Pipe supports

Finding the type and settings in Rohr2 for supports from

Lisega

&

SSG-standard

Contents

1. Disclaimer

The objective of this document is to provide guidelines on how to model various supports, including information on settings in Rohr2.

The user of the ROHR2 piping software is responsible for model setup, selection of pipe supports and to check the validity of calculated results.

The information in this document may be obsolete or change at any time without notice and it is up to the user of the Rohr2 piping software to carefully read the update notes included with each program update or revision.

2. Trademarks

Lisega is the trademark of Lisega SE, Gerhard-Liesegang-Straße 1, 27404 Zeven, Germany (www.lisega.de)

SSG is the trademark of the SSG Standard Solutions Group, Skönsbergsvägen 3, 856 41 Sundsvall, Sweden (www.ssgsolutions.com)

Rörklammerfabriken is a manufacturer of pipe supports following the SSG standard.

Address:

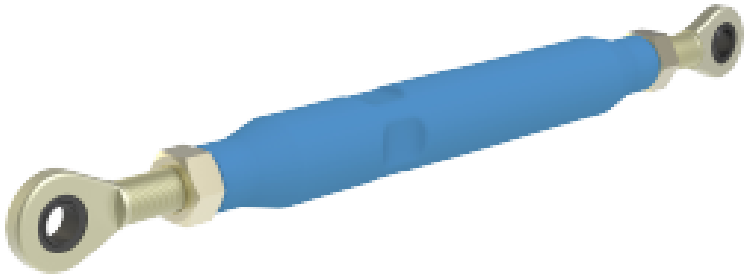
Rörklammerfabriken AB, Box 31, 241 21 Eslöv, Sweden, www.rorklammerfabriken.se

3. Figures used in this document

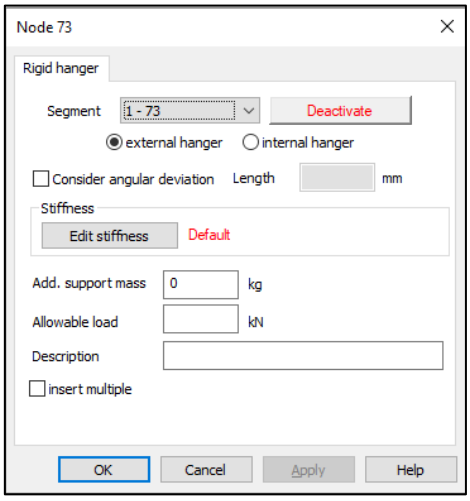
Pictures showing Lisega components are taken from the Lisega product catalogue and are shown with courtesy of Lisega SE.

Pictures showing SSG components are taken from the webpage of Rörklammerfabriken AB with courtesy of SSG Standard Solutions Group and Rörklammerfabriken AB.

4. Lisega rigid link

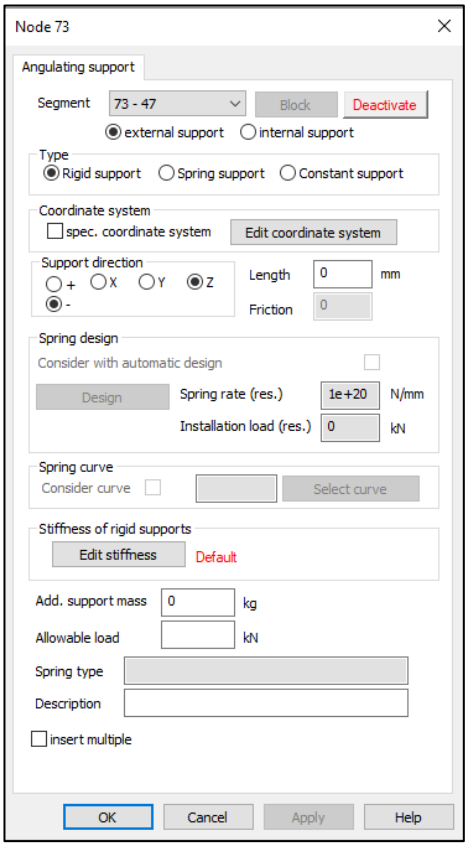


Rigid hanger



- Is working in vertical direction only
- Carries load in both tension and compression
- “internal hanger option” allows for connection to other existing beam- or pipe structures in the analysis model
- Axial stiffness may be given
- Bending moments and torques are <u>not</u> restrained.
    1. PX, PY and PZ= free
- Length must be entered if angular deviation is wanted
    1. The maximum angulation of the support rod from the vertical shall be 4° (according to EN 13480)
- Mass of component may be input
- Allowable load may be input

Angulating support, Rigid support

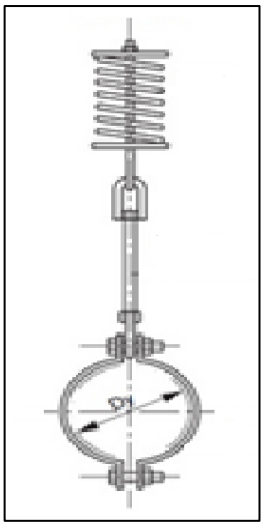


- Is working in any direction
    - Specify “special coordinate system” when the support is not aligned with the global Cartesian coordinate system
- Carries load in both tension and compression
- “internal support option” allows connection to other existing beam or pipe structures in analysis model
- Axial stiffness may be given
- Bending moments and torques are <u>not</u> restrained.
    - PX, PY and PZ= free
- Length must be entered if angular deviation is wanted.
- Mass of component may be input
- Allowable load may be input

5. Spring hanger, Lisega and SSG type 4

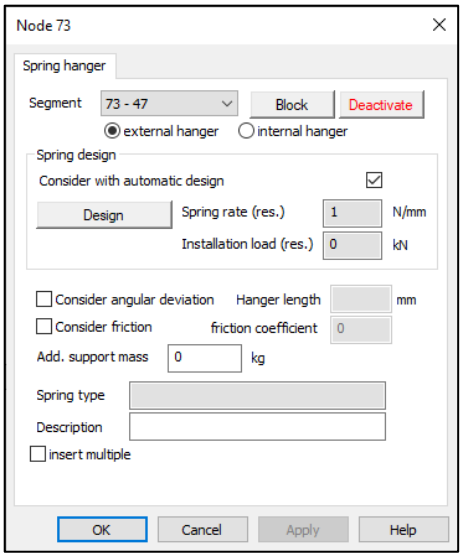
Lisega spring hanger

Spring hanger SSG type 4

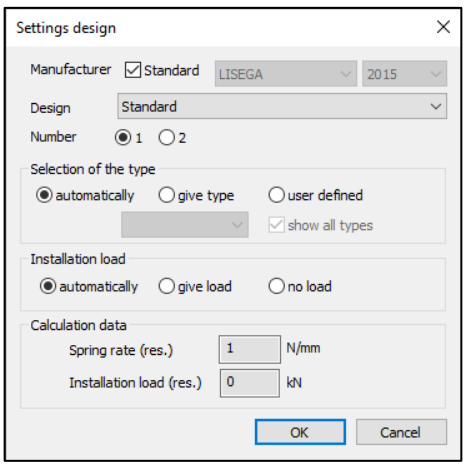


Rohr2 menus:

Spring hanger



- Is working in vertical direction only
- "Internal hanger" option allows connection to other existing beam or pipe structures in model
- Bending moments and torques are <u>not</u> restrained
    1. PX, PY and PZ= free
- Automatic design according to spring manufacturer design rules is default.
    1. Data from existing hangers may be specified
- Length must be entered if angular deviation is wanted.
    1. The maximum angulation of the hanger from the vertical shall be 4° (according to EN 13480)
- Friction is only considered in nonlinear analysis
- Mass of component may be input



- Design allows for:
    1. selection of different brand of hanger.
    2. User defined installation load
    3. User may select hanger type from catalogue

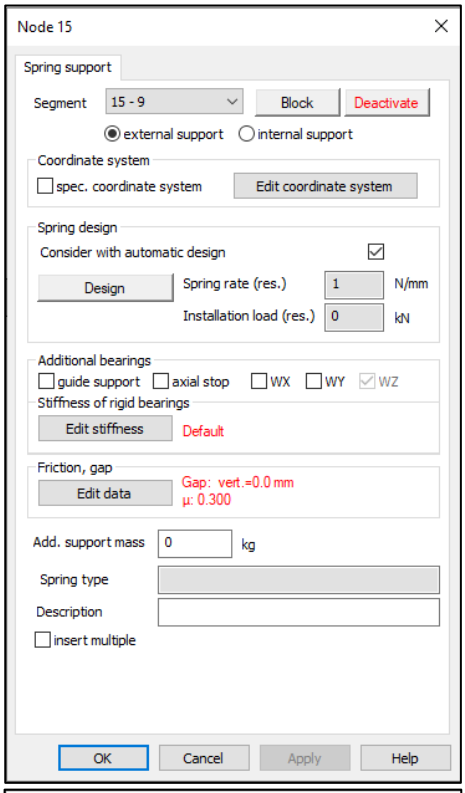
6. Spring Support, Lisega

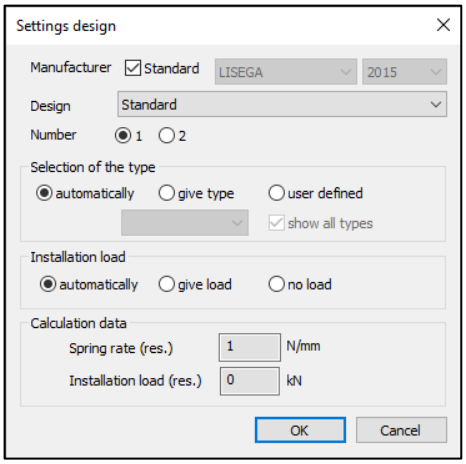
Lisega spring support:

Rohr2 menus:

Spring support

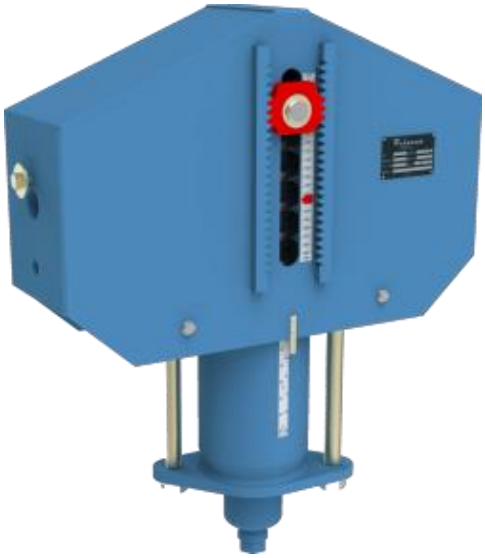
- Is working in vertical direction and provides options for lateral and axial restraints.
    1. Gap and friction may be entered
- "Internal support" option allows connection to other existing beam or pipe structures in analysis model
- Bending moments and torques are <u>not</u> restrained.
    1. PX, PY and PZ= free
- Automatic design according to spring manufacturer design rules is default.
    1. Data from existing supports may be specified
- Friction is only considered in nonlinear analysis
- Mass of component may be input
- Design allows for:
    1. Selection of different brand of spring support
    2. User defined installation load
    3. User may select hanger type from catalogue





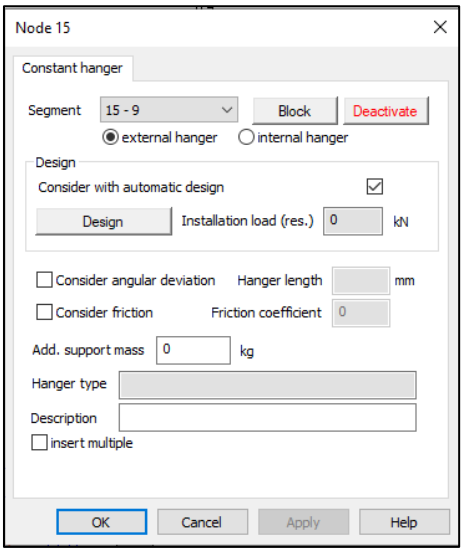
7. Constant hanger, Lisega

Lisega constant hanger

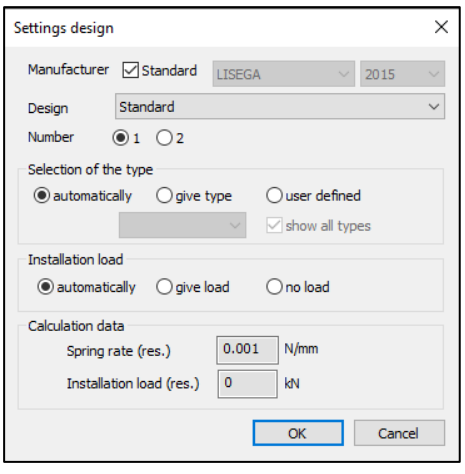


Rohr2 menus:

Constant hanger

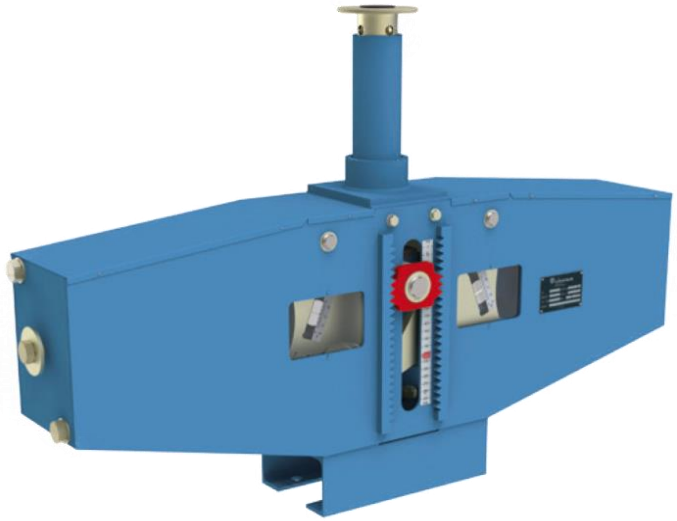


- Is working in vertical direction only providing a constant lifting force at any vertical movement
- "Internal hanger" option allows connection to other existing beam or pipe structures in analysis model
- Bending moments and torques are <u>not</u> restrained.
    1. PX, PY and PZ= free
- Automatic design according to hanger manufacturer design rules is default.
    1. Data from existing hangers may be specified
- Length must be entered if angular deviation is wanted.
    1. The maximum angulation of the hanger from the vertical shall be 4° (according to EN 13480)
- Friction is only considered in nonlinear analysis
- Mass of component may be input
- Design allows for:
    1. selection of different brand of hanger.
    2. User defined installation load
    3. User may select hanger type from catalogue

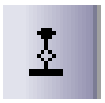


8. Constant Support, Lisega

Lisega constant support:

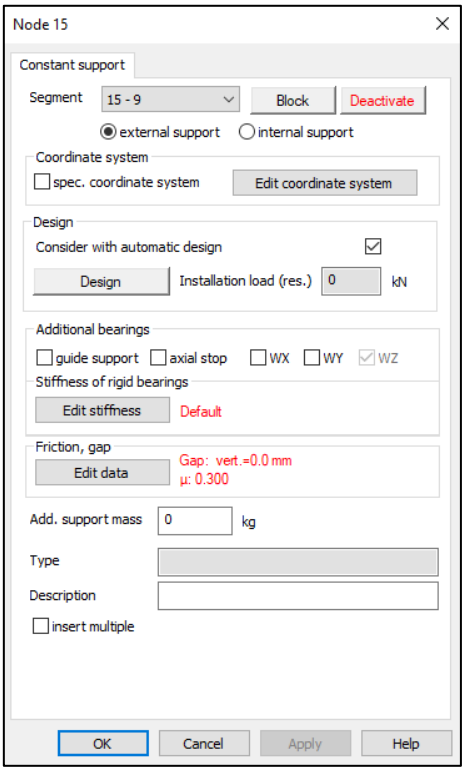


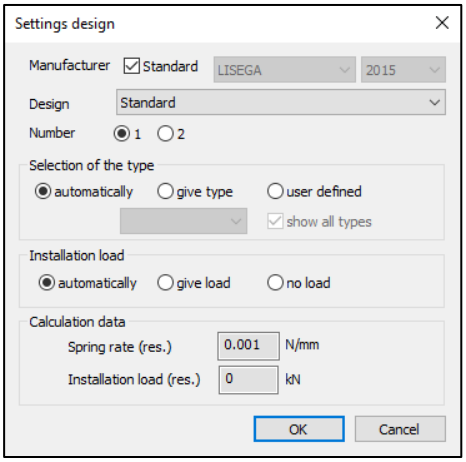
Rohr2 menus:



Constant support

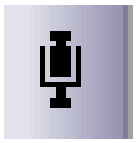
- Is working in vertical direction and provides options for lateral and axial restraints.
    1. Gap and friction may be entered
- "Internal support" option allows connection to other existing beam or pipe structures in analysis model
- Bending moments and torques are <u>not</u> restrained.
    1. PX, PY and PZ= free
- Automatic design according to hanger manufacturer design rules is default.
    1. Data from existing hangers may be specified
- Friction is only considered in nonlinear analysis
- Mass of component may be input
- Design allows for:
    1. selection of different brand of hanger.
    2. User defined installation load
    3. User may select hanger type from catalogue





9. Lisega Shock absorber

Rohr2 menus:



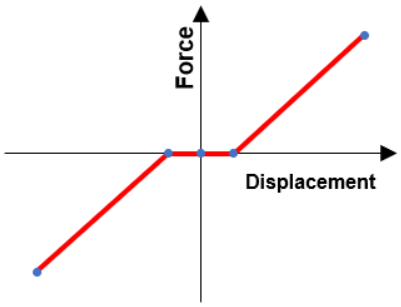
Shock absorber

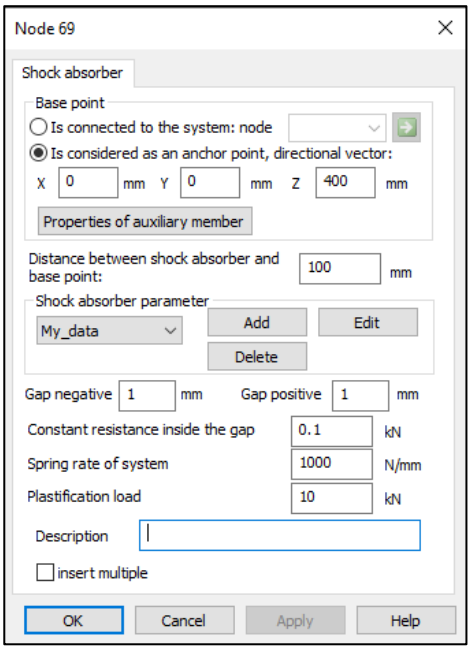
- Component is active in dynamic analysis only. The shock absorber allows slow thermal movements within a specified range but restricts fast movements due to fast dynamic events.

