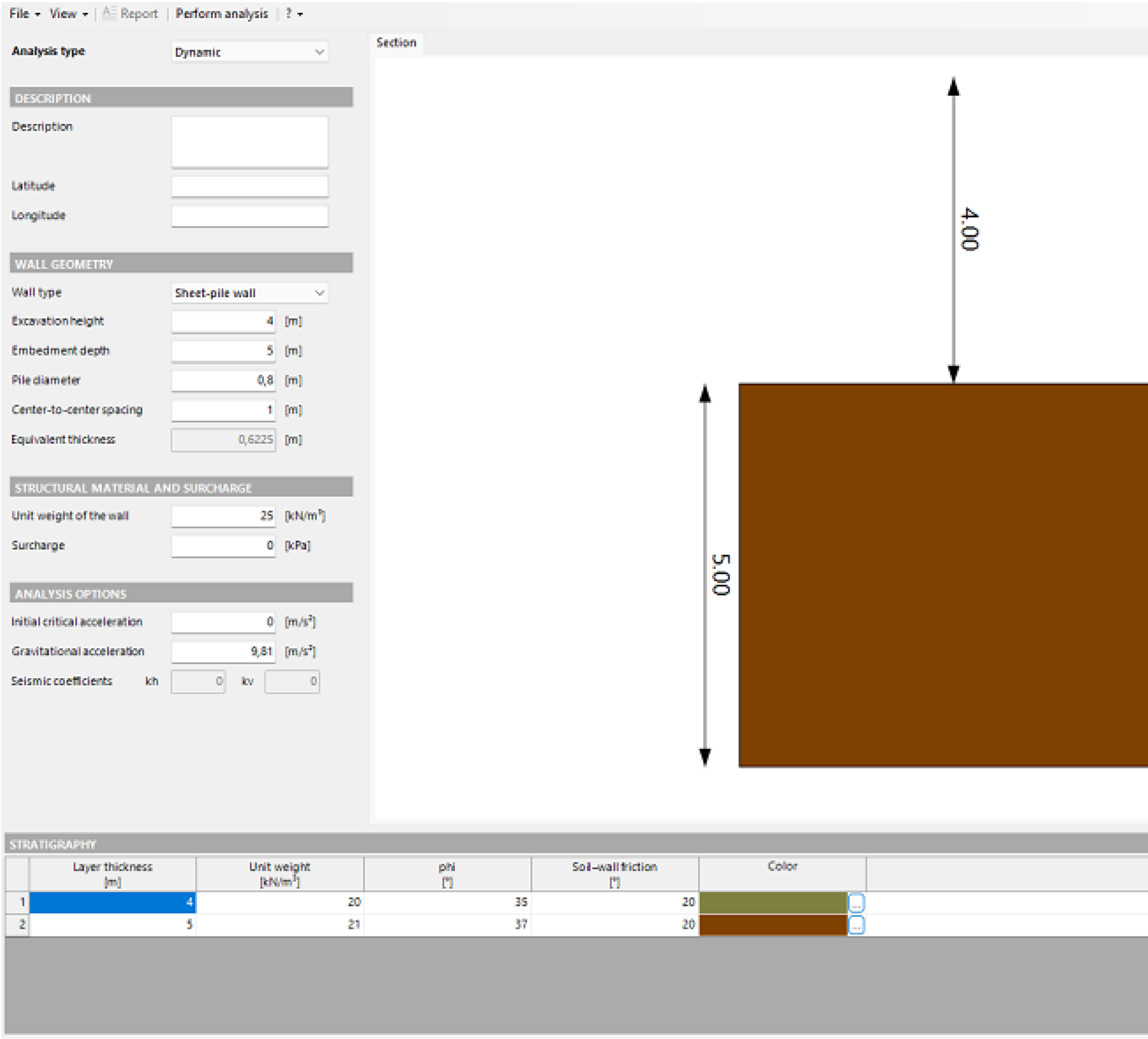
1 Introduction

Stability analysis of embedded cantilever retaining walls in seismic area is generally carried out by calculating a factor of safety against a possible mechanism of collapse. However, a more rational approach consists in assessing the performance of the structure in terms of accumulated permanent displacement. Indeed, this approach is required by many national standards as well as Eurocodes, such as in particular, Eurocode 7 Part 1 (§2.4.8, §9.8.2) and Eurocode 8 Part 5 (§7.1(1)P, §7.1(2)).

In this context, DReW Seismic allows predicting the earthquake-induced permanent displacements of embedded cantilever retaining walls, such as diaphragm or sheet-pile walls. DReW Seismic is developed on the basis of the method recently published by Conte, Pugliese and Troncone (2022), in the journal *Géotechnique*.



General overview of DReW Seismic

GENERAL FEATURES

DReW Seismic performs a dynamic analysis of embedded cantilever retaining walls in cohesionless soils, calculating the evolution with time of the permanent displacement of these structures owing to earthquakes. The dynamic analysis refers to the solution developed by Conte, Pugliese and Troncone (2022). The main features of the software are listed below:

- The redistribution of the soil pressure on the wall as a function of the wall displacement is accounted for, as required by Eurocode 7 Part 1 at §9.7.1(5)
- Different typology of structures: diaphragm and sheet-pile walls
- Layered soil
- Presence of surcharge

For the sake of completeness, a pseudostatic analysis can be performed as well. This latter refers to the procedure developed by Conte, Troncone and Vena (2017).

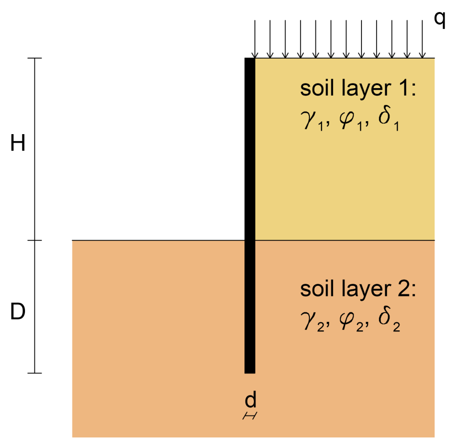
REQUIRED INPUT

DReW Seismic is very easy to be used and requires a limited number of input parameters (see the figure below). In particular, the following data is required:

- Excavation height, H
- Embedment depth, D
- Soil unit weights, γ_1 and γ_2
- Angle of shearing resistance of the involved soils, φ_1 and φ_2
- Friction angle at the soil-wall interfaces, δ_1 and δ_2
- Unit weight of the wall, γ_{wall}
- Wall thickness, B (in case of diaphragm wall)
- Pile diameter, d, and spacing between piles, s (in case of sheet-pile wall)
- Surcharge intensity, q

Moreover, since a dynamic analysis is performed, an acceleration time-history representative of the considered site is required. To this purpose, it is possible to refer to an acceleration time-history that has been previously recorded at the site. A database of earthquakes to refer to is available on this website.

If a pseudostatic analysis is performed, the horizontal and vertical seismic coefficients, respectively k_h and k_v, are required.



Sketch of the geometry considered in DReW Seismic

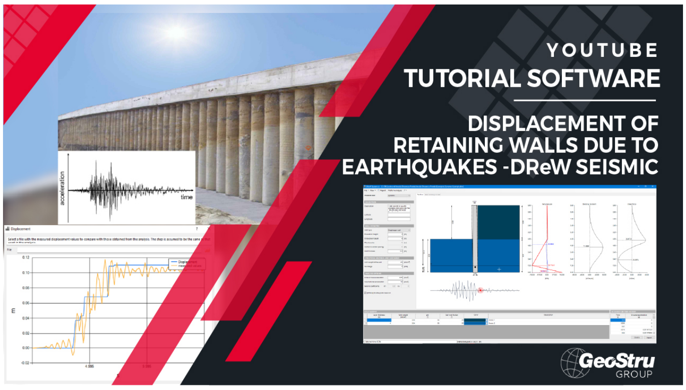
OUTPUT

DReW Seismic provides the outputs listed below when a dynamic analysis is performed:

- displacement time-history owing to a given earthquake. The displacement is calculated for the top of the wall
- comparison between the ground acceleration time-history and the corresponding critical threshold, which is also updated during the earthquake
- evolution with time of the angular acceleration of the wall
- evolution with time of the angular velocity of the wall
- evolution with time of the rotation of the wall
- evolution with time of the net pressure at the wall end and comparison of this latter with the corresponding limit value
- evolution with time of the depth "X", which define the portion of the soil in which the passive resistance is completely mobilized
- evolution with time of the center of rotation of the wall "Y"
- evolution with time and depth of the net pressure acting on the wall

When a pseudostatic analysis is performed, the following outcomes are provided:

- net pressure acting on the wall
- shear force
- bending moment



2 Analysis

This section describes how to perform the analysis in DReW Seismic.

Working with DReW Seismic

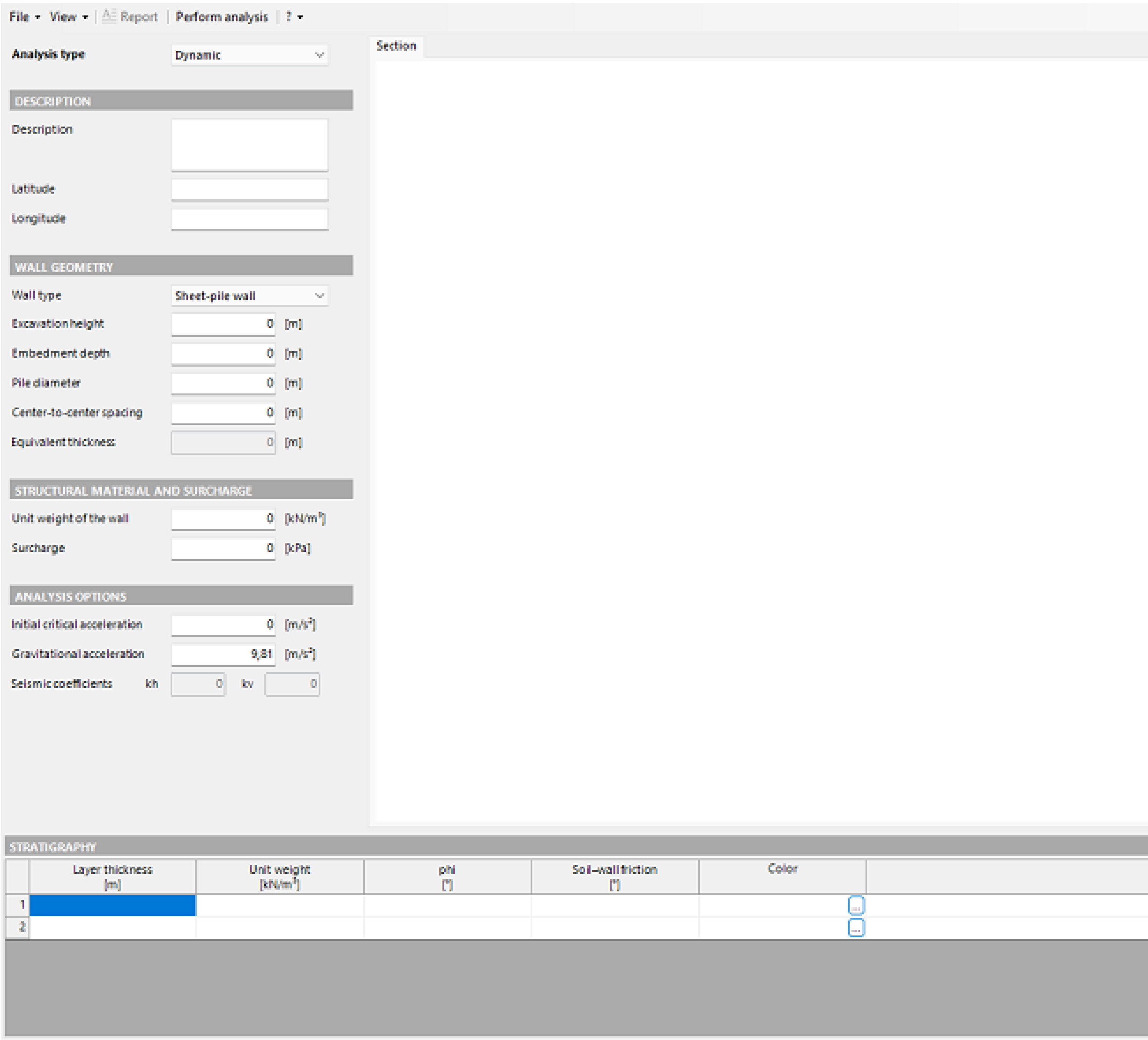
➢ Input

➢ Calculation

➢ [Output](#)

2.1 Input

When a new project is open in DReW Seismic, a window as that shown in the following appears.



New project window in DReW Seismic

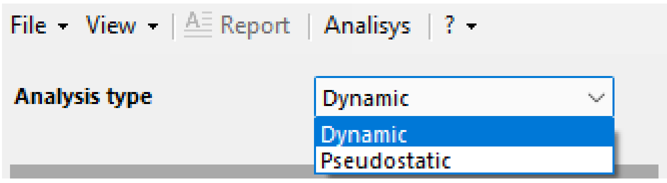
As shown from the above figure, the following fields are required in the input section:

- Analysis type
- Description
- Wall geometry

- Structural material and surcharge
- Analysis options
- Stratigraphy
- Acceleration time-history

ANALYSIS TYPE

Two different types of analysis are possible in DReW Seismic: these are "Dynamic" and "Pseudostatic".



Analysis type

The default option for analysis type is Dynamic.

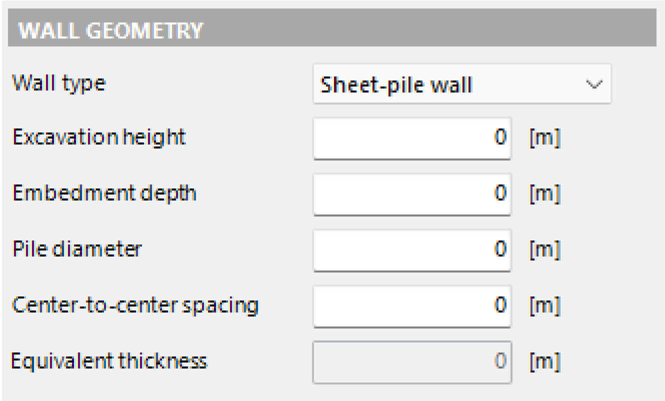
DESCRIPTION

General information about the project could be added in this section.

Description

WALL GEOMETRY

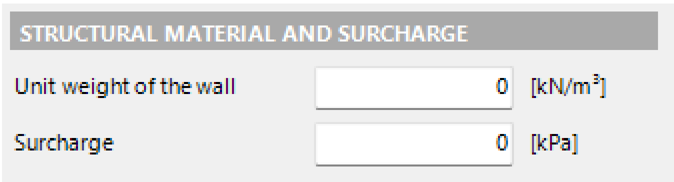
The typology of the wall (diaphragm wall or sheet-pile wall) and the concerning dimensions are chosen in this section.



