

User Guide
TOM Mechanical Calculation Software

www.tomcalculation.com



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1. Welcome

We welcome you to the **Mechanical Calculation Program TOM®** developed by **Molecor Tecnología, S.L.** (“**Molecor**”).

The program is a mechanical calculation software for buried plastic pipes of Oriented PVC (PVC-O) **TOM®** and is based on the standards:

- **ATV-DVWK-A 127E:2000**: “Static Calculation of Drains and Sewers”.
- **UNE 53331:2020**: “Unplastized poly(vinyl chloride) (PVC-U), oriented unplasticized poly(vinyl chloride) (PVC-O), polyethylene (PE) and polypropylene (PP) pipes. Criterion for the assessment of pipes for plastics piping systems with car without pressure under external loads”.

This calculation method is one of the most widespread in the world together with the **AWWA** one. The experience over the years has shown that the results obtained are reliable, as long as the input parameters correspond to the reality of the project.

The Program generates the results for the different stresses and loads that the pipe will withstand as well as the safety coefficients at breaking and crushing.

It is important to perform the mechanical calculation of buried pipes to assess the mechanical stresses that are transmitted to the pipe by the action of the different external loads, so that the mechanical calculations of the **TOM® pipes** should be done before designing an installation.

The program offers the following features:

- **Projects** description and **calculations** associated with them.
- Accessing from the menu **Projects Management**:
 - **Create new project**
 - **Create new calculation**
- Registry of projects and calculations made by the user.
- On-screen help, consisting images with explanatory text. Indication of the maximum values (if any) and minimums of each parameter warning in case the condition is not fulfilled.
- Information about the range of **TOM® PVC-O pipes** with standard dimensions and pressures.
- **Abbreviated** and **extensive** results report.
- **Changes for validation**. If the results obtained in the report do not meet the conditions of the selected safety coefficients, or the pipe’s maximum admissible deformation, the application offers the possibility of modifying different parameters in order to ensure the installation is valid.
- Possibility to print the report with the results of the calculation.
- **Inquiry form** that will be assisted by the Molecor Technical Department.
- **Support documentation**: documentation, certification, videos and product images.
- **Terms of use**.

The access to the **TOM® Mechanical Calculation Software** will be done through the web application:

<http://www.tomcalculation.com>

The advantages associated with the application are numerous:

- It is not necessary to install it on any device.
- It is accessible and functional directly from the web.
- It does not imply the management of updates by the user.
- The subsequent modifications / improvements of the application will be visible in real time for the user.
- The final user already has the necessary tools to run the application: the internet browser.
- There is the possibility to access the application from any device, including tablet and mobile phone.

Registered users will have an access password, this password provides **free access** to all the contents of the application, having a customized platform for the creation of their own projects and associated calculations.

It is possible to choose between **spanish, english** and **french**.

The data for the calculation are classified in pages arranged as follows:

- Type of installation (**Create new calculation**)
- Diameter and nominal pressure required for the calculation (**Pipe dimensions**)
- Trench geometry (**Trench and pressure data**)
- Bedding type (**Bedding**)
- Backfill type and modulus of resilience (**Backfill and soil zones**)
- Overloads general parameters (**Traffic**)
- Reporting (**Results**)

Molecor TOM® v.1.2. May 2020



To access the application from any browser (Mozilla Firefox, Google Chrome, Internet Explorer,...) include the address:

<http://www.tomcalculation.com/>



2. Language

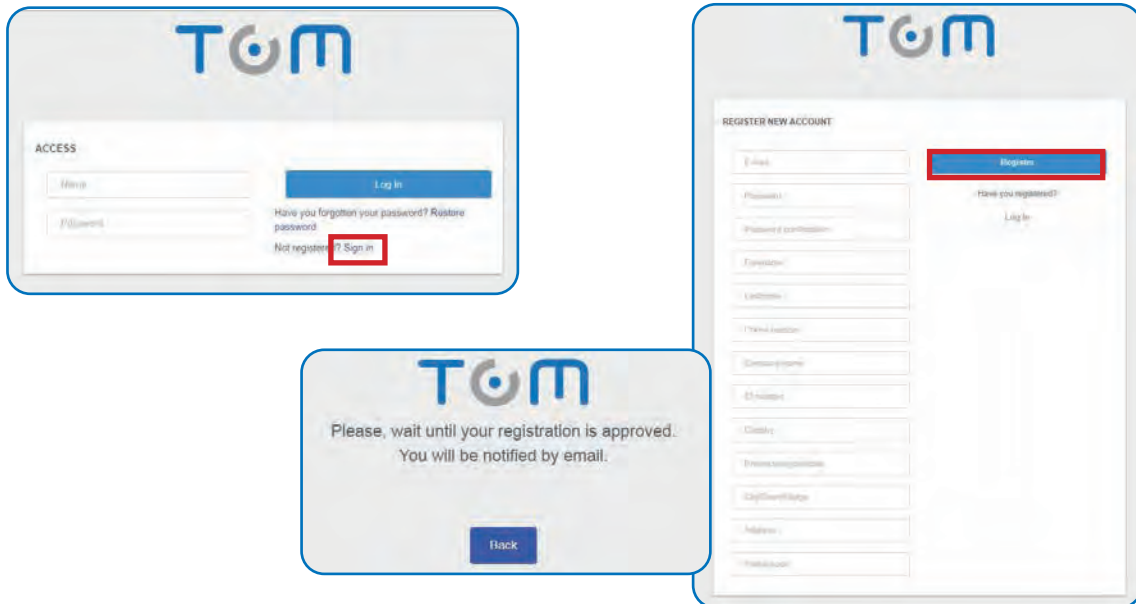
To choose the **language** in which you want to perform the calculation, click on the **flag** symbol and select the desired one.

