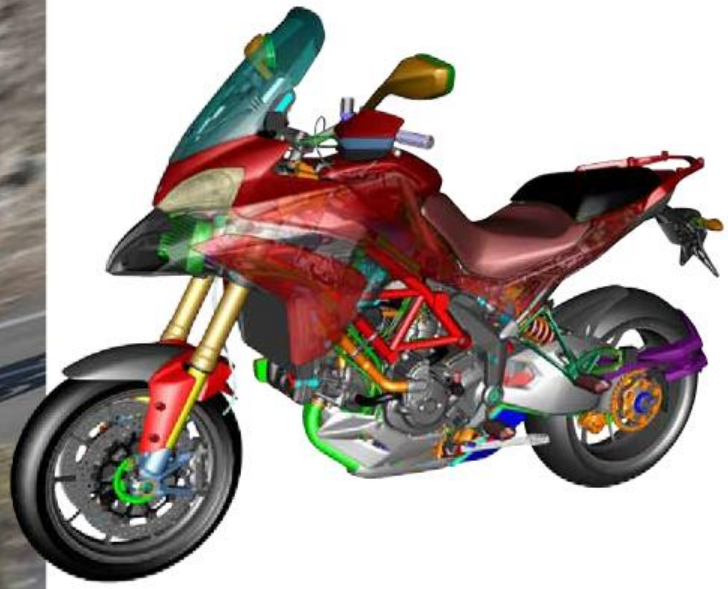
Computer simulations

Simulation: imitation of any real thing, state or process.

Creating a virtual model on computer through software, which is a image of reality. / e.g. machine part under load /

