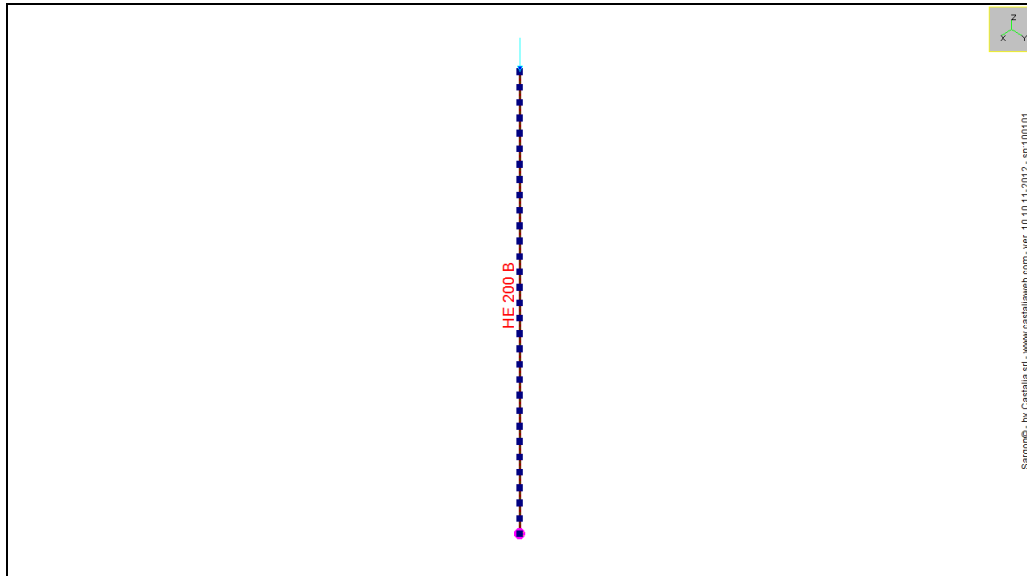


<b>SARGON BUCKLING SOLVER</b>	TEST 01	Tested by: M. Croci
VALIDATION, CROSS CHECKS, RELIABILITY, BENCHMARK	rev.1 14/12/12	Checked by: P. Rugarli



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<b>MODEL TO BE CHECKED (A)</b>			
	MODEL NAME	OUTPUT FILE	ANALYSIS TYPE
A	buckling_01.wsr	.bou	Sargon buckling

<b>REFERENCE MODELS</b>			
	MODEL NAME	OUTPUT FILE	ANALYSIS TYPE
B	buckling_01.nas	.out	NEiNastran buckling
C	buckling_01.sdb	.log	Sap2000 buckling
D	buckling_01_soclever.wsr	.sou	Sargon second order nonlinear

**CROSS-CHECK**

The multiplier computed by Sargon buckling (A) is compared to those computed in reference models: % difference (A-X) is equal to  $(A-X)/X \times 100$ , where X value is the result of considered reference X model (for example B). Since this case can be easily computed by hand, the theoretical result is assumed as reference value (E). The model is a column under concentric axial compression ( $F=1,00e5N$ ), with one end fixed and one end free: critical force is  $F_{cr}=\pi^2EI/(4L^2)$ . Material is S235 (with  $E=210000N/mm^2$ ), cross-section is HEB200 ( $I_{min}=2,00e7mm^4$ ),  $L=4000mm$ . It results  $F_{cr}=6,477e5N$ . Reference value (E) is equal to  $F_{cr}/F=6,47693$ .

A	B	% diff. (A-B)	C	% diff. (A-C)	D	% diff. (A-D)	E	% diff. (A-E)
6,4774	6,47624	0,02	6,47743	0,00	6,44535	0,50	6,47693	0,01

Settings for Sargon analyses:

- Buckling: modes: 1; subspace order: 10; tolerance: 1e-6; max number of iterations: 50
- Second order non linear: load steps: 1; tolerance: 1e-6; max number of iterations: 10

Note well: the second order analysis performed by Sargon solver (SOCLEVER) is different from a buckling analysis. Second order step by step does not assume that internal forces grow linearly with load multiplier, as in eigenvalue analysis. Multiplier by second order step by step solver were got by artificially increasing 10 or 100 times the load applied, so that convergence could not be reached. The multiplier < 1 is then multiplied times the increasing factor applied.

Nastran model was automatically created by Femap from the neutral file automatically created by Sargon (.wsr → .neu → .nas).

Sap2000 models were prepared by converting cross sections analysis data (A, J2, etc), with no use of cross-section dimensions, as Sap2000 does not manage all fillet radius precisely