Press “Log in” button:

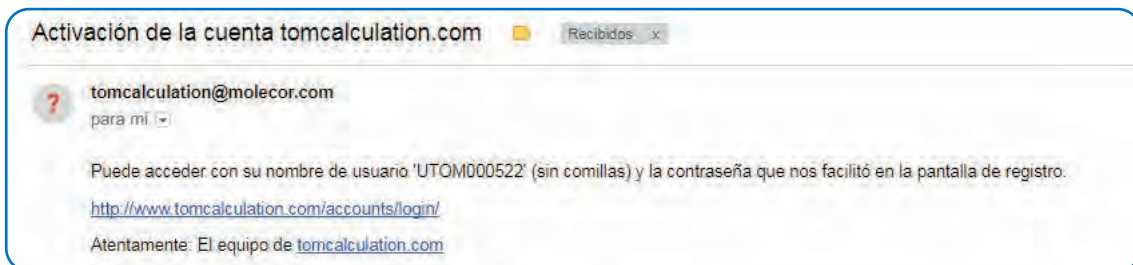


3. User registration

If we access the application for the first time, and we are not registered click on **“Sign in”**. Complete the data requested in the **form**. Once completed, click on **“Register”**.



You will receive a message with the confirmation of your user name:



Now proceed to include the user name without quotes, for example **UTOM00048** and the password indicated at the time of registration. Click on **“Login”**:



In order to access the application you must accept:

I agree with the terms and conditions

PERSONAL DATA PROTECTION. CONFIDENTIALITY

Regarding the protection of personal data entered to use the Program Molecor, the current legislation strictly applies in the terms contained in this website and you can consult them clicking in the appropriate tab in the page footer.

As for the data introduced in the Program on the occasion of its use, Molecor is committed to keep them totally confidential and only use them for the improvement of the Program and the assistance for its use and eventually offer its products to the users unless they indicate otherwise.

©Molecor TECNOLOGIA S.L. v 1.0, Madrid (España), July 2015

I agree with terms of use
 I authorize to receive commercial information

[Log in to TomCalculation](#)

Once you have accepted the terms and conditions of use, go to the main screen where the user is already registered and click on **“Log in”**:



3.1 Reset password

If you are already registered in the application as a user, but you do not remember the password, click on **“Reset password”**:

TOM

ACCESS

[Log in](#)

[Have you forgotten your password? Restore password](#)

Not registered? Sign in.

Include the email address and **“Send”**:

TOM

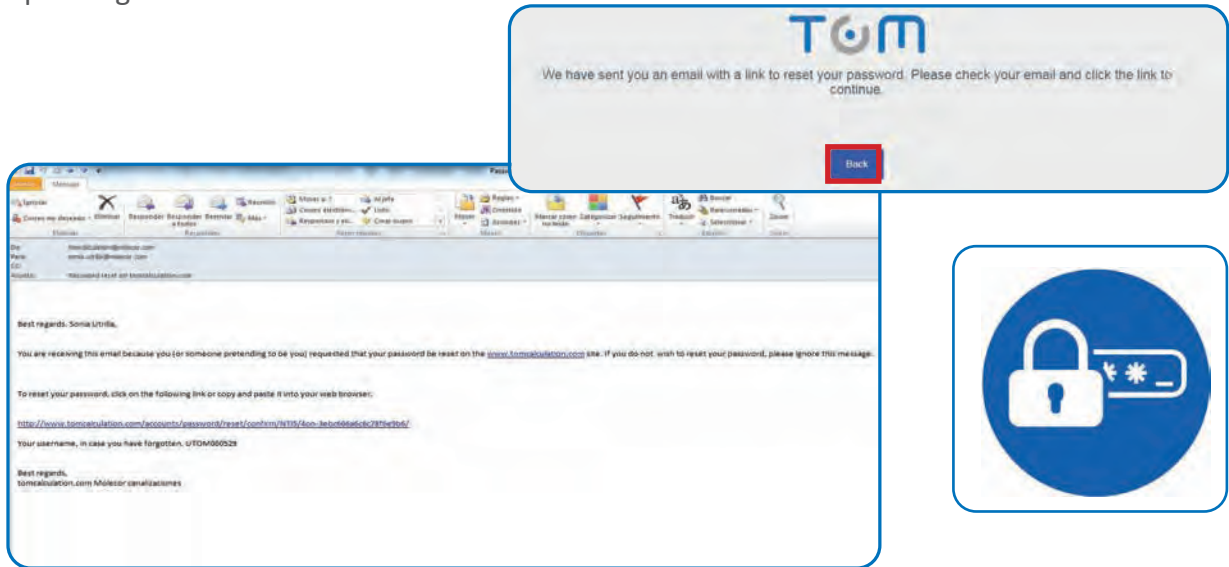
PASSWORD RECOVERY

Have you forgotten your password? Introduce your e-mail address and we will send you the instructions to create a new password.

[Send](#)



Once your e-mail address is included, you will receive an email with the username and the corresponding instructions:



4. User profile

You can access the **“User profile”** through the header menu:



From this menu, we can also access the **“Project List”** and the option **“Create New Project”**.



5. Projects

5.1 View projects

To view the list of **Projects**, we must access the menu **“Projects / View projects”**.

We can create as many projects as we want, and their descriptions will appear on the same screen we are visualizing.



5.2 Create new project

Enter the **“List of projects”** screen and click on **“Create new project”**. This project will be associated with the calculations, we wish to make for it.

When we click the button **“Create new project”** the form in which we must enter the data related to the project appears. You can also associate an image with the project.

Once completed, press **“Save Data”**.



Once the data of the project are included, the system will ask for confirmation. If the data are correct, press **“Confirm”**.



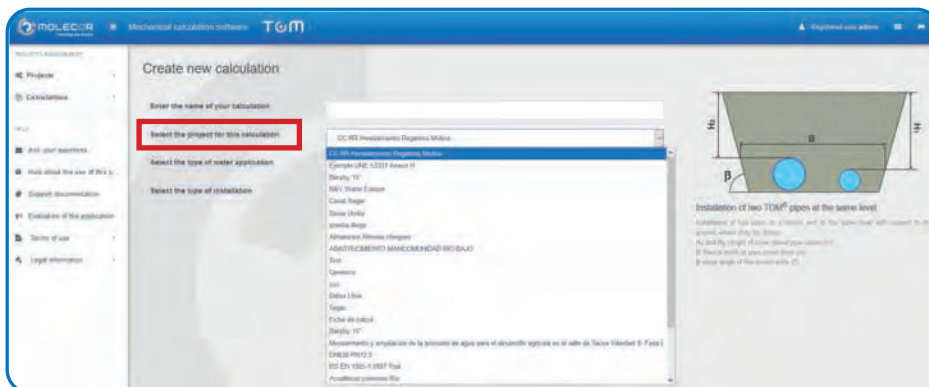
6. Calculations

6.1 Create new calculation

Once the new project is included, the system takes us to the option **“Create new calculation”** to start performing the corresponding calculation:

