

PLE-micro-CAD version 3.10.01

The new version 3.10.01 of PLE-micro-CAD contains a number of modifications and extensions of functionality resulting in the availability of new applications. The modified modules are:

- K-module : the Kernel Module:
 - In this module the modeling of elastic spring supports has been extended. These supports can be provided now with a support length along the pipe axis and a support angle as in case of soil. If a free pipe span develops adjacent to such a support, it is strongly recommended to switch the Redistribution option on.
 - In case of local supports there was often a very slow convergence of the iteration process in Design Function 5 due to an error in the rotation procedure. This has been solved in the current PLE version.
- T0-module : the NEN 3650 stress check module:
 - The primary membrane stress check $\sigma_v:pm$ has been adapted according to the explanation in the modification quire NEN 3650-2:2003/A1:2006.
 - Moreover the Flexible option can be used now within the NEN 3650 module, if the Flexible module is available.
- M-module : the Non-linear Material Behaviour Module:
 - To the available stress-strain relations BILIN, DUC and DSH a new relation has been added: CYCLIC for material behaviour under cyclic loading.
- S-module : the Stress Module:
 - The contents of the result table PRIMSEL for primary membrane stress elements in Design Function 6.1 has been adapted to the explanation in the modification quire NEN 3650-2:2003/A1:2006.
 - An implosion check has been added according to appendix D.3.3.4 of NEN 3650-2:2003 due to external pressure, bending moments and a combination.

The existing modules of version 3.09.14 have been modified / extended as follows.

SN013.1 Function 2: Compose pipeline configuration

- If the IDENT in input table ORIGIN has been left blank, the name 'Start' is assigned automatically by the program.
- The new input table SUPPORT has been added containing the specification of the location and type of external supports along the pipeline. The supports can be provided with a length along the pipeline and a support angle resulting in 2 support elements with half the specified length. If no length and angle has been entered, the support spring is assigned to the node at the specified location. In that case the support force will cause no ovalisation of the pipe cross-section. It is referred to the existing input tables ELSPRS and TFSPRS in Design Function 3.3 for the support spring properties. Further, see Help descriptions of table SUPPORT.
- Three types of support elements can be distinguished in result table ELEMNTS: SUPP in a straight pipe section, SUPB in a bend and SUPE in an elastic bend. All support elements are collected in the element group 'Support'. See also result tables GRELEM and AVGRPS.

SN013.2 Function 3.1: Compose pipe data model

- The columns SIGEPS and CHKEPS for specification of the elasto-plastic material properties in case of plastic calculations has been moved from the input table ISTROP to a new input table called SIGEPS.
- The new input table SIGEPS contains the specification of the stress-strain relation of the pipe material. A **new** stress-strain relation has been added describing the material behaviour under cyclic loading. This relation, **CYCLIC**, may result in much lower strains compared to the existing BILIN, DUC and DSH relations. The new relation can be used for other models as well, for instance the well known Ramberg-Osgood formulation. However, then sufficient material data for the input parameters should be available.
- The columns SIGEPS and CHKEPS for specification of the elasto-plastic material properties in case of plastic calculations has been moved from the result table PIPEMAT to a new result table called PIPEPLS. In this new result table the generated data from the new input table SIGEPS are reported.

SN013.3 Function 3.3: Compose model boundary conditions

- The input table SUPLOC has been removed. This table is replaced by input table SUPPORT in Design Function 2.
- The column SUPANGLE for specification of the supporting angle at elastic supports has been moved from the input table TFSPRS to the new input table SUPPORT.
- The result table CONDI has been extended with columns for the specified support length and support angle.

SN013.4 Function 5: Determine pipeline behaviour

- The Advanced Screen of Function 5 contains a button for switching the FLEXIBLE option ON or OFF (= default). If ON, horizontal soil support springs are applied at the points of the cross-section that move outward. To the soil springs the value $KLG = KLH$ or $(KLS + KLT)/2$ without uncertainty factors is assigned whichever is the smallest one. The soil resistance is maximised at 50 % of the smallest bearing capacity in accordance with NEN 3650. The original value of KLG is reported in result table BENDFAC. In case of pressureless thinwalled steel pipe or pressureless plastic pipe the resulting ovalisation may be reduced by factors. Modules K, N, Q, (R and S) are required when using the FLEXIBLE option.

