Geocentrix

Repute 2.5

Quick-Start Guide

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Introducing Repute 2.5

Repute[®] provides a rich set of capabilities for engineers to design/analyse:

- various types of single pile, using current and historical design standards (such as Eurocode 7 and BS 8004:2015)
- pile groups under generalized 3-dimensional loading, using linear of non-linear soil models

Repute considers single pile response using a variety of calculation methods for ultimate and serviceability limit states. Both traditional lumped factors-ofsafety and modern partial factors can be applied in these calculations.

Repute analyses pile group behaviour using the boundary element method, employing the leading analytical program PGroupN (developed by and included under exclusive licence from Geomarc). PGroupN provides a complete 3D non-linear boundary element solution of the soil continuum, which overcomes limitations of traditional interaction factor methods and gives more realistic predictions of deformations and the load distribution between piles.

What's new in Repute 2.5?

New features

- Multi-threaded boundary element engine, up to 100x faster than before
- Support for spun piles and micropiles
- Action Import Wizard
- Pile Group Import Wizard
- Ability to choose which sections and materials appear in the Stockyard
- Support for BS 8004:2015
- Direct support for rock within the boundary element analysis

Improved features

• Pile Group Wizard now supports a wider range of pile types

- Greater distinction between different calculations in Stockyard
- Updated Quick-Start Tutorial
- Support for using the program across wide area networks
- Numerous other minor improvements

Documentation

Repute is supplied with a detailed Quick-start Guide, comprehensive User Manual, and authoritative Reference Manual. The latest versions of these manuals (including any corrections and/or additions since the program's first release) are available in electronic (Adobe[®] Acrobat[®]) format from the Geocentrix website. (www.geocentrix.co.uk/repute and follow links to Repute's documentation).

Quick-Start guide (this document)

The *Repute 2.5 Quick-Start Guide* includes six tutorials that show you how to use the main features of Repute. Each tutorial provides step-by-step instructions on how to drive the program. There are three tutorials dealing with single pile design and three with pile group design. The tutorials increase in difficulty and are designed to be followed in order.

User manual

The *Repute 2.5 User Manual* explains how to use Repute. It provides a detailed description of the program's user interface and explains how to employ it to maximum effect.

Reference manual

The *Repute 2.5 Reference Manual* gives detailed information about the engineering theory that underpins Repute's calculations. The manual assumes you have a working knowledge of the geotechnical design of single piles and pile groups but provides appropriate references for further study if you do not.

Help system

Repute's help system contains detailed information about the program, including most of the content of the *Quick-Start Guide*, *User Manual*, and

Reference Manual – plus additional information that is not found in any of these documents.

Help appears in a separate window to Repute, allowing you to view the help topics while you continue to work with Repute itself. To open the help system:

- Press F1
- Click the Help button in any dialog box
- Click on the Help button on the right-hand side of Repute's Ribbon

Note

Screenshots in this document were produced on Windows 10 and 11. Their appearance may differ on your computer. Not all options are available in every edition of Repute.

In this document, '[Docs]' refers to the folder where the documents that ship with Repute were installed, typically here:

C:\Users\Public\Documents\Geocentrix\Repute\2.5

Software Re-Assurance™

Software Re-Assurance for Repute (including updates, upgrades, and technical support) is available direct from Geocentrix or through your local distributor. To obtain Re-Assurance, contact Geocentrix as follows:

Repute Technical Support Geocentrix Ltd Scenic House, 54 Wilmot Way, Banstead, Surrey, SM7 2PY, United Kingdom tel: +44 (0)1737 373963 email: <u>support@geocentrix.co.uk</u> web: www.geocentrix.co.uk/support

Please quote your licence number when contacting technical support

Tutorial 1. H-pile in clay and sand

Introduction

This tutorial demonstrates the basic features of Repute, through a worked example involving the analysis of a single H-pile installed in clay and sand:

- Ground conditions comprise 5 m of clay overlying 20 m of dense sand. The clay has unit weight of 20.5 kN/m³, angle of shearing resistance of 23 °, and undrained shear strength of 60 kPa. The sand has unit weight of 18 kN/m³ and angle of shearing resistance of 35°.
- The foundation comprises a 305 x 305 x 110 H-pile of steel grade S275.
- A vertical load of 700 kN is to be applied to the pile.
- You want to determine the minimum length of pile needed to safely carry the applied action according to traditional UK practice.

This tutorial is written for users of the Standard, Enterprise, and Trial Editions of Repute only. Users of the Professional Edition should look at Tutorials 4-6.

Overview

- In Step 1, you will use the Project Wizard to enter project information, select a design standard, and create scenarios to represent short- and long-term conditions.
- In Step 2, you will use the Borehole Wizard to create a borehole containing clay and sand layers.
- In Step 3, you will create an H-pile and specify its cross-section and steel grade.
- In Step 4, you will create the force applied to the pile.
- In Step 5, you will use the Calculation Wizard to create the calculations you want Repute to perform.
- In Step 6, you will perform the calculations and review the results.
- In Step 7, you will produce a report summarising the results of the calculations.
- In Step 8, you will close (and optionally save) the project.

If Repute is not already running, open the program by pressing the Windows key, typing Repute 2.5 in the search bar, and clicking on the Repute 2.5 item that should appear. Once the splash screen has disappeared, Repute displays its Welcome screen.

If you have an existing project open, click **Close** on the program's **File** menu. (You will be prompted to save your work if you have not already done so.)

Step 1 – create the project

In Step 1, you will use the Project Wizard to enter project information, select a design standard, and create scenarios to represent short- and long-term conditions.

 Open the Project Wizard by selecting the Wizards tab on Repute's ribbon and clicking on the Project Wizard button.



- 2. When the Wizard appears, type Tutorial 1 in the **Project** name box. Choose the folder where you want to save this project by using the **Path** control. (If you do not change the setting here, it will be saved in your Documents folder.)
- 3. Enter H-pile in clay and sand in the Description box and 01 in the Project ID box.

1. Enter	the admin	istrative details for	your project
Project	name	Tutorial 1	
Path		Desktop	*
Descript	tion	H-pile in clay and s	and
Project	ID	01	

4. Click Next to display the next page (the standards that appear depend on which edition of Repute you are running). Select BS 8004:2015 by clicking on the relevant checkbox (a tick mark appears when a standard is selected).



5. Click Next to display the next page. Increase the Number of scenarios to 2 and then change the Design Situation of Scenario 1 to Transient but leave Scenario 2 as Persistent.

Project Wizard					×
	3. Define the	scenarios to cr	reate in this proj	ject	
	Number of sce	marios	2	¢	
	Scenario		Design Situ	ation	
	I 1		Transient		*
	2		Persister	nt	
	161 4 b M				
		😢 Cancel	G Back	🕥 Next 🔊	Finish

- Click Next to display the final page. If you wish to review any of the settings you have made, click Back to return to the relevant page.
- When you are ready, click Finish to generate the project. The Project Wizard then:
 - creates Site 1, Ground Surface 1, Design Standard 1, Situation 1, and Situation 2
 - adds Ground Surface 1 to Situation 1 and Situation 2
 - creates and saves a new project named Tutorial 1.rpx with all these items

- You can view these items by rightclicking anywhere inside the Project Manager to display its context menu and selecting the Expand All command. The Project Manager will then look as shown in the picture alongside.
- 9. To view the properties of any particular item, select that item in the **Project Manager** (e.g. Site 1)
- 10. Display the Property Inspector for the item:
 - by right-clicking on the item, to display its context menu, and clicking the **Properties...** command; or
 - by double-clicking on the item
- 11. The program's Property Inspector will open and display the properties of the selected item. (For example, for Site 1 the Description is shown as Hpile in clay and sand and the Project ID as 01.)

[Docs]\Tutorials\Tutorial 1\Step 1.rpx captures everything you've done so far.

Step 2 – create the borehole

In Step 2, you will use the Borehole Wizard to create a borehole containing clay and sand layers.

 Open the Borehole Wizard by selecting the Wizards tab on Repute's ribbon and then clicking on the Borehole Wizard button.



80	Property Inspector	÷.	×
-	General		
	Name	Site 1	
	Туре	Construction Site	
	Kind	Project Information	
	Notes	Created by the Project W	¥
Ξ	Project Information		
[Description	H-pile in clay and sand	Ŧ
	Project ID	01	
	Address		Ŧ
	Links		
+	Help		



Д.

😚 Project Manager

✓ Geometry

Project Information
 Project Information

🗸 💽 Design Standards

🥔 Site 1

Ground Surfaces

---- discound Surface 1

Items

2. When the Wizard appears, increase the number of layers to 2.



 Click Next to display page 2 of the Wizard. Change Layer 1 to Clay, its Thickness to 5 m, and its Weight density to 20.5 kN/m³. Leave Layer 2 as Sand but change its thickness to 20 m and weight density to 18 kN/m³.

2. Please specify the thickness and ground type of each layer						
Layer Ground type Thickness Weight density						
	1	1 Clay -		5 m	20.5 kN/m³	
I	2	Sand	+	20 m	18 kN/m³	

- Click Next to display page 3. Change the Internal friction of Layer 1 to 23° and that of Layer 2 to 35°. Leave the Cohesion of both soils unchanged at 0 kPa and the At Critical State? boxes unchecked.
- Click Next to display page 4. Change the Undrained Strength (top) and Undrained Strength (bottom) of Layer 1 to 60 kPa. Note that Soil 2 does not appear on this page, since – being a sand – it does not have undrained strength.



- 6. Click **Next** to display page 5. Since the ground profile does not include rock, there is nothing to set on this page.
- Click Next to display page 6. Leave the stiffness properties (i.e. Shear modulus) of both layers unchanged.

- 8. Click **Next** to display page 7. Click **All** to select both scenarios.
- Click Next to display the final page. If you wish to review any of the settings you have made, click Back to return to the relevant page.
- 10. When you are ready, click **Finish** to generate the borehole. The **Borehole Wizard** then:
 - creates Soil 1 and Soil 2, Layer 1 and Layer 2, and Borehole 1
 - links Soil 1 to Layer 1
 - links Soil 2 to Layer 2
 - adds Layer 1 and Layer 2 to Borehole 1

[Docs]\Tutorials\Tutorial 1\Step 2.rpx captures everything you've done so far.

Step 3 – create the pile

In Step 3, you will create an H-pile and specify its cross-section and steel grade.

C:\Software Development\Users\Public\Docu 1. Open the Wizards Tools View Dra Build Stockyard 6 by selecting Welcome Normal Construct Specify Check News Drawing Project Stockyard Board 0 the View tab Desktops

on Repute's ribbon and then clicking on the **Construct** button.

2. When the program has switched to its Construction Desktop (in which the Drawing Board, Project Manager, and Stockyard are displayed), right-click anywhere inside the Stockyard to display its context menu and select the Sections > Bearing Piles command. The Bearing Piles group will open.

7. Select the scenarios in which
♥ Situation 1
♥ Situation 2
All None

- 3. Create the section by selecting the item labelled UKBP 305x305x95, right-clicking to display its context menu, and then selecting the command Create 'UKBP 305x305x95'. The newly created hotrolled section will appear in the Project Manager (under Sections > Bearing Piles) as Section 1.
- Next, right-click anywhere inside the Stockyard to display its context menu and select the Steels command. The Steels group will open.
- Stockyard
 # x

 Bearing Piles

 I
 HP 10 x 57

 I
 HP 12 x 89

 Full P
 14

 I
 UKBP 305x305x 79

 I
 UKBP 305x305x 79

 I
 UKBP 305x305x 95

 I
 UKBP 305x305x100

 I
 UKBP 305x305x126

 I
 UKBP 305x305x149

 I
 UKBP 305x305x186
- 5. Create the steel by holding the Ctrl key down and clicking on the item labelled S275. (When the Ctrl key is pressed, Repute automatically creates any item that you select in the Stockyard. This saves you the effort of displaying the popup menu each time you want to create a new item.) The newly created steel will appear in the **Project Manager** (under Materials > Steels) as Steel 1.
- Finally, click on the Stockyard's Structural Elements caption (near the bottom of the Stockyard). The Structural Elements panel will open.
- Create the pile by holding the Ctrl key down and clicking on the item labelled H-pile. The newly created pile will appear in the Project Manager (under Structural Elements > Piles) as Pile 1.



In the Project Manager, right-click on
 Pile 1 to display its context menu and select the Properties...
 command. The Property Inspector will appear.

- 9. In the Property Inspector, change the Material Name (under Material Properties) from Not specified to Steel 1. Then change the Section Name (under Section Properties) from Not specified to Section 1. Leave all other properties of the pile unchanged.
- 10. Returning to the Project Manager, select Situation 1 (under Scenarios > Situations) and, in its Property Inspector, place a tick next to Pile 1 (under Structural Elements) to add the pile to this scenario. The Drawing Board will refresh.

Notes	Created by the Project W 👻
Design Situation	Transient *
Geotechnical Con	istituents
Layer 1	
Layer 2	
Borehole 1	V
Structural Eleme	nts
Pile 1	
Geometry	
Ground Surface	1 🔍
And and the second seco	a persona have been been and a second

- 11. Repeat the previous instruction for Situation 2.
- 12. In this step, you have:
 - created Section 1, Steel 1, and Pile 1
 - linked Section 1 and Steel 1 to Pile 1
 - added Pile 1 to Situation 1 and Situation 2
- 13. The **Drawing Board** will now look something like this:



[Docs]\Tutorials\Tutorial 1\Step 3.rpx captures everything you've done so far.

Step 4 – create the force

In Step 4, you will create the force applied to the pile.

 Open the Stockyard's Actions panel by selecting the Insert tab on



Repute's ribbon and then clicking on the **Action** button.