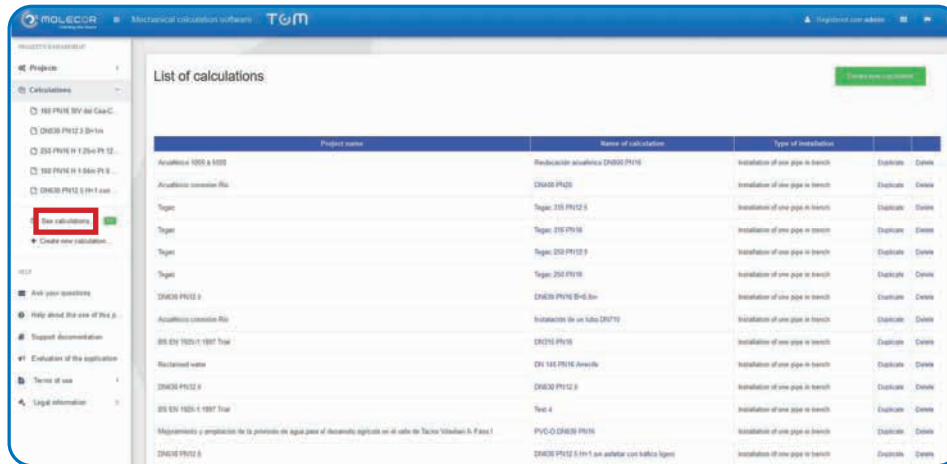


When different projects already exist and we want to associate a calculation with any of them, we will access through the **“Calculations / Create new calculation”** menu and select the project to which we want to associate it:



6.2 View calculations

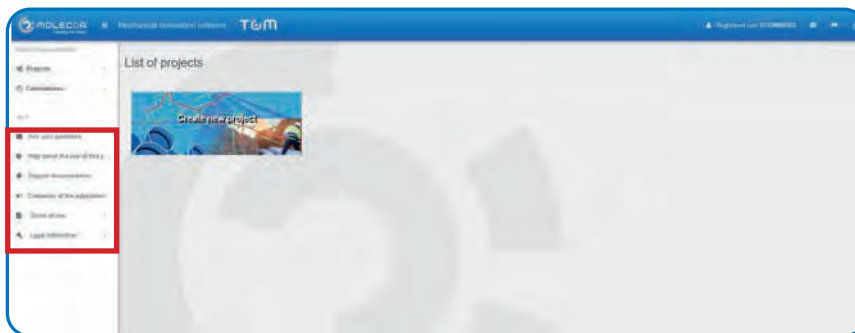
To view the list of “**Calculations**” made, we must access the menu “**Calculations / View calculations**”. We will be able to duplicate or delete it.



7. Help

The **Help** menu consists of the following sections:

- Make your questions
- Help with the use of the software
- Support documentation
- Evaluation of the software
- Terms of use
- Legal notice



7.1 Make your questions

The questions form will be attended by the **Molecor Technical Department**. The user can submit the form with doubts or queries related to the use of the application. Complete the data and click on “**Submit**”.



7.2 Help with the use of the software

The “Help with the use of the software” menu consists of the following sections:

- Welcome
- Installation help
- Help with the pipe
- Help on the trench and pressures
- Help with the bedding
- Help with the backfill and soil
- Help with the traffic
- Help with the results
- Help with the changes for validation



7.2.1 Welcome



7.2.2 Installation help

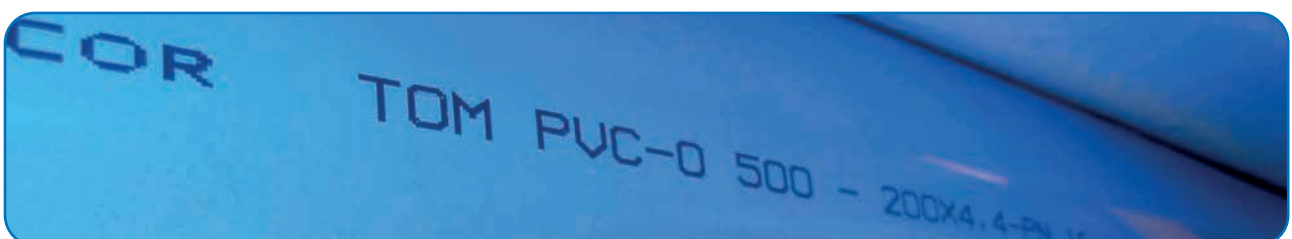
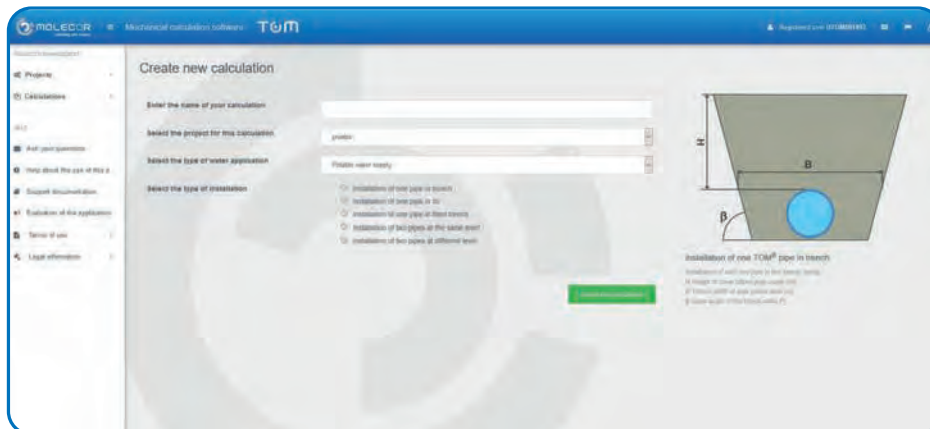
In this section you must include the description “name” of the calculation and select the project to which it is associated. To do this, we must have previously completed the project data through the direct access + **Create new project**.

