Reporting in Tekla Structures

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Bachelor's thesis

Construction Engineering

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ABSTRACT

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ABSTRACT

The aim of the Bachelor's thesis was to make a research on foundations, explore the different types and the cases in which they are applicable and to create a custom-made foundation report of a test model in a step by step structure. The model which was used is provided by the Website of Tekla Corporation. The thesis also gives general information about Tekla Structures and projects which were executed with the help of the software.

The theoretical part of the thesis was collected from various sources. It includes general information about Tekla Structures, a short explanatory information on what reports are in Tekla Structures and how to use them, and research on the different foundations and their advantages.

The practical part of the thesis involves the creation of a custom foundation report of a test model. The report was done using the Template Editor tool of Tekla Structures software. Tekla Structures was used as a main research tool.

As a result of the thesis, a step by step guide on how to create a custom report in Tekla Structures was formulated. The guide can serve as a future reference to new users of Tekla.

Keywords Foundations, report, Tekla Structures, BIM, software, template editor

Pages 29 p. + appendices 29p.

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1 INTRODUCTION

Building Information Modelling (BIM) is a model-based process of creating and managing building data during the building's life cycle. BIM helps architects, engineers and constructors apply the same approach to building and infrastructure projects, i.e. it enables a more collaborative process. (Autodesk, 2011) With BIM (Building Information Modelling) technology, one or more accurate virtual models of a building are constructed digitally. They support design through its phases, allowing a better analysis and control than manual processes. When completed, these computer-generated models contain precise geometry and data needed to support the construction, fabrication, and procurement activities through which the building is realized. (Eastman, Teicholz, Sacks & Liston 2011)

The objective of this thesis is to explore one of the possibilities that the BIM, Tekla Structures in particular, provides. Creating custom reports is a useful and a highly valuable option. Even though the procedure is rather easy, it requires knowledge. There aren't many free tutorials available and therefore the main purpose of the thesis is to provide an easy-to-follow guide on how to create a report using the Template Editor tool from Tekla, a foundation report in particular. Reports are a very important part of the construction process, especially for cost-estimation purposes. The scope of the thesis is limited only to a foundation report on a test model, created with Tekla Structures.

The process of writing the thesis began with defining the objectives by the supervisor and the author. Data and information regarding Tekla Structures, BIM in general, different types of foundations and lastly – the Template Editor tool from Tekla, was gathered from various sources and then put together. The next step was to create the actual report and to document each step of it. Lastly, the report was generated according to the specific model.

2 TEKLA STRUCTURES SOFTWARE

2.1 Tekla Overview

Tekla Structures is a 3D building information modelling (BIM). It is widely used for steel and concrete detailing, precast and in-situ cast concrete by structural engineers, detailers and fabricators in the construction industry. Tekla enables the users to model anything from stadiums and residential buildings to bridges and skyscrapers since it works with all materials and models of all complexity. The software also gives its users the opportunity to cover the entire building process from concept to the actual fabrication. Tekla Structures has different configurations in order to meet a wider range of its costumers' needs. Having 30 localized environments and 14 user interface languages as well as a special configuration for students has made the use of the software easy and accessible (Tekla). Figure 1 below shows an example of a Tekla model

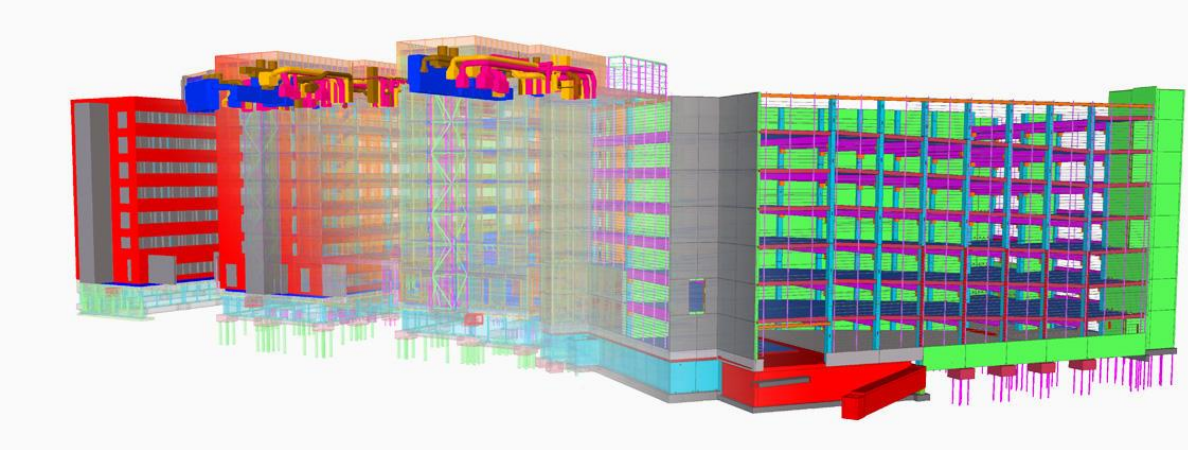

Figure 1 Tekla Example Model (www.tekla.com)

2.2 Projects execution with Tekla

Tekla Structures has been preferred as a solution to many big and important projects. Its diverse tools and options allow the users to use Tekla in various situations and to solve many different problems.

2.2.1 Manskun Rasti Project

One of Tekla's big projects was the Manskun Rasti one in 2012 – a complex of four office buildings in Helsinki, Finland. The main contractor of the project was Skanska, which is a world leading project development and construction group. An information model was created for each stage of the construction. The first model that was created represented the earthworks and the foundation construction. Its purpose was to visualize

the construction work phase by phase from the soil excavation to the foundation casting as well as to help organize the schedule using Tekla task manager. The second model included the construction of the underground floors. Moreover, Tekla modelling was used for planning logistics and work safety as well as quantity surveying.

The Manskun Rasti construction site in Helsinki, Finland, is a showcase of the future. Skanska has taken the building information modelling process to a new dimension by boldly putting the limits and possibilities of BIM to the test. Manskun Rasti is the winner of the Tekla Global BIM Awards 2011 competition in the Building Information Modelling category. According to the jury, utilization of building information modelling has been ground-breaking in the project. The building trade magazine Rakennuslehti awarded Manskun Rasti the title of Construction Site of the Year 2011, largely thanks to the use of the building information modelling (www.tekla.com). Figure 2 below shows the Manskun Tekla model.

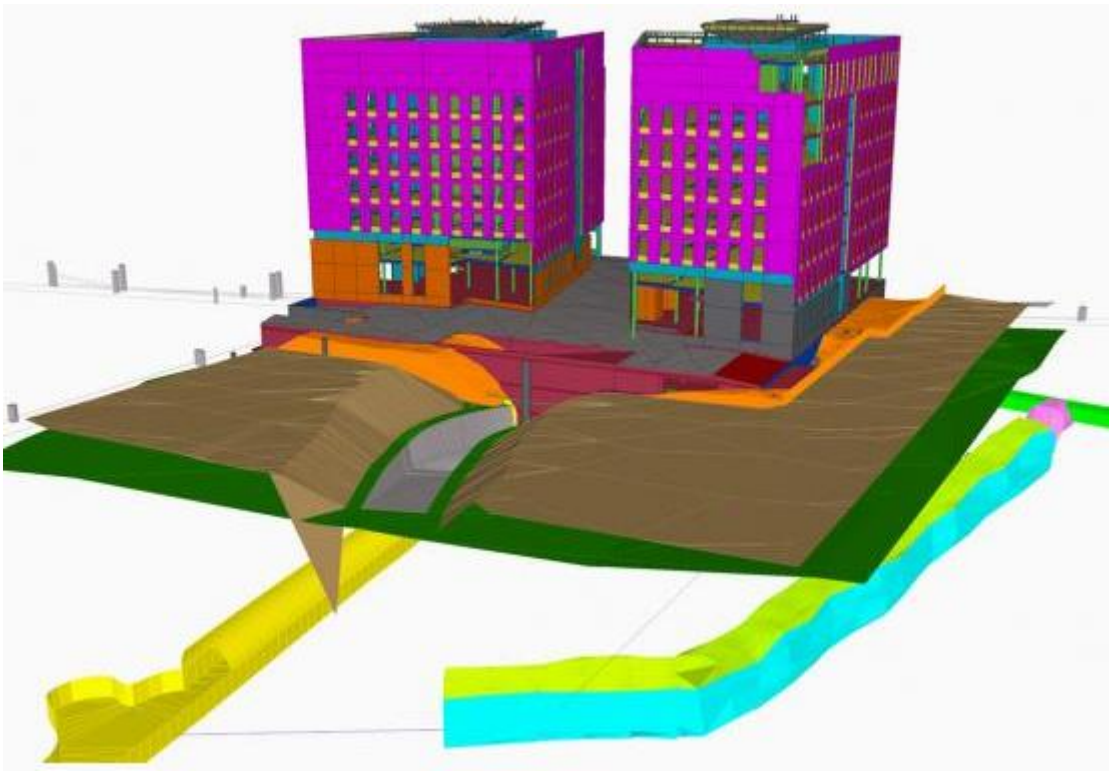

Figure 2 Maskun Rasti Tekla Model (www.tekla.com)

2.2.2 Puuvilla Project

Another very impressive project which was created with the help of Tekla Structures is the Puuvilla Project. Porin Puuvilla used to be a cotton factory one hundred years ago which was turned into a shopping center in 2014. The center combines both old and new structures as well as housing retail, offices and parking space. Thirteen different project parties were

involved in the construction of the shopping center. The construction was involved with a very tight schedule and the key to keeping it was that instead of using emails and paper as a communication tool, models were used. Thanks to the models made with Tekla Structures, contracting offices situated in different parts of the country were able to communicate with each other and work on the same project (Tekla). Figure 3 shows a picture of the Puuvilla Tekla model.

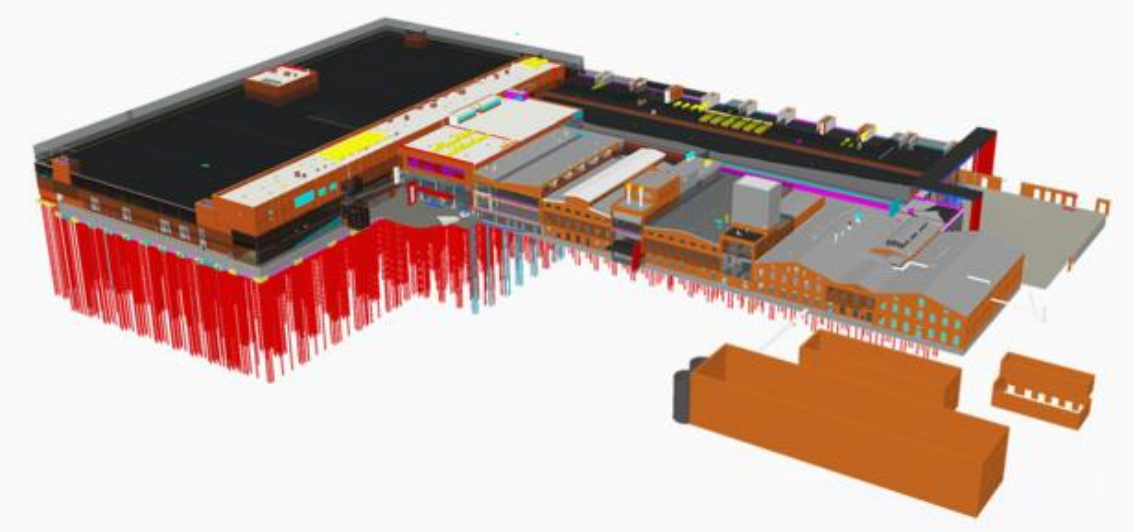

Figure 3 Puuvilla Tekla Model (www.tekla.com)

2.3 Reports in Tekla Structures

The Tekla Structures Software provides the users with the option to create reports based on the information used in the models. These reports are directly created from the model, thus the extracted information is always accurate. Tekla reports give information about either the whole model or certain parts, they could be lists of drawings, assemblies, parts, materials used, etc. Many standard report templates which are ready to use are included in the software. In case that one needs to modify an existing report or create one according to one's specific needs, (www.tekla.com) Tekla's Template Editor can be used. How exactly the reports are being extracted has been explained more in depth later on in the thesis. The relation between reports and templates is to be found in Appendix 1. Figure 4 shows the Drawings & Reports window in Tekla and figure 5 – an exemplary report.