SN013.5 Function 6.1: Compose cross-section data model

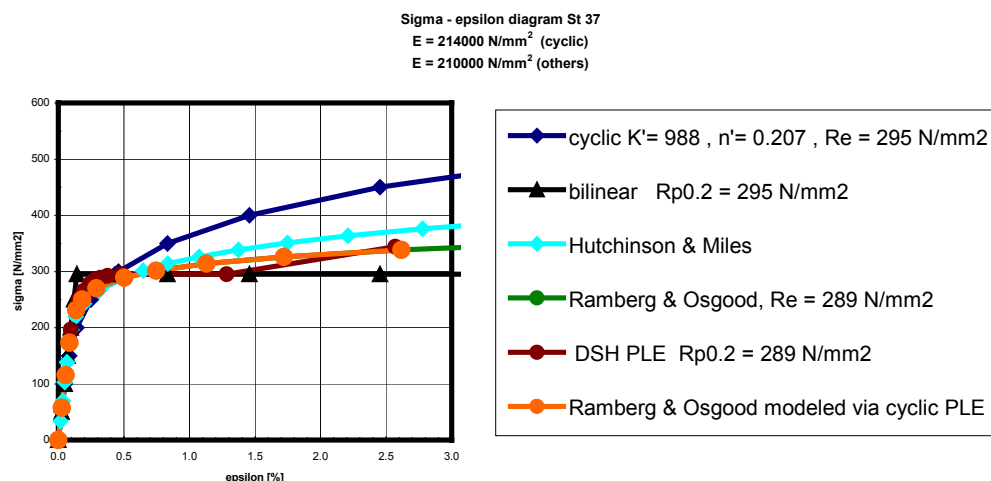
- If supports with support angle have been specified, the (constant) support angles are reported in result table CROSDAT in the columns ANG1 and ANG2. All other column fields remain empty in the rows for the support elements.
- The new result table ADDSUP contains the additional support forces, if any, due to the extra top(soil)load resulting from SOILNB and/or TOPLOAD, if the ADDCROS option is ON. Moreover total support forces are reported resulting from the sum of the values from table SUPREA and the additional values in table ADDSUP.
- The meaning of the use of Capitals for primary membrane stress elements in result table PRIMSEL has been changed. The name 'PRIMARY' is assigned to primary elements above ground and the name 'Primary' to primary elements below ground.
- An implosion check has been added according to appendix D.3.3.4 of NEN 3650-2 :2003 due to external pressure, bending moments and a combination.

SN013.6 Function 6.3: Perform cross-section NEN checks

- If FLEXIBLE is ON, the bilinear horizontal soil support springs are taken into account. The ultimate displacements for the linear branch of the springs (at 50% of the bearing capacity) and the actual (max.) value of the springs are reported in result tables RMAXNEN and RDPLNEN.
- The stress check for primary membrane stresses is performed according to table D.3 of NEN 3650-2:2003/A1:2006 (quire 5). The replacing stress $\sigma_{v;pm}$ (the primary membrane stress) has been removed from this table, but the check has been explained sub "Pipeline on pile foundation". Only when the pipeline is loaded as a spanning beam mainly and the occurring stresses are primary membrane stresses for the greater part, making equilibrium with the loadings directly, this check stress has to be performed. The stress check is **not** applicable for buried continuous pipelines without (pile) supports even if a free span develops below ground. The stress checking in PLE version 3.10 has been adapted accordingly.

SN013.7 Function 6.5: Perform cross-section calculations (material non-linear analysis)

- Calculations can be made applying the new stress-strain relation CYCLIC for material subject to cyclic loading. A description of the formulation can be found in the Help screens for input table SIGEPS.
- Below some examples of possible stress-strain relations are shown.

SN013.8 EDS Hardware Key

For users provided with a **Sentinel SuperPro** key (USB key or small parallel key) the following advise is important.

This key is not (yet) suitable for PLE-micro-CAD version 3.10 or later. If you want the key to be updated for use of version 3.10, please contact EDS. If you have downloaded version 3.10 and overwritten the previous PLE version and the key has not been updated yet, you can not run PLE. So it is recommended to save the current program version(s) temporarily, for instance in a different directory or by renaming the program. The updated key can not be used anymore for program version 3.08 or earlier. If required, we may restore the key to it's old status.

To assess the status of the key run the program StatusKey in a DOS window. The StatusKey program can be found in the Tools directory (subdirectory of PLE directory).