- 2. The Actions group will open in the **Stockyard**. Hold the Ctrl key down and click on the item labelled Force.
- The newly created force will appear in the Project Manager (under Actions > Forces).
- 4. In the Property Inspector, change the Variability of Force 1 (under Options) to Permanent and the value of Fz (under Components of Action) to 700 kN. The Resultant will automatically change to 700 kN.
- Change the Tether to ... item to Pile 1. This will ensure that the force's plan position will always



± Level	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Options	
Variability	Permanent *
Components of activity	on
+ Fx	0 kN
🕀 Fy	0 kN
+ Fz	700 kN
Resultant	700 kN
	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

match the pile's plan position, even if the pile is moved.

6. In the Project Manager, select Situation 1 (under Scenarios > Situations) and then, in its Property Inspector, place a tick next to Force 1 (under Actions) to add the action to this scenario. The Drawing Board will refresh and now look like this:



- 7. Repeat the previous instruction for Situation 2.
- 8. In this step, you have:
  - created Force 1
  - added Force 1 to Situation 1 and Situation 2

[Docs]\Tutorials\Tutorial 1\Step 4.rpx captures everything you've done so far.

#### Step 5 – create the calculations

In Step 5, you will use the Calculation Wizard to create the calculations you want to perform.

 Open the Calculation Wizard by selecting the Wizards tab on Repute's ribbon and then clicking on the Calculation Wizard button.



2. When the Wizard appears, select Longitudinal ULS. (The calculations that appear here depend on which edition of Repute you are running.)



3. Click Next to display page 2 of the Wizard. Select Design



Standard 1 (this is the BS 8004:2015 design standard created in Step 1 of this tutorial).

- 4. Click **Next** to display page 3. Click **All** to select both situations.
- 5. Click **Next** to display the final page of the Wizard. If you wish to review any of the settings you have made, click **Back** to return to the relevant page.
- 6. When you are ready, click **Finish** to generate the calculations.
- 7. The Calculation Wizard then:
  - creates Calculation 1 and Calculation 2
  - links Situation 1 to Calculation 1
  - links Situation 2 to Calculation 2
  - links Design Standard 1 to Calculation 1 and Calculation 2

[Docs]\Tutorials\Tutorial 1\Step 5.rpx captures everything you've done so far.

#### Step 6 – perform and review the calculations

In Step 6, you will perform the calculations and review the results.

 Run the calculations by selecting the **Build**



tab on Repute's ribbon and then clicking on the Run All button.

 Repute will perform all the calculations that you have specified (i.e. Calculation 1 and Calculation 2) and

Calculation 2) and then change to its



**Checking Desktop** (which displays the Workbook and Graph Paper). You can switch to this display at any time by clicking on the **Check** button on the **View** tab of Repute's ribbon.

3. Your screen will now look something like this:



4. The **Graph Paper** (top-centre panel) shows:

- the effects-of-actions *E* (the sum of the applied forces and the self-weight of the pile) increasing slightly with depth
- separate components of shaft and base resistances, R_s and R_b

- the total compressive resistance,  $R_c = R_s + R_b$ , exceeding the effect of actions ( $E \le R_c$ ) at a depth between 13.5 and 14.5 m (depending on which calculation is displayed)
- 5. The Workbook (top-left panel) shows the same information, but in tabular format. The Workbook contains a lot more information than is initially shown. To display this additional information, click on the button labelled * in the top-left-hand corner of the Workbook (to the left of the heading Depth) and select the data you want to see.
- The Message Board (bottom panel) shows any warning or error messages that were generated during the calculation. You should review these

messages to ensure that the calculations have performed as you expected.

7. To view the results of the second calculation, select Calculation 2 in the Project Manager. Repute will automatically update the Workbook and Graph Paper with this calculation's data.

[Docs]\Tutorials\Tutorial 1\Step 6.rpx captures everything you've done so far.

#### Step 7 – produce a report

In Step 7, you will produce a report summarising your calculations.

 Display Repute's **Reporter** by selecting the **View** tab on the ribbon and then clicking on the **Review** button.



* Caraval	Ac	tions	Material		
General	Design	n values	Design v		
Depth     (m)	F,d (kN)	W,d (kN)	phi,d (°)	c,c (kPa	
Type		11.47	35	0	
Depth		11.66	35	0	
Circumferen	ice	11.85	35	0	
Gross base	area	12.04	35	0	
Notes		12.23	35	0	
🗹 F,d		12.41	35	0	
₩,d		12.6	35	0	
i phi,d		12.79	35	0	
₹ c,d		12.98	35	0	
⊻ cu,d		13.17	35	0	
Shart coem	cient	13.36	35	0	
Skin mouon	limit	13.54	35	0	
Base coeffic	ient	13.73	35	0	
Bearing pre-	course	13.92	35	0	
Bearing press	ssure limit	14.11	35	0	
V E.d		14.3	35	0	
Rst,d		14.48	35	0	
Rs,d		14.67	35	0	
🛛 Rb,d		14.86	35	0	
🖉 Rt,d		15.05	35	0	
Utilization		15.24	35	0	
Overdesign	factor	15.42	35	0	
16.77	700	15.61	35	0	

2. The Reporter will appear and automatically generate a report together with a set of thumbnails.

🛃 Reporter									
i 👰 🖗 📓 🖬 🖬	Show Inumbrails	1 1 1 1 1 1 C	-						
All and a second second				Rej	рите кер	on			
		Client			Project	ID 01		Page 1	1 of 5
and the second s		Engineer			Made b	У	(	Date (	05/03/2024
19 7 1		Site	Site 1		Revisio	n -	1	lime 1	17:55:12
1.1.1.10		C:\Softwar	e Development\Users\Pul	blic\Docume	nts\Geocentrix	(Repute\2.5)	Tutorials)	Tutorial 1\Ste	ep 5.rpx
Statement 1				Proje	ect informa	tion			(1 no.)
3			General		Project infe	ormation		Specific inf	formation
精制的		Name	Site 1	Descript	on H-pile in c	lay and san	d	Project ID	01
11 11111		Type	Construction Site					Made by	
10-10-2		Category	Project Information	Addre	88			Revision	
- A.		Role						Date	
4		140163	Created by the Project	ct wizard or	2024-Mar-05				
Inne					- state of shift				(4 )
Construction of the local division of the lo			Connert	Geon	netrical obj	ects			(1 no.)
54C 8 3			General	Loca	aon	Dimension	ris .		
1 1		Name	Ground Surface 1	x	0 m	Slope	0 °		
		Type	Plane Ground	Y	0 m				
State State State		Category	Ground Surfaces	Z	0 m				
				Level	0 m				
		Notes	Created by the Project	ct Wizard or	2024-Mar-05				
			Our cont		Actions	E			(1 no.)
			General	Loca	eon	Force		Mom	ent
		A/	F	v	<u> </u>	-	A 1.4		
URL requested			URL loaded						

 You can navigate around the report using the controls on the Reporter tab on the ribbon: First Page, Previous Page, Next Page, and Last Page. You can jump to specific pages by clicking on the thumbnails on the left-hand side.



- You can also re-size the report using the Fit Width, Fit Height,
   Zoom In, and Zoom Out controls.
- You can choose what to include in your report by selecting or deselecting individual items in the Elements group, then clicking the Refresh button.
- Finally, you can output the report onto paper using the **Print** command and choosing from the options provided in the dialog box that appears on your screen.

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#### Step 8 – close the project

In Step 8, you will close and – optionally – save the project. (Note: this is not available in the Trial Edition.)

- 1. Close the project by clicking on the File menu's **Close** command.
- If you have made changes to the project since it was last saved, Repute will ask you if you want to save before proceeding. Click the appropriate button to answer Yes or No.
- 3. Repute will then (if requested) save and close the project.

You will find a copy of the project in its final form here:

[Docs]\Tutorials\Tutorial 1\Tutorial 1.rpx

#### What next?

Tutorial 2 shows you how to perform Fleming's hyperbolic analysis.

# Tutorial 2. Fleming's hyperbolic analysis

#### Introduction

Tutorial 2 shows you how to construct a load vs displacement curve for a single pile, using Fleming's hyperbolic analysis, described in his 1992 Géotechnique paper *A new method for single pile settlement prediction and analysis* (see vol. 42, no. 3, pp 411-425). This tutorial demonstrates how to setup a calculation in Repute without using the program's built-in wizards, thereby showing you how versatile the program's user interface is.

The worked example is taken from Figure 6 in Fleming's paper, which is based upon from tests carried out at Wembley by Whitaker and Cooke. We are interested in replicating the load vs displacement curve given by Fleming's analysis.

- Ground conditions at the site are not given in the paper, so we will assume 25 m of London Clay with an undrained strength of 100 kPa and internal friction angle of 23°.
- The pile studied is a 12.2 m long, 775 mm diameter bored pile made of concrete with Young's modulus equal to 19.5 GPa.
- A vertical load of 200 tonnes (approximately 2000 kN) is applied at the centre of the pile.
- The ultimate load that the pile can carry has been calculated (separately) as 1994 kN on the shaft and 1002 kN from the base. The soil modulus below the pile base is 33.125 MPa. Other parameters used by Fleming are the shaft flexibility factor (0.0017 or 0.17%) and effective column length factor (0.45).

This tutorial is written for users of the Standard, Enterprise, and Trial Editions of Repute only. Users of the Professional Edition should look at Tutorials 4-6.

#### Overview

- In Step 1, you will enter project information about the site and the Engineer.
- In Step 2, you will define the site's ground conditions.

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- In Step 3, you will create a bored pile and specify its cross-section and concrete grade.
- In Step 4, you will create the force applied to the pile.
- In Step 5, you will sleeve the pile through the made ground.
- In Step 6, you will create the scenario and calculation and link various items together.
- In Step 7, you will perform the calculation and produce a report showing the relationship between load and displacement.
- In Step 8, you will close (and optionally save) the project.

If Repute is not already running, open the program by pressing the Windows key, typing Repute 2.5 in the search bar, and clicking on the Repute 2.5 item that appears. Once the splash screen has disappeared, Repute displays its Welcome screen.

If you have an existing project open, click **Close** on the program's **File** menu. (You will be prompted to save your work if you have not already done so.)

#### Step 1 – create the project information

In Step 1, you will enter project information about the site and the Engineer.

1. Click **New** on the program's **File** menu to create a blank project. Alternatively, click on the **New** button on the Quick-access toolbar, located on the right-hand side of Repute's icon in the tile bar.

Open the Stockyard's Project 2. Information group by selecting the Insert tab on Repute's ribbon and then clicking on the **Project** 

Information button.





3. In the Stockyard, hold the Ctrl key down and click on the item labelled Construction Site. A newly created site will appear in the Project Manager (under Project Information > Project Information).

- 4. In the **Project Manager**, double-click on the newly created site (Site 1) to open its Property Inspector.
- 5. In the Property Inspector, change the Name to Wembley; enter Fleming's hyperbolic analysis in the Description box and click OK to confirm what you have typed; and, finally, enter Figure 6 in the Project ID box.



- 6. Returning to the Stockyard, create a Party by holding down the Ctrl key and clicking on the item labelled Party. A newly created party will appear in the Project Manager (under Project Information > Project Information) as Party 1 and the Property Inspector will display its default properties.
- 7. In the **Property Inspector**, change the **Name** of the newly created party to Whitaker and Cooke and the role to Engineer (if not already selected).

[Docs]\Tutorials\Tutorial 2\Step 1.rpx captures everything you've done so far.

#### Step 2 – create the ground conditions

In Step 2, you will define the site's ground conditions.

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  - Returning to the Stockyard, click on the button labelled Common to open the Common group, where you will find (amongst other items) Plane Ground.
  - Hold the Ctrl key down and click on the item labelled Plane Ground to create it.
  - In the Property Inspector, change the Name Ground Surface 1 to Horizontal ground but leave the other (default) properties unchanged.
  - Back in the Stockyard, open the Grounds group so that you can create a Clay. You may need to click one of the small buttons at the bottom of the Stockyard to display this group. You can move the mouse over each

🔋 Stockyard **р**х Common Bored Pile Borehole 🖥 Clay 🧢 Construction Site Force Ground Water Table H H-Pile 🙎 Party Pile Group Plane Ground 器 Rock Layer 🍓 Sand 📹 Situation Soil Layer Ĵ Common

button in turn to display a tooltip indicating which panels they control. Create the Clay by  $\tt Ctrl-clicking$  on it.

- 5. In the Property Inspector, change the Name of the new Clay to London Clay and enter the following properties: under the heading Strength > Drained Strength, Peak friction = 23°; under Strength > Undrained strength, Undrained strength = 100 kPa.
- In the Stockyard, open the Geotechnical Constituents group and create both a Soil Layer and a Borehole.
- Select Layer 1 in the Project Manager and then (in the Property Inspector) change its Name to Clay layer, its Thickness to 25 m, and select London Clay in its Soil box.
- Now select Borehole 1 in the Project Manager and (in the Property Inspector) rename it Wembley borehole. Next, press the Select ... button.

9. In the dialog box that appears, click on the >> button to move Clay layer from the Available layers box to the Selected layers box. Click OK to confirm the changes.

Select items to include in 'Wembley borehole'				
Available: (Clay layer		<u>S</u> elected:		
		Cancel		

[Docs]\Tutorials\Tutorial 2\Step 2.rpx captures everything you've done so far.

#### Step 3 – create the pile

In Step 3, you will create a bored pile and specify its cross-section and concrete grade.