Wall geometry

STRUCTURAL MATERIAL AND SURCHARGE

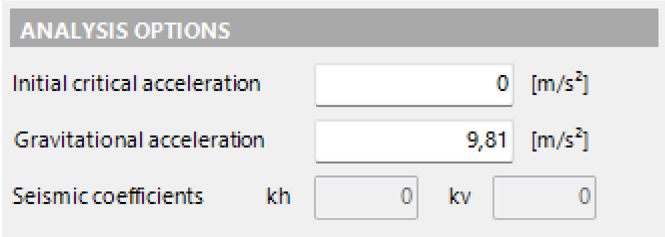
This section allows choosing the unit weight of the material that the wall is made up of, along with the surcharge acting on the retained side.



Structural material and surcharge

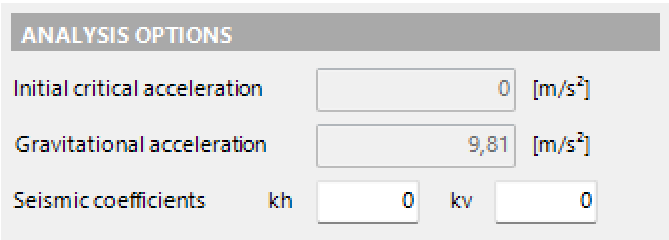
ANALYSIS OPTIONS

This section appears differently on the basis of the chosen analysis type. If a dynamic analysis is performed, the initial critical acceleration and the gravitational acceleration have to be input. The gravitational acceleration is set by default at 9.81 m/s^2. The initial critical acceleration has to be chosen by the user. This data has to be set to 0 for a retaining wall of new construction. On the contrary, it has to be taken equal to the maximum acceleration that acted on the retaining wall during the previous earthquakes hitting the structure. However, lacking more accurate information, the assumption of the value 0 also for existing structures leads to precautionary results. Indeed, the greater the initial critical acceleration, the smaller the earthquake induced permanent displacement.



Analysis options for dynamic calculation

On the contrary, only the horizontal and vertical seismic coefficient, k_h and k_v, are required when a pseudostatic analysis is performed.



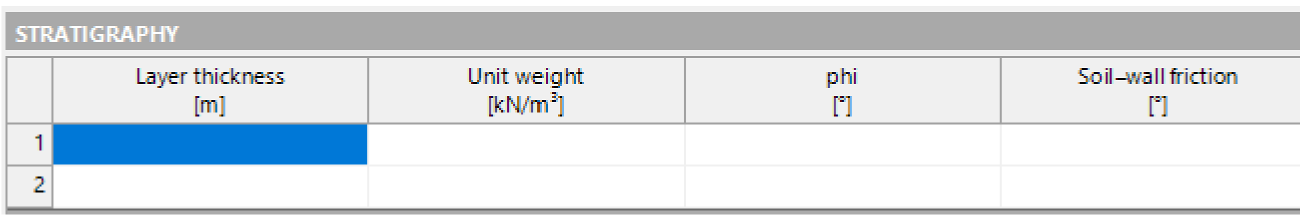
Analysis options for pseudostatic calculation

STRATIGRAPHY

Information about the soil layers is input in this section. Two layers are allowed in this version of DReW Seismic, with the interface between them at the depth of the excavation level. The thickness of the layers is automatically taken by DReW Seismic on the basis of the excavation height and embedment depth. The other parameters required for the two layers are:

- Soil unit weight, γ_1 and γ_2
- Angle of shearing resistance of the involved soils, φ_1 and φ_2
- Friction angle at the soil-wall interface, δ_1 and δ_2

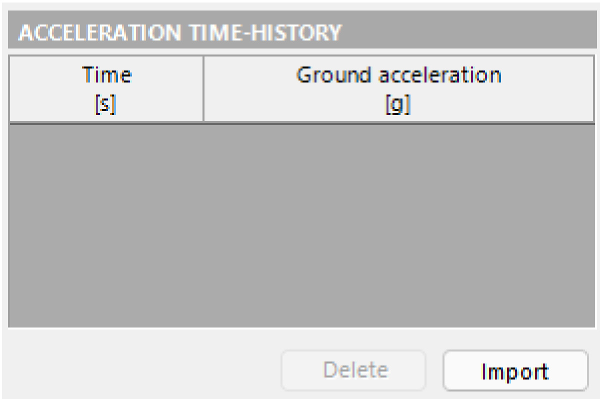
A color for the graphic representation and a description may be included as well.



Stratigraphy

ACCELERATION TIME-HISTORY

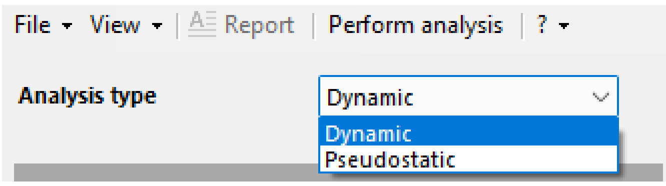
In order to perform a dynamic analysis, an acceleration time-history has to be applied to the soil to predict the earthquake-induced displacement of the wall. To this purpose, it is possible to refer to an acceleration time history that has been previously recorded at the site. A database of earthquakes to refer to is available on this website.



Acceleration time-history

2.1.1 Analysis type

Two different analysis types are possible in DReW Seismic: these are "Dynamic" and "Pseudostatic".



Analysis type

The dynamic analysis, which represents the main feature of DReW Seismic, is an innovative calculation that allows predicting the evolution of the horizontal displacement of the top of a cantilever embedded retaining wall due to an earthquake. As required by the design codes of many countries, this analysis represents a more rational approach than the simple calculation of the safety factor of these structures. Indeed, this approach is required by many national standards as well as Eurocodes, such as in particular, Eurocode 7 Part 1 (§2.4.8, §9.8.2) and Eurocode 8 Part 5 (§7.1(1)P, §7.1(2)).

The dynamic analysis employs the method developed by Conte, Pugliese and Troncone (2022). The calculation procedure is summarized here. The results provided by this type of analysis are:

- displacement time-history owing to a given earthquake. The displacement is calculated for the top of the wall
- comparison between the ground acceleration time-history and the corresponding critical threshold, which is also updated during the earthquake
- evolution with time of the angular acceleration of the wall
- evolution with time of the angular velocity of the wall
- evolution with time of the rotation of the wall
- evolution with time of the net pressure at the wall end and comparison of this latter with the corresponding limit value
- evolution with time of the depth "X", which defines the portion of the soil in which the passive resistance is completely mobilized
- evolution with time of the center of rotation of the wall "Y"
- evolution with time and depth of the net pressure acting on the wall

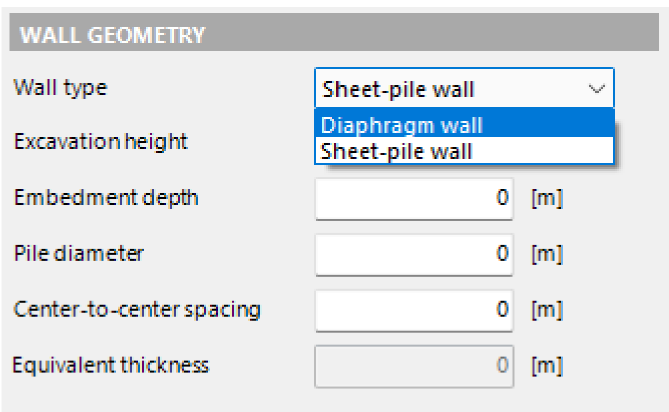
For the sake of completeness, a pseudostatic calculation can be also performed. In this case, the method developed by Conte, Troncone and Vena (2017) is employed, which is based on a distribution of the stresses acting on the wall that is more realistic than the ones assumed in classical methods. The results provided by the pseudostatic analysis are:

- net pressure acting on the wall
- shear force
- bending moment

The default option for analysis type is Dynamic.

2.1.2 Geometry

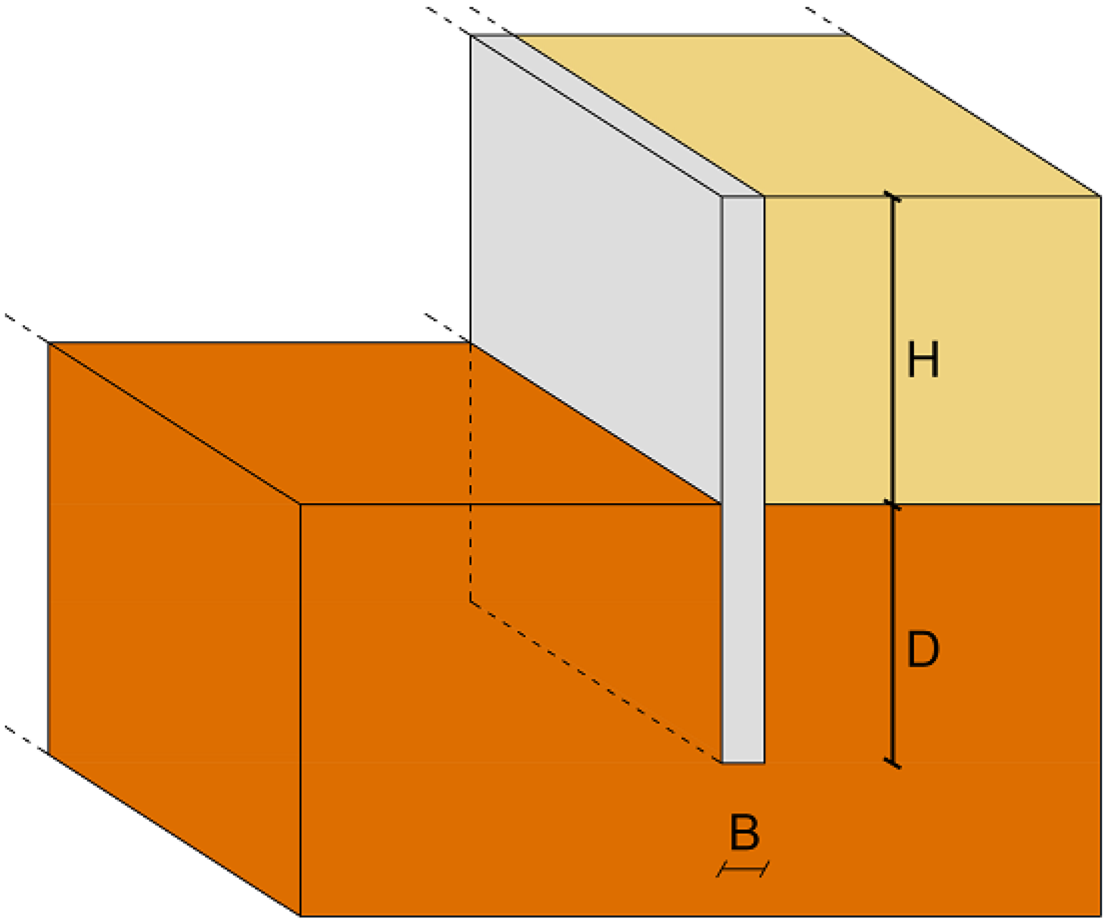
Two different wall types can be accounted for in DReW Seismic. These are diaphragm wall and sheet-pile wall.



Geometry

DIAPHRAGM WALL

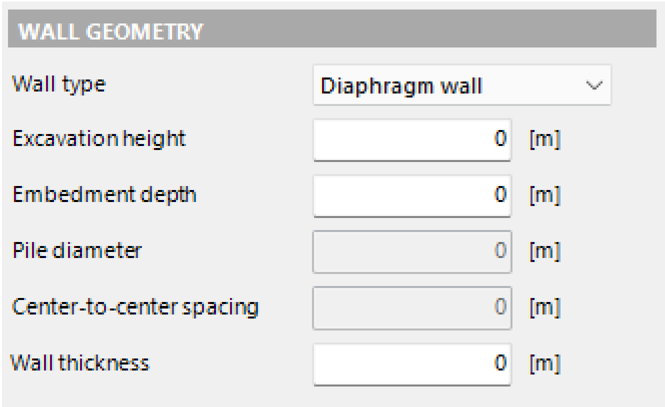
Diaphragm walls refer to the scheme reported in the figure shown in the following.



Sketch of a diaphragm wall

When the wall type is set on diaphragm wall, the following data is required as input:

- excavation height, H
- embedment depth, D
- wall thickness, B

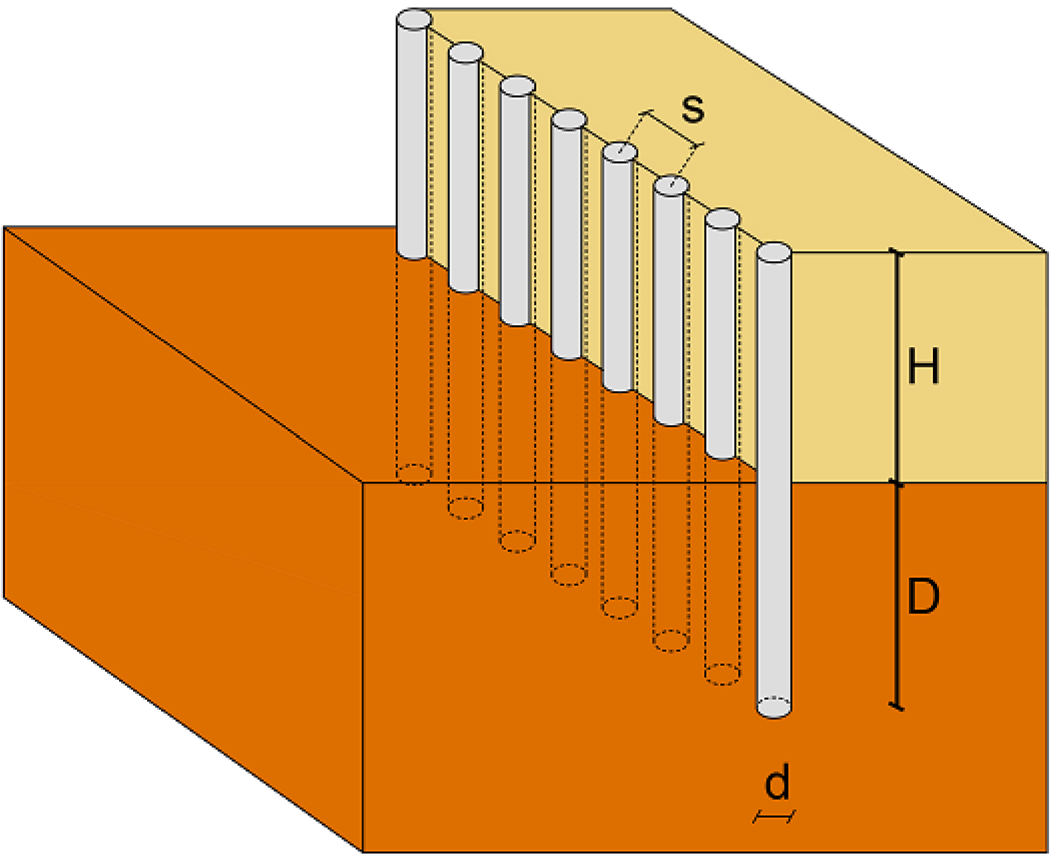


Input for diaphragm walls

The fields "pile diameter" and "center-to-center spacing" are ignored in this case, as they are used only when the wall type is set on sheet-pile wall.