The user can select the **type of water application** for which the calculation is performed:

- Potable water supply
- Water reusability
- Irrigation
- Sewage
- Fire networks
- Industrial applications
- Others

The **type of installation** for the calculation will be selected. Five types of installation are considered for calculation purposes, each one of them is associated with identification image and explanatory text of the described fields:

- Installation of one pipe in trench
- Installation of one pipe in embankment
- Installation of one pipe in embanked trench
- Installation of two pipes at the same level
- Installation of two pipes at different level



7.2.3 Help with the pipe dimensions

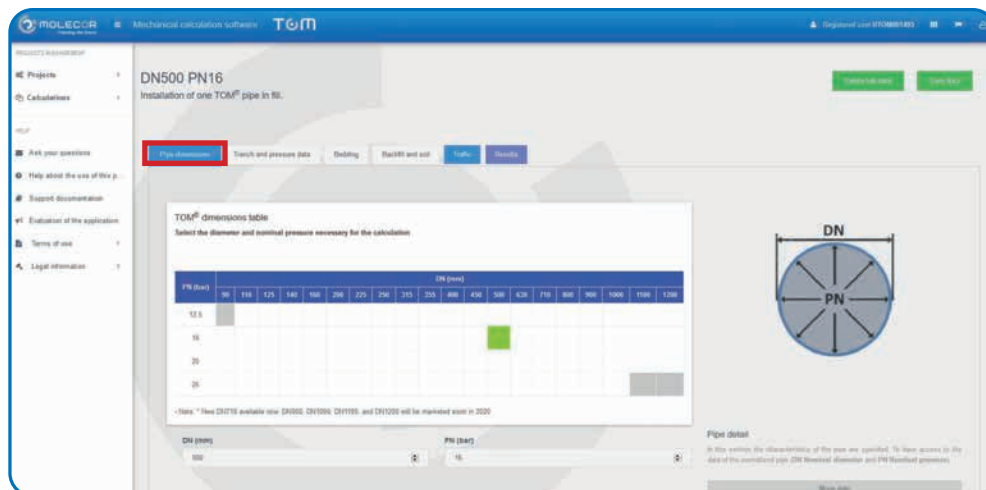
This section specifies the dimensional characteristics of the pipe, through the **TOM® dimensions table**, we will select, depending on the type of installation, the pipe data required for the calculation.

If the installation consists of a single pipeline, we will find that only the section corresponding to a pipe appears.

If the installation consists of two pipelines, the sections corresponding to “**pipe one**” and “**pipe two**” will be activated.

The fields that appear in this section are:

- **DN:** Nominal diameter of the pipe (mm).
- **PN:** Nominal pressure of the pipe (bar).



7.2.4 Help on the trench and pressures

In this section all data concerning **the geometry of the trench** must be entered, indicating the characteristics of the trench and the pressures that are applied.

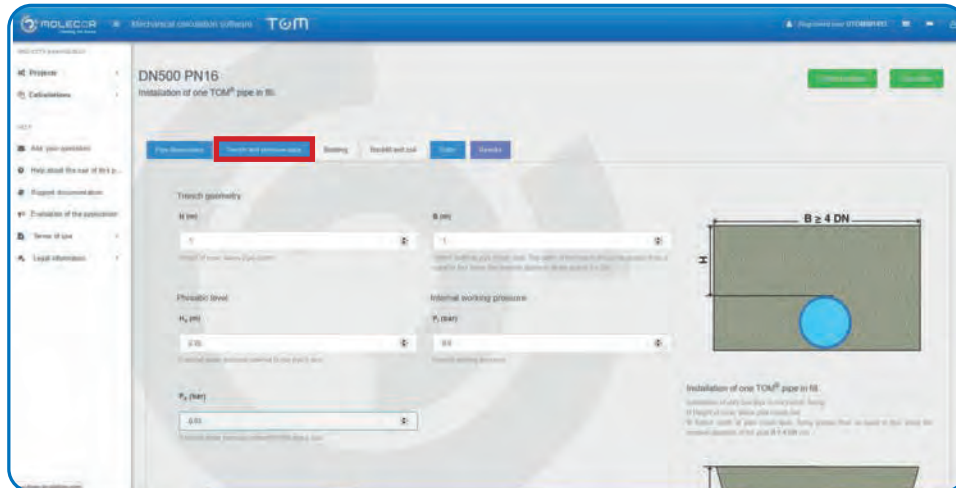
If the installation consists of two pipelines, the sections corresponding to “**pipe one**” and “**pipe two**” will be activated.

As we have previously selected the type of installation, in the right margin will appear the corresponding image and identifying fields:

- **H** and **H₃** Height of cover above pipe crown (m).
- **H₁** Height of trench cover (m).
- **H₂** Height of embankment cover (m).
- **B₁** and **B₂** Trench width at pipe crown level (m).
- **β** Slope angle of the trench walls (°).

In addition to the information of the trench geometry, we should identify the **phreatic level** over the pipe crown and the working pressure:

- H_a Height of the phreatic level over the pipe crown (m).
- P_i Internal working pressure (bar).
- P_e External water pressure referred to the pipes axis (bar).

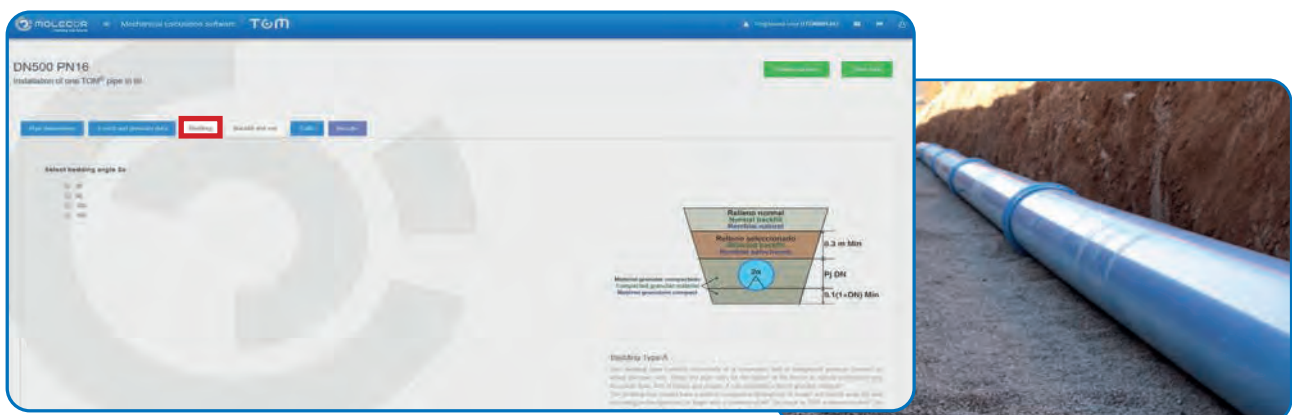


7.2.5 Help with the bedding

The **UNE 53331: 2020** Standard specifies one bedding type for the pipes in trench:

Apoyo Tipo A: This bedding type consists essentially of a continuous bed of compacted granular material on which the pipe rests. When the pipe rests on the bottom of the trench or natural soil formed only by sandy soils, free of lumps and stones, it can resemble a bed of granular material. The bedding type should have a uniform compaction throughout its length and should wrap the pipe according to the foreseen 2α angle with a minimum of 60° . 2α equal to 120° is recommended. The projection ratio for this type of bedding is $P_j = 1$

If the installation consists of two pipes, we will find sections corresponding to “**pipe one**” and “**pipe two**” active.



7.2.6 Help with the backfill and soil

Once the pipes are placed and the joints are executed, the trench will be filled.

This section shows the **Modulus of resilience table E_s (N/mm²)** depending on the ground type (backfill and soil) and the proctor degree of compaction.

Four ground types are considered:

- **G1. Non-cohesive soils.** This group includes loose gravel and sand. The particle size $\phi \leq 0,06$ mm should be lower than 5 %.
- **G2. Slightly cohesive soils.** This group includes slightly clayey or silty gravel. The particle size $\phi \leq 0,06$ mm should be between 5 % and 15 %.
- **G3. Cohesive mixed soils.** This group includes clayey or silty gravel and sand, cohesive stony residual soil. The particle size $\phi \leq 0,06$ mm should be between 15 % and 40 % and few plastic silts.
- **G4. Cohesive soils.** This group includes clays, silts and soils with a mixture of organic compounds.

Then, the backfill compaction should be selected:

- Filling with compacted layers against the natural soil (without verifying the degree of compaction), also applicable for plank-supported walls (Berlin construction).
- Vertical construction of the pipe trench with channel sheet piling that is removed after filling. Plates or construction devices that are removed step by step when filling the trench. Uncompacted covering of the trench. Injection of the covering (only in soils of the group G1).
- Vertical construction of the trench with cofferdams, lightweight piling profiles, wooden planks, plates or other construction devices that are removed after filling.
- Filling of the trench by compacted layers against the natural soil, with verification of the degree of compaction required by the UNE-CEN/TR 1046 Standard; also for support plank walls (Berlin construction). A4 filling conditions does not apply to soils of the G4 group.

Besides this, it is necessary to add the specific weight of the filling of the trench area. In case of installation in an embankment trench or with two pipelines at different level, the specific weight of the embankment must be specified.

The system fills automatically the unit weight of the backfill with a value of 20 kN/m³ (usual value).

For the calculation of earth loads, it is necessary to know the modulus of resilience of the backfill covering the pipe, above the pipe, at both sides and at the bottom of the trench.



The following zones and their corresponding modulus of resilience are considered:

Backfill - Modulus of resilience E_1 and E_2 .

Once the pipe is placed and the joints are executed, we will proceed with the filling at both sides of the pipe. The degree of compaction to be obtained will be the same as the one of the bedding. Special care should be taken to ensure that no unfilled spaces remain under the pipe.

If no tests are performed, the values E_1 and E_2 can be taken from the table “**Modulus of Resilience**” table according to the specific degree of compaction to the filling and according to the type of soil. $E_1 = E_2$ should be taken when the material and compaction, at both sides of the filling, are the same.

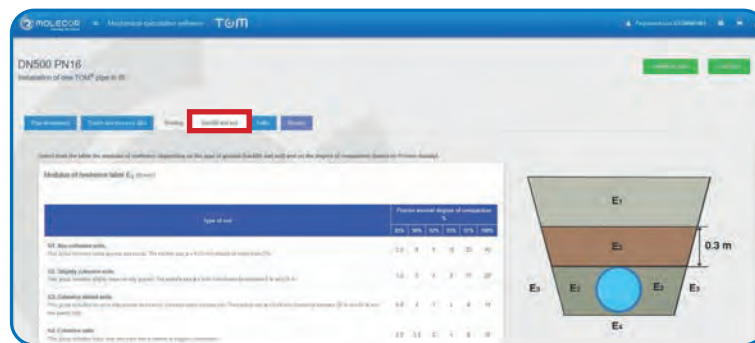
Soil - Modulus of resilience E_3 and E_4 .

Regarding the ground type at both sides and below the trench, modulus of resilience E_3 and E_4 should be taken into account.

The values of E_3 and E_4 should be selected according to the actual conditions of the soil of the trench. If these values are unknown, $E_3 = E_2$ can be adopted. In the case of installation under embankment, $E_1 = E_2 = E_3$ will generally be taken. For normal soils, the value of E_4 can be selected from the table, for 100% normal proctor compaction.

If the installation consists of two pipelines, the sections corresponding to “**pipe one**” and “**pipe two**” will be activated. The values of E_3 and E_4 will be the same for both pipes. The system offers the option of entering different E_1 and E_2 values for each pipeline (although generally E_1 and E_2 are identical in both cases).

The application will take automatically the first value selected in the table “**modulus of resilience**” for all the fields E_1 , E_2 , E_3 , and E_4 . If you want to change the coefficient, click on the box and select the value again in the table.



7.2.7 Help with the traffic

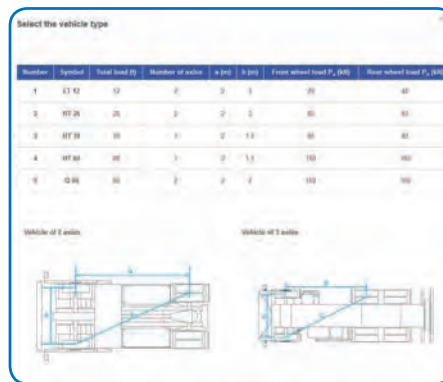
In this section we will identify whether it is an installation **without traffic loads**, **with concentrated traffic loads** or **with distributed traffic loads**. We should also specify if it is a **paved zone** or **without pavement**.

