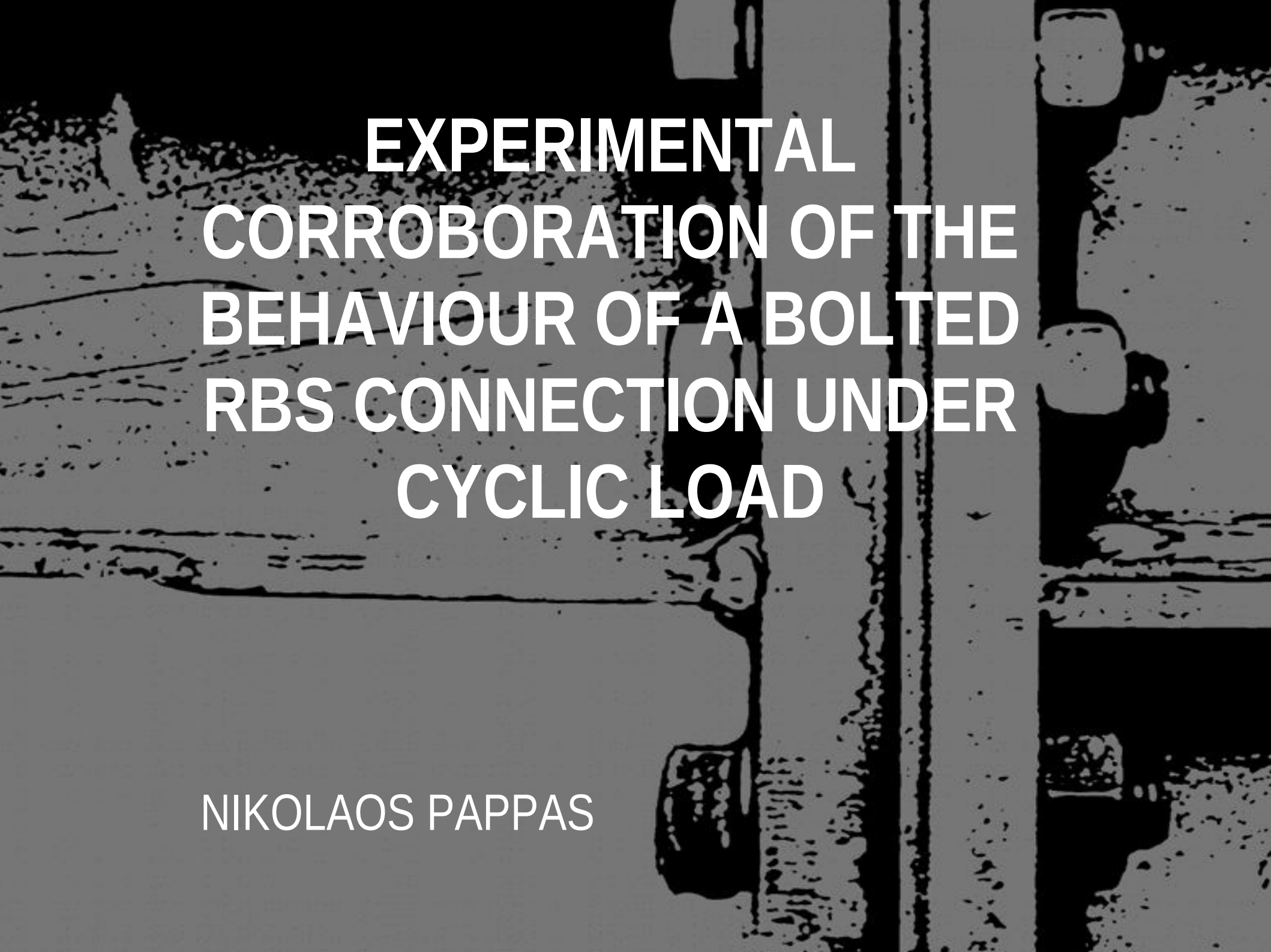
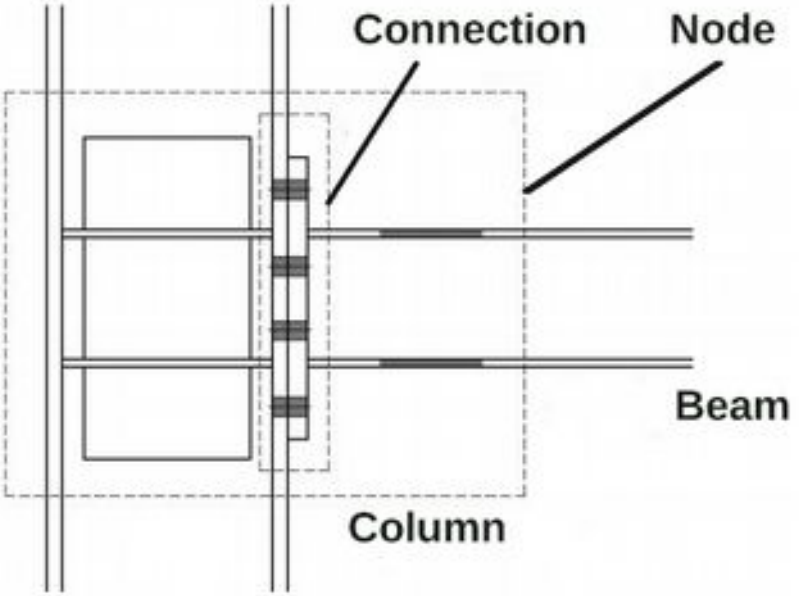
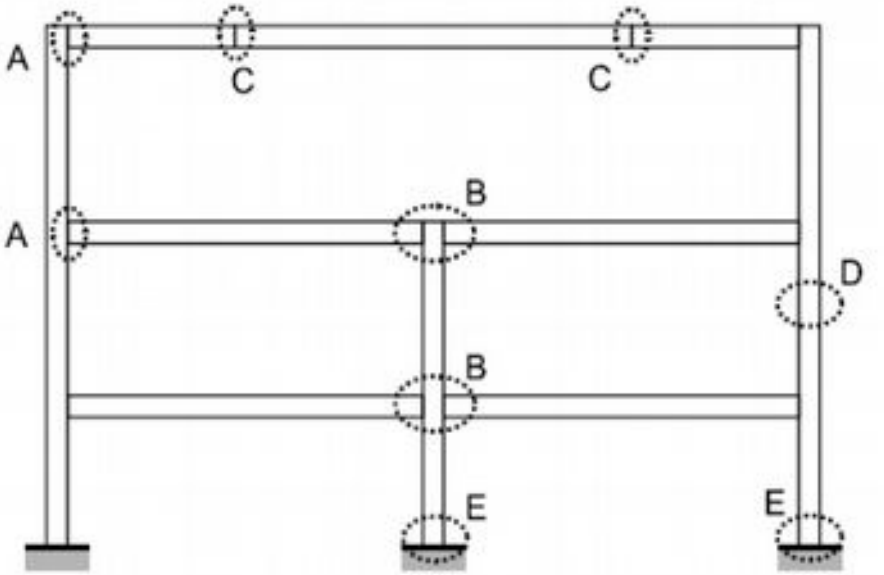