SHEET-PILE WALL

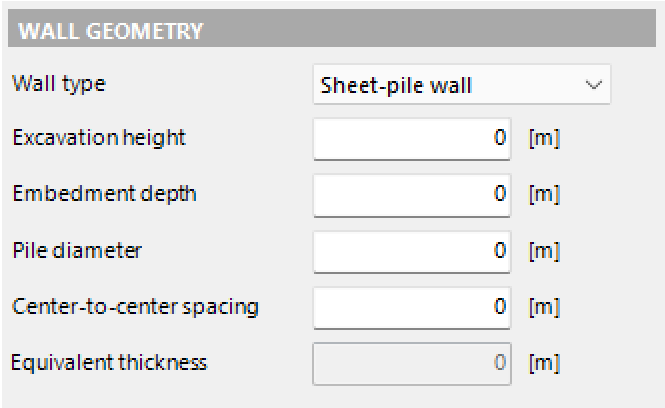
Sheet-pile walls refer to the scheme reported in the figure shown in the following.



Sketch of a sheet-pile wall

When the wall type is set on sheet-pile wall, the following data is required as input:

- excavation height, H
- embedment depth, D
- pile diameter, d
- center-to-center spacing, s



Input for sheet-pile walls

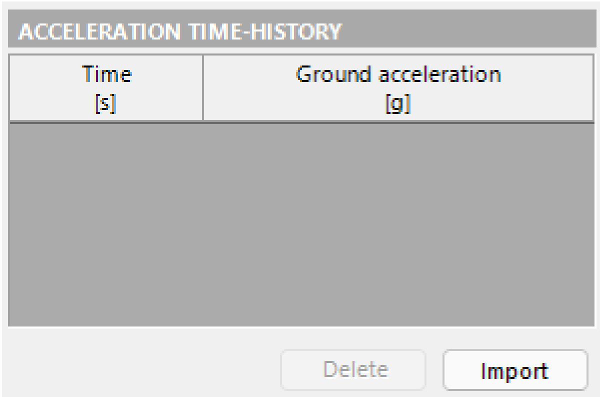
In this case, the sheet-pile wall is considered as an equivalent plate element. In this context, DReW Seismic calculates an equivalent thickness, d_{eq}, to be employed in the calculation, according to the following equation:

$$d_{eq} = \sqrt[3]{\frac{12\, I_p}{s}}$$

where I_p is the moment of inertia of the pile and s is the spacing. The value of the equivalent thickness calculated according to this equation is shown in the input space, but cannot be changed.

2.1.3 Acceleration time-history

In order to perform a dynamic analysis, an acceleration time-history has to be applied at the soil in order to predict the earthquake-induced displacement of the wall. To this purpose, it is possible to refer to an acceleration time-history that has been previously recorded at the site. A database of earthquakes to refer to is available on this website.

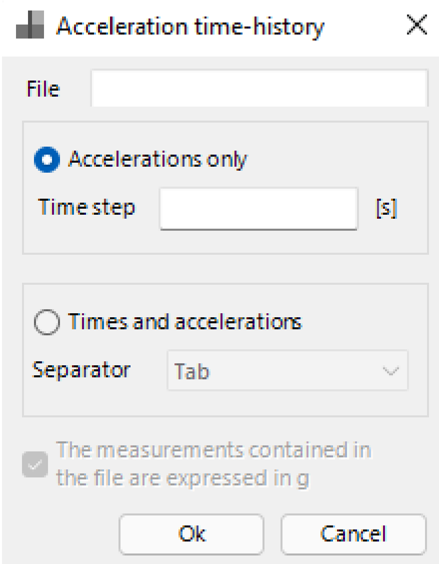


Acceleration time-history section

To be imported in DReW Seismic, the acceleration time-history should be saved in a .txt file. Two options are possible:

1. the .txt file is made up of one column, which reports the values of acceleration. In this case, any value of acceleration is time-spaced of a certain time-step that has to be specified by the user
2. the .txt file is made up of two columns, with the first column representing the time and the second one indicating the corresponding values of acceleration

After clicking on "Import", specify the path where the .txt file is saved and select it. Afterwards, the following window will appear:

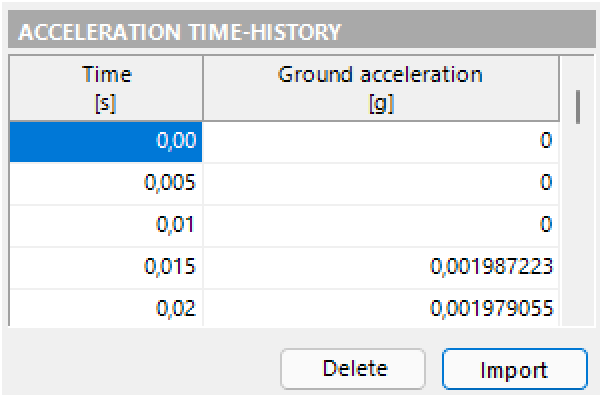


Acceleration time-history options

If the .txt file is made up of just one column, the first option has to be chosen, i.e. "Accelerations only". In this case, the time-step has to be indicated as well.

If the .txt file is made up of two columns, the option "Times and accelerations" has to be chosen. In this case, it is necessary to specify if the two columns in the .txt file are separated by a space, a tab or ";".

After clicking "OK", the table in DReW Seismic will be filled, as shown in the following figure.

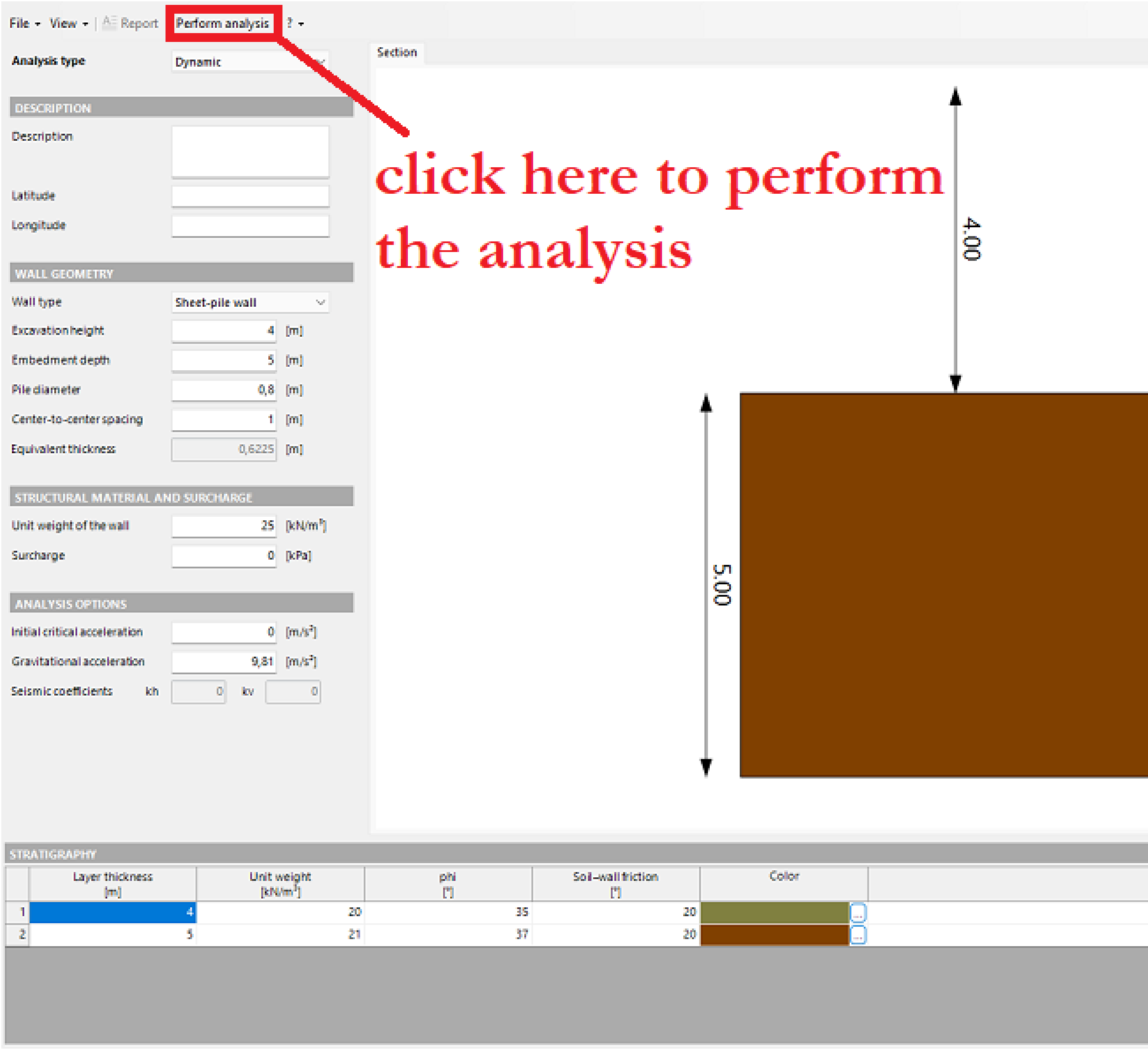


Time [s]	Ground acceleration [g]
0,00	0
0,005	0
0,01	0
0,015	0,001987223
0,02	0,001979055

Loaded acceleration time-history

2.2 Calculation

After all input data is filled in, the calculation can be started just by clicking on the "Perform analysis" button. DReW Seismic refers to the method developed by Conte, Pugliese and Troncone (2022). The main steps of the method are also summarized here.



Calculation

2.3 Output

After the calculation has finished, DReW Seismic provides different results, based also on the type of analysis performed. The dynamic analysis, which represents the main feature of DReW Seismic, is an innovative calculation that allows predicting the evolution of the horizontal displacement of the top of a cantilever embedded retaining wall due to an earthquake. As required by the design codes of many countries, this analysis represents a more rational approach than the simple calculation of the safety factor of these structures. Indeed, this approach is required by many national standards as well as Eurocodes, such as in particular, Eurocode 7 Part 1 (§2.4.8, §9.8.2) and Eurocode 8 Part 5 (§7.1(1)P, §7.1(2)).

The dynamic analysis employs the method developed by Conte, Pugliese and Troncone (2022). The results provided by this type of analysis are:

- displacement time-history owing to a given earthquake. The displacement is calculated for the top of the wall
- comparison between the ground acceleration time-history and the corresponding critical threshold, which is also updated during the earthquake
- evolution with time of the angular acceleration of the wall
- evolution with time of the angular velocity of the wall
- evolution with time of the rotation of the wall
- evolution with time of the net pressure at the wall end and comparison of this latter with the corresponding limit value
- evolution with time of the depth "X", which define the portion of the soil in which the passive resistance is completely mobilized
- evolution with time of the center of rotation of the wall "Y"
- evolution with time and depth of the net pressure acting on the wall

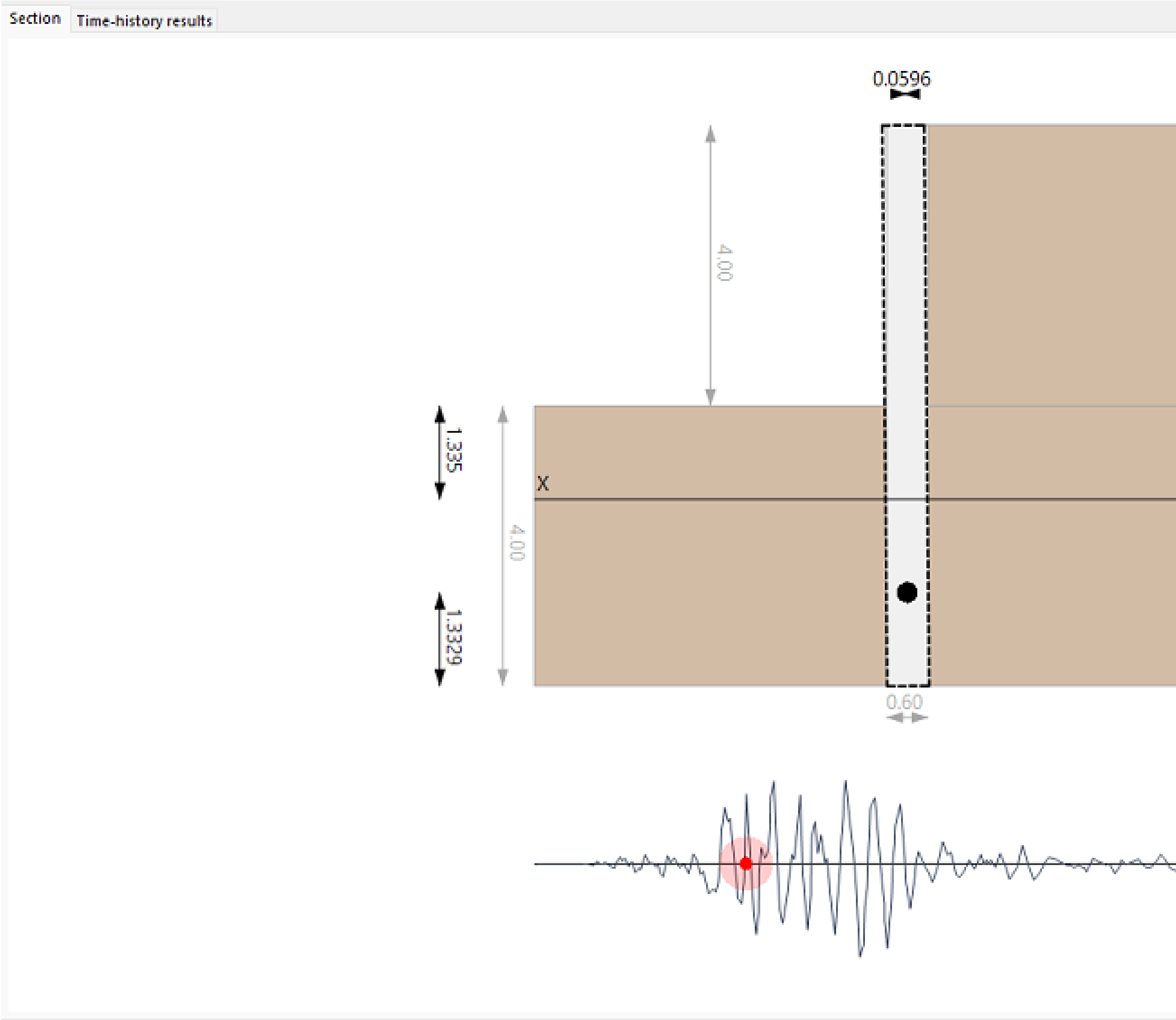
For the sake of completeness, it is possible to perform a pseudostatic analysis as well. In this case, the method developed by Conte, Troncone and Vena (2017) is employed, which is based on a distribution of the stresses acting on the wall that is more realistic than the ones assumed in classical methods.
The results provided by the pseudostatic analysis are:

- net pressure acting on the wall
- shear force
- bending moment

2.3.1 Dynamic analysis

The dynamic analysis employs the method developed by Conte, Pugliese and Troncone (2022).