To determine the pressure on the pipe due to vertical overloads it is necessary to know:

Concentrated overloads. It is considered as concentrated overloads those originated, mainly, by the specific traffic loads, located in the wheels. The following data must be known:

- P_c Concentrated overload (kN). In the case of vehicles, the maximum load per wheel is considered.
- a Distance between wheels (m).
- b Distance between axis (m).
- Number of vehicle **axis**.
- Φ Coefficient of restitution.

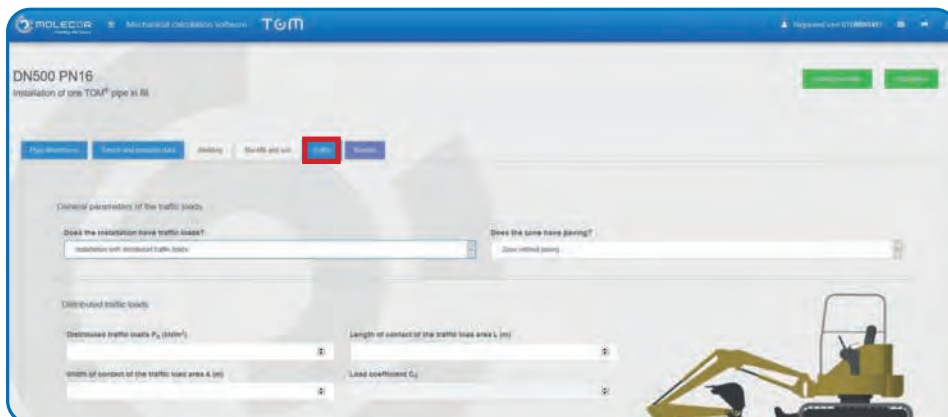
The values will be automatically obtained by clicking **“Select the type of vehicle”** and choosing the specific vehicle:



Distributed overloads. These type of overloads are commonly caused by stored materials, chained vehicles, etc. It is necessary to know the following information:

- P_d Distributed traffic loads (kN/m²). In the case of chained vehicles, the overload considered is half of the vehicles’ load divided by the area of the chain in contact with the ground.
- Length of contact of the traffic load area L (m).
- Width of contact of the traffic load area A (m).
- Load coefficient C_d .

The calculation of the C_d coefficient of distributed overloads will be done automatically when the actions are determined.



Type of paving. This data is essential in the case of an installation under a paved area. The data to be specified are the following :


h_1, h_2 Height of the first and second layers of pavement respectively (m).

E_{f1}, E_{f2} Compression modulus of the first and second layers of paving (N/mm²).

The different types of common pavements and their compression modules can be visualized in the table **“Data about paving materials”**.

Information about paving materials:

Type of material	E_f (N/mm ²)	E_f depends on ...:
Soil-cement	50-2000	Soil type and particle size
Gravel-cement	1000-15000	Soil type and particle size
Macadam	90-350	Degree of compaction
Compact gravel	100-900	Degree of compaction
Compact dross	80-250	Degree of compaction
Asphalt agglomerate	6000-20000	Composition, temperature
Asphalt emulsion	400-4000	Temperature
Poor concrete	15000	-
Concrete slabs	21000-35000	Concrete quality



7.2.8 Help with the results

Once all the data have been entered the calculations can be done. For this, we will access the **“Results”** tab where we will indicate the safety coefficient that we want to apply to the calculations of mechanical actions.

The safety coefficients for PVC-O pipes are indicated according the safety class and it has been taken with a burst percentage of 5% of annular resistance under flexural stress. The probability of failure (pf) is classified regarding safety class:

Safety coefficient type A. General and more restrictive case. A coefficient >2.5 applies.

- Phreatic layer threat
- Service reduction
- Failure with remarkable economic consequences

Safety coefficient type B. Special and less restrictive case. A coefficient > 2 applies.

- No phreatic layer threat
- Weak service reduction
- Failure with small economic consequences

Click on the button **“Calculate”** to obtain the results.

The program will check automatically the data introduced and will identify in the section **“Results of the calculation”** if the case is a **Valid installation** o **Not valid installation**.

The software calculates the short and long term loads automatically.

In the case of a valid installation, a pdf file may be generated to print the **abbreviated** and **detailed reports**.

If you have omitted any necessary data for the calculation, a window will be displayed specifying that you have incomplete or incorrect data in the calculation form, and you will have to check and verify that the data have been entered correctly.

