

**PLE-micro-CAD version 3.06**

An extended new version 3.06 of PLE-micro-CAD has become available for distribution on September 15, 1995. Apart from many adaptations and extensions to the facilities of the existing modules a new module has been developed:

- . Y-module: branching module, being capable of handling pipeline branches and networks. The maximum number of branches is less than 30 depending on the basic computer memory available for execution of programs.

The T-module has been adapted to the calculational methods and stress and deformation checks of the new Dutch pipeline Standard NEN 3650.

With regard to version 3.05 the following modifications and additions have been made. See also USER MANUALS Vol. 1 and Vol. 2, being made available in a complete new version.

**SN007.1**      General functions

- In the installation program a choice can be made between sending plots to plotter or (HP laser) printer, on-line or off-line (via file). The printer must be capable to process HPGL-instructions. See chapter 10.1 of User manual. A3 plots will be scaled to A4 format automatically when plotting on a printer.
- The STATUS table contains a list of 'settings' including the main switch positions: Pipeline Standard Used, calculational method (linear or nonlinear), redistribution, etc.
- To the Errors (E) and Warnings (W) Messages (M) are added being stored temporarily in the Warning table when encountered. They contain information for the designer not important enough to be saved permanently.
- The default position of the WARNING TRAP function is off now.

**SN007.2**      Graphics functions

- Several plots may be combined to one plot/print file.
- To Multi Graph the option is added to leave out the vertical element lines for stress plots in order to obtain a more clear plot diagram when plotting several stress graph lines.

**SN007.3**      Table functions

- Up till now the input data were specified along the global X-axis (X-P), in nodes (NODE) or elements (ELEM). Each input table contained one of these definitions. In version 3.06 the following specification options are added:
  - . length coordinate along pipeline axis (AX-L)
  - . length coordinate along projection of polygon lines on horizontal plane (AX-LP)
  - . identification name (IDENT)

At table data input the columns in question can be toggled to a NODE, ELEM, X-P, AX-L, AX-LP or IDENT position. This position may be different for each input table. The result tables remain node or element oriented for the time being.

The new result table IDENTs contains all ident's specified and the related values in the other coordinate systems.

- The REPLACE function is default on in input tables unless a table is LOCKED.

#### SN007.4 *Function 1: Initiate pipeline design*

- The table X-TOOL (old name: XP-TOOL) contains a column for each coordinate system (IDENT, NODE, ELEM, X-P, AX-L, AX-LP).

If tested, a column of X-TOOL may be copied into the corresponding 'toggle' column of an empty input table.

When design function 2 has been processed, table X-TOOL can be filled up with all existing IDENTs and related coordinates by using the GENERAT table function key.

- The loadcase identification from table LOCASE can be changed by means of the new table CHANGE without the need of processing function 5 again, resulting in numerical and graphical output provided with the new name. This is convenient if one has forgotten to change the name of the loadcase when setting back or copying a database.

#### SN007.5 *Function 2: Compose pipeline configuration*

- Tables ORIGIN, POLYDIF, SHAPEP, SHAPEB, NODES and ELEMNTS have been extended in view of the additional identification and coordinate options. Moreover, an arbitrary node number can be assigned to the starting point of the configuration.
- In case of pipeline branches the configuration continues to consist of one continuous polygon causing connecting lines which do not exist: these connecting polygon lines have to be specified as WEAK in table POLYDIF, i.e. without axial and flexural stiffness. Only usable in the Y-module.

#### SN007.6 *Function 3.1: Compose pipe data model*

- Several wallthicknesses can be specified: apart from the nominal wallthickness a minimum manufacturing tolerance and a corrosion allowance resulting in two additional wallthicknesses:
  - . nominal minus corrosion allowance, applied in the pipeline behaviour determination and most stress calculations.
  - . minimum wallthickness (nominal minus manufacturing tolerance minus corrosion allowance), applied in hoop stress calculations.

