



Talren v6

Guide for using the new features

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4. « Sensitivity » module
5. Internal stability of a nailed soil massif (NF P 94 270 – October 2020)
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1. Introduction

This document aims to present the new features of the new version of Talren (v6).

This new version integrates a new calculation kernel, several new features as well as additional modules allowing to extend the application fields of the software.

The new features are :

- « Pile » module
- « Water flow » module
- « Sensitivity » module
- Internal stability of a nailed soil massif (NF P 94 270 – October 2020)
- Internal stability assistant
- Seismic module
- Automatic calculation of the safety factor with the kinematic method of yield design
- Determination of the safety margin with respect to external loads.

2. « Pile » module

This additional module allows a more accurate estimation of the resistance contribution along a reinforcement element of the "nail" type, representative of a pile, an inclusion or a barrette working in flexion-shear. The calculation is based on a "p-y" type elasto-plastic model taking into account the multi-layer nature of the soil.

Talren v6 allows the consideration of a multilayer soil around the pile and integrates the possibility to take into account the plasticization of the soil, which will lead to obtain a higher shear force compared to the calculation performed with Talren v5 where the working domain of the "nail" was limited to the beginning of the plastic domain of the soil.

In general, a pile will tend to plasticize after the soil, which allows full use of its bending-shear strength to determine a higher shear force than that found with Talren v5.

Required conditions

The search for the mobilisable shear diagram is performed in the calculation phase. To trigger this option, the axial calculation rule for each nail for which we want to start this search must be defined as follows:

Clous (2) Tirants Bandes Butons

Clous et familles du projet (2)

Pieu 1

Résistance axiale structurale R_a

☐ Valeur de R_a imposée

Φ_{barre} (m) 0,040 σ_a (kPa) 1,00E07

Résistance par frottement axial

$q_{s_{\text{clou}}}$ issus de Abaques

☒ Rqs calculée à partir de $q_{s_{\text{clou}}}$

Rayon équivalent du forage (m) 0,500

Règle de calcul multicritère de la résistance du clou

Règle de calcul

Moment de plastification (kN.m)

Produit d'inertie EI (kN.m²)

Calcul de la résistance au cisaillement

Résistance axiale nulle et résistance au cisaillement calculée par phase avec l'assistant

Résistance axiale calculée et résistance au cisaillement imposée

Résistance axiale nulle et résistance au cisaillement calculée

Résistance axiale calculée et résistance au cisaillement calculée

Résistance axiale nulle et résistance au cisaillement calculée par phase avec l'assistant

Access to the module

Then access the phase where the nail to be processed is active, the new module is accessible via the following button:

Arborescence du projet

- Projet "Renforcement de la pente" (2)
 - Géométrie (7 / 6)
 - Caractéristiques des sols (3)
 - Surcharges
 - Renforcements (2)
 - Phase "Phase 1"
 - Situation "Situation 1"
 - Ajouter une nouvelle situation
 - Ajouter une nouvelle phase

Propriétés de la phase

Nom: Phase 1

Conditions hydrauliques: Néant

Nappe

☐ Nappe extérieure manuelle

Renforcements

Cisaillement mobilisable des clous **Définir**

☐ ru par couche **Définir**

☐ Multiplicateur par surcharge **Définir**

Use of the module for search the mobilizable shear of nails

The module is composed of 2 tabs:

- Tab **Soil definition**: it lists all the soil layers traversed by the active nails in the current phase that must be characterised to define the frontal reaction law, i.e. :
 - From the pressuremeter data (PMT), defining:
 - E_M : pressuremeter module [kPa]
 - p_f : creep pressure [kPa]
 - α : rheological coefficient [-]

Assistant cisaillement mobilisable des clous

Définition des sols Calcul des clous

Couches de sol concernées par cet assistant

- Couche Remblais
- Couche Alluvions
- Couche Argiles sableuses

Type de données

E_M (kPa) **PMT**

p_f (kPa) **CPT**

α (-) Saisie libre 0,33

Fermer

- From penetrometric data (CPT), defining:
 - q_c : cone resistance [kPa]
 - Type of soil : soil category as defined by standard NF P 94-262

- Customized input :

- $k_s B$: reaction modulus, i.e. the slope of the frontal reaction law [kPa]
- p_{max} : maximum pressure that the soil can support [kPa]

- **Tab Nail calculation:** allows the calculation of the mobilisable shear force diagram of each "nail"

The drop-down list allows you to choose the pile to be manipulated, the calculation parameters already defined at the beginning are displayed as a reminder:

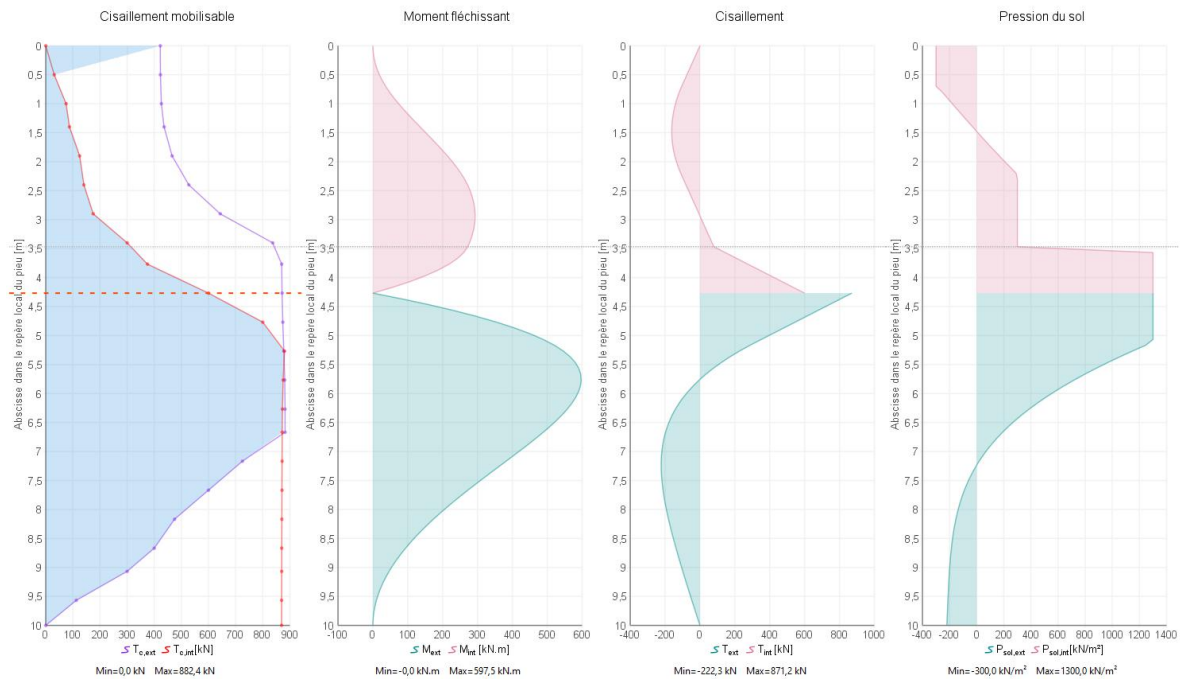
- Equivalent diameter B [m]
- Product of inertia EI [kN.m²]
- Total length of the element [m]
- Plasticity moment, i.e. the bending moment that must not be exceeded [kNm]
- Length to be examined: External or Internal/External

A summary table of the stratigraphy traversed is then displayed, specifying the value of the surface stiffness of each soil layer (k_s [kPa/m]) as well as the maximum value of pressure that the soil is allowed to support. (p_{max} [kPa]).

In addition, there are several digital options available to us:

- **Possibility to take into account soil plasticization :**
 - If this option is checked, plasticisation will be allowed, the mobilisable shear will tend to be larger.
 - If this option is unchecked, plasticization will not be allowed and the average soil pressure will be limited to the value of p_{max} , which will allow to reproduce the results of Talren v5.
- **Possibility to take into account or not a possible plastification of the nail :**
 - If this option is checked, the generation of a plastic hinge is allowed in the nail for the cases where it will plasticize before the ground.
 - If this option is unchecked, the calculation is stopped as soon as the bending moment obtained is equal to or greater than the plasticizing moment, without generation of a plastic hinge.
- **Maximum calculation step [m]:** discretization of the nail which fixes the levels at which the search for mobilizable shear will be carried out.
- **Number of subdivisions [-]:** number of sections that will make up the nail according to the maximum calculation step defined above.

- **Number of calculation points [-]:** used to define the discretisation of each length (internal/external) to be treated for each level examined.
- **Number of loading increments [-]:** number of times the initial loading will be applied to each examined level.
- **Maximum number of iterations [-]:** number of times the iterative process will be allowed to try to converge to find the balance between the nail and the ground.
- **Relative tolerance [-]:** calculation parameter which allows to decide on the convergence, by default equal to .
- **Initial load [kN]:** initial force that will be applied to each level examined.



The lower buttons allow either to launch the calculation of the active nail (the one selected in the drop-down list), or to launch the calculation of all the active nails in the current phase (all those in the drop-down list).

Once the calculation is launched, it is possible to click on each examined level of the Shear mobilisation graph to access the following diagrams for each length that has been examined (internal/external):

- **Mobilizable shear [kN]**
- **Bending moment [kNm]**
- **Shear [kN]**
- **Soil pressure [kN/m²]**

The obtained mobilizable shear diagram will be an input to the stability calculation performed by Talren v6 for all situations within the current phase.