EXPERIMENTAL CORROBORATION OF THE BEHAVIOUR OF A BOLTED RBS CONNECTION UNDER CYCLIC LOAD

NIKOLAOS PAPPAS

NODES





CONNECTIONS

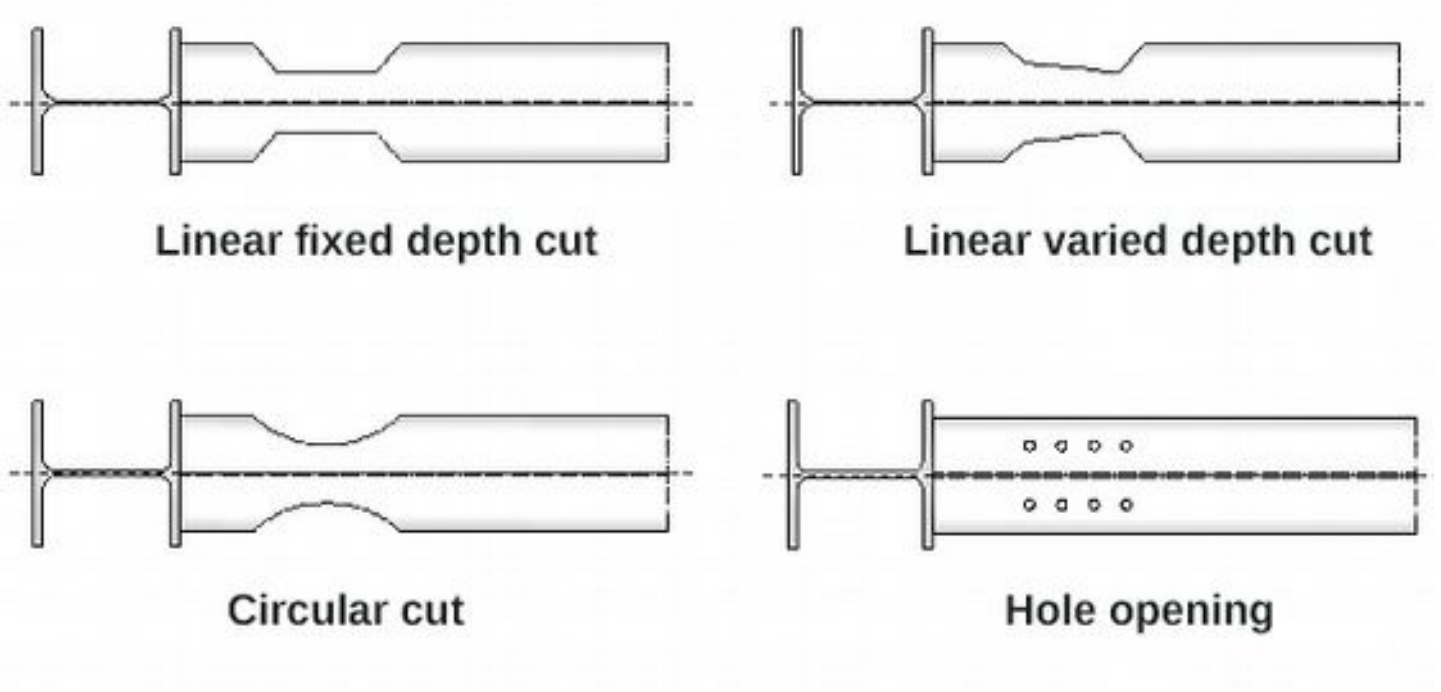
Northbridge (1994) and Kobe (1995) earthquakes

New way of forming moment connections

seeking:

- Increased rotational capacity of nodes
- Better behaviour of steel frames
- Protection of the connection parts and the column

