GENERIC PYTHON SCRIPT FOR ANALYSING EXPERIMENTAL REINFORCED CONCRETE BEAMS

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Civil Engineering
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  - Providing different assistance levels
    - Setting up models
    - Scripting
    - Executing analyses
    - Reporting with code checking

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- Input
  - Beam
  - Reinforcement
  - Plates
- Output
  - Results
  - Report
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- Future

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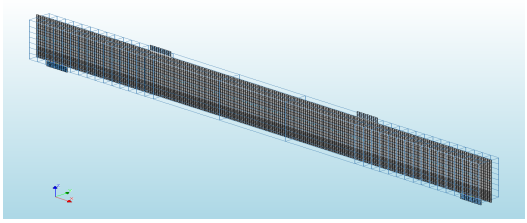
Introduction

- Geometry model
- Mesh
- Prepared analyses
- Post-processing
- Report generation



```
# model=2;   2D shell model; all Y displacements supported, fastest calculation.
# model=2.5; 2D shell model; out-of-plane beam movement allowed
# model=3;   3D solid model
model=2
#
#Symmetry conditions (0 no symmetry;1 symmetry plane at right side, which requires input of the left part of the beam
only!!)
#Bottom and top plates can have their original dimensions even if they are placed on the symmetry axis;
#script will half the force load if needed
symR=0
```

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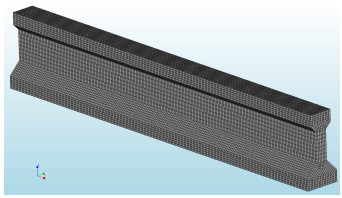
Input: Beam - Geometry

- Simple: length width height
- Advanced: Cross-sections
- Web openings
- Height dependent element size
- Concrete material properties



```
# GENERIC INPUT WITH VERTICAL sections for each section a list of Y, Z coordinates clock wise input
# secX[0]= start cross section
#       (<  X                  >,[<        Y    >,<          Z          >,])
secX[0]=(   0                   ,[  +width/2     ,          0           ,
                                    -width/2     ,          0           ,
                                    -width/2     ,          height      ,
                                    +width/2     ,          height      ] )
```

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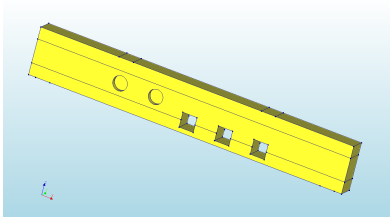
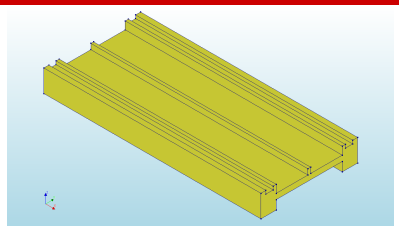
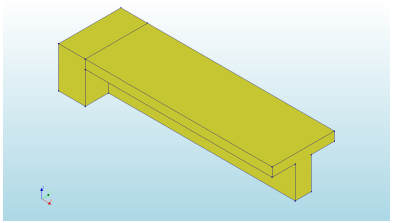
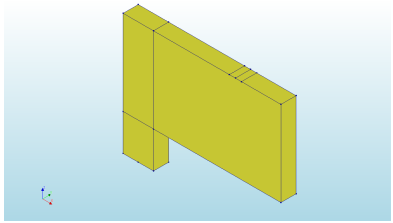
Input: Beam – 3D Examples









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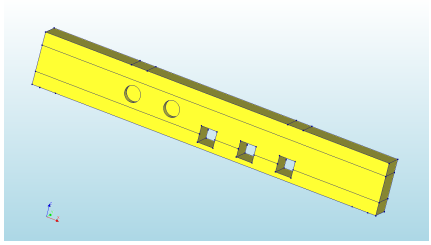
Input: Beam - Web openings

- Circular openings
- Rectangular openings
- Variable width
- Along the beam axis



```
### WebOpenings
### webOpenings can be placed along the beam
### input position ( Y not used), dimenions( width not used ), amount and ctc distance
### X Y Z is middle of hole, for dimensions: if height = 0 than circle, else if height > 0 than rectangle
#                position                        dimensions
#           [ X  ,  Y   , Z   ]  , [length/diameter ,  width, height], nr. , c.t.c.   )
webOpen[0]=( [1500 ,  0   , 400 ]  , [           250  ,  width,    0 ], 2   ,   625    )
webOpen[1]=( [2750 ,  0   , 200 ]  , [           250  ,  width, 250 ], 3   ,   625    )
```

