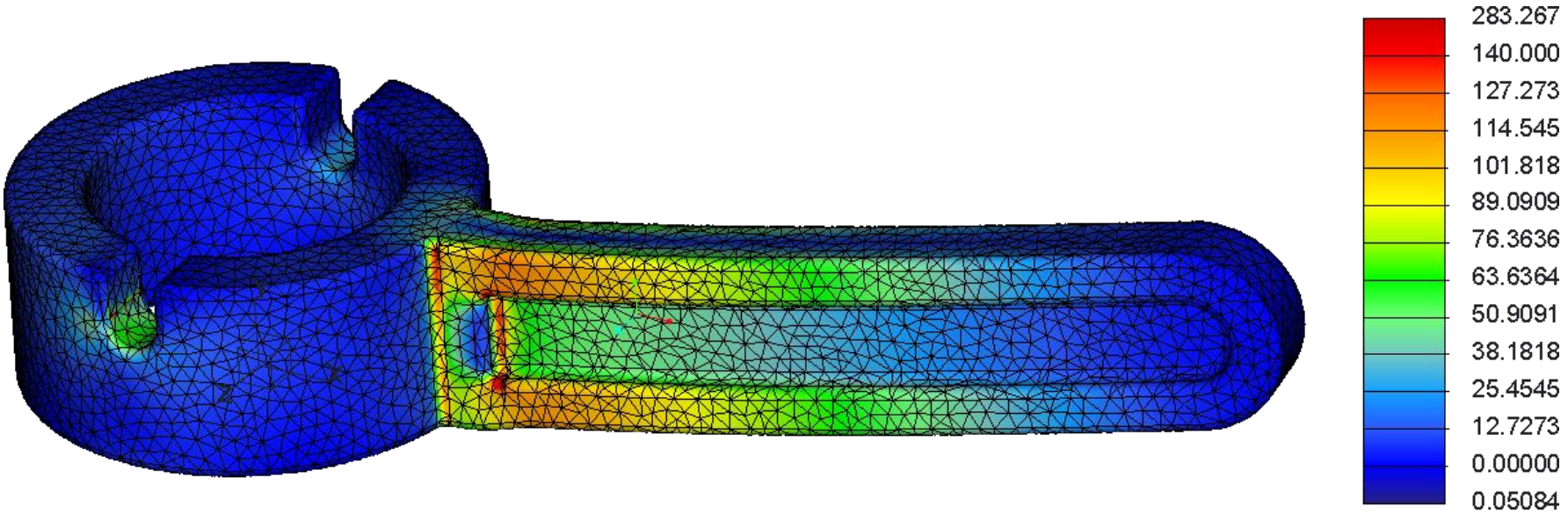
Additive manufacturing (3D printing)



Input Geometry for Simulations



Input Geometry for Simulations



Learning outcomes & content

After the module student will be familiar with computer-aided tools utilized in the field of mechanical engineering.

- Concept of feature-based and parametric CAD
- Creation of parts and assemblies
- Sheet medal design
- Engineering drawings
- Performing basic motion and strength simulations

Staff

Kaur Jaakma

- Teacher-in-charge
- Lectures
- Wednesday’s exercise guidance

Tuukka Ormio

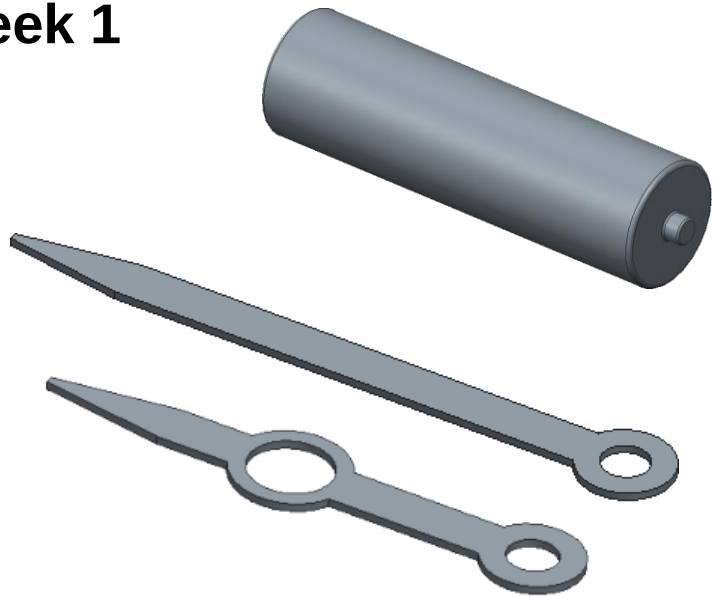
- Friday’s exercise guidance

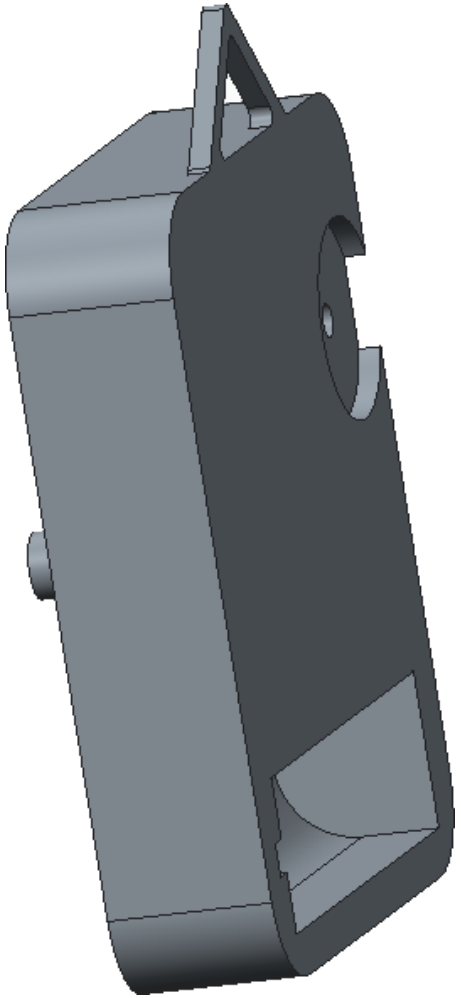
Exercises

Week	Topics
44	**Part modeling and Part families (1.1, 1.2, 1.3)**
45	**Sheet medal products and Assemblies (2.1, 2.2)**
46	**Engineering drawings (3.0, 3.1, 3.2)**
47	**Advanced features and Parametrization (4.1, 4.2)**
48	**Mechanism and Strength analyses (5.1, 5.2)**
49-50	**Final project (6.1)**

Exercises Illustrated

Week 1





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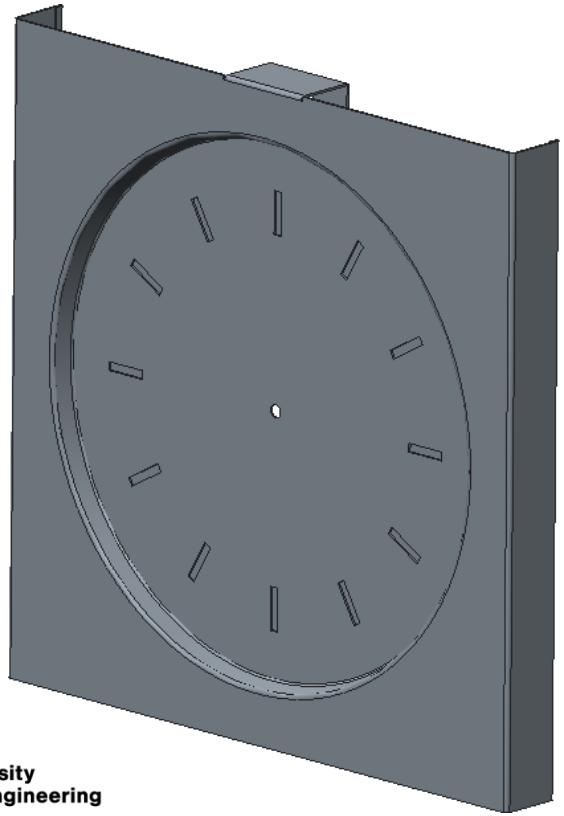
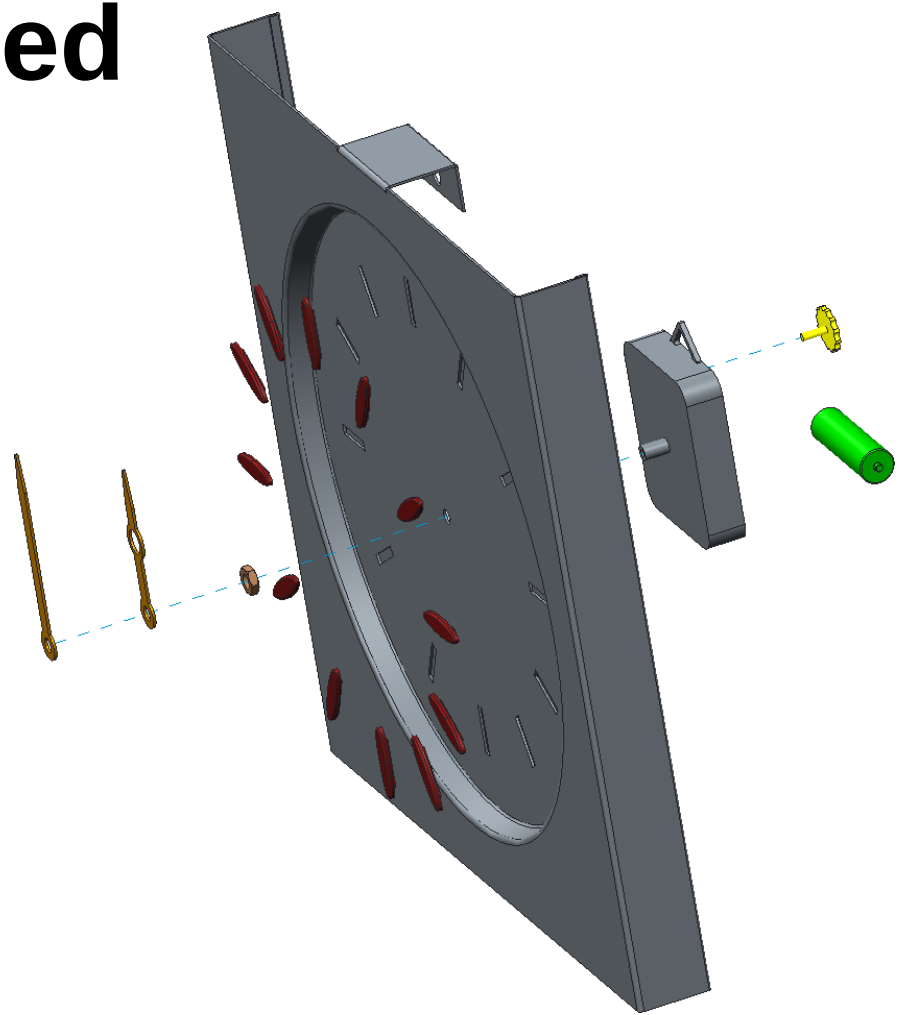
Exercises Illustrated