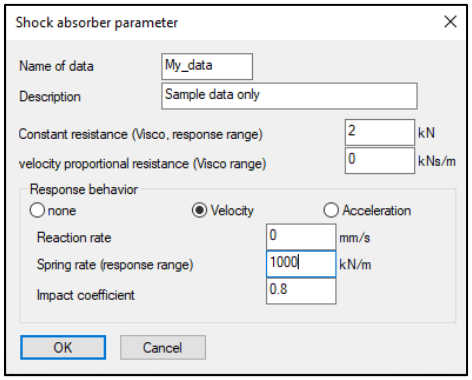
    1. Eigenfrequency analysis: Only the stiffnesses for both system and spring rate is considered

    2. Linear dynamics: Same as for eigenfrequency analysis

    3. Transient fully integrated analysis: all features are considered: gaps (backlash effect including impact), friction and viscous effect.



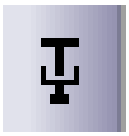




- Direction of action is specified by user.
- Carries load in both tension and compression.
- “Is connected to the system node”, allows connection to other existing beam or pipe structures in model.
- Bending moments and torques are <u>not</u> restrained
    1. PX, PY and PZ= free
- The shock absorber has no mass

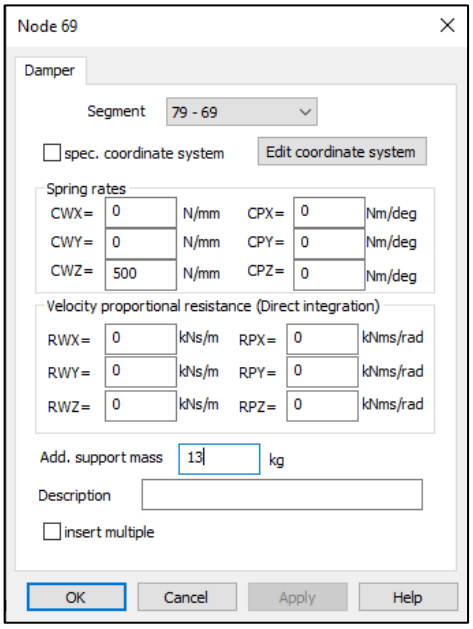
10. Lisega Damper

Rohr2 menus:



Damper

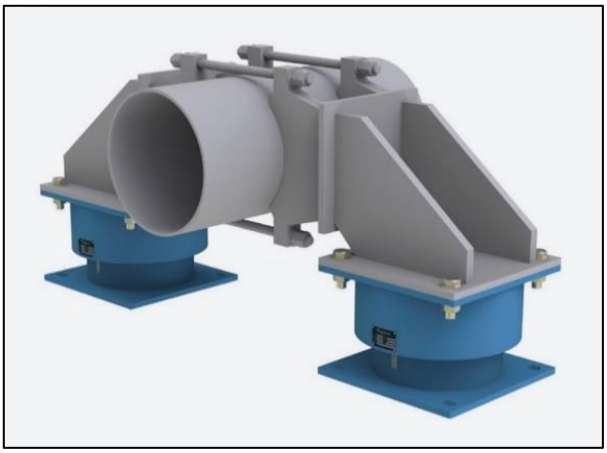
- Component is active in dynamic analysis only. The damper allows slow thermal movements but restricts fast movements due to fast dynamic events.
    1. Eigenfrequency analysis: Only the stiffnes for spring rate is considered.
    2. Linear dynamics: Same as for eigenfrequency analysis.
    3. Transient fully integrated analysis: all features are considered: Stiffness and viscous effect.
- Spring rates and viscous damping may be specified for all six degrees of freedom (translations & rotations).
    1. User defined coordinate system is available.
    2. Connects to ground only.
- Carries load in both positive and negative direction.
- The mass of the damper may be given.



Comment:

The damper is a simpler component compared to the shock absorber from where most advanced features has been eliminated.

11. Lisega Visco Damper



Rohr2 menus:

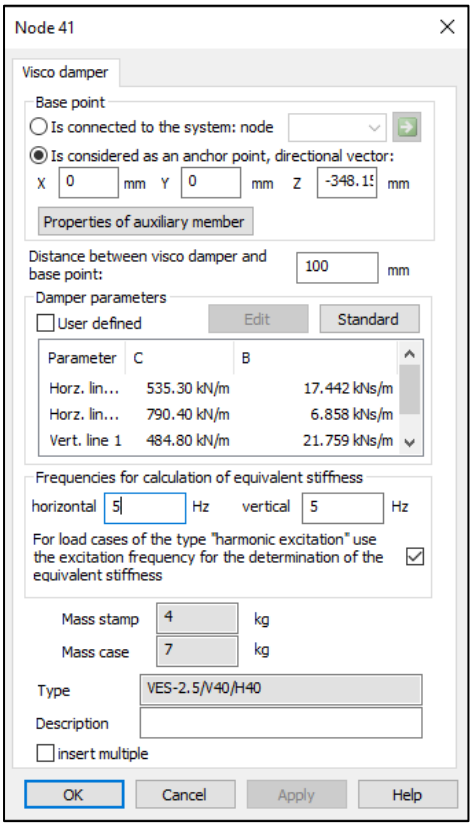
Visco damper

- Component is active in dynamic analysis only. The damper allows slow thermal movements but restricts fast movements due to fast dynamic events.

    1. Eigenfrequency analysis: Only the stiffness for spring rate is considered.

    2. Linear dynamics: Same as for eigenfrequency analysis but stiffness may be based on critical eigenfrequency value.

    3. Transient fully integrated analysis: all features are considered: Stiffness and viscous effects.



- Bending moments and torques are <u>not</u> restrained.
    1. PX, PY and PZ= free.

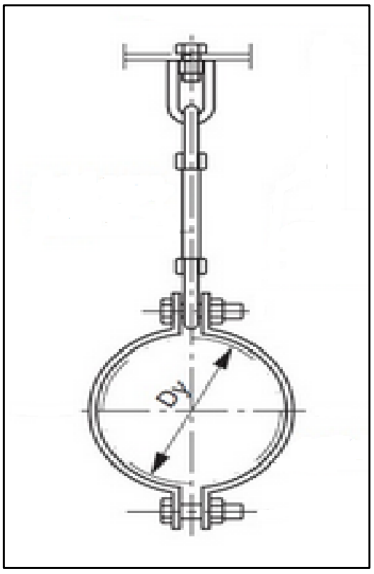
- Carries load in both positive and negative direction in horizontal and vertical directions simultaneously.

- The main advantage of the visco damper that there is no play/gap in the connection to the piping. This means that the visco damper also prevents small movements.

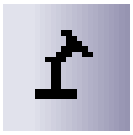
- Database of visco dampers is from the manufacturer Gerb

- The mass of the damper may be given.

12. Lisega Rod support, SSG type 1, 2 & 3



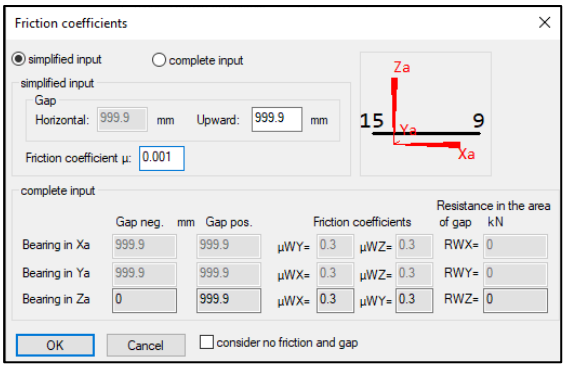
Rohr2 menus:



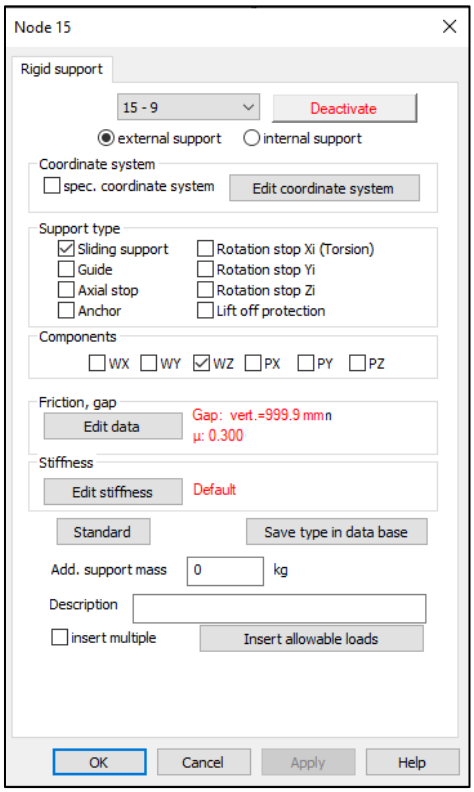
Lisega Rod support

- The support may be modelled in multiple ways:

1. Rigid support, sliding support. The most easy way to model a rod support in a static structural analysis.
   - Set coefficient of friction to m= 0.001

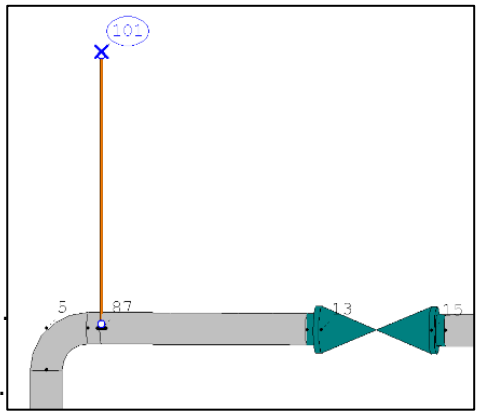


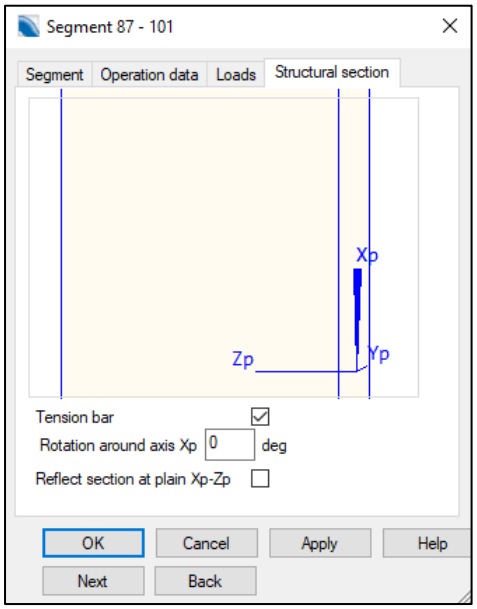
   - Active in vertical direction only, all other translations and rotations are free (PX, PY and PZ= free).



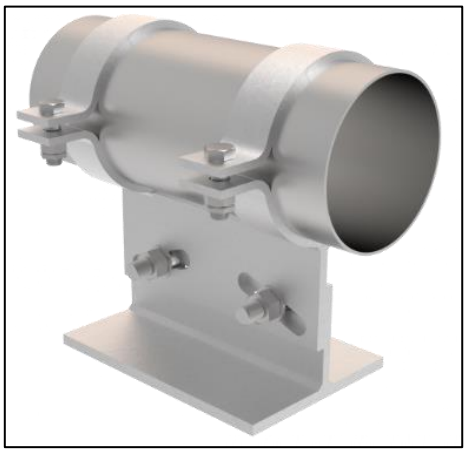
Lisega Rod support and SSG type 1, 2 & 3, continued:

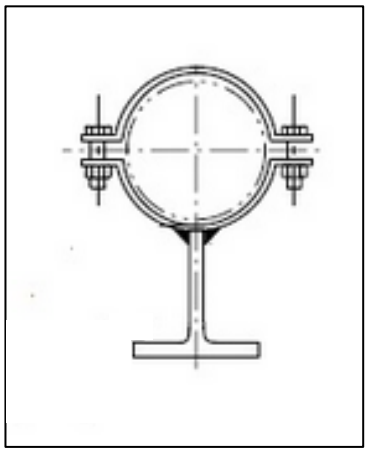
2. Using a rigid element with the option "Tension bar"
   - Require modelling of rigid element, applying anchor at free and setting option "Tension bar".
   - Angulation of rod is calculated.
   - Carry load in both tension and compression.
     - User must check for upward loads (warning is given at end of analysis).
   - All rotations are free (PX, PY and PZ= free)



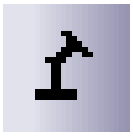


13. Lisega Sliding shoe, SSG type 11



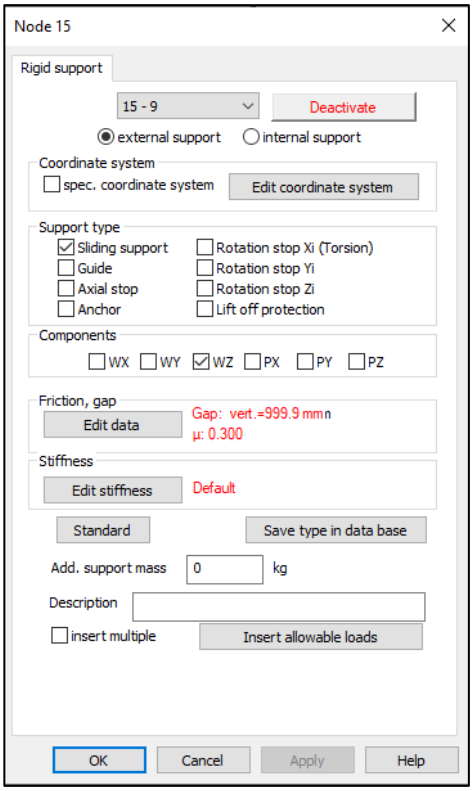


Rohr2 menus:

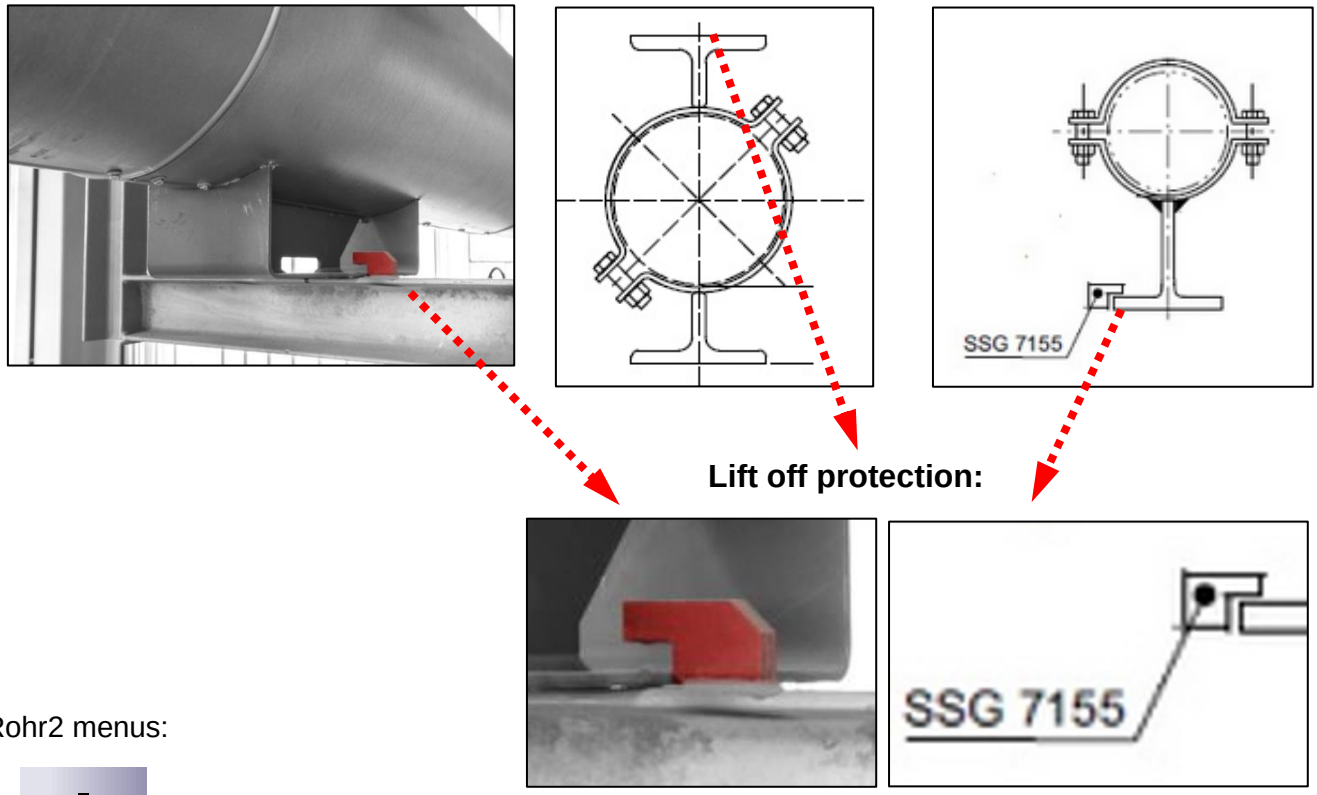


Lisega Sliding shoe, SSG type 11

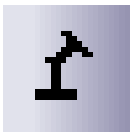
- Rigid support, sliding support.
    1. Active in vertical direction only, all other translations and rotations are free (PX, PY and PZ= free).