- Right-click on the Stockyard and selected Concretes from the opup menu that appears. Then Ctrl-click on the concrete grade C35/45.
- In the Property Inspector, change the Young's modulus (E) of the new concrete to 19.5 GPa and its Name to Fleming's concrete.
- Open the Structural Elements group in the Stockyard and create a Bored Pile.

o Property Inspector	ά Χ
🖃 General	
Name	Fleming's concrete
Туре	Grade Concrete
Category	Concretes
and the second second	Materials

ar ten.	witz entra
<ul> <li>Cube strength</li> </ul>	Not specified MPa
🛨 Cylinder strength	35 MPa
Stiffness	
Young's modulus (E)	19.5 GPa
🛨 Poisson's ratio (v)	0.2
the first second states and	in a second second second

4. In the Property Inspector, change the Length of the new pile to 12.2 m and its Shaft diameter to 775 mm (its Base diameter will automatically increase to 775 mm). Finally, select Fleming's concrete in the Material name box.

[Docs]\Tutorials\Tutorial 2\Step 3.rpx captures everything you've done so far.

#### Step 4 – create the force

In Step 4, you will create the force applied to the pile.

- Open the Actions group in the Stockyard and create a Force.
- In the Property Inspector, change the Options > Variability flag of the new force to Permanent.
- Change Fz (under Components of action) to 2000 kN, whereupon the Resultant will automatically change to 2000 kN.

70	Property inspector	τ.
	General	
	Name	Force 1
	Туре	Force
	Category	Direct Action
	Kind	Actions
	Notes	
= 1	Location	
ĺ	Relative Positi	on
	X-position	0 m
	Y-position	0 m
	Depth	0 m
(	+ Absolute Posit	ion
=	Options	
Γ	Variability	Permanent
- (	Components of a	ction
0	+ Fx	0 kN
0	+ Fy	0 kN
0	+ Fz	2000 kN
0	+ Decultant	2000 KN

[Docs]\Tutorials\Tutorial 2\Step 4.rpx captures everything you've done so far.

#### Step 5 – sleeve the pile

In Step 5, you will sleeve the pile through the made ground.

- Open the Algorithms group in the Stockyard and create a No contact algorithm.
- 2. In the Property Inspector, change the Name of the new algorithm to Length in made ground and its Custom depth to 1.4 m. The Algorithm Option will automatically change to Custom depth. In the example calculation, the No contact depth will also change to 1.4 m



(which is depth of ground that the calculation will ignore when calculating shaft friction).

[Docs]\Tutorials\Tutorial 2\Step 5.rpx captures everything you've done so far.

#### Step 6 – create the scenario and calculation

In Step 6, you will create the scenario and calculation and link various items together.

- Open the Common group in the Stockyard and create a Situation.
- 2. In the Property Inspector, change the scenario's Duration to Transient (if not already set). Then, tick the following items so that they appear in this scenario (as you do so, they will appear on the Drawing Board):
  - Wembley borehole
  - Pile 1
  - Horizontal ground
  - Force 1



- Open the Calculations group in the Stockyard and create a Fleming's Analysis.
- In the Property Inspector, set the Scenario to Situation 1 and the No contact algorithm to Length in made ground.
- Enter the following values for the calculation's other properties:
   Ultimate shaft load (Us) = 1994 kN; Ultimate base load (Ub) =
   1002 kN; Base stiffness (Eb) = 33.125 MPa; Shaft flexibility (Ms)
   = 0.17%; and Effective column length (Ke) = 45%. These values are taken directly from Fleming's paper.
- 6. Finally, set the **Maximum settlement ratio** to 1%. This controls how much of the load vs displacement curve is generated. You

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want to go up to about 8 mm displacement, which is 1% of the pile diameter.

[Docs]\Tutorials\Tutorial 2\Step 6.rpx captures everything you've done so far.

#### Step 7 – perform and review the calculation

In Step 7, you will perform the calculation and produce a report showing the relationship between load and displacement.

 Run the calculation by selecting the Build tab on Repute's ribbon and then clicking on the button labelled Run Calculation 1.



- Repute performs the calculation and then changes to its Checking Desktop (which displays the Workbook and Graph Paper).
- 3. Your screen will now look something like this:



- 4. The **Graph Paper** displays a graph which is near-identical to Figure 6 in Fleming's paper, showing:
  - base load vs displacement (in blue)

- shaft load vs displacement (in pink)
- total load vs displacement (in green)
- 5. You can view the data on which this graph is based in the **Workbook** (left).

#### Step 8 – close the project

In Step 8, you will close and – optionally – save the project. (Note: this is not available in the Trial Edition.)

- 1. Close the project by clicking on the **File** menu's **Close** command.
- If you have made changes to the project since it was last saved, Repute will ask you if you want to save before proceeding. Answer Yes or No by clicking the appropriate button.
- 3. Repute will then (if requested) save and close the project.

You will find a copy of the project in its final form here:

[Docs]\Tutorials\Tutorial 2\Tutorial 2.rpx

#### What next?

Tutorial 3 shows you how to design a single pile in accordance with the requirements of Eurocode 7.

## Tutorial 3. Single pile design to Eurocode 7

#### Introduction

Tutorial 3 shows you how to design a single pile according to the requirements of Eurocode 7. The worked example is taken from Chapter 13 of the book *Decoding Eurocode 7* by Bond and Harris (2008), London: Taylor and Francis.

- Ground conditions comprise 8 m of medium strength sandy CLAY overlying medium dense gravelly SAND. The clay has a representative undrained strength of 45 kPa and a representative weight density of 18.5 kN/m³. The sand has a representative peak internal friction angle of 36°, zero effective cohesion, and representative weight density of 20 kN/m³. The sand's constant-volume angle of shearing-resistance is 33°.
- Groundwater at the site is at 1 m depth and skin friction above groundwater will be ignored.
- The pile studied is a 10 m long, 400 mm square pile made of concrete with characteristic weight density of 25 kN/m³.
- Vertical loads of 650 kN (permanent) and 250 kN (variable) will be applied to the pile.
- You want to determine the minimum pile length required by Eurocode 7 according to the National Annexes published in Ireland and in the United Kingdom.

Full hand calculations for this example are given as Examples 13.1 and 13.2 in Bond and Harris (2008).

This tutorial is written for users of the Standard, Enterprise, and Trial Editions of Repute only. Users of the Professional Edition should look at Tutorials 4-6.

#### Overview

• In Step 1, you will use the Project Wizard to enter project information, select design standards, and create a scenario to represent short-term conditions.

- In Step 2, you will use the Borehole Wizard to create a borehole containing the clay and sand layers.
- In Step 3, you will add a water table to the scenario.
- In Step 4, you will create a pile and specify its cross-section and concrete grade.
- In Step 5, you will use the Action Wizard to create the forces applied to the pile.
- In Step 6, you will use the Calculation Wizard to create a calculation and specify the design standard to use in that calculation.
- In Step 7, you will specify precise details of how you want the calculation to be performed.
- In Step 8, you will perform the calculations and review the results.
- In Step 9, you will create a second calculation, identical to the first but based on the UK National Annex to Eurocode 7.
- In Step 10, you will close (and optionally save) the project.

If Repute is not already running, open the program by pressing the Windows key, typing Repute 2.5 in the search bar, and clicking on the Repute 2.5 item that should appear. Once the splash screen has disappeared, Repute displays its Welcome screen.

If you have an existing project open, click **Close** on the program's **File** menu. (You will be prompted to save your work if you have not already done so.)

#### Step 1 – create the project

In Step 1, you will use the Project Wizard to enter project information, select design standards, and create a scenario to represent short-term conditions.

 Open the Project Wizard by selecting the Wizards tab on Repute's ribbon and then clicking on the Project Wizard button.

Rh 🕒 i	🎽 🖩 🕍					
File	Home	Insert	Scenario	Build	Wizards	Toe
	<b>,</b>		R	1		R
Project Wizard	Borehole Wizard	Pile <u>G</u> ro Wizard	oup <u>A</u> ctio I Wizaro	n <u>C</u> alc d Wiz	ulation I zard	mport : <u>G</u> roup
3		Wizar	ds			In

#### Page | 36

- 2. When the Wizard appears, type Tutorial 3 in the Project name box. Choose the folder where you want to save this project by using the Path control – for example, choose Desktop if you want to save the project on Windows' Desktop.
- Enter Single pile design to Eurocode 7 in the Description box and 03 in the Project ID box.

Project Wizard			×
	1. Enter the admin Project name Path Description Project ID	istrative details for y Tutorial S Desktop Single pile design to 03	vour project
	8	Cancel	S Next S Finish

- 4. Click **Next** to display page 2 of the Wizard. The design standards that appear here depend on which edition of Repute you are running (the Enterprise Edition supports more design standards than the Standard and Professional editions).
- 5. Select BS EN 1997-1:2004 and IS EN 1997-1:2005 by clicking on the relevant check boxes (a tick mark appears next to a standard when it is selected).

2. Select the design standards you want to use in this project				
AS 2159:2009	ENV 1997-1:1994			
BS 8004:1986	▼ IS EN 1997-1:2005			
BS 8004:2015	NTC 2008			
▼ BS EN 1997-1:2004	NTC 2018			
🔲 Custom Design Standard	SS EN 1997-1:2010			
EN 1997-1:2004				

 Click Next to display page 3. Keep the Number of scenarios as 1 but change the Design Situation of Scenario 1 to Transient.
3. Define the scenarios to create in this project					
Number of scenarios	1	\$			
Scenario	Design Situ	Jation			
Ι 1	Transie	nt			
	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				

- 7. Click **Next** to display the final page of the Wizard. If you wish to review any of the settings you have made, click **Back** to return to the relevant page.
- 8. Click **Finish** to generate the project. The Project Wizard then:
 - creates Site 1, Ground Surface 1, Design Standard 1 and Design Standard 2, and Situation 1
 - adds Ground Surface 1 to Situation 1
 - creates a new project named Tutorial 3.rpx containing all these items
- 9. Finally, rename the design standards to make it easier to identify them later, as follows. In the Project Manager, right-click on Design Standard 1 (under Design Standards > Limit State Standards) and select Properties The Property Inspector will appear. Change the Name of this standard to EC7 with UK NA.
- 10. Repeat the previous step for Design Standard 2, renaming it EC7 with Irish NA.

[Docs]\Tutorials\Tutorial 3\Step 1.rpx captures everything you've done so far.

Step 2 – create the borehole

In Step 2, you will use the Borehole Wizard to create a borehole containing the clay and sand layers.

- Open the Borehole Wizard by selecting the Wizards tab on Repute's ribbon and clicking on the Borehole Wizard button.
- 🖆 🔳 🔁 🏹 🗦 Wizards Build Z **Pile Group** Action Project Borehole Calculation Import Pile Wizard.. Wizard... Wizard... Wizard... Group Wizards Import
- 2. When the Wizard appears, set the number of layers to 2.



 Click Next to display page 2 of the Wizard. Change Layer 1's Ground type to Clay, it Thickness to 8 m, and its Weight density to 18.5 kN/m³. Leave Layer 2's Ground type as Sand and its Weight density as 20 kN/m³ but change its Thickness to 5 m.

2. Please specify the thickness and ground type of each layer								
	Layer	Layer Ground type Thickness Weight density						
	1	Clay 🔹	8 m	18.5 kN/m³				
I	2	Sand 🔹	5 m	20 kN/m³				

 Click Next to display page 3. Leave the clay's properties unchanged but change the sand's Internal friction to 35°. Leave its Cohesion at 0 kPa and leave the At Critical State? box unticked.

3. Please enter the drained strength properties of each soil						
Lay	yei	Soil Type	Internal friction	Cohesion	At Critical S	
1		Clay	25 °	0 kPa		
1 2	2	Sand	35 °	0 kPa		

Click Next to display page 4. The sand does not appear on this page since – as a fine soil – it does not have undrained strength. Change the Undrained Strength (top) and Undrained Strength (bottom) of the clay to 45 kPa.



- 6. Click **Next** to display page 5. Since the ground profile does not include rock, there is nothing to set on this page.
- Click Next to display page 6. Leave the stiffness properties (i.e.
 Shear Modulus) of both layers unchanged.
- 8. Click Next to display page 7. Tick Situation 1 to add the new borehole to that scenario.
- 9. Click **Next** to display the final page of the Wizard. If you wish to review any of the settings you have made, click **Back** to return to the relevant page.
- 10. Click **Finish** to generate the borehole. **The Borehole Wizard** then:
 - creates Soil 1 and Soil 2, Layer 1 and Layer 2, and Borehole 1
 - links Soil 1 to Layer 1
 - links Soil 2 to Layer 2
 - adds Layer 1 and Layer 2 to Borehole 1

[Docs]\Tutorials\Tutorial 3\Step 2.rpx captures everything you've done so far.

Step 3 – add a water table

In Step 3, you will add a water table to the scenario.

 Open the Stockyard's Geotechnical Constituents panel by selecting the Insert tab on Repute's ribbon and



then clicking on the Geotechnical Constituents button.

2. Hold the Ctrl key down and click on the item labelled Ground Water Table. The newly created water table will appear in the Project Manager (under Geotechnical Constituents > Water Tables).

- 3. In the Property Inspector (under Location > Relative Position), change the Depth of Water Table 1 to 1 m.
- In the Project Manager, select Situation 1 (under Scenarios > Situations).
- In the Property Inspector, place a tick next to Water Table 1 (under Geotechnical Constituents) to add the water table to this scenario. The Drawing Board will refresh.
- 6. In this step, you have:
 - created Water Table 1
 - added Water Table 1 to Situation 1

[Docs]\Tutorials\Tutorial 3\Step 3.rpx captures everything you've done so far.

Step 4 – create the pile

In Step 4, you will create a pile and specify its cross-section and concrete grade.

1. Display Repute's Construct desktop by



selecting the **View** tab and clicking on the **Construct** button. The program will display the **Drawing Board**, **Project Manager**, and **Stockyard**.

