



ROHR2

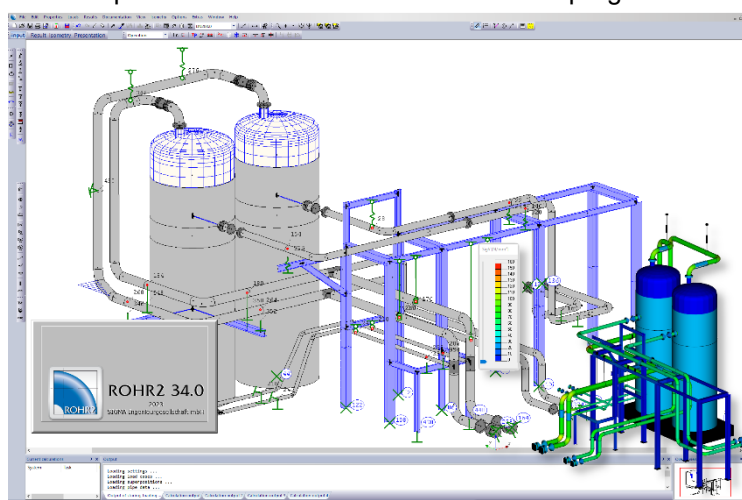
Program System for Static and Dynamic Analysis of
Complex Piping and Skeletal Structures

ROHR2 34.0 April 2023 New Features and Improvements

The program system ROHR2 with its additional modules is checked and modified continuously within the scope of the maintenance agreement.

The program release ROHR2 34.0 replaces the ROHR2 33.1.

This document shows the improvements and enhancements of the program release ROHR2 34.0:

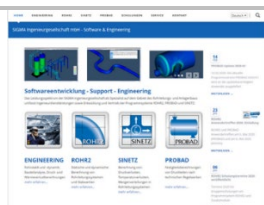


Overview

- Update of the implemented calculation rules
- New calculation rule ASME NM.1 for plastic pipes
- New component "pipe coupling" (e.g. Victaulic coupling)
- Specification of an eccentric mass (e.g. drive) on valves
- Specification of movement limits for axial expansion joints is now possible
- New boundary condition "Hot-Tapping" to automatically generate the deformation breaks for a connection to a hot line
- Load-time functions for pig loads can be generated automatically
- Export function to PROBAD for detailed component analyses
- ROHR2fesu: new component "saddle"

Contact:

SIGMA Ingenieurgesellschaft mbH
Bertha-von-Suttner-Allee 19
D-59423 Unna
Tel +49 2303 33233-0
Email info@rohr2.de



www.rohr2.de

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ROHR2 34.0, Modifications and Improvements in detail

Update of stress codes

Title	Content, keywords and source	Edition
EN 13941	Design and installation of pre-insulated bonded pipe systems for district heating	2022
ASME B31.1	Power Piping ASME Code for Pressure Piping, The American Society of Mechanical Engineers, New York	2022
ASME B31.3	Chemical Plant and Petroleum Refinery Piping ASME Code for Pressure Piping The American Society of Mechanical Engineers, New York	2022
ASME B31.4	Liquid Transportation Systems Piping ASME Code for Pressure Piping The American Society of Mechanical Engineers, New York	2022
ASME B31.5	Refrigeration Piping ASME Code for Pressure Piping The American Society of Mechanical Engineers, New York	2022
ASME B31.8	Gas Transmission and Distribution Piping Systems ASME Code for Pressure Piping The American Society of Mechanical Engineers, New York	2022
ASME NM.1	Thermoplastic Piping Systems SME Standards for Nonmetallic Pressure Piping Systems	2020
ASME CL1 ²⁾	NB-3600 "PIPING DESIGN" in ASME-BOILER AND PRESSURE VESSEL CODE SECTION III SUBSECTION NB CLASS 1	2021
ASME CL2 ²⁾	NC-3600 "PIPING DESIGN" in ASME-BOILER AND PRESSURE VESSEL CODE SECTION III SUBSECTION NC CLASS 2	2021
ASME CL3 ²⁾	NC-3600 "PIPING DESIGN" in ASME-BOILER AND PRESSURE VESSEL CODE SECTION III SUBSECTION ND CLASS 3	2021