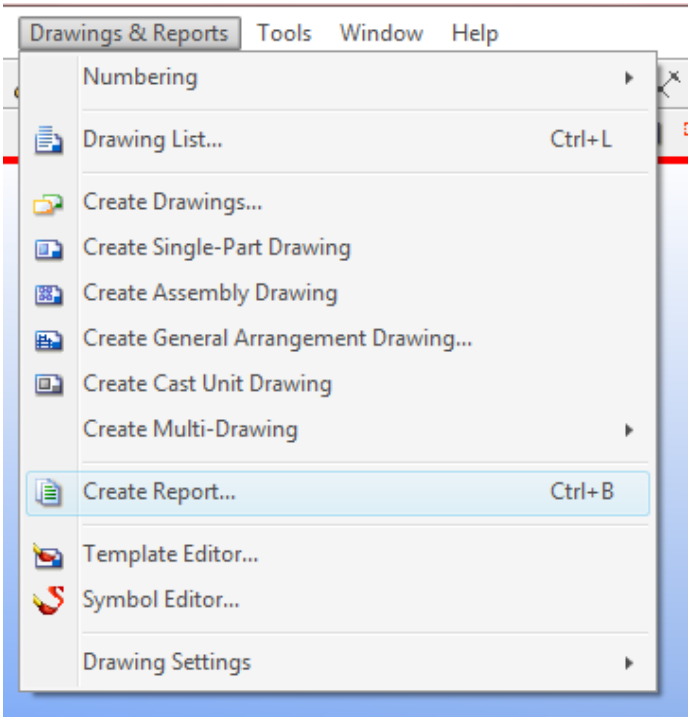

Figure 4 Drawings & Reports in Tekla

Example

TEKLA STRUCTURES PARTS LIST FOR CONTRACT NO: 1 Page: 1
CONTRACT: Tekla Corporation Date: 16.09.2009

PartPos	Profile	No.	Material	Length	Area(m2)	Weight(kg)
Concrete	250*12000	2	K30-2	12000	227.6	0.0
Concrete	250*12000	6	K30-2	12000	250.2	0.0
Concrete	250*14997	18	K30-2	12000	278.4	0.0
Concrete	250*14997	54	K30-2	12000	301.0	0.0
Concrete	1500*1500	8	K30-2	500	7.5	0.0
Concrete	500*1000	4	K30-2	12000	37.0	0.0
Concrete	380*380	80	K40-1	4000	6.4	0.0
Concrete	4000*300	80	K30-2	12000	105.6	0.0
Concrete	CHS323.9X7.1	80	S275J0	4000	4.1	222.0
Concrete	800*400	80	Concret	8620	21.3	6620.2
P/1	IPE500	80	S235JR	12000	20.9	1092.7
P/2	IPE500	80	S235JR	13909	24.3	1266.6
	Total for 572 members:				38030.7	736117.6

Figure 5 Exemplary Report (www.tekla.com)

2.4 Template Editor

In order to serve the purpose of this thesis, the Template Editor option from Tekla Structures was used to create a foundation report. The Template Editor can be run from Tekla as well as on its own as a standalone program. It is used to produce reports, labels and legends. Using the Template Editor, both Textual and Graphical Templates can be created. The Graphical templates are generally used to present map legends and labels as well as project and company information and they can also contain tables, pictures and symbols. The textual templates on the other hand only contain text. Since they are used for creating reports - that is the tool that was used for creating the foundation report for the thesis (www.tekla.com). Figure 6 below shows the Tekla Template Editor window in Tekla.

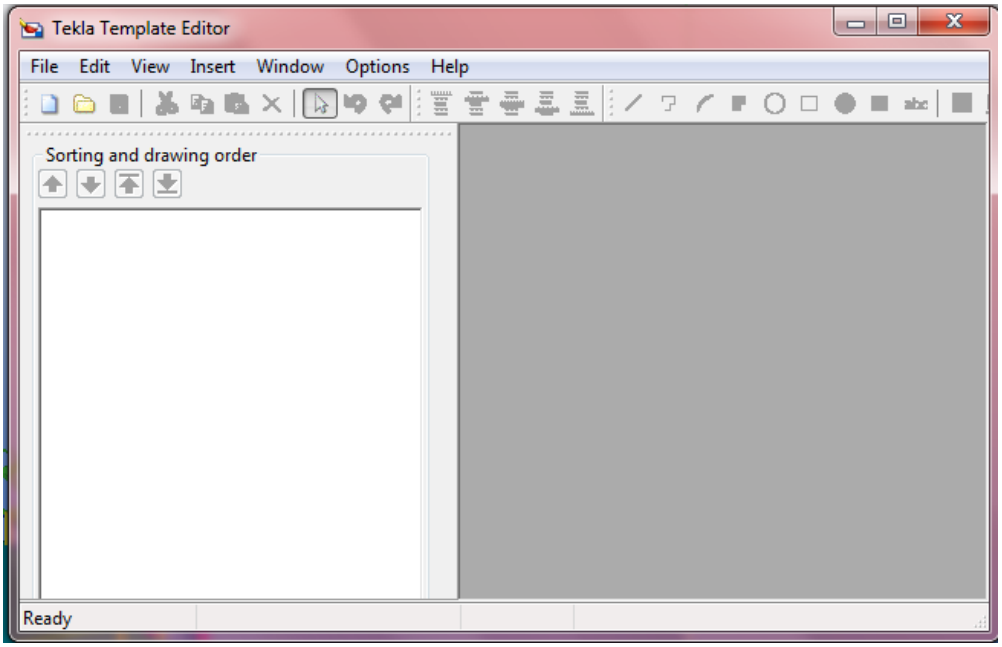

Figure 6 Tekla Template Editor

3 FOUNDATIONS

The foundation is a part of the structure the purpose of which is to transmit the load of the building to the ground lying underneath. It is always built below the ground level in order to increase the lateral stability of the whole structure. Every building usually has numerous individual foundations, which are called “footings” and each column lays on its own footing. Thus, a foundation is a connecting link between the structure and the ground that supports it.

Since the whole weight of the building rests on the soil, its properties and safe bearing capacity need to be carefully examined and determined in order to ensure that it can carry the imposed loads of the structure. The SBC

is the capacity of the soil to support the loads imposed to the ground, i.e. it is the amount of weight per unit that the soil can bear. This capacity changes according to the depth. The general rule is that the deeper it gets, the greater the SBC, although this is not always the case, because there might be “pockets” of weak soil in the earth. Usually, the soil near the surface is weak and loose and for the proper support of the building, strong and firm soil is needed. That is the reason why the building contractors dig until this strong and firm soil is reached.

All engineering structures need foundations because of the following reasons:

- Prevention of lateral movement of the supporting material
- Distribution of the load of the structure over a big bearing area
- Loading the bearing surface uniformly in order to prevent unequal settlement
- General increment of the stability of the structure
- Securing a firm bed for building operations

Broadly said, foundations are classified into two main categories: shallow and deep foundations.

3.1 Shallow Foundations

The shallow foundations, as their name suggests are constructed at a shallow depth below the ground surface or below the deepest basement of a building. They can be used only in case that the soil at the level where they are built can adequately support the load. Shallow foundations also need to be placed below the frost line, which means that the soil needs to be excavated, until this particular level is reached, although there are also the so called frost-protected shallow foundations, which provide the necessary protection against frost damage and do not require specific placement below this frost line. Shallow foundations are further classified into the following four categories of strip foundations, pad footing, raft foundations and strap or cantilever footing. These will be discussed in the following chapters.

3.1.1 Strip Footing

Also known as a continuous footing, the strip footing is a popular solution for supporting load-bearing walls or for a row of columns the spread footings of which are too closely positioned or nearly touch each other. In such cases the strip footing is a more economical solution. Strip foundations are usually used in cases where the loads are being carried by entire walls instead of columns. It is a solution only where the soil has good bearing capacity. The size and the position of the strip foundation depends on the overall width of the wall that is being supported. Figure 7 below

shows a drawing of a strip footing, and Figure 8 shows a strop footing of an actual house. (http://buildgood.blogspot.fi)

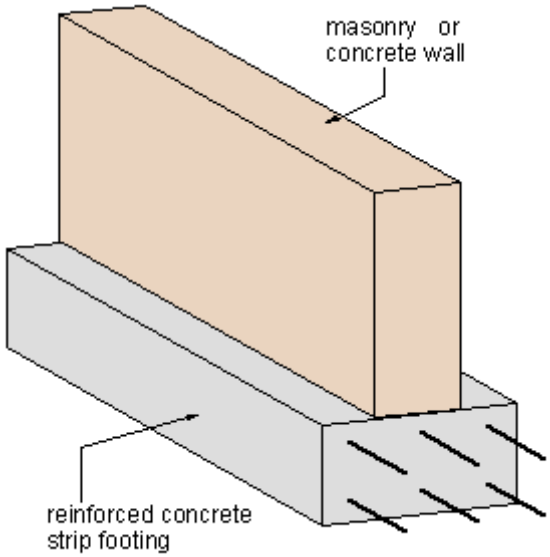

Figure 7 Drawing of a strip footing (http://www.builderbill-diy-help.com/strip-footing.html)

Figure 8 Strip footing of an actual house (http://buildgood.blogspot.fi)

3.1.2 Pad Footing

The pad footings, or individual or spread footings as they are also known, are the most common and simple types of foundation solutions. They are used to support columns and usually each column is supported by an individual concrete pad footing. The footings are isolated, or in other words, there isn't any connection between them. The pad footings are a good solution for a light-weight timber-framed houses. Figure 9 contains a drawing of a pad footing and Figure 10 shows how the pad footings during construction.

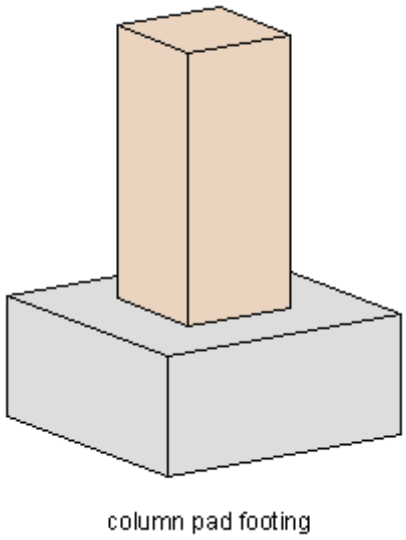

Figure 9 Drawing of a pad footing (http://civilblog.org/wp-content/uploads/2014/10/pad-footing.png)

Figure 10 Pad footings during construction (http://propertyforsalephuket.co.th/wp-content/uploads/2010/12/Footing-pads.jpg)

3.1.3 Raft Foundations

Also known as mat foundation, the raft foundation is a big slab extending below the entire building and supporting all the walls and columns. It can be used for the whole building or only partially. The raft foundation is usually used for office or public buildings or where the soil conditions are very poor – the bearing capacity is low and individual footings cannot be used.

Figure 11 Raft foundation (http://www.builderbill-diy-help.com/image-files/concrete-raft-foundation.jpg)

3.1.4 Strap or Cantilever Footing

A strap footing is when two independent pad footings are connected by a beam. The strap beam is not in contact with the soil, which means that it will not transfer any pressure to the soil underneath. It serves as a distributor of load between both columns which then transfer the loads onto the soil. The strap footing is used as a solution when for example, a column lies close to the property limit and the distance between this and the adjoining column is too big. Figure 12 shows a drawing of a strap foundation.