Week 2





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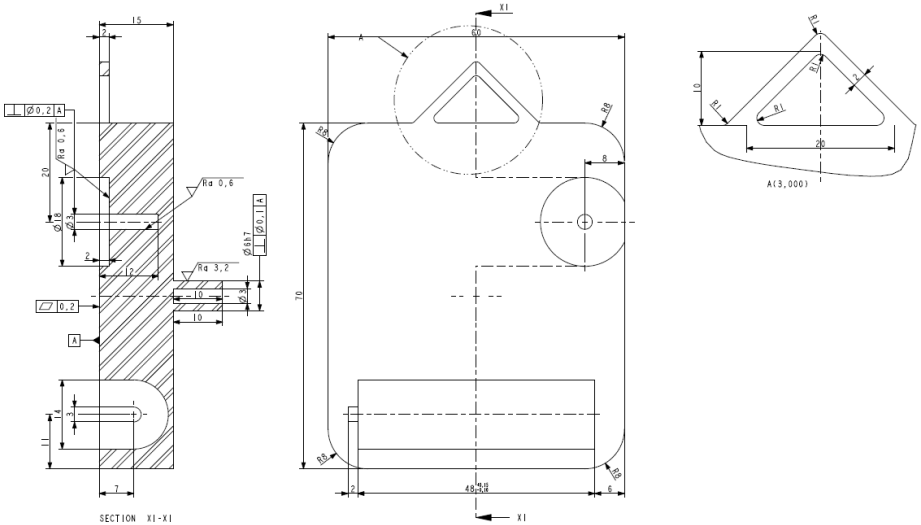
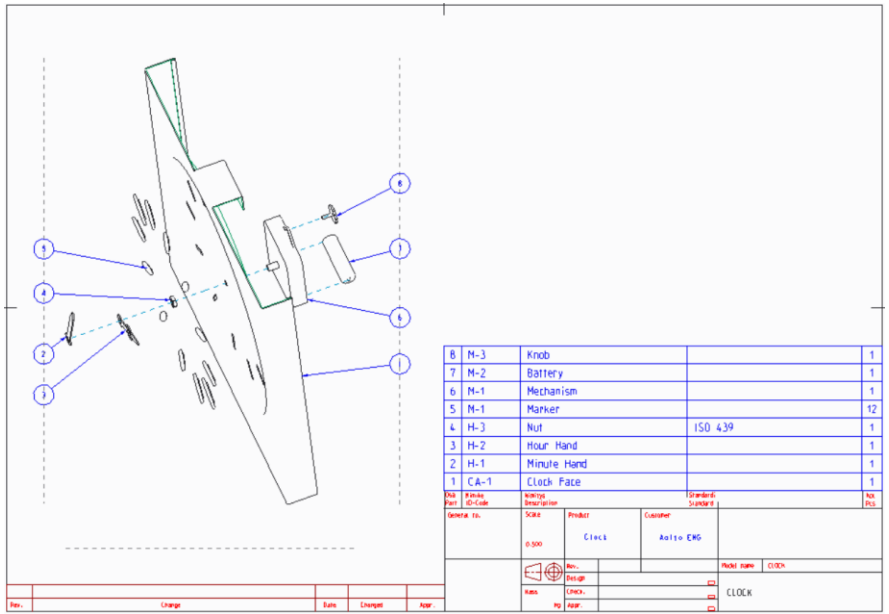
Exercises Illustrated

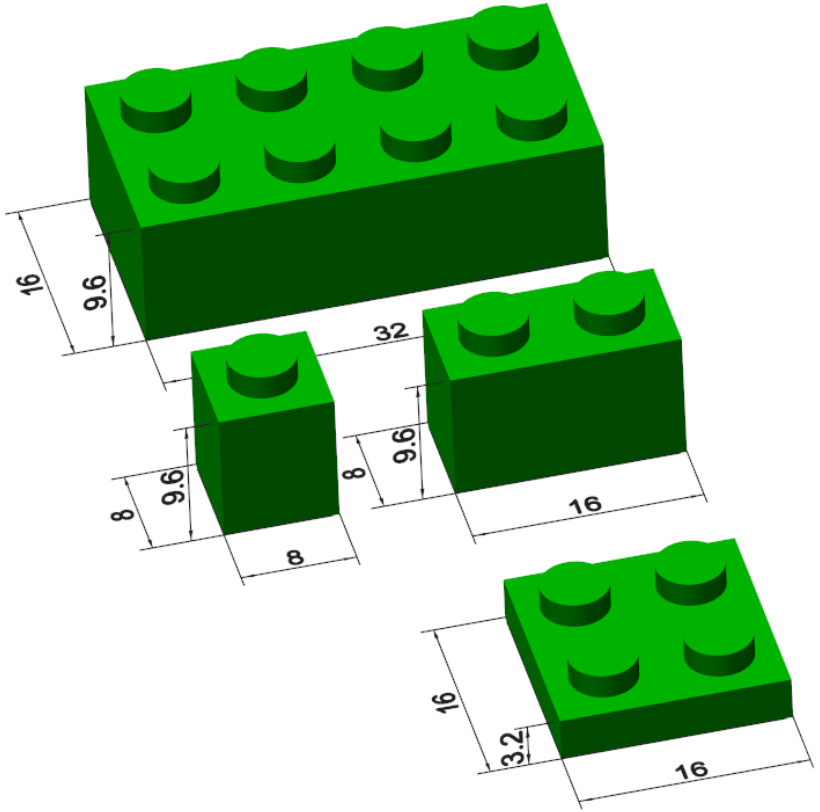
Week 3





Exercises Illustrated

Week 4



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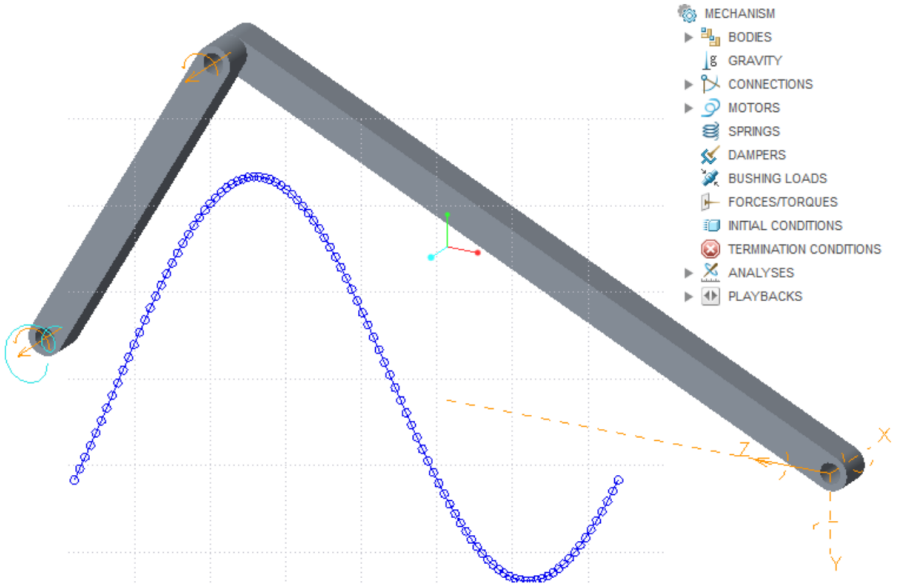
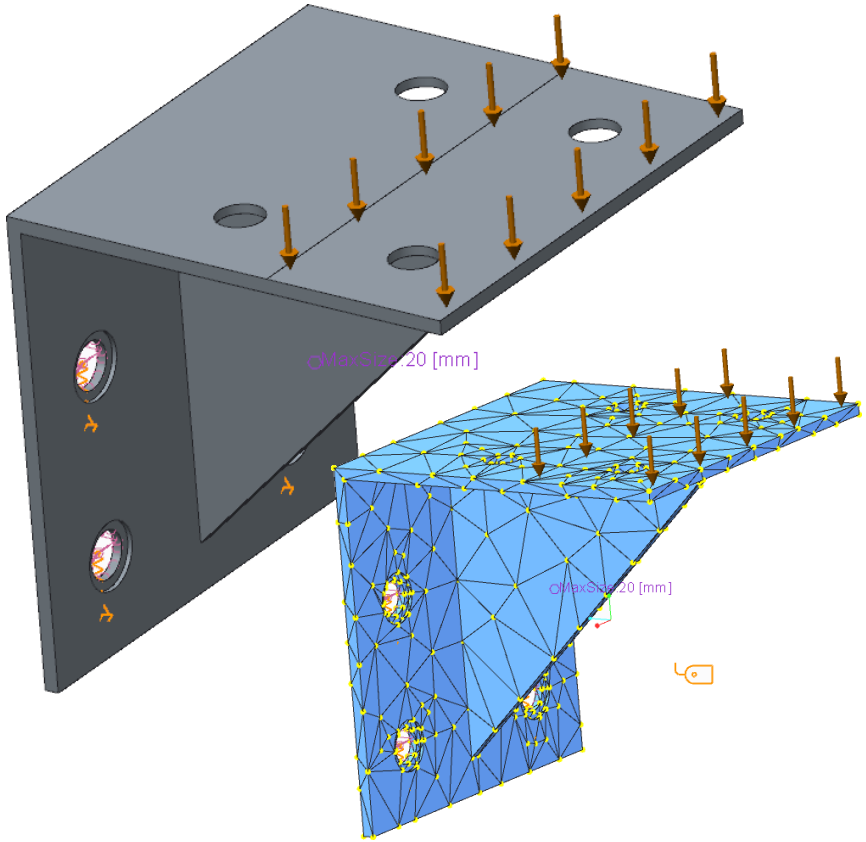
Exercises Illustrated