As soon as the calculation ends, the following sketch results are first shown in "Section".



Graphic results shown in "Section"

As the analysis is dynamic, the obtained results are interactive. Specifically, it is possible to view what happens at any time of the simulation just by hovering over the desired time in the acceleration time-history shown at the bottom of the screen. For any considered time, this output shows:

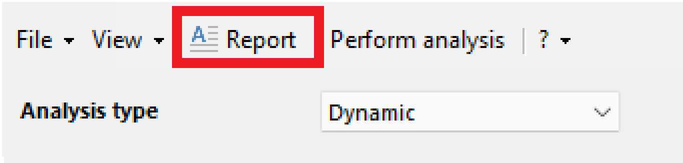
- the horizontal displacement at the top of the wall
- the distance of the center of rotation from the wall base
- the depth "X" measured from the excavation level. This value indicates the portion of the soil where the passive resistance is fully mobilized
- net pressures acting on the wall

Switching on "Time-history results", the evolution with time of the calculated results is shown. Specifically, the following outcomes are provided by DReW Seismic:

- displacement of the top of the wall

- comparison between the acceleration time-history (given as input) and the calculated corresponding critical value of acceleration
- angular acceleration of the wall
- angular velocity of the wall
- rotation of the wall
- net pressure at the wall base and comparison with the corresponding limit value
- depth X, along which the passive resistance is fully mobilized
- distance of the center of rotation from the wall base

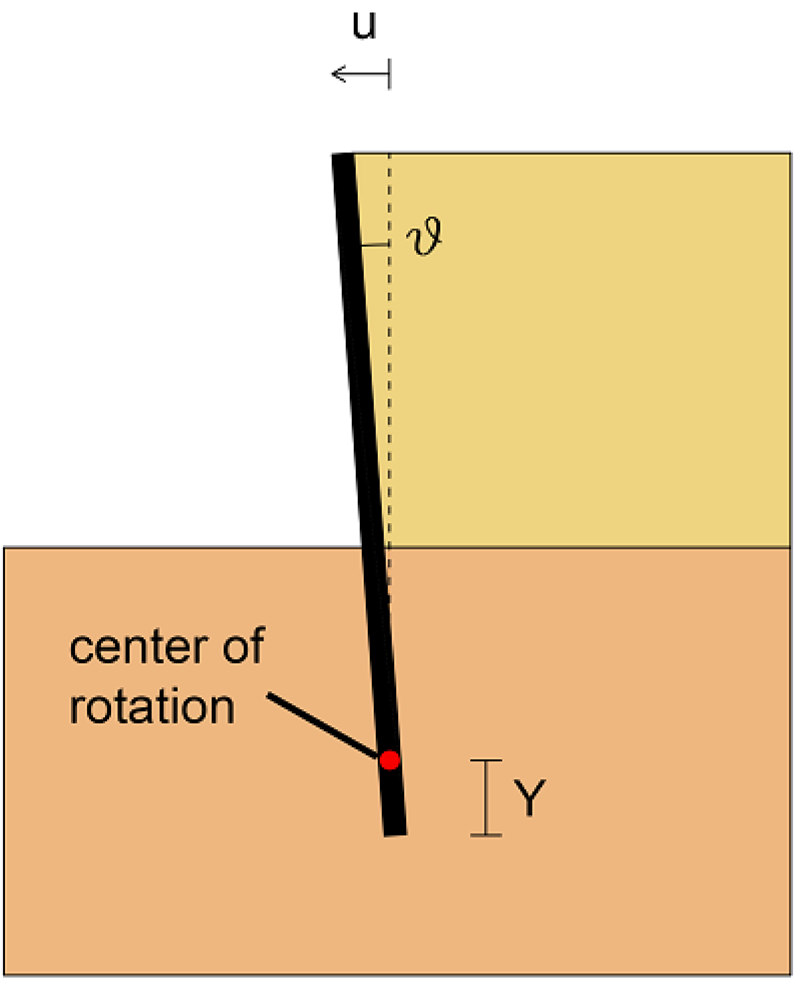
In addition, all the obtained results can be exported in a Excel file, by using the button "Report".



How to create a report file

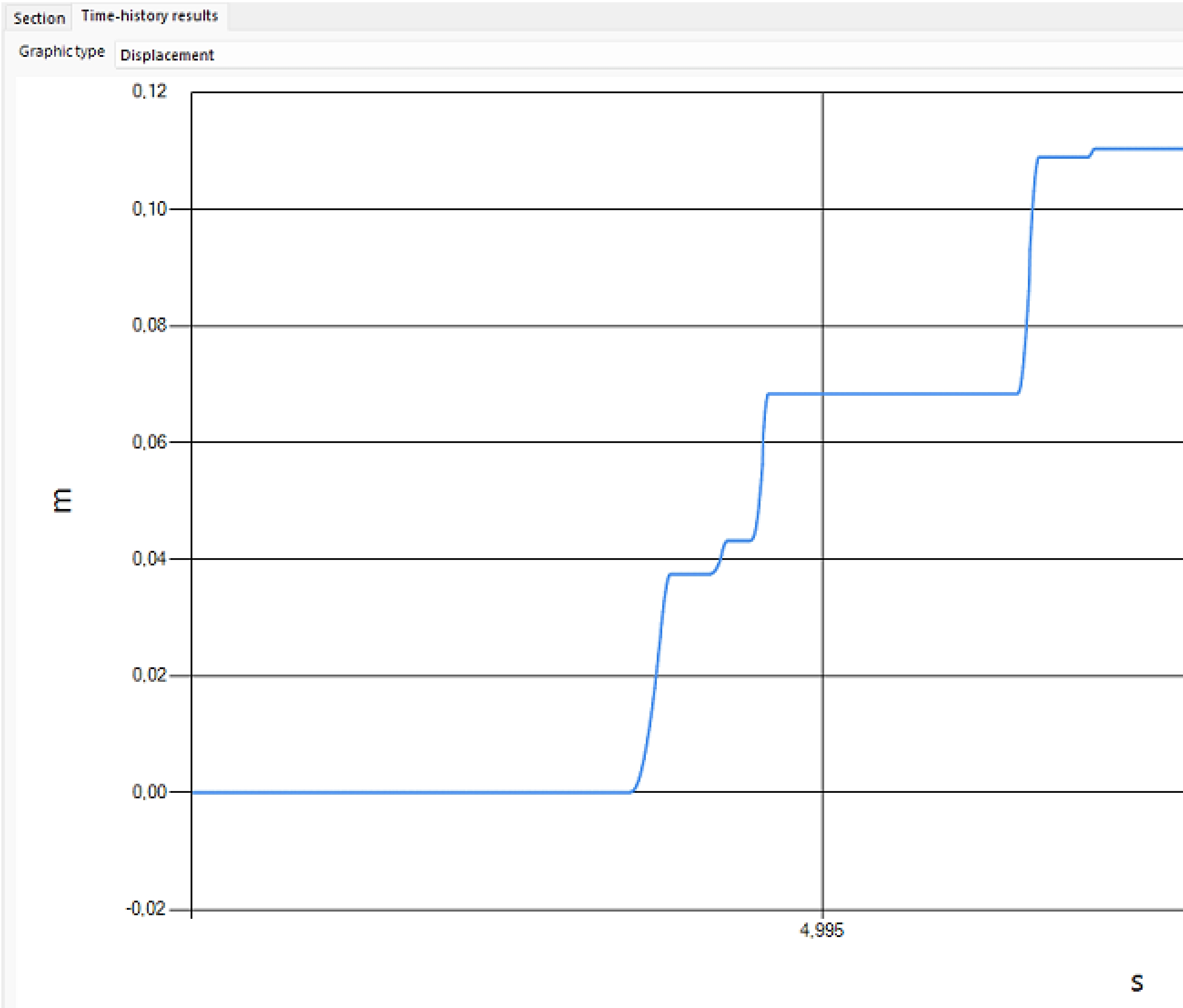
2.3.1.1 Displacement

This output plots the evolution with time, during the earthquake, of the displacement of the top of the wall (see the figure below), and represents the main feature of DReW Seismic. In the figure below, *u* represents the displacement of the wall top towards the excavation, θ is the wall rotation and *Y* is the distance between the center of rotation and the wall base.



Movement undergone by the wall during the earthquake

The output will look like the following figure.



Evolution with time of the displacement of the top of the wall

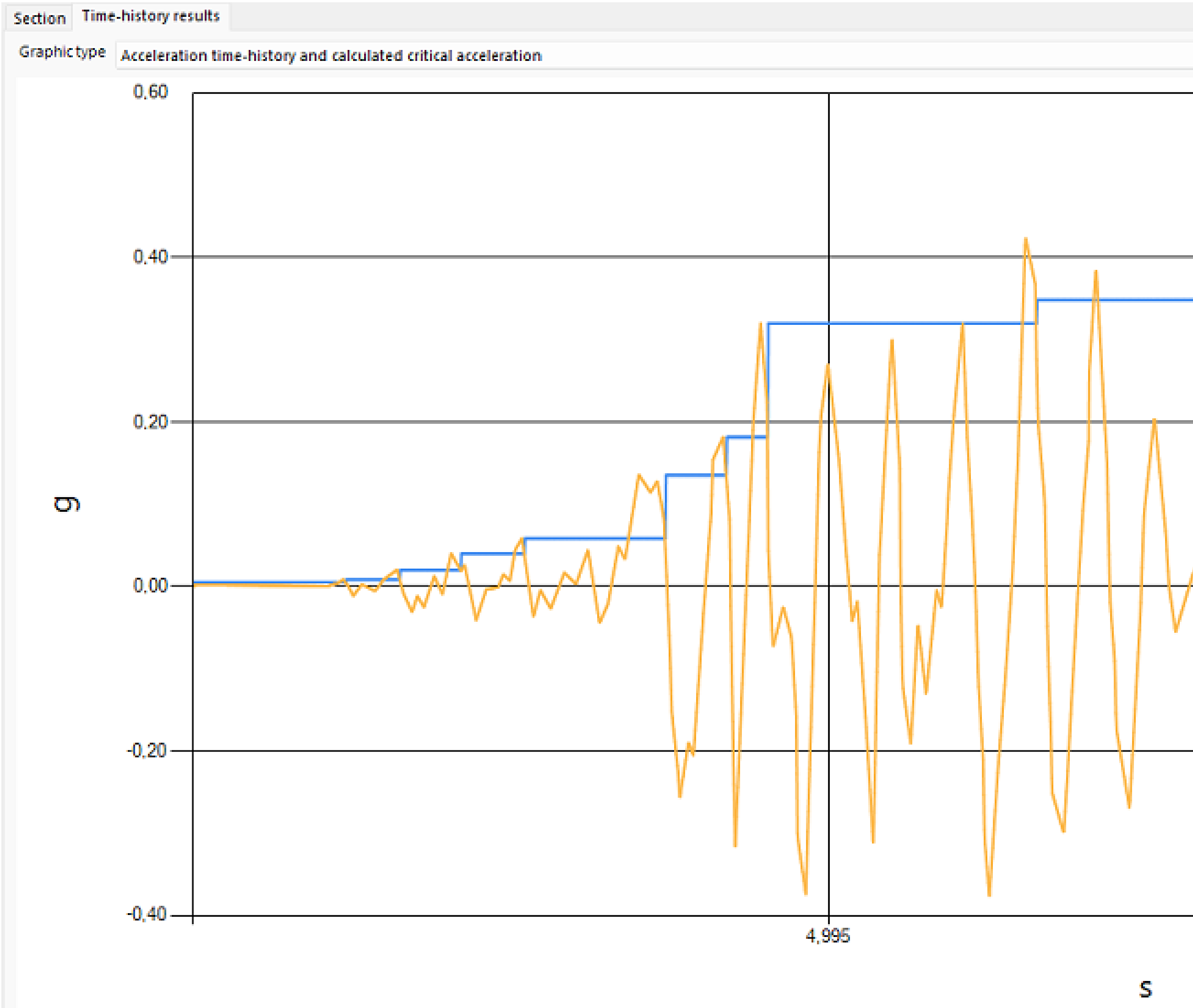
In addition, in DReW Seismic it is possible to compare the calculated displacement time-history with that eventually recorded in field (for example in case of a back analysis). To this purpose, right click on the graph and click on "Compare with real values" so that a new window will appear. Now, select the folder where the real measurements are saved and upload the file containing the real measurements. These latter must be provided through a .txt file. After the file is selected, the comparison will look like the following figure.

Comparison between calculated and measured displacement

2.3.1.2 Acceleration time-history and critical value

DReW Seismic employs the method developed by Conte, Pugliese and Troncone (2022), which calculates the wall rotation (and, consequently, the corresponding displacement) in the time intervals when the ground acceleration exceeds a critical threshold. This latter is assumed to be variable during the seismic event, as explained here.

