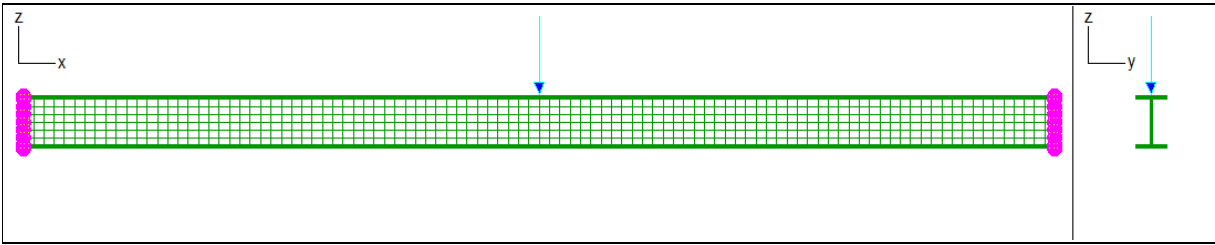


| | | | |
|--|---|--------------------|-------------------------|
| Validation of Sargon Nonlinear solver (CURAN, version 9.70) | | | |
| TEST SO020 | VALIDATION, CROSS CHECKS, RELIABILITY, BENCHMARK | Marco Croci | Rev.2-11/04/2011 |

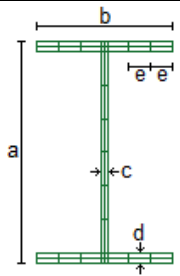


| Test description | |
|--|--|
| Constitutive law of solids material: linear elastic. Solution should coincide with a linear elastic analysis solution. | |
| Cross-check solver: CLEVER (Sargon) | |
| Test model: curansO_020.WSR | Target model: C020SO_CLEVER.WSR |

| Material properties | | |
|----------------------------|-------|-------------------------|
| Name | ν | E |
| S235LE | 0,3 | 210000N/mm ² |

| Model data |
|-------------------|
|-------------------|

| Beam | | Constraints | | Load (z direction) | |
|----------------|-------------|-------------|-------|--------------------|----------|
| LENGTH | SHAPE SIZES | LEFT | RIGHT | APPLICATION P. | FORCE |
| 10000mm | See image | Fixed | Fixed | Middle point | -100000N |
| a | b | c | d | e | |
| 500mm | 300mm | 14,5mm | 28mm | 50mm | |
| Solid elements | | Type | | d.o.f. | |
| 4400 | | BRICK8WI | | 20493 | |



| CROSS CHECK |
|--------------------|
|--------------------|

Displacement in the middle of the beam is $\delta = FL^3 / 3EI + L\chi T / 2GA$ where χ is shear factor and T is internal shear force

| Load case | Value | Unit | CURAN | TARGET | KIND | % diff. |
|-----------|------------------------------------|-------------------|------------|------------|-------------|---------|
| 1 | Node 1843 displacement (z) | mm | -2,796E+00 | -2,806E+00 | theoretical | -0,35 |
| 1 | σ_x element 2952, node 4052 | N/mm ² | 2,747E+01 | 2,744E+01 | cross-check | 0,10 |
| 1 | Node 1943 reaction (x) | N | -2,199E+03 | -2,199E+03 | cross-check | 0,00 |

$$\% \text{ difference} = (\text{CURAN} - \text{CLEVER}) / \text{CLEVER} * 100$$

Precision of limit multiplier for the analysis: 0.005
 BRICK8WI: isoparametric element with Wilson-Ibrahimbegovic modification