As the soil around the nail can change from one phase to another, this should be done for all phases where each nail for which the mobilizable shear diagram is requested is active.

3. « Water flow » Module

This module allows an integrated calculation, under steady state conditions, of the pore pressure field to be considered for stability analyses. The calculation is based on a numerical resolution of the Laplace equation taking into account the multilayer and anisotropic character of the ground (vertical and horizontal permeabilities are differentiated).

This flow calculation is complementary, i.e. at the request of the user in each calculation phase. The old modes of hydraulic conditions remain unchanged compared to the previous version (water table, pressures given along a polygonal rupture surface and triangular mesh of pore pressures calculated).

The hydraulic conditions resulting from this additional module will constitute an input to the mechanical problem when assessing the stability of the structure. They will be used, in particular, to evaluate the effective stresses in the soil.

Talren v6 allows to choose in which soil layers the flow can develop and in which the flow is not allowed (i.e.: impermeable horizons).

This choice is made when defining each soil layer (by default, flow is not allowed in any new layer):

Retour **Caractéristiques des sols**

Couches de sol du projet (5)

Couche 1

Nom: Couche 1

γ (kN/m³): 20,0 ☐ Favorable

c (kPa): 10,0 Δ_c (kPa/m): 0,0

Cohésion: Effective

☐ Anisotropie

ϕ (°): 35,00

Courbe: Linéaire

☐ Forcer l'affichage de tous les paramètres relatifs aux clous

☐ Coefficients de sécurité spécifiques

☒ Autoriser l'écoulement dans cette couche

kh = perméabilité horizontale (m/s): 1,00E-06

kv = perméabilité verticale (m/s): 1,00E-06

Exporter vers la base de données

In soils where flow is allowed, it is necessary to define :

- k_h : horizontal permeability [m/s]
- k_v : vertical permeability [m/s]

If flow is not allowed in a soil layer, it will be considered impermeable.

When defining the calculation phase, you should choose : **Triangular pore pressure mesh calculated** to be able to start the flow calculation:

Propriétés de la phase

Nom Phase

Conditions hydrauliques Maillage triangulaire de pressions interstitielles calculé

Nappe

☒ Toit de la nappe

☐ Fond de la nappe

Assistant calcul d'écoulement

Raffinement du maillage Fin

Calcul d'écoulement Calculer

Champ de vitesses d'écoulement Voir

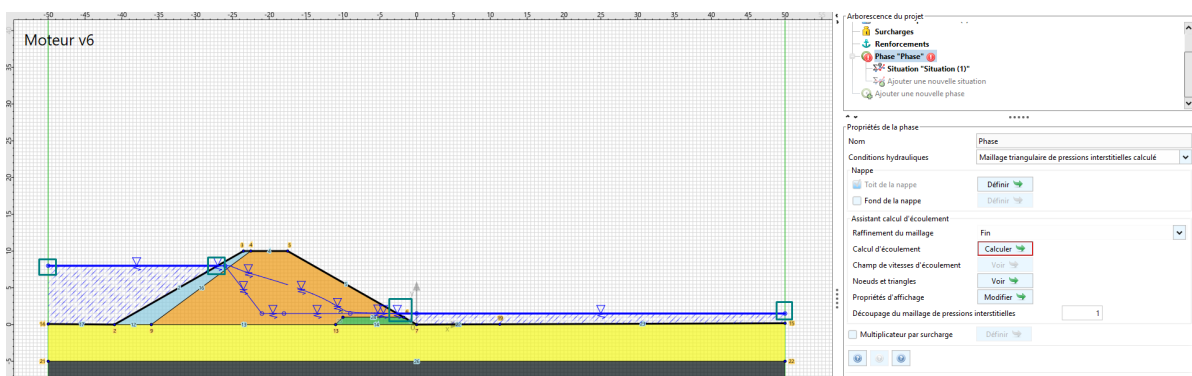
Noeuds et triangles Voir

Propriétés d'affichage Modifier

Découpage du maillage de pressions interstitielles 1

First of all, the boundary conditions must be defined. This is done by defining the **Water table** using the **Define** button:

Only the conditions at the ends of the model and at the level of the intersection with the natural ground will be "prescribed values". Talren then looks for the position of the water table within the ground.

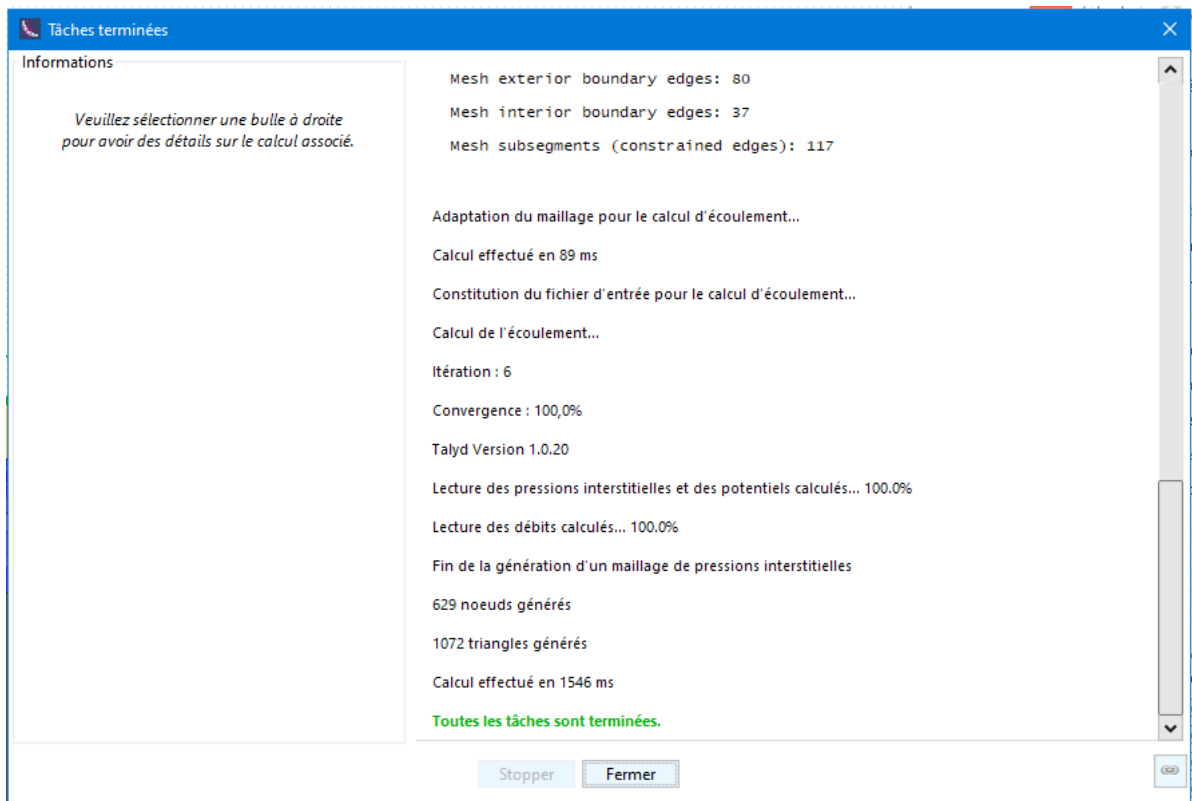


The flow calculation module allows you to choose the mesh refinement:

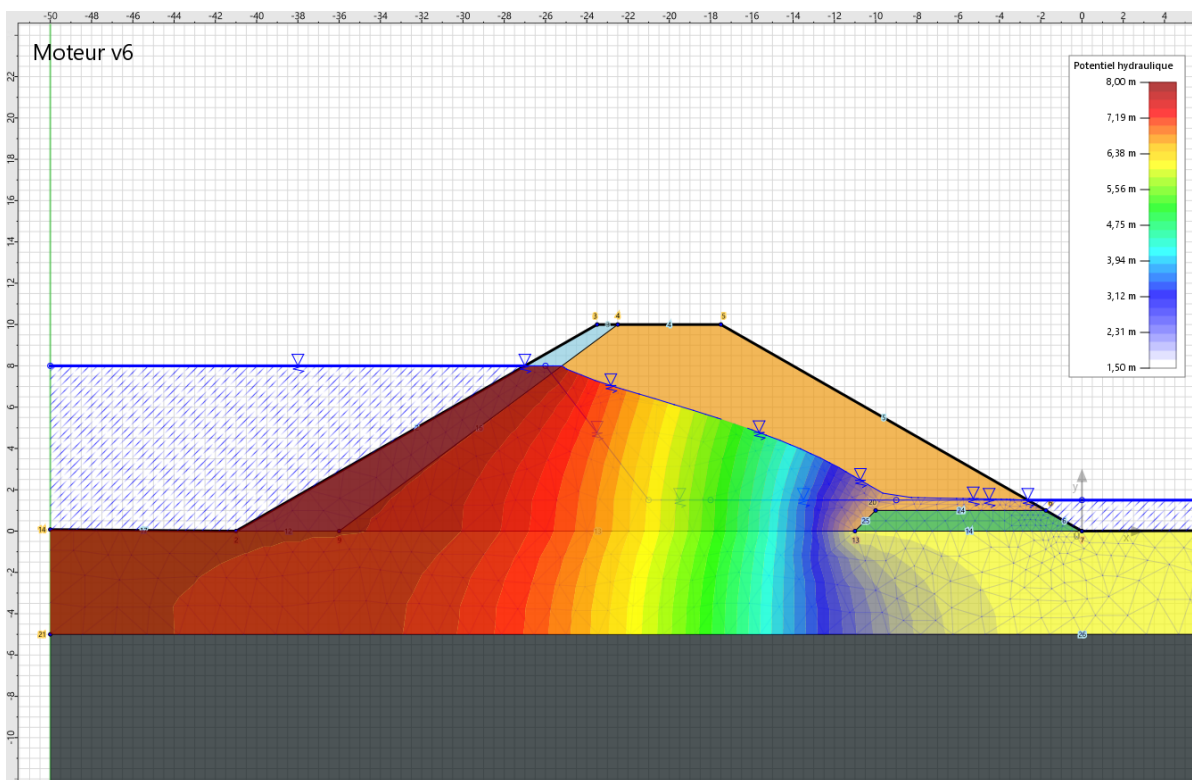
- Very coarse
- Coarse
- Medium
- Fine
- Very fine

In general, a refinement of type "fine" (default choice) is sufficient for common projects.