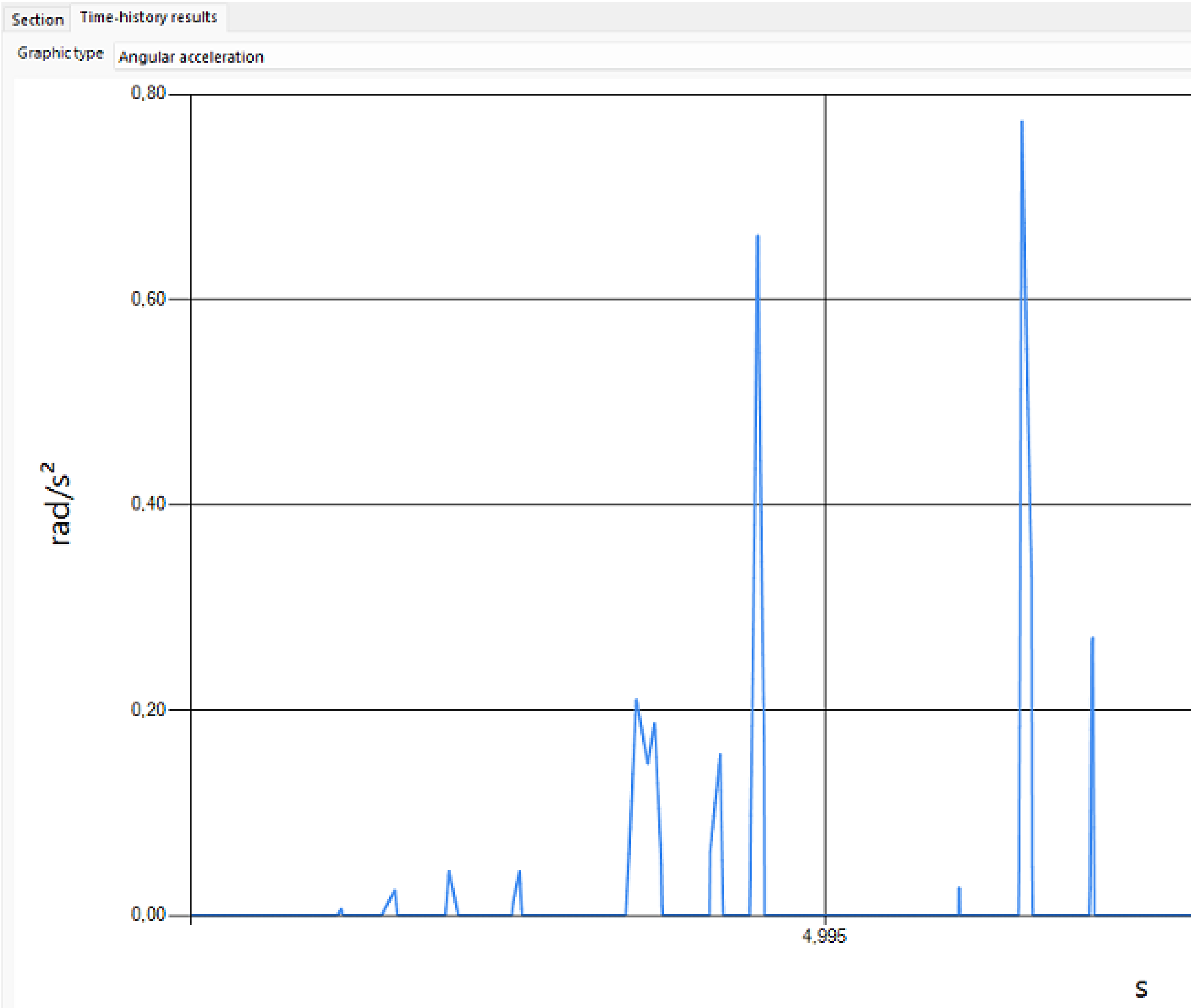
After the calculation has finished, DReW Seismic shows the comparison between the input ground acceleration and the calculated critical threshold, which will look like the following figure.



Comparison between the input ground acceleration and the calculated critical threshold

2.3.1.3 Angular acceleration

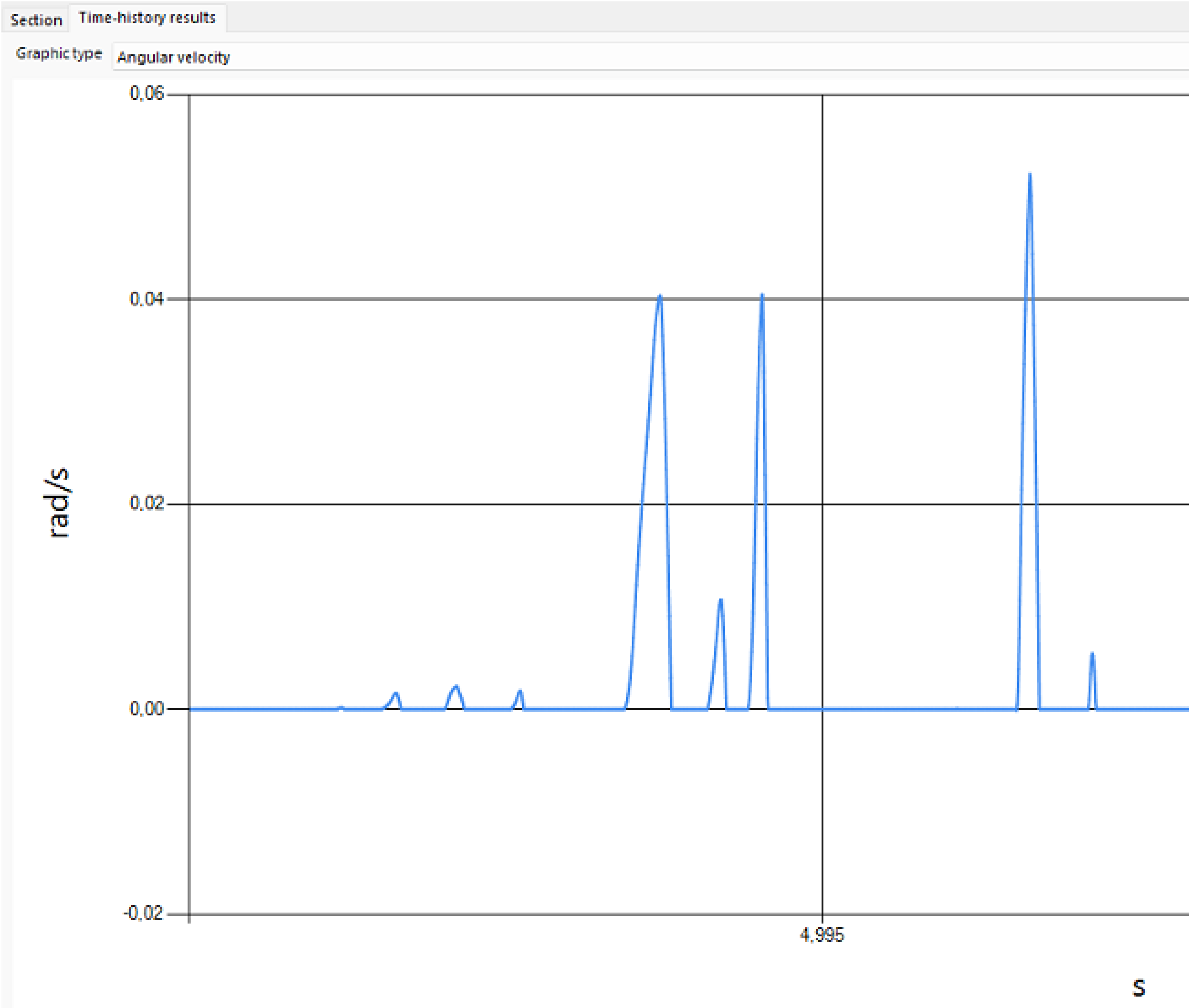
The angular acceleration is calculated in the time intervals in which the ground acceleration exceeds the critical threshold, by solving the equation of motion. A typical output of angular acceleration is shown in the figure below.



Evolution with time of the angular acceleration of the wall

2.3.1.4 Angular velocity

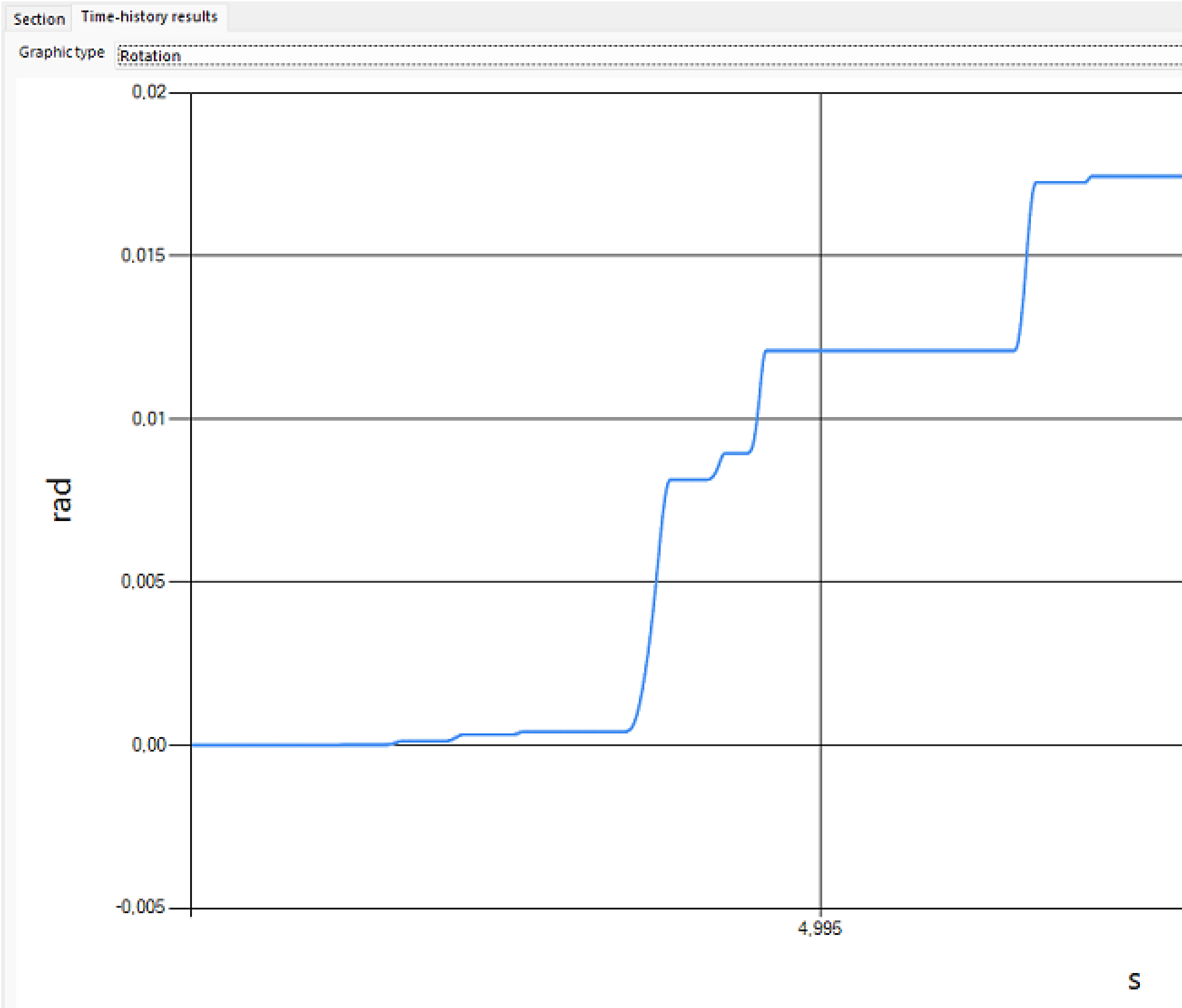
After solving the equation of motion, the angular velocity of the wall is calculated by integrating the angular acceleration. A typical output of angular velocity is shown in the figure below.



Evolution with time of the angular velocity of the wall

2.3.1.5 Wall rotation

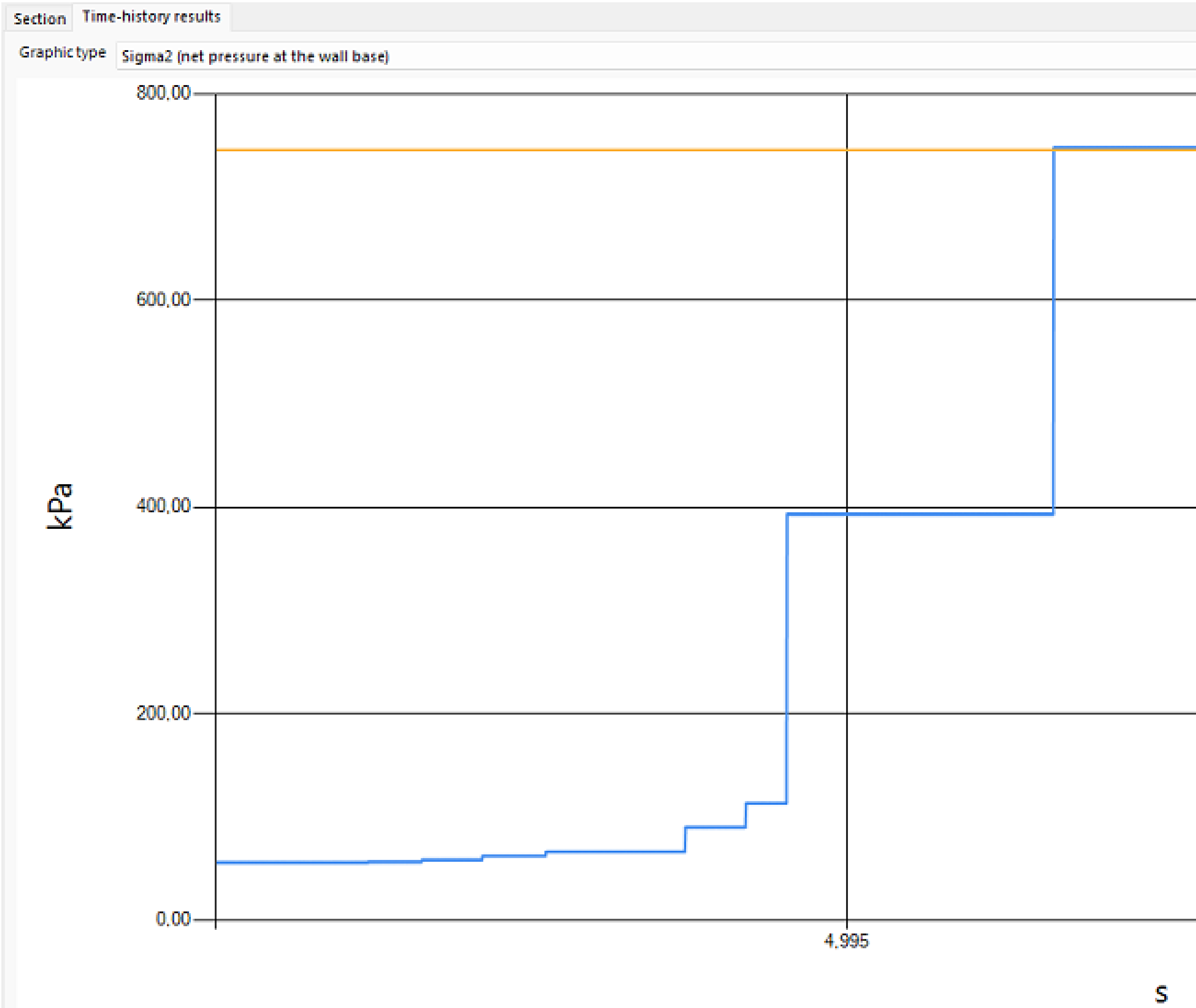
After solving the equation of motion, the wall rotation is calculated by double integration of the angular acceleration. A typical output of angular velocity is shown in the figure below.



Evolution with time of the rotation of the wall

2.3.1.6 Net pressure at the wall base

The net pressure exerted by the soil on the wall varies during the earthquake. However, the net pressure has a upper limit that cannot be exceeded, which corresponds to the condition of limit equilibrium. To check if this condition is always satisfied during the calculation, DReW Seismic plots the evolution with time of the net stress calculated at the base of the wall and compares it to the value corresponding to the limit equilibrium condition. The method developed by Conte, Troncone and Vena (2017) is used to this purpose. An example is shown in the following.