User interface in general

- Under Extras there is now the possibility to generate sinusoidal load-time functions
- Function Ring: when specifying a gradient, the number of turns can now also be specified to generate a spiral
- List dialog box:
 - the support type can be changed for rigid supports via the "right mouse button" for all supports marked in the list. It is possible to specify a local support condition or to select a support type from the database.
 - Adjustment load and spring rate can now also be assigned to hangers via the "right mouse button"
 - Axial compensators: bellows data added
 - profile dimensions: the column "line mass given" has been added
- - inner support/inner hanger: when specifying the foot point, a section can now also be clicked. The base point is then inserted into this section at the correct position.
- Custom shortcuts can be defined
- Substance properties of water/steam can be displayed
- The representation of the coordinate systems has been changed
- maximum support spans according to EN 13480-3, Annex Q can be displayed
- The settings for the display and texts can be exported and imported to be able to exchange these settings e.g. between different users
- Existing text patterns can be edited
- Text patterns for nodes can optionally be inserted at all or selected nodes of the selected area
- the sensitivity when zooming with the mouse wheel can be adjusted
- visibility check for (dialog) windows has been revised, especially for multiple unequal monitors
- A new function "Print mode shapes" has been added to automatically print all mode shapes in the current view
- The center of gravity of the currently visible model can be displayed
- For inserting macros/placeholders when entering texts, there are now filter functions to make the selection clearer
- When defining the directions of a special coordinate system over 2 points, the points can now also be clicked with the mouse
- A new function for creating internal supports/suspenders by automatically searching for a base point has been implemented. This allows, for example, a pipeline to be automatically coupled with the steel structure existing in the model.
- Tolerances according to EN 10029 have been added
- List: The insertion of data from the clipboard has been optimized. If data is available in CSV format, it can be pasted anywhere in the list with Ctrl+V. Write-protected fields are not changed. Multiline data records can be pasted
- The function "Create connection to an existing section" has been extended by an additional option
- The function "Transfer segment data" has been extended to also take over soil properties
- The functions "Print lines", "Print regions" and "Print views" have been extended:
 - for lines/ regions, only currently visible lines/ regions can optionally be displayed
 - in addition to the "Select all" button, there is now also "Reset selection".
- Section operating data dialog: the resulting axial force from internal pressure is now also displayed. For jacket pipes (outer pipe), the force due to the annular surface is displayed
- Boundary conditions dialog: Texts can be entered with predefined line breaks, "||" is used as an identifier for a line break



Components

- New component "pipe joint" (e.g. Victaulic coupling) with non-linear properties, such as backlash for twisting
- The calculation model for axial expansion joint has been extended: The specification of movement limits for compression and/or expansion is now possible (e.g. length-limited expansion joint). These properties can only be taken into account in nonlinear calculation.
- For armatures, an eccentric mass can be taken into account (e.g. a drive). In this case, a rigid auxiliary rod with single mass is additionally considered in the calculation model.
- T-piece: if the option "extruded" is selected, then TEX is now automatically selected as the component name at the node
- Heads/blind flanges can optionally manage a special material
- Standard tees can now also be inserted if the branch is not exactly perpendicular. The coordinates are then adjusted accordingly
- There is a new component type *Support construction*, which can be used to insert saddles and brackets. These are mainly required for component analyses with ROHR2fesu or PROBAD. Basic data of these components are managed in the ROHR2 model and do not have to be entered subsequently anymore

Boundary conditions

- For supports, an additional option has been added in the dialog window to ignore them for extreme value formations
- For linear calculation, the same stiffnesses are now considered by default for new models as for nonlinear calculation. This option can be deactivated to obtain the same behavior as in previous program versions.
- A new boundary condition "Hot tapping" has been added to automatically generate and consider the deformation jumps for a connection to a hot line

Load cases, loads

- the control of the stress levels e.g. according to KTA or ASME Class 1 and control of the factors for the permissible stress S_h for occasional loads has been revised. If no analysis with load levels exists, then the designations of the load types/impact durations from the respective calculation standard are now offered for selection
- Cold springing can now optionally be calculated as a separate load case. The factors for loading and unloading effects are then taken into account by load case combination with each operating condition. This cold springing load case is only included in the extreme value formations. The double definition of the operating load cases (for stress analysis and extreme value formations) is then omitted.
- Load case earthquake static: the dialog now checks whether accelerations have been specified
- for each operating condition, an associated load case primary loads can optionally be calculated. Thus, for example, bearings lifting off automatically in the operating case are correctly considered for the stress analysis. Likewise, states with and without filling are then automatically taken into account correctly.
- Load cases of the type primary loads can optionally be calculated automatically with the maximum operating data. The separate definition of operating data for these load cases is then not necessary.
- The buckling safety check in the load case calculations with vacuum can be optionally deactivated
- Load case superposition: for the combination of additional loads, an operator can now be specified to be used instead of the automatically used operators
- A function for generating load-time functions to consider centrifugal forces of a pig on arcs has been added. These load-time functions can then be used to perform a time-history calculation.
- Wind loads: the import and export of user-defined dynamic pressure tables was enabled