The flow calculation is started via the **Calculate** button.



Once the calculation is complete, Talren displays the hydraulic potentials, which allows us to identify the equipotential lines:



The flow velocity field can be viewed via the **View** button:

Propriétés de la phase

Nom Phase

Conditions hydrauliques Maillage triangulaire de pressions interstitielles calculé

Nappe

☒ Toit de la nappe Définir

☐ Fond de la nappe Définir

Assistant calcul d'écoulement

Raffinement du maillage Fin

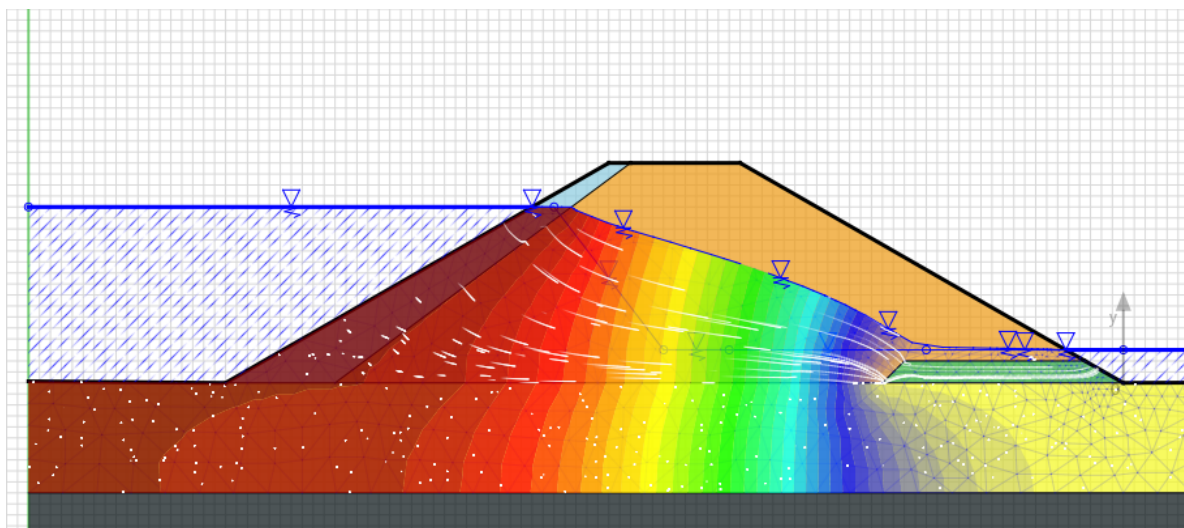
Calcul d'écoulement Calculer

Champ de vitesses d'écoulement Voir

Noeuds et triangles Voir

Propriétés d'affichage Modifier

Découpage du maillage de pressions interstitielles 1



The coordinates of the nodes and triangles used in the calculation are accessible via the **View** button:

Propriétés de la phase

Nom Phase

Conditions hydrauliques Maillage triangulaire de pressions interstitielles calculé

Nappe

☒ Toit de la nappe Définir

☐ Fond de la nappe Définir

Assistant calcul d'écoulement

Raffinement du maillage Fin

Calcul d'écoulement Calculer

Champ de vitesses d'écoulement Voir

Noeuds et triangles Voir

Propriétés d'affichage Modifier

Découpage du maillage de pressions interstitielles 1



Retour

Noeuds et triangles

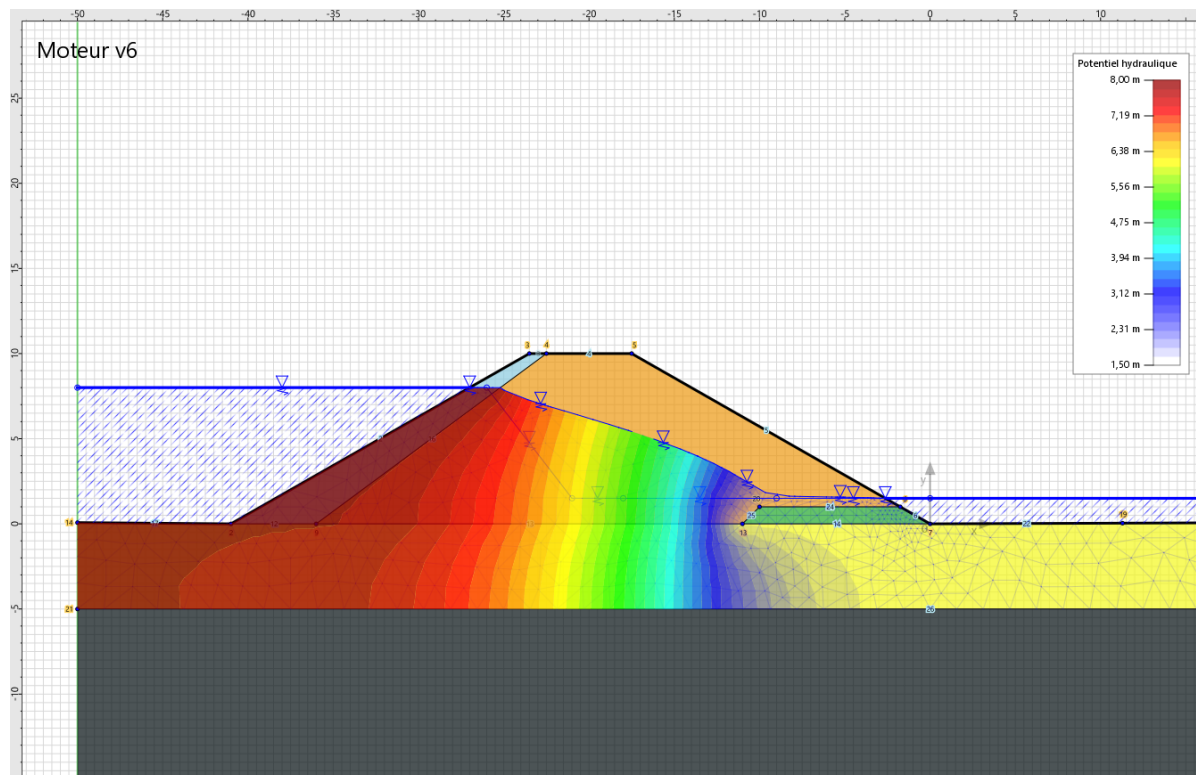
Noeuds

Triangles



N°	X (m)	Y (m)	u (kPa)
1	-36,000	0,000	80,000
2	-1,750	1,000	5,000
3	-10,000	1,000	6,478
4	-11,000	0,000	16,706
5	-41,000	0,000	80,000
6	0,000	0,000	15,000
7	-50,000	-5,000	130,000
8	-50,000	0,074	79,260
9	11,286	0,040	14,600
10	50,000	0,176	13,240

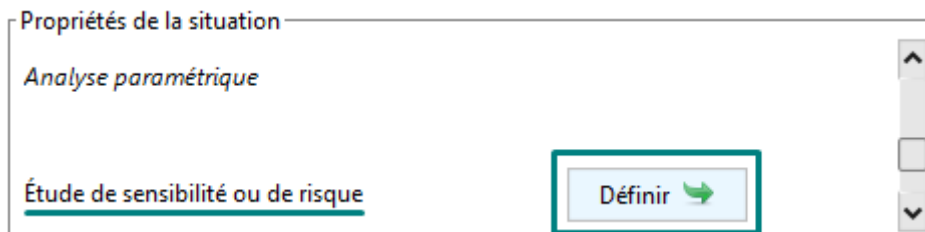
- In the **Display Properties** menu, the following options are available:
 - Show isovalues**: if checked, the results are coloured on the drawing area.
 - Soft continuous mode (slower)**: if checked, a gradient is applied along the isovalues, which does not allow the equipotentials to be identified.
 - Magnitude to be represented**:
 - Hydraulic potential, or
 - Pore pressure