14. Lisega Sliding shoe, SSG type 12 &13



Rohr2 menus:

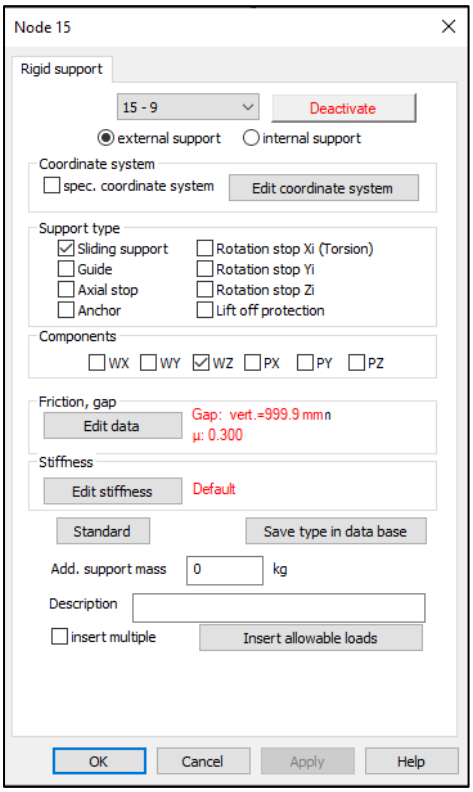


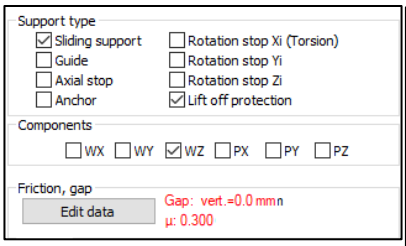
Lisega Sliding shoe, SSG type 11 & 12

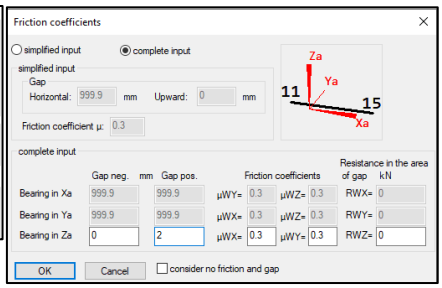
- Rigid support, sliding support.
  1. Active in vertical direction only, all other translations and rotations are free (PX, PY and PZ= free).

  2. Checking the option “Lift off protection” will restrain upward movement. Any gap in upward direction is specified at “Friction, gap” In figures below a gap of 2 mm is defined for upward movement of piping.

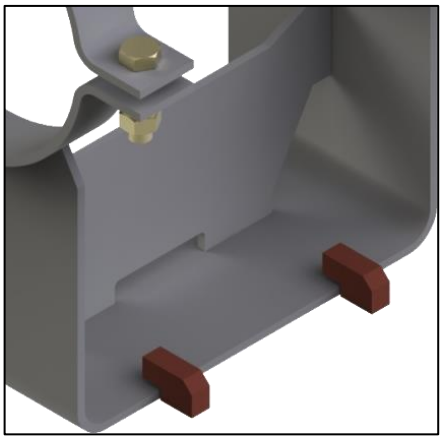
  3. Note that the “hook” and SSG 7155 vertical restraint can restrain lateral movement if the lateral movements are large.



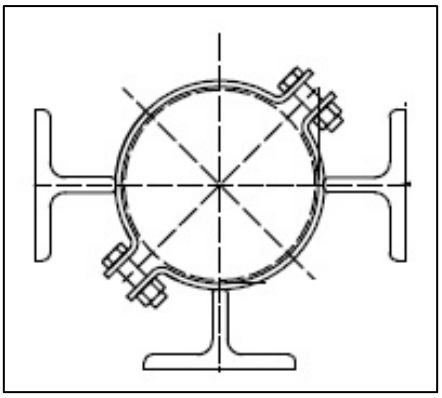




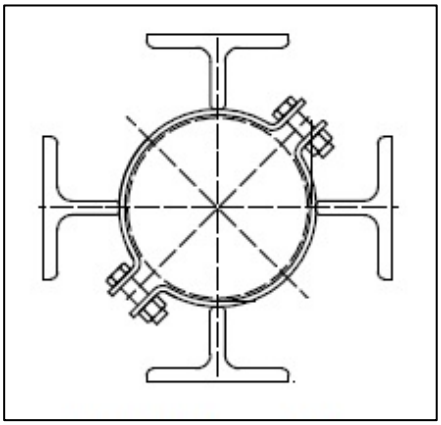
15. Lisega Sliding shoe w. guide, SSG type 14 & 15



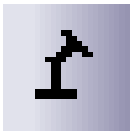
SSG type 14



SSG type 15



Rohr2 menus:

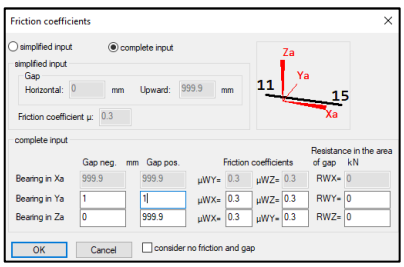


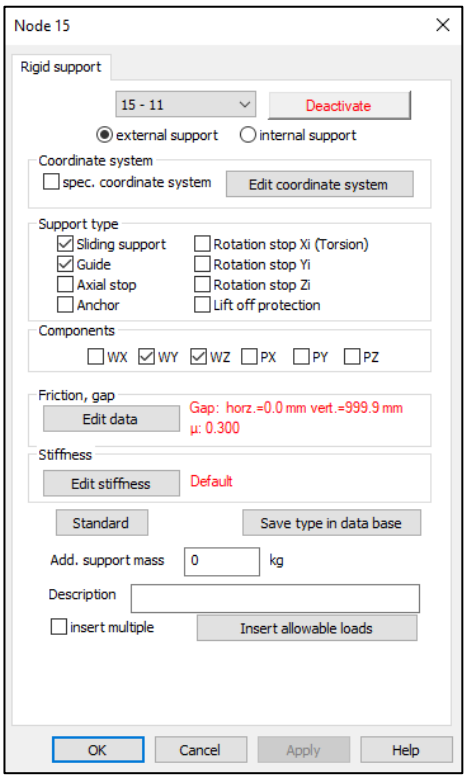
Lisega Sliding shoe, SSG type 14 & 15

- Rigid support, sliding support + Guide.
  1. Active in vertical and lateral direction only, axial translation and all rotations are free (PX, PY and PZ= free).

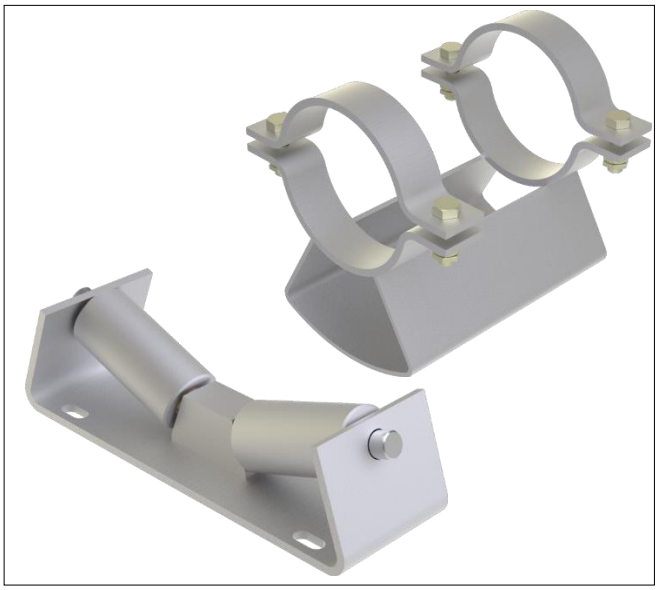
  2. Note the following:
     a. For horizontal pipes both “Sliding support” and “Guide” must be checked
     b. Checking the option “Lift off protection” will restrain upward movement
     c. For vertical pipe runs only “Guide” must be checked

  3. Friction and gap may be entered in all directions

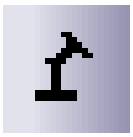




16. Lisega roller bearing support



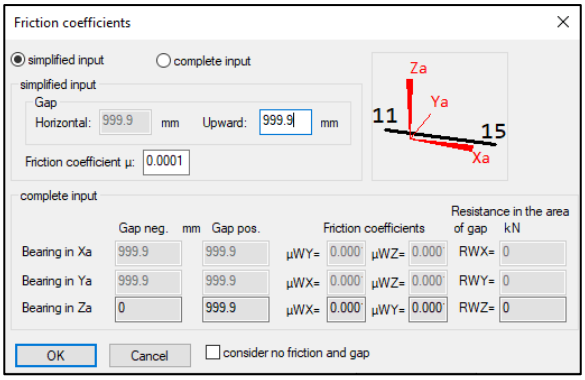
Rohr2 menus:



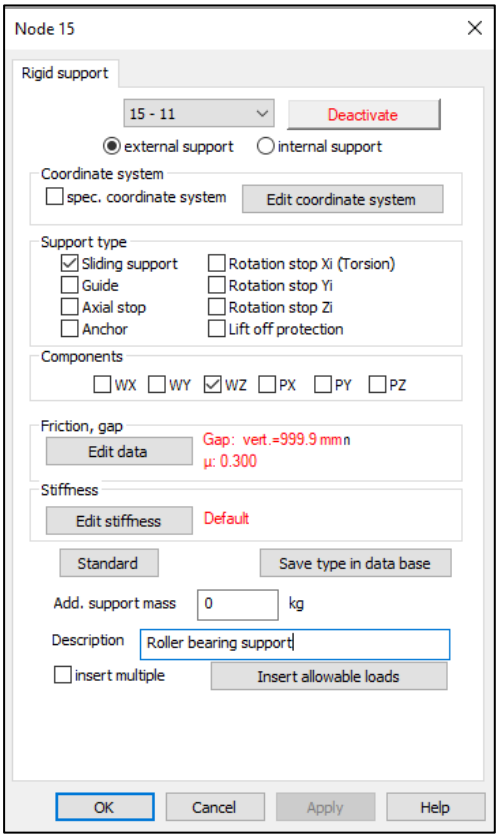
Lisega roller bearing support

- Rigid support, sliding support
    1. Active in vertical direction but can optionally have “Lift of protection” and lateral support (Guide) included. Axial translation and all rotations are free (PX, PY and PZ= free)