Reducing the Beam Section relatively far from the connection

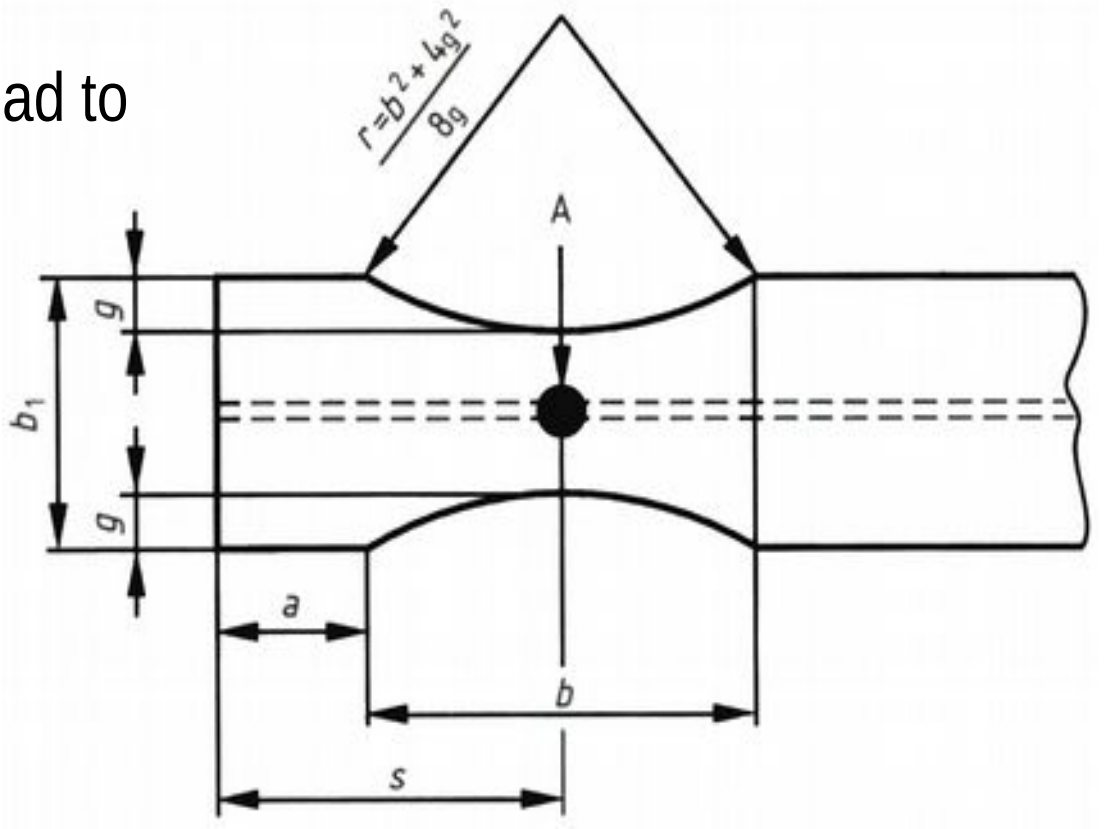


RBS GEOMETRICAL PARAMETERS

a : distance from the column head to the beginning of the cut

b : cut length

g : cut depth



NORM LIMITS

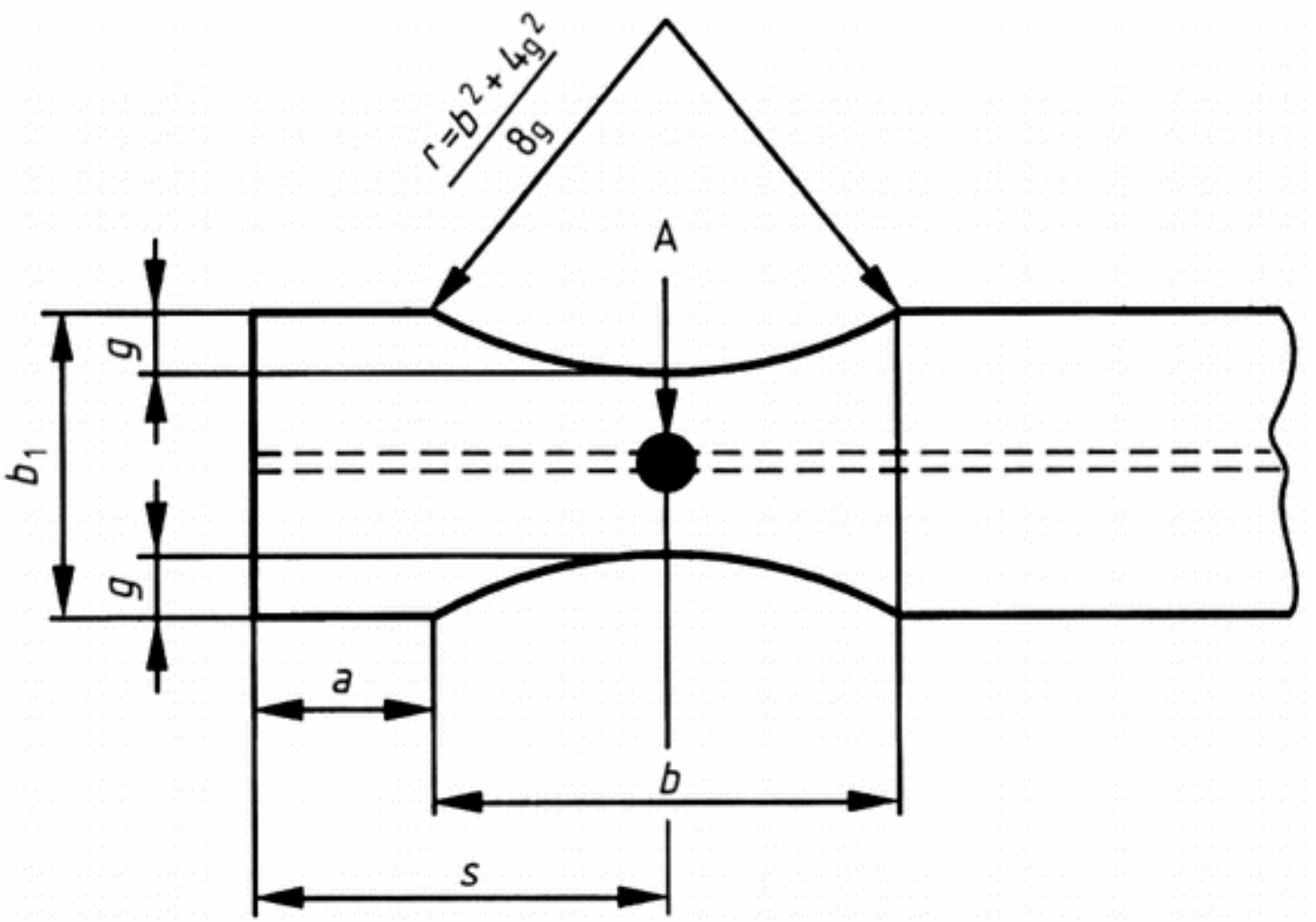
Parameter	Eurocode 8	FEMA
a	$0.60*b_f$	$(0.5 – 0.75)*b_f$
b	$0.75*d_b$	$(0.65 – 0.85)*d_b$
g	$< 0.25*b_f$	$0.20*b_f$