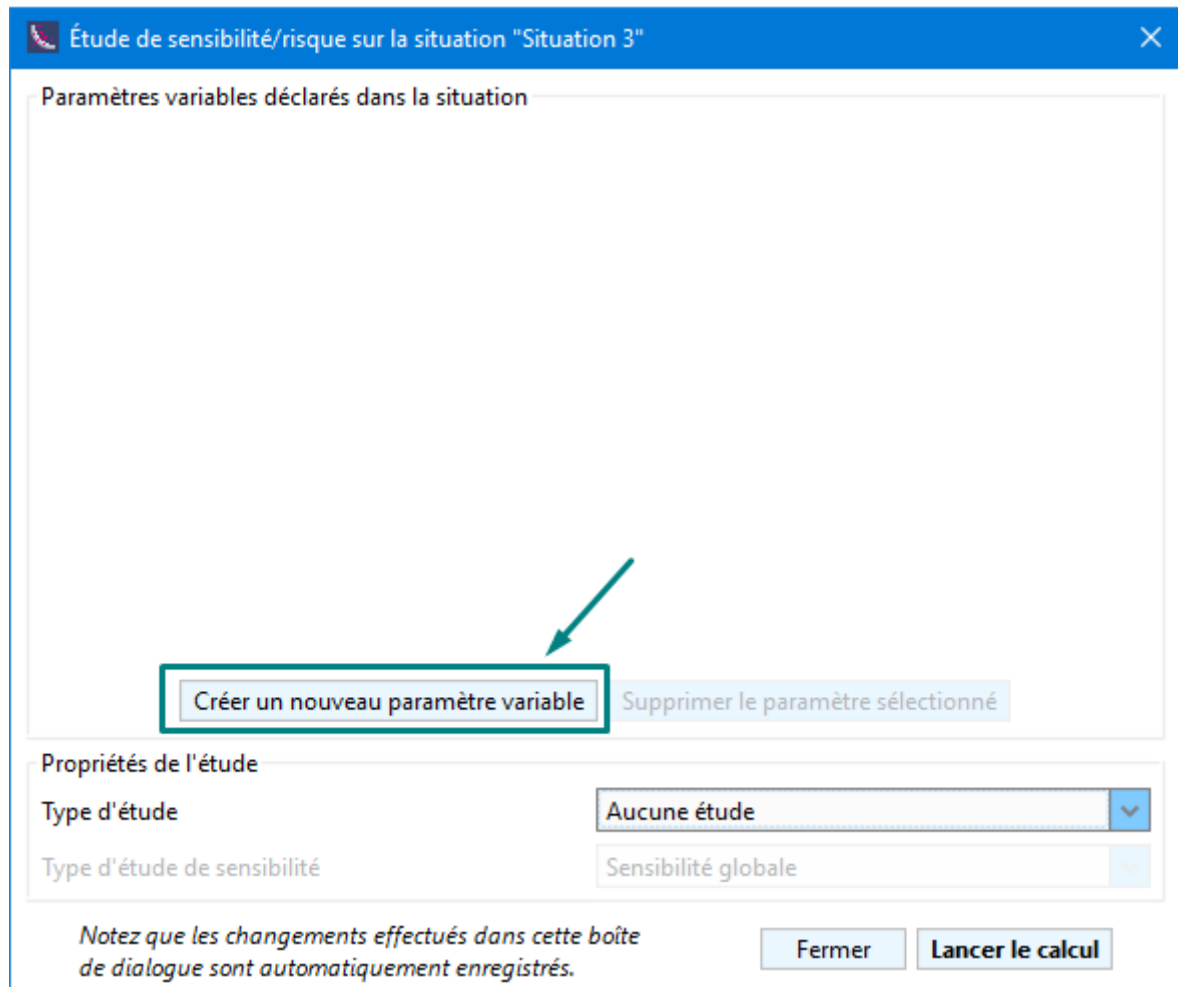
4. « Sensitivity » module

This module offers the possibility of automatically conducting sensitivity studies to evaluate the influence of the various model parameters on the stability of the structure studied. It is also possible to perform a reliability analysis, which consists in quantifying the safety in terms of reliability index or failure probability (analysis based on the RSM method).

The "Sensitivity" module is part of the properties of the situation and is accessible via the **Define** button:




In order to launch the sensitivity study, it is necessary to create as many parameters as you wish to vary via the **Create a new variable parameter** button.



Each parameter to be varied must be selected beforehand from those already defined in the project and the active phase/situation.

The choice of parameter is made via the three lists of elements presented next. First, choose the type of object to be manipulated (*Soil layer*, for example), then the object to be manipulated (*Marne infra*, for example) and finally the parameter to be varied (*Friction angle*, for example).


Étude de sensibilité/risque sur la situation "Stabilité mixte"
✕

Type d'objet possédant un paramètre variable

<< Tous les types >>

Projet


Couche de sol


Clou


Tirant

Objet possédant un paramètre variable

<< Tous les objets >>

 Remblai 30°

 **Marne infra**

 Remblai réel

Paramètre variable

Poids volumique

Cohésion

Variation de la cohésion

Angle de frottement

Frottement latéral unitaire

Pression de plastification


⋮

Annuler

Créer

Next, it is necessary to define the variation of the parameter to be considered, in particular :

- **The average value of the parameter** [unit of the parameter]: the value proposed corresponds to the one entered during the definition of the project.
- **Coefficient of variation** [unit-less] to be considered, usually defined as the ratio between the standard deviation and the mean.
- **Standard deviation** [unit of parameter] to be considered, a measure of the dispersion of the sample values.
- **Type of law**: choice between normal law and log-normal law.


Étude de sensibilité/risque sur la situation "Stabilité mixte"
✕

Propriétés du paramètre

Type d'élément concerné	Couche de sol
Nom de l'élément concerné	Marne infra
Désignation du paramètre	Angle de frottement
Valeur moyenne du paramètre (°)	31,00
Coefficient de variation (sans unité)	0,100
Écart-type (°)	3,10
Type de loi	<div> Loi normale </div> <div> Loi normale </div> <div> Loi log-normale </div>

Retour

Once the variation of the parameter to be considered has been defined, all the information is displayed in the main window of the assistant:

Étude de sensibilité/risque sur la situation "Stabilité mixte"

Paramètres variables déclarés dans la situation (1)

Type d'élément concerné : Couche de sol	Valeur moyenne du paramètre : 31,00 °
Nom de l'élément concerné : Marne infra	Coefficient de variation : 0,100
Désignation du paramètre : Angle de frottement	Type de loi : Loi normale

Créer un nouveau paramètre variable Supprimer le paramètre sélectionné

Propriétés de l'étude

Type d'étude : **Aucune étude**

Type d'étude de sensibilité : **Sensibilité globale**

Notez que les changements effectués dans cette boîte de dialogue sont automatiquement enregistrés.

Fermer Lancer le calcul

It is possible to define as many parameters to vary as desired:

Étude de sensibilité/risque sur la situation "Situation"

Paramètres variables déclarés dans la situation (5)

Type d'élément concerné : Couche de sol	Valeur moyenne du paramètre : 35,00 °
Nom de l'élément concerné : Couche 3	Coefficient de variation : 0,200
Désignation du paramètre : Angle de frottement	Type de loi : Loi normale
Type d'élément concerné : Couche de sol	Valeur moyenne du paramètre : 35,00 °
Nom de l'élément concerné : Couche 2	Coefficient de variation : 0,200
Désignation du paramètre : Angle de frottement	Type de loi : Loi normale
Type d'élément concerné : Couche de sol	Valeur moyenne du paramètre : 19,0 kN/m³
Nom de l'élément concerné : Couche 2	Coefficient de variation : 0,100
Désignation du paramètre : Poids volumique	Type de loi : Loi normale
Type d'élément concerné : Tirant	Valeur moyenne du paramètre : 1350,000 kN
Nom de l'élément concerné : Tirant 2	Coefficient de variation : 0,200
Désignation du paramètre : Résistance du scellement	Type de loi : Loi normale

Créer un nouveau paramètre variable Supprimer le paramètre sélectionné

Propriétés de l'étude

Type d'étude : **Étude de sensibilité**

Type d'étude de sensibilité : **Étude de sensibilité**

Notez que les changements effectués dans cette boîte de dialogue sont automatiquement enregistrés.

Fermer Lancer le calcul

To initiate the sensitivity study, a **Sensitivity Study** study type must be selected. The **No Study** option allows you to keep track of changes in the defined parameters without initiating the sensitivity calculation.

It is possible to start the calculation immediately using the **Start Calculation** button. As soon as the window is closed, it is quite possible to launch the same calculation by calculating the situation.

