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Tekla Structures Custom Components and Open API in the design of precast elements

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Abstract

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Abstract

The work aimed to improve precast concrete element design in Tekla Structures software by developing support tools using the integrated Custom Component system and Tekla Open API. The thesis also includes general information about Stud connection, Safety Railing detail, Tekla Structures Custom Components and Tekla Structures Open API.

In the practical part of the study, the process of creating Custom Components and external applications is explained and the user's manual is written for every tool. In addition to the Tekla Structures software, Microsoft Visual Studio 2019 was used to provide application development.

As a result, 5 custom components for standardized wall-to-wall Stud connection and Safety Railing tube details, as well as an application for automated component inserting were created. The developed tools can be used in the working process for implementing projects that have corresponding precast concrete structures.

Keywords

Tekla Structures, Concrete structures, Precast concrete, Custom components, Wall to wall connection, Tekla Open API

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1 List of concepts

C# – a programming language used for the creation of the application.

Microsoft Visual Studio – an integrated development environment (IDE) by Microsoft. It was used to develop the application.

Tekla Open API – programming interface for different kinds of applications to interact with Tekla Structures software.

2 Introduction

The idea of this thesis was given by the employer (Nodetec Oy) during the training period. The original task was to improve the process of modelling and detailing precast concrete structures in Tekla structures (TS), as it is a widely popular type of structure used in current and near-future company's projects.

This thesis should ideally be used as a presentation of how the modelling process in TS can be optimized using existing ways of extension opportunities such as Custom components and Tekla Open API.

After preliminary research about current needs in the process in question, few ideas were collected for detailed consideration. The object of work was defined using previously obtained work experience with precast concrete elements. In addition to that, the ideas were collected from fellow workers in the company.

Tekla Structures currently already includes a wide range of tools and components made for modelling precast parts and details. That is why the specific detailings became the objects of the research. As a result of narrowing down the scope, it was decided to consider 2 types of detailings.

1. A wall-to-wall stud connection is a horizontal connection between wall elements (more details in part 3.2).
2. Safety railing sleeves are used on the construction site for fast assemble of railings (more details in part 3.3).

Both detailings are quite common and widely used, but no existing component solutions were found for them. That is why they came under consideration. The task was set to develop a variety of Tekla custom components for different usage cases and, in addition, external applications using Tekla Open API for automated inserting of those details into a model. This way the process of modelling those details is supposed to become faster.

Tekla Structures software includes all the tools for creating custom components. Developing an external application requires programming software. Since Tekla Open API works with C#, Microsoft Visual Studio 2019 was used.

3 Tekla Structures software

3.1 Scope of the use

Tekla Structures is currently a widely used software for structural design. It puts in basis the conception of BIM design in construction. This approach brings a lot of benefits to the construction industry at all phases of the construction process.

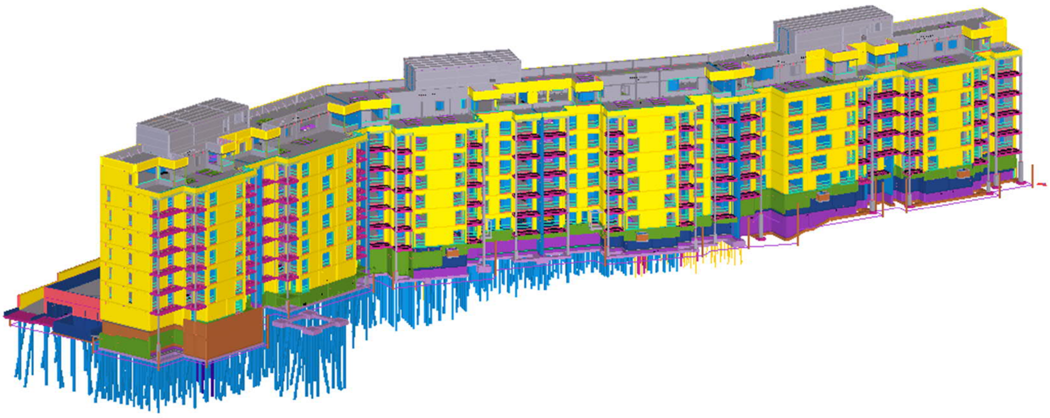

Figure 1 Tekla Structures model example

The process of creating a 3D information model leads to new demand for optimization of this process. Fortunately, the construction industry due to standardization and unification principles uses a finite number of parametric parts, that can be used as elemental pieces of the model. This makes the process of creating models much faster but requires preparatory work of creating such parts.