- Right-click anywhere inside the Stockyard to display its context menu and select the Concretes command. The Concretes group will open.
- 3. Create the concrete by holding the Ctrl key down and clicking on C30/37. (When the Ctrl key is pressed, Repute automatically creates an instance of the item that is selected in the Stockyard.) The newly created concrete will appear in the Project Manager (under Materials > Concretes).
- 4. Next, click on the **Stockyard**'s Structural Elements caption (near the bottom of the Stockyard). The **Structural Elements** group will open.

- 5. Create the pile by holding the Ctrl key down and clicking on Square Pile. The newly created pile will appear in the Project Manager (under Structural Elements > Piles).
- In the Project Manager, right-click on Pile 1 and select
 Properties The Property Inspector will appear.
- 7. In the Property Inspector, change the Material name (under Material Properties) from Not specified to Concrete 1. Then change the pile's Length (under Dimensions) to 10 m and its Breadth (under Section Properties) to 400 mm. Leave all other properties of the pile unchanged.

Dimensions	
H Length	10 m
Free-standing length	0 m
Embedded length	10 m
+ Rake	0 °
Rake orientation	0 °
X-rake	0 °
	0 °
X-gradient	INF
Y-gradient	INF
Material Properties	
Material name	Concrete 1
 Mass density 	2549 kg/m ³
E (Young's modulus)	32.84 GPa
Anisotropy	1
Section Properties	
🗉 Breadth	400 mm
Circumference	160 cm

- Returning to the Project Manager, select Situation 1 (under Scenarios > Situation).
- 9. In the Property Inspector, place a tick next to Pile 1 (under Structural Elements) to add the pile to this scenario. The Drawing Board will refresh.
- 10. In this step, you have:
 - created Concrete 1 and Pile 1
 - linked Concrete 1 to Pile 1
 - added Pile 1 to Situation 1

[Docs]\Tutorials\Tutorial 3\Step 4.rpx captures everything you've done so far.

Step 5 – create the forces

In Step 5, you will use the Action Wizard to create the forces applied to the pile.

 Open the Action Wizard by selecting the Wizards tab on Repute's ribbon



and clicking on the Action Wizard button.

- 2. When the Wizard appears, increase the No. of forces to 2; Force 1 and Force 2 will be created.
- 3. Set the Fz value for Force 1 to 650 kN and change its Variability to Permanent. Then set the Fz value for Force 2 to 250 kN but keep its Variability as Variable. Leave all other properties unchanged (at zero).

	•			•	,				
	1. Define the forces to create in this project								
r	No. of forces			2	\$				
_									
	Force	Fx (kN)	Fy (kN)	Fz (kN)	Variability	x (m)	y (m)	Depth (m)	
	1	0 kN	0 kN	650 kN	Permanent	0	0	0	
	2	0 kN	0 kN	250 kN	Variable 🔹	0	0	0	
	Armed.	الم المعين	M. A.	and we all	a series of	and a		and the second	

- 4. Click **Next** to display page 2 of the Wizard. Since no moments are applied to the pile, leave the **No. of moments** as 0.
- 5. Click Next to display page 3. Increase the No. of combinations to 1; Combination 1 will be created. Click on the label None selected under the column Forces to include and then tick Force 1 and Force 2.



- Click Next to display the last page of the Wizard. If you wish to review any of the settings you have made, click Back to return to the relevant page.
- Click Finish to generate the actions and their combination. The Actions Wizard will then:
 - create Force 1 and Force 2
 - create Combination 1
 - add Force 1 and Force 2 to Combination 1
- Returning to the Project Manager, select Situation 1 (under Scenarios > Situations).

9. Then, in the **Property Inspector**, place a tick next to Combination 1 (under Actions) to add the combination to this scenario. The **Drawing Board** will refresh.

[Docs]\Tutorials\Tutorial 3\Step 5.rpx captures everything you've done so far.

Step 6 – create the calculation

In Step 6, you will use the Calculation Wizard to create a calculation and specify the design standard to use in that calculation.

Open the Calculation
 Wizard by selecting the
 Wizards tab on Repute's
 ribbon and then clicking
 on the Calculation
 Wizard button.



2. When the Wizard appears, tick Longitudinal ULS. (The calculations that appear here depend on which edition of Repute you are running. The Enterprise Edition provides more calculations than the Standard and Professional editions.)



 Click Next to display page 2 of the Wizard. Select EC7 with Irish NA.



- Click Next to display page 3. Tick Situation 1. 4.
- Click Next to display the final page of the Wizard. If you wish to 5. review any of the settings you have made, click **Back** to return to the relevant page.
- 6. When you are ready, click **Finish** to generate the first calculation. The Calculation Wizard then:
 - creates Calculation 1
 - links Situation 1 to Calculation 1
 - links EC7 with Irish NA to Calculation 1

[Docs]\Tutorials\Tutorial 3\Step 6.rpx captures everything you've done so far.

Step 7 – customize the calculation

In Step 7, you will specify precise details of how the calculation is to be performed, following the decisions made by Bond and Harris, 2008.

1. Open the Stockyard's Algorithms group by



Insert tab on Repute's ribbon and then clicking on the Algorithm button.

2. Hold the CTRL key down and click on No contact algorithm in the Stockyard. Then, in the Property Inspector, change the Name of the new algorithm to No skin
friction and enter Ignore skin friction above
water table in its Notes field. Enter a value of 1.0 m into the
Custom depth box, whereupon Algorithm > Option will
automatically change to Custom depth.

3. Hold the CTRL key down and click on Alpha in the Stockyard. Change the Name of the new algorithm to Alpha in clay and enter From US Army Corps of Engineers in its Notes

Reference	*
Algorithm	
Option	Custom alpha 🔹 👻
🛨 Custom alpha	0.8
Example Calculation	
🛨 Undrained strength	50 kPa
Uertical effective stress	100 kPa
Slenderness ratio	10
🛨 Alpha	0.8
Links	

field. Enter a value of 0.8 into the **Custom alpha** box, whereupon **Algorithm > Option** will automatically change to Custom alpha.

- 4. Hold the CTRL key down and click on Earth pressure coefficient in the Stockyard. Change the Name of the new algorithm to Ks in sand and enter Nq/50 in its Notes field. Enter a value of 1.59 into the Custom compression coefficient box, whereupon Algorithm > Option will automatically change to Custom earth pressure coefficient.
- 5. Hold the CTRL key down and click on Wall friction in the Stockyard. Change the Name of the new algorithm to Delta in sand and enter critical state friction angle in its Notes field. Enter a value of 33° into the Custom friction value box, whereupon Algorithm > Option will automatically change to Custom friction value.
- 6. Hold the CTRL key down and click on Bearing capacity algorithm in the Stockyard. Change the Name of the new algorithm to Nq in sand. Change the Option to Berezantzev. In the Example Calculation group, change the

Angle of shearing resistance to 35° and the Slenderness ratio to 25. The value of Nq will update (to 47.23), while Nc remains Not specified (Berezantzev's algorithm is only applicable to sands, hence N_c is not available).

- In the Project Manager (under Calculations > Single Pile Calculations), select Calculation 1.
- 8. In the **Property Inspector**, link the calculation to the algorithms you have just created by selecting the appropriate items in the drop-down boxes next to the following headings.
- 9. Under Algorithms:
 - No contact algorithm select No skin friction
- 10. Under Soils:
 - Undrained adhesion select Alpha in clay
 - Earth pressure coefficient select Ks in sand
 - Wall friction (delta/phi) select Delta in sand
 - Bearing capacity in soil select Nq in sand
- 11. Finally, set the Drainage condition to Undrained to tell the program to base the calculation in clay on total stresses.

👂 Property General Name Calculation 1 Longitudinal ULS Type Category Single Pile Calculations Kind Calculations Notes Created by the Calculation Links Scenario Situation 1 Design Standard EC7 with Irish NA Options Drained Output Undrained Minimum no of nodes 100 Maximum node spacing 1 m Tanore nile self-weight Factor shaft and base : Algorithms No contact algorithm No skin friction Skin friction limit Bearing pressure limit Plugging Soils Undrained adhesion Alpha in clay Beta Earth pressure coef Ks in sand Wall friction (delta/r Delta in sand Bearing capacity in : Ng in sand Rocks

[Docs]\Tutorials\Tutorial 3\Step 7.rpx captures everything you've done so far.

Step 8 – perform and review the calculations

In Step 8, you will perform the calculation and review the results.

 Run the calculation by selecting the **Build** tab on Repute's ribbon and then



clicking on the Run Calculation 1 button.

 Repute will perform the specified calculation and then change to its Check Desktop (which displays the Workbook and Graph Paper). Your screen will now look something like this:



3. The Graph Paper (middle panel) shows the:

- effect of actions (*E*, equal to the sum of the applied forces and the self-weight of the pile) increasing with depth
- separate components of tensile resistance (*R*t), base resistance (*R*b), and shaft resistance (*R*s) also increasing with depth
- the total compressive resistance $(R_c = R_s + R_b)$ exceeding the effect of actions $(R_c > E)$ at a depth between 11 and 12 m
- 4. The Workbook (left panel) shows the same information in tabular format. The Workbook contains a lot more information than is initially shown. To display this additional information, click on the button in the top-left-hand corner (labelled *) and select the data you want to see. The picture here shows results for the depth 10 m.

General	Act	ions	M	aterial Propert	ies			Effects of Ac		Resis	tance	
donordi	Design	values		Design values				Design value		Design	values	
Depth (m)	F,d (kN)	W,d (kN)	phi,d (°)	c,d (kPa)	cu,d (kPa)	Skin friction (kPa)	Bearing pressure (kPa)	E,d (kN)	Rst,d (kN)	Rs,d (kN)	Rb,d (kN)	Rt,d (kN)
9.29	975	37.17	36	0		95.55	7253.16	1012.17	-209.55	257.91	510.11	768.0
9.39	975	37.58	36	0		96.61	7281.05	1012.58	-215.1	264.74	512.07	776.8
9.49	975	37.98	36	0		97.67	7310.15	1012.98	-220.71	271.64	514.12	785.7
9.6	975	38.38	36	0		98.73	7340.39	1013.38	-226.37	278.61	516.25	794.8
9.7	975	38.79	36	0		99.8	7371.69	1013.79	-232.1	285.67	518.45	804.1
9.8	975	39.19	36	0		100.86	7403.99	1014.19	-237.89	292.79	520.72	813.5
9.9	975	39.6	36	0		101.92	7437.22	1014.6	-243.75	300	523.06	823.05
10	975	40	36	0	-	102.99	7471.33	1015	-249.66	307.27	525.46	832.7
10.1	975	40.4	36	0	-	104.05	7506.26	1015.4	-255.64	314.63	527.91	842.54
10.2	975	40.81	36	0		105.11	7541.97	1015.81	-261.67	322.06	530.42	852.41
10.3	975	41.21	36	0	-	106.18	7578.41	1016.21	-267.77	329.56	532.99	862.55
10.4	975	41.62	36	0		107.24	7615.53	1016.62	-273.93	337.14	535.6	872.7
10.51	975	42.02	36	0	-	108.3	7653.31	1017.02	-280.15	344.8	538.25	883.06
10.61	975	42.42	36	0		109.37	7691.7	1017.42	-286.43	352.53	540.95	893.49

- 5. The results calculated by Repute differ from those given in the book by Bond and Harris (2008), where a model factor on resistance of 1.5 was used (following the draft Irish National Annex). Instead, Repute uses the value 1.75 that appears in the published version of that Annex.
- 6. You can check this by selecting the View tab on Repute's ribbon and then clicking on the Specify button. Then, select EC7 with Irish NA in the Project Manager to display its properties in the Property Inspector – the value given for Options > Model factor on resistance is 1.75.



A Repute project that reproduces Bond and Harris's results can be found here:

[Docs]\Examples\Bond and Harris (2008) Ex 13.1.rpx.

Step 9 – change the design standard

In Step 9, you will create a second calculation, identical to the first but based on the UK National Annex to Eurocode 7.

 Returning to the Project Manager, create a copy of Calculation 1 by right-clicking on it (look under Calculations > Single Pile Calculations) and selecting the Edit > Duplicate command.

- In the Property Inspector, change the Name of the newly created calculation to UK calculation and its Design Standard to EC7 with UK NA.
- In the Project Manager, select the Design
 Standard EC7 with

80	Property Inspector	₽ X
Ξ	General	
	Name	UK calculation
	Туре	Longitudinal ULS
	Category	Single Pile Calculations
	Kind	Calculations
	Notes	Created by the Calculation 🔻
Ξ	Links	
	Scenario	Situation 1
	Design Standard	EC7 with UK NA 🔹
Ξ	Options	
	Distant e condition	 Q

UK NA (under Design Standards > Limit State Standards).

4. Then in the Property Inspector, set Options > Pile testing to Investigation tests. The values of the model factor and the resistance factors will change. This setting is appropriate when the calculated resistance will be checked by static pile load tests taken to ultimate load. 5. In the Project Manager, select the UK calculation (under Calculations > Singler Pile Calculations) and then run the calculation by selecting the Build tab on Repute's ribbon and clicking on the Run UK calculation button. Your screen will now look something like this:



[Docs]\Tutorials\Tutorial 3\Step 9.rpx captures everything you've done so far.

Step 10 – close the project

In Step 10, you will close and – optionally – save the project. (Note: this is not available in the Trial Edition.)

- 1. Close the project by clicking on the File menu's **Close** command.
- If you have made changes to the project since it was last saved, Repute will ask you if you want to save before proceeding. Answer Yes or No by clicking the appropriate button.
- 3. Repute will then (if requested) save and close the project.

You will find a copy of the project in its final form here:

[Docs]\Tutorials\Tutorial 3\Tutorial 3.rpx

What next?