RBS PARAMETER CHOICE

$a = 0{,}45 * b_f$

$b = 0{,}75 * d_b$

$g = 0{,}20 * b_f$



FINITE ELEMENT MODEL DESCRIPTION

Part

Material

Assembly

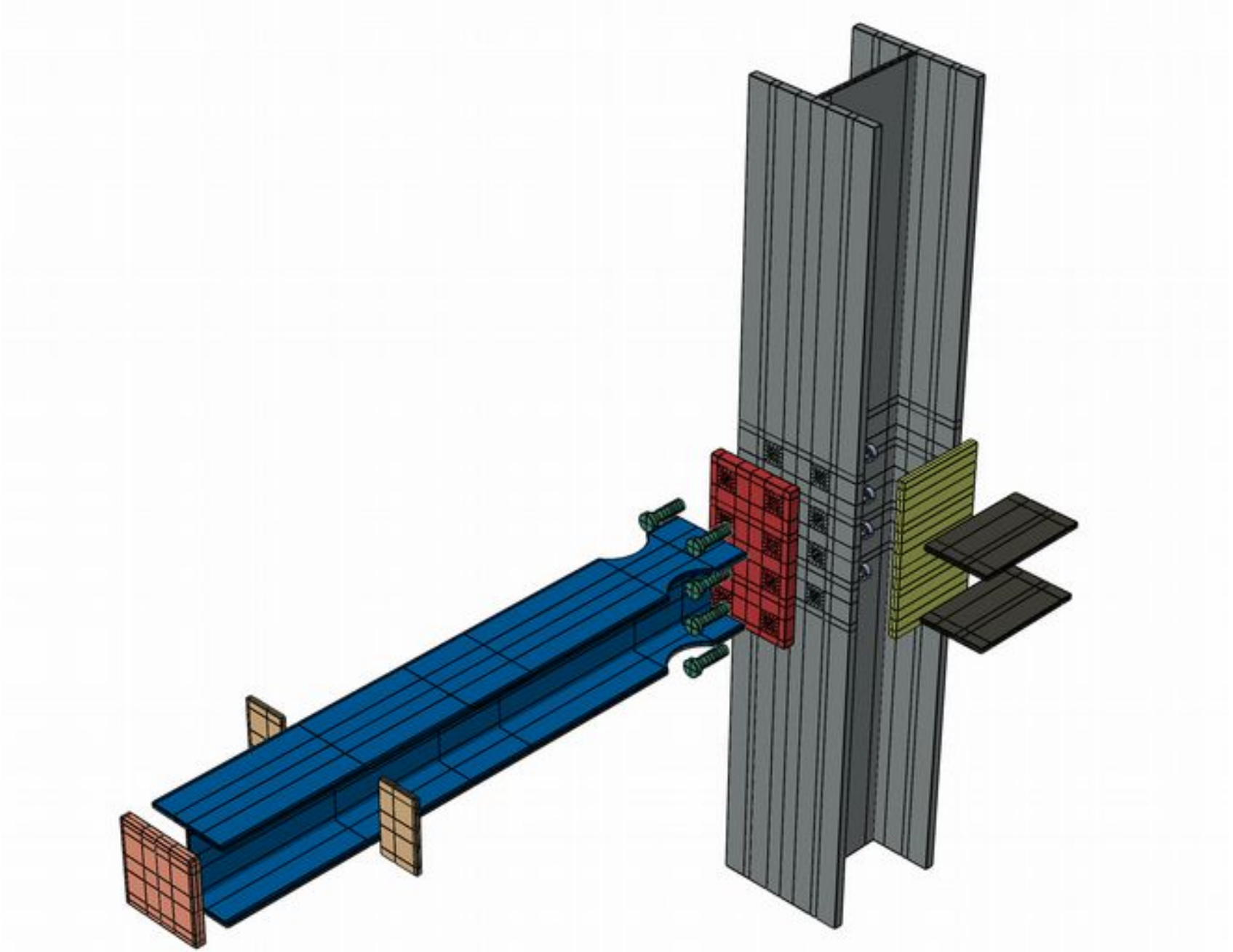
Step

Interaction

Load

Mesh

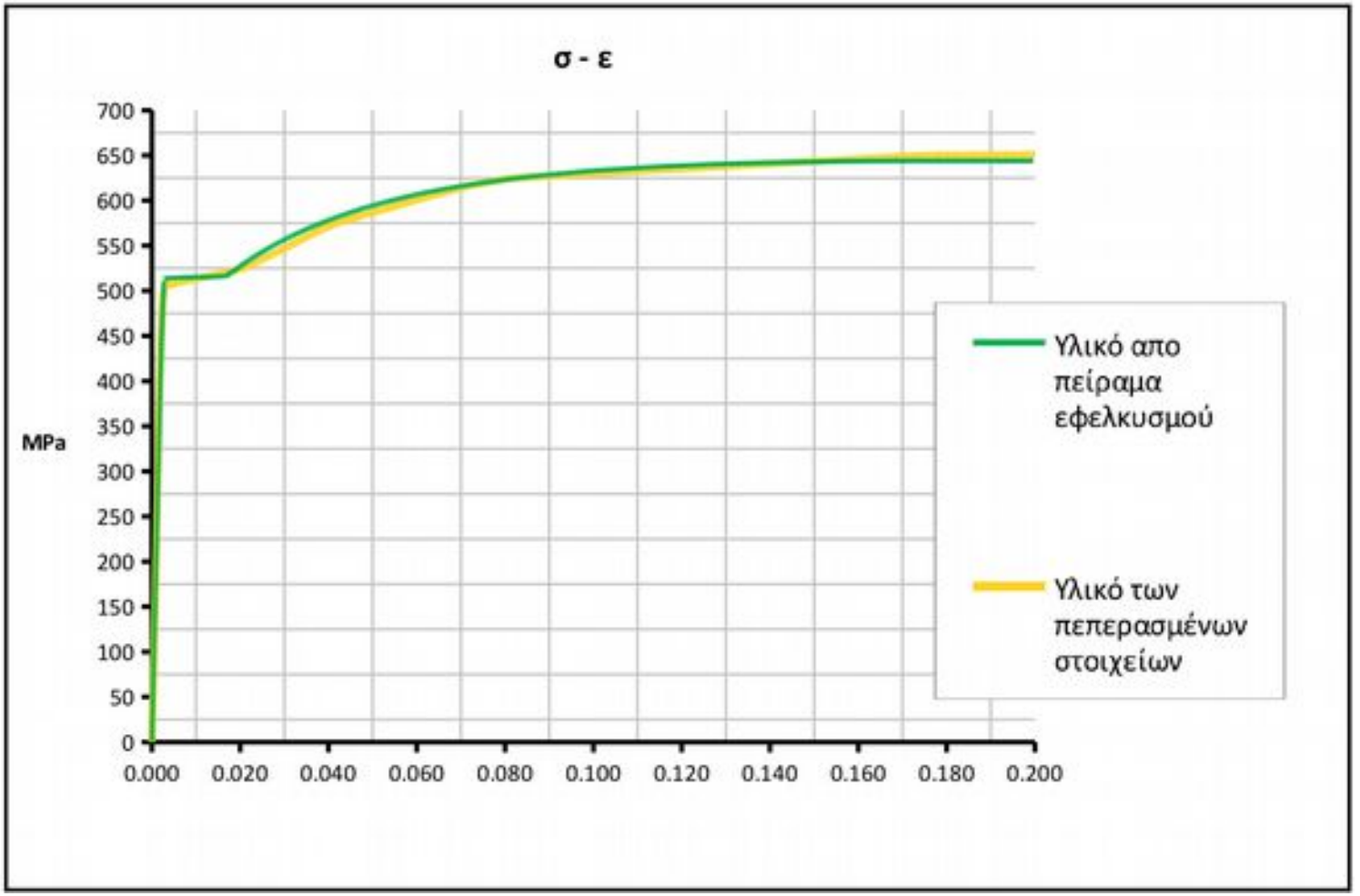
PARTS



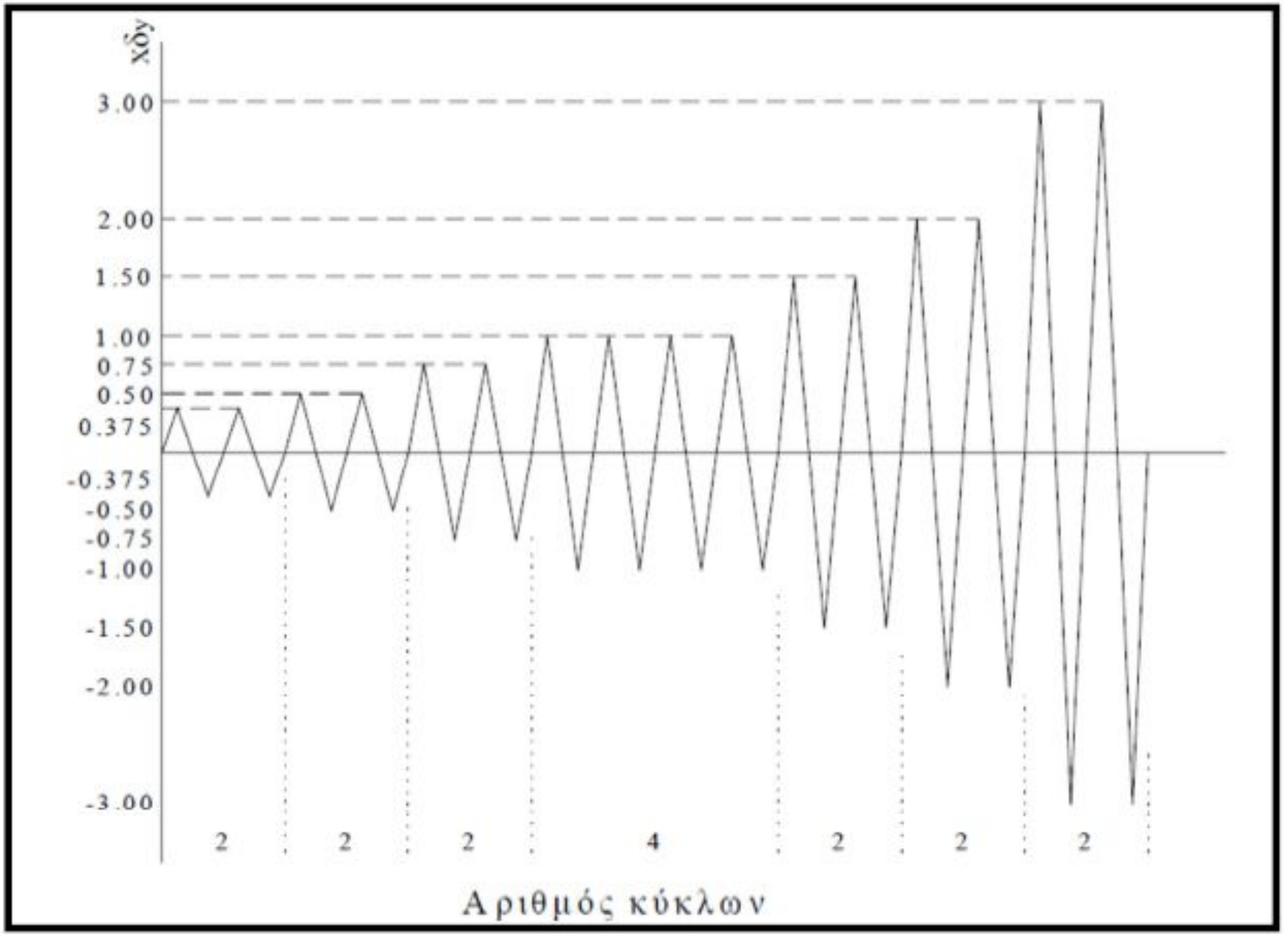