Once the calculation is completed, Talren announces the relative sensitivities that have been calculated based on the possible variation of each parameter:

Sensibilités relatives calculées :

— [Couche de sol "Couche 3"] Angle de frottement : $\alpha = 44,63\%$

— [Couche de sol "Couche 2"] Angle de frottement : $\alpha = 23,46\%$

— [Couche de sol "Couche 2"] Poids volumique : $\alpha = 6,96\%$

— [Tirant "Tirant 2"] Résistance du scellement : $\alpha = 7,85\%$

— [Tirant "Tirant 5"] Résistance axiale structurale : $\alpha = 17,09\%$

Fin de l'étude de sensibilité

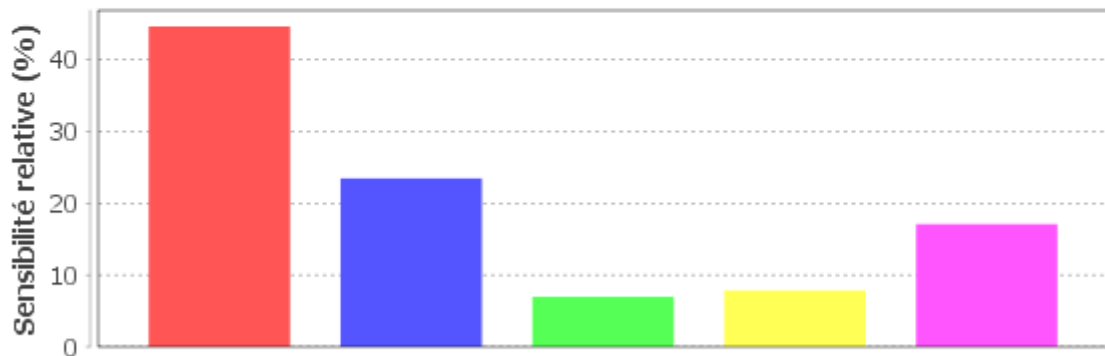
Toutes les tâches sont terminées.

**Étude :**

- Type d'étude :
Étude de sensibilité
- Type d'étude de sensibilité :
Sensibilité globale
- Paramètres étudiés :
 - [Couche de sol "Couche 3"] Angle de frottement ($\mu_1=35,00^\circ$, $\sigma_1=7,00^\circ$)
 - [Couche de sol "Couche 2"] Angle de frottement ($\mu_2=35,00^\circ$, $\sigma_2=7,00^\circ$)
 - [Couche de sol "Couche 2"] Poids volumique ($\mu_3=19,0 \text{ kN/m}^3$, $\sigma_3=1,9 \text{ kN/m}^3$)
 - [Tirant "Tirant 2"] Résistance du scellement ($\mu_4=1350,000 \text{ kN}$, $\sigma_4=270,000 \text{ kN}$)
 - [Tirant "Tirant 5"] Résistance axiale structurale ($\mu_5=800,00 \text{ kN}$, $\sigma_5=240,00 \text{ kN}$)

Résultats :

- Coefficient de sécurité obtenu avec $x_1=\mu_1$, $x_2=\mu_2$, $x_3=\mu_3$, $x_4=\mu_4$, $x_5=\mu_5$:
 $F_{\min,0} = 0,9927$
- Coefficient de sécurité obtenu avec $x_1=\mu_1-\sigma_1$, $x_2=\mu_2$, $x_3=\mu_3$, $x_4=\mu_4$, $x_5=\mu_5$:
 $F_{\min,1-} = 0,9296$
- Coefficient de sécurité obtenu avec $x_1=\mu_1+\sigma_1$, $x_2=\mu_2$, $x_3=\mu_3$, $x_4=\mu_4$, $x_5=\mu_5$:
 $F_{\min,1+} = 1,0613$
- Coefficient de sécurité obtenu avec $x_1=\mu_1$, $x_2=\mu_2-\sigma_2$, $x_3=\mu_3$, $x_4=\mu_4$, $x_5=\mu_5$:
 $F_{\min,2-} = 0,9572$
- Coefficient de sécurité obtenu avec $x_1=\mu_1$, $x_2=\mu_2+\sigma_2$, $x_3=\mu_3$, $x_4=\mu_4$, $x_5=\mu_5$:
 $F_{\min,2+} = 1,0265$
- Coefficient de sécurité obtenu avec $x_1=\mu_1$, $x_2=\mu_2$, $x_3=\mu_3-\sigma_3$, $x_4=\mu_4$, $x_5=\mu_5$:
 $F_{\min,3-} = 1,0031$
- Coefficient de sécurité obtenu avec $x_1=\mu_1$, $x_2=\mu_2$, $x_3=\mu_3+\sigma_3$, $x_4=\mu_4$, $x_5=\mu_5$:



- [Couche de sol "Couche 3"] Angle de frottement
- [Couche de sol "Couche 2"] Angle de frottement
- [Couche de sol "Couche 2"] Poids volumique
- [Tirant "Tirant 2"] Résistance du scellement
- [Tirant "Tirant 5"] Résistance axiale structurale

This study makes it possible to appreciate the influence of each parameter on the equilibrium calculation. The detailed results indicate the value of the stability coefficient (F) obtained for each value of the parameter examined while keeping the average value of the other parameters chosen, for example:

- $F_{\min,i-}$: value of F obtained for a parameter value equal to $x_i = \mu_i - \sigma_i$
- $F_{\min,i+}$: value of F obtained for a parameter value equal to $x_i = \mu_i + \sigma_i$

5. Internal stability of a nailed soil massif (NF P 94 270 – October 2020)

Talren v6 now offers the possibility to automatically specify and/or set the nail head forces required to verify the internal stability of a nailed soil mass, in accordance with the provisions of the new NF P 94 270 standard dated October 2020.

The principle of the modelling consists in foreseeing a phase (and a situation) for each stage of earthworks. In each situation, we will ask Talren v6 to find the force to be applied at the head of the nail that is placed at that moment (and that will have to be mobilised by the facing) so as to reach the limit equilibrium ($F_{min} = 1.00$), while keeping the forces at the head that were previously found in the rest of the nails already placed. It is also possible to consider a redistribution of the forces on all the active nails at each phase (and situation).

This approach to setting the forces at the head of the nails assumes the implicit contribution of the axial force that can be mobilised over the internal length of the nail (that contained in the sliding soil block).

It is therefore necessary to allow the calculation of the axial resistance on the **Internal/external** length when defining each nail to be handled in this setting approach.

Propriétés du projet

Retour Renforcements

Clous (5) Tirants Bandes Butons

Clous et familles du projet (5)

Clou 1

Règle de calcul multicritère de la résistance du clou

Règle de calcul Résistance axiale calculée et résistance au cisaillement impo...

☐ Résistance au cisaillement variable (le long du clou)

Rc (kN) 0,0

Calcul de la résistance axiale Interne/externe

Exporter vers la base de données

Clous de la base de données

It then becomes necessary to decide on the way in which the nails are placed on site. It is usual to consider the excavation of the passes by studs, which allows the nails to be placed alternately on the same bed. In the calculation, this makes it possible to excavate a new pass by considering the presence of the bed of nails present near the level of excavation of the pass.

In all cases, the phasing must include a calculation phase for each earthwork and nail bed placement pass.

The calculation of the forces at the head of each bed of nails is done at the level of the situation of each phase (the **Define** button is accessible once the box is checked):

Propriétés de la situation

Nom: Situation 5

Méthode de calcul: Calcul à la rupture

Jeu de coef. de sécurité: Situations durables et transitoires - A... Voir

Sécurité globale sur la résistance au cisaillement XF

Gestion de XF: Calcul avec valeur imposée

XF imposé: 1,1000

Critères de recherche des mécanismes de rupture

Surface de rupture: Spirales logarithmiques Définir

Conditions de passage: (0) Définir

☐ Séisme kh 0,000

☐ Rech. auto. comb. kv 0,000

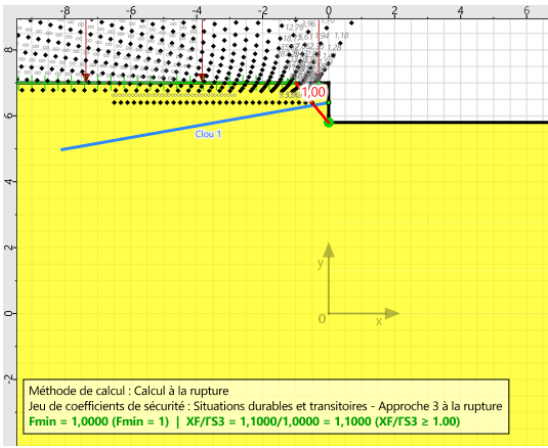
☐ Recherche automatique de l'accélération déstabilisante

☒ Efforts en tête des clous Définir

Below is the classic setting that is recommended for each phase/situation: the head force of the last bed of nails is requested to be automatically adjusted while keeping the head forces of the other beds of nails that have already been installed ($T_{R,0}$). To do this, it is necessary to define a reference phase/situation common to all the nails for which the nail head force is to be recovered. If desired, it is also possible to enter the value of the head force (manual entry).

The automatic adjustment initiates the search for the nail head force that needs to be mobilised to reach the limit balance.

