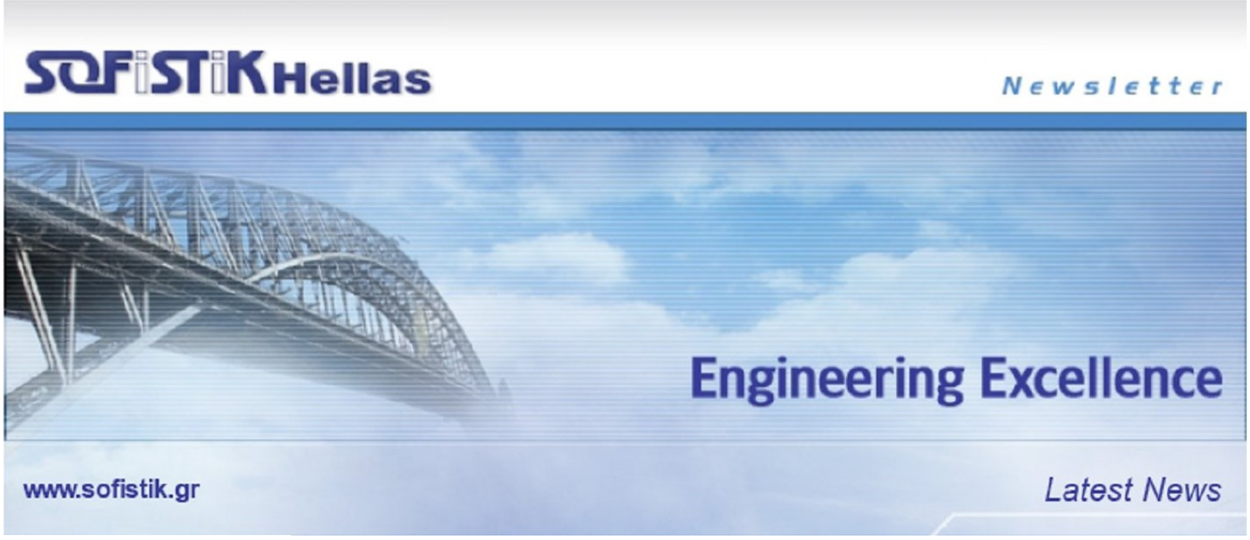

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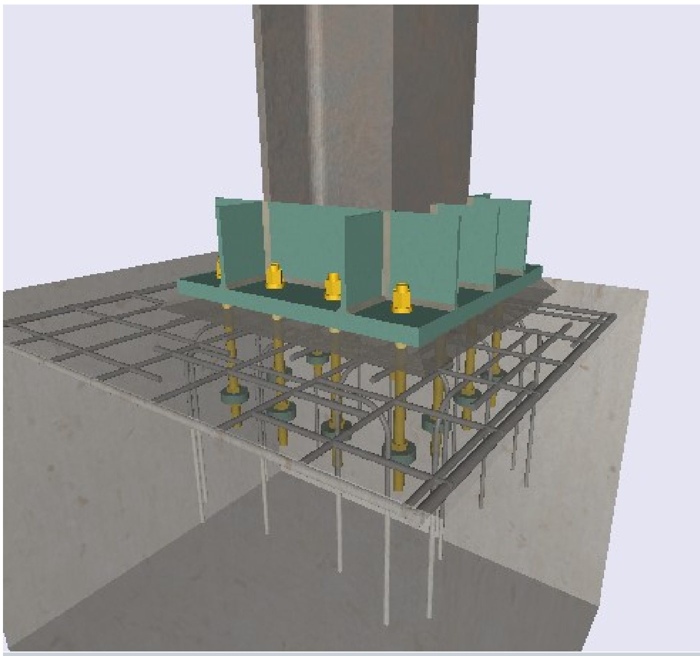
Steel Structures

New version of program STeelCON 2019.042

Dear colleagues,

A new version of the “**STeel CONnections**” program for the design of bolted and welded steel connections has been released.

New Anchorage Calculations for Footing Plate Connection, elastic method



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Design of concrete foundation anchorages with **elastic analysis** according to prEN1992-4 is an important addition to the program. The tensile loads of the anchors are calculated assuming elastic behavior of both concrete and the anchor steel, so that static equilibrium with the column bending moments and axial force is fulfilled. Contrary to the plastic analysis, where the tensile anchor loads, for the needs of concrete verification, are determined so that they exceed the capacity of the steel anchors, such prerequisite is not imposed under the elastic analysis and as a result more rational final anchorage designs can be achieved in most cases. The main advantages of the new analysis procedure are:

- Usually, lower demands for the concrete verification checks, such as cone failure, splitting failure, pullout failure and blowout failure.
- Compared to the plastic analysis, a successful design may be achieved with reduced foundation size, concrete strength or depth of anchorage.
- A successful design may be achieved without supplementary reinforcements that would otherwise be necessary.
- More insightful design procedure, allowing for quicker interpretation of the results and consequently better handling of problematic cases.
- Less restrictions on constructional details are required according to prEN1992-4, compared to the plastic analysis.