STRUCTURE OF THE EXPERIMENT

MATERIAL

σ (MPa)	$\varepsilon_{plastic}$
505	0.00
525	0.02
575	0.04
625	0.08
650	0.20

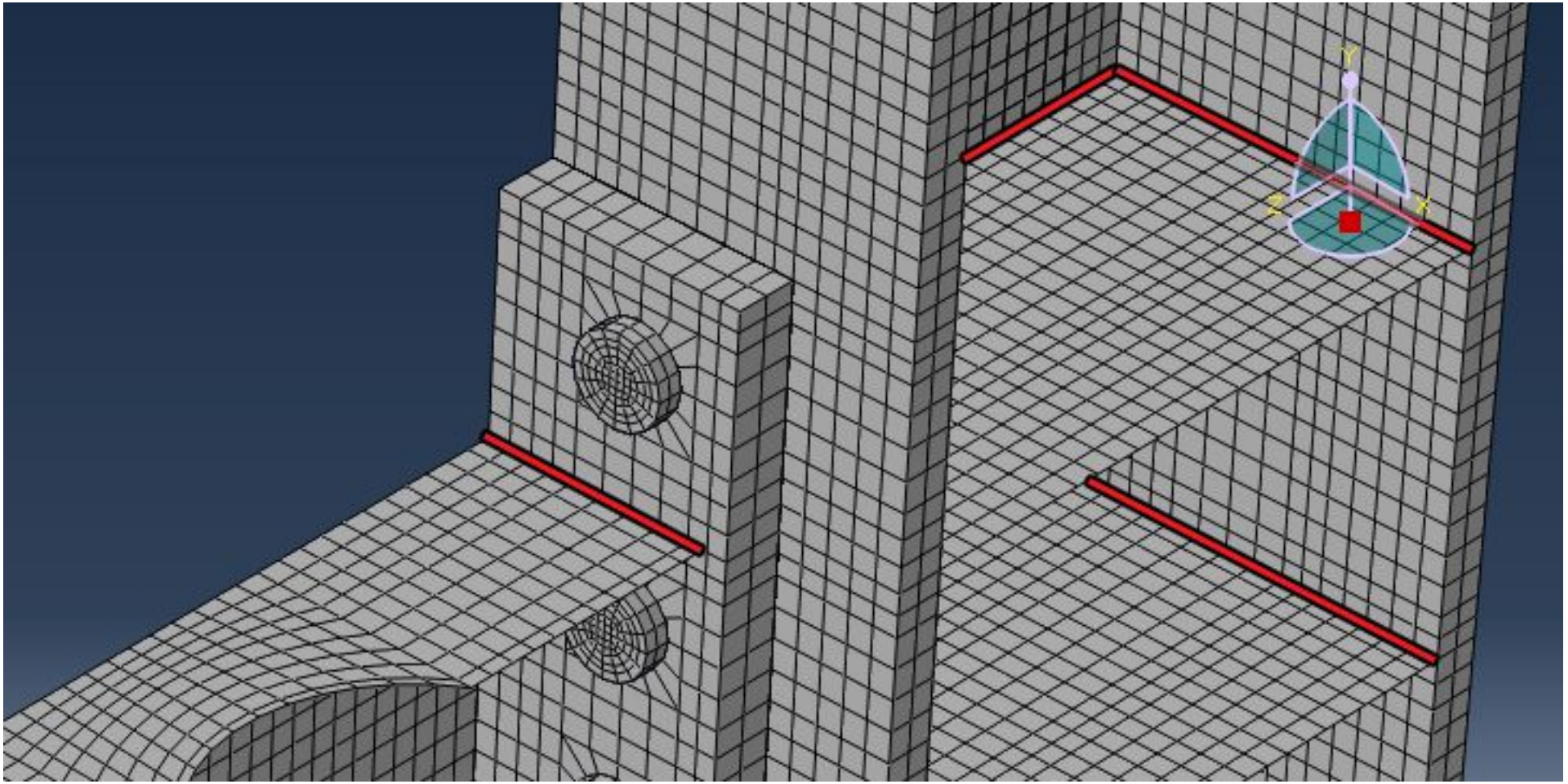


LOAD PROTOCOL



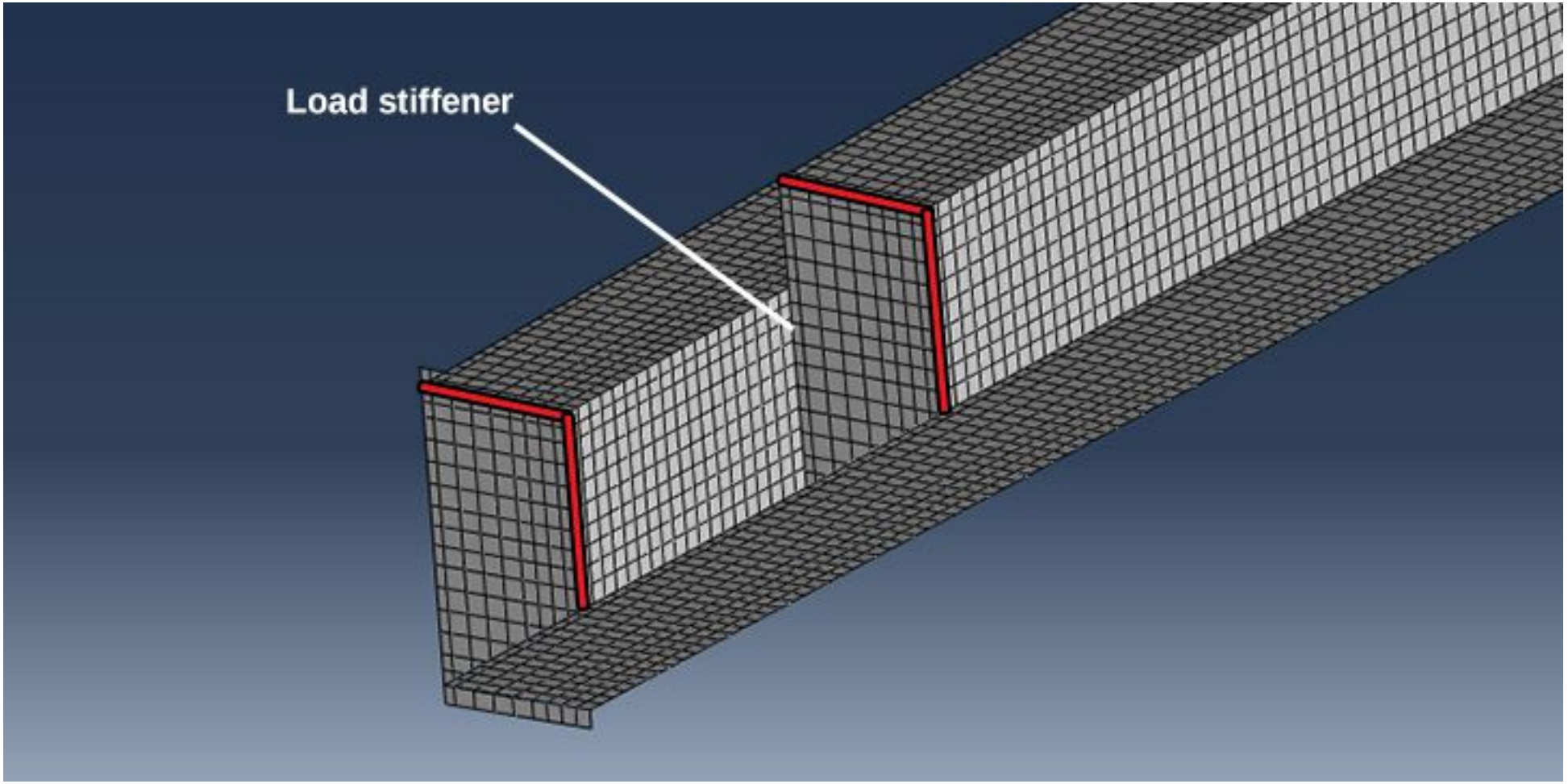
INTERACTION

Ties



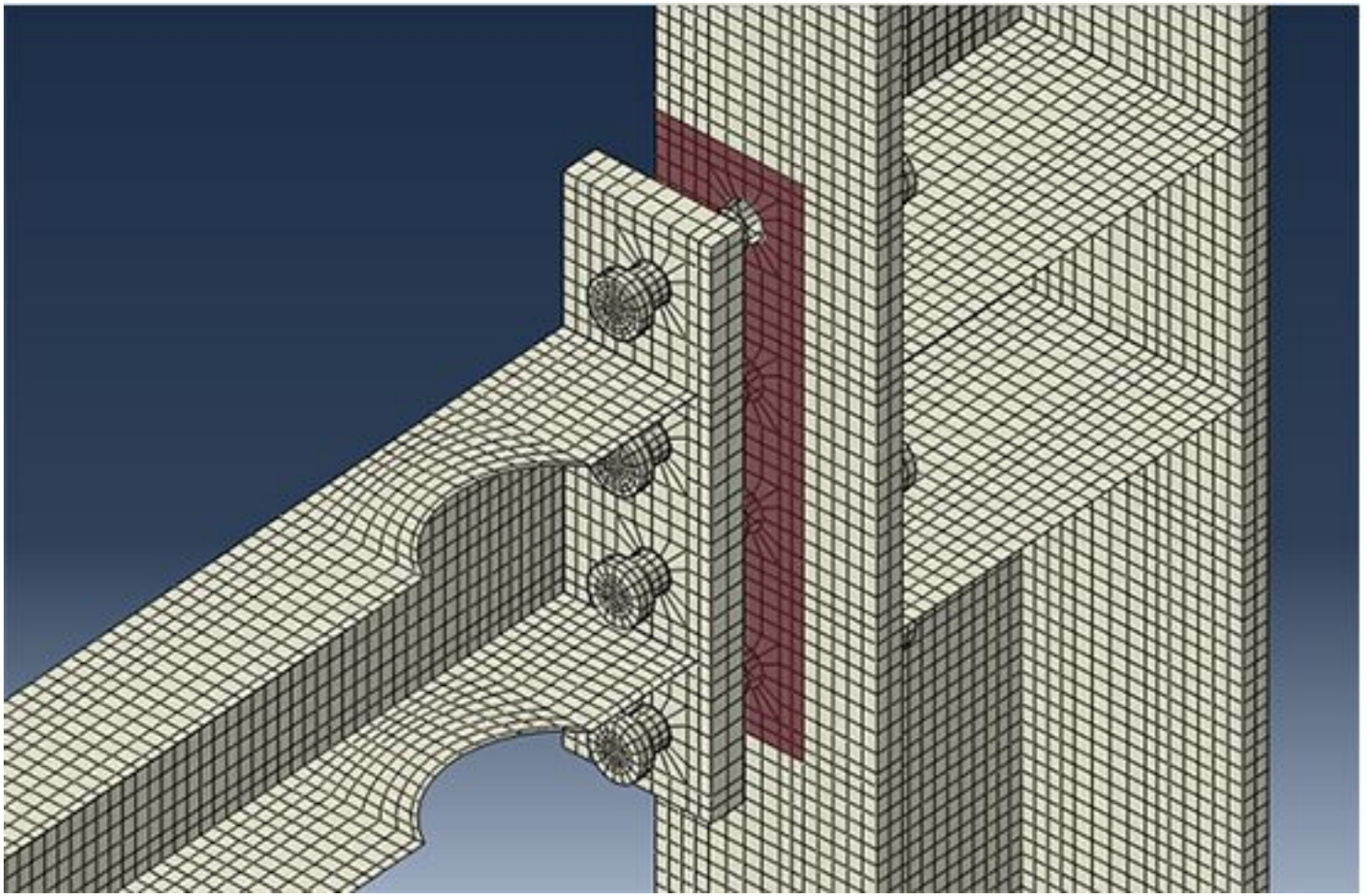
INTERACTION