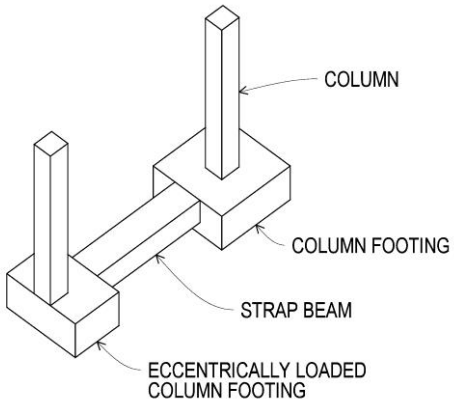

Figure 12 A drawing of a strap foundation (http://upload.wikimedia.org/wikipedia/commons/4/49/Strap_footing.jpg Assessed 28th January 2015)

3.1.5 Combined Footing

The combined footing provides support for two or more columns. Building individual, or pad footings is less cost effective rather than building a combined footing. That is why combined footings are selected as a solution only when it is inevitable – when two or more columns are too close together or when a column is too close to a property line and it needs to be combined with an interior column. Figure 13 below shows a drawing of a combined footing.

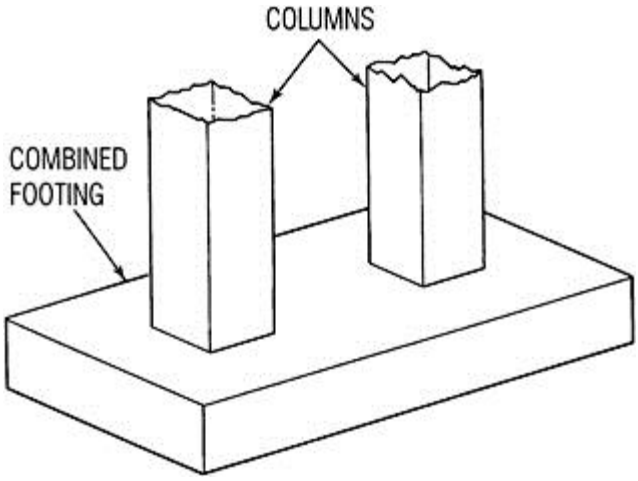

Figure 13 A drawing of a combined footing (http://images.books24x7.com/bookimages/id_15273/fig337_02.jpg)

3.2 Deep Foundations

Deep Foundations are used to transfer the load from a given structure through the weak and compressible soil to a deeper stronger soils or rocks with better bearing capacity. The reason for using them can be either the lack of strong soil which can provide adequate support for the structure or limited property lines. Deep foundations have been classified into two categories i.e. pile foundation and caisson foundations.

3.2.1 Pile Foundation

The pile foundation is a necessary solution when the soil which is at the surface is weak and cannot provide the support that the structure needs, when building in marine conditions, or when the building has very big concentrated loads. The piles are made of a strong material such as concrete and are being pushed deep into the soil so that they would bypass the weak soil in order to reach the strong soil or rock underneath where the loads will be transferred. They can take bigger loads than the spread footings. The pile foundation usually consists of a base, the so called pile cap, which is supported by the piles underneath. There are two types of pile foundations, the choice of which depends mainly on the soil condition, the load of the structure and the cost budget. Figure 14 shows a drawing of a pile foundation.

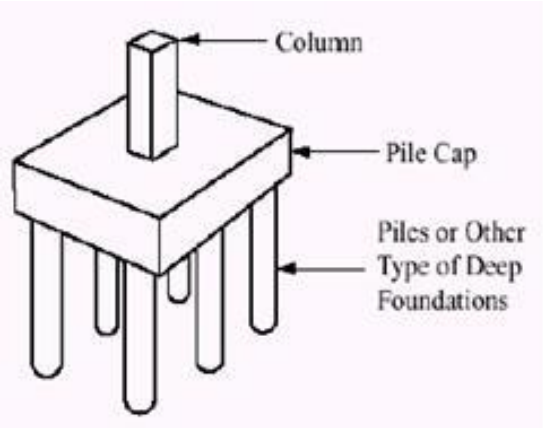

Figure 14 A drawing of a pile foundation (http://osp.mans.edu.eg/deepfoundation/ch1.files/image030.jpg)

The end bearing piles are used when the solid bedrock is within a reasonable depth from the surface and so the loads are being transferred directly to the underlying soil. Friction piles on the other hand are used when the solid soil is at a greater depth and thus, the use of end bearing piles wouldn't be cost efficient. The friction piles' surface is in friction with the soil and it thus resists the loads from the structure. The difference between end bearing and friction piles is shown in Figure 15.

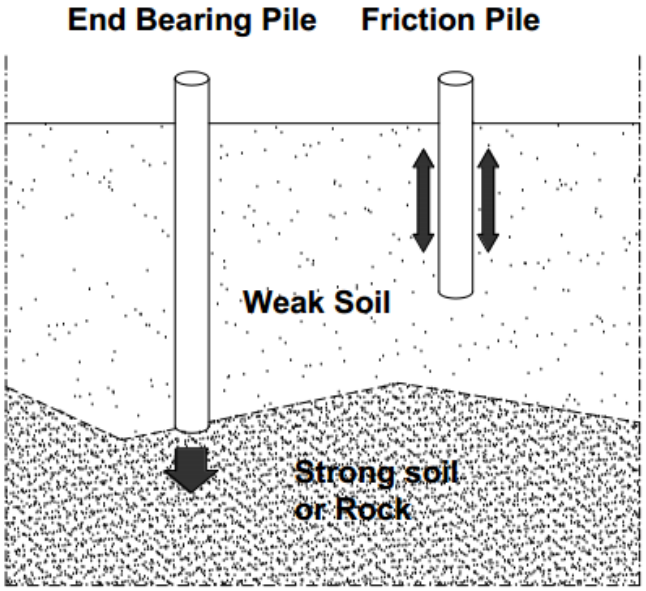

Figure 15 The difference between end bearing and friction piles

3.2.2 Caisson Foundations

Another type of deep foundation is the caisson, which is also known as a pier foundation. They are very strong and are capable of supporting very big concentrated loads. The foundation consists of a large cylindrical col-

umn through which the loads are being transferred to the strong stratum underneath. They are a perfect solution for a house which is on a hill for example. The pier foundations may differ from each other. There are different types like a masonry pier and drilled caisson. In general, the pier foundation works by drilling a shaft into the soil which is then reinforced with steel and concrete is being poured inside the shaft. Figure 16 shows a picture of masonry pier and of drilled caisson concrete.

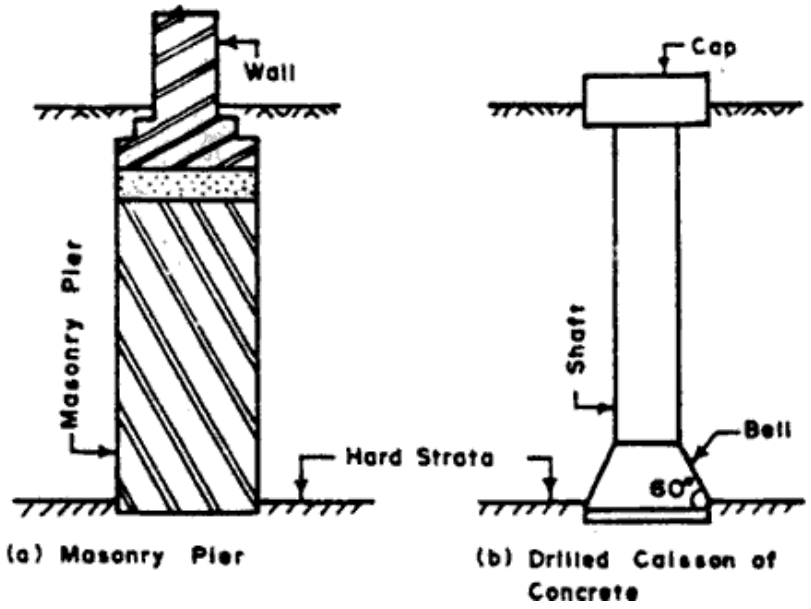

Figure 16 Caisson foundations (www.abuildersengineeer.com)

4 TEKLA MODEL

For the purpose of the thesis, the foundation report was executed on a test model, available for download in the Tekla Campus website (https://campus.tekla.com/introduction-drawings). The structure is a four-storey building and has a steel frame and cast in-situ concrete slabs. It is supported by strip, or also known as continuous, foundation and concrete piles with pile caps – both rectangular and trapezoidal ones. The piles have a diameter of 600mm. The pile caps are reinforced and so are the strip footings. More detailed drawings of the model are to be found in Appendix 2. Figure 17 shows the Tekla Campus test model.

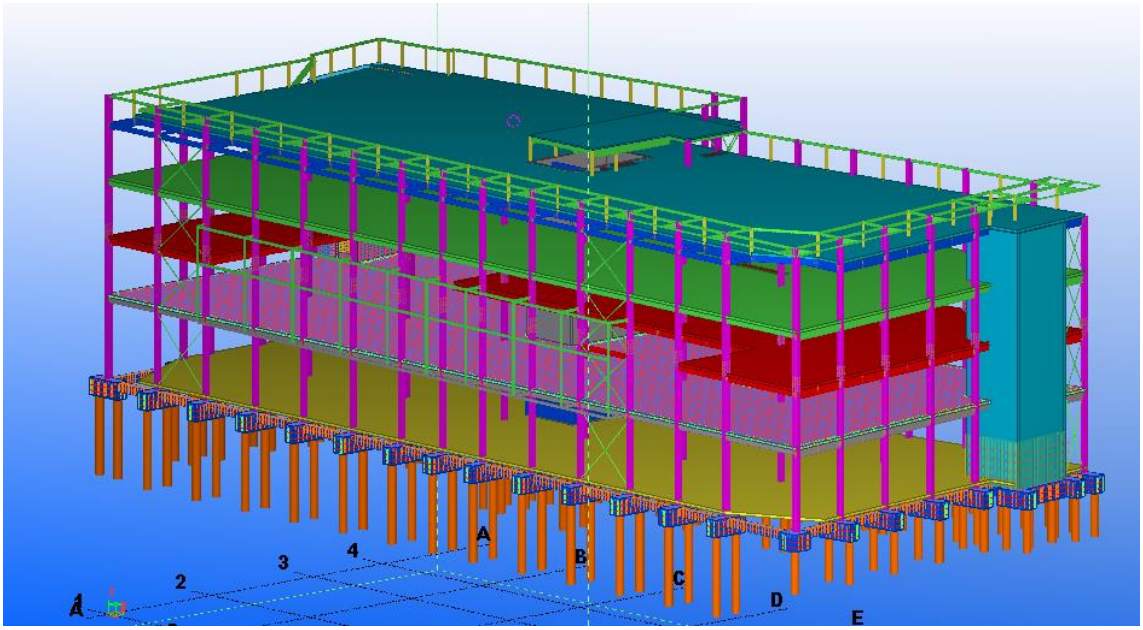

Figure 17 Tekla Campus Test Model

5 REPORTING IN TEKLA STRUCTURES

5.1 Creating Reports in Tekla

Tekla Structures has provided its users with a number of standard report templates. These can easily be accessed by clicking **Drawings & Reports** and then **Create Report**. Then, a report template needs to be chosen from the list – anything from rebar reports, weld lists, to assembly and drawing lists. Under **Titles in reports**, the titles can be entered and the file can be renamed in the **Name** box. From the **Options** tab, certain settings may be modified. The report may now be created either from the entire model by clicking **Create from all** or it can be run from selected objects only by clicking the **Create from selected** (www.tekla.com). Figure 18 shows the report window in Tekla and the list of the ready-to-use template reports.

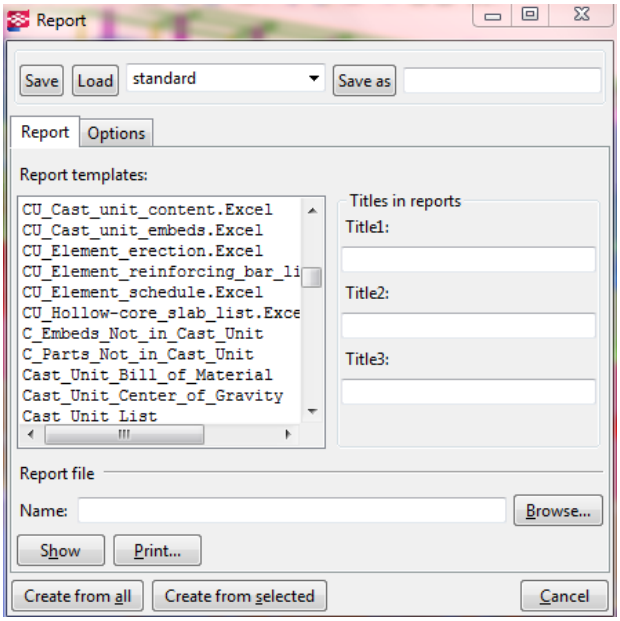

Figure 18 Report generator in Tekla

Below in Table 1 the different report options are explained.