Tutorial 4 shows how the boundary element method can be used to analyse a pile group.

Tutorial 4. Pile group in clay and sand

Introduction

Tutorial 4 demonstrates how the boundary element method can be used to analyse a pile group. The worked example involves a group of four bored piles in stiff clay overlying dense sand:

- Ground conditions comprise 8m of stiff clay overlying dense sand. Both soils will be modelled as linear elastic materials.
- The stiff clay has a vertical Young's modulus of 40 MPa and a horizontal modulus of 20 MPa, with Poisson's ratio equal to 0.5.
- The dense sand has the same Young's modulus vertically and horizontally, equal to 50 + 10 z MPa (where z is the depth below the top of the sand in metres), and Poisson's ratio equal to 0.3.
- The bored piles are installed on a 2 x 2 grid, at 3 m spacing (centreto-centre). Each pile is 20 m long, 1050 mm in diameter, with a Young's modulus (vertically and horizontally) of 30 GPa.
- A characteristic vertical force of 12 MN (permanent), horizontal force of 1 MN (variable), and moment of 2 MNm (variable) are applied at the centre of the pile group.
- You want to determine the displacement and rotation of the pile cap under serviceability conditions.

This tutorial is written for users of the Professional, Enterprise, and Trial Editions of Repute only. Users of the Standard Edition should look at Tutorials 1-3.

Overview

- In Step 1, you will use the Project Wizard to enter project information and create a scenario to represent a persistent design situation.
- In Step 2, you will use the Pile Group Wizard to create a 2 x 2 pile group and specify the piles' properties.
- In Step 3, you will use the Borehole Wizard to create a borehole containing stiff clay and dense sand layers.
- In Step 4, you will enter the stiffness parameters for Soils 1 and 2.

- In Step 5, you will use the Action Wizard to create the actions applied to the pile group.
- In Step 6, you will use the Calculation Wizard to create the calculation you want Repute to perform.
- In Step 7, you will perform the calculation and review the results.
- In Step 8, you will produce a report summarising the calculation.
- In Step 9, you will close and (optionally) save the project.

If Repute is not already running, open the program by pressing the Windows key, typing Repute 2.5 in the search bar, and clicking on the Repute 2.5 item that should appear. Once the splash screen has disappeared, Repute displays its Welcome screen.

If you have an existing project open, click **Close** on the program's **File** menu. (You will be prompted to save your work if you have not already done so.)

Step 1 – create the project

In Step 1, you will use the Project Wizard to enter project information and create a scenario to represent the design situation to be analysed.

 Open the Project Wizard by selecting the Wizards tab on Repute's ribbon and then clicking on the Project Wizard button.



- 2. When the Wizard appears, type Tutorial 4 in the **Project** name box. Choose the folder where you want to save this project by using the **Path** control. If you do not change the setting here, the file will be saved in your Documents folder.
- 3. Enter Pile group in clay and sand in the Description box and 04 in the Project ID box.
- 4. Click **Next** to display page 2 of the Wizard. Since we are not going to use a design standard, there is nothing to set on this page.

- Click Next to display page 3. In the table, change the Design
 Situation of Situation 1 to Persistent (if it is not already set).
- Click Next to display the final page of the Wizard. If you wish to review any of the settings you have made, click Back to return to the relevant page.
- When you are ready, click Finish to generate the project. The Project Wizard then:
 - creates Site 1, Ground Surface 1, and Situation
 1
 - adds Ground Surface 1 to Situation 1
 - creates a new project Tutorial 4.rpx containing all these items

[Docs]\Tutorials\Tutorial 4\Step 1.rpx captures everything you've done so far.

Step 2 – create the pile group

In Step 2, you will use the Pile Group Wizard to create a 2 x 2 pile group and specify the piles' properties.

Open the Pile Group
 Wizard by selecting the
 Wizards tab on Repute's
 ribbon and clicking on

 Image: Second Control of Control of

the Pile Group Wizard button.

2. When the Wizard appears, choose the Predefined plan arrangement and change the Total number of piles to 4. The picture on the lefthand side of the Wizard will change to show you the default 2 x 2 pile arrangement. Change the



Spacing between the piles to 3000 mm but leave the **Cover** at its default value (150 mm).

1. Specify the plan arrange	 Specify the plan arrangement and number of piles 				
Choose a plan arrangeme	ent				
Predefined	O Q	ustom			
Select the number of pile	s				
Total number of piles	4	*			
Specify the dimensions					
· · · · ·					
🗄 🛄 Spacing (s)		3000 mm			
🗉 🔜 Cover (c)		150	-		

 Click Next to display page 2 of the Wizard. If not already set, set the pile type to (Cast-in-place Concrete) Bored Pile.

Choose the pile type		
choose the pile type		
(Cast-in-place Concret	e) <u>B</u> ored Pile	
Cast-in-place Concret	e) <u>A</u> ugered Pile	
O (Pre-cast Concrete) So	uare Pile	
O (Pre-cast Concrete) Sp	un Pile	
Micropile		
🔘 (Steel) <u>H</u> Pile		
(Steel) Pipe Pile		

 Click Next to display page 3. Change the Concrete class to C20/25 and the Diameter/Breadth to 1050 mm. By default, this concrete's Young's modulus will be set to 30 GPa (not shown).

3. Select the pile mate	rial and section	
Choose the material		
Concrete class	C20/25	•
Steel grade	S235	-
Choose the section		
Diameter/Breadth	1050 mm	•
H-section	HP 10 x 57	-
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~	

5. Click Next to display page 4. Change the Embedded length (L) to 20 m but leave the Upstand (U) as 0 m.



 Click Next to display page 5. Leave all the values on this page as zero – this will position the pile group centrally in the co-ordinate system (and not rotated).



- Click Next to display page 6. Tick Situation 1 to add the pile group to the scenario.
- 8. Click **Next** to display the last page of the Wizard. If you wish to review any of the settings you have made, click **Back** to return to the relevant page.

- When you are ready, click Finish to generate the pile group. The Pile
   Group Wizard then:
  - creates Piles 1 to 4
  - creates Pile Group 1
  - creates Concrete 1
  - links Piles 1 to 4 to Concrete 1
  - adds Piles 1 to 4 to Pile Group 1
  - adds Pile Group 1 to Situation 1
- In the Property Inspector, set the Pile Cap > Pile cap thickness to 1.5 m and press ENTER.

[Docs]\Tutorials\Tutorial 4\Step 2.rpx captures everything you've done so far.

# Step 3 – create the borehole

In Step 3, you will use the Borehole Wizard to create a borehole containing stiff clay and dense sand layers.

 Open the Borehole Wizard by selecting the Wizards tab on Repute's ribbon and clicking on the Borehole Wizard button.



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Home Insert Scenario Build Wizards

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- 2. When the Wizard appears, increase the number of layers to 2.
- 3. Click Next to display page 2 of the Wizard. Change the Ground type of Layer 1 to Clay, its Thickness to 8 m, and its Weight density to 18 kN/m³. Leave the Ground type of Layer 2 as Sand but change its Thickness to 20 m and its Weight density to 21.5 kN/m³.



2	2. Please specify the thickness and ground type of each layer								
	Layer	Ground typ	e	Thickness	Weight density				
	1	Clay	+	8 m	18 kN/m³				
>	2	Sand	+	20 m	21.5 kN/m³				

 Click Next to display page 3. Change the Internal friction angle of Layer 1 to 25° and that of Layer 2 to 36°. Leave the Cohesion of both soils as 0 kPa and the At Critical State? boxes unchecked.

3. Please enter the drained strength properties of each soil						
Layel Soil Type Internal friction Cohesion At Critical S						
1	Clay	25 °	0 kPa			
1 2	Sand	36 °	0 kPa			

5. Click Next to display page 4. Change the Undrained strength (top) of Layer 1 to 100 kPa and its Undrained strength (bottom) to 600 kPa. This strength increase will occur over the full thickness of Layer 1, i.e. 8 m (as specified above). Layer 2 does not appear on this page because – as a sand – it has no undrained properties.



- 6. Click **Next** to display page 5. Since the ground profile does not include rock, there is nothing to set on this page.
- 7. Click **Next** to display page 6. For Layer 1, to obtain a largestrain undrained Young's modulus  $E_u = 40$  MPa, enter its **Shear modulus G1** as 13.33 MPa, which is equal to  $E_u/2(1 + v_u) = E_u/3$ , with a Poisson's ratio  $v_u = 0.5$ . Leave its **Shear Modulus G0** value as 100 MPa.
- 8. For Layer 2, to obtain a large-strain drained Young's modulus E' = 50 MPa, enter its **Shear modulus G1** as 19.23 MPa which is equal to E'/2(1 + v) = E'/2.6, with a Poisson's ratio v = 0.3. Leave its **Shear Modulus G0** value as 100 MPa.

Layer         Ground Type         Shear Modulus G0         Shear Modulus G1           1         Clay         100 MPa         13.33 MPa	6. Please enter stiffness properties for each ground type							
1 Clay 100 MPa 13.33 MPa		Layer	Ground Type	Shear Modulus G0	Shear Modulus G1			
		1	Clay	100 MPa	13.33 MPa			
2 Sand 100 MPa 19.23 MPa	>	2	Sand	100 MPa	19.23 MPa			

- 9. Click Next to display page 7. Tick Situation 1 to add the borehole to the scenario.
- 10. Click **Next** to display the last page of the Wizard. If you wish to review any of the settings you have made, click **Back** to return to the relevant page.
- 11. When you are ready, click **Finish** to generate the borehole. The **Borehole Wizard** then:
  - creates Soils 1-2
  - creates Layers 1-2
  - creates Borehole 1
  - links Soil 1 to Layer 1
  - links Soil 2 to Layer 2
  - adds Layers 1-2 to Borehole 1
  - adds Borehole 1 to Situation 1

[Docs]\Tutorials\Tutorial 4\Step 3.rpx captures everything you've done so far.

#### Step 4 – modify the soils' stiffness properties

In Step 4, you will modify the stiffness properties of Soils 1 and 2.

- 1. Select Soil 1 in the Project Manager (under Materials > Soils).
- In the Property Inspector, change the value of Stiffness > Undrained Young's modulus (Eu) > Large strain stiffness > Undrained Young's modulus (Eu) to 40 MPa (from 39.99 MPa).
- 3. The **Stiffness ratio G1/G0** is shown as 13.33%, which is obtained by dividing the **Small strain stiffness > Shear modulus (G)** value of 100 MPa (=  $G_0$ ) by **Large strain stiffness > Shear modulus (G)** value of 13.33 MPa (=  $G_1$ ). Look under the heading **Stiffness > Shear modulus (G)** for these values.

- Type 0.5 in the Stiffness > Anisotropy box to change the Large strain stiffness > Horizontal Young's modulus (Eh) value to 20 MPa (i.e. 40 MPa x 0.5).
- Back in the Project Manager, select Soil 2. The Property Inspector will change to display its properties.
- Under the heading Depth, check that Reference depth 1 (z,ref1) is equal to 8 m (this is the top of the soil layer) and Reference depth 2 (z,ref2) is equal to 28 m (this is the bottom of the layer).
- 7. Under the heading **Stiffness**, check that the **Poisson's ratio (v)** of this soil is equal to 0.3.
- 8. Under the heading Young's modulus (E) > Large-strain stiffness, expand the heading Variation with depth by clicking on the + button. Enter 250 MPa into the E',ref2 box. The value of Young's modulus gradient (dE/dz) will change to 10 MN/m³ equal to (E',ref1 E',ref2) / (z,ref1 z,ref2) = (250 MPa 50 MPa)/(28 m 8 m).

[Docs]\Tutorials\Tutorial 4\Step 4.rpx captures everything you've done so far.

# Step 5 – create the forces and moments

In Step 5, you will use the Action Wizard to create loads applied to the pile group.

 Open the Action Wizard by selecting the Wizards tab on Repute's ribbon and clicking on the Action Wizard button.



2. When the Wizard appears, increase the No. of forces to 2. Set the Fz value of Force 1 to 12000 kN, its Variability to Permanent, and its Depth to -1.5 m. Set the Fx value of Force 2 to 1000 kN, its Fz value to 0 kN, and its Depth to -1.5 m but leave its Variability as Variable.

1. Define the forces to create in this project								
No. of forces			2 ‡					
	Force	Ex (kN)	Ev (kN)	F7 (KN)	Variability	x (m)	v (m)	Depth (m)
	1		0 60	12000 kN	Permanent	× (iii)	y (m)	-1.5
5	2	1000 kN	0 kN	0 kN	Variable	0	0	-1.5
É	-	1000 KN	U KN	U KN	Variable	5	0	1.5

3. Click Next to display page 2 of the Wizard. Increase the No. of moments to 1. Set the My value of Moment 1 to 500 kNm and its Depth to -1.5 m but leave its Variability as Variable.



Click Next to display page 3. Increase the No. of combinations to
 Under the column Forces to include, click the text None
 selected and then tick Force 1 and Force 2. Click away.
 Then, under the column Moments to include, click the text None

selected and then tick Moment 1. Click away.

3. Define the combinations of actions to create in this project						
No. of combinations			1	¢		
		-				
	Combination	Forces to	include			Moments to include
I	1	Force 1;Fo	orce 2			Moment 1
_						

- 5. Click **Next** to display the last page. If you wish to review any of the settings you have made, click **Back** to return to the relevant page.
- 6. When you are ready, click Finish to generate the actions and their combination. The **Actions Wizard** then:
  - creates Forces 1 and 2
  - creates Moment 1
  - creates Combination 1
  - adds Forces 1 and 2 and Moment 1 to Combination 1

- Going back to the Project Manager, select Situation 1 7. (under Scenarios > Situations).
- 8. Then, in the Property Inspector, tick Combination 1 (under Actions) to add the combination to this scenario. The **Drawing** Board will automatically update.