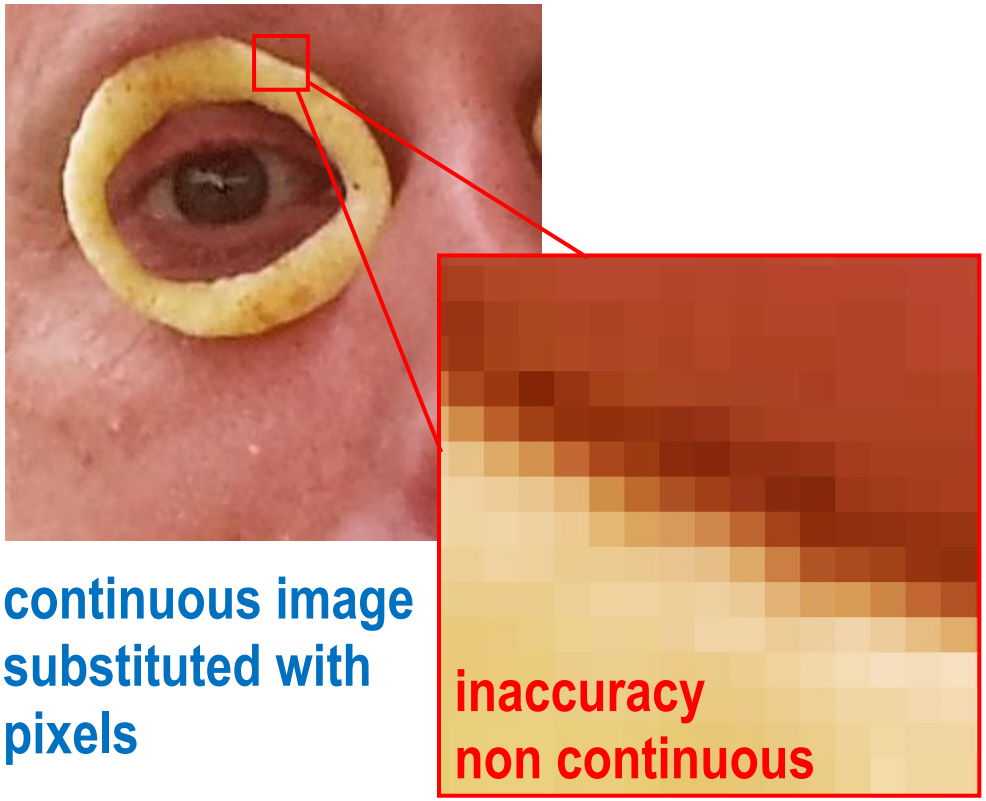
REALITY

COMPUTER VIRTUAL MODEL

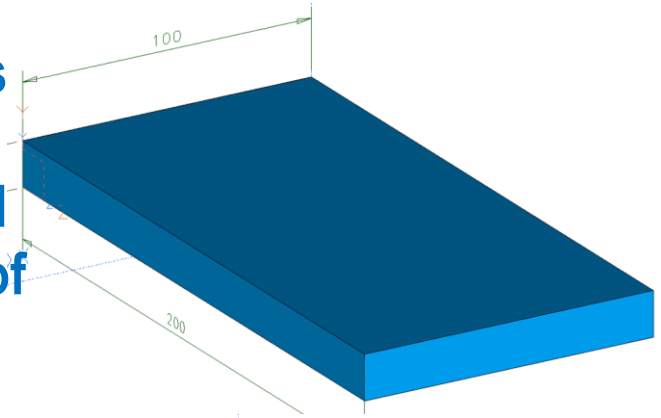


FEM, Finite Element Method

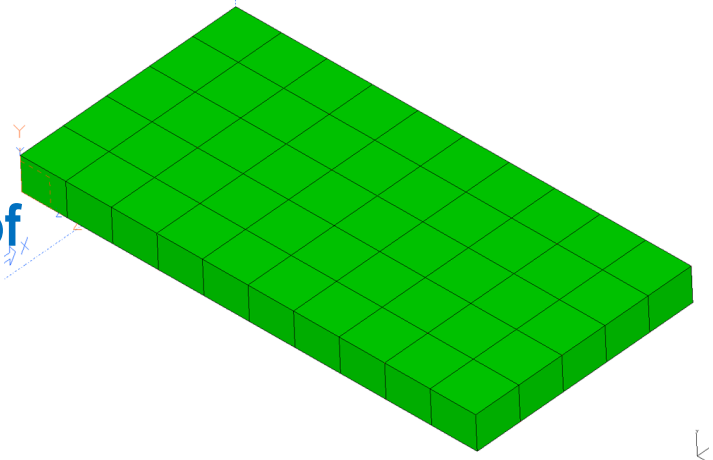
Mathematical method: converting a problem to a system of linear equations.
Discretion: substituion a continuous environment with a set of points.
Origin since approx 1950. Full use by computers.



continuous volume substituted with a set of points.



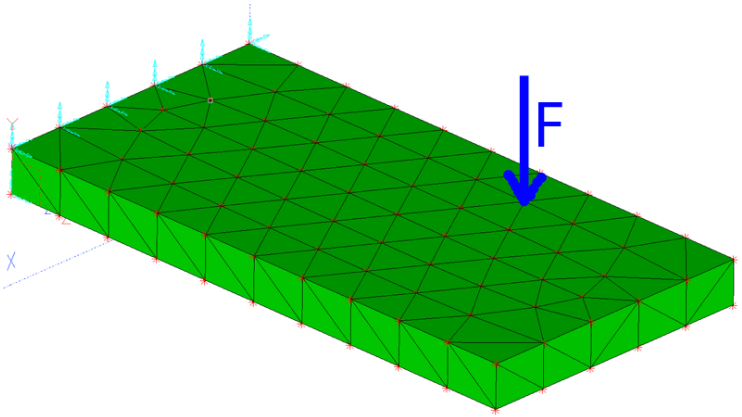
Mesh of elements. definition of geometry.