Stress analyses

- ASME Class 1, Class 2/3 Edition 2021
- B31.3 Edition 2022
- B31.4 Edition 2022
- B31.5 Edition 2022
- B31.8 Edition 2022
- EN 13480-3: SIFs according to B31J can be considered
- ASME NM.1 for plastic piping was added
- EN 13941 revision 2022 was added
- Range selection: the "inverse range" can also be taken into account, i.e. all data not selected for the range
- For stress analyses based on load cycles (district heating, ASME NM.1), load cycles for each temperature case can optionally (preset) be generated automatically based on the number of load cycles specified for the stress analysis and adapted to this number. Without this option, any load cycles can be defined
- Even if the stress analysis is not based on operating conditions, the primary and operating load cases to be considered can now be selected

Flange verification

- The flange verification completely revised. The separate user interface has been eliminated. All necessary data is entered directly for the calculation model
- The associated overlay rule is now managed in the dialog directly with the flange verification and can no longer be selected for other tasks

Presentation of results

- Display of stress results: In addition to the stress utilization, all available stress components are now displayed in color.
- Stress analysis VGLSR: now additionally the stresses at inner and outer fiber are displayed ("S_i", "S_o")
- The display of an equivalent stress in the load case results is now controllable (von Mises or Tresca, with or without stress intensification factors according to EN 13480-3 or ASME B31J). By default, a equivalent stress is no longer displayed with the load case results, since this information is normally not required.
- When listing details of stress analyses and extreme value table at the node, there is now a filter function analog to the normal list function
- When displaying the differential movements for jacket pipes in the node dialog, exceeding the allowable displacement is now highlighted by an icon.
- An additional result text "minimum result" is now available
- List support loads: for transformable results (i.e. results of an original load case or a linear combination of original load cases), it is now possible to choose between the coordinate system of the support, the global coordinate system and the local coordinate system for the output
- The display of the deformation line can now be disabled via the display settings
- Time history results can optionally be displayed incl. the results of the corresponding operating case (also with ROHR2fun)



Interfaces

- - Interface CII general
 - the table with material assignments was updated
- CII Export:
 - format changed to CII 11.0 to be able to export additional data like line designations and designations of supports
 - the additional mass on hangers is now considered as "Hanger Hardware weight" for the export
 - nozzles on intermediate nodes without flexibility are now exported as Anchor with CNode
 - point loads force/torque are now considered
- The CSV interface has been extended to import soil properties
- NTR interface:
 - The types for TEE are now: A=extruded (TEX), B=forged welding tee (TFS), ' '= fabricated tee (TTU). Type=H is always accepted, corresponds to type=B
 - The interface has been extended to import bedding data
 - Data in UTF-8 format is now possible.
- Export LICAD: Adaptation to the current LICAD version
- Export of results in CSV format has been revised: The data to be exported now are configurable, configurations are saved, multiple configurations are possible. The export is now only for extreme value formations.
- PROBAD Export Interface
 - Data from selected system parts are exported to PROBAD for special component analyses. The data of the ROHR2 model are automatically divided into PROBAD components. The desired calculation standards for the analyses are selected by the user. If external loads have to be considered for a component analysis, they are automatically determined from the results of the ROHR2 model and transferred to PROBAD.

ROHR2fesu

- A new component saddle was implemented. Saddles can now be modeled and calculated following the DIN 28080:1994 and DIN 28080:2015 standards
- ROHR2fesu is now a 64-bit program and can therefore use more than 3.50 GB memory. This is especially beneficial for large models, as more processor cores can now be used simultaneously.
- Circumferential and axial division are not coupled.
- Changing the circumferential division previously did not change the axial division. Now, the axial division can be automatically adjusted according to the change of the circumferential division.
- The tables for the documentation of the points, super elements, jackets and intersections have been revised.
- The maximum stress/utilization can now be shown not only with respect to a substructure, but also per intersection.
- ROHR2fesu stress analysis: for primary verifications, the allowable stress is now determined by default based on the calculation temperature T_c and no longer based on the operating temperature T_o . Primary loads can occur at any temperature, but the maximum temperature may not always be specified as the operating temperature for primary loads. Therefore, the verification with the allowable stress at operating temperature is not always not conservative.
- For substructures that are used multiple times, when the substructure is changed, there is now an option to create a copy of the substructure so that the change only affects the current substructure
- After the calculation end of the stress analysis, warnings are now issued per equation type if the utilization is $> 100\%$
- A new function has been implemented to mark select FE elements of an intersection area that are completely inside the wall. These elements can be ignored for the evaluation if necessary.