[Docs]\Tutorials\Tutorial 4\Step 5.rpx captures everything you've done so far.

#### Step 6 – create the calculation

In Step 6, you will use the Calculation Wizard to create the calculation you want Repute to perform.

1. Open the Calculation Wizard by selecting the Wizards tab on Repute's ribbon and then clicking



the Calculation Wizard button.

2. When the Wizard appears, select Boundary Element Analysis. (The calculations that appear here depend on which edition of Repute you are running. The Enterprise Edition provides more calculations than the Standard and Professional editions.)



- 3. Click **Next** to display page 2 of the Wizard. Since there are no design standards to select from, there is nothing to do on this page.
- Click Next to display page 3. Select Situation 1 to link the 4. boundary element analysis to that scenario.

- Click Next to display the last page of the Wizard. If you wish to review any of the settings you have made, click Back to return to the relevant page.
- When you are ready, click Finish to generate the calculation. The Calculation Wizard then:
  - creates Calculation 1
  - links Calculation 1 to Situation 1
- 7. In the Property Inspector, for Calculation 1, change the Stress-strain model (under Options) to Linear-elastic. The strength of the soils is irrelevant in a linearelastic analysis and hence it does not matter whether the Drainage condition is set to Drained or Undrained.

o Property Inspector 🖃 General Name Calculation 1 Туре Boundary Element Analysis Category Pile Group Calculations Calculations Notes Created by the Calculation 🗆 Links Scenario Situation 1 Design Standard Options Drained O Undrained Drainage condition Pilecap stiffness Fully-rigid Stress-strain model Linear-elastic Poulos Yamashita Laver averaging Save results Advanced options

[Docs]\Tutorials\Tutorial 4\Step 6.rpx captures everything you've done so far.

# Step 7 – perform and review the calculation

In Step 7, you will perform the calculation and review the results.

 Run the calculation by selecting the Build tab on Repute's ribbon and clicking on the Run Calculation 1 button.



- 2. Repute will run Calculation 1 and then change its display to show its Checking Desktop (which displays the Workbook and Graph Paper). You can switch to this display at any time by clicking on the Check button on the View tab of Repute's ribbon.
- 3. Your screen will now look something like this:

4.



To display the force distribution along the piles, select **Axial force Fz** in the drop-down box labelled **Pile Group** on the **Graph Paper** tab. The graph will change to display:



#### Step 8 – close the project

In Step 8, you will close and – optionally – save the project. (Note: this is not available in the Trial Edition.)

- 1. Close the project by clicking on the **File** menu's **Close** command.
- If you have made changes to the project since it was last saved, Repute will ask you if you want to save before proceeding. Answer Yes or No by clicking the appropriate button.
- 3. Repute will then (if requested) save and close the project.

You will find a copy of the project in its final form here:

[Docs]\Tutorials\Tutorial 4\Tutorial 4.rpx

#### What next?

Tutorial 5 shows you how to set up a non-linear boundary element analysis of a pile group in stiff clay overlying rock.

# Tutorial 5. Pile group in stiff clay over a rigid layer

#### Introduction

This tutorial demonstrates non-linear boundary element analysis of a pile group. It shows you how to:

- Specify a non-linear analysis
- Introduce a rigid layer into the calculations
- Produce a load displacement graph for the pile cap
- Print the results of your calculations

The worked example involves the analysis of a group of 4 piles installed in stiff clay overlying a rigid layer.

- The ground conditions at the site comprise 35 m of stiff clay (Young's modulus 75 + 10 z MPa vertically and half that horizontally, where z is the depth below the top of the layer; Poisson's ratio 0.5) overlying a rigid layer.
- A non-linear soil model will be used for the clay, with unit weight 19.8 kN/m³, undrained strength 75 + 10 z kPa, and adhesion factor 0.5.
- The water table is at the ground surface.
- The piles will be installed on a 2 x 2 grid, at 3 m spacing (centre-tocentre) along the edge of the grid. Each pile is 20 m long, 1.05 m in diameter, with a free-standing length of 0.5 m and Young's modulus of 30 GPa (both axially and laterally). This is the same pile group as was used in Step 2 of Tutorial 4.
- You are interested in the displacements and rotation of the pile cap under a combined vertical load of 20 MN, horizontal load of 2 MN, and moment of 3 MNm. The loads will be applied at the centre of the pile cap.
- Hyperbolic curve fitting constants of 0.5 (for the shaft), 0.99 (for the base), and 0.9 (for lateral response) should be used.

This tutorial is written for users of the Professional, Enterprise, and Trial Editions of Repute only. Users of the Standard Edition should look at Tutorials 1-3.

#### Overview

- In Step 1, you will use the Project Wizard to enter project information and create a scenario to represent the design situation to be analysed.
- In Step 2, you will create four piles and connect them together in a pile group.
- In Step 3, you will create a stiff clay and specify its properties.
- In Step 4, you will create a layer, borehole, and water table.
- In Step 5, you will create a force, moment, and combination of actions (to combine the force and moment).
- In Step 6, you will create the calculation that you want Repute to perform.
- In Step 7, you will perform the calculation.
- In Step 8, you will export results to a Microsoft Excel spreadsheet.
- In Step 9, you will close and (optionally) save the project.

If Repute is not already running, open the program by pressing the Windows key, typing Repute 2.5 in the search bar, and clicking on the Repute 2.5 item that should appear. Once the splash screen has disappeared, Repute displays its Welcome screen.

If you have an existing project open, click **Close** on the program's **File** menu. (You will be prompted to save your work if you have not already done so.)

# Step 1 – create the project

In Step 1, you will use the Project Wizard to enter project information and create a scenario to represent the design situation to be analysed.

 Open the Project Wizard by selecting the Wizards tab on Repute's ribbon and then clicking on the Project Wizard button.

Rh 🕒 🔒	🎽 H 😫					
File	Home	Insert	Scenario	Build	Wizards	Тоо
	<b>,</b>		R	1		R
Project Wizard.	<u>B</u> orehole Wizard	Pile <u>G</u> ro Wizard	up <u>A</u> ctio Wizaro	n <u>C</u> alc d Wia	ulation zard	Import ⁽ <u>G</u> roup
64		Wizard	ls			- b

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- 2. When the Wizard appears, type Tutorial 5 in the Project name box. Choose the folder where you want to save this project by using the Path control. (If you do not change the setting here, it will be saved in your Documents folder.) Enter Pile group in stiff clay over a rigid layer in the Description box and 05 in the Project ID box.
- 3. Click **Next** to display page 2 of the Wizard. Since we are not going to use a design standard, there is nothing to set on this page.
- 4. Click Next to display page 3. Since the Design Situation of Situation 1 is already set to Persistent, there is nothing to change on this page.
- 5. Click **Next** to display the final page of the Wizard. If you wish to review any of the settings you have made, click **Back** to return to the relevant page.
- Click Finish to generate the project.
   The Project Wizard then:
  - creates Site 1, Ground
     Surface 1, and Situation
     1
  - adds Site 1 and Ground Surface 1 to Situation 1
  - creates a new project with Tutorial 5.rpx with all these items in it



[Docs]\Tutorials\Tutorial 5\Step 1.rpx captures everything you've done so far.

# Step 2 – create the pile group

In Step 2, you will create four piles and connect them together in a pile group.

 Switch to Repute's
 Construction Desktop by selecting the View tab on Repute's ribbon and

2	<b>§</b> ] =								C
Ł	Insert	Scenario	Build	Wizaro	ls Too	ols Licer	nce Vie	w Drawin	g Be
2	2	1	<b>/</b>				8	<b>İ</b>	1
mal	Construct	<u>S</u> pecify	Chec <u>k</u>	<u>R</u> eview	N <u>e</u> ws	Drawing Board	<u>P</u> roject Manager	<u>S</u> tockyard	Pro In:
	De	sktops							

clicking on the **Construct** button. (The **Construction Desktop** displays the **Drawing Board**, **Project Manager**, and **Stockyard**.)

Right-click anywhere in the **Stockyard** and select **Concretes** from

2.

the pop-up menu to open the **Concretes** group. Then:

- click on C20/25, keeping the left mouse button pressed
- drag the cursor away from the Stockyard (whereupon the cursor will change to signal the dragging operation) and position it over the Project Manager
   Project Manager
- release the mouse button to drop the concrete in the Project Manager



(where it will appear as Concrete 1, under the heading Materials > Concretes).

- Back in the Stockyard, click on the heading Structural Elements to open the Structural Elements group. Then drag a Bored Pile to the Project Manager as described above.
- 4. Repeat the previous instruction for a Pile Group.
- Switch to Repute's Specification
   Desktop by selecting the View tab on
   Repute's ribbon and clicking on the
   Specify button. (The Specification
   Desktop displays the Drawing Board,
   Project Manager, and Property
   Inspector.)



- 6. In the Project Manager, select Pile 1 (under Structural Elements > Piles). The Property Inspector will change to show its properties.
- 7. In the **Property Inspector**:
  - under Location > Relative
     Position, change both the pile's X-position and Y-position to 1.5
     m.
  - under Section Properties, tick the box Has casing and change the pile's Shaft diameter to 1050 mm. The pile's Base diameter will change to 1050 mm as well.
  - under Material Properties, select Concrete 1 in the Material name box.
  - under Dimensions, change the pile's Length to 20 m (if not

General			
Name	Pile 1		
Type	Bored Pile		
Category	Piles		
Kind	Structural Elements		
Notes	*		
Validate to EN 1536	V		
Location			
Relative Position			
X-position	1.5 m		
Y-position	1.5 m		
* Depth	-0.5 m		
Absolute Position			
Pile toe			
Dimensions			
Length	20 m		
Free-standing length	0.5 m		
Embedded length	19.5		
🛨 Rake	0 °		
Rake orientation	0°		
and also have been a	to and the second second		

Julion view	
Anisotropy	1
Section Properties	
<ul> <li>Shaft diameter</li> </ul>	1050 mm
Has casing	V
Base diameter	1050 mm
Circumference	329.87 cm
with which	and a second

already set) and its Free-standing length to 0.5 m.

8. Next, duplicate Pile 1 by right-clicking on it in the Project Manager and selecting Edit > Duplicate on the pop-up menu. Pile 1 - Copy will appear in the Project Manager and its

Structural Eler	nents	Absolute     Pile toe	Position			
Pie Pie Gro	Properties Build	F12 F9	g length		20 m 0.5 m	
-	Create Edit	,	ngth Cop	y	19.5 m Ctrl+C	
	Select All		Past	e	Ctrl+V	_
	Expand All Collapse All		Dele Dup	icate N	Ctrl+Del Ctrl+D	
	Sort	•	_	hys	0 °	
	Print Preview Print	Ctrl+P	erties e	Not specif	ied	¥
	Refresh	F5	ulus (E)		0 kg/m ³ 0 GPa	

properties will be displayed in the Property Inspector.

9. In the **Property Inspector**, change the **Name** of the copied pile to Pile 2 and its X-position to -1.5 m. Leave all its other properties unchanged.

- 10. Duplicate Pile 2 via the Edit > Duplicate command (as described above) or even quicker select Pile 2 and then press CTRL+D to duplicate it.
- 11. In the Property Inspector, change the Name of the copied pile to Pile 3 and its Y-position to -1.5 m, keeping its X-position as -1.5 m.
- 12. Finally, duplicate Pile 3, changing the duplicate's Name to Pile 4 and its X-position to (plus) 1.5 m and keeping its Yposition as -1.5 m.
- 13. Next, select Pile Group 1 in the Project Manager and, in the Property Inspector:
  - change its Level (under the heading Location > Absolute Position) to 0.5 m.
  - tick all four piles (under the heading Piles)
  - change the Pile cap thickness to 1.25 m (under the heading Pile Cap) and click the Resize button to ensure the pile cap's dimensions reflect the piles' new positions
- 14. Finally, in the Project Manager, select Situation 1 (under Scenarios > Situations) and tick Pile Group 1 in its Property Inspector to add the pile group to the scenario.

<b>3</b> c	Property Inspector	÷ ×	•
=	General		
	Name	Pile Group 1	٦
J	Туре	Pile Group	

	Number of piles	4 🗘						
Ξ	Location							
	Relative Position							
	<ul> <li>X-position</li> </ul>	0 m						
	Y-position	0 m						
	Depth	-0.5 m						
	Absolute Position							
	Easting	0 m						
	Northing	0 m						
	± Level	0.5 m						
	Dimensions							
	<ul> <li>Group orientation</li> </ul>	0 °						
	<ul> <li>Group centroid X</li> </ul>	0 m						
	<ul> <li>Group centroid Y</li> </ul>	0 m						
-	Piles							
	Pile 1	V						
	Pile 2	V						
	Pile 3	V						
	Pile 4	V						
-	Pile Cap							
	Auto resize pile cap	V						
	Pile cap shape	Rectangular Pile Cap 🔹 🔹						
	X-position	0 m						
	Y-position	0 m						
	Depth	-0.5 m						
	<ul> <li>Orientation</li> </ul>	0 °						
	<ul> <li>Pile cap thickness</li> </ul>	1 m						
	\pm Pile cap breadth in X-di	4.35 m						
	\pm Pile cap breadth in Y-di	4.35 m						
	<ul> <li>Pile cap cover</li> </ul>	150 mm						
	<ul> <li>Plan area of pile cap</li> </ul>	18.92 m ²						
	Material name	Not specified *						
	Self-weight of pile cap     Self-weight of pile     Self-weightof pil	0 kN						
		<b>R</b>						
100	and a set of the set of the set	the second s						

- Page | **72** 
  - 15. The Drawing Board will now look something like this (note that the pile cap appears in yellow, since we have not specified a material to link to this element).
  - 16. In this step you have:
    - created Concrete 1, Pile 1, and Pile Group 1
    - linked Pile 1 to Concrete 1
    - duplicated Pile 1 to create Piles 2, 3, and 4 and changed their locations
    - added Piles 1-4 to Pile Group 1
    - added Pile Group 1 to Situation 1



[Docs]\Tutorials\Tutorial 5\Step 2.rpx captures everything you've done so far.