Table 1 Report Options (www.tekla.com)

Option	Description
Titles in reports	Optional report titles. You can enter up to three report titles. All the titles are not used in every standard report. **Title1**, for example, is used to show phase information in the **Assembly_list** report.
Browse...	Use to change the folder where the report will be stored. By default, reports are stored in the current model folder.
Show report	Defines how Tekla Structures displays reports. **On dialog** displays the report in a new window. **With associated viewer** displays the report in the associated program. For example, you can have Tekla Structures open all HTML reports in a web browser.
Show created report	Defines whether or not the report is automatically shown on the screen after it has been created.

5.2 Creating a Foundation Report with Template Editor

The report that was created with Tekla's Template Editor is a foundation report. It gives information about the formwork area, the concrete volume, the weight of the concrete and the identification number of each member

in the model. It was done in a step by step structure in order to be as simple as possible and to enable a better understanding for the reader.

1) The first step to creating a report is to open the **Template Editor** from Tekla in **Drawings & Reports**. This will open the Template Editor in a new window. To create a new report **File** must be selected and then **New** and then **Textual.** The default background of the Template Editor is white which is not practical because whenever there are letters in lighter colors such as yellow for example, they are not clear and visible enough. Therefore a better option is to use a grey background. This can be changed by going to **Options -> Preferences -> Workarea**. By double clicking the background Template Page Properties can be accessed and the size of the working area can be modified.
2) To create a header click **Insert -> Component -> Header**. This creates a header at the top of the working area. Its size can be changed by clicking and dragging the small white cubes situated at the center of the header. The header provides general information about the report such as its name, company's name, date, etc. Figure 19 shows what the template should look like at this stage.

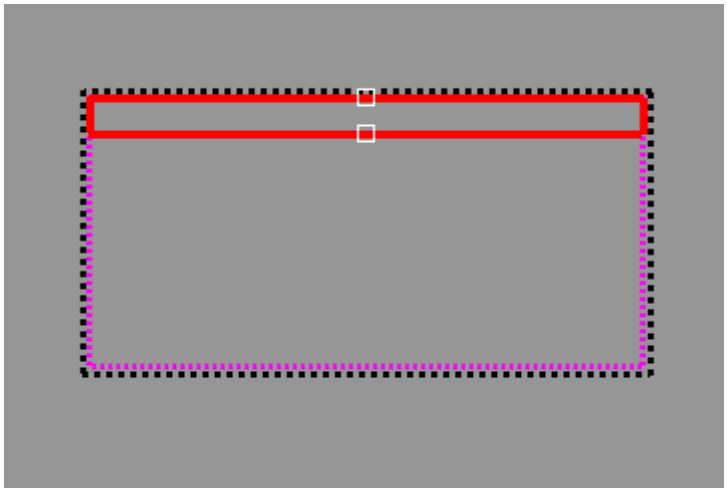

Figure 19 Header of the report

3) To give a name to the report click **Insert** and then **Text**. This opens a box to enter the text. After that it can be placed anywhere in the header. The following information was added to the foundation report :
   - Report title
   - Project title
   - Company name/University

   By double clicking the existing text the content and the font of the text can be changed. For this report Courier New font was used. Figure 20 shows how the titles have been placed in the template.

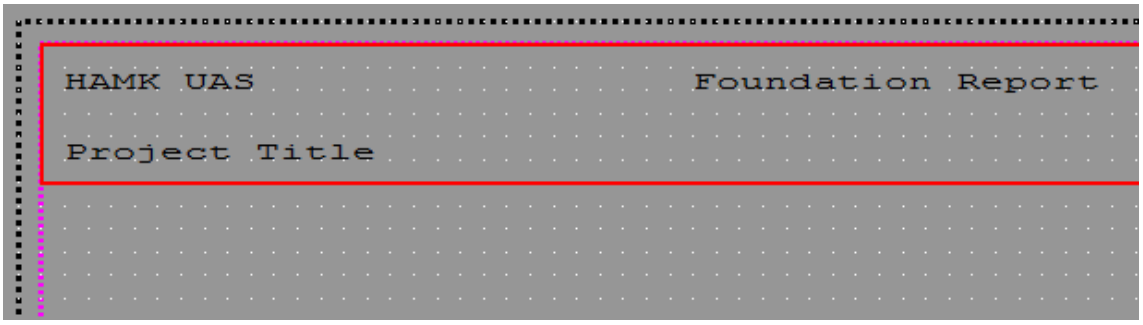

Figure 20 Inserted text in the header

4) After the text has been entered, value fields can be added. Unlike the text, the value fields pull information from the model and insert it into the report. A value field was added to the Project Title and also a date value was added. To add a value field press **Insert -> Value Field**. This opens a list of attributes from which the correct one was chosen – **Date** (Fig. 21) and **Project -> Name**. When double clicking on the value field its properties can be seen and changed – name, data type, unit, etc. For aesthetical reasons, an equal sign was added as a border at the bottom of the header.

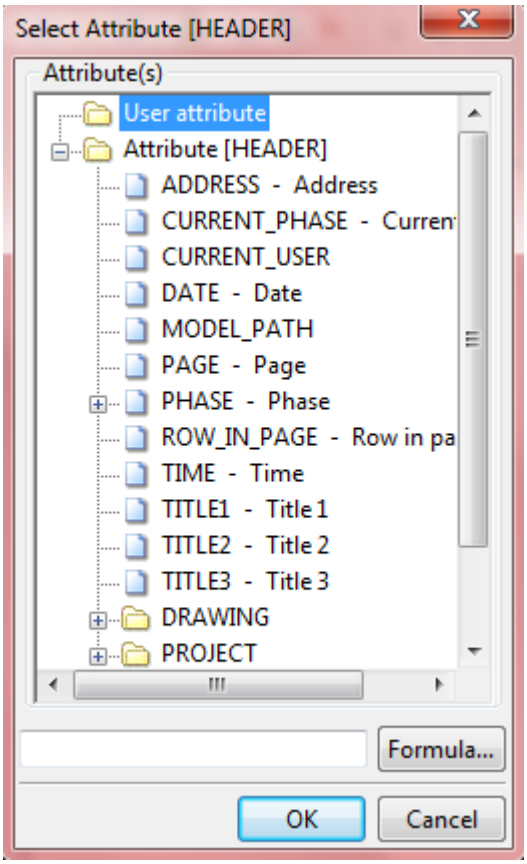

Figure 21 Add date value field

After all the text in the header has been added as well as the value fields, the template looks as shown in Figure 22.

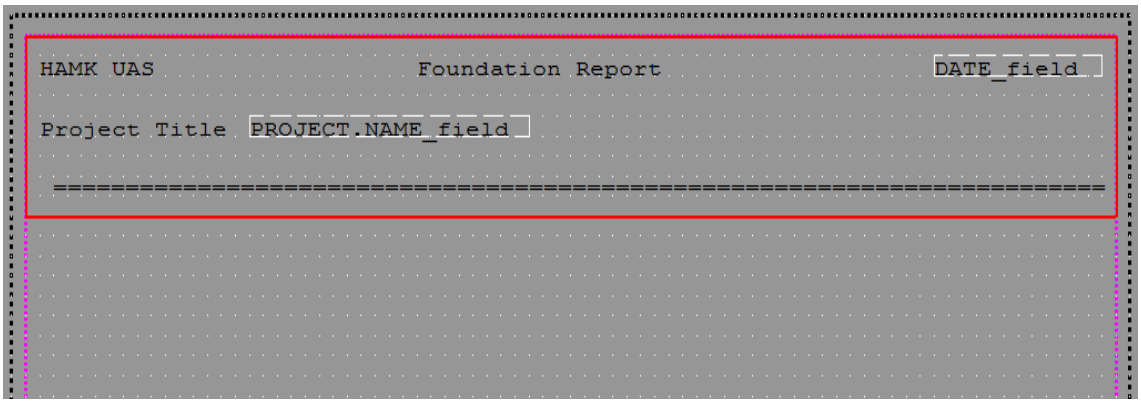

Figure 22 Finished header

5) After the basics of the report is done, a new **Row** can be created. The row contains text and the extracted information from the model. A new row can be created by clicking **Insert -> Component -> Row**. This opens a Select Content Type window where it is of high importance that the correct content type is chosen (Fig 23). The first row contains only textual information :

- Name Of The Item
- Formwork Area
- Concrete Volume
- Concrete Weight
- Item ID (Identification Number)

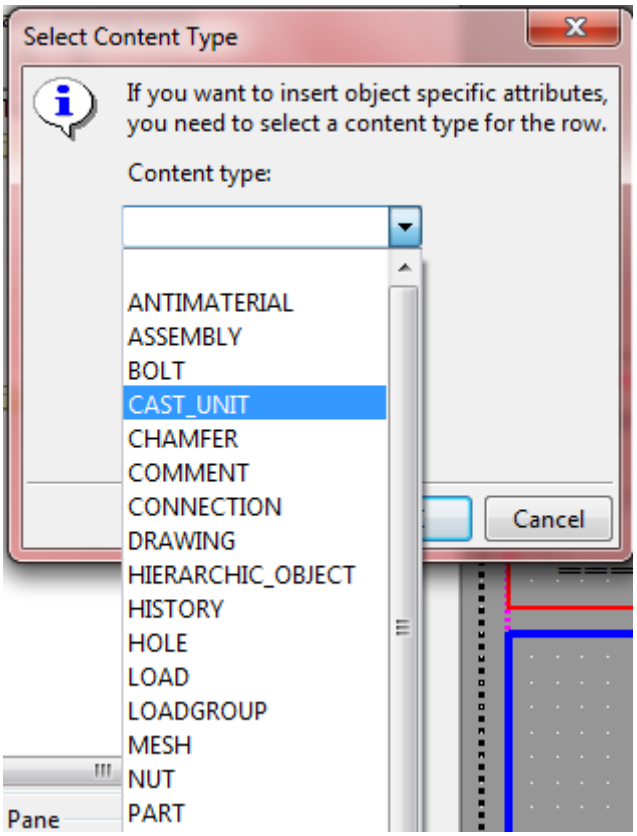

Figure 23 Select content type

The content type for this report is **CAST_UNIT**. The next step is to add the textual information. This is done by clicking **Insert -> Text**. The text needs to be positioned so that there is space for everything and so that nothing is overlapping. Figure 24 shows the finished row with textual information.

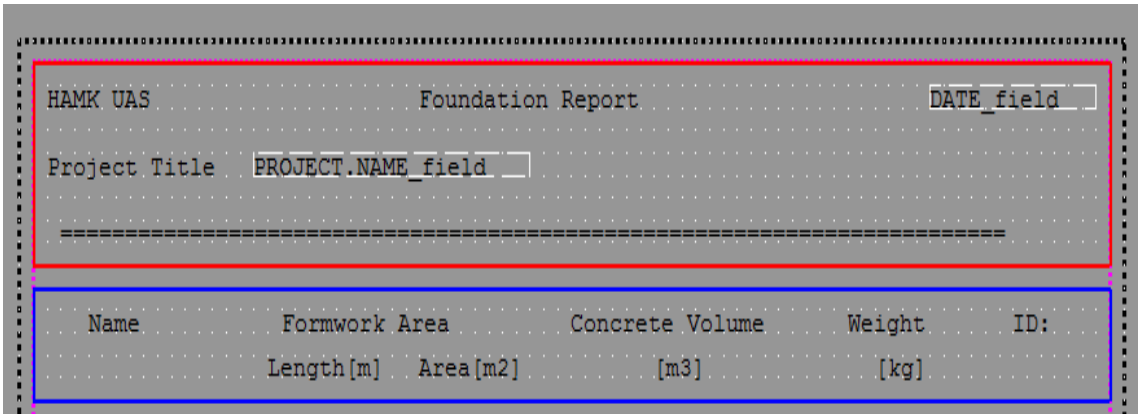

Figure 24 Row with textual information

6) After specifying the title and placement, the values themselves can be added. For that purpose, a new **Row** is needed – **Insert -> Component -> Row**. The content type is **CAST_UNIT**. The first value that was added is the name of each object. This is done by clicking **Insert -> Value Field** and then choosing the corresponding value (Fig. 25 and Fig. 26). This applies for the concrete volume, weight and ID. The Formwork Area includes the length and the area of the concrete member. After all the values have been chosen, they need to be positioned correctly and correspondingly to the previous Row.