Computer simulation FEM, basic process

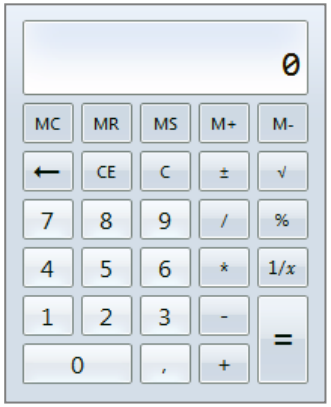
Preprocessor >>>>

creation of a computational model



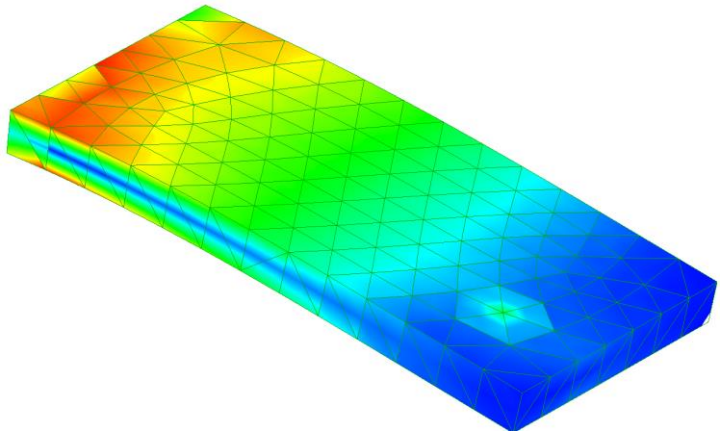
Processor

Calculate of job (system of linear equations)



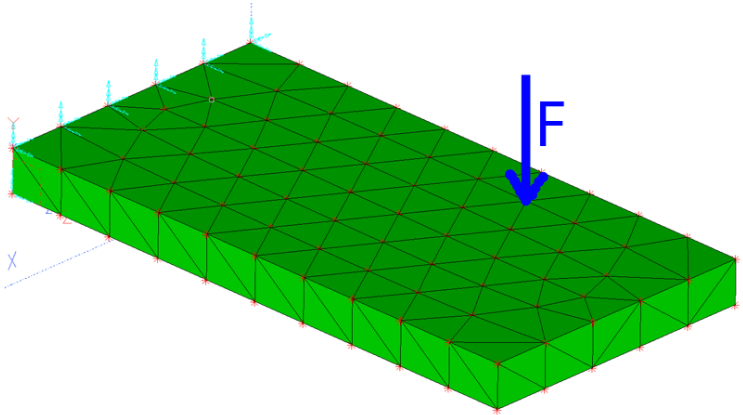
>>>> **Post**processor

Displaying and evaluating results



Cost optimization: minimizing licenses for solvers

Computational model



MESH

Body definition.

Definition of the geometry:

- **Elements** (e.g. tetrahedrons, 3D geometry parts for 3D task)
- **Nodes** (points, vertices of elements)

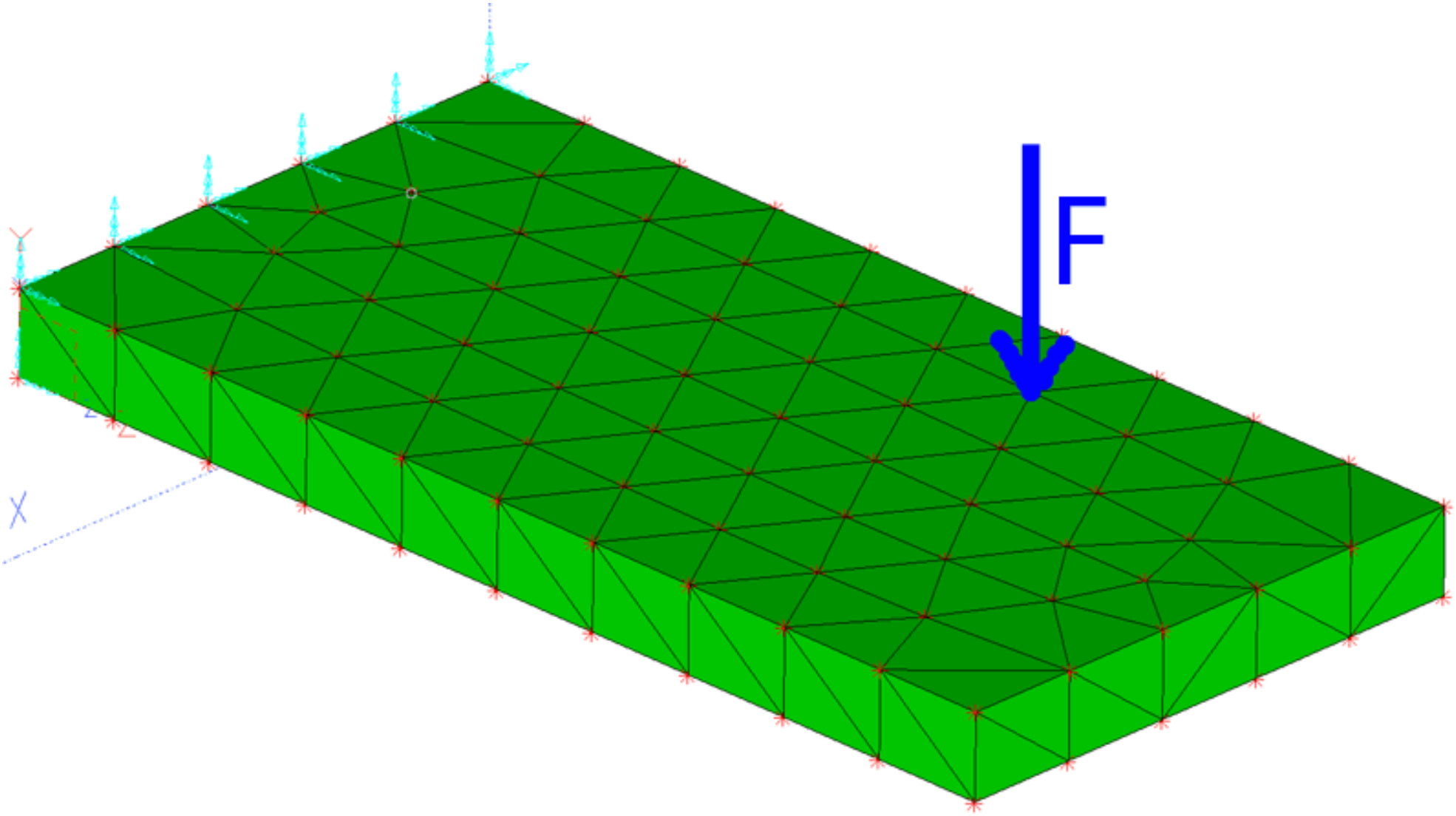
Material: relevant characteristics for kind of simulation