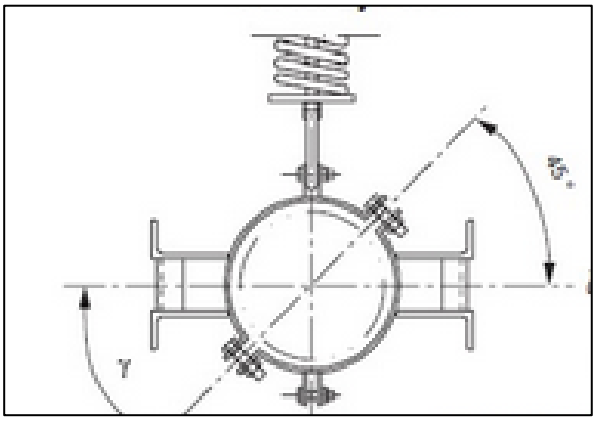
    2. Coefficient of friction must be set to almost zero:



    3. Note: Minimum value of coefficient of friction in Rohr2 is µ= 1.0×10^{-6}.

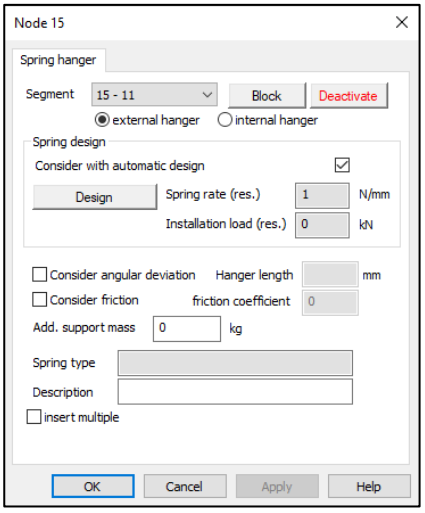


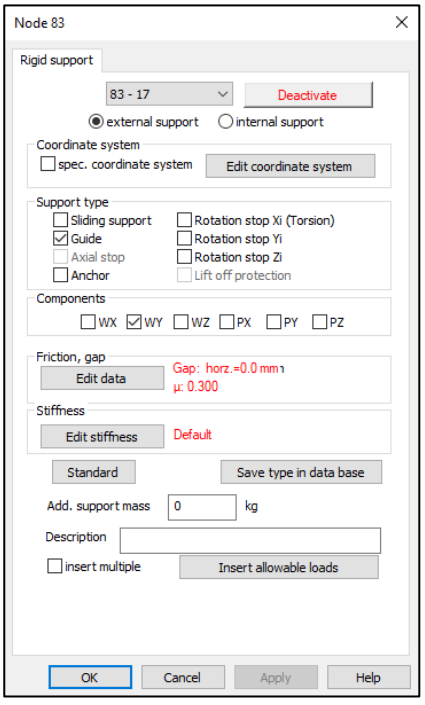
17. Lateral support & spring, SSG type 17 & 18



Rohr2 menus:

 +  Spring hanger with guide (optional)





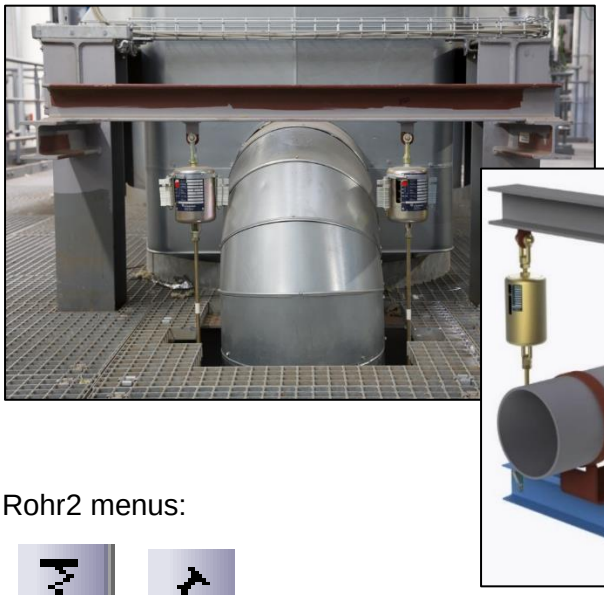
In Rohr2 only one type of pipe support can be applied at a node. If multiple types of supports are needed at a single position, a new node point must be created close to an existing node having the different type of support.

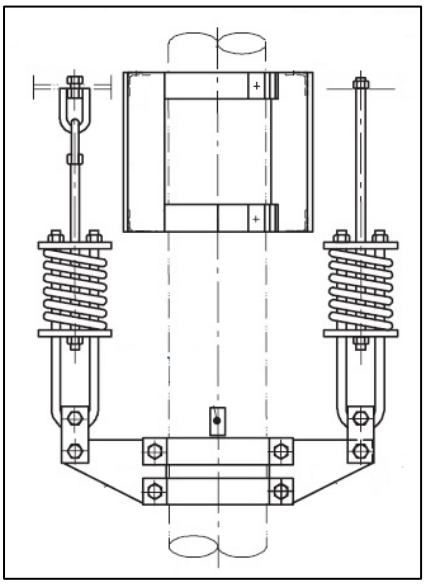
The pipe support in top right picture, SSG type 17 – 18 is modelled as follows:

1. Create a spring hanger.

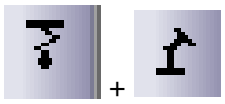
2. Create an additional (rigid) support) close (1 mm) to the existing spring hanger.

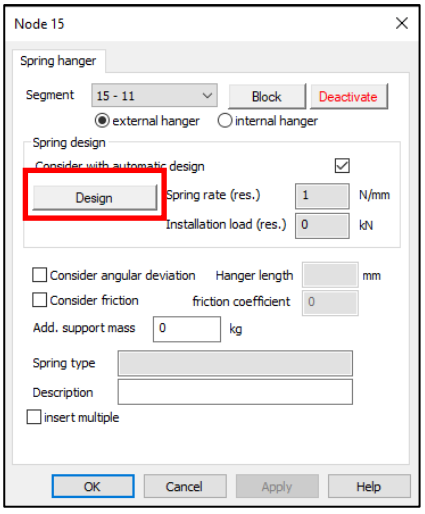
18. Lisega spring support vert. pipe, SSG type 27 - 30





Rohr2 menus:

 Spring hanger with guide (optional)

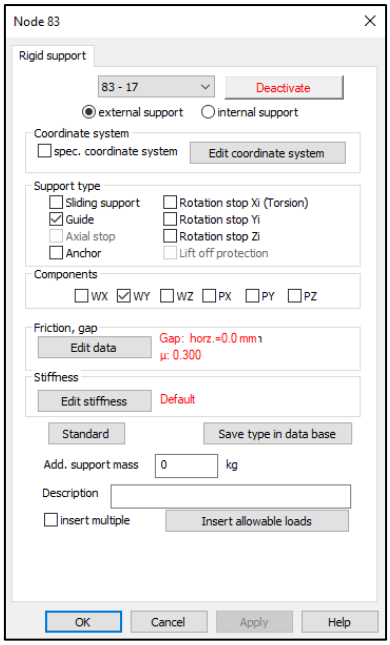


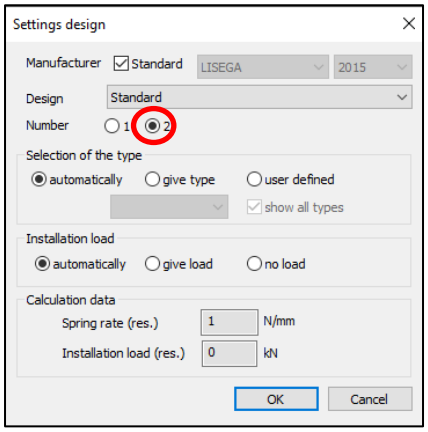
In Rohr2 only one type of pipe support can be applied at a node. If multiple types of supports are needed at a single position, a new node point must be created close to an existing node having the different type of support.