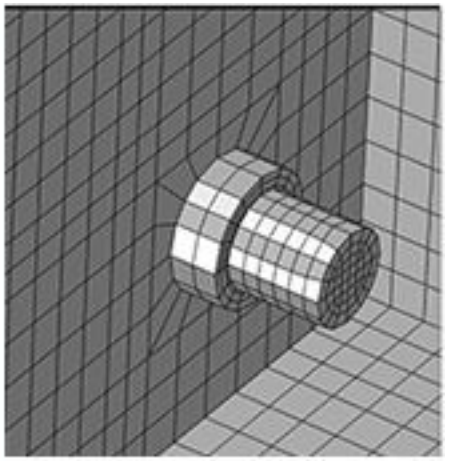
Ties

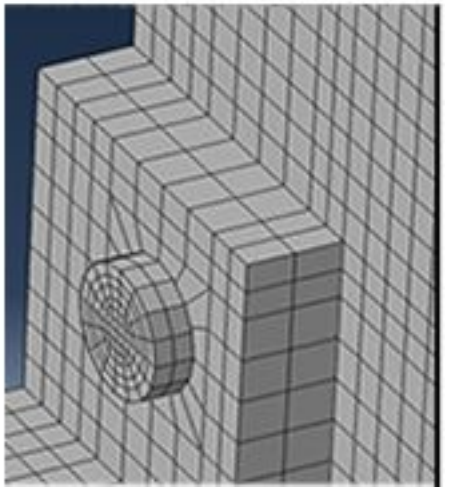


INTERACTION

Contact







MESH

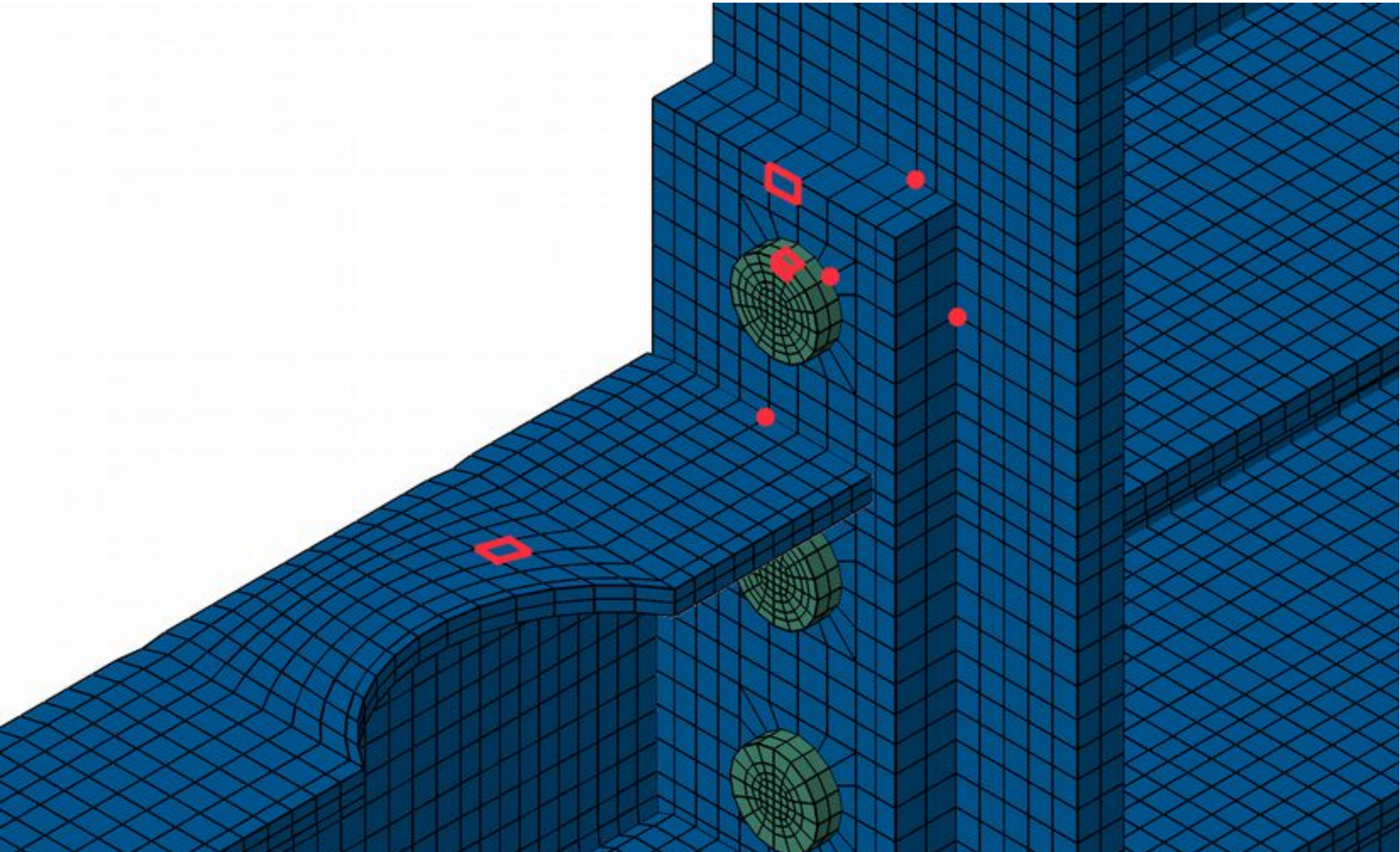
The division of the parts into shapes that allow the computer to aproximate the behaviour of the whole, solving a set of simple equations