BOUNDARY CONDITIONS

Conditions of the state or process. External action or constraint on the body.

- Constraints
- Loads (force, torque)

Computational model



Calculation of the computational model

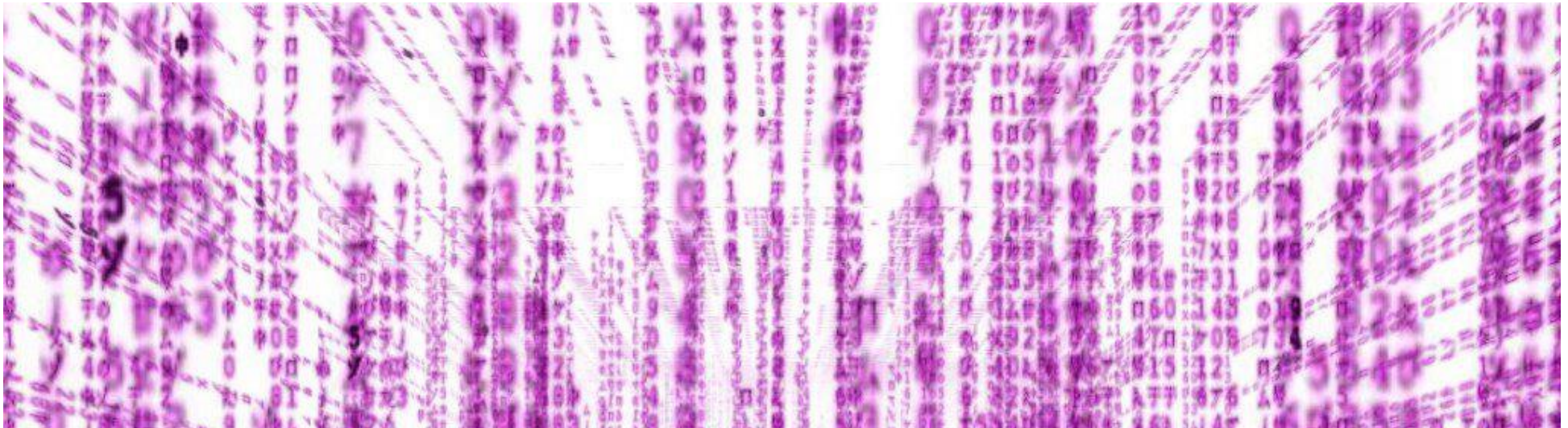
Solving of system of linear equations - matrix. Requires CPU performance.