Week 5





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Exercises Illustrated

Weeks 6-7

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Workload

2,5 ECTS → 67,5 hrs

7 weeks = 9,6 hrs/week

(6 weeks = 11,25 hrs/week)

2 hrs of lectures, 8 hrs of guidance sessions with assistant / week

Software

Utilized software is PTC Creo 6.0.2.0

- Parametric module
- Integrated CAD/CAE/CAM software

Home usage

- \\work\COURSES\T\Kon\ENG-A1001\general\Creo media\
- Demands constant VPN connection to Aalto license server

Remote desktop connection to classroom computers

- mfavdi.aalto.fi and Maari-C, K148 or A046/a classrooms

Example Creo users in Finland

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Source: Econocap Oy, Convia Oy

Example Creo users in the World

Source: https://www.linkedin.com/groups/What-are-most-famous-companies-1542977.S.591289180280064819 4 Refered on 3.3.2015

CAD in Mechanical Engineering

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Computer-aided Tools in the field of Mechanical Engineering

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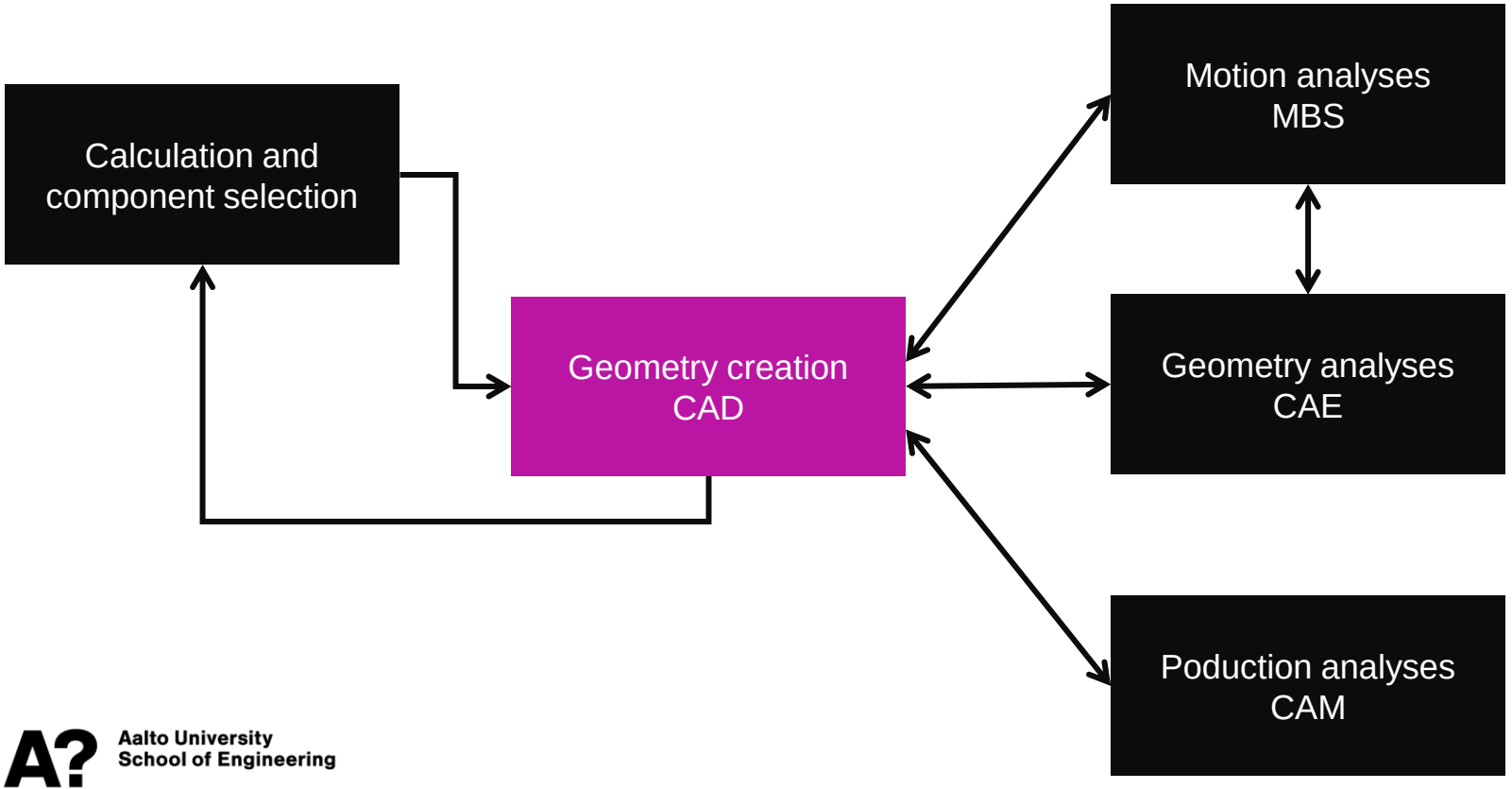
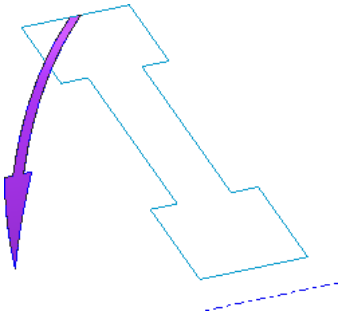
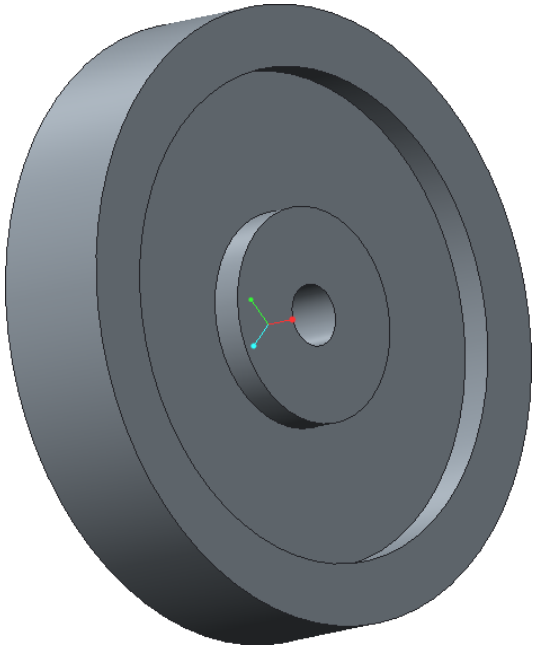
Relationships between software