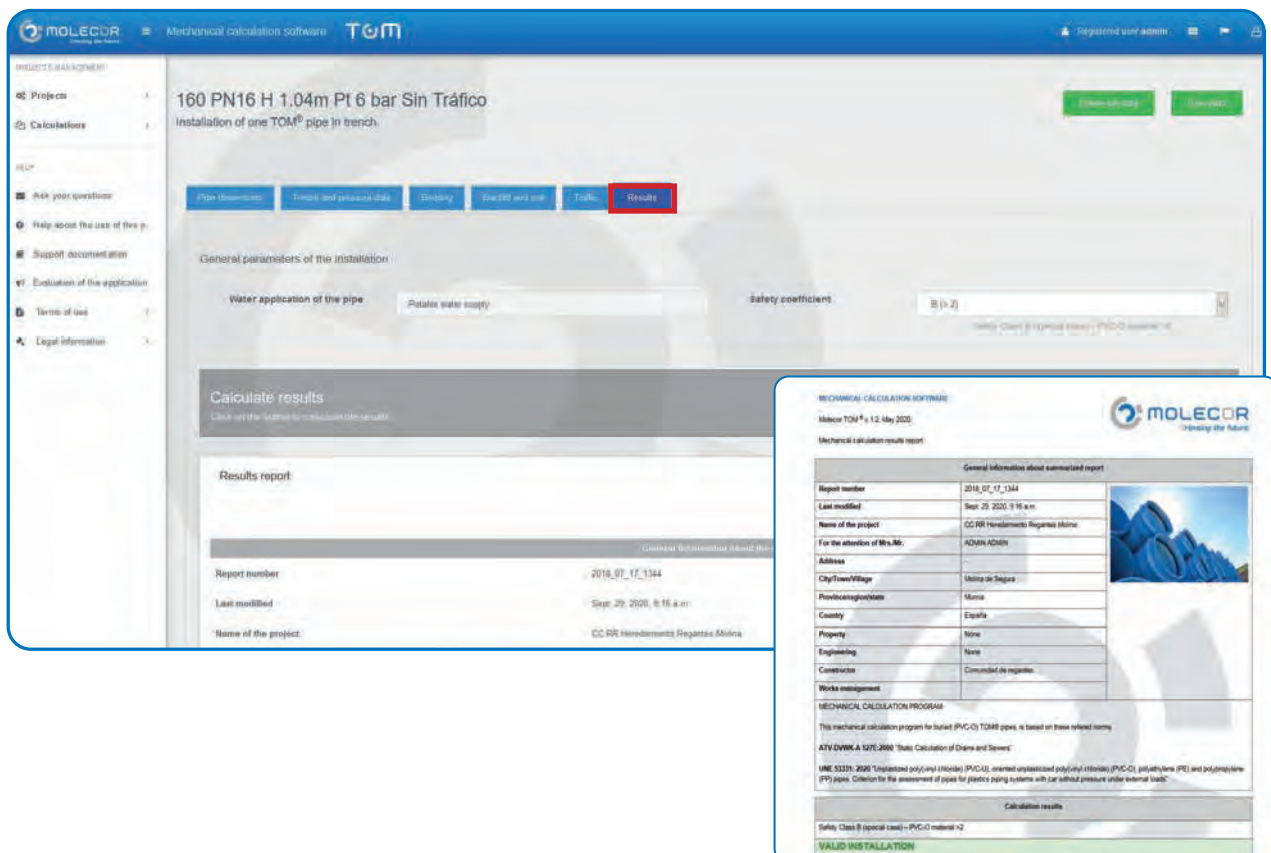
Once the software checks that there are no missing data, a window with the results of the actions/loads will be displayed.

If a safety coefficient (A or B) has been specified when introducing the data, the system will apply it to the result of the actions/loads calculation, so that those results that do not meet the requirements will appear in red.

This page contains the following options:

- Visualization of the **results report** with the determination of the actions/loads on the pipe in the short and long term.
- Possibility of generating a **pdf file** for **printing** with the abbreviated and extensive reports.

If the installation data is changed or updated, you must click on the **“Calculate”** button again to regenerate the calculations with the modified values.



The screenshot displays the MOLECOR software interface. The main window shows the project details: "160 PN16 H 1.04m Pt 6 bar Sin Tráfico" and "Installation of one TOM® pipe in trench". Below this, there are tabs for "Pipe description", "Trench and pressure data", "Bidding", "Barriers and use", "Traffic", and "Results". The "Results" tab is active, showing a "Calculate results" button and a "Results report" section. The report section contains a table with the following data:

General Information about summarized report	
Report number	2016_07_17_1344
Last modified	Sept. 29, 2020, 9:16 a.m.
Name of the project	CC RR Heredamientos Regatilla Mioma
For the attention of Mrs./Mr.	ADMIN ADMIN
Address	
City/Town/Village	Molina de Segura
Province/Region/State	Murcia
Country	España
Property	None
Expanding	None
Construction	Comunidad de regantes

Below the table, there is a section for "MECHANICAL CALCULATION PROGRAM" and "MECHANICAL CALCULATION PROGRAM" with a description of the software's capabilities and a "VALID INSTALLATION" status.

7.2.9 Help with the changes for validation

The user must enter the installation parameters and calculate the installation in the section “Results”.

If the results obtained in the report do not meet the conditions of the selected safety coefficients, or the pipe’s maximum admissible deformation, the application offers the possibility to modify the different parameters already defined, in order to obtain a valid installation.

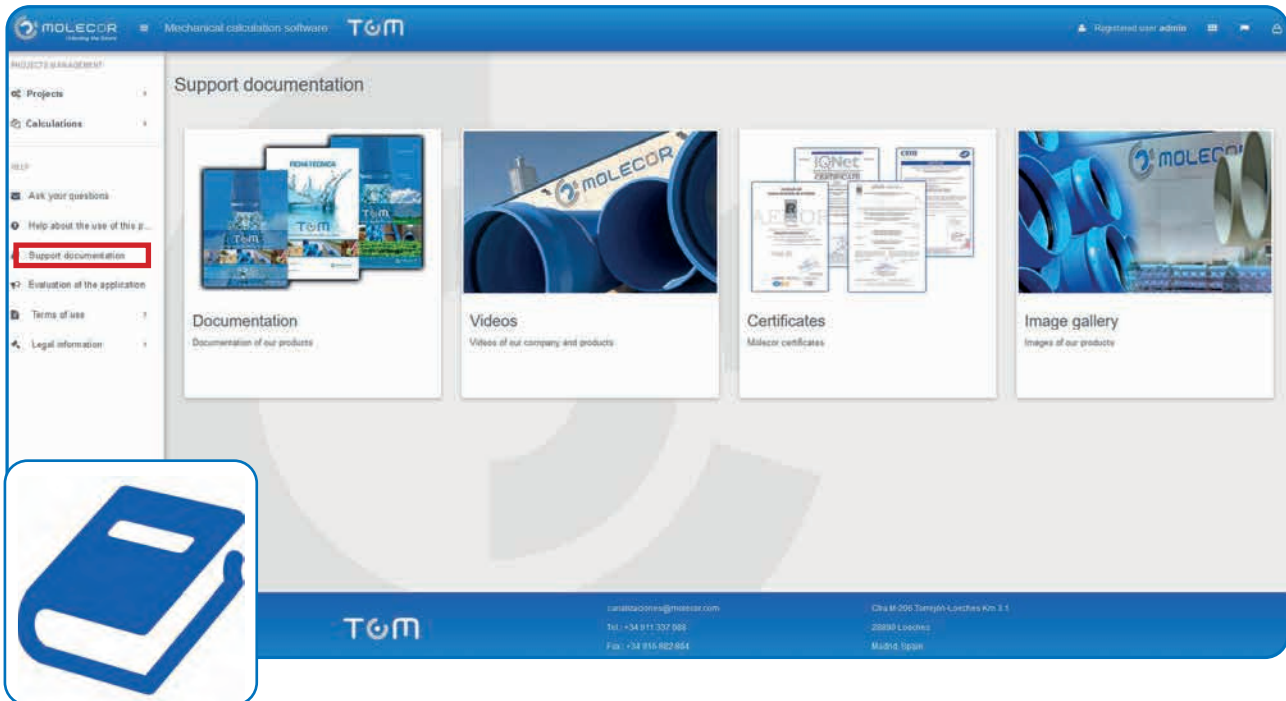
The defined parameters are:

- **Safety coefficient used in the calculation: Class A>2.5 / Class B>2.** It does not meet the minimum security coefficient.
- **Working pressure (bar): P_i .** The working pressure has been considerably reduced and has not reached an optimum result. Please try another parameter from the list.
- **Cover height above the pipe crown (m): H .** The calculation has been made by modifying the height of the filling and the safety coefficients are not satisfactory. Please try another parameter from the list.
- **Nominal pressure (bar).** The calculation has been performed with the maximum nominal pressure (PN25) and the safety coefficients are not satisfactory. Please try another parameter from the list.
- **Bedding angle (°): 2α .** The calculation has been performed with the maximum support angle (180 °) and the safety coefficients are not satisfactory. Please try another parameter from the list.
- **Traffic:**
 - If you chose to install with **concentrated traffic loads**: The calculation of the installation has been performed with the lighter traffic option (LT12) and the safety coefficients are not satisfactory. The only more favorable option would be an installation without concentrated traffic loads. To do this change you should go to the “Traffic” tab.
 - If you choose to install **without concentrated traffic loads**: The installation does not have concentrated traffic loads and the safety coefficients are not satisfied. Please, try another parameter from the list.
 - If you choose to install **with distributed traffic loads**: The installation has been calculated with distributed traffic loads and the safety coefficients are not satisfactory. To change the traffic conditions please go to the “Traffic” tab.



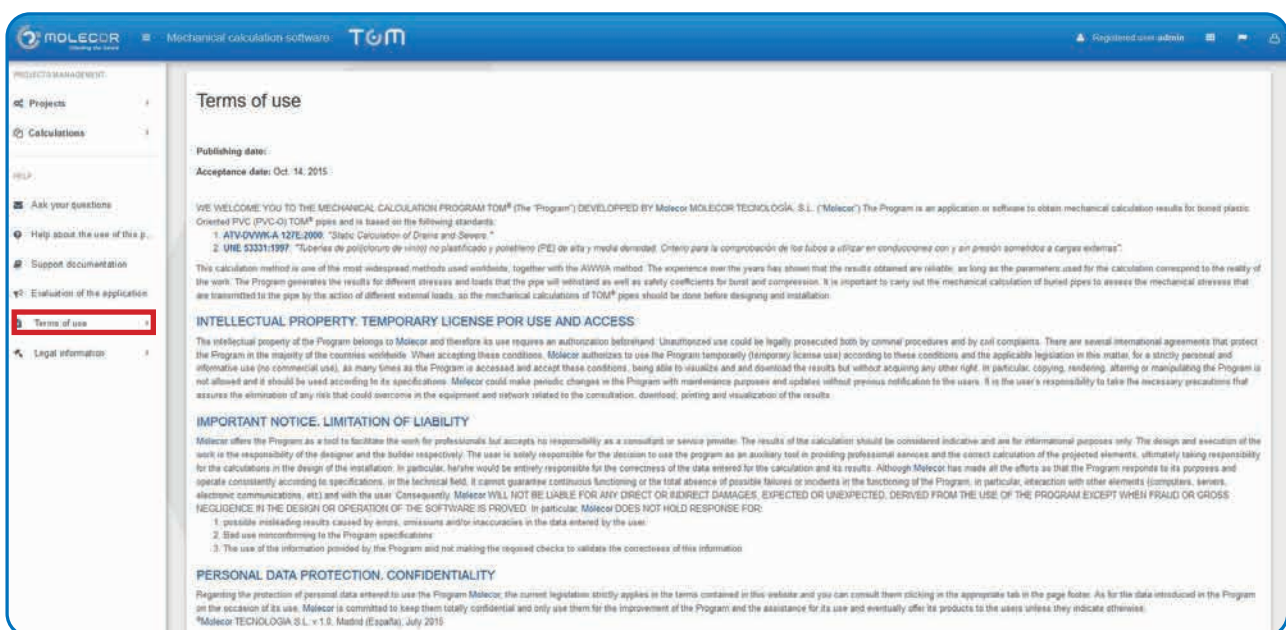
7.3 Support documentation

In this section you will find direct access to our **Documents**, **Videos**, **Certifications** and **Images**:



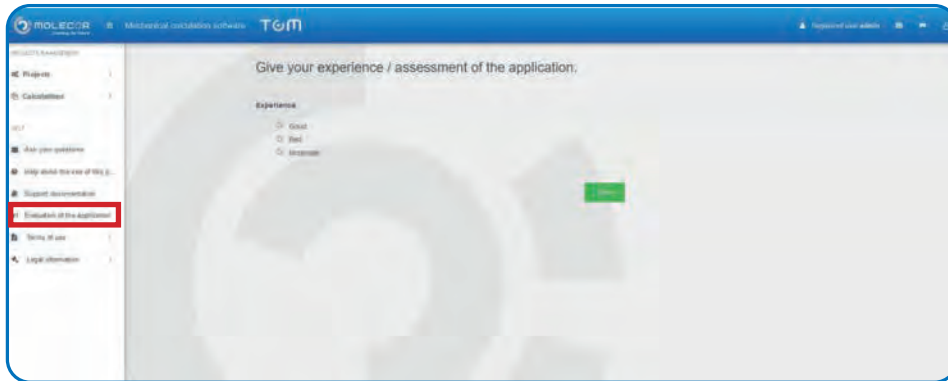
7.4 Terms of use

In this section are the approved **“Terms of Use”** at the time of registration, if there are several versions would appear the history with the date of their approval to know which terms were approved at the time of performing the calculations.



7.5 Evaluation of the software

In this section the user can evaluate the application.



7.6 Legal notice

You can access to **Legal notice** and **Data protection policy**.