Solver

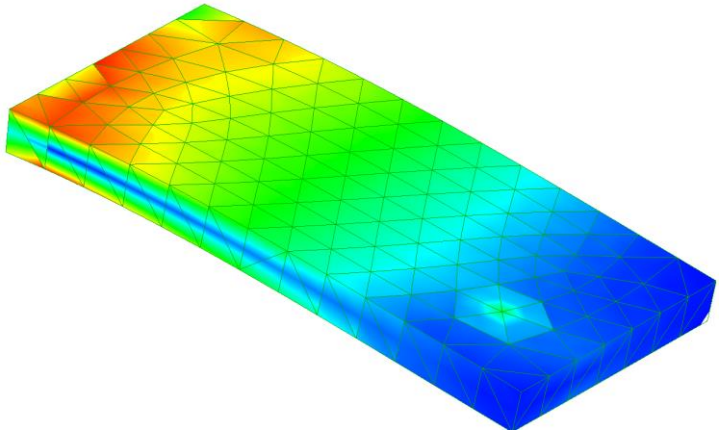
- Usualy external performance servers
- Solver licenses separately from viewers or model preparation

Optimization: write a matrix to a computer, calculation time, applied Math

Designer in industry: work with the simulation program



Results of computer simulation



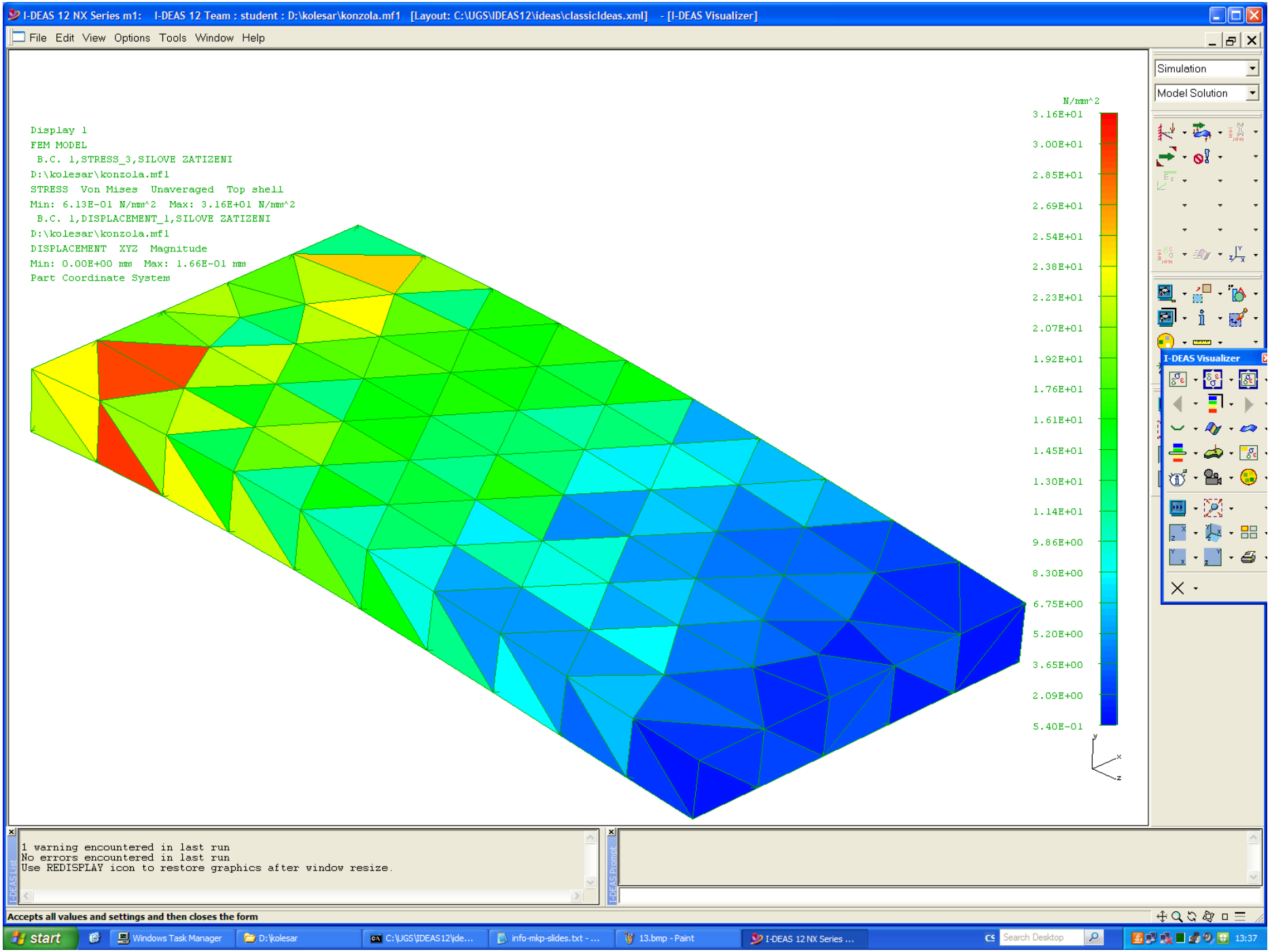
Display & Evaluation

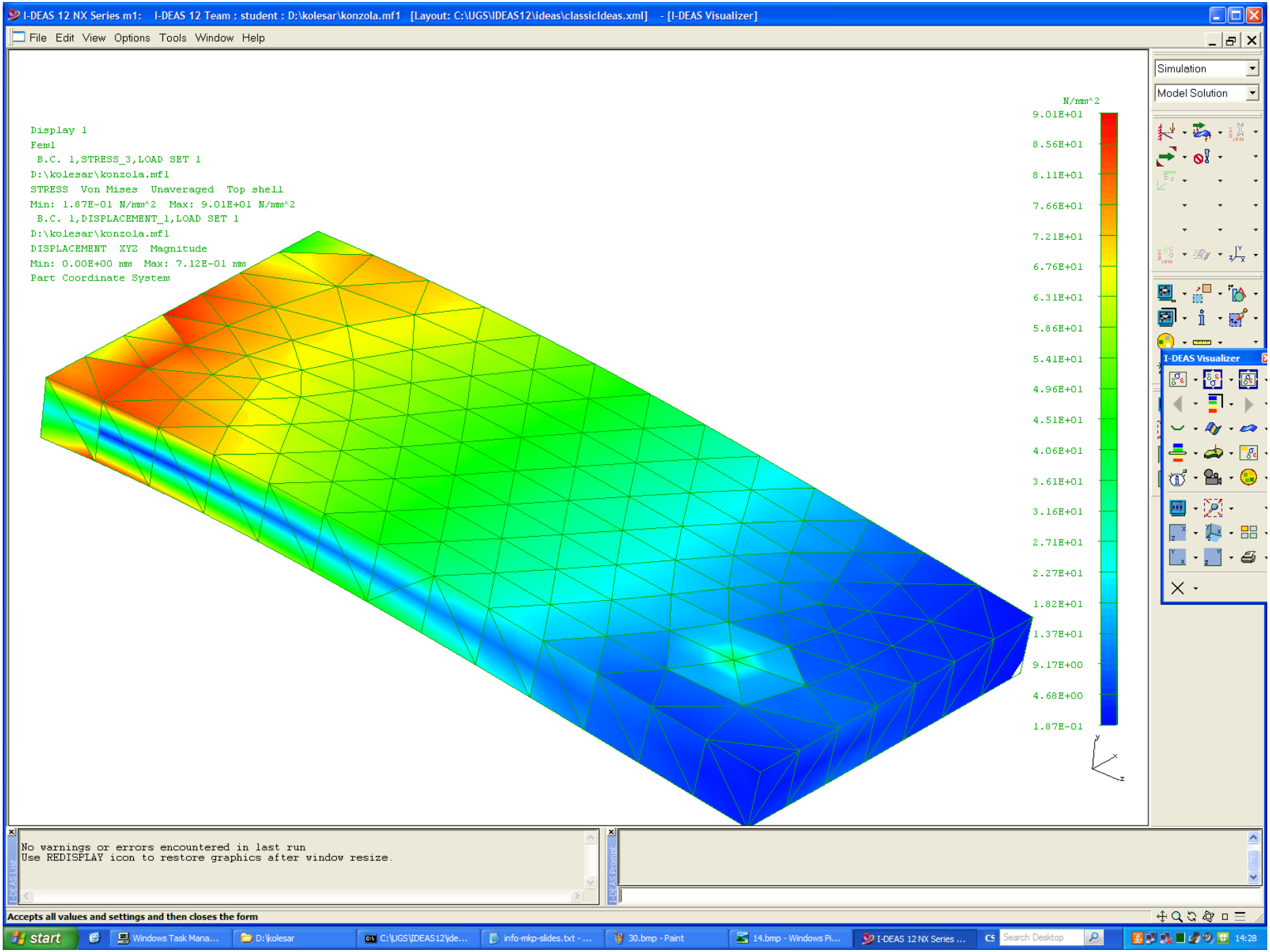
Display

- Trough software

Evaluation

- Relevance of the results
- Divergence of the results from the exact values /rate of difference, FEM method/
- Possibility of use the results, exact or approximate indicative


I-DEAS 12 NX Series m1: I-DEAS 12 Team : student : D:\kolesar\konzola.mf1 [Layout: C:\UGS\IDEAS12\ideas\classicIdeas.xml] - [I-DEAS Visualizer]
File Edit View Options Tools Window Help
Display 1
FEM MODEL
B.C. 1,STRESS_3,SILOVE ZATIZENI
D:\kolesar\konzola.mf1
STRESS Von Mises Unaveraged Top shell
Min: 6.13E-01 N/mm^2 Max: 3.16E+01 N/mm^2