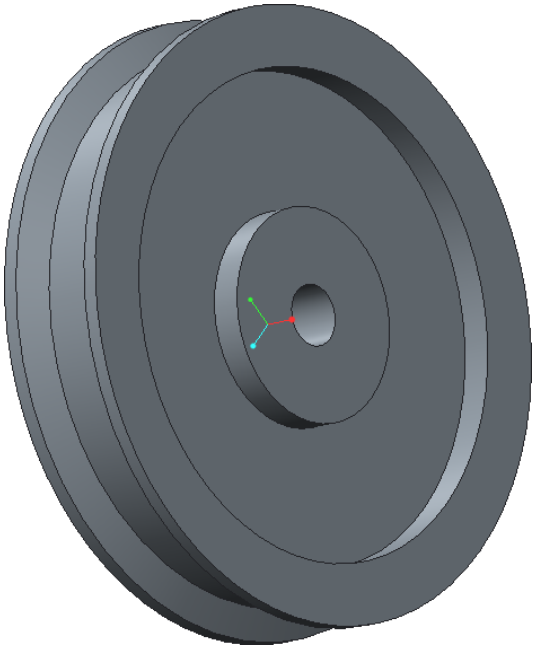
Modeling with 3D-CAD



Profile

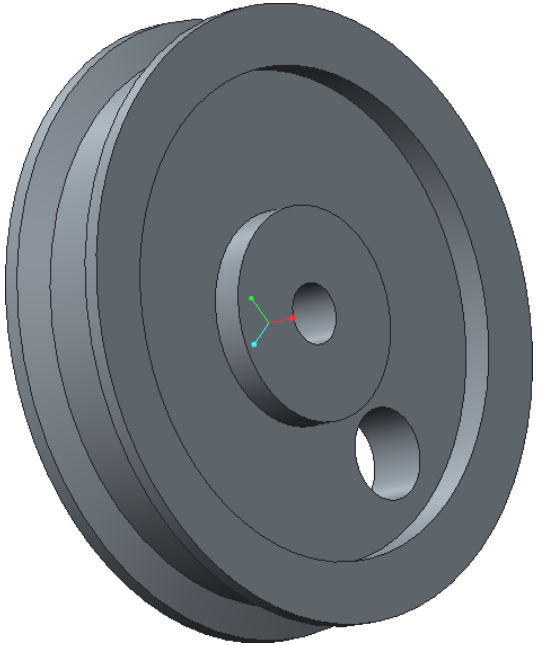


3D shape

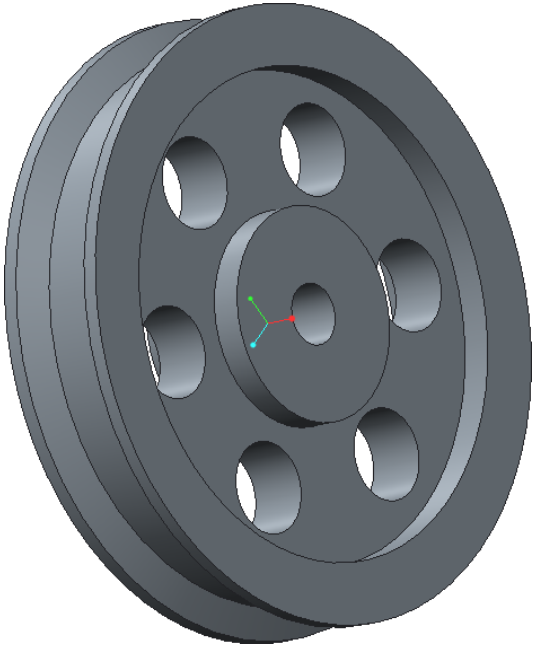


Cutout

Modeling with 3D-CAD



A hole



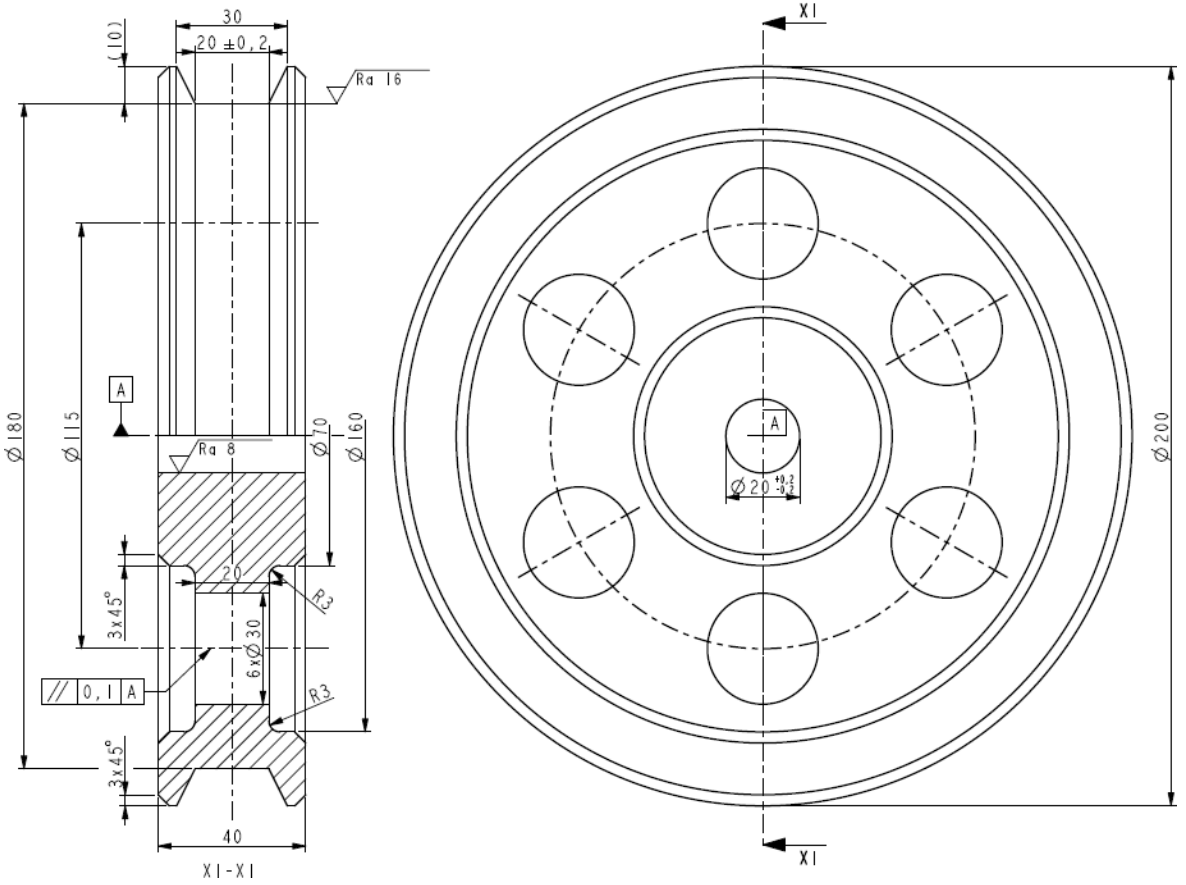
A pattern of holes

Fine-tuning

Utilization of 3D model

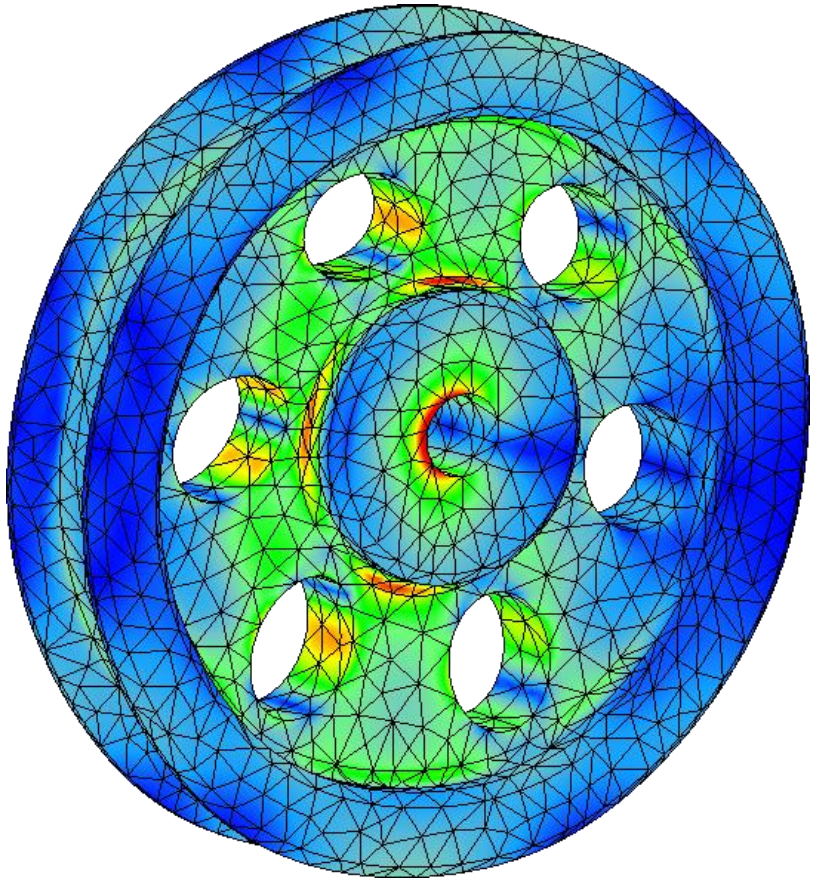
2D Engineering Drawing

- For manufaktuurin
- For documentation



Utilization of 3D model

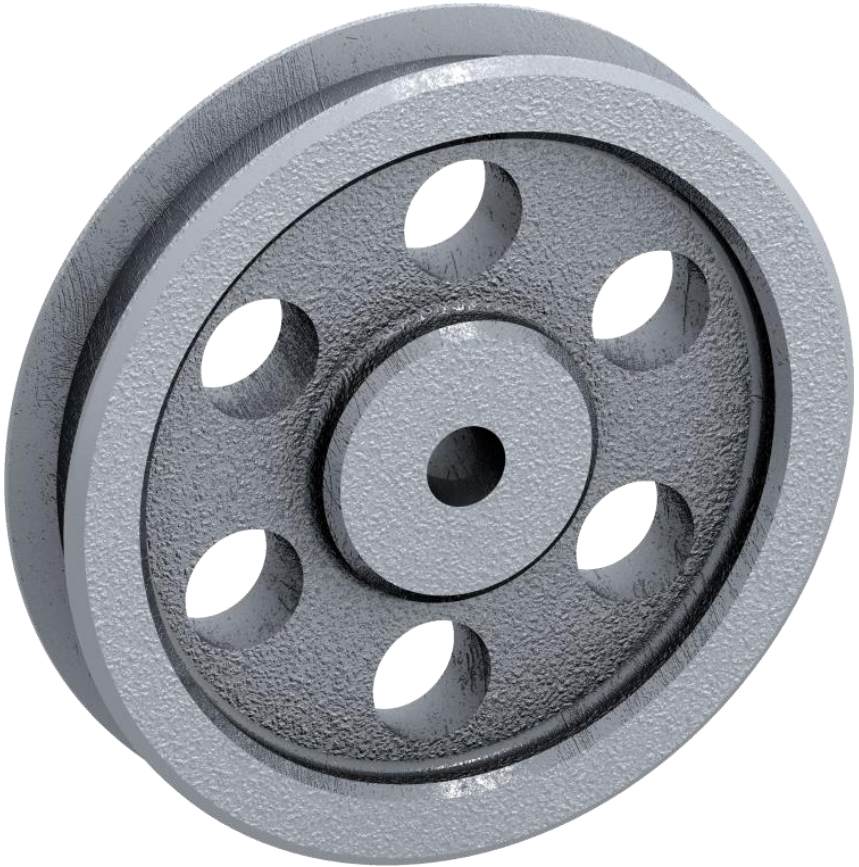
