

PLE-micro-CAD version 3.09

The new version 3.09 of PLE-micro-CAD contains a number of modifications and extensions of functionality resulting in the availability of new applications. The modified/new modules are:

- T0-module : this module is adapted to the new NEN 3650:2003 standard including the corrections dated January 2004. The module is applicable for steel pipelines only.
- J-module : a new option has been added to the articulated pipeline module. To the joints axial, transverse, torsional and rotational stiffnesses may be assigned.
- S-module : a new feature is the division of the sections in elements with primary membrane stresses and other elements.
- M-module : the method of calculation of stresses and strains has been changed in view of the development of the Flexible Module.
- U-module : the Flexible Module: the stiffness of the soil counteracting the ovalisation of a cross-section is taken into account resulting in lower ovalisation and stresses, especially of importance for pressureless flexible and/or thinwalled pipes.

The Flexible module will be available for distribution at short notice.

The existing modules of version 3.08 have been modified / extended as follows.

SN011.1 Function 3.1: Compose pipe data model

- The input table ISTROP containing the material data of the pipeline has been extended with a column for specification of the yield stress at θ° being the maximum or minimum temperature to be specified in input table TEMP in view of the new NEN 3650:2003 Code.
- If in input table ISTROP the field for CHKEPS has been left blank (empty), this check strain was taken as 3 times the yield strain. This has been changed to the values given in NEN 3650:2003: 7‰ if $Re \leq 360 \text{ N/mm}^2$ and 5‰ if $Re > 360 \text{ N/mm}^2$.
- To table PIPEMAT a column named ReT has been added containing the new yield stress at a temperature of θ° . The name of the existing column SYIELD has been changed to Re (yield stress at 20° Celsius).

SN011.2 Function 3.2: Compose soil data model

- The default values of the uncertainty factors for the mechanical soil properties have been adapted to be in compliance with the new NEN 3650:2003 Code. The values for sand have been selected.
- The path of the soil properties is given as a trilinear shape in the new NEN 3650. This shape may be approximated by the TANH curve in PLE. However, the application of a bilinear path remains allowable.

SN011.3 Function 3.3: Compose model boundary conditions

- In the new table JNTSPRS a bellows kind of connection can be specified with stiffnesses in axial, transverse, torsional and rotational direction. In the result table J-SDATA these characteristics are assigned to the elements in question. Moreover, some data calculated by the program are added.

SN011.4 Function 4.2: Compose pipeline loadings

- The default values of the uncertainty factors for soil settlements / subsidences have been adapted to be in compliance with the new NEN 3650:2003 Code.
- Input table SUBSIDE now contains a new column for the uncertainty factor.

SN011.5 Function 5: Determine pipeline behaviour

- The load factors for the loads to be taken into account have been changed, in this case reduced. The new default values in input table LOCASE are in compliance with load combinations BC3 and BC 4 from table 2 of NEN 3650-2:2003.
- The stress intensification factor in circumferential direction i_y should be taken now 2 times the one in longitudinal direction i_x , or according to table NB-3685.1-2 of the Boiler and Pressure Vessel Code (as is the case in the General option of the program). In the NEN 3650 module the option $i_y = 2 i_x$ has been incorporated.

SN011.6 Function 6.1: Compose cross-section data model

- The default values for the uncertainty and load factors of the soil overburden and the topload (traffic load) have been adapted to the values given in the new NEN 3650-2:2003.
- The new table PRIMSEL provides an indication whether a section is to be considered as an element with primary membrane stresses in the sense of the new NEN 3650 code. The indication is given for 2 situations: soil overburden only and soil overburden + topload. It is distinguished between 2 kinds of primary elements: elements within a pipe span and elements in the adjacent bearing zones. The table may be existing too if the General Option is active.
- The program calculates the all-sided external overpressure (including soil pressure) on the cross-sections. If the calculated value exceeds the allowable long term value (= one third of the critical all-sided external overpressure for radial elastic instability), two warnings are given: one with the maximum value and the element concerned and one with the range of elements where the allowable value has been exceeded.

SN011.7 Function 6.3: Calculate/check cross-section behaviour according to NEN 3650

- Input table SWEIGH has been added to this function. Sometimes additional stress intensification factors have to be applied, for instance for mitre bends, as long as these bends are modeled with an equivalent bend radius to be specified by the user. Similarly the result table CSWEIGH has been added.
- The stress check is performed on basis of table D.2 of NEN 3650-2:2003. The check stresses σ_{pr} , $\sigma_v:pm$ and σ_v are calculated and checked against the limit values.
- The result tables SMAXNEN and STRSNEN have been replaced by the tables NENSMAX and NENSTRS. These new tables contain the new check stresses divided by the limit stresses. These quantities should not exceed the value 1. If so, a warning is given and the table button(s) will turn red.

SN011.8 Function 6.5: Perform plastic cross-section calculations

- The cross-sectional behaviour according to the plasticity theory has been refined (numerical in stead of harmonic calculations) resulting in more accurate values that possibly may be somewhat different from version 3.08.