# Step 3 – create the soil

In Step 3, you will create a stiff clay and specify its properties.

 Open the Stockyard's Grounds group by selecting the Insert tab on Repute's ribbon and clicking on the Ground button.



- 2. In the **Stockyard**:
  - click on Clay while keeping the left mouse button pressed
  - drag the cursor away from the Stockyard over the Project
     Manager (The cursor will change to signal you are dragging)
- release the mouse button when the cursor is over the Project
   Manager to drop the clay there (it will appear as Soil 1
   under the heading Materials > Soils)
- 3. Double-click on Soil 1 to open its Property Inspector.
- 4. In the **Property Inspector** for Soil 1:
  - if necessary, untick Strict validation (under Classification)
  - change the clay's Weight density (under Mass/weight density to 19.8 kN/m³ its Mass density will change accordingly
     General Soil 1 Type Clay
  - set Reference depth
     2 (z,ref2) (under
     Depth) to 35 m –
     this is the bottom of
     the soil layer
  - change the clay's
     Undrained strength
     (under Strength >
     Undrained strength)
     to 75 kPa
  - open the heading Undrained strength > Variation with depth

O Property Inspector 4 X				
🖃 General				
Name	Soil 1			
Туре	Clay			
Category	Soils			
Kind	Materials			
Notes				
Classification				
Class	Cl 👻			
State	- *			
Strict validation				
Plasticity index	0 %			
Is fissured?				
Mass/weight densities				
Mass density	2019.04 kg/m ³			
<ul> <li>Weight density</li> </ul>	19.8 kN/m³			
Equal dry and wet dens				
Dry densities				
🖃 Depth				
Reference depth 1 (z,r	0 m			
🛨 Reference depth 2 (z,r	35 m			
+ Depth ratio (z,ref2/z,re	TNF			

by clicking on the + button to the left of it and set **cu,ref2** to 425 kPa – the **Undrained strength gradient (dcu/dz)** will change to 10 kN/m³

- 5. Continuing in the Property Inspector for Soil 1 under the heading Stiffness > Undrained Young's modulus > Small strain stiffness:
  - set the clay's
     Undrained Young's
     modulus (Eu) to 75
     MPa the Large
     strain stiffness >
     Undrained Young's
     modulus (Eu) will
     change to 15 MPa,
     since the Stiffness
     ratio G1/G0 and
     hence E_{u1}/E_{u0} is (by
     default) set to 20%
  - open the heading
     Variation with depth and enter 425 MPa as the value of
     Eu,ref2 – the Young's modulus gradient



(dE/dz) will change to 10 MN/m³

Finally, change the clay's Anisotropy (under Stiffness) to 0.5 – the clay's Small strain stiffness > Horizontal Young's modulus (Eh) changes from 75 MPa to 37.5 MPa

[Docs]\Tutorials\Tutorial 5\Step 3.rpx captures everything you've done so far.

# Step 4 - create a layer, borehole, and water table

In Step 4, you will create a layer and borehole to hold the stiff clay and a water table (at ground surface).

 In the Stockyard, open the Geotechnical Constituents group and then create a Soil Layer, a Rigid Layer, a Borehole, and a Ground Water Table by dragging-anddropping these items from the Stockyard to the Project Manager.



- 2. Add Water Table 1 to the scenario by dragging it from the **Project Manager** to the **Drawing Board**.
- Select Layer 1 in the Project Manager and then, in the Property Inspector, change its Thickness to 35 m and its Soil to Soil 1.
- 4. Select Borehole 1 in the Project Manager and, in the Property Inspector, press the Select ... button. In the dialog box that appears, click on the >> button to move Layer 1 and Layer 2 from the Available box to the Selected box. Click OK to confirm the changes.



 Select Situation 1 in the Project Manager and, in the Property Inspector, tick Borehole 1 to add it to the scenario. The borehole column will appear on the left-hand side of the **Drawing Board**.

- 6. In this step you have manually:
  - created Layers 1-2, Borehole 1, and Water Table
     1
  - added Water Table 1 to Situation 1
  - linked Soil 1 to Layer 1
  - added Layers 1-2 to Borehole 1
  - added Borehole 1 to Situation 1

[Docs]\Tutorials\Tutorial 5\Step 4.rpx captures everything you've done so far.

#### Step 5 – create forces and moments

In Step 5, you will create a force, moment, and combination of actions (to combine the force and moment).

 In the Stockyard, open the Actions group and then create a Force, a Moment, and a Combination of Actions



by dragging-and-dropping these items from the **Stockyard** to the **Project Manager**.

- 2. Select Force 1 in the **Project Manager** and, in the Property Inspector, change its Level (under Location > Absolute Position) to 1.75 m the **Depth** will change to -1.75 m as you do this (the change in level is necessary to place the force on top of the pile cap). Change the force's Fx value to 2000 kN and its Fz value to 20 000 kN - the **Resultant** will change to 20 099.75 kN. 3. Select Moment, 1 in the
- 3. Select Moment 1 in the Project Manager and, in the Property Inspector, change its Level to

8	Property Inspector	4	1	×
Ξ	General			
	Name	Force 1		
	Туре	Force		
	Category	Forces		
	Kind	Actions		
	Notes			-
Ξ	Location			
	Relative Position			
	+ X-position	0 m		
	+ Y-position	0 m		
	🛨 Depth	-1.75 m		
	Absolute Position			
	+ Easting	0 m		
	<ul> <li>Northing</li> </ul>	0 m		
	± Level	1.75 m		
	Tether to	Not specified		*
Ξ	Options			
	Variability	Variable		*
	Variable load category	Imposed load		•
	Imposed load area	Storage area		*
Ξ	Components of action			
	+ Fx	2000 kN		
	+ Fy	0 kN		
	+ Fz	20000 kN		
	🛨 Resultant	20099.75 kN		
	Orientation	0 °		
<u>ا ما</u>	hatim		P	-

1.75 m but leave its My value as 500 kNm.

- 4. Select Combination 1 in the Project Manager and, in the Property Inspector, tick both Force 1 and Moment 1. Note that the My value is shown as 4000 kNm because of the additional moment due to Fx (which is at a level of 1.75 m) is 2000 kN x 1.75 m = 3500 kNm. If you change the Level of Combination 1 to 1.75 m, then the My value will revert to 500 kNm as the lever arm of Fx becomes zero.
- 5. Finally, select Situation 1 in the Project Manager and, in the Property Inspector, tick Combination 1 to add it to the scenario. Arrows representing the applied force and moment will appear on the Drawing Board above the pile group.
- 6. In this step you have manually:

- created Force 1, Moment 1, and Combination 1
- added Force 1 and Moment 1 to Combination 1
- added Combination 1 to Situation 1

[Docs]\Tutorials\Tutorial 5\Step 5.rpx captures everything you've done so far.

#### Step 6 – create the calculation

In Step 6, you will create a boundary element analysis of the pile group.

- 1. In the **Stockyard**, open the **Calculations** group by right-clicking and selecting **Calculations** from the pop-up menu.
- 2. Drag-and-drop a Boundary Element Analysis from the **Stockyard** to the **Project Manager**.
- 3. In the **Property** Inspector, change the Scenario (under Links) to Situation 1. Then, change the **Drainage** condition (under Options) to Undrained and the **Stress-strain** model to Hyperbolic.
- 4. In this step you have:
  - created Calculation 1



• linked Situation 1 to Calculation 1

[Docs]\Tutorials\Tutorial 5\Step 6.rpx captures everything you've done so far.

## Step 7 – perform and review the calculation

In Step 7, you will perform the calculation and review the results.

 Run the calculation by selecting the Build tab on Repute's ribbon and then clicking on the Run All button.



Repute will perform the calculation and then change its display to show its Checking Desktop (displaying the Project Manager, Workbook, and Graph Paper). You can switch to this display at any time by clicking on the Check button on Repute's View tab.

3. Your screen will now look something like this:



# Step 8 – export the results

In Step 8, you will export results to a Microsoft Excel spreadsheet.

- Right-click in the Workbook to reveal its context menu and select the Export ... command. Only the data that is currently displayed in the Workbook will be exported. To include other results, click on the asterisk * in the top left corner of the worksheet and select the results you want to include.
- Enter the File name for the spreadsheet, navigate to the folder where you want to save it, and then click on the Save button. By default, Repute will save the data in a Microsoft Excel workbook (*.xlsx) file.

3. If you open that workbook in Microsoft Excel, it should look something like the image below (if opened in Excel 2016).



[Docs]\Tutorials\Tutorial 5\Tutorial 5.xlsx contains the exported data in Microsoft Excel format.

## Step 9 – close the project

In Step 9, you will close and – optionally – save the project. (Note: this is not available in the Trial Edition.)

- 1. Close the project by clicking on the **File** menu's **Close** command.
- If you have made changes to the project since it was last saved, Repute will ask you if you want to save before proceeding. Answer Yes or No by clicking the appropriate button.
- 3. Repute will then (if requested) save and close the project.

You will find a copy of the project in its final form here:

[Docs]\Tutorials\Tutorial 5\Tutorial 5.rpx

## What next?

Tutorial 6 looks at the more complicated case of an asymmetric pile group under 3-dimensional loading.

# Tutorial 6. Asymmetric pile group under 3D loading

# Introduction

Tutorial 6 considers a more complicated project: that of an asymmetric pile group under general 3-dimensional loading. This tutorial shows you how to:

- Modify an existing project
- Change the location of individual piles within a pile group
- Specify 3D loading

The worked example involves the analysis of a group of 15 piles installed in stiff clay overlying dense sand.

- The ground conditions at the site are identical to those in Tutorial 5.
- The piles will be installed on an irregular grid, shown below. The spacing between adjacent rows is 3 m in the X-direction and 1.5 m in the Y-direction.
- Each pile is 20 m long, 1 m in diameter, and has a Young's modulus of 30 GPa (both axially and laterally).



You are interested in the displacements and rotation of the pile cap under a combined vertical load of 50 MN, horizontal loads of 10 MN (in the X direction) and 7 MN (in the Y direction), and moments of 5 MNm (in the XZ

plane) and 3 MNm (in the YZ plane). The vertical load will be applied on the pile cap at the location of Pile 9.

This tutorial is written for users of the Professional, Enterprise, and Trial Editions of Repute only. Users of the Standard Edition should look at Tutorials 1-3.

## Overview

- In Step 1, you will open and modify an existing project.
- In Step 2, you will delete the existing pile group from the project.
- In Step 3, you will create a new pile group.
- In Step 4, you will move the piles to their final positions.
- In Step 5, you will modify the actions on the pile group.
- In Step 6, you will perform the calculation and review the results.
- In Step 7, you will close and (optionally) save the project.

If Repute is not already running, open the program by pressing the Windows key, typing Repute 2.5 in the search bar, and clicking on the Repute 2.5 item that should appear. Once the splash screen has disappeared, Repute displays its Welcome screen.

If you have an existing project open, click **Close** on the program's **File** menu. (You will be prompted to save your work if you have not already done so.)

# Step 1 – open and modify an existing project

In Step 1, you open an existing project and modify its project information.

 Click on the File > Open command and, in the dialog box that appears, navigate to the folder [Docs]\Tutorials\Tutorial 6 and select the file Tutorial 4.rpx (this is a copy of the file that was saved at the end of Tutorial 4).

→  <  ↑    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •    •	Geocentrix > Repute > 2.5 > Tutorials > Tut	torial 6 🗸 🖑 Se	arch Tutorial 6	م
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Examples				
Tutorials				
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- 2. Click on the **Open** button to open this project.
- In the Project Manager, double-click on Site 1 to display its properties. Then, in the Property Inspector, change the

Γ	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	······
-	Project Informat	ion
	Description	Asymmetric pile group un
	Project ID	06
	Address	
~~		And the second s

**Description to** Asymmetric pile group under 3D loading and the Project ID to 06.

4. Save the project under a different name, by clicking the File > Save As command and then clicking on Repute 2 file. In the dialog box that appears, change the File name to Tutorial 6 and click on the Save button. It will automatically be saved in



the folder [Docs]\Tutorials\Tutorial 6 unless you choose another location for it.

[Docs]\Tutorials\Tutorial 6\Step 1.rpx captures everything you've done so far.

## Step 2 – delete the existing pile group

In Step 2, you will delete the existing pile group from the project.

- Right-click anywhere on the Drawing Board and select
   Plan. (Alternatively, select the Drawing Board tab on Repute's ribbon and then click on the Plan button.)
- Increase the scale of the drawing by right-clicking on one of the rulers at the edge of the Drawing Board and selecting 1:50. (Alternatively, click on the 1:50 button on the Drawing Board tab.)
- 3. Click on the top-left pile (Pile 1) in the pile group. A blue selection rectangle will appear with square handles at each corner and Pile 1 will be highlighted in the Project Manager.



4. Select Pile 1 in the Project Manager. Then, while holding the CTRL key down, select (one at a time) Pile 2, Pile 3, Pile 4, and Pile Group 1. When all five items are highlighted, right-click on the Project Manager and select Edit > Delete on the pop-up menu that appears. Click Yes to All to confirm that you want to delete all these items from the project (whereupon they will disappear from both the Project Manager and the Drawing Board).