Strenght analyses



Utilization of 3D model

Visualization

Rendering



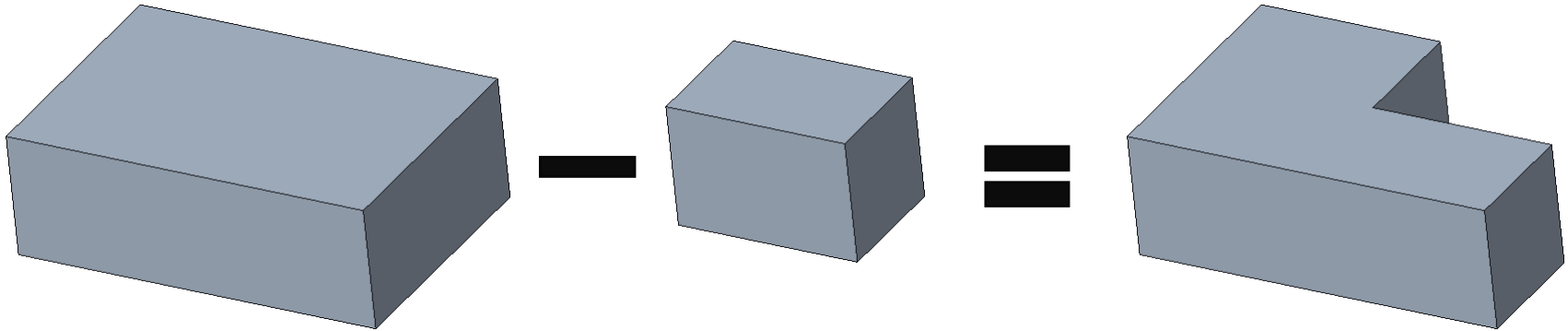
CAD Models

CAD models in mechanical engineering are

- Feature-based
- History-based
- Parametric
- Solid models

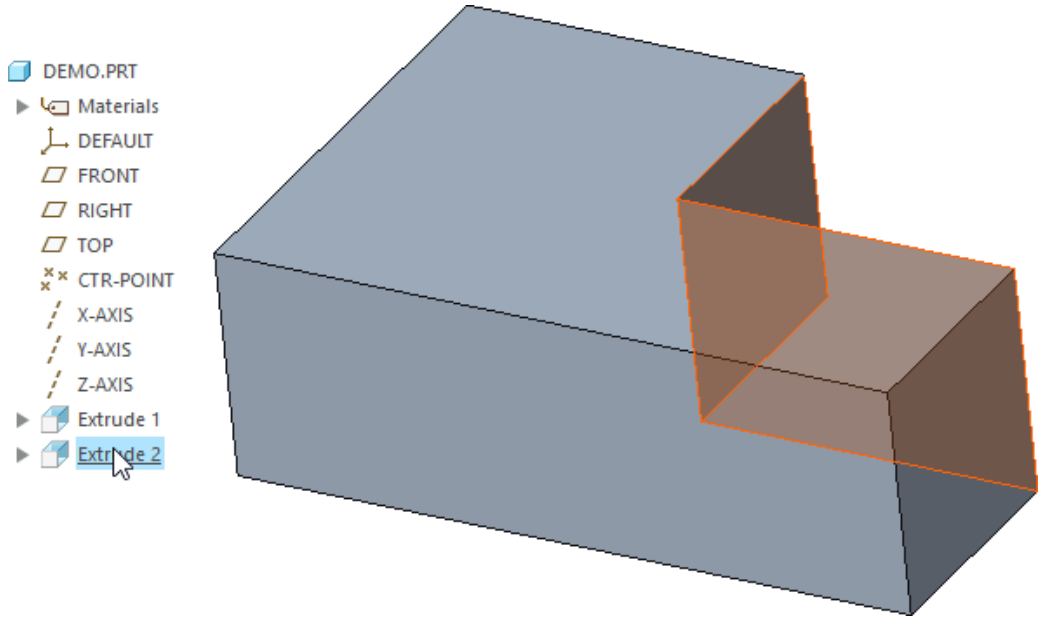
Feature-based

Complex geometries are built on features and operations between them



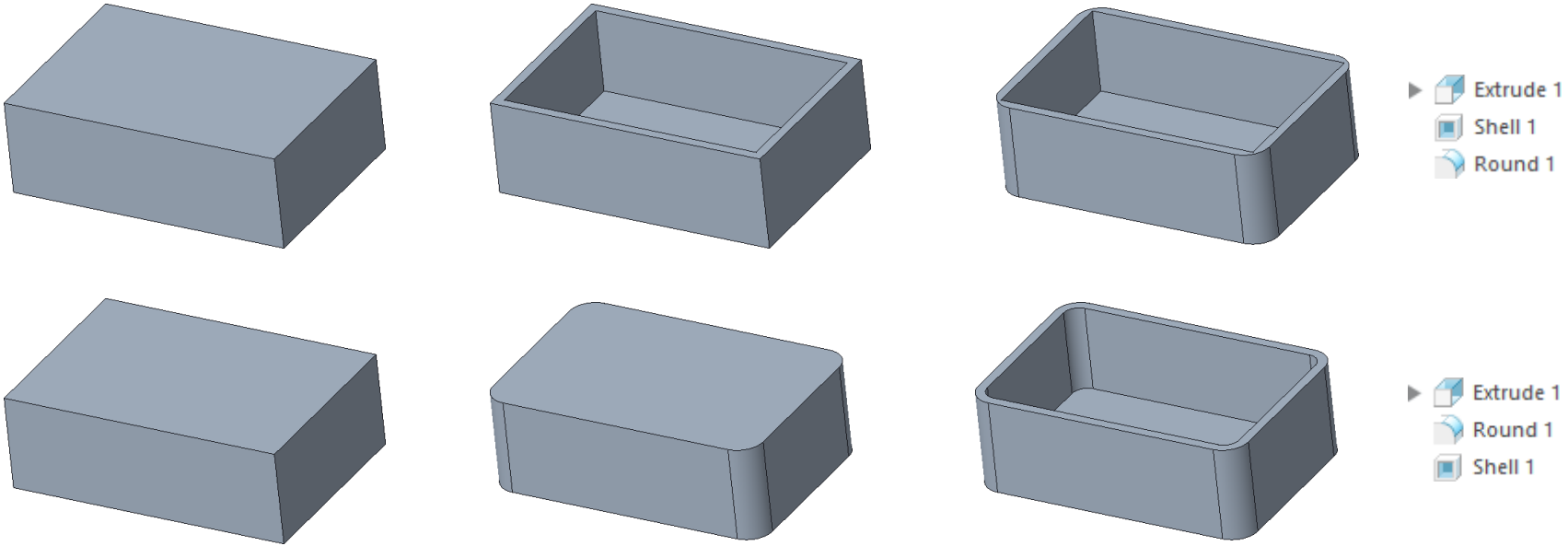
History-based

Features are arranged history-based on Feature Tree