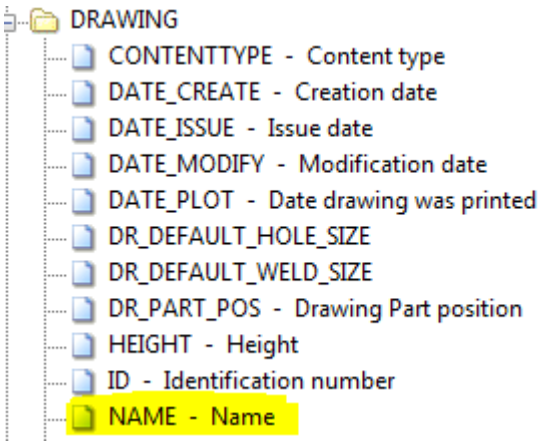

Figure 25 Adding "Name" value field

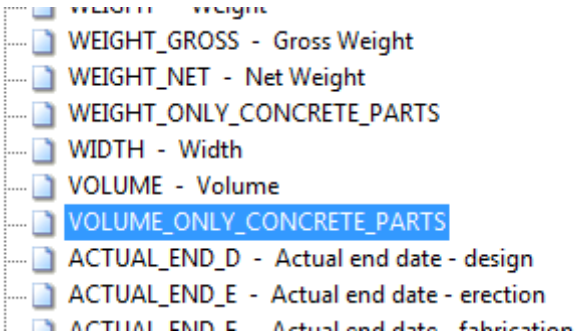

Figure 26 Adding "Volume" value field

The **Name Value Field** can be double clicked which will open up a window with its properties. From there, the sorting was set to **Ascending** – this will sort all the parts in an alphabetical order (Fig. 27). Also, the character's length was decreased to 10 characters in order to take up less

space. This, however, has only aesthetical importance and does not change the output of the report.

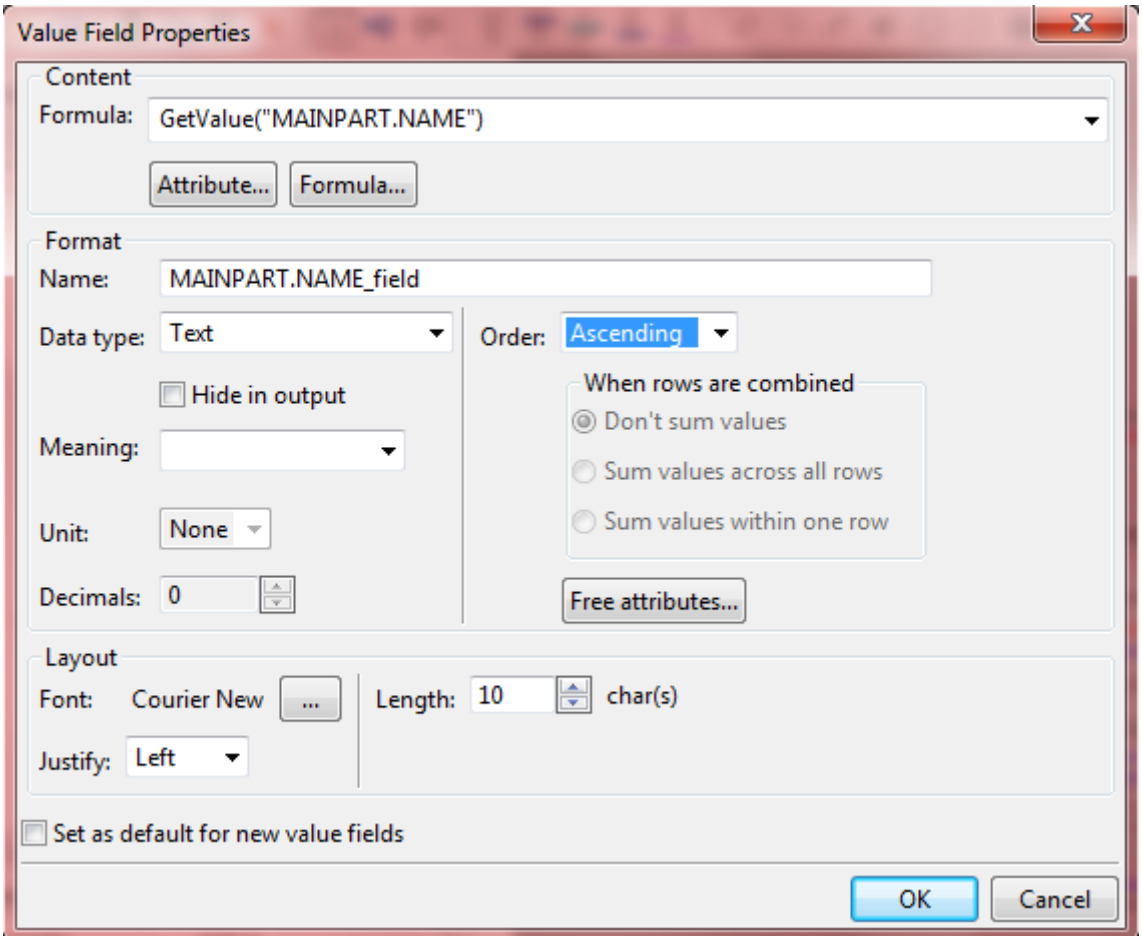

Figure 27 Changing the order to ascending

The **ID Value Field** allows one to make the report interactive. This gives the advantage of being able to click on a certain item from the report and by doing so the item is also being selected and highlighted in the model. That helps, for example, to easily make multiple changes such as renaming more than one object.

By double clicking the **Row** containing the value fields, the Row properties can be accessed. From there, the **Sort Type** was changed to **Distinct** (Fig. 28). In that way, every item is listed separately whereas if the **Combined** option is selected, all of the items from the same type will be combined together as well as their value fields such as length, volume, weight, etc.

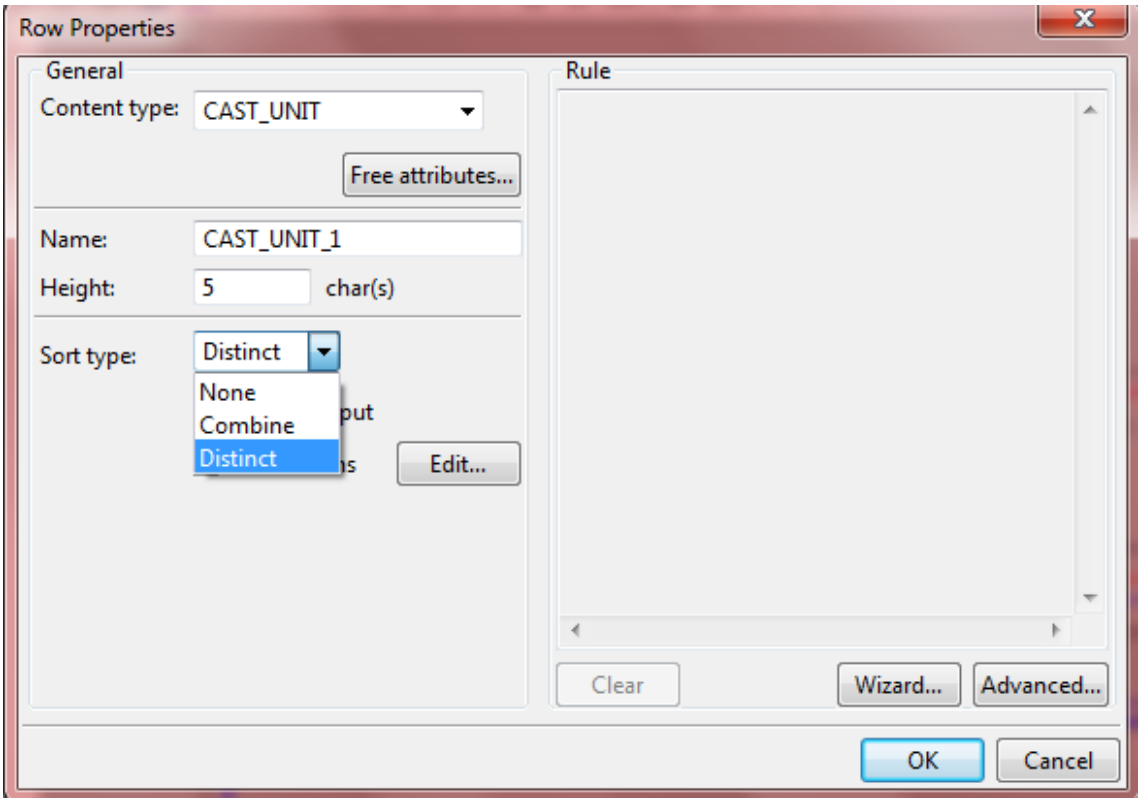

Figure 28 Changing the sort type of the row to "Distinct"

After all the values are added, the report looks like this as shown below in Figure 29.

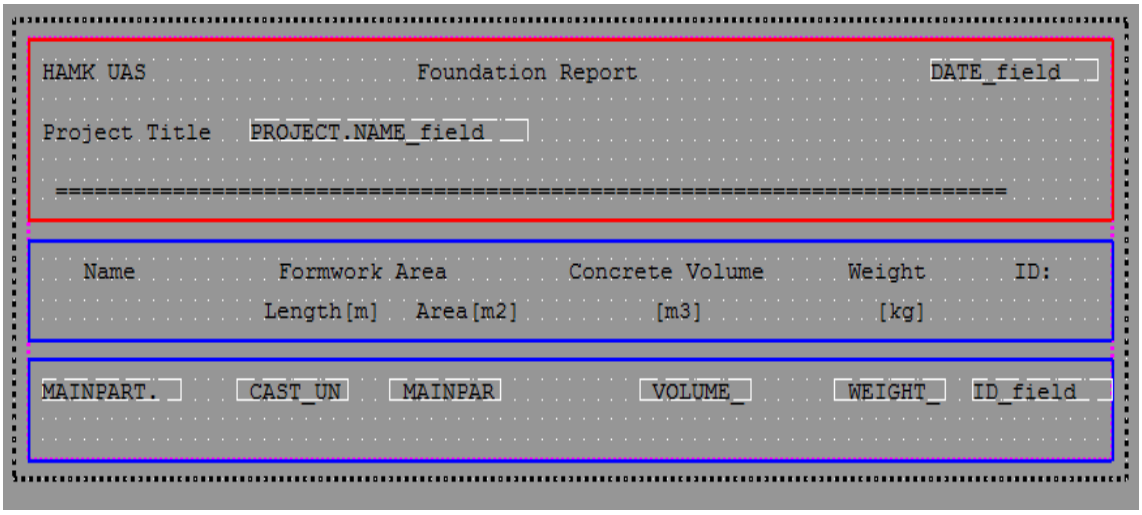

Figure 29 Report

7) The next step of creating the report is to add a Footer. The Footer will be used to summarize all the values, in the particular case – Formwork area (length and area), concrete volume and weight. To add a Footer

click **Insert -> Component -> Page Footer**. This opens a green box at the bottom of the report (Fig. 30). Then text is added (**Insert -> Text)** underneath the relevant values, in this case – Total Weight and Total Volume.