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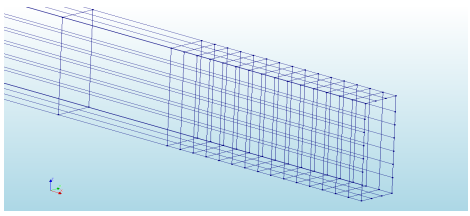
Input: Reinforcement

- Horizontal bars
- Vertical bars
- Stirrups
- Material properties



```
#Horizontal reinforcements
# for each zone with equal diameter and equal core-to-core distance
#             name,  number of bars,[< location X,Y,Z coordinates]          ,<1=closed>< diameter>  ctc-dir
E   ,   fy,hard[%], epsult[%] )
#             Name          ,Nr,     X        ,    Y,        Z  ],                0/1,DIAM, [X ,                     Y, Z
],      E,   fy,  [%],     [%] )
horBars[0]=( "MAIN_BOTTOM" , 4, [ [ cover       , -width/2+cover, cover        ],
                                  [ length-cover, -width/2+cover, cover        ] ], 0,  20, [ 0, (width-2*cover)/(4-1), 0
], 210000,  435,    6,      25 )
horBars[1]=( "MAIN_TOP"    , 4, [ [ cover       , -width/2+cover, height-cover ],
                                  [ length-cover, -width/2+cover, height-cover ] ], 0,  12, [ 0, (width-2*cover)/(4-1), 0
], 210000,  435,    6,      25 )
```

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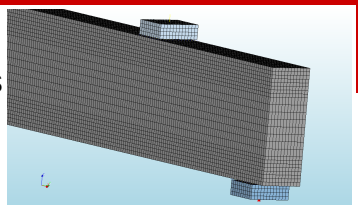
Input: Plates

- Top and bottom plates
- Point/line/surface supports/loads
- Deformation/force loads
- Beam-plate interfaces

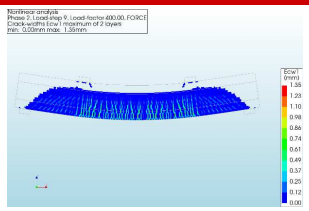


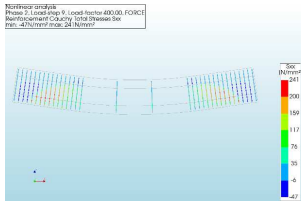
```
#Top plates
#                (      X          ,   Y,  Gap, length,  width,height,P/L/S,     TRX,TRY,TRZ, F/D,  LOX,LOY,     LOZ, SW )
topPlates[0]=( 250+1250        ,   0,   10,    250,  width,   100,    P,       0,  1,  0,   F,    0,  0,   -1000,  0 )
topPlates[1]=( length-250-1250,   0,   10,    250,  width,   100,    P,       0,  1,  0,   F,    0,  0,   -1000,  0 )

#Bottom plates
#                (      X          ,   Y,   Gap, length,  width,height,P/L/S,     TRX,TRY,TRZ, F/D,  LOX,LOY,     LOZ, SW )
botPlates[0]=( 250             ,   0,    10,    250,  width,   100,    P,       1,  1,  1,   D,    0,  0,       0,  1 )
botPlates[1]=( length-250      ,   0,    10,    250,  width,   100,    P,       0,  1,  1,   D,    0,  0,       0,  1 )
```


Output: Results

- Beam result screen shots
- Reinforcement result screen shots
- Load-displacement data

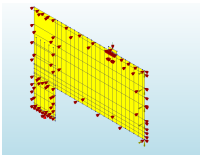


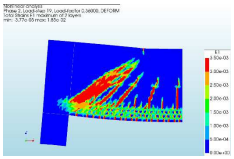


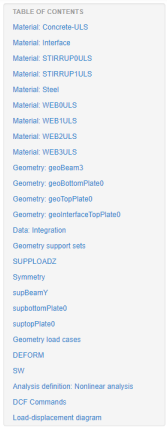
1 Row	2 Phase	3 Nr	Type	4	5 Nr	Load	6 Factor	7 Result	8 Label	9 node	10 Value [MM]	11
1	Phase	2	Start-step		1	Load-factor	1	Displacements	TDtZ	116	-0.143739795	
2	Phase	2	Load-step		2	Load-factor	50.000,	Displacements	TDtZ	116	-0.753513004	
3	Phase	2	Load-step		3	Load-factor	100.00,	Displacements	TDtZ	116	-1.965300097	
4	Phase	2	Load-step		4	Load-factor	150.00,	Displacements	TDtZ	116	-3.555343529	
5	Phase	2	Load-step		5	Load-factor	200.00,	Displacements	TDtZ	116	-5.376441892	
6	Phase	2	Load-step		6	Load-factor	250.00,	Displacements	TDtZ	116	-7.446627423	
7	Phase	2	Load-step		7	Load-factor	300.00,	Displacements	TDtZ	116	-9.62709783	
8	Phase	2	Load-step		8	Load-factor	350.00,	Displacements	TDtZ	116	-12.03053775	
9	Phase	2	Load-step		9	Load-factor	400.00,	Displacements	TDtZ	116	-31.56233843	
10	Phase	2	Load-step		10	Load-factor	450.00,	Displacements	TDtZ	116	-14799.96663	