B.C. 1,DISPLACEMENT_1,SILOVE ZATIZENI
D:\kolesar\konzola.mf1
DISPLACEMENT XYZ Magnitude
Min: 0.00E+00 mm Max: 1.66E-01 mm
Part Coordinate System
N/mm^2
3.16E+01
3.00E+01
2.85E+01
2.69E+01
2.54E+01
2.38E+01
2.23E+01
2.07E+01
1.92E+01
1.76E+01
1.61E+01
1.45E+01
1.30E+01
1.14E+01
9.86E+00
8.30E+00
6.75E+00
5.20E+00
3.65E+00
2.09E+00
5.40E-01
Simulation
Model Solution
I-DEAS Visualizer
1 warning encountered in last run
No errors encountered in last run
Use REDISPLAY icon to restore graphics after window resize.
Accepts all values and settings and then closes the form
start
Windows Task Manager
D:\kolesar
C:\UGS\IDEAS12\ide...
info-mkp-slides.txt - ...
13.bmp - Paint
I-DEAS 12 NX Series ...
Search Desktop
13:37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File Edit View Options Tools Window Help
Display 1
Feml
B.C. 1,STRESS_3,LOAD SET 1
D:\kolesar\konzola.mf1
STRESS Von Mises Unaveraged Top shell
Min: 1.87E-01 N/mm^2 Max: 9.01E+01 N/mm^2