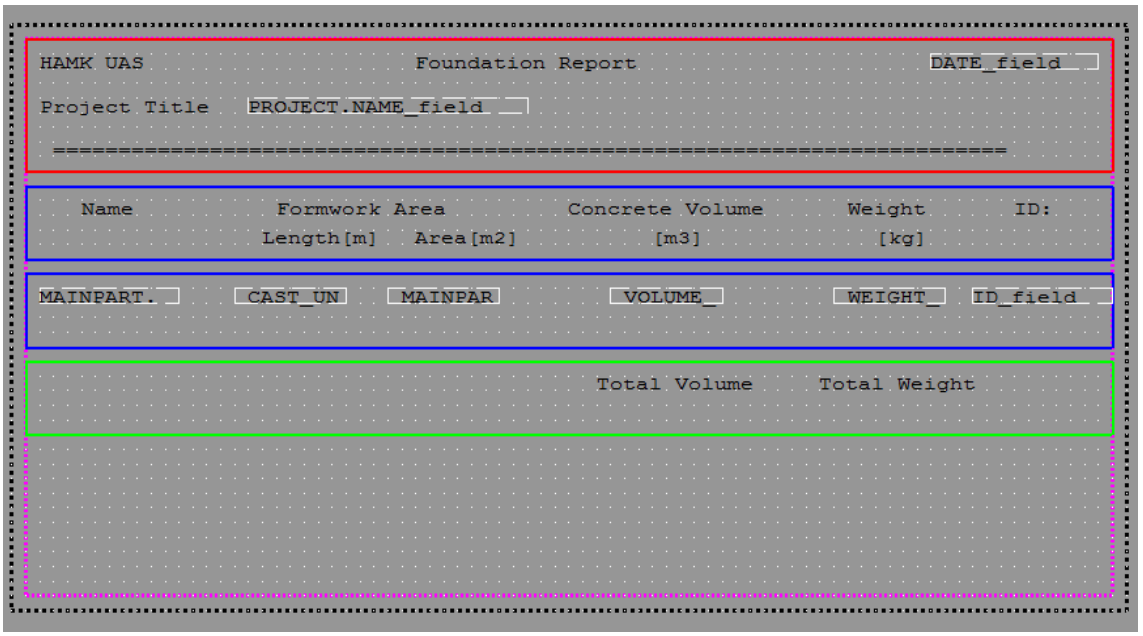

Figure 30 Adding a footer

Next, **Value Fields** are added next to the previously added text. These can be copied from the above standing Value Fields (Volume and Weight) and then pasted, or they can be added by clicking **Insert -> Value Field**. In figure 31 the positioning of the added text and value fields can be seen.

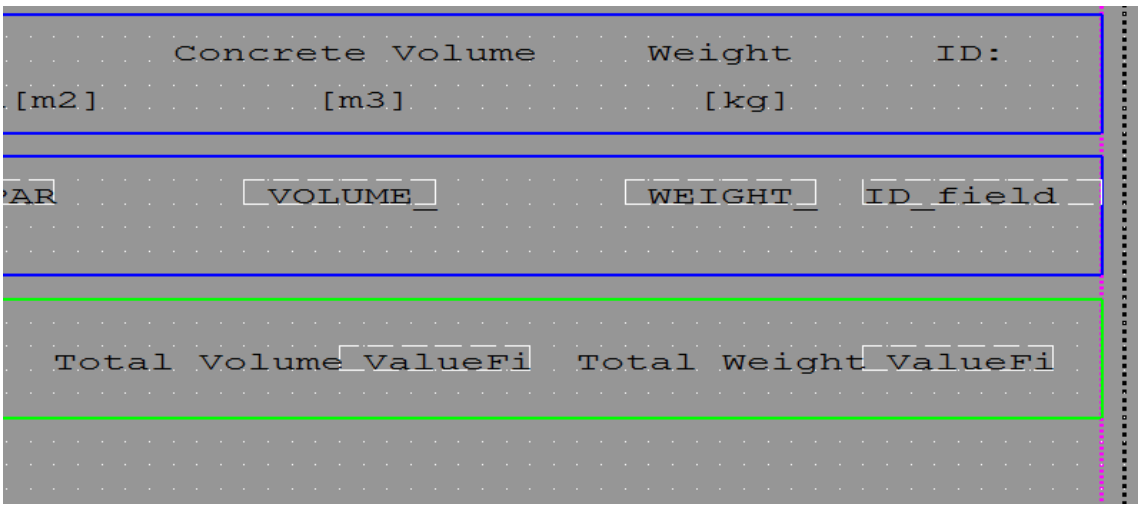

Figure 31 Adding value fields to the footer

In order for the report to be able to calculate the total volume or report, a different command needs to be used in the attribute.

By double clicking the Volume Value Field which was used in the previous row, the **Value Field Properties** can be accessed. Under **Format** and then **Name** the data has to be copied (Fig. 32).

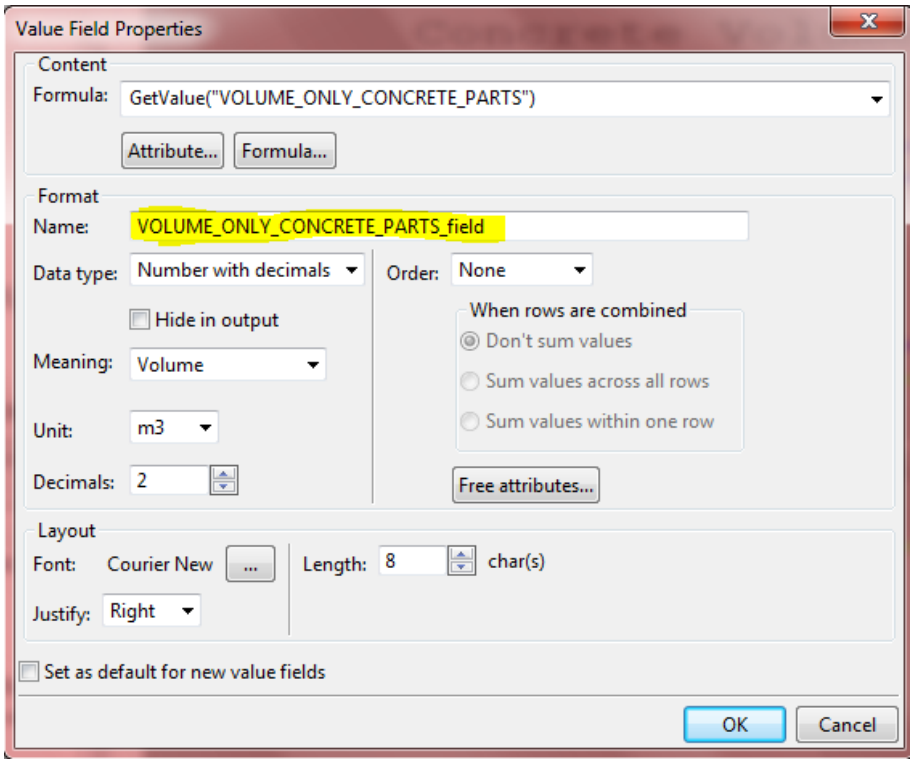

Figure 32 Copying the format name of the value field

After the name is copied from the **Value Field Properties** of the Volume, the Value Field Properties of the **Total Volume** needs to be opened. There, all the data that is written under **Formula** needs to be deleted. After that, by clicking the Formula button underneath, a new window called **Formula Contents** is opened (Fig. 33).

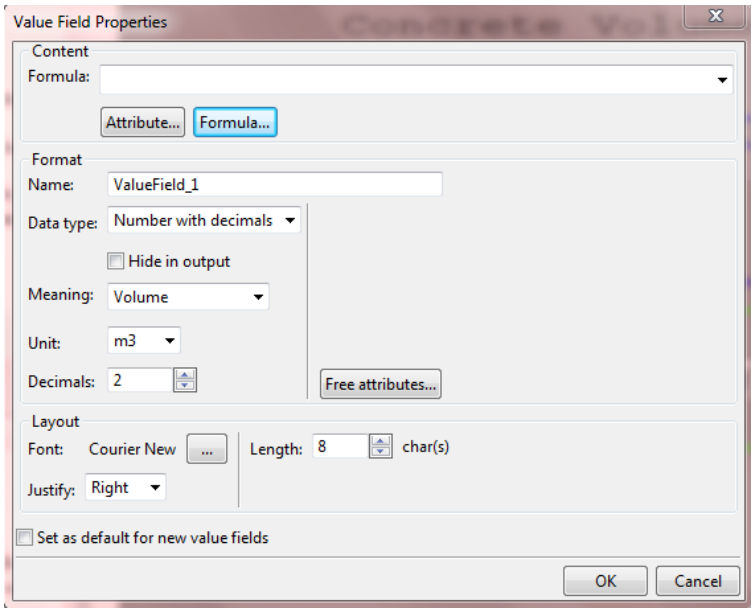

Figure 33 Deleting the formula content

In the Formula Contents a drop down menu **Function** can be found under **Value Field**. From there, **Sum** option needs to be chosen (Fig. 34).

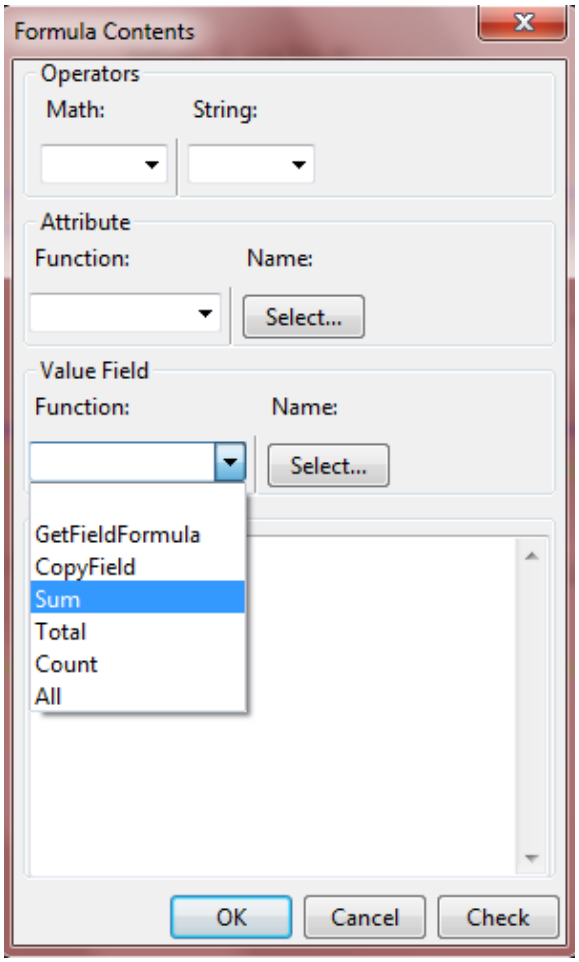

Figure 34 Choosing SUM function

In the same window, under the drop down menu, the previously copied data from the Volume needs to be pasted into the brakets as shown in Fig. 35.

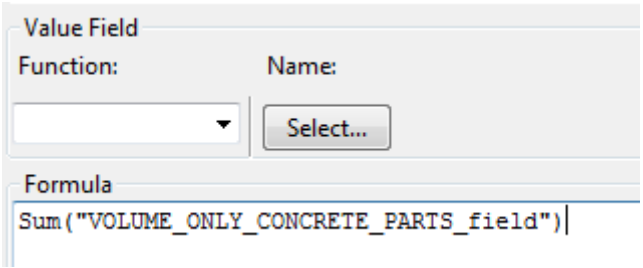

Figure 35 Pasting the data into the formula field

The same must be done for the Total Weight as well, this time copying and then pasting the formula from the Weight value. The last step concerning the Footer is to double click it so that the **Page Footer Properties** opens. From there, the output policy needs to be set to **Last**, so

that the Total Volume and the Total Weight appear at the bottom of the repor (Fig. 36).

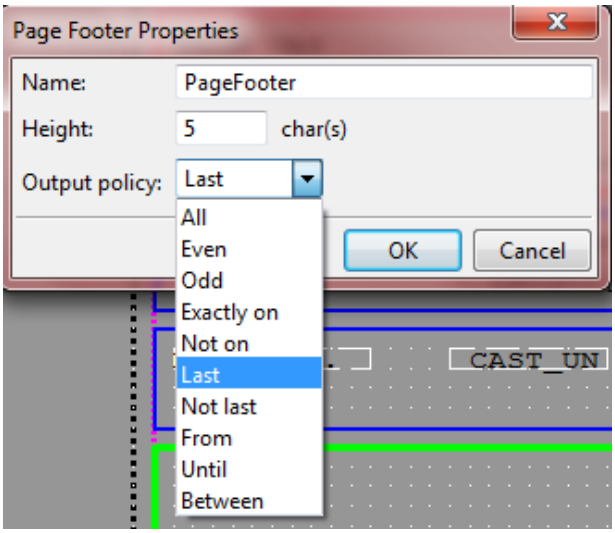

Figure 36 Changing the footer properties

8) After all the previous steps are made, the report needs to be saved by clicking **File -> Save As**. The report needs to be given a name. After that, it can be used in Tekla.