The pipe support in top right picture, SSG type 27 – 30 is modelled as follows:

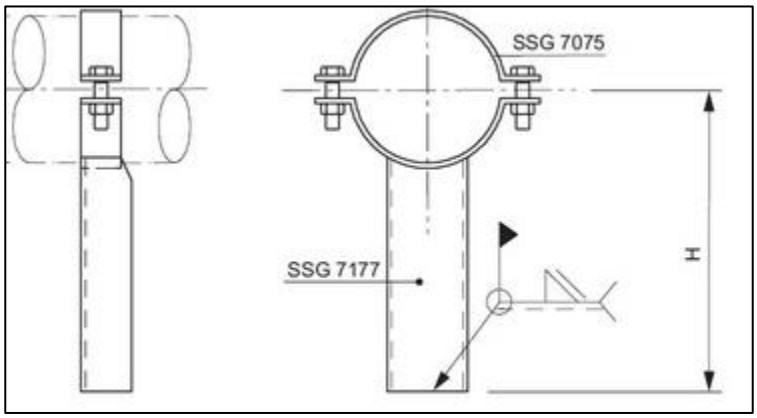
1. Create a spring hanger using two hangers

2. Create an additional (rigid) support) right above the existing spring hanger

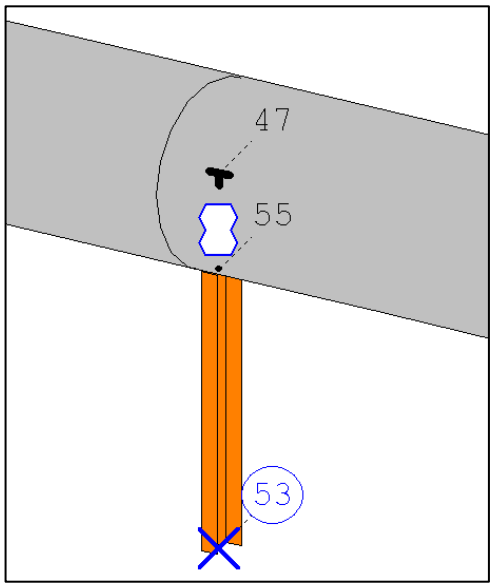




19. Pipe – beam connection, SSG type 31

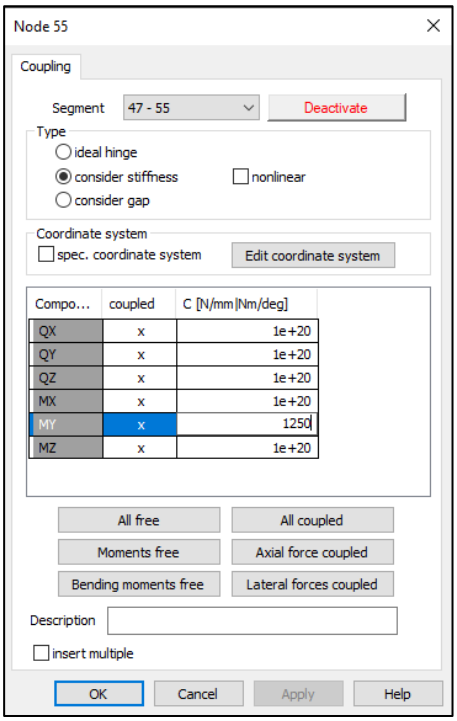


This pipe support is built as a structural beam connecting to the pipe:

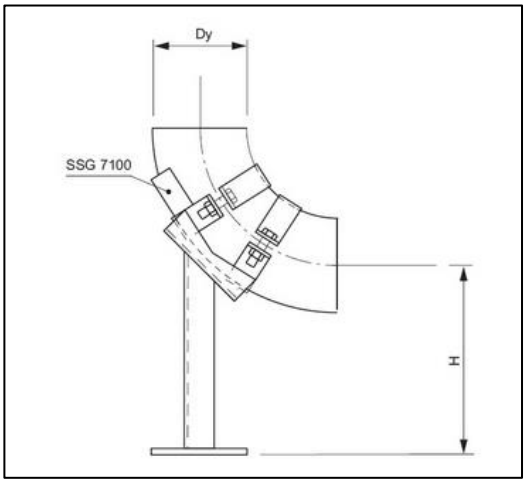


Consider the following using this support:

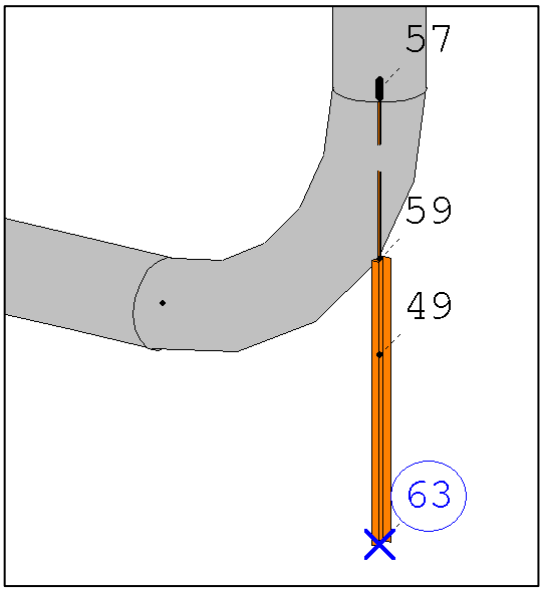
- This support is not intended for large axial forces or displacements. Sliding between pipe clamp is not desired.
- The angulation of pipe must be small. Angle between beam – pipe should be 90°.
- Create a rigid element within the pipe (between node 47 and node 55 in figure) to get correct stiffness of the beam-pipe connection. Otherwise the support will be too flexible.
- Additional flexibility between pipe and beam may be defined using “Coupling”
    a. Stiffness values must be obtained by other means, for example FE-analysis



20. Trunnion support, SSG type 32

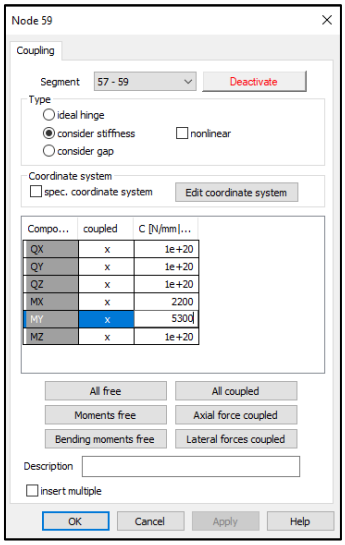


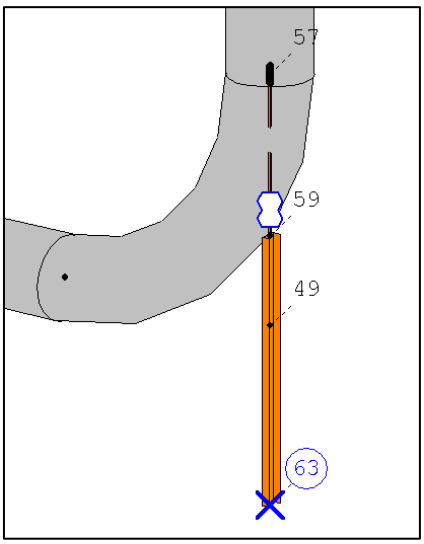
This pipe support is built as a structural beam connecting to the pipe bend:



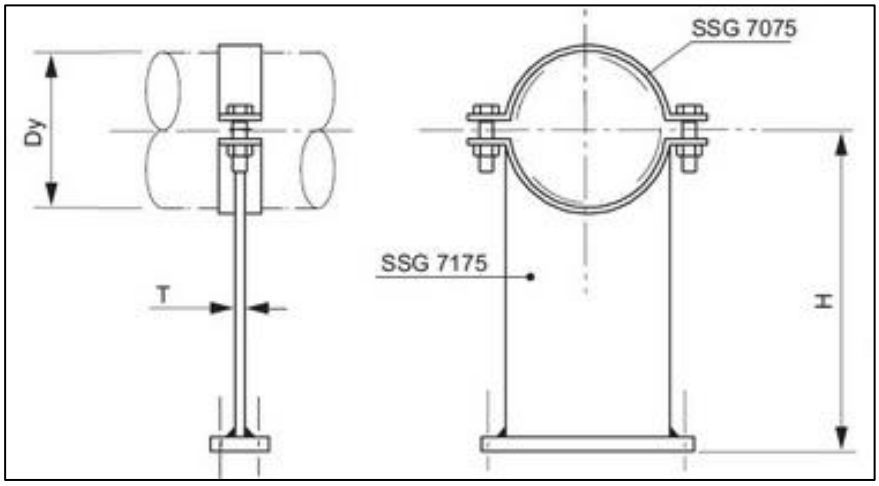
Consider the following using this support:

- This support is not intended for large horizontal forces or displacements. Sliding between pipe clamp is not allowed.
- The angulation of pipe must be small.
- Create a rigid element within the bend (between node 57 and node 59 in figure) to get correct stiffness of the beam-pipe connection. Otherwise the support will be too flexible.
- Additional flexibility between pipe and beam may be defined using “Coupling”
    a. Stiffness values must be obtained by other means, for example FE-analysis