Directly linked with the results´ accuracy

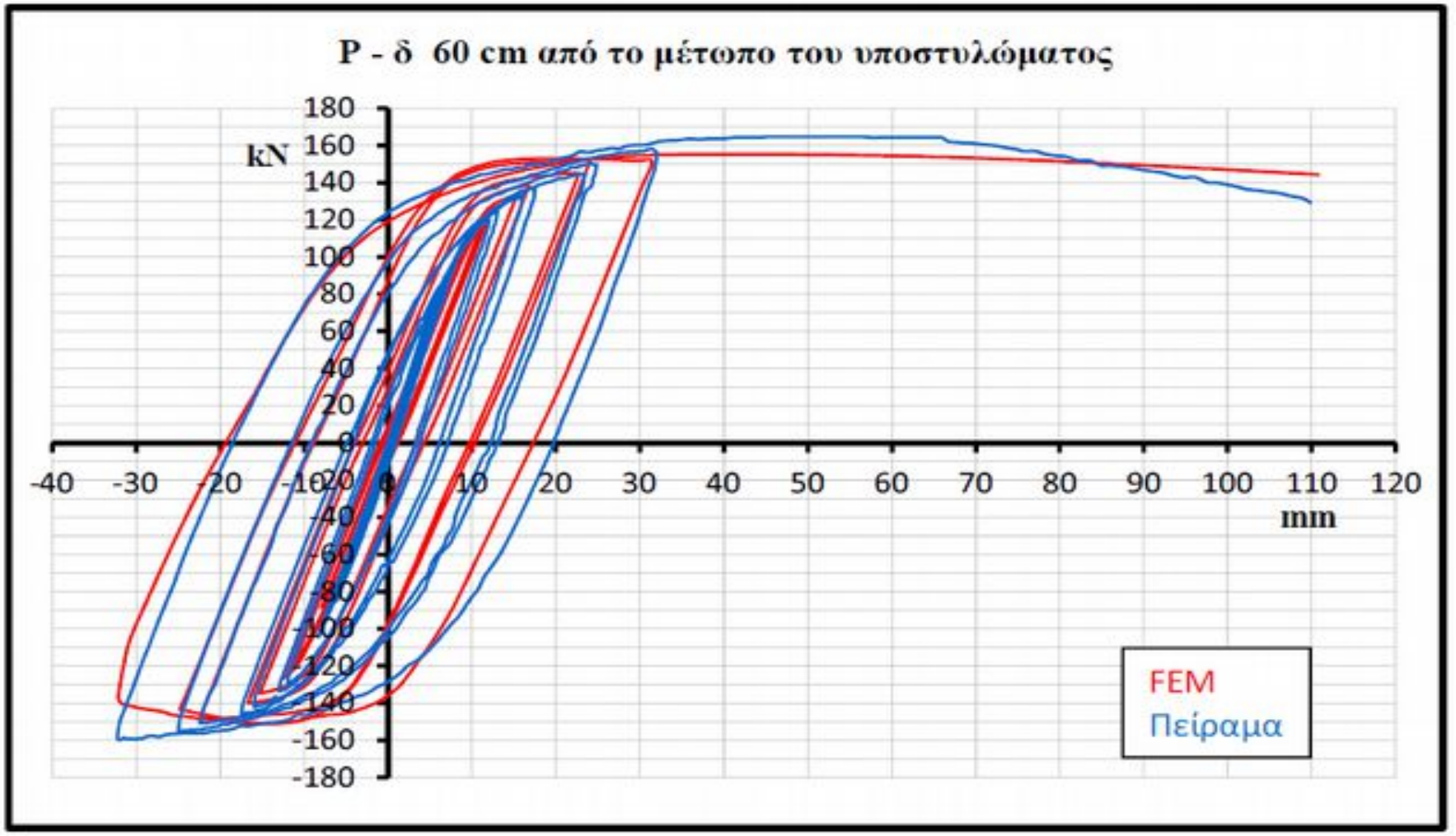
Coincident nodes where different parts meet