This approach is particularly applicable to precast concrete design. The precast concrete element in the model mainly consists of the concrete geometry of the element, reinforcement, and custom parts (embedded objects). Tekla Structures has good functionality to create different model shapes. The integrated components mostly cover the needs to model reinforcement. For custom parts, it is often used ready products designed by factories. Those factories often provide their own TS components for a fast and comfortable way to insert these parts into a model.

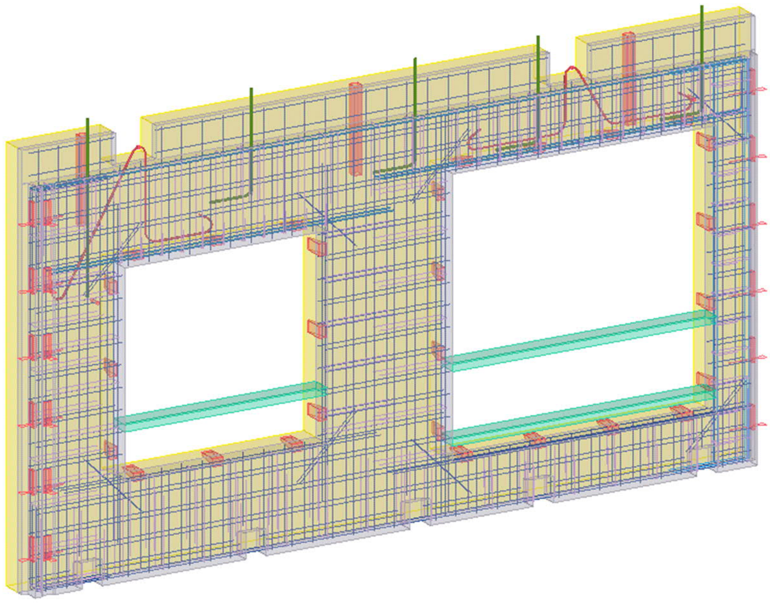

Figure 2 Precast concrete element

However, not all the used parts have an existing ready solution. There can be many different reasons for that, for instance, the product can be unique or brand new. Anyway, some common detailings are currently being created in TS using elementary modelling tools (part and reinforcement geometry) and this can be optimized using extension options.

3.2 Custom components

The integrated custom component system allows user to create new own components and use them in the model. It is generally a set of parts tied together that can have parametric variables for distances and properties.

There are 4 different types of custom components in TS: connection, detail, part, and seam.

Connections create joint objects and connect the end(s) of the secondary part(s) to the main part. The main part may be continuous at the connection point.

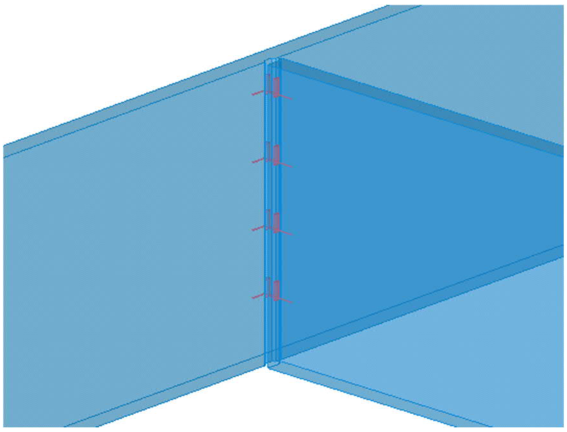

Figure 3 Wall to wall vertical connection

Details create detailing objects and connect them to a single part at a picked location.

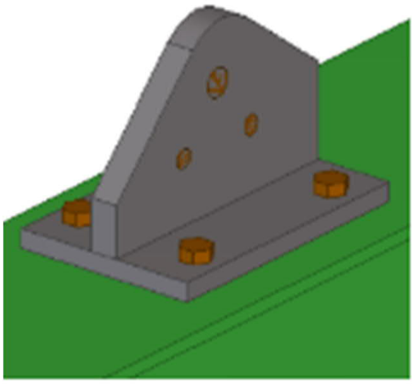

Figure 4 Steel beam lifting brackets detail

Parts create a group of objects that may contain connections and details. They form a separate entity that does not have to be attached to another entity in the model.

