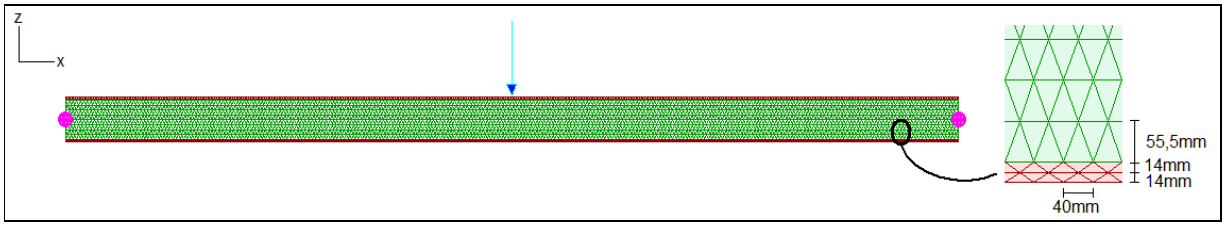
| Validation of Sargon Nonlinear solver (CURAN, version 9.60) | | | |
|---|---|---|---|
| **TEST MB021** | **VALIDATION, CROSS CHECKS, RELIABILITY, BENCHMARK** | **Marco Croci** | **29/11/2010** |

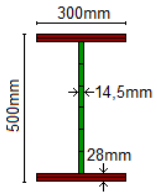



| **Test description** |
|---|
| Constitutive law of membranes material: linear elastic. Solution should coincide with a linear elastic solution. |
| Theoretical check and cross-check with Sargon linear solver (CLEVER) |
| Test model: **curanMB_021.WSR** Target model: **C021MB_CLEVER.WSR** |

| **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 | Simple support | Middle point | -100000N |
| | | | | |
| Membrane elements | | Type | Thicknesses | d.o.f. |
| 6012 | | CST | See image | 6534 |




**CROSS CHECK**

Displacement in the middle of the beam is $\delta=FL^3/48EI+L\chi T/2GA$ where $\chi$ is shear factor and T is internal shear force

| **Load case** | **Value** | **Unit** | **CURAN** | **TARGET** | **KIND** | **% diff.** |
|---|---|---|---|---|---|---|
| 1 | Node 1638 displacement (z) | mm | -9,874E+00 | -9,943E+00 | theoretical | -0,69 |
| 1 | $\sigma_{VM}$ element 4476, node 2437 | N/mm$^2$ | 3,060E+01 | 3,060E+01 | cross-check | 0,00 |
| 1 | $\sigma_x$ element 4473, node 2429 | N/mm$^2$ | 1,323E+01 | 1,323E+01 | cross-check | 0,00 |

% difference = (CURAN - TARGET) / TARGET * 100

Precision of limit multiplier for the analysis: 0.005