ROHR2iso

- Printout of graphic with parts list on separate sheet: The parts list is now the next page in the printout. This means that when printing in PDF format, the model and parts list are now in one file.
- A minimum length for pipes can be specified for the parts list. Shorter pipe sections are then ignored when the parts list is generated.
- The apex of soils can be measured

Presentation mode

- An export function in stl format was implemented

Report generation, documentation

- An additional report module for spectra incl. graphical display has been added
- For graphics, the desired size can optionally be specified in the placeholder. For this purpose, "[size specification]" must be added to the file name after the extension. Possible is the specification of [width]x[height] in 1/1mm or the specification of format (A0 - A4) and
- Alignment (L="landscape/transverse, "P"=portrait/upright), e.g. "_TotalSystem__view.png|10000x2000" or "_TotalSystem__view.png|A2P".

Databases

- The material database was completely revised and significantly expanded. Now ROHR2 and PROBAD are using the same material database
- The flange database was completely revised and significantly expanded. Now ROHR2 and PROBAD are using the same flange database
- FleXomat expansion joint data revision 2023 were added



Changes that affect the calculation results in existing models

ROHR2 beam model

- Standard flanges
 - Lengths of ASME flanges were corrected
 - Masses were partially adjusted
- Cross-sectional data of circular structural steel was corrected
- Bend flexibility (k-factor)
 - For buried pipes, the k-factors are now determined analogously to other calculation rules based on the cold E-modulus (previously: warm E-modulus).
 - For calculations according to ISO 14692, the k-factors are now limited to a maximum of 3 according to the standard
- The cold modulus of elasticity is now always determined at room temperature ($=20^{\circ}\text{C}$), previously at assembly temperature. The conversion E_h/E_h in the stress calculation may therefore give slightly different results to calculations with older program versions.
- on tees with the "extruded" option, "TEX" is now set as the component name if this component name is possible for the selected calculation rule. Previously, the component name was set to "TTU". Due to different stress intensification factors, different calculated stresses can result at these nodes.
- The start vectors for load case-follow-ups at nonlinear acting couplings have been corrected, displacements have not been considered so far
- ASME B31.4: As of revision 2022, the stress intensification factors as specified in ASME B31J must be used. Different calculated stresses may result due to different stress intensification factors compared to the previous ones.
- EN 13941/FW401: Only temperature cases are now included in the SRR verification (fatigue verification, Limit State B1). The previous consideration of combinations of operation+occasional load is not required in accordance with the calculation rules.
- Stress calculation with time history: Now the time step is considered at which the maximum stress results even with different i-factors for different load directions (ii, io, it). Previously, the time step with maximum resulting moment was taken into account for the stress calculation, which may not have been conservative.
- Low temperatures, ASME B31.3:
According to ASME B31.3, the allowable stress does not have to be reduced at low temperatures, but it must be checked that the minimum allowable temperature of the material (depending, among other things, on the stress level) do not fall below. The stress calculation is carried out with the allowable stress at the lowest specified temperature. Up to now, the allowable stress was reduced analogously to the procedure according to AD; this could lead to unnecessarily unfavorable results.

ROHR2fesu

- Analyses for primary stresses (Pm, PI, PI+Pb) are now carried out with allowable stresses at calculation temperature (previously: allowable stresses at the operating temperature specified here). The reason for this is that primary loads usually act at all operating conditions and thus also at all temperatures. The allowable stress must therefore be determined for these verifications at the maximum operating temperature (= calculation temperature). In the previous procedure, stress utilization could be too favorable if the maximum operating temperature was not specified for primary load cases.

ROHR2fesu

- The calculation according to EN 1591-1 has been adapted to the latest revision. Older revisions can no longer be accessed



Development, Sales and Support

SIGMA Ingenieurgesellschaft mbH
Bertha-von-Suttner-Allee 19
D-59423 Unna

Telephone +49 (0)2303 332 33-0
Fax+49 (0)2303 332 33-50
Email: sales@rohr2.com
Internet: www.rohr2.de www.rohr2.com

Software-Support, German +49 (0) 2303 332 33 33
Software-Support, English +49 (0) 2303 332 33 44

support@rohr2.de
support@rohr2.de