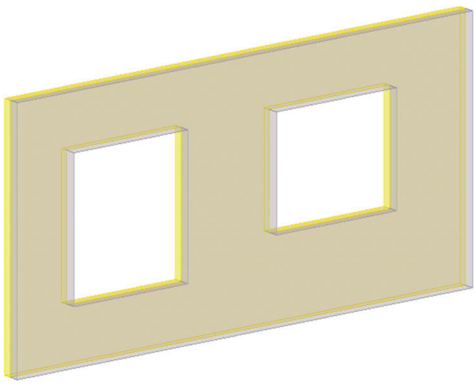

Figure 5 Wall layout component

Seams create joint objects and connect parts along a line picked with two points. The parts are usually parallel.

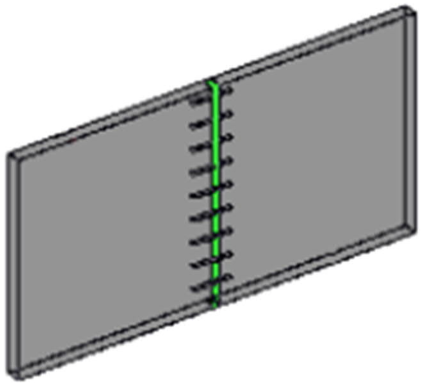

Figure 6 Seam joint component

Custom components are very useful when there are a lot of repetitive detailings. You can simply make changes to one instance and it will affect all the copies.

Parameterization in custom components is based on binding points to planes. The bound distances can be modified with formulas. It is quite simple to use this integrated tool, but it has significant disadvantages. Mainly because the possibilities are very restricted. That is why when the detailing is complex it may be not efficient or even impossible to apply a custom component option.

3.3 Tekla Open API

Tekla Open API is a much more powerful tool as it is not an environment, but an interface that allows interaction with TS software. Tekla Open API lets users' 3rd party applications integrate and communicate within the Tekla Structures modelling and drawing environment (Trimble). In other words, it allows external applications to obtain information from the model or drawings, proceed it whichever way the user wants and commit changes to the model or drawings. It opens a huge potential for model transformations because the processing of the obtained data is not anyhow limited by TS. Therefore, there are many different scenarios where it can be used.

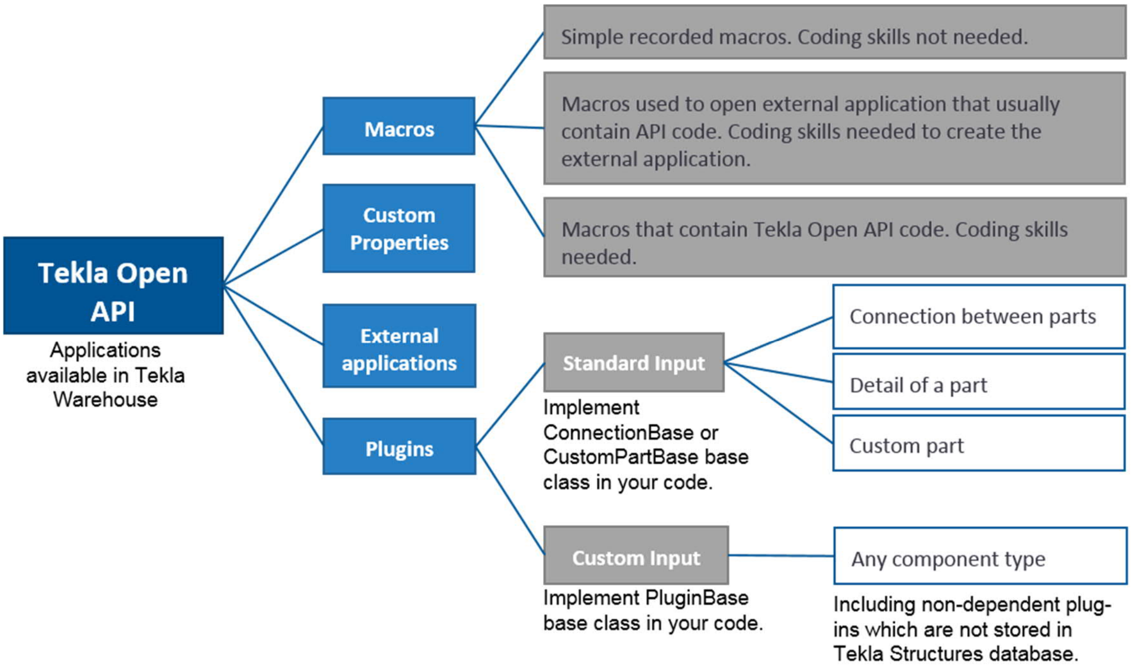

Figure 7 Customizing Tekla Structures using Tekla Open API (Trimble).