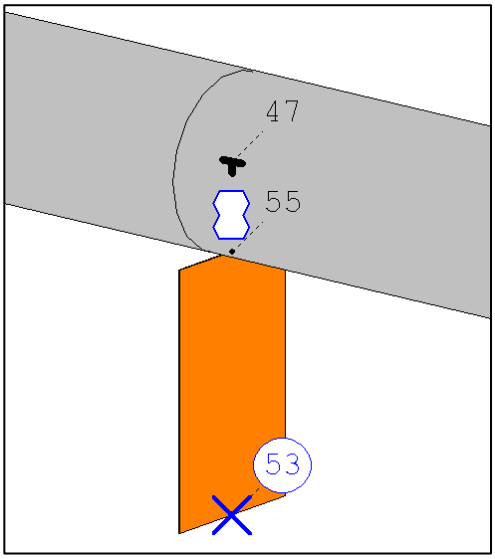




21. Axial flex plate support, SSG type 33 & 34

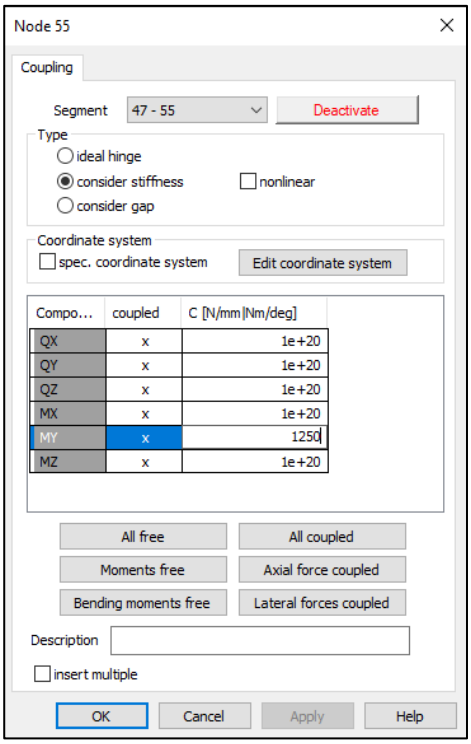


This pipe support is built as a structural beam connecting to the pipe:

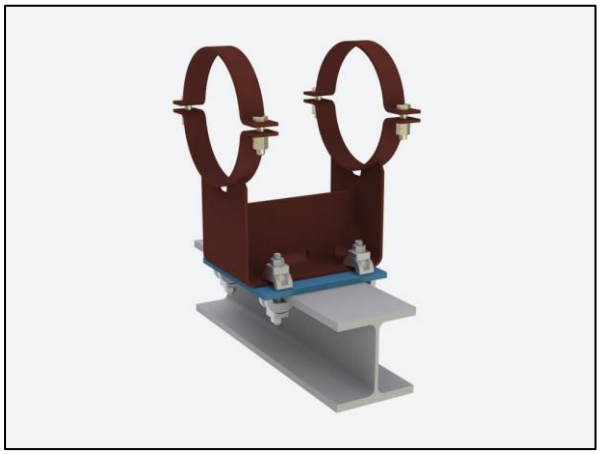


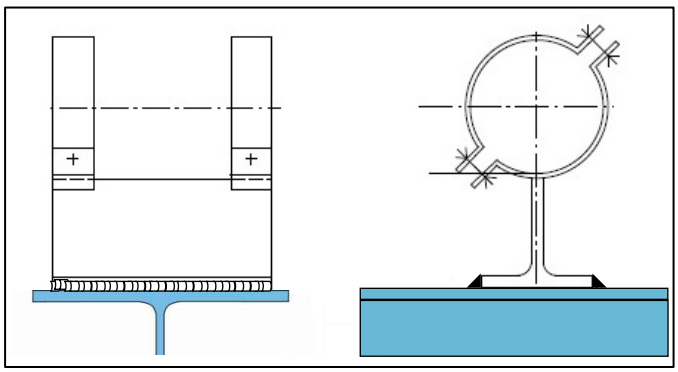
Consider the following using this support:

- This support is flexible in axial direction and is stiff in lateral and vertical directions.
- Create a rigid element within the bend (between node 47 and node 55 in figure) to get correct stiffness of the beam-pipe connection. Otherwise the support will be too flexible
- Additional flexibility between pipe and beam may be defined using “Coupling”
    a. Stiffness values must be obtained by other means, for example FE-analysis

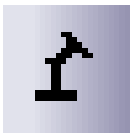


22. Lisega anchor support, SSG type 35 & 36





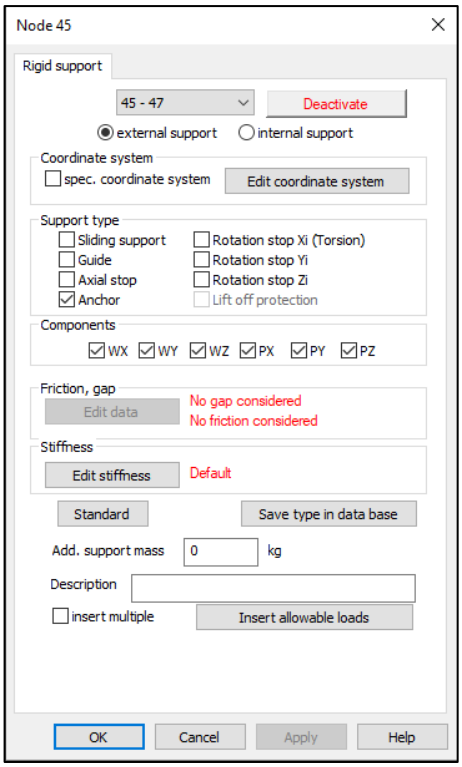
Rohr2 menus:



Lisega anchor support, SSG type 35 & 36

Rigid support, Anchor

1. All translations and rotations are restrained
2. Stiffness values may be specified for all degrees of freedom
3. It is not possible to specify any gaps for any direction or rotation



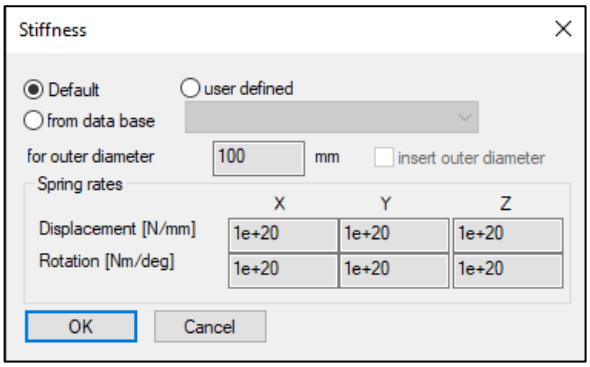
23. Stiffness values for supports

Within Rohr2, most supports are modelled using node to node contact elements, often called as “gap” elements. For supports where the pipe component may slide on the support or change status from contact to non-contact and vice verse, the equation solver must use an iterative procedure to find a solution. Since a contact problem is a “status” type of non linearity it is sensitive to a numerical difficulty called “chattering”.

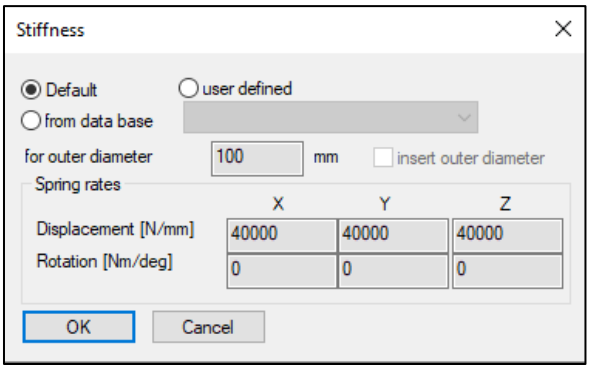
Chattering means that the pipe at one iteration is penetrating into the support. In response to this a spring is introduced to push the pipe up to the correct position of the support at the next iteration. If this spring is “to stiff” it might push the pipe away from the support and hence the spring is removed. And this penetration and lift-off will continue until the of allowable number of equilibrium iterations are exhausted and a warning is issued that the accuracy of the solution is not achieved.

For this reason Rohr2 selects a contact stiffness based on material type and pipe dimension at current support to provide better conditions for the equation solver of finding a solution.

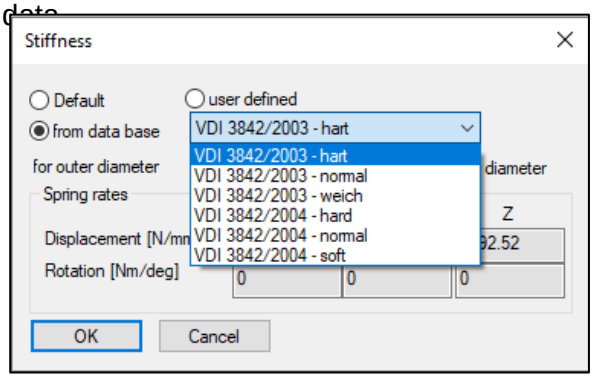
Anchor point (virtually infinite stiff):



Sliding support:



In real life the piping supports are not infinite stiff, since they are designed by sheet metal strips with various shapes and dimensions and the support is suspended by secondary steel which also adds additional flexibility. For this reason, Rohr2 provides data bases according to VDI 3842 year 2003 and 2004 release to provide data to real life support structures.



Note that the stiffness values are based on pipe outer diameters.

The pipe supports are divided in three categories, soft, normal and hard.

The secondary steel must be taken into account when choosing the categories of the pipe supports.

Selecting the proper stiffness category requires that the analyst has knowledge about the structures supporting the piping system which is unique for every installation. At the end choosing “Default” value for static structural analysis may be sufficient and a little on the “safe side”. See also:

VDI3842, VDI-RICHTLINIEN, Schwingungen in Rohrleitungssystemen / Vibrations in piping systems, Beuth Verlag GmbH, 107 72 Berlin, 2004