Rectangular elements are optimum

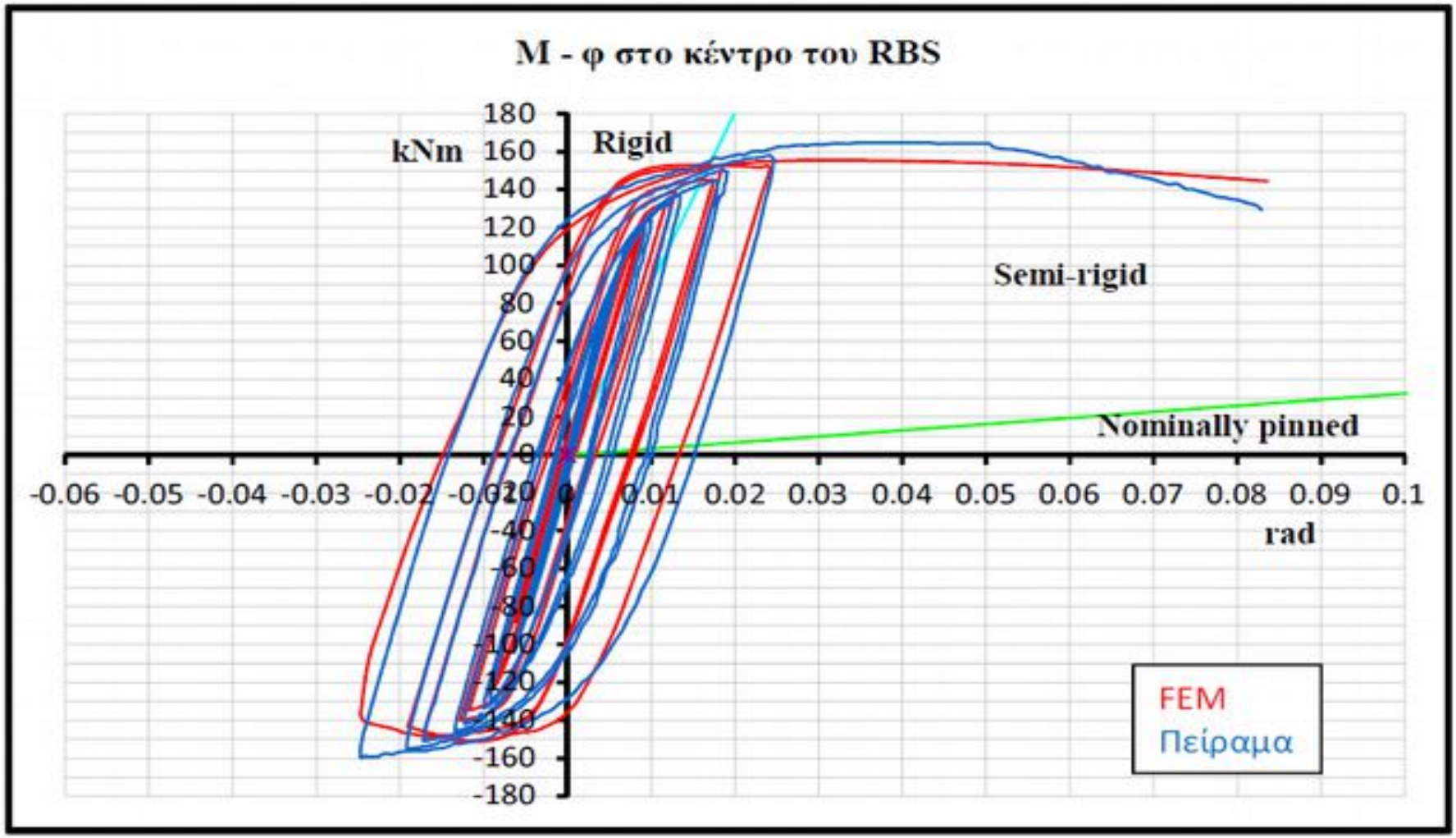
MESH



RESULTS

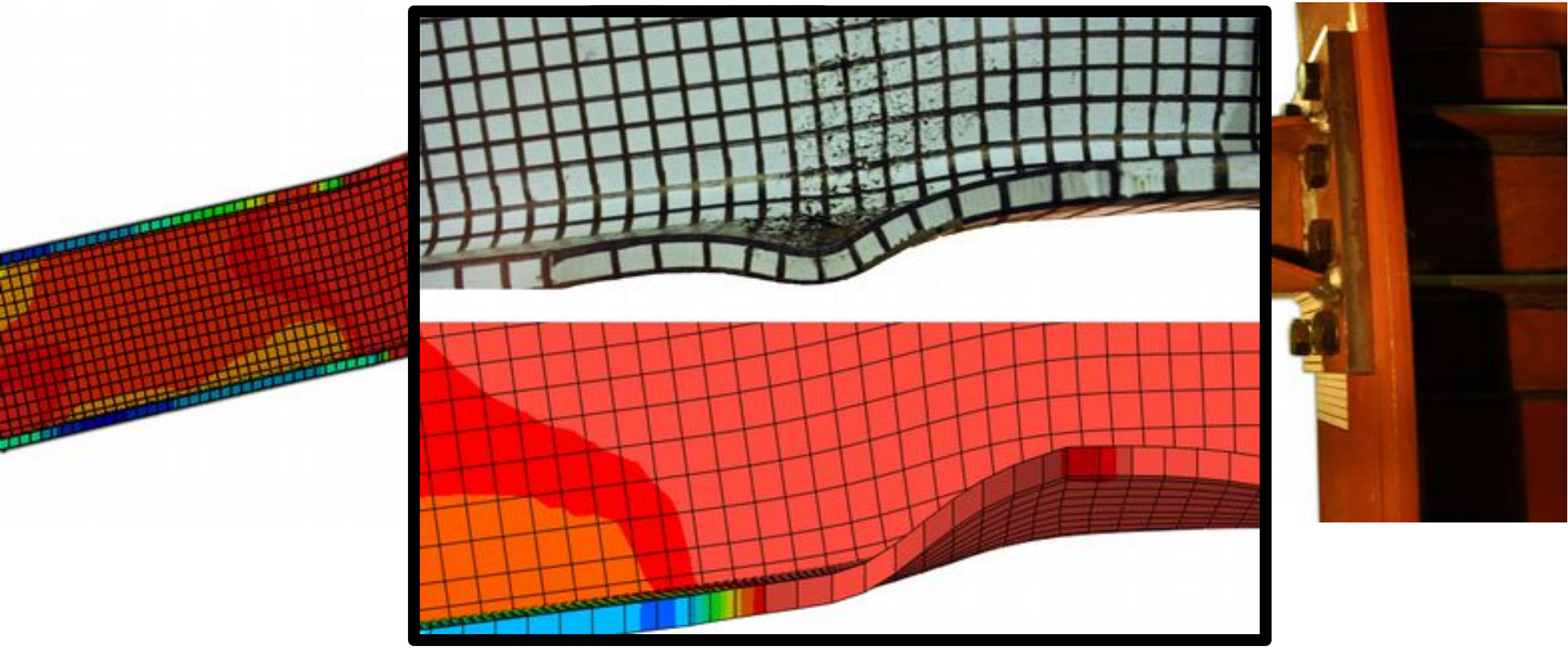

P - δ 60 cm από το μέτωπο του υποστυλώματος
kN
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
mm
FEM
Πείραμα

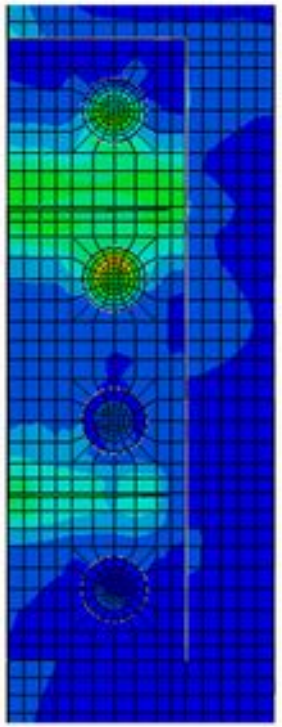
RESULTS


M - φ στο κέντρο του RBS
kNm
Rigid
Semi-rigid
Nominally pinned
rad
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-0.06 -0.05 -0.04 -0.03 -0.02 -0.01 0 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.1
FEM
Πείραμα

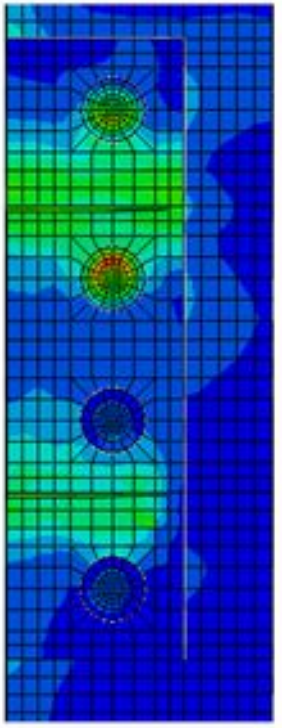
RESULTS COMPARISON

FEM-EXPERIMENT CONTRASTING

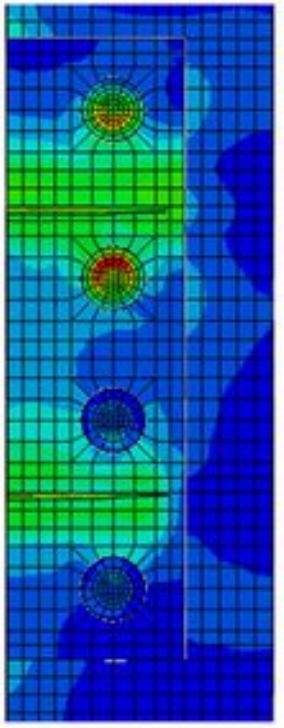




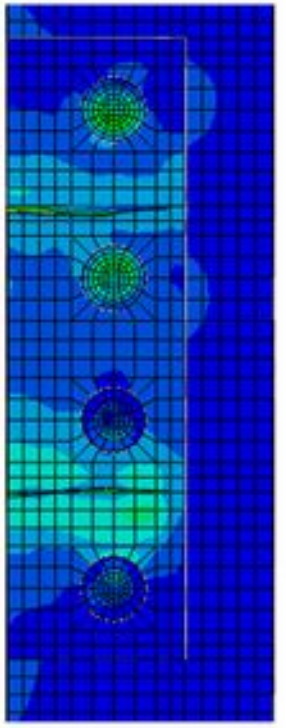
α
150%



β
200%



γ
300%



δ
αστοχία

CONCLUSIONS

The behaviour of the connection is satisfactory as the plastic hinge is created at the position of the cut

The analytical model is reliable

Although in one of the controlled parameters the recommended by EC8 value is not used, we conclude that the method is indeed effective. Such fact provides reasonable doubt about the recommendations of the code as they are a result of an adoption of what FEMA is proposing

The rotational capacity of the node is at least satisfactory as it proved to be way higher than the limits of EC8 and those of FEMA

The lower limit of parameter a that the Eurocode 8 recommends is justified as we observe the plastic hinge tend to get closer to the connection and therefore the possibility of the connection getting is higher. In none of the anterior experiments, that honoured the limit, had occurred such displacement

Experimental Procedure

Girder cutting

Part perforation

Part welding

RBS cut

Tension test

Structure Assembly

Pilot load

Dimension check

Dimension check

Weld control

Dimension check

Material determination

Optimal positioninng

Equipment control

Simulation Procedure

Material Input

Element determination
2d-3d elements

Calibrating Model

Actions

Tensile test simulation

Model eficiency
and accuracy

Along with data from
previous experiments

Actual beam's vertical
deformation @60cm