In Figure 7, different ways to extend TS possibilities are presented. Each can be effectively used in different cases. In the scope of this work, it was decided to consider external applications as these are the most appropriate options for settled tasks.

3.3.1 Macros

Macros are recorded or manually created .cs files stored in the folder defined by the XS_MACRO_DIRECTORY advanced option. In Tekla Structures, start macros from the Applications & components catalogue. Macros are C# source files (.cs) that are compiled at run-time. Macros can, for example, be used for creating drawings or reports. Macros are also sometimes used to run an application. (Trimble). It is a very handy tool, as they can be created very quickly, though they require some knowledge in programming.

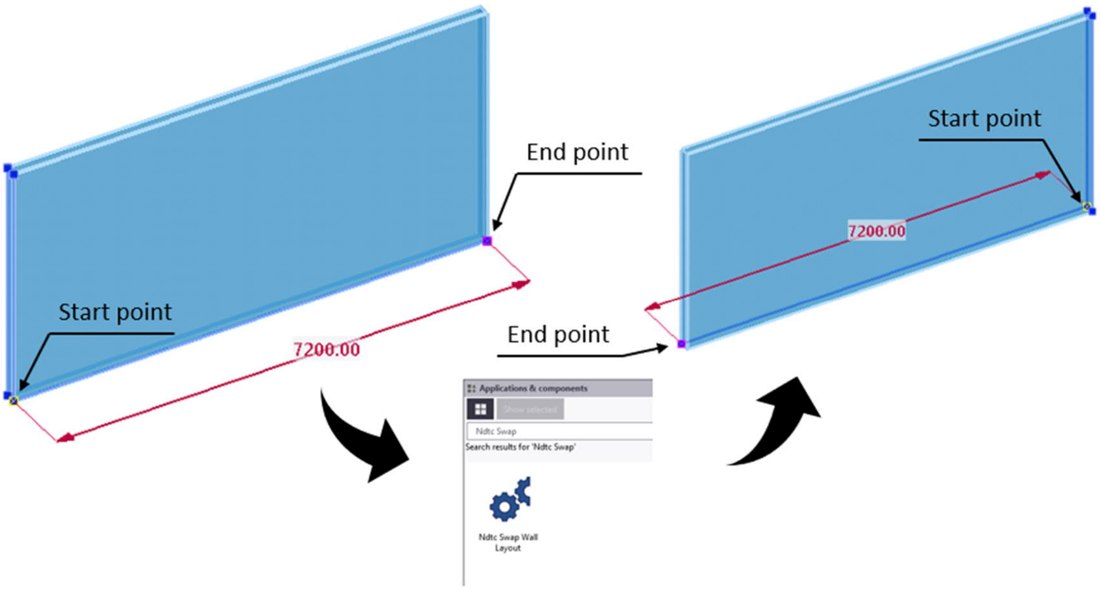

Figure 8 Example of macros that swaps anchor point of a wall element

In Figure 8, a simple macro is presented as an example. All it does is simply swapping of start and end anchor points of a wall element modelled using a wall layout tool. That example was developed for a specific task in a large-scale project. Due to using that macro the time spent on the task was significantly reduced, even though it was necessary to create the macro first.

3.3.2 Custom properties

Custom property plug-ins are programmed tools for calculating template values used in reporting and drawings. (Trimble). It is used when it is necessary to obtain some property of an object that is not available among the standard list of properties.