Phase 1



Setting Situation 1

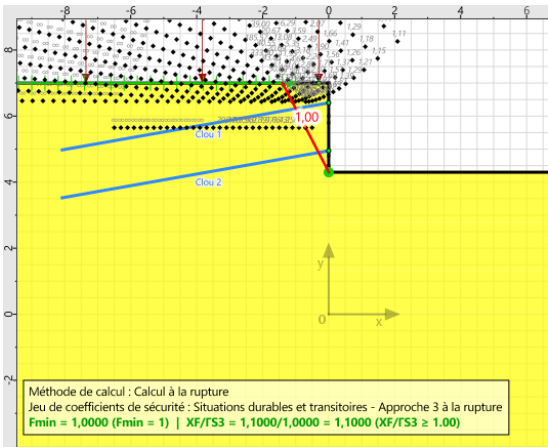
Propriétés de la phase

[Retour](#) Efforts en tête par clou

[Remise à zéro de tous les efforts](#)

Nom du clou	Type	T _{R,0} [kN]
Clou 1	Ajustement automatique	-

Phase 2



Setting Situation 2

Propriétés de la phase

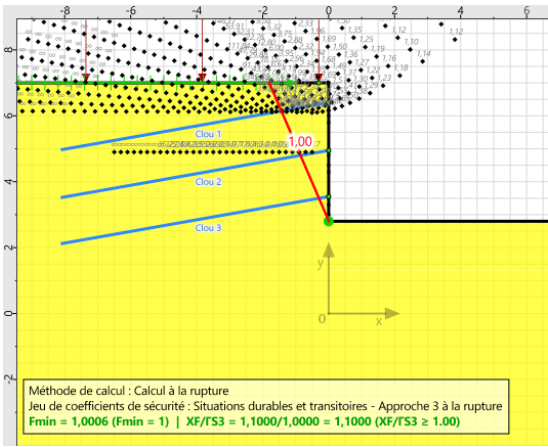
[Retour](#) Efforts en tête par clou

[Remise à zéro de tous les efforts](#)

Nom du clou	Type	T _{R,0} [kN]
Clou 1	Valeur récupérée à partir d'un...	3,04
Clou 2	Ajustement automatique	-

Situation de référence Phase 1 / Situation 1

Phase 3



Setting Situation 3

Propriétés de la phase

[Retour](#) Efforts en tête par clou

[Remise à zéro de tous les efforts](#)

Nom du clou	Type	T _{R,0} [kN]
Clou 1	Valeur récupérée à partir d'un...	3,04
Clou 2	Valeur récupérée à partir d'un...	38,16
Clou 3	Ajustement automatique	-

Situation de référence Phase 2 / Situation 2

Phase 4

Setting Situation 4

Phase 1

Méthode de calcul : Calcul à la rupture
Jeu de coefficients de sécurité : Situations durables et transitoires - Approche 3 à la rupture
 $F_{min} = 0,9940$ ($F_{min} = 1$) | $XF/TS3 = 1,1000/1,0000 = 1,1000$ ($XF/TS3 \geq 1,00$)

Setting Situation 1

Propriétés de la phase

[Retour](#) Efforts en tête par clou

Remise à zéro de tous les efforts

Nom du clou	Type	$T_{R,0}$ [kN]
Clou 1	Valeur récupérée à partir d'un...	3,04
Clou 2	Valeur récupérée à partir d'un...	38,16
Clou 3	Valeur récupérée à partir d'un...	66,78
Clou 4	Ajustement automatique	-

Situation de référence

Phase 3 / Situation 3

Phase 5

Méthode de calcul : Calcul à la rupture
Jeu de coefficients de sécurité : Situations durables et transitoires - Approche 3 à la rupture
 $F_{min} = 0,9911$ ($F_{min} = 1$) | $XF/TS3 = 1,1000/1,0000 = 1,1000$ ($XF/TS3 \geq 1,00$)

Setting Situation 5

Propriétés de la phase

[Retour](#) Efforts en tête par clou

Remise à zéro de tous les efforts

Nom du clou	Type	$T_{R,0}$ [kN]
Clou 1	Valeur récupérée à partir d'un...	3,04
Clou 2	Valeur récupérée à partir d'un...	38,16
Clou 3	Valeur récupérée à partir d'un...	66,78
Clou 4	Valeur récupérée à partir d'un...	95,42
Clou 5	Ajustement automatique	-

Situation de référence

Phase 4 / Situation 4

It is also possible to request the redistribution of efforts over several nail beds at the same time. To do this, it is sufficient to request automatic adjustment on several active nail beds within the same phase/situation.

At the end of the calculation of the situation, the effort mobilised at the head associated with the limit equilibrium is provided in the results:

Propriétés de la situation

[Retour](#) **Résumé des résultats**

☒ Résumé
 ☐ Propriétés d'affichage
 ☐ Par surface
 ☐ Par renforcement
 ☒ Par tranche

- Efforts en tête des clous $T_{R,0}$:

Nom	Statut	$T_{R,0}$ [kN]
Clou 1	Valeur imposée	3,04
Clou 2	Valeur imposée	38,16
Clou 3	Valeur imposée	66,78
Clou 4	Valeur imposée	95,42
Clou 5	Calcul convergé	107,39

Meaning of the calculation status :

- **Prescribed value:** a value has been given by the user
- **Not applicable:** $F_{min} > 1$ without mobilisation of the forces at the head of the nails (the manually entered forces are however taken into account)
- **Converged calculation:** the search for the head effort for which $F_{min} = 1$ has been successfully completed
- **Internal stability problem:** the value of $F_{min} = 1$ cannot be reached and the increase in the force at the head no longer allows T_R to be increased.
- **External instability failure:** failure in the nails occurs in the steel or by friction on the external length
- **Divergent calculation:** no surface was generated, problem with the calculation of nails (wrong definition or missing information)

6. Internal stability assistant

Talren v6 also offers the possibility to calculate the forces in the reinforced concrete facing of a nailed wall (stress and bending moments).

The internal stability assistant is accessible from the results window of any situation where there are active nails:

Propriétés de la situation

[Retour](#) **Efforts dans les renforcements**

☐ Résumé
 ☐ Propriétés d'affichage
 ☒ Par renforcement
 ☐ Par tranche

Surface: N°= 477; Xp=26,32; Yp=32,44

Clou
 Tirant
 Bande
 Buton
 Exportation

Nom	LU	RNcal	ITR	IPTR	Rc	ICIS	IPCI	T _{R,0}
Clou 1	2,676	43,240	2	3	0,000	0	5	3,04
Clou 2	2,155	70,538	2	3	0,000	0	5	38,16
Clou 3	1,605	90,889	2	3	0,000	0	5	66,78
Clou 4	0,963	108,743	2	2	0,000	0	5	95,42
Clou 5	0,314	112,105	2	3	0,000	0	5	107,39

Assistant stabilité interne

The wizard allows you to choose the nails and situations (among those calculated) to be considered for calculating the forces in the facing:

The **Ctrl** key is used to select multiple nails or phases/situations.

The **Shift** key is used to select several nails or phases/situations at the same time.

Assistant stabilité interne – efforts au parement

Sélection des clous faisant partie de la vérification de la stabilité interne

Clou 1
Clou 2
Clou 3
Clou 4
Clou 5

Tout sélectionner
Tout désélectionner

Sélection des situations calculées à prendre en compte dans le calcul de l'enveloppe

Phase 1 / Situation 1
Phase 2 / Situation 2
Phase 3 / Situation 3
Phase 4 / Situation 4
Phase 5 / Situation 5

Tout sélectionner
Tout désélectionner

Vérification de la stabilité interne

Entraxe vertical (m)

1,800

Entraxe horizontal (m)

1,800

Reprendre

Largeur de la plaque d'ancrage (m)

0,200

Coefficient de Poisson (-)

0,200

Clou	TR_{max} [kN]	$\sigma_{parement}$ [kPa]	M_{int} [kN.m/ml]	M_{ext} [kN.m/ml]
Clou 1	43,240	10,143	-6,120	1,291
Clou 2	70,538	16,546	-9,984	2,107
Clou 3	90,889	21,320	-12,865	2,715
Clou 4	108,743	25,508	-15,392	3,248
Clou 5	112,105	26,296	-15,868	3,348

Fermer

The calculation of the forces in the facing requires the following parameters to be entered:

- **Vertical spacing [m]** : average vertical spacing of nail beds
- **Horizontal spacing [m]** : horizontal spacing of nail beds

The **Resume** button is used to recover the value entered when defining the nails.

- **Anchor plate width [m]**: value to be entered (default is 0.20 m).
- **Poisson's ratio [-]**: value to be entered (default is 0.20).

As the previous parameters are selected and entered, the table at the bottom right is updated to retain the effort TR_{max} "seen" by each nail over the set of selected phases/situations. The calculated results are as follows:

Result	Unit	Description
$\sigma_{parement}$	kPa	Average stress at the wall
M_{int}	kNm/m	Bending moment tensioning the inside fibre of the wall
M_{ext}	kNm/m	Bending moment tensioning the outer fibre of the wall

7. Seismic module

Talren v6 offers several new features related to seismic aspects:

- **Determination of seismic coefficients according to Eurocode 8.**
- **Automatic search for the destabilising seismic acceleration (that leading to the limit equilibrium)**

This destabilising seismic acceleration can be used as an input to assess the irreversible displacement using the wizard below.

- **Assistant to assess the irreversible post-earthquake displacement :**
 - Empirical approaches: Ambraseys and Menu (1988), Jibson (2007) and Lazari and Padopoulos (2012)
 - Quantitative earthquake approach using the Newmark method

7.1. Determination of seismic coefficients (Eurocode 8)

Seismic conditions are defined at situation level.

Propriétés de la situation

☒ Séisme ☐ Rech. auto. comb. ☐ Recherche automatique de l'accélération déstabilisante

kh 0,000

kv 0,000

A new wizard is available in this new version to define the horizontal and vertical earthquake acceleration ratios according to Eurocode 8.