B.C. 1,DISPLACEMENT_1,LOAD SET 1
D:\kolesar\konzola.mf1
DISPLACEMENT XYZ Magnitude
Min: 0.00E+00 mm Max: 7.12E-01 mm
Part Coordinate System
N/mm^2
9.01E+01
8.56E+01
8.11E+01
7.66E+01
7.21E+01
6.76E+01
6.31E+01
5.86E+01
5.41E+01
4.96E+01
4.51E+01
4.06E+01
3.61E+01
3.16E+01
2.71E+01
2.27E+01
1.82E+01
1.37E+01
9.17E+00
4.68E+00
1.87E-01
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start
Windows Task Mana...
D:\kolesar
C:\UGS\IDEAS12\ide...
info-mkp-slides.txt - ...
30.bmp - Paint
14.bmp - Windows Pi...
I-DEAS 12 NX Series ...
Search Desktop
14:28

Software systems and terms

Software systems for computer simulations:

Autodesk Inventor

Pro Engineer

Catia

NX

ANSYS, MARC

CAD: Computer Aided Design

CAM: Computer Aided Manufacturing

CAE: Computer Aided Engineering

CAx: Computer Aided (anything)

PLM: Product Lifecycle Management

FEA: Finite Element Analysis

FEM: Finite Element Method

MKP: Metoda konečných prvků – FEM by Czech language.