The benefits are more profound when the column bending moments and axial force are relatively small. In such cases, plastic analysis normally leads to overdesign of the concrete foundation. On the other hand, elastic analysis leads to no benefit when column loading increases and pushes anchor tensile forces to their plastic resistance.
The above considerations are better described with the following example. Considering a typical design case, that is depicted in the figure below (HE-300B column, C30/37 concrete, footing size 1000x1200mm and Φ20 headed anchors) the column major moment was gradually increased, while all other parameters remained constant, including the anchorage depth. The worst ratio (maximum) for all verification was recorded both under elastic as well as under plastic analysis.

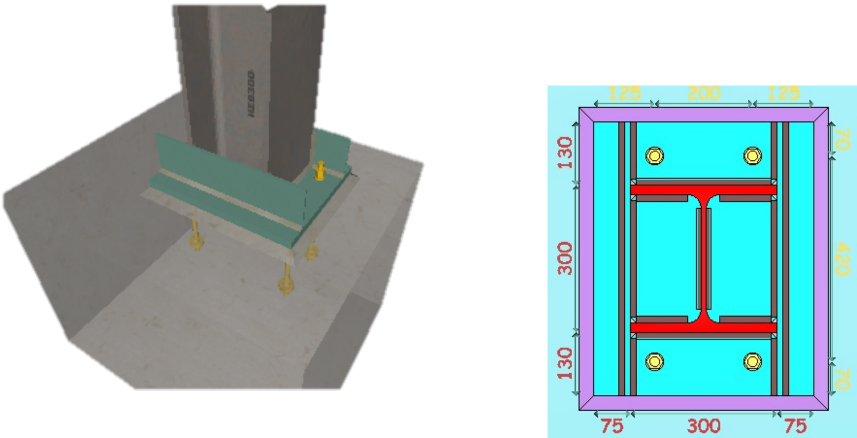


***Figure 1**. Geometry of the example*

The results are plotted in the following graph. The horizontal axis represents the column moment while the vertical one the calculated worst ratio. In this particular case the line that represents elastic analysis (blue one) is below the corresponding line for plastic analysis (red one) for the whole range of applied moments that permit a successful design (ratio <1). In other words, elastic analysis proves more successful to pass the verification, which in turn can lead to more economic design. The benefit becomes more significant with lower applied loading, where the line for plastic analysis remains insensitive to the applied loading, because in those conditions, the worst ratio is derived from concrete verifications, for which anchor tension is capacity based.