Assistant séisme EC8

Zone de sismicité Zone de sismicité 1

Classe de sol Sol de classe A

Catégorie ouvrage Ouvrage d'importance I

Accélération en surface a_N (m/s²) 0,32

Facteur r (≥ 1) 2,00

Coefficient sismique horizontal k_h 0,016

Coefficient sismique vertical k_v 0,008

Transférer Fermer

The parameters to be defined are the following:

- **Seismicity zone:** zones 1 to 5

- **Soil class:** classes A to E
- **Category of importance of the structure:** from I to IV

The surface acceleration a_N [m/s²] is then determined according to the previous parameters.

- **Factor r (≥ 1):** this coefficient, taken from EC8, is intended to reflect the capacity of the structure to move or not under seismic action. The choice of an " r " greater than 1 is favourable to the design and therefore consists of designing with a seismic acceleration equal to a fraction $1/r = 0.5$ to 1 of the maximum acceleration, which means that a displacement (which can range from a few mm to a few cm) of the structure studied is implicitly authorised. This displacement is only possible if the structure is "isolated" (e.g. a maritime quay, a heavy retaining wall, etc.)

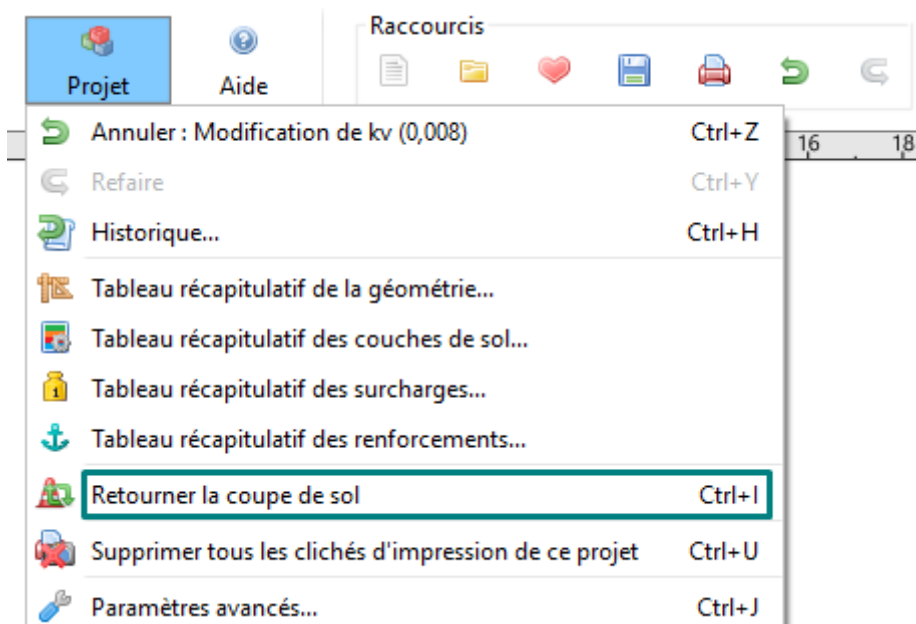
The horizontal (k_h) and vertical (k_v) seismic coefficients are then deduced and can be transferred to the situation.

7.2. Search for the most unfavourable combination of k_h and k_v

Talren v6 allows to get rid of the sign of definition of the seismic coefficients. It is possible to ask it to examine the 2 possibilities: lightening earthquake and weighing earthquake combined with a horizontal acceleration towards the right. In this case, the values of k_h and k_v must be entered as absolute values.



We remind you that Talren v6 only examines kinematics to the right. If the project has been defined in "reverse", it is quite possible to reverse it using the **Ctrl+I** key or from the **Project - Reverse Ground Section** menu.



After calculation, the most unfavourable seismic combination is found:

Propriétés de la situation

[Retour](#) **Résumé des résultats**

☒ Résumé
 ☐ Propriétés d'affichage

☐ Par surface
 ☐ Par renforcement
 ☐ Par tranche

Surface critique :

- Type de surface :
Surface circulaire
- Numéro de la surface :
 $N^{\circ} = 204$
- Abscisse du centre du cercle :
 $X_0 = 37,53 \text{ m}$
- Cote du centre du cercle :
 $Y_0 = 54,33 \text{ m}$
- Rayon du cercle :
 $R = 14,50 \text{ m}$
- Moment moteur :
 $M_{\text{MOT}} = 2052 \text{ kN}$
- Combinaison sismique la plus défavorable :
 $a_h/g = 0,016 \quad a_v/g = 0,008$
- Coefficient de sécurité minimal obtenu :
 $F_{\text{min}} = 0,7857$

7.3. Automatic search for destabilising seismic acceleration

Talren v6 offers the possibility to automatically search for the destabilising seismic acceleration (the one leading to the limit equilibrium). This acceleration is searched as a multiple of the acceleration.

Propriétés de la situation

☒ Séisme
 ☐ Rech. auto. comb.
 ☒ Recherche automatique de l'accélération déstabilisante

k_h
 k_v

Once the calculation has been completed, Talren provides the multiplication coefficient XA that has been applied to the values of k_h and k_v to arrive at the limit equilibrium ($F_{\text{min}}=1.00$).

Propriétés de la situation

[Retour](#) **Résumé des résultats**

☒ Résumé
 ☐ Propriétés d'affichage
 ☐ Par surface
 ☐ Par renforcement
 ☒ Par tranche

Surface critique :

- Type de surface :
Surface spirale logarithmique
- Numéro de la surface :
 $N^{\circ} = 571$
- Abscisse du pôle :
 $X = 18,50 \text{ m}$
- Cote du pôle :
 $Y = 31,35 \text{ m}$
- Angle au centre :
 $\alpha = 0,00^{\circ}$
- Moment moteur :
 $M_{\text{MOT}} = 32193507 \text{ kN}$
- Coefficient XF :
 $XF = 1,0000$
- Coefficient de sécurité minimal obtenu :
 $F_{\text{min}} = 1,0061$
- Coefficient XA :
 $XA = 1,6000$
- Statut de la recherche XA :
Recherche aboutie

7.4. Wizard for assessing irreversible post-earthquake displacement

Talren v6 also includes a wizard for assessing irreversible displacement outside of any project.



It proposes two approaches:

- Empirical approaches:

Ambraseys and Menu (1988)

Assistant séisme

Déplacements irréversibles (approche empirique) | Déplacements irréversibles (Newmark)

Référence: Ambraseys et Menu (1988)

Accélération déstabilisante a_{dsb} (m/s^2): 0,82

Accélération nominale a_N (m/s^2): 1,20

Déplacement irréversible (cm): 0,68

Fermer

Jibson (2007)

Assistant séisme

Déplacements irréversibles (approche empirique) | Déplacements irréversibles (Newmark)

Référence: Jibson (2007)

Accélération déstabilisante a_{dsb} (m/s^2): 0,82

Accélération nominale a_N (m/s^2): 1,20

Magnitude: 7,50

Déplacement irréversible (cm): 0,37

Fermer

Lazari and Padopoulos (2012)

Ambraseys and Menu (1988)

Assistant séisme

Déplacements irréversibles (approche empirique) Déplacements irréversibles (Newmark)

Référence: Lazari et Padopoulos (2012)

Accélération déstabilisante a_{dsb} (m/s^2): 0,82

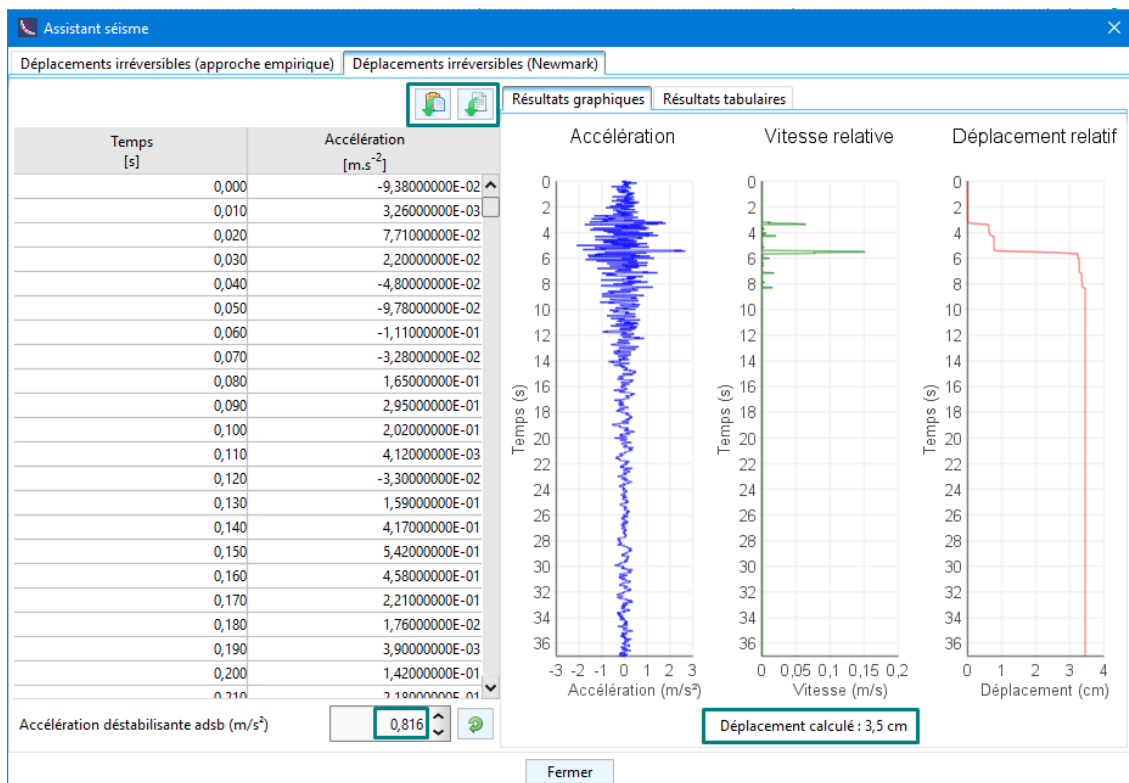
Accélération nominale a_N (m/s^2): 1,20

Déplacement irréversible, borne max (cm): 1,90

Déplacement irréversible, borne min (cm): 0,18

Fermer

- Quantitative approach (**Newmark**): this wizard completes the pseudo-static calculations made by Talren from the seismic coefficients k_h and k_v .