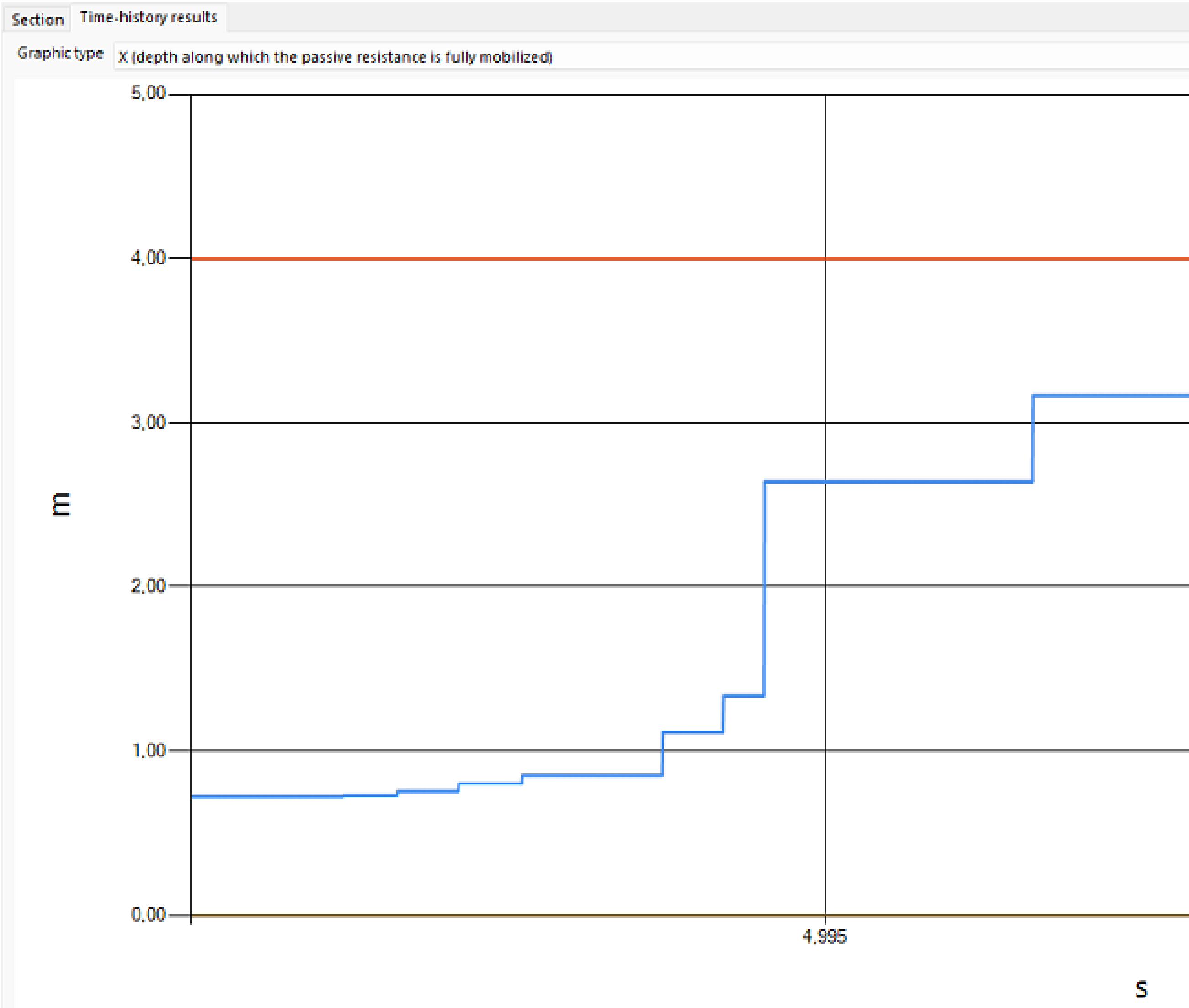
Comparison between the net pressure calculated at base of the wall and the maximum threshold corresponding to the limit equilibrium condition

After the calculation, the user should verify that the net pressure calculated at the wall base never exceeds the limit value.

2.3.1.7 Depth X

Following the study by Conte, Troncone and Vena (2017), the passive resistance is fully mobilized only down to a depth X form the excavation level (see here), with X that is less or equal to the embedment depth, D. As the net pressure changes during the earthquake, the portion of the soil where the passive resistance is fully mobilized progressively increases. Consequently the depth X increases as well.

An example of the evolution of the depth X during the earthquake provided by DReW Seismic is shown in the figure below.

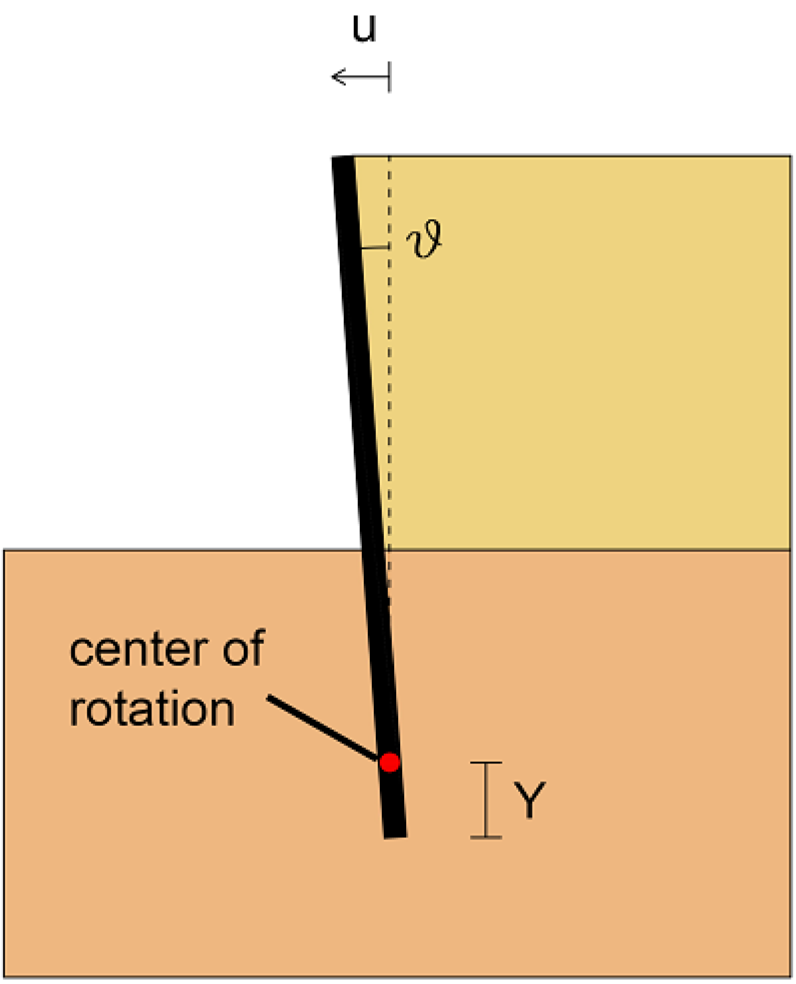


Evolution of the depth X during the considered earthquake

The user must be careful that the depth X provided by DReW Seismic is never greater than the embedment depth. In addition, it is necessary to check that X takes positive values.

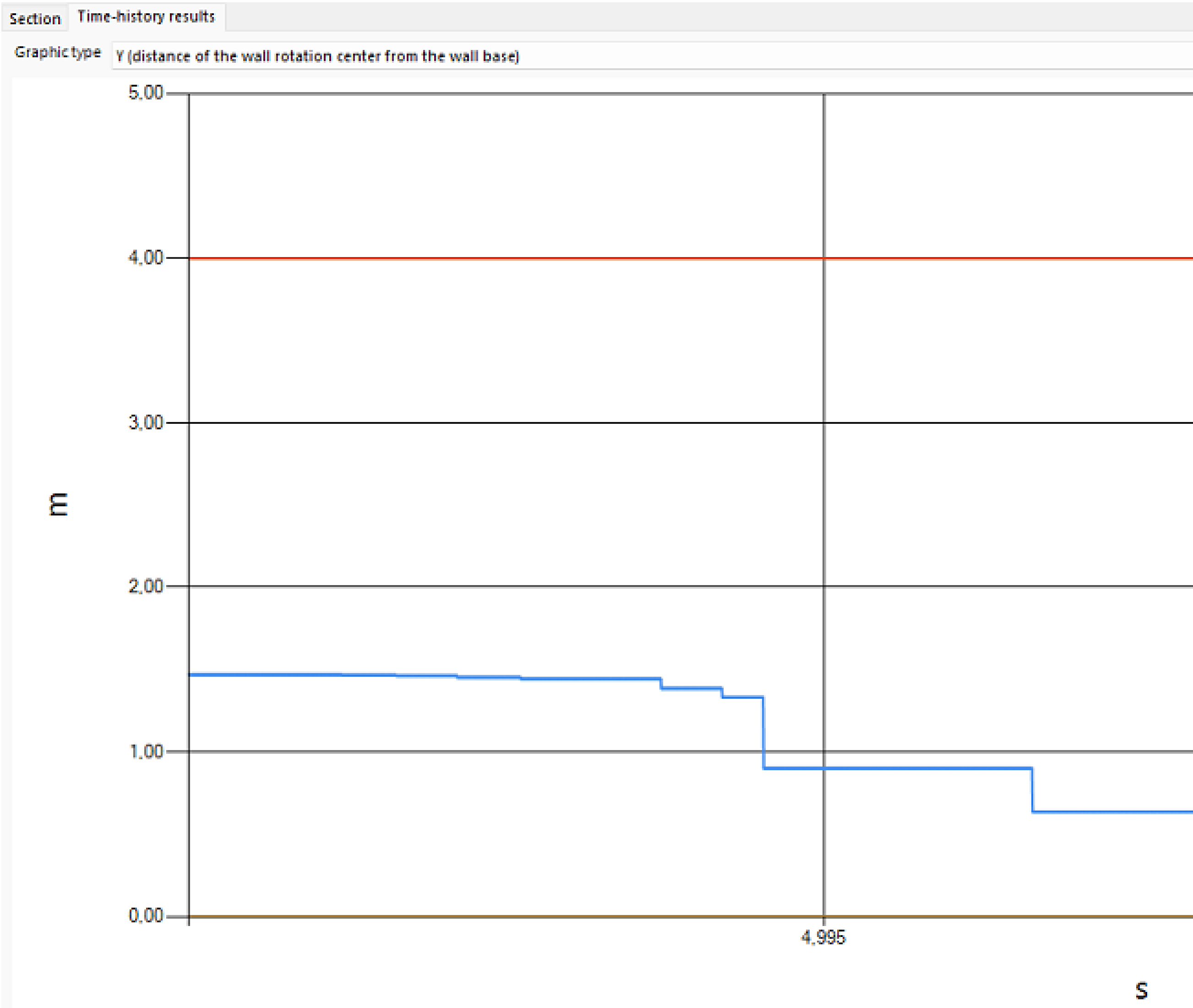
2.3.1.8 Position of the center of rotation

DReW Seismic is based on the method developed by Conte, Pugliese and Troncone (2022), in which it is assumed that the wall undergoes a rigid rotation (θ) around a point located close to the wall base. The distance between the center of rotation and the wall base is indicated as *Y* (see the figure below).



Movement undergone by the wall during the earthquake

The position of the center or rotation will vary during the earthquake. In this context, DReW Seismic provides the evolution of Y with time due to the seismic oscillation. An example is shown below.



Evolution of the position of the center of rotation, Y, during the considered earthquake

The user must be careful that the values of Y provided by DReW Seismic are always positive, but less than the depth of embedment.

3 Calculation method

The calculation method employed by DReW Seismic was developed by [Conte, Pugliese and Troncone (2022)](). The main features of the method are summarized in this section.

The main steps are the calculation of:

- [the distribution of the net pressures acting on the wall]()

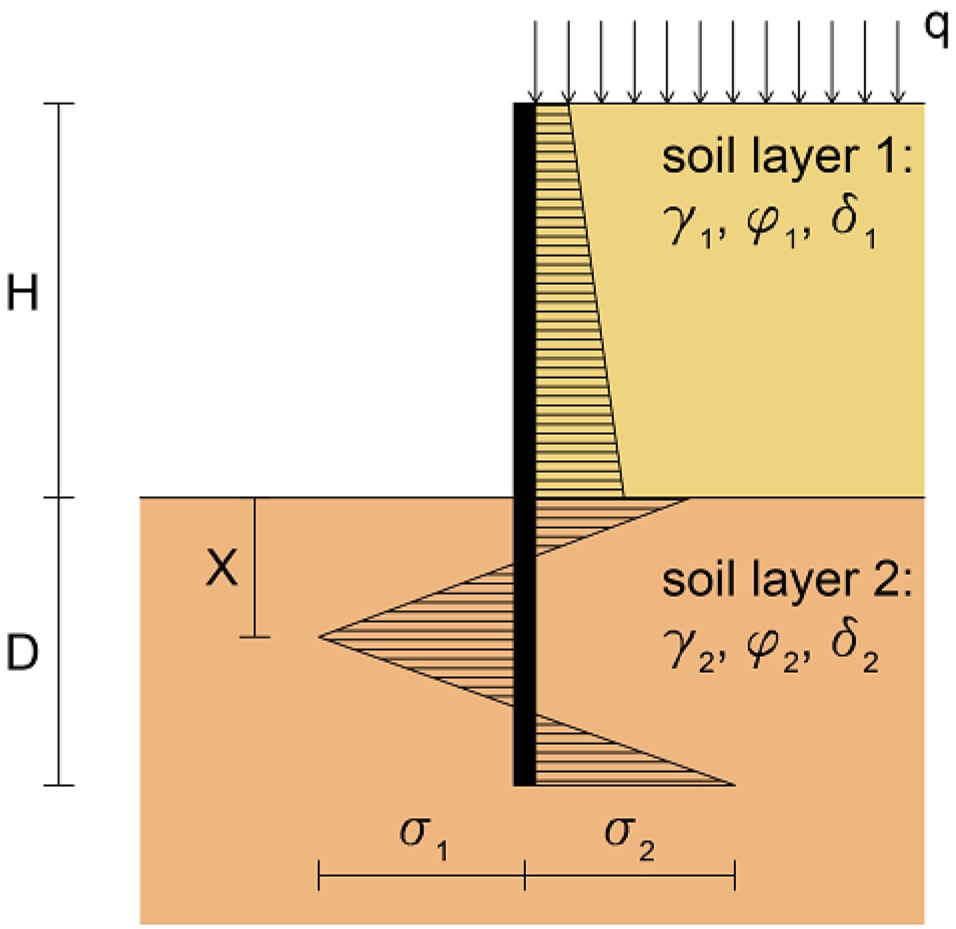
➢ the critical acceleration

➢ the horizontal displacement of the top of the wall

As the method is dynamic, all the above quantities vary with time due to the considered earthquake.