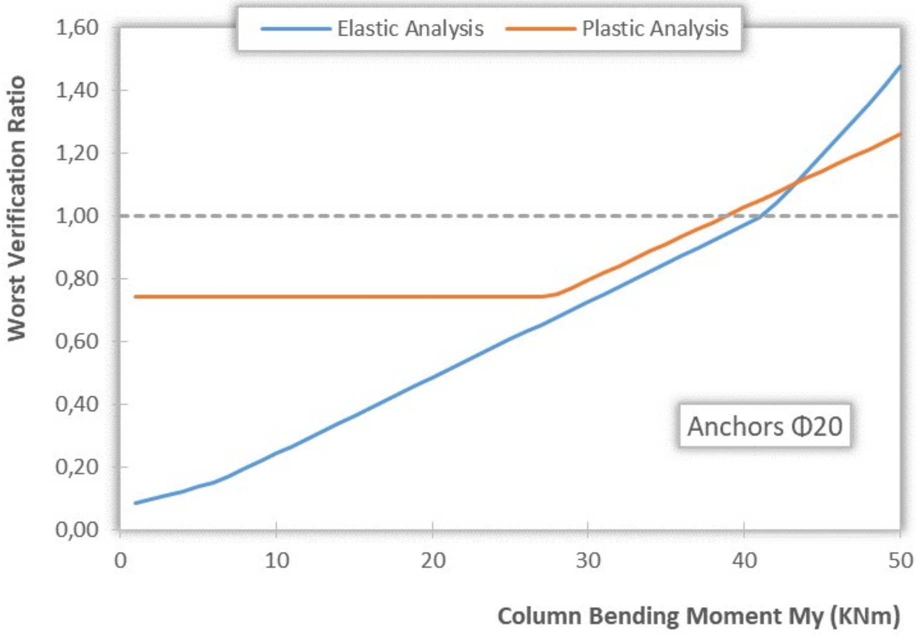
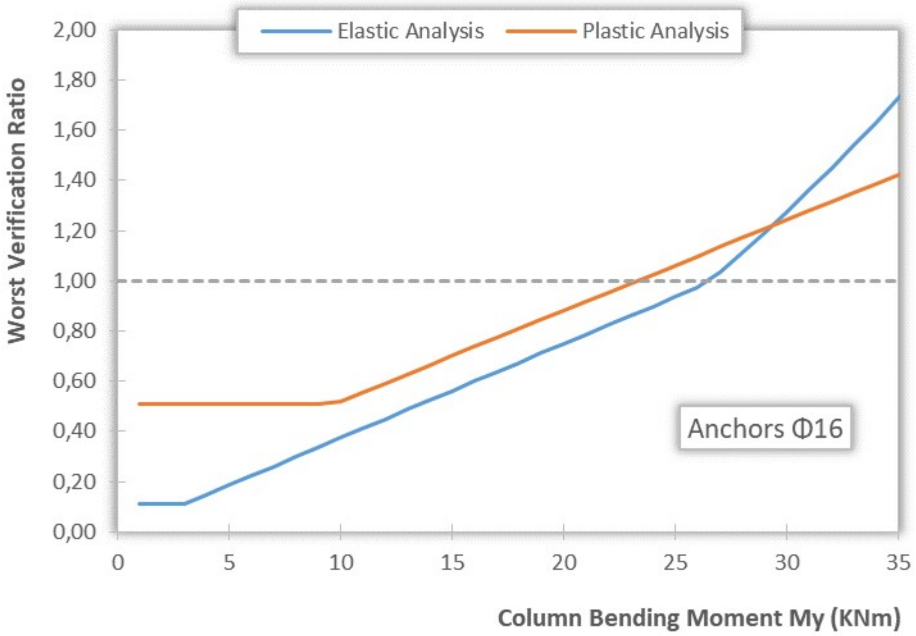


***Figure 2**. Plots of the calculated worst verification ratio (maximum) versus the applied column bending moment under elastic and plastic analysis.*

Modifying the above example, by changing the anchor diameter to Φ16 and Φ24, so that the relative strengths of the anchors and the concrete foundation is altered, we get the following two graphs. The plots are greatly affected but the observations made for the Φ20 anchors are still valid.



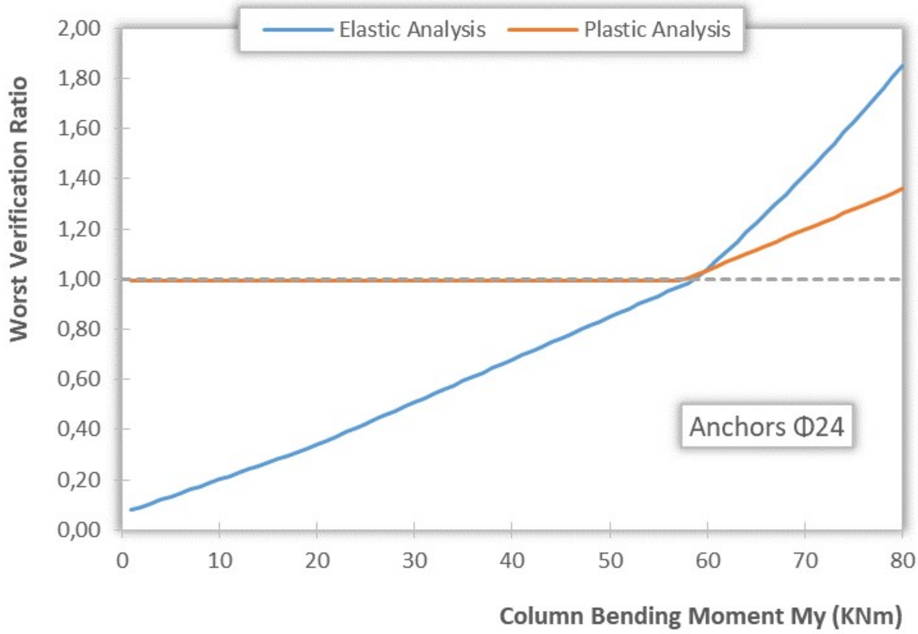


***Figure 3**. Investigation of the relative strength of anchors to the foundation concrete for the worst verification ratio plots.*

SteelCON is SOFiSTiK Version 2018, 2016 as well as older Versions compatible. All geometrical and topological data as well as forces can be imported from the overall structure. Connection design results are then a part of the SOFiSTiK Output Report.

14.02.2019, Munich Germany