9) Before the report can be generated, the parts included in the report need to be chosen. Since this report is a foundation report, only the foundation parts will be selected. Once they have been selected and highlighted in Tekla, the report can be generated. In order to run the report click **Drawings & Reports -> Create Report** or the shortcut command **Ctrl+B**. (Figure 37)

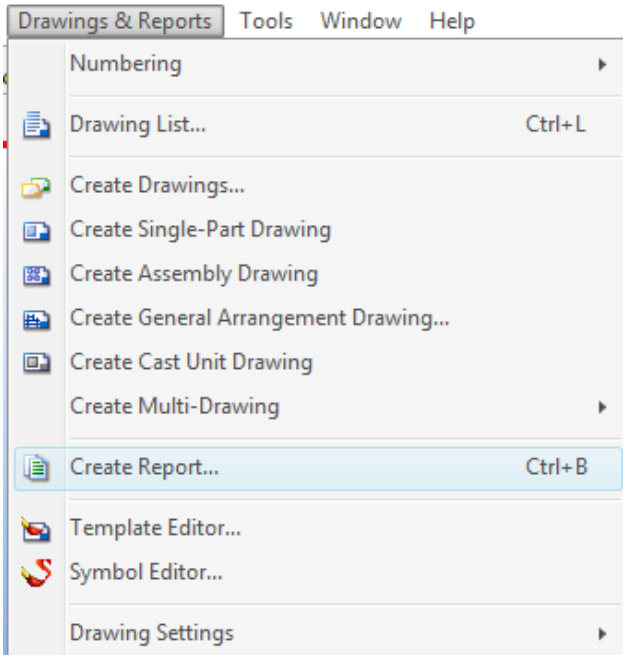

Figure 37 Create report in Tekla

Once the list with reports is opened, the Foundation Report needs to be found. The last step is to click **Create From Selected**, since the report is regarding foundations only. This will generate the report in a separate window, as shown in Figure 38.

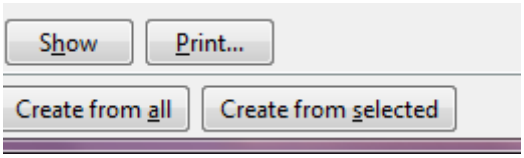

Figure 38 Create report from selected members

6 CONCLUSION

As a main result of the thesis a step by step guide on how to create a custom report using Tekla's tool Template Editor was created. The guide provides vast and detailed information on every step of the procedure and covers the most important techniques. It is written in an accessible manner so that it can be easily understood by users who are new to Tekla Structures. All the steps were visualized by photos of the actual process. The final generated report is to be found in Appendix 3. Being able to create a custom report according to the user's needs is an important skill because it gives the user more flexibility and independence.

Custom-made reports are needed daily in the construction field and thus, being able to create one would be a beneficial skill for one's carrier.

The thesis also presented an introduction to Building Information Modelling and its advantages. Furthermore, it gives us information on what Tekla Structures is and on two of its big projects.

The research on the different types of foundations provides a good summary of the general and most important principles about foundations. It gives knowledge of what types of foundations there are, about their stability and the cases in which they are used.

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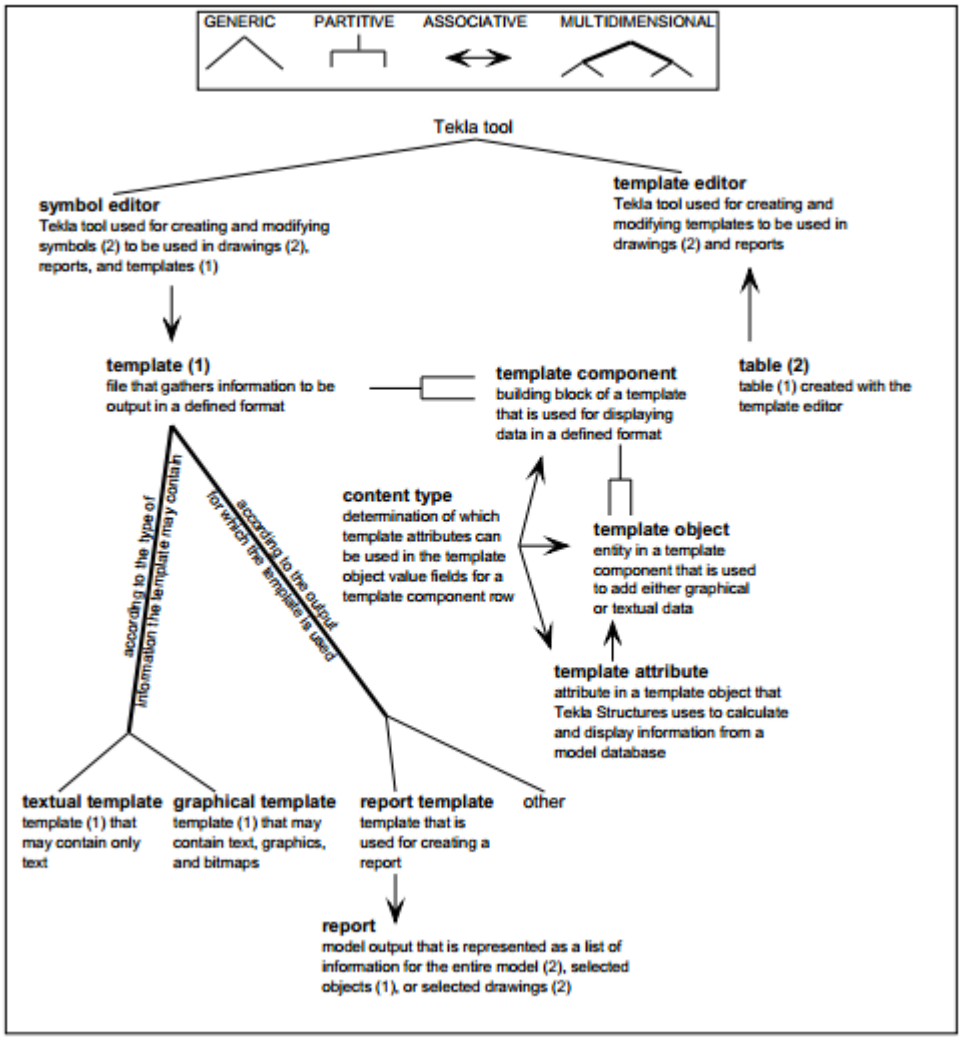
Appendix 1

TEMPLATES AND REPORTS

4 TEMPLATES AND REPORTS



Concept diagram 42. *Editors and Templates.*

Appendix 2

TEKLA TEST MODEL DRAWINGS

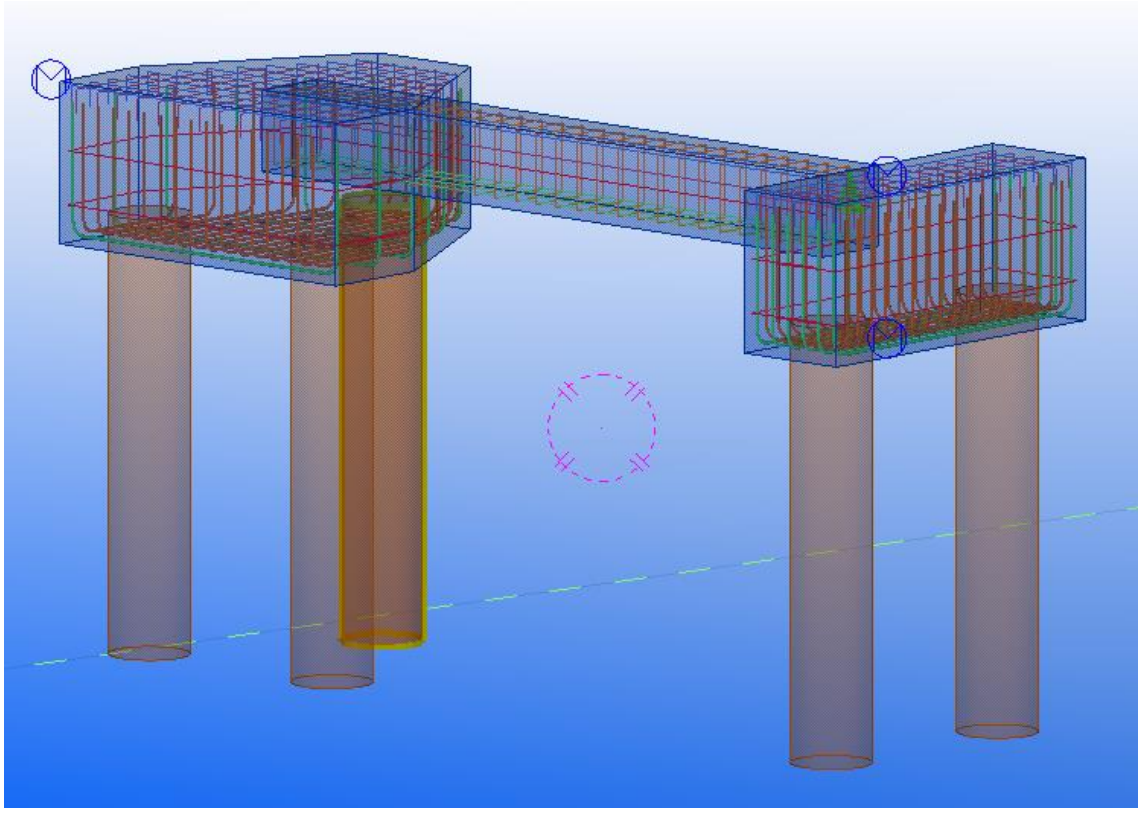


Figure 39 Piles with pile caps

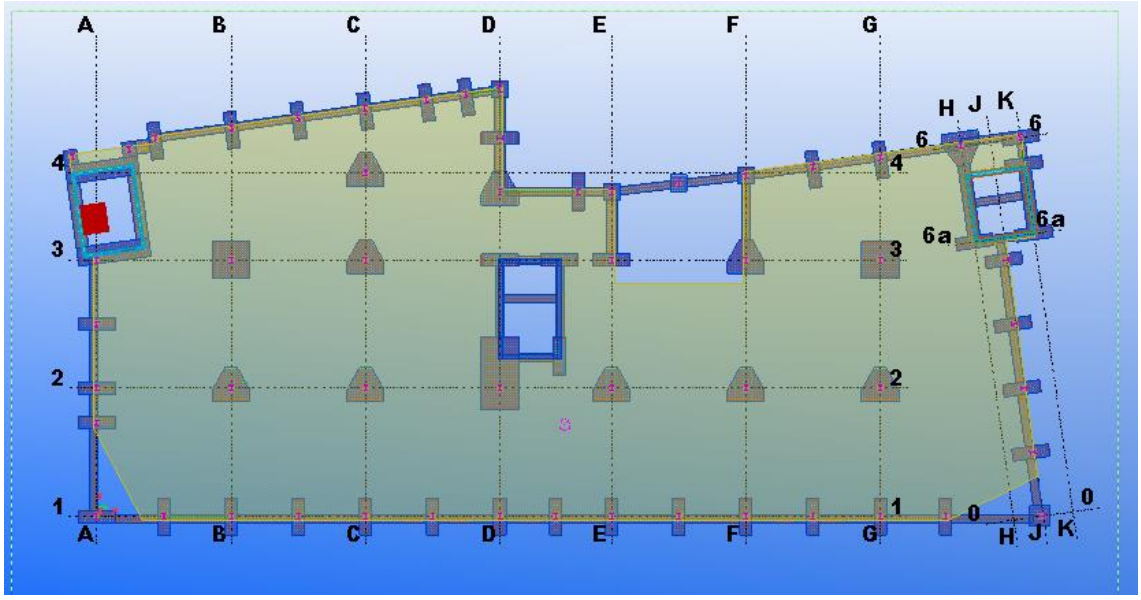


Figure 40 Top View Plan

Appendix 3

FOUNDATION REPORT

HAMK UAS Foundation Report 08.03.2015

Project Title Tekla Corporation

Name	Formwork Area		Concrete Volume	Weight	ID:
	Length[m]	Area[m2]	[m3]	[kg]	
FOOTING	3771	10	1.33	3197	157407
PILE	5750	11	1.62	3886	490037
FOOTING	1200	9	1.73	4147	490024
PILE	3250	7	0.92	2196	301062
PILE	3250	7	0.92	2196	301043
PILE	3250	7	0.92	2196	300901