3.1 Calculation of the net pressure

The first step for the calculation of the earthquake-induced displacement of an embedded cantilever retaining wall is the definition of the net pressure distribution exerted by the soil on the wall. It is worth to point out that the term *net pressure* is employed to indicate the difference between the passive and active soil stresses on the wall. To this purpose, DReW Seismic refers to the solution provided by Conte, Troncone and Vena (2017). An example of this distribution is shown in the following figure.



Net pressure distribution acting on the wall

This distribution depends on the seismic horizontal coefficient, k_h, which varies during the earthquake. At the generic time t, the seismic horizontal coefficient is related to the ground acceleration $a(t)$ through the following equation $k_h(t)=a(t)/g$, where g is the gravity acceleration.

As the type of movement usually experienced by these structures consists of an approximately rigid rotation around a point located close to the wall base, an active limit state occurs behind the wall, above the excavation level. Below this level, the active pressure and passive resistance are fully mobilized down to a depth X, whereas the passive resistance is not fully mobilized at higher depths. As an approximation, it is assumed that the net pressures varies linearly from σ_1 to σ_2, as shown from the above figure. More details can be found in the paper by Conte, Troncone and Vena (2017).

The active thrust and passive resistance acting above the depth X depend on the active and passive earth pressure coefficients in seismic conditions, K_{aE} and K_{pE}, respectively. These coefficients are calculated in DReW Seismic using the solution developed by Lancellotta (2007). The depth X and the net pressure at the wall base σ_2 are calculated from the equilibrium. Their solution can be found in the paper by Conte, Troncone and Vena (2017).

3.2 Calculation of the critical acceleration

When a dynamic acceleration time-history is considered, the wall movement occurs in the time intervals when the ground acceleration exceeds a critical threshold, which varies during the seismic excitation (Conte, Pugliese and Troncone, 2022). In particular, the critical thresholds increases during the earthquake according to the following simple rules:

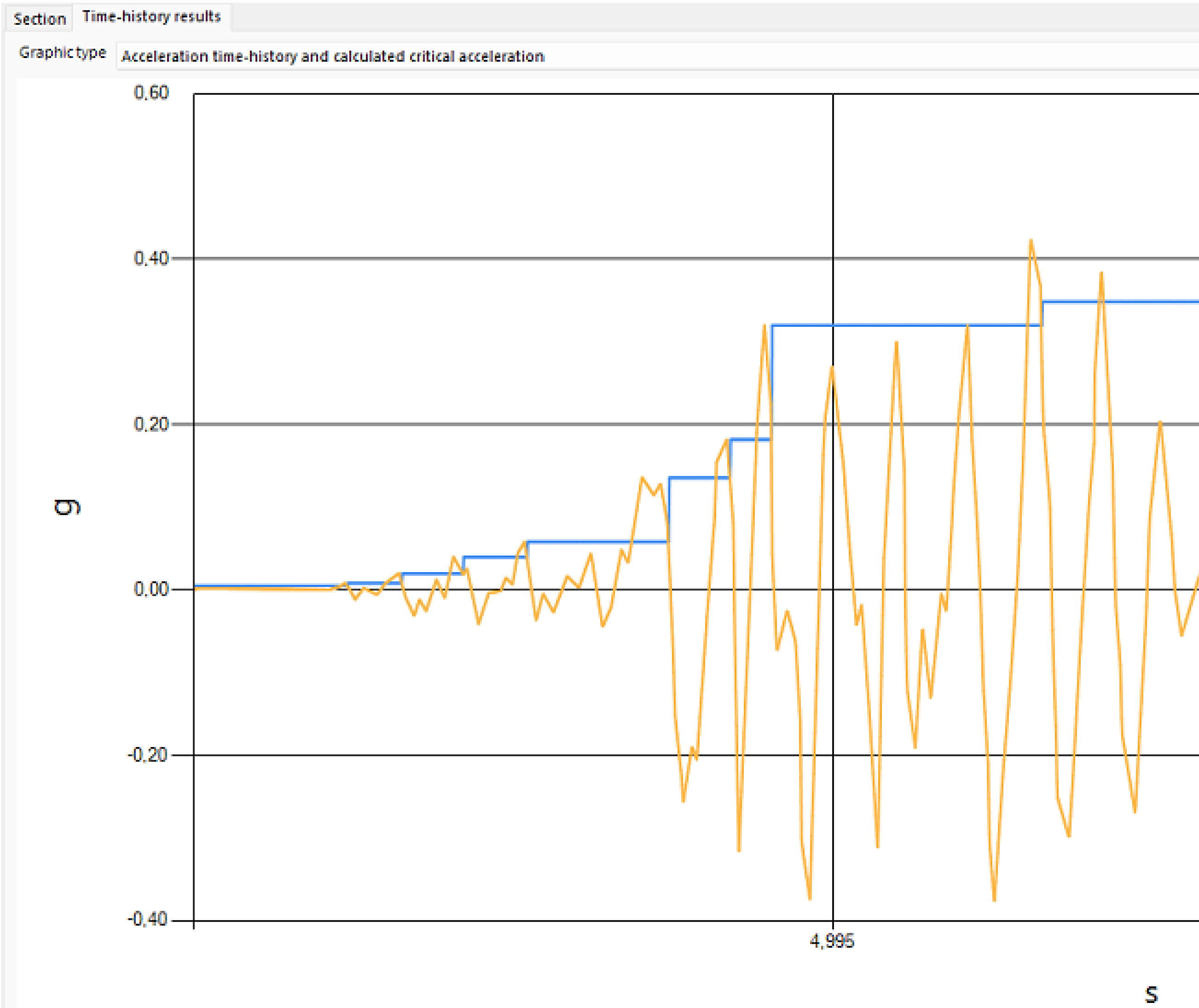
1. at the beginning of the earthquake, the critical acceleration assumes an initial value, which has to be given as input by the user. This parameter has to be set to 0 for a retaining wall of new construction. On the contrary, it has to be taken equal to the maximum acceleration that acted on the retaining wall during the previous earthquakes hitting the structure. However, lacking more accurate information, the assumption of the value 0 also for existing structures leads to precautionary results. Indeed, the greater the initial critical acceleration, the smaller the earthquake-induced permanent displacement.

2. when the ground acceleration exceeds the actual threshold, this latter is initially kept constant

3. when the ground acceleration returns below the critical threshold, this latter is updated and taken equal to the maximum value of ground acceleration that has just occurred

4. the critical threshold cannot never exceed an upper bound, corresponding to the limit equilibrium condition. This latter is calculated as explained by Conte, Troncone and Vena (2017).

The example shown in the following figure aims at better explaining the above described procedure.



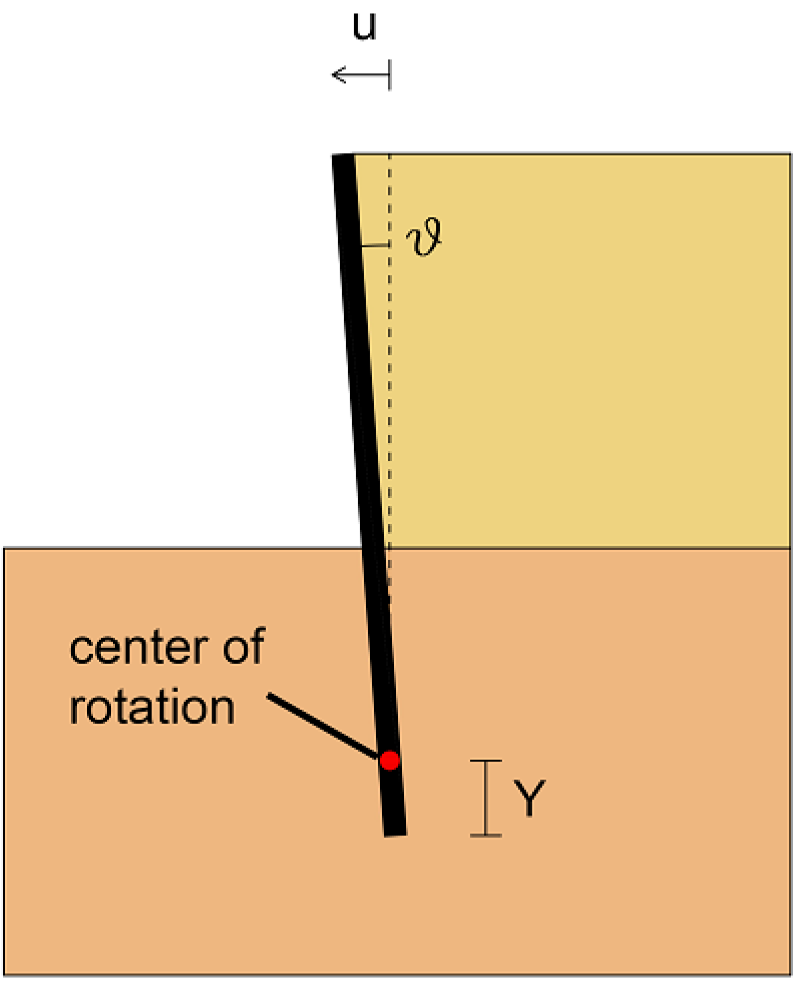
Comparison between the input ground acceleration and the calculated critical threshold

3.3 Calculation of the wall displacement

To calculate the wall displacement due to the earthquake, DReW Seismic compares the ground acceleration time-history with the critical threshold at any time of the simulation.

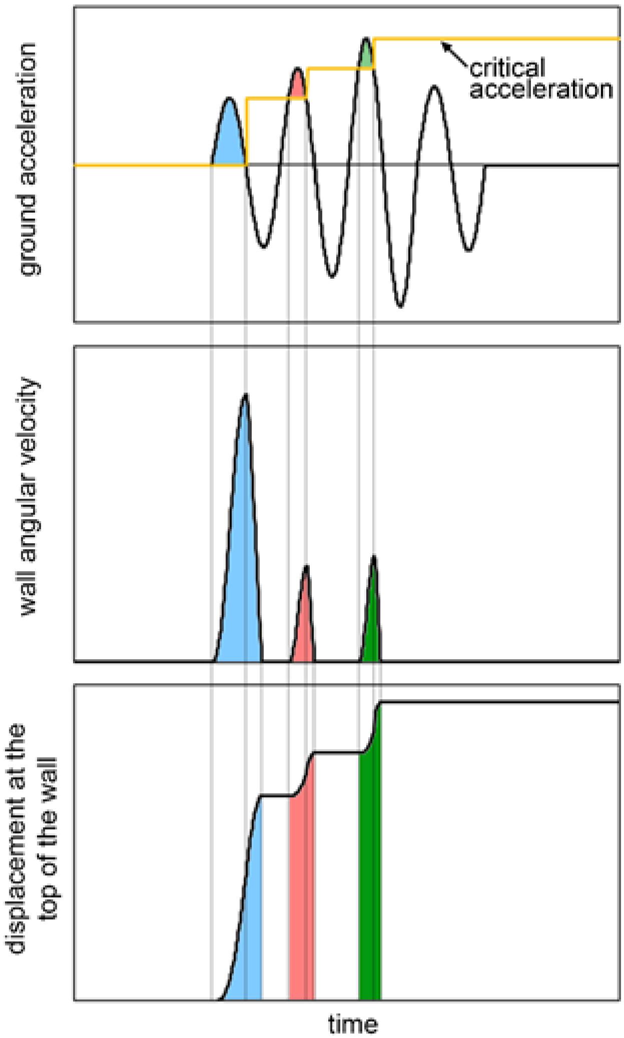
When the ground acceleration exceeds the critical threshold, the motion equation is solved to calculate the angular acceleration of the wall. Once this latter is known, angular velocity and rotation (θ) of the wall are calculated by successive integration. All the equations employed can be found in the paper by Conte, Pugliese and Troncone (2022).

Finally, the displacement of the top of the wall (u) is calculated under the reasonable assumption that the wall rotates rigidly around a point located at a distance Y from its base, as shown from the following figure.



Movement undergone by the wall during the earthquake

A schematic representation of the integration procedure is shown in the following figure.



Schematic representation of the integration procedure of the differential equation of motion

4 Validation

DReW Seismic allows the prediction of the earthquake-induced permanent displacement of cantilever retaining walls. To this purpose, the method developed by Conte, Pugliese and Troncone (2022) is employed. This method has been validated by means of comparisons with the results of both experimental tests and advanced numerical simulations. A good agreement is found for any considered case, as documented here.

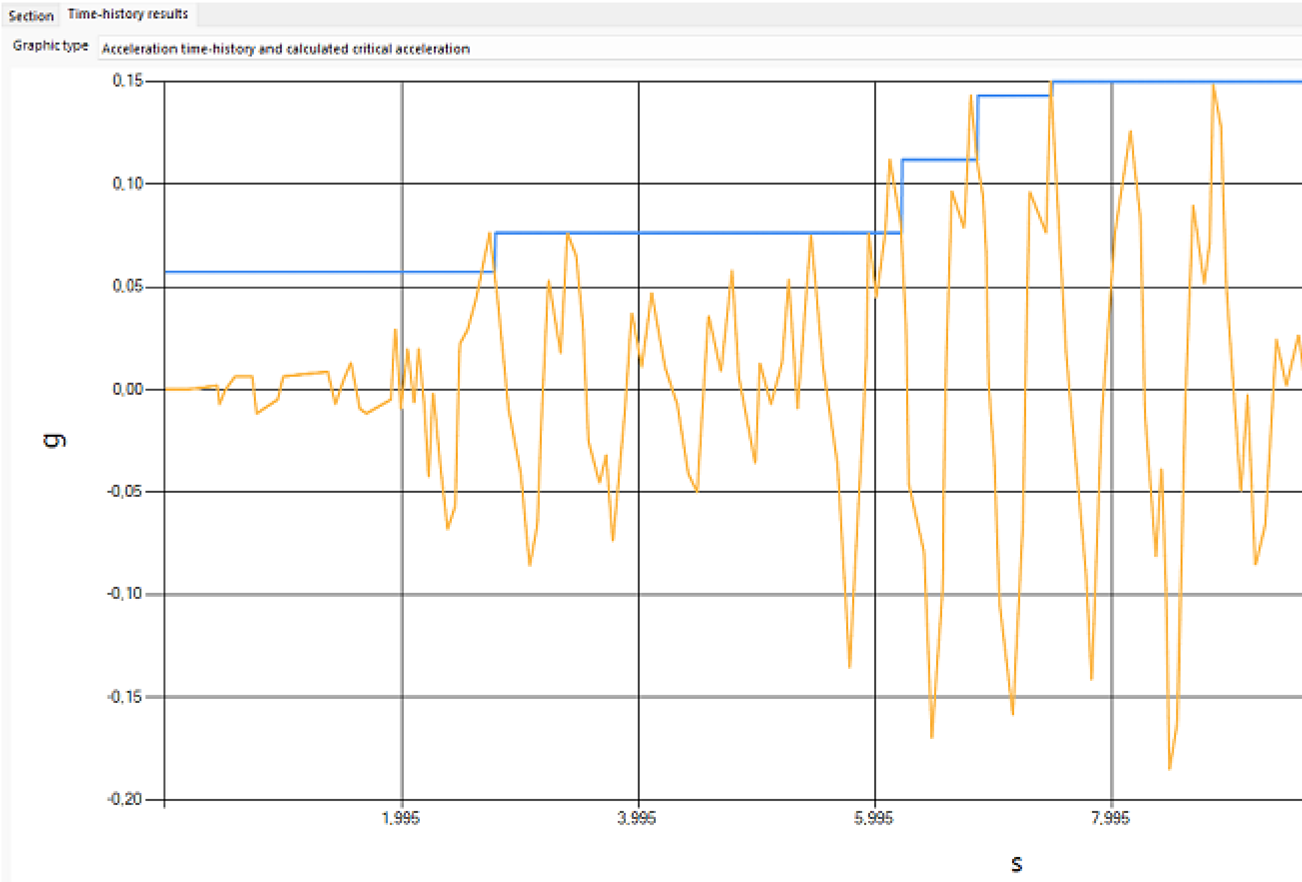
However, a worked out example is shown in this section, for the sake of completeness. Specifically, DReW Seismic is employed in the following to analyze the experimental case study documented by Madabhushi & Zeng (2006). This case concerns an embedded cantilever retaining wall characterized by an excavation height H = 7.20 m and an embedment depth

D = 7.20 m. The wall consists of an aluminum diaphragm with a thickness B = 0.264 m and a unit weight γ_{wall} = 27 kN/m^3. The wall is built in a homogeneous soil consisting of a dry sand with the following parameters: unit weight γ = 16.4 kN/m^3, angle of shearing resistance φ = 34° and a friction angle at the wall-soil interface δ = 12°.