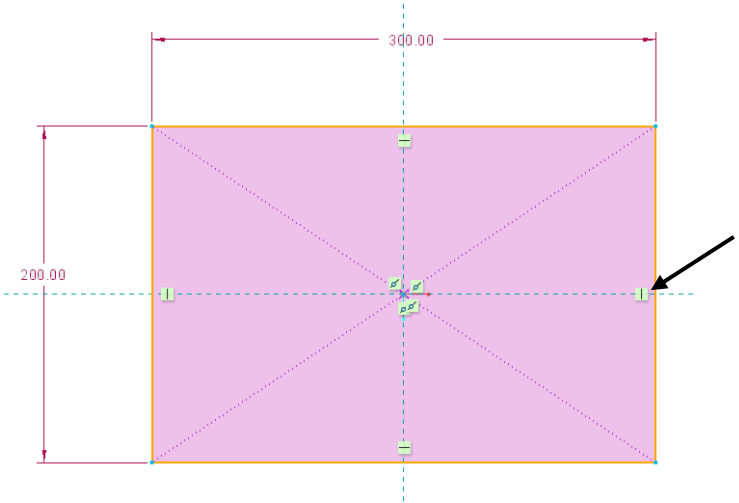
History-based

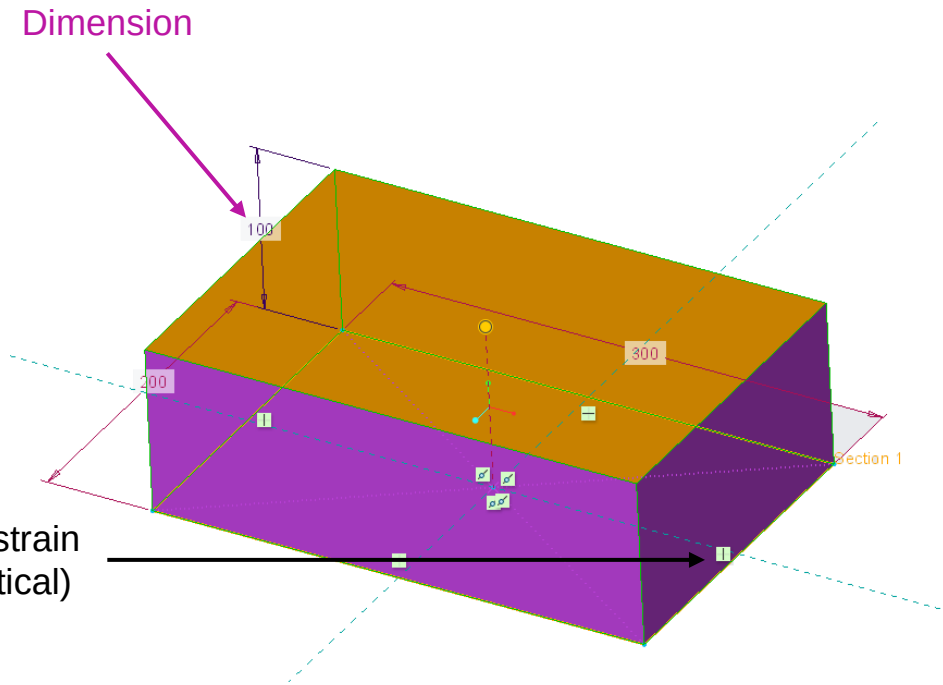
Feature Tree order affects how the geometry is built up



Parametric

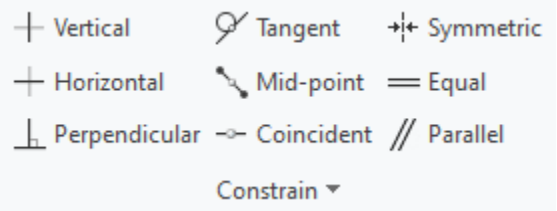
Part's geometry is defined with dimensions and constrains

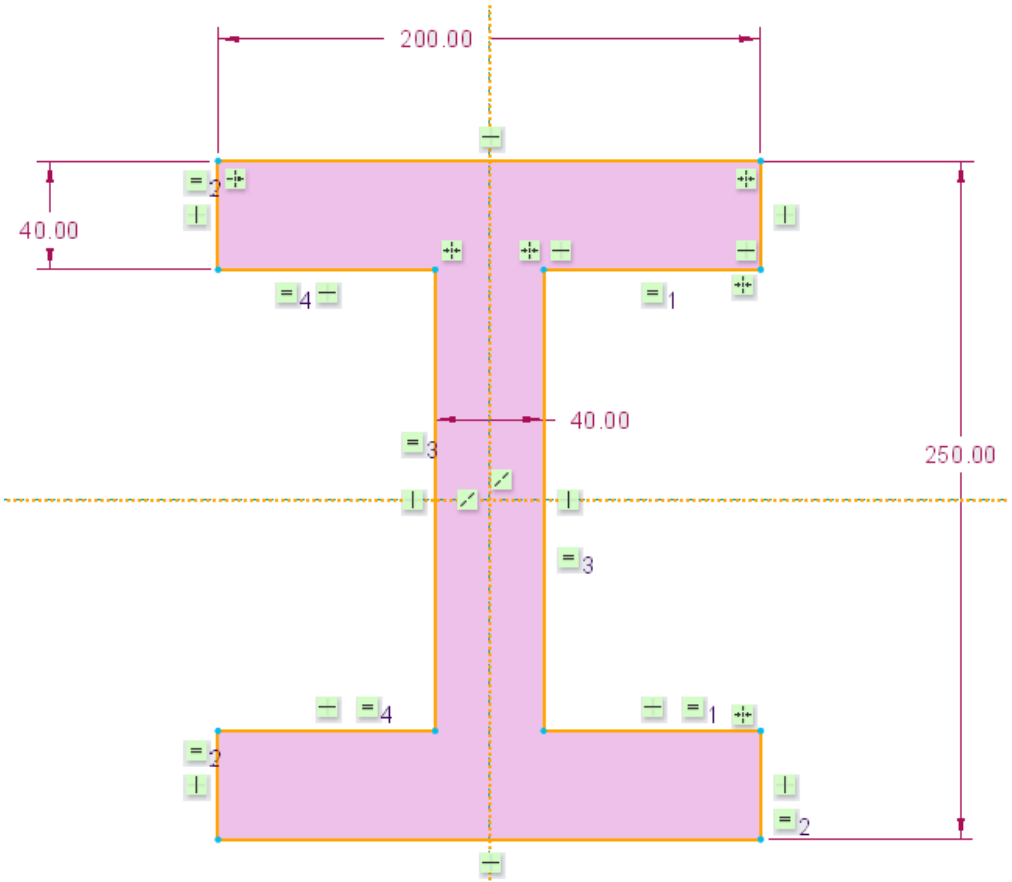




Sketch Constrains

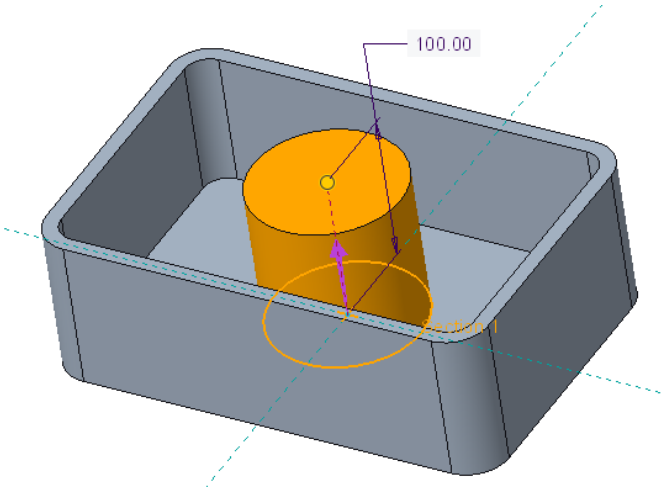
Geometric constrains help to reduce the amount of dimensional constrains