FOOTING	1200	28	8.75	20995	256650
PILE	5750	11	1.62	3886	256603
FOOTING	2466	8	1.18	2841	2797213
FOOTING	1945	6	0.93	2241	2796120
FOOTING	1380	4	0.50	1192	2795027
PILE	3250	7	0.92	2196	254606
PILE	3250	7	0.92	2196	254587
PILE	3250	7	0.92	2196	254568
FOOTING	3026	21	6.23	14956	254548

PILE	5750	11	1.62	3886	254409
PILE	5750	11	1.62	3886	254390
FOOTING	1468	4	0.51	1232	2793934
FOOTING	1200	13	2.92	6998	2792841
PILE	5750	11	1.62	3886	253919
PILE	5750	11	1.62	3886	253900
FOOTING	1200	9	1.73	4147	253875
FOOTING	1200	14	2.92	6999	2791748
PILE	5750	11	1.62	3886	253729

PILE	5750	11	1.62	3886	252038
PILE	5750	11	1.62	3886	252019
PILE	3250	7	0.92	2196	245474
PILE	3250	7	0.92	2196	245455
PILE	5750	11	1.62	3886	245269
PILE	5750	11	1.62	3886	245250
PILE	5750	11	1.62	3886	245230
PILE	5750	11	1.62	3886	244811
PILE	5750	11	1.62	3886	244791

PILE	5750	11	1.62	3886	253710
FOOTING	1200	9	1.73	4147	253591
FOOTING	1200	14	2.92	6998	2903255
PILE	5750	11	1.62	3886	252387
PILE	5750	11	1.62	3886	252368
PILE	5750	11	1.62	3886	252189
PILE	5750	11	1.62	3886	252170
PILE	5750	11	1.62	3886	252077
PILE	5750	11	1.62	3886	252058

PILE	5750	11	1.62	3886	185712
PILE	5750	11	1.62	3886	185693
PILE	5750	11	1.62	3886	185674
PILE	5750	11	1.62	3886	185655
PILE	5750	11	1.62	3886	185595
PILE	5750	11	1.62	3886	185576
PILE	5750	11	1.62	3886	185557
PILE	5750	11	1.62	3886	185538

PILE	5750	11	1.62	3886	185518
PILE	5750	11	1.62	3886	185499
PILE	5750	11	1.62	3886	185326
PILE	5750	11	1.62	3886	185307
PILE	5750	11	1.62	3886	185288
PILE	5750	11	1.62	3886	185269
PILE	5750	11	1.62	3886	185250
PILE	5750	11	1.62	3886	185231
PILE	5750	11	1.62	3886	185212

PILE	5750	11	1.62	3886	244772
PILE	5750	11	1.62	3886	244752
PILE	5750	11	1.62	3886	244733
PILE	5750	11	1.62	3886	185867
PILE	5750	11	1.62	3886	185848
PILE	5750	11	1.62	3886	185789
PILE	5750	11	1.62	3886	185770
PILE	5750	11	1.62	3886	185750
PILE	5750	11	1.62	3886	185731

PILE	5750	11	1.62	3886	185193
PILE	5500	11	1.55	3717	185026
PILE	5750	11	1.62	3886	185007
PILE	5750	11	1.62	3886	184987
PILE	5750	11	1.62	3886	184968
PILE	5750	11	1.62	3886	184926
PILE	5750	11	1.62	3886	184907
PILE	3250	7	0.92	2196	184841
PILE	3250	7	0.92	2196	184822

PILE	3250	7	0.92	2196	184803
PILE	3250	7	0.92	2196	184783
PILE	3250	7	0.92	2196	184764
PILE	3250	7	0.92	2196	184745
PILE	3250	7	0.92	2196	184725
PILE	3250	7	0.92	2196	184706
PILE	3250	7	0.92	2196	184687
PILE	3250	7	0.92	2196	184667
PILE	3250	7	0.92	2196	184648

PILE	3250	7	0.92	2196	184629
PILE	3250	7	0.92	2196	184609
PILE	3250	7	0.92	2196	184590
PILE	3250	7	0.92	2196	184571
PILE	3250	7	0.92	2196	184551
PILE	3250	7	0.92	2196	184532
PILE	3250	7	0.92	2196	184513
PILE	3250	7	0.92	2196	184493

PILE	3250	7	0.92	2196	184474
PILE	3250	7	0.92	2196	184455
PILE	3250	7	0.92	2196	184313
FOOTING	1200	12	2.70	6480	184220
FOOTING	1200	9	1.73	4147	184190
FOOTING	4770	12	1.72	4121	2902162
FOOTING	1200	14	2.92	6998	2799399
FOOTING	4000	10	1.44	3456	2798306
FOOTING	1000	7	1.20	2880	175461

FOOTING	8450	30	29.86	71654	2925075
PILE	3250	7	0.92	2196	172731
PILE	3250	7	0.92	2196	172712
PILE	3250	7	0.92	2196	172676
FOOTING	3771	10	1.33	3197	2802678
FOOTING	850	3	0.31	734	2803771
FOOTING	11305	48	32.46	77894	160891
FOOTING	1048	3	0.38	905	2809236
FOOTING	1640	5	0.59	1417	2810329

FOOTING	3447	9	1.24	2972	2811422
FOOTING	4194	20	4.53	10872	2812515
FOOTING	5131	24	5.54	13300	2813608
FOOTING	4001	10	1.44	3457	2814701
FOOTING	3895	12	1.87	4487	2817980
FOOTING	2990	8	1.08	2583	2821259
FOOTING	5484	14	1.97	4738	2822352
FOOTING	4023	10	1.45	3476	2823445
FOOTING	3909	10	1.39	3341	2824538

FOOTING	2002	6	0.72	1729	2825631
FOOTING	3600	9	1.30	3110	2826724
FOOTING	4000	10	1.44	3456	2827817
FOOTING	4700	12	1.69	4061	2828910
FOOTING	1600	5	0.58	1382	2830003
FOOTING	4200	11	1.51	3629	2831096
FOOTING	3750	10	1.35	3240	2832189
FOOTING	5900	15	2.12	5098	2833282

FOOTING	3975	10	1.43	3434	2844212
FOOTING	3150	8	1.13	2722	2845305
FOOTING	3150	8	1.13	2722	2846398
FOOTING	3975	10	1.43	3434	2847491
FOOTING	3975	10	1.43	3434	2848584
FOOTING	3975	10	1.43	3434	2849677
FOOTING	3975	10	1.43	3434	2850770
FOOTING	3975	10	1.43	3434	2851863
FOOTING	3075	8	1.11	2657	2852956

FOOTING	2700	21	6.23	14950	2855145
FOOTING	1200	13	2.92	6998	2856238
FOOTING	3026	21	6.23	14956	2859517
FOOTING	3026	21	6.23	14956	2860613
FOOTING	3026	21	6.23	14956	2861706
FOOTING	3026	21	6.23	14956	2862799
FOOTING	3026	21	6.23	14956	2863895
FOOTING	3026	21	6.23	14956	2864988
FOOTING	3026	21	6.23	14956	2866084

FOOTING	1200	14	2.92	6998	2867180
FOOTING	1200	14	2.92	6998	2868273
FOOTING	1200	14	3.05	7309	2869366
FOOTING	1200	13	2.92	6998	2870462
FOOTING	1200	13	2.92	6998	2871555
FOOTING	1200	14	2.92	6998	2872648
FOOTING	1200	13	2.92	6998	2873741
FOOTING	1200	13	2.92	6998	2874834

FOOTING	1200	13	2.92	6998	2875927
FOOTING	1200	13	2.92	6998	2877020
FOOTING	1200	14	2.92	6999	2878113
FOOTING	1200	14	2.92	6998	2879206
FOOTING	1200	14	2.92	6998	2880299
FOOTING	1200	13	2.92	6998	2881392
FOOTING	1200	14	2.92	6998	2882485
FOOTING	1200	14	2.92	6998	2883578
FOOTING	1200	14	2.92	6998	2884671

FOOTING	1200	14	2.92	6998	2886857
FOOTING	1200	14	2.92	6998	2887950
FOOTING	1200	14	2.92	6998	2889043
FOOTING	1200	14	2.92	6998	2890136
FOOTING	1200	14	2.92	6998	2891229
FOOTING	1200	14	2.92	6998	2892322
FOOTING	1200	14	2.92	6998	2893415
FOOTING	1200	14	2.92	6998	2894508
FOOTING	1200	14	2.92	6998	2895601

FOOTING	1200	14	2.92	6998	2896694
FOOTING	1200	14	2.92	6998	2897787
FOOTING	1200	14	2.92	6998	2898880
FOOTING	1200	14	2.92	6998	2899973
FOOTING	1200	14	3.05	7309	2901066
PILE	4750	10	1.34	3210	160981
PILE	4750	10	1.34	3210	160962
PILE	4750	10	1.34	3210	160943
PILE	4750	10	1.34	3210	160924

FOOTING	3800	10	1.37	3283	2834375
FOOTING	3800	10	1.37	3283	2835468
FOOTING	3800	10	1.37	3283	2836561
FOOTING	3481	9	1.24	2971	2837654
FOOTING	5883	15	2.12	5083	2838747
FOOTING	3850	10	1.39	3326	2839840
FOOTING	3975	10	1.43	3434	2840933
FOOTING	3975	10	1.43	3434	2842026
FOOTING	3975	10	1.43	3434	2843119

PILE	4750	10	1.34	3210	160905
PILE	3250	7	0.92	2196	160347
PILE	4750	10	1.34	3210	160111
PILE	4750	10	1.34	3210	160016
PILE	5750	11	1.62	3886	159997
PILE	5750	11	1.62	3886	159959
PILE	5750	11	1.62	3886	159917
PILE	5750	11	1.62	3886	159860

PILE	5750	11	1.62	3886	159818
PILE	5750	11	1.62	3886	159780
PILE	3250	7	0.92	2196	159760
PILE	3250	7	0.92	2196	159740
PILE	3250	7	0.92	2196	159720
PILE	3250	7	0.92	2196	159700
PILE	5250	10	1.48	3548	159681
PILE	5250	10	1.48	3548	159662
PILE	5250	10	1.48	3548	159643

PILE	5250	10	1.48	3548	159624
PILE	5750	11	1.62	3886	159586
PILE	5750	11	1.62	3886	159567
PILE	3250	7	0.92	2196	159371
PILE	3250	7	0.92	2196	159311
PILE	3250	7	0.92	2196	159291
PILE	3250	7	0.92	2196	159267
PILE	3250	7	0.92	2196	159247
PILE	3250	7	0.92	2196	159227

PILE	3250	7	0.92	2196	159207
PILE	3250	7	0.92	2196	159187
PILE	3250	7	0.92	2196	159167
PILE	3250	7	0.92	2196	159147
PILE	3250	7	0.92	2196	159127
PILE	3250	7	0.92	2196	159107
PILE	3250	7	0.92	2196	159087
PILE	3250	7	0.92	2196	159067
PILE	3250	7	0.92	2196	158987

PILE	3250	7	0.92	2196	158967
PILE	5750	11	1.62	3886	158796
PILE	5750	11	1.62	3886	158777
PILE	5750	11	1.62	3886	158133
PILE	5750	11	1.62	3886	158114
PILE	3250	7	0.92	2196	158094
PILE	3250	7	0.92	2196	158074
PILE	3250	7	0.92	2196	158054
PILE	3250	7	0.92	2196	157825
PILE	3250	7	0.92	2196	157805
FOOTING	2700	28	8.75	20995	157385
FOOTING	3026	21	6.23	14956	157363

Total Volume 501.69 Total Weight 1204047