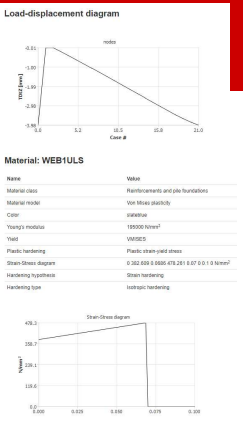
Output: Report

- Material data
- Geometry data
- Non-linear analysis settings
- Results
- Several formats available









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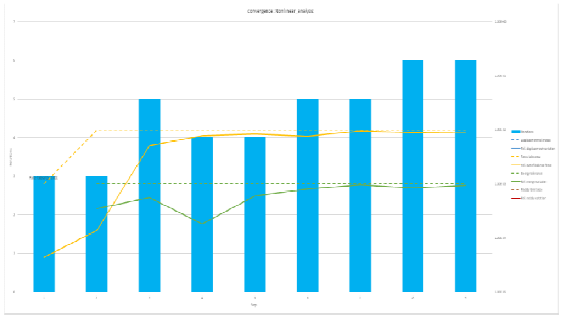
Output: Convergence

- Compact:
  - Stepwise
  - CSV file
  - Excel graph
- Detailed
  - Per iteration
  - CSV file



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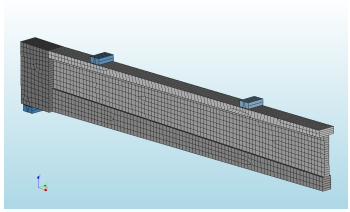
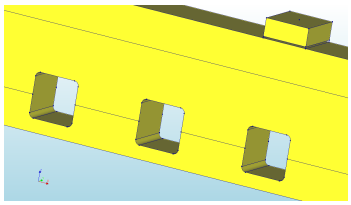
Future Developments

- Based on user feedback
  - Missing functionality
  - Change requests
  - Improvements
  - Missing information
  - Clarification/explanation
- Tapered beams
- Chamfers and fillets
- …





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Question?

More information?:
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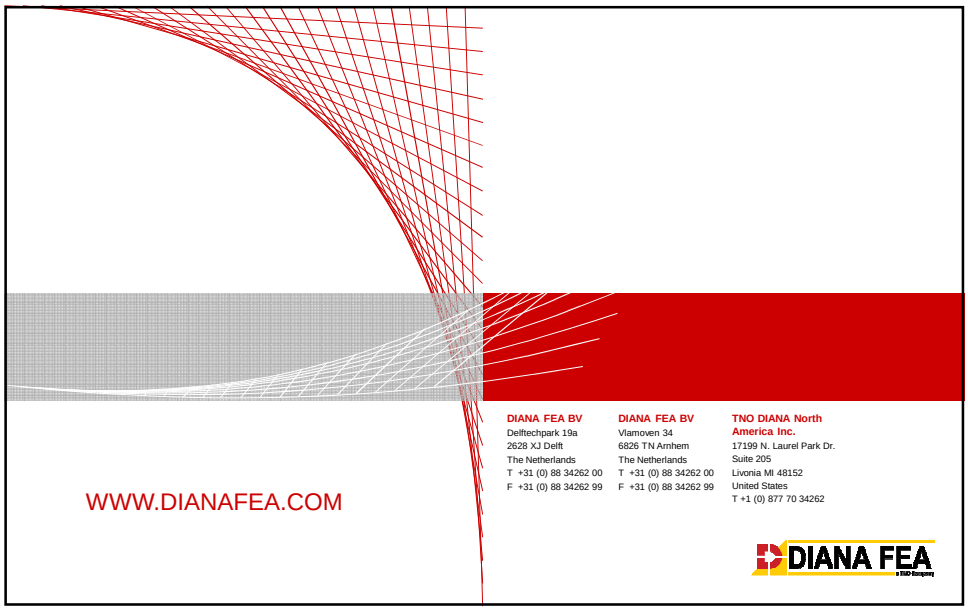

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