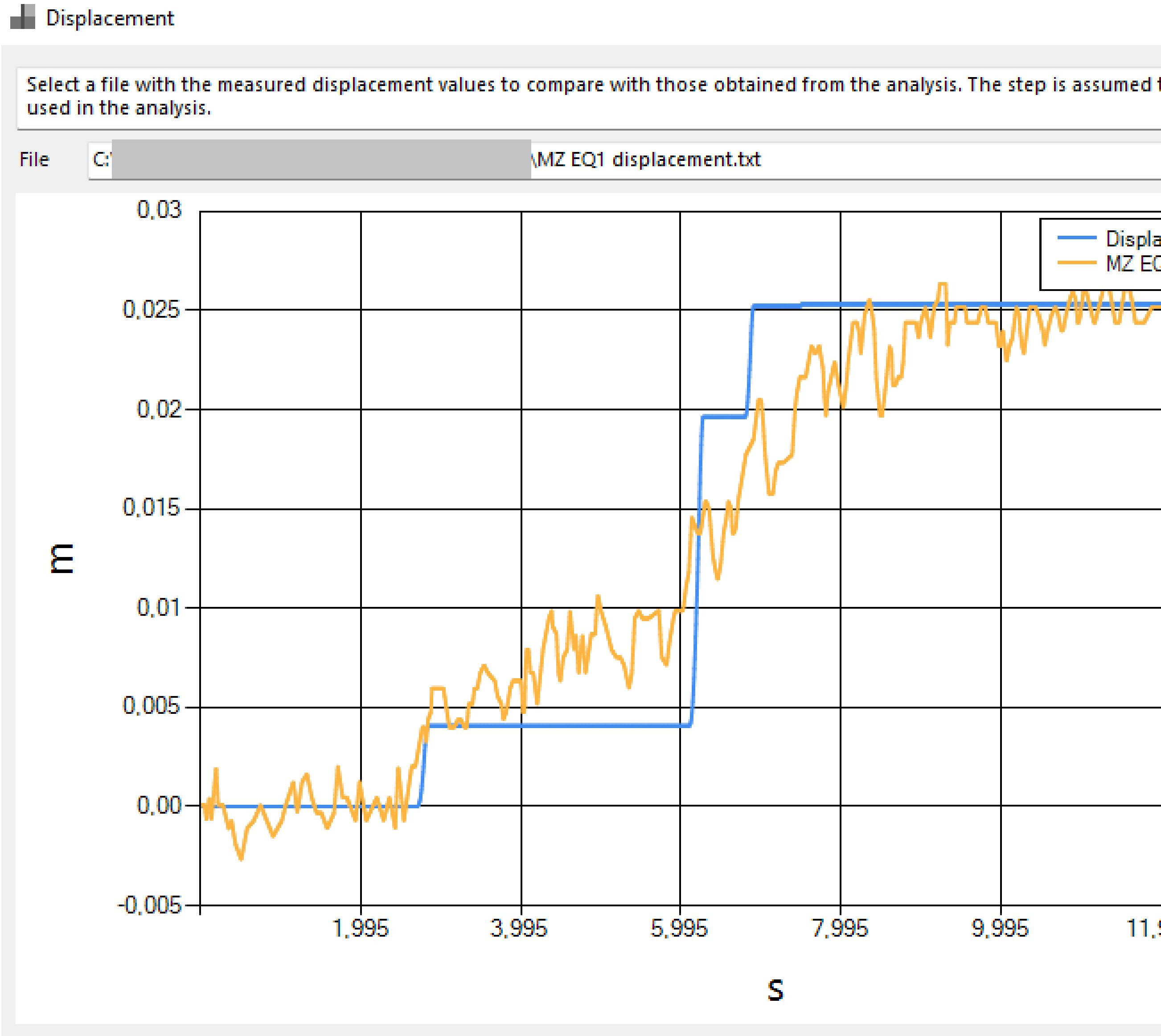
The wall was subjected to two consecutive earthquakes, named EQ1 and EQ2, respectively. The files .txt containing the acceleration time-history of these events, as well as those corresponding to the recorded displacements, can be downloaded from the following link. These files contain only one column with the values of acceleration or displacement. The corresponding time step is 0.005 s.

The above-indicated parameters are input following the procedure explained in this section. Afterwards, the calculation is performed. Specifically, two analyses are performed, each for any considered earthquake.

In the first analysis the earthquake EQ1 is considered. As the wall had been previously subjected to further vibrations, the initial critical acceleration is first calibrated by matching the calculated displacement time-history with the recorded one by a trial and error procedure. The resulting value of critical acceleration is 0.56 m/s^2. The comparison between the acceleration time-history and the calculated critical acceleration and the comparison between the displacement time-history provided by DReW Seismic and the measured one are provided in the following figures.

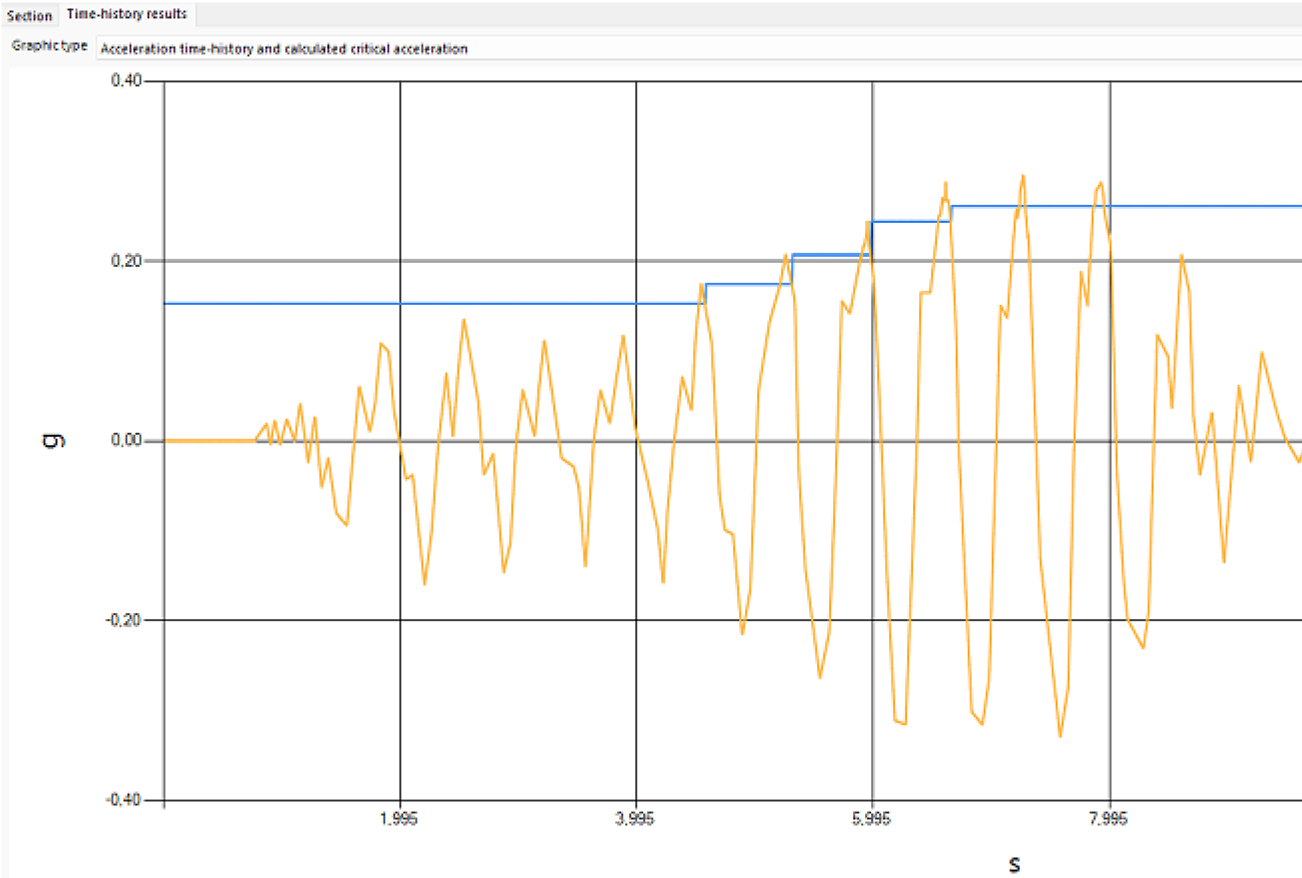


Comparison between the acceleration time-history given as input and the critical acceleration calculated by DReW Seismic, for earthquake EQ1

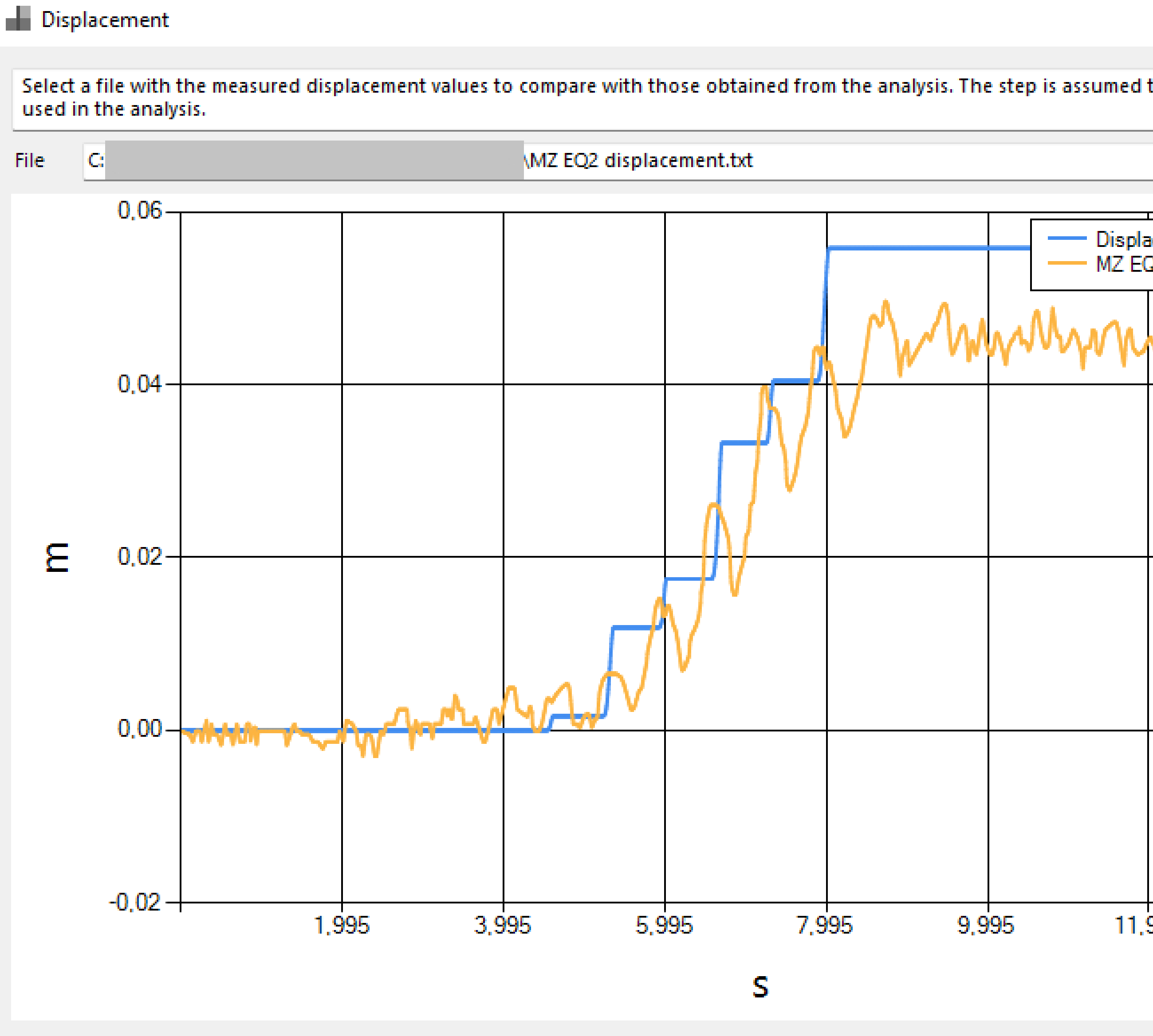


Comparison between the experimental displacement time-history (orange curve) and that calculated by DReW Seismic (blue curve), for earthquake EQ1

The earthquake EQ2 is considered in the second analysis. As this earthquake hit the wall after EQ1, the initial value of the critical acceleration is taken equal the the maximum value of acceleration recorded during EQ1, acting towards the excavation (i.e., among the positive values). This results in a value of 1.5 m/s^2. The comparison between the acceleration time-history and the calculated critical acceleration and the comparison between the displacement time-history provided by DReW Seismic and the measured one are provided in the following figures.



Comparison between the acceleration time-history given as input and the critical acceleration calculated by DReW Seismic, for earthquake EQ2



Comparison between the experimental displacement time-history (orange curve) and that calculated by DReW Seismic (blue curve), for earthquake EQ2

As can be seen, DReW Seismic provides a satisfactory prediction of the earthquake-induced permanent displacement of embedded cantilever retaining walls, by using a very simple to use calculation method.

5 Contacts

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DReW Seismic is available at the corresponding product page.