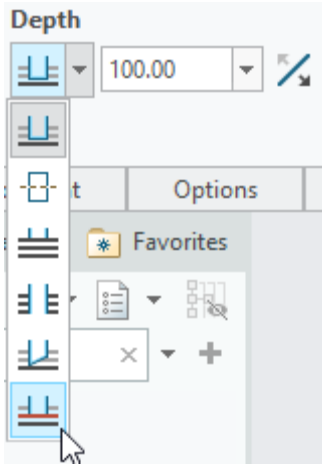


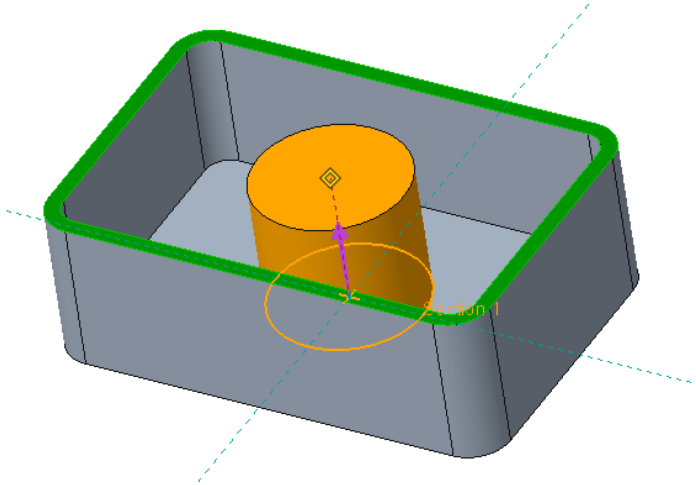


Feature Constrains

Features can be depended on previous features

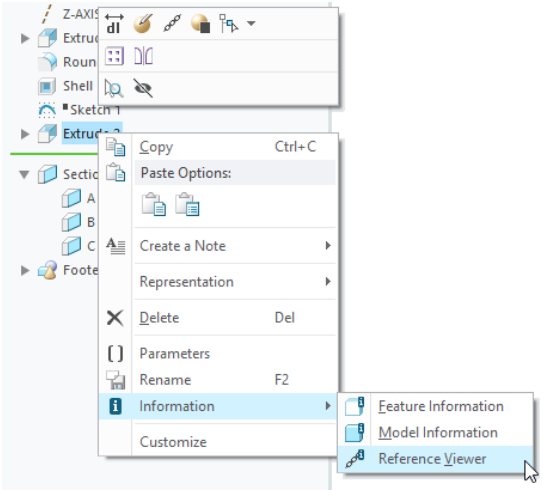


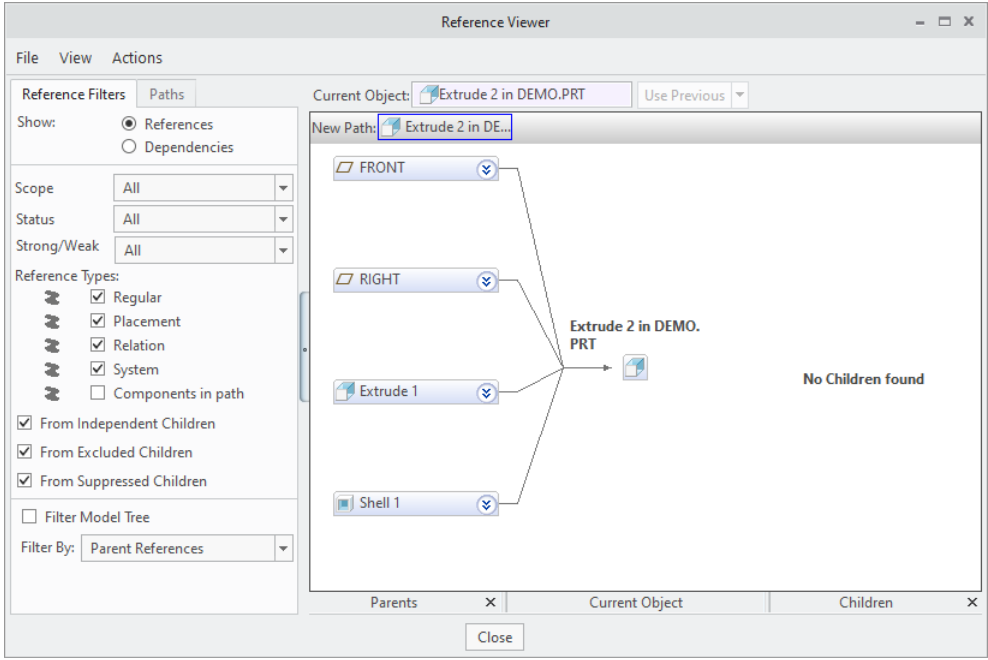




Feature Constrains

Reference Viewer can be used to see relationships between features





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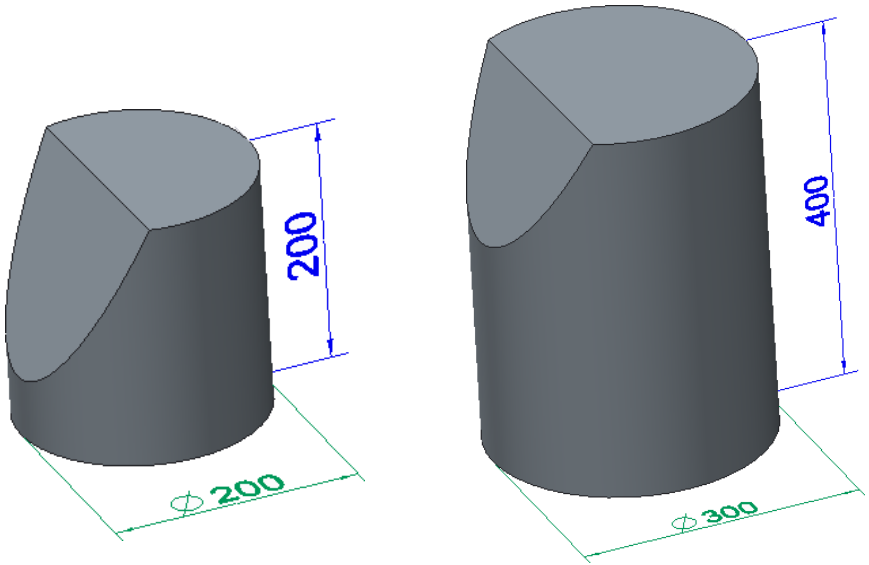
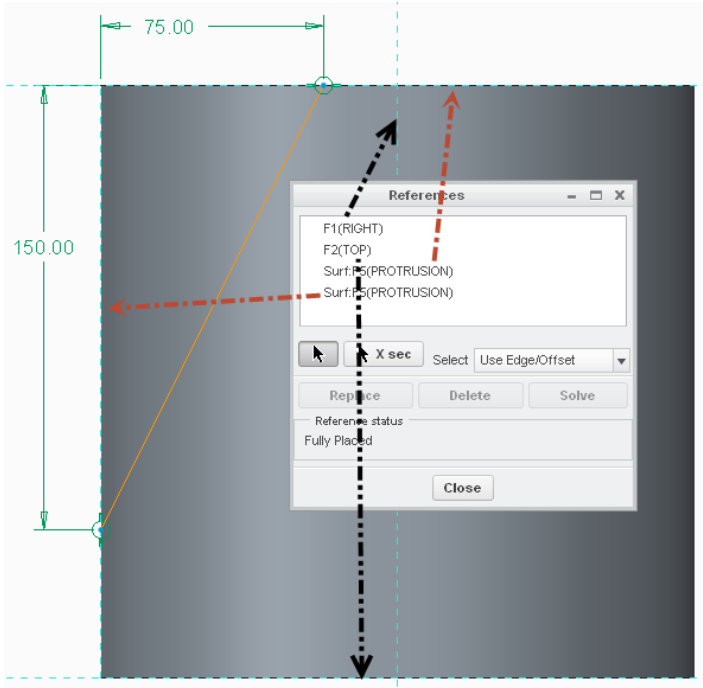
References

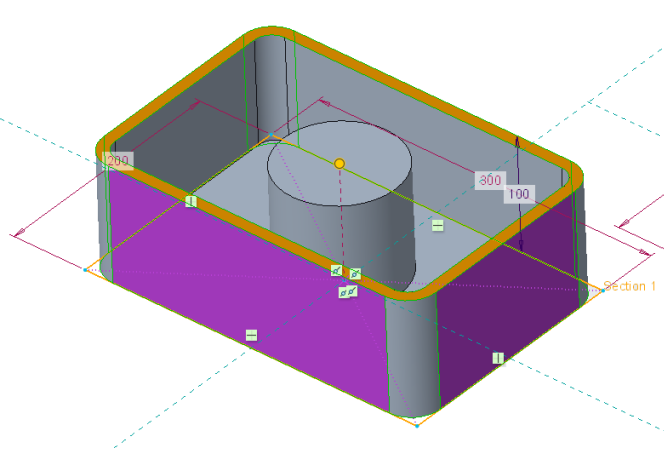
Features can “follow” each other using both sketch and feature references





Solving Geometry

CAD software tries to find an unambiguous solution based on constrains and dimensions



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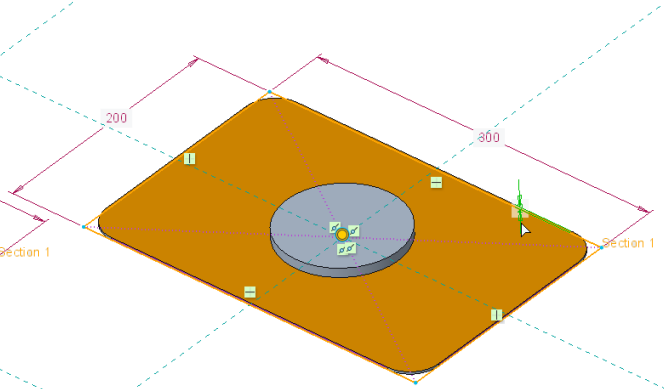

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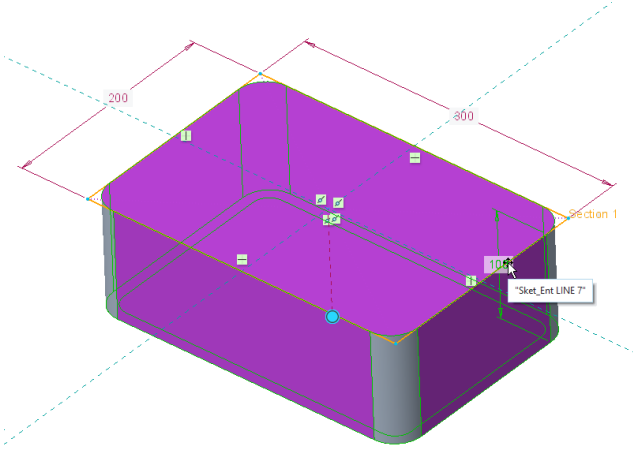
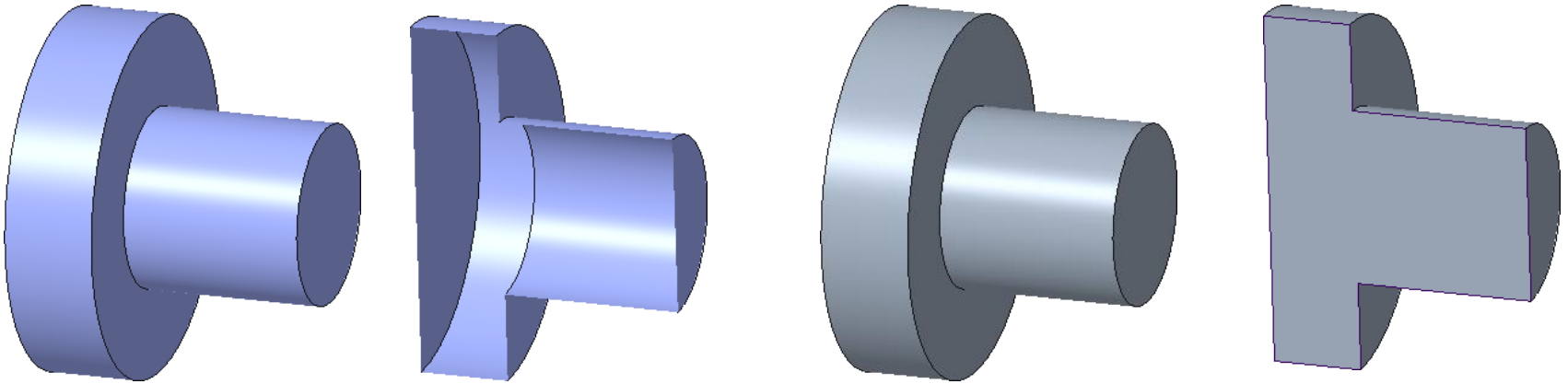