Repute	
2	Are you sure you want to delete 'Pile 1' (Bored Pile)? This item is being used by 'Pile Group 1' (Pile Group)
	Yes to <u>A</u> ll No to All Yes <u>No</u>

#### [Docs]\Tutorials\Tutorial 6\Step 2.rpx captures everything you've done so far.

#### Step 3 – create a new pile group

In Step 3, you will create a new pile group to replace the old one.

 Open the Pile Group Wizard by selecting the Wizards tab on Repute's ribbon and clicking on the Pile Group Wizard button.



2. When the Wizard appears, choose the **Custom** plan arrangement and change the number of pile rows to m = 5 by n = 3. (The picture on the left-hand side of the Wizard will change to show you a generic rectangular pile arrangement.) Enter 3000 mm as both the X spacing (sx) and the Y Spacing (sy) but leave the Cover (c) as 150 mm.



 Click Next to display page 2 of the Wizard. Choose (Cast-inplace Concrete) Bored Pile as the pile type.



 Click Next to display page 3. Change the Concrete class to C20/25 and the Diameter/Breadth to 1050 mm. By default, the concrete will be assigned a Young's modulus of 30 GPa.

I and section				
Choose the material				
000/05				
C20/25	· ·			
S235	-			
1				
1050 mm	<b>*</b>			
HP. 100				
	1 and section C20/25 S235 1050 mm Hp. 10			

5. Click **Next** to display page 4. Change the **Embedded length (L)** to 20 m but leave the **Upstand (U)** as 0 m.

	•
3. Enter the pile length and upstand	
🛨 🔣 Embedded length (L)	20 m
🗉 🔣 Upstand (U)	0 m 👻

6. Click Next to display page 5. Change the pile group's X position (dX) to 6 m but leave its Y position (dY) as 0 m and its Rotation (dθ) as 0°. This will move the piles in the group closer to their final positions.



- Click Next to display page 6. Tick Situation 1 to add the pile group to the scenario.
- Click Next to display the last page of the Wizard. If you wish to review any of the settings you have made, click Back to return to the relevant page.
- When you are ready, click Finish to generate the pile group. The Pile Group Wizard then:
  - creates Piles 1-15 and Pile Group 1
  - creates Concrete 2

- links Piles 1-15 to Concrete 2
- adds Piles 1-15 to Pile Group 1
- adds Pile Group 1 to Situation 1
- 10. The Drawing Board will now look something like this (change the scale to 1:100 to see this more clearly):



[Docs]\Tutorials\Tutorial 6\Step 3.rpx captures everything you've done so far.

## Step 4 – move the piles to their final positions

In Step 4, you will move the piles to their final (asymmetric) positions.

1. Select Pile Group 1 in the Project Manager and then, if it is not already visible, open the Workbook by clicking on View > Workbook on Repute's ribbon. Widen the Workbook so that you can (see at a minimum) the columns headed General, Location, and Dimensions while still displaying the Drawing Board, like this:

Drag a skanin hoader here tay proze here at callent Tener at the first production of the first produc	Work	book						φ×	Drawing Board
Caretal         Description         Description <thdescription< th=""> <thdescription< th=""> <th< th=""><th>Drag a co</th><th>lumn header hen</th><th>e to group by</th><th>that column</th><th></th><th></th><th></th><th></th><th>🖬 1:100</th></th<></thdescription<></thdescription<>	Drag a co	lumn header hen	e to group by	that column					🖬 1:100
New         Test         New of Net         Control         Linght         Precedants         Desc         Test         Test         Precedants         Desc         Test         Test         Precedants         Desc         Test         Test         Precedants         Desc         Test		General		Location Pile head		Dime	risions		
Part 1     Part 1     Part 2     Part 1     Part 2       Part 2     Part 1     Part 2     Part 1     Part 2       Part 2     Part 1     Part 2     Part 1     Part 2       Part 2     Part 2     Part 2     Part 2     Part 2       Part 2     Part 2     Part 2     Part 2     Part 2       Part 2     Part 2     Part 2     Part 2     Part 2       Part 2     Part 2     Part 2     Part 2     Part 2       Part 2     Part 2     Part 2     Part 2     Part 2       Part 2     Part 2     Part 2     Part 2     Part 2       Part 2     Part 2     Part 2     Part 3     Part 3       Part 2     Part 3     Part 3     Part 3     Part 3       Part 3     Part 3     Part 3     Part 3     Part 3       Part 3     Part 3     Part 3     Part 3     Part 3       Part 3     Part 3     Part 3     Part 3     Part 3       Part 3     Part 3     Part 3     Part 3     Part 3       Part 3     Part 3     Part 3     Part 3     Part 3       Part 3     Part 3     Part 3     Part 3     Part 3       Part 4     Part 3     Part 3     Part 3	Name	Туре	X-position (m)	Y-position (m)	Depth (m)	Length (m)	Free-standi ng length (m)	Mat	
Par2     Districtive     -3     -3     0     20     0     Con       Max     Bostel Nie     -3     0     20     0     Con     1       Max     Bostel Nie     -3     0     20     0     Con     1       Max     Bostel Nie     -3     0     20     0     Con     1       Max     Bostel Nie     -3     0     20     0     Con     1       Max     Bostel Nie     -3     0     20     0     Con     1       Max     Bostel Nie     -3     0     20     0     Con     1       Max     Bostel Nie     -3     0     20     0     Con     1       Max     Bostel Nie     -3     0     20     0     Con     1       Max     Bostel Nie     -3     0     20     0     Con     1       Max     Bostel Nie     -3     0     20     0     Con     1       Max     Bostel Nie     -3     0     20     0     Con     1       Max     Bostel Nie     -3     0     20     0     Con     1       Max     Bostel Nie     -3     0     20 </td <td>Pie 1</td> <td>Bored Pile</td> <td>-6</td> <td>-0</td> <td>0</td> <td>20</td> <td>0</td> <td>Con</td> <th></th>	Pie 1	Bored Pile	-6	-0	0	20	0	Con	
103 3       10       20       0       20       0       10         104 4       Buckfine       0       3       0       20       0       Con         104 5       Buckfine       0       3       0       20       0       Con       1         106 5       Buckfine       0       3       0       20       0       Con       1         106 5       Buckfine       0       0       20       0       Con       1       1         106 5       Buckfine       0       0       20       0       Con       1       1         107 5       Buckfine       0       0       20       0       Con       1       1         116 5       Buckfine       0       0       20       0       Con       1       1         118 5       Buckfine       0       3       0       20       0       Con       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1	Pile 2	Bored Pile	-3	-3	0	20	0	Con	10
Note: 10: 0     3     3     0     20     0     Constraint       Note: 10: 0     0     20     0     Constraint     1       Note: 10: 0     0     20     0     Constraint     1       Note: 10: 0     0     20     0     Constraint       Note: 10: 0     0     20     0     Constraint <t< td=""><td>Pile 3</td><td>Bored Pile</td><td>0</td><td>-3</td><td>0</td><td>20</td><td>0</td><td>Con</td><th>E 3</th></t<>	Pile 3	Bored Pile	0	-3	0	20	0	Con	E 3
10       5       Thread This       6       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0       -0	Pile 4	Bored Pile	3	-3	0	20	0	Con	E E
Part 6         Duter file         4         0         0         20         0         Con           Part 7         Duter file         3         0         0         Con         1         1         Part 6         1         0         0         20         0         Con         1         1         Part 6         1         0         0         20         0         Con         1         1         Part 6         1         0         0         20         0         Con         1         1         Part 6         1         0         0         20         0         Con         1         1         Part 6         1         0         0         20         0         Con         1         1         Part 6         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1	Pile 5	Bored Pile	6	-3	0	20	0	Con	
P7 Protechie -3 0 0 0 20 0 Con P86 Brotechie -3 0 0 20 0 Con P89 Brotechie -3 0 0 20 0 Con P81 Brotechie -3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Pile 6	Bored Pile	-6	0	0	20	0	Con	
Note The 0         0         0         2         0         Con           Neg 0         Directifie         3         0         20         0         Con           Neg 0         Directifie         6         0         0         20         0         Con           Neg 10         Directifie         6         0         0         20         0         Con           Neg 11         Directifie         0         3         0         20         0         Con           Note The         3         3         0         20         0         Con         Term         Pie 31         Pie 32         Pie 33         Pie 33         Pie 33         Pie 33         Pie 34         Pie 34 <th< td=""><td>Pile 7</td><td>Bored Pile</td><td>-3</td><td>0</td><td>0</td><td>20</td><td>0</td><td>Con</td><th><b>H</b> 3</th></th<>	Pile 7	Bored Pile	-3	0	0	20	0	Con	<b>H</b> 3
19       Bruechine       3       0       0       20       0       Con       1         12       Bruechine       3       0       20       0       Con       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1	Pile 8	Bored Pile	0	0	0	20	0	Con	E E
No.10         Description         G         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D         D <thd< th=""> <thd< th="">         D         &lt;</thd<></thd<>	Pile 9	Bored Pile	3	0	0	20	0	Con	
Part 1         Directive         4         3         0         20         0         Con           Part 1         Directive         4         3         0         20         0         Con         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1	Pile 10	Bored Pile	6	0	0	20	0	Con	
Pie 12         Directifie         3         0         20         0         Cm         Term           We13         Bracking         0         3         0         20         0         Cm         Term         Pie 12         Pie 13         Pie 14         Pie 13         Pie 13         Pie 14         Pie 13         Pie 14         Pie 14         Pie 13         Pie 14	Pile 11	Bored Pile	-6	3	0	20	0	Con	
No.1         Description         0         3         0         20         0         Com         T           VB1         Description         0         3         0         20         0         Com         T         Pla 12         Pla 12         Pla 12         Pla 13         Pla 13         Pla 14         Pla 14         Pla 14         Pla 15         Pla 15         Pla 15         Pla 16         Pla 16 <td< td=""><td>Pile 12</td><td>Bored Pile</td><td>-3</td><td>3</td><td>0</td><td>20</td><td>0</td><td>Con</td><th></th></td<>	Pile 12	Bored Pile	-3	3	0	20	0	Con	
Pie H         Direct/Tile         3         3         0         20         0         Con         Tel         Pie 13         Pie 13         Pie 14         Pie 17           Pie 15         Rowel Tile         6         3         0         20         0         Con         Image: 1         Pie 13         Pie 14         Pie 15         Pie 14         Pie 14         Pie 15         Pie 14         Pie 15         Pie 14         Pie 15         Pie 14         Pie 15         Pie 14	Pile 13	Bored Pile	0	3	0	20	0	Con	
	Pie 14	Bored Pile	3	3	0	20	0	Con	Pile 11 Pile 12 Pile 13 Pile 14 Pile
	Pile 15	Bored Pile	6	3	0	20	0	Con	
									Part Part Part Part Part Part Part Part

- In the row for Pile 2, select the cell under the column Y-position (m) and enter the value -4.5 and press ENTER. The pile's position on the Drawing Board will change automatically.
- 3. Repeat the previous instruction for Pile 4.
- 4. Change the **Y-position (m)** of:
  - Piles 7 and 9 to -1.5 m
  - Piles 12 and 14 to 1.5 m.
  - Pile 15 to 4.5 m.
- 5. Finally, change the X-position (m) of Pile 15 to -3.0 m.

6. Back in the Property Inspector for Pile Group 1, click on the Resize button to enlarge the pile cap. The Drawing Board will now look something like this:



[Docs]\Tutorials\Tutorial 3\Step 4.rpx captures everything you've done so far.

## Step 5 – modify the loads

In Step 5, you modify the actions on the pile group.

- Select Force 1 in the Project Manager and then, in its Property Inspector, change Fz to 50 000 kN and select Pile 8 in the Tether to ... box (this will automatically change the Depth of Force 1 to 0 m to match that of Pile 8).
- 2. Select Force 2 in the Project Manager and, in its Property Inspector, change Fx to 10 000 kN, Fy to 7 000 kN, and select Pile 8 in the Tether to ... box.
- 3. Select Moment 1 in the Project Manager and, in its Property Inspector, change Mx to 3 000 kN, My to 5 000 kN, and select Pile 8 in the Tether to ... box.

4. The Drawing Board will now look something like this:



[Docs]\Tutorials\Tutorial 6\Step 5.rpx captures everything you've done so far.

# Step 6 – perform and review the calculation

In Step 6, you will perform the calculation and review the results.

 Right-click on Calculation 1 in the Project Manager and select the Build command on the pop-up menu that appears. Repute will perform the calculation and then change its display to show its Checking Desktop (which displays the Project Manager, Workbook, and Graph Paper). You can switch to this display at any time by clicking on the Check button on the View tab. The load vs displacement graph will now look something like this:



 You can change the graph that appears on the screen by selecting one of the options in the Pile Group drop-down box on the Graph Paper tab. For example, if you select the Moment vs rotation option, the graph will change to look something like this:



3. You can change the appearance of the graph by experimenting with the extensive set of controls provided via its **Options** box. To display this box, click on the **Options** button on the **Graph Paper** 

**tab**. Click on the help button to find instructions for using this box to customize your graph.

## Step 7 – close the project

In Step 7, you will close and – optionally – save the project. (Note: this is not available in the Trial Edition.)

- 1. Close the project by clicking on the **File** menu's **Close** command.
- If you have made changes to the project since it was last saved, Repute will ask you if you want to save before proceeding. Answer Yes or No by clicking the appropriate button.
- 3. Repute will then (if requested) save and close the project.

You will find a copy of the project in its final form here:

[Docs]\Tutorials\Tutorial 6\Tutorial 6.rpx

## What next?

Further information about the program's capabilities can be found in the *Repute 2.5 User Manual* and the program's built-in help system. Details of the theory that underpins the program's calculations can be found in the *Repute 2.5 Reference Manual*.

Further resources are available from the Geocentrix website:

www.geocentrix.co.uk/repute