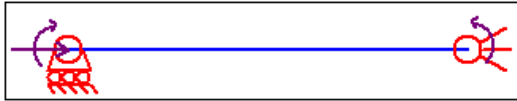


|                           |                                       |                              |
|---------------------------|---------------------------------------|------------------------------|
| <b>TEST SCHEDULE B 21</b> | <b>EN 1993-1-1: 2005 (EUROCODE 3)</b> | <b>Sargon ©, Cescopius ©</b> |
| BUCKLING                  | COMPRESSION + BENDING 2               | <b>EC3.BUC.NNM2.001</b>      |



**Program:** WEURO © version October 2007 for Sargon and Cescopius  
**Keywords:** EN 1993, Eurocode 3, example, validation, benchmark, reliability, quality control, error measure. **Parole chiave:** Eurocodice 3, esempio, validazione, test ,affidabilità, controllo di qualità, misura dell'errore  
**Tv**=exploitation target value, **Cv**=exploitation computed value  
**Authors:** Ing. Marco Croci, Ing. Paolo Rugarli

| BEAM        |   |                  |           |
|-------------|---|------------------|-----------|
| Length [mm] | Buckling factors                            | Left end         | Right end |
| 1000        | $\beta_1=0 \quad \beta_2=1 \quad \beta_3=1$ | SIMPLY SUPPORTED | HINGE     |

| LOAD                 |                 |                      |  |
|----------------------|-----------------|----------------------|--|
| Type                 | Value           | Point of application |  |
| COMPRESSION          | N=100.000N      | LEFT END             |  |
| Type                 | Value           | Point of application |  |
| BENDING MOMENT $M_2$ | M=2.000.000Nmm  | LEFT END             |  |
| BENDING MOMENT $M_2$ | M=-2.000.000Nmm | RIGHT END            |  |

| MATERIAL                   |                            | S275                   |       |               |               |               |
|----------------------------|----------------------------|------------------------|-------|---------------|---------------|---------------|
| $f_y$ [N/mm <sup>2</sup> ] | $f_u$ [N/mm <sup>2</sup> ] | E [N/mm <sup>2</sup> ] | $\nu$ | $\gamma_{M0}$ | $\gamma_{M1}$ | $\gamma_{M2}$ |
| 275                        | 430                        | 2,10E+05               | 0,3   | 1,1           | 1,1           | 1,25          |

| CROSS SECTION                       | YPE 100                           | CLASS: N → 1 M <sub>2</sub> → 1 N + M <sub>2</sub> → 1 (reclasses method****) |                                   |                                   |                                   |
|-------------------------------------|-----------------------------------|---|-----------------------------------|-----------------------------------|-----------------------------------|
| A [mm <sup>2</sup> ]                | J <sub>2</sub> [mm <sup>4</sup> ] | J <sub>3</sub> [mm <sup>4</sup> ]   | J <sub>t</sub> [mm <sup>4</sup> ] | W <sub>2</sub> [mm <sup>3</sup> ] | W <sub>3</sub> [mm <sup>3</sup> ] |
| 1032                                | 1,710e+06                         | 1,592e+05   | 1,202E+04                         | 3,420e+04                         | 5,789e+03                         |
| W <sub>pl2</sub> [mm <sup>3</sup> ] | W <sub>pl3</sub>                  | i <sub>2</sub> [mm]   | i <sub>3</sub> [mm]               | i <sub>t</sub> [mm]               |                                   |
| 3,941e+04                           | 9,145e+03                         | 40,7  | 12,42                             | 15,88                             |                                   |
| h                                   | b                                 | t <sub>w</sub>  | t <sub>f</sub>                    | r                                 |                                   |
| 100                                 | 55                                | 4,1   | 5,7                               | 7                                 |                                   |

| OTHER DATA* |          |          |          |          |
|-------------|----------|----------|----------|----------|
|             | $k_{yy}$ | $k_{yz}$ | $k_{zy}$ | $k_{zz}$ |
| Method 1    | 1,068    | /        | 0,618    | /        |
| Method 2    | 1,033    | /        | 0,620    | /        |

#### TARGET VALUES BASED ON PRELIMINAR COMPUTATIONS

$$\left. \begin{aligned}
 Tv_{1,j} &= N / (\chi_2 A f_y / \gamma_{M1}) + k_{yy} M_2 / (\chi_{LT} W_{pl2} f_y / \gamma_{M1}) \\
 Tv_{2,j} &= N / (\chi_3 A f_y / \gamma_{M1}) + k_{zy} M_2 / (W_{pl2} f_y / \gamma_{M1})
 \end{aligned} \right\} Tv_{method\ j} = \max(Tv_{1,j}, Tv_{2,j})$$

| Tv <sub>method1</sub> ** | Tv <sub>method2</sub> *** |
|--------------------------|---------------------------|
| 7,279E-01                | 7,282E-01                 |

#### CHECKER'S RESULTS (COMPUTED VALUES) AND COMPARISON WITH THE TARGET

| Cv <sub>method1</sub> | (Cv <sub>1</sub> -Tv <sub>1</sub> )/Tv <sub>1</sub> | Cv <sub>method2</sub> | (Cv <sub>2</sub> -Tv <sub>2</sub> )/Tv <sub>2</sub> |
|-----------------------|---|-----------------------|---|
| 7,277E-01             | <b>-2,133E-04</b>                                   | 7,280E-01             | <b>-2,818E-04</b>                                   |

(\*) formulae given in EN 1993-1-1 6.3.3, annex A and annex B

(\*\*) more accurated

(\*\*\*) easier to use

(\*\*\*\*) P. Rugarli, *Strutture in acciaio, La classificazione delle sezioni, Commento all'Eurocodice 3*, EPC Libri, 2007