Height=-100
(flips)

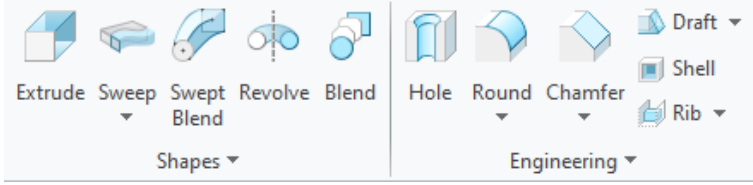
Solid Models

Blue is a surface model (no mass, may have volume)

Gray is a solid model (has mass and volume)

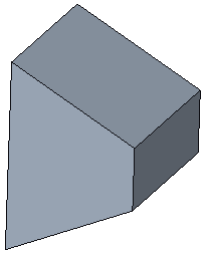


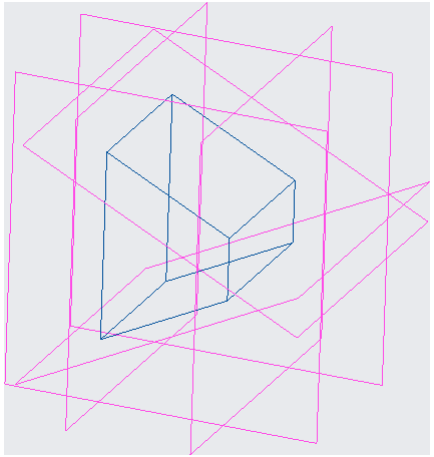
Solid Models

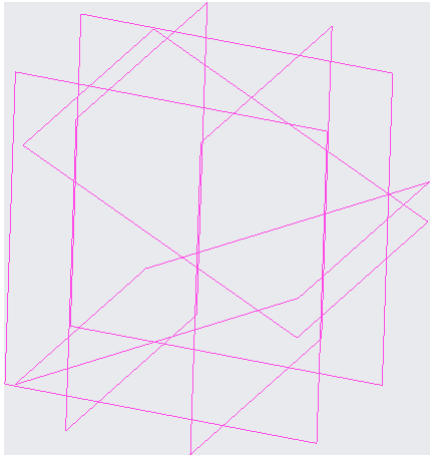


Actually, Solid Model is created based on surfaces

- If surfaces limit a volume, it can be turned into solid model
- Using solid modeling tools, the user don't need to interfere with it



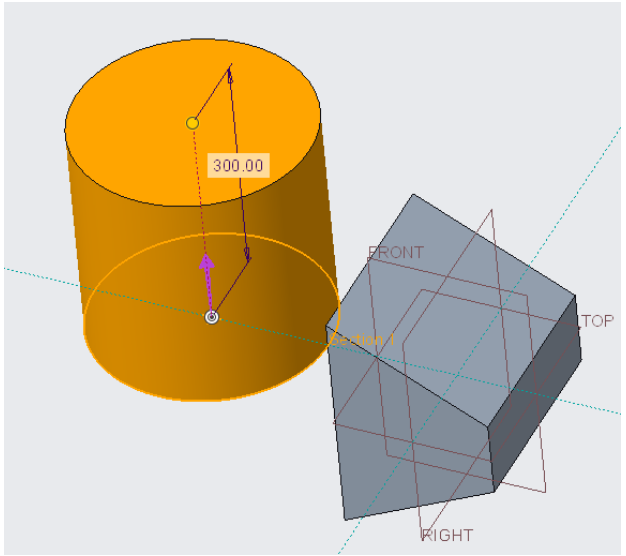


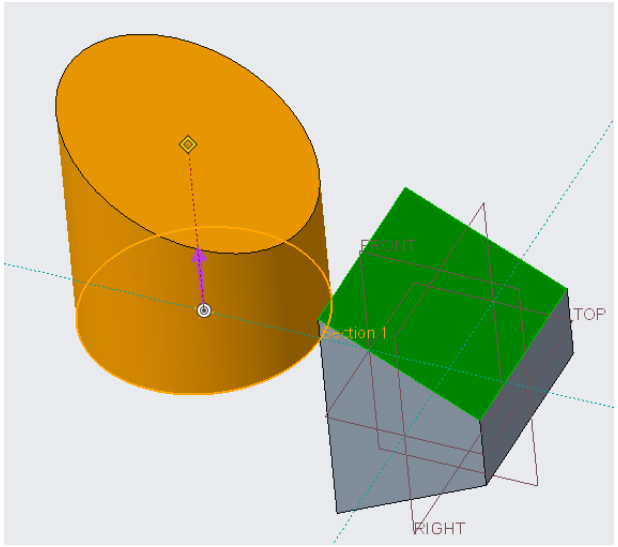


Solid Models

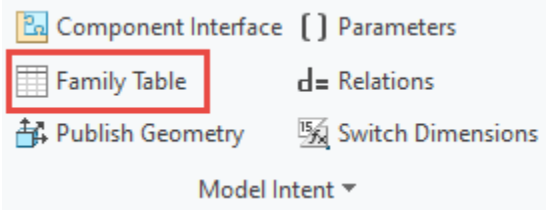
Sometimes, these creation method can be utilized

- For ex. To Selected limit can “see” the surface



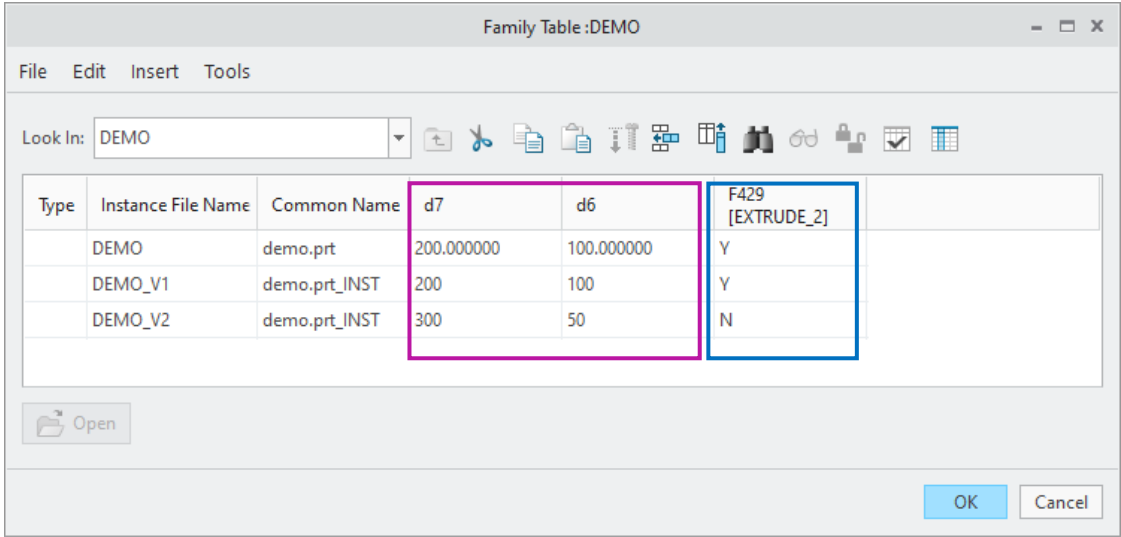


Family Table

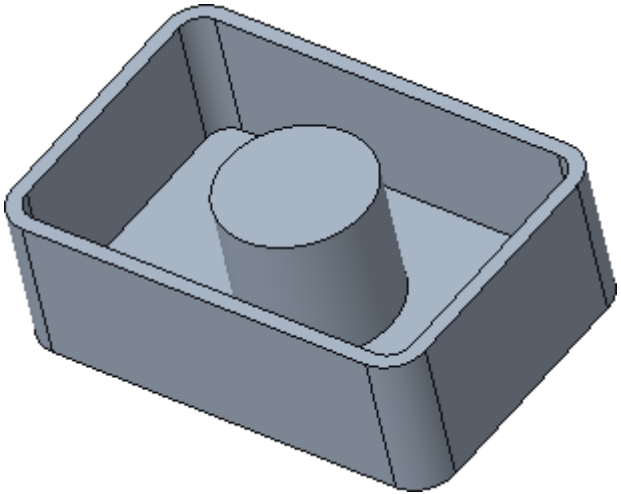


If parts have some common shape and they are some differences on features and on dimension values, we call them Product Families (Family Table in Creo)

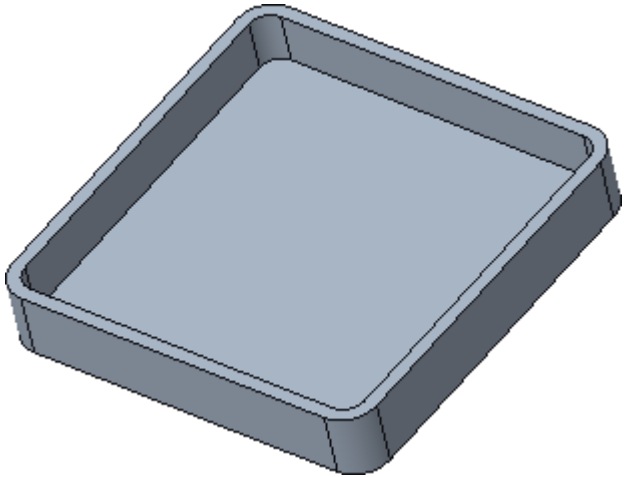
- Reduces extra modeling work



Family Table



DEMO_V1



DEMO_V2

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