The wizard requires as input :

- The **accelerogram** which can be imported directly from the clipboard (for example, by copying and pasting it into Excel beforehand) or from a .txt file using the buttons available on the left-hand side of the table
- The **disturbing acceleration** a_{dsb} [m/s^2] which can be entered manually or retrieved using the button on its right.

The accelerogram is then plotted and integrated to obtain the velocity to obtain the cumulative relative displacement which is plotted on the right.

The results are also displayed in tabular form:

Assistant séisme

Déplacements irréversibles (approche empirique) Déplacements irréversibles (Newmark)

Résultats graphiques Résultats tabulaires

Temps [s]	Accélération [m.s^{-2}]	Temps [s]	Accélération [m.s^{-2}]	Vitesse relative [m.s^{-1}]	Déplacement relatif [m]
0,000	-9,38000000E-02	0,000	-9,38000000E-02	0,00000000E00	0,00000000E00
0,010	3,26000000E-03	0,010	3,26000000E-03	0,00000000E00	0,00000000E00
0,020	7,71000000E-02	0,020	7,71000000E-02	0,00000000E00	0,00000000E00
0,030	2,20000000E-02	0,030	2,20000000E-02	0,00000000E00	0,00000000E00
0,040	-4,80000000E-02	0,040	-4,80000000E-02	0,00000000E00	0,00000000E00
0,050	-9,78000000E-02	0,050	-9,78000000E-02	0,00000000E00	0,00000000E00
0,060	-1,11000000E-01	0,060	-1,11000000E-01	0,00000000E00	0,00000000E00
0,070	-3,28000000E-02	0,070	-3,28000000E-02	0,00000000E00	0,00000000E00
0,080	1,65000000E-01	0,080	1,65000000E-01	0,00000000E00	0,00000000E00
0,090	2,95000000E-01	0,090	2,95000000E-01	0,00000000E00	0,00000000E00
0,100	2,02000000E-01	0,100	2,02000000E-01	0,00000000E00	0,00000000E00
0,110	4,12000000E-03	0,110	4,12000000E-03	0,00000000E00	0,00000000E00
0,120	-3,30000000E-02	0,120	-3,30000000E-02	0,00000000E00	0,00000000E00
0,130	1,59000000E-01	0,130	1,59000000E-01	0,00000000E00	0,00000000E00
0,140	4,17000000E-01	0,140	4,17000000E-01	0,00000000E00	0,00000000E00
0,150	5,42000000E-01	0,150	5,42000000E-01	0,00000000E00	0,00000000E00
0,160	4,58000000E-01	0,160	4,58000000E-01	0,00000000E00	0,00000000E00
0,170	2,21000000E-01	0,170	2,21000000E-01	0,00000000E00	0,00000000E00
0,180	1,76000000E-02	0,180	1,76000000E-02	0,00000000E00	0,00000000E00
0,190	3,90000000E-03	0,190	3,90000000E-03	0,00000000E00	0,00000000E00
0,200	1,42000000E-01	0,200	1,42000000E-01	0,00000000E00	0,00000000E00
0,210	2,18000000E-01	0,210	2,18000000E-01	0,00000000E00	0,00000000E00

Accélération déstabilisante adsb (m/s^2) 0,816

Fermer

8. Automatic calculation of the safety factor with the kinematic method of yield design calculation

This new version also makes it easier to use the kinematic method of calculation at failure with the possibility of automatically setting the XF factor (which plays the role of the safety factor with regard to the shear strength).

Propriétés de la situation
Sécurité globale sur la résistance au cisaillement XF

Gestion de XF: Ajustement automatique pour Fmin = 1

Intervalle de recherche: Ajustement automatique pour Fmin = 1

Calcul avec valeur imposée

This option is available when defining the situation with two possible choices:

- **Automatic adjustment for $F_{min} = 1$:** it is necessary to limit the range of values of XF that one wishes to examine.

By default, the range examined is $XF_{min}=1.00$ to $XF_{max}=3.00$, but this can be extended as required.

Propriétés de la situation
Sécurité globale sur la résistance au cisaillement XF

Gestion de XF: Ajustement automatique pour Fmin = 1

Intervalle de recherche: Min 1,0000 Max 3,0000

- **Imposed value calculation:** This calculation reproduces the calculation of the previous version by prescribing a specific security level.

Propriétés de la situation
Sécurité globale sur la résistance au cisaillement XF

Gestion de XF: Calcul avec valeur imposée

XF imposé: 1,3000

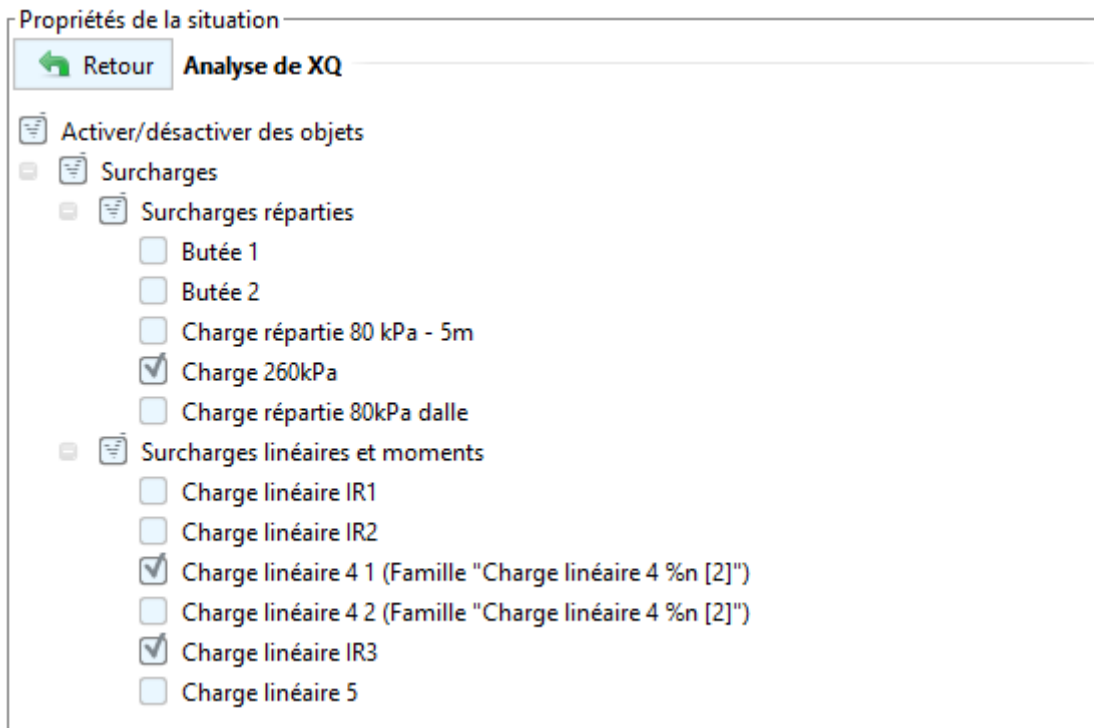
9. Determination of the safety margin against external loads.

It is now also possible to specifically identify safety margins for external overloads applied in the field (new XQ factor).

This option is available in the situation definition:



The XQ analysis consists of evaluating the possible increment that can be applied on the selected surcharges to reach the limit equilibrium ($F_{min}=1.00$). The surcharge will be the same on all selected surcharges.



After calculation, the XQ coefficient is found in the results of the situation under review.



Retour

Résumé des résultats

☒ Résumé

☐ Propriétés d'affichage

☐ Par surface

☐ Par renforcement

☒ Par tranche

Surface critique :

- Type de surface :
Surface spirale logarithmique
- Numéro de la surface :
 $N^{\circ} = 481$
- Abscisse du pôle :
 $X = 5,71 \text{ m}$
- Cote du pôle :
 $Y = 46,13 \text{ m}$
- Angle au centre :
 $\alpha = 50,00^{\circ}$
- Moment moteur :
 $M_{\text{MOT}} = 69632 \text{ kN}$
- Coefficient XF :
 $XF = 1,6250$
- Coefficient de sécurité minimal obtenu :
 $F_{\text{min}} = 1,0023$
- Valeur XQ :
 $XQ = 1,212$



terrasol

setec