SN007.7 Function 3.2: Compose soil data model

- The soil input tables distinguish now between high and low uncertainty factors: UNCF-H and UNCF-L. Default values have been taken from NEN 3650 (sand values) and are different for both uncertainties. Possible ‘load’ factors to be considered as corrections to the uncertainty are included in the default values.

SN007.8 Function 3.3: Compose model boundary conditions

- Table ENDPTS has been changed in view of the branching module. The number of boundary (end) points can be more than 2 in the new program version.
- The new input table CONNECT contains the specification of pipeline points connected rigidly to each other (Tees in most cases).
- Table CONDI has been extended and contains all nodes with an end point, spring or branch.

SN007.9 Function 4: Compose pipeline loading model

Function 4 has been divided into two sub-functions.

In the first one (4.1) the wave/current loading module (W) being in the test phase will be incorporated.

The second sub-function contains the loadings from the former function 4.

The first sub-function will be locked automatically in the absence of the W-module, when going to a READY function 4.2.

SN007.10 Function 4.2: Compose pipeline loadings

- To the soil settlement tables SETX, SETY, SETZ columns are added for the uncertainty factors to be multiplied by.
- When all values specified in table SETZ are positive, a warning in question appears. The vertical settlements are directed upward then what is not meant in most cases.
- The new table SUBSIDE offers the option to specify in a simple way a subsidence with a sinusoidal path along the pipeline axis.
- Result table LOADATA contains the cumulated values of settlement including uncertainties and subsidences for each node.
- The FOCUS load has been taken away from table NODALL and has been incorporated into a separate table FOCUSL.

SN007.11 Function 5: Determine pipeline behaviour

- The switch for the pipeline Standard to follow has been moved to the main menu screen behind function 5.

Options: - GENERAL, i.e. not according to a special code  
- NEN 3650.

The difference between both options in function 5 is that NEN 3650 has prescribed load factors and a slightly different formulation of the stiffness reduction and stress concentration factors in bends.

A warning is given when in case of NEN 3650 calculations one or more load factors do not correspond with the code in question.

- The default values of the load factors in the slightly modified table LOCASE are corresponding with NEN 3650.
- Table SOILREA contains additional data providing a clear indication of the location and extent that soil failure in different directions occurs.
- 3 new result tables provide an overview of the actually applied element, node and settlement loadings including all uncertainty and load factors.

SN007.12 Function 6.1: Compose cross-section data model

- Tables SOILNB and TOPLOAD have been provided with load factors with default value 1.5 (for NEN 3650 calculations).
- When a traffic load is existing at the location of the pipeline (section) and the pipeline does not (completely) follow the soil settlements, a new calculation should be performed with the traffic load (TOPLOAD) added to the ultimate passive soil reaction (RVT). Because this implies an additional run, another approach has been chosen in version 3.06.

In the above loading case additional pipeline moments and soil reactions caused by the traffic load are calculated automatically and reported in result table ADDCROS. These additional moments and soil reactions are taken into account in the stress calculations.

SN007.13 Function 6.2 and 6.3: Perform cross-section calculations

- In table SECTION an allowable stress level possibly varying along the pipeline axis may be specified. This stress level is reported also in result table CSGEN. In case of GENERAL calculations a warning is given if a check stress from table CSTRMAX exceeds this allowable stress level. In case of NEN 3650 calculations the specified stress is considered to be the yield stress  $Re_b$  in stead of the SYIELD value from table MATS; if not meant in this way, the column in question in table SECTION should be left empty.
- The stress weighing factors may vary along the pipeline in the modified table SWEIGH.
- The calculated hoop stress has been added to the result tables CSTRMAX and CSTRESS. The stress increase and reduction of the hoop stress in bends is calculated now according to the Torus formula in stead of Wilbur.
- The new tables RDISPLMAX, RDISPLC (function 6.2) and RMAXNEN, RDPLNEN (function 6.3) contain the calculated radial deformations of the pipe cross-sections.