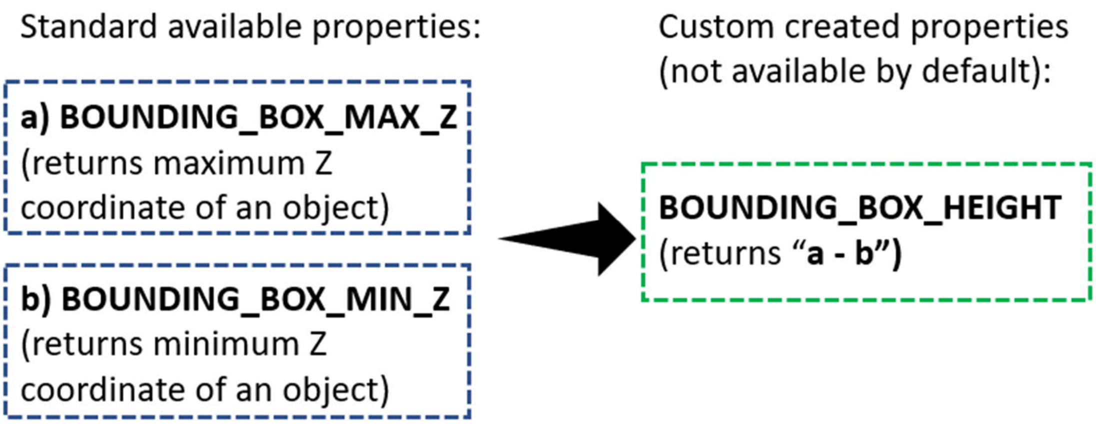

Figure 9 Example of custom property

3.3.3 External application

Application is a tool executed in a separate process. Applications can use WindowsForms, WPF, or just be console applications without UI. In Tekla Structures, start applications from the Applications & components catalogue. (Trimble).

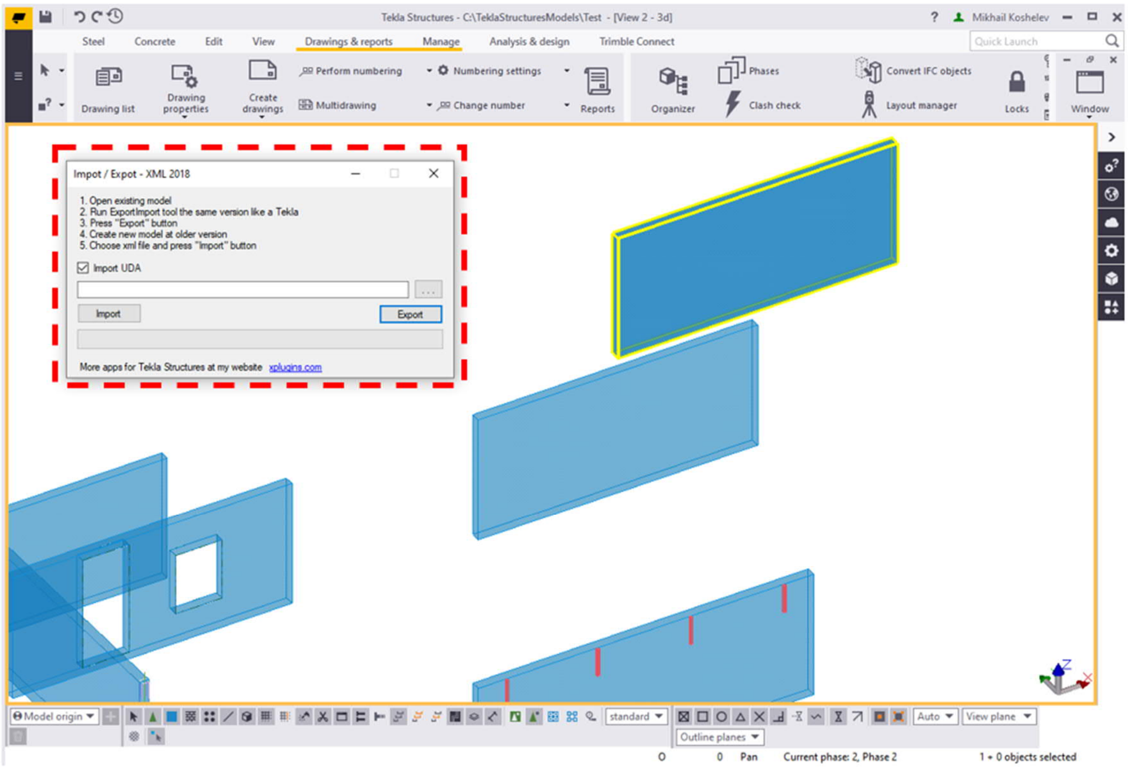

Figure 10 Example of application for Export/Import of objects

In Figure 10, an application for import and export model objects between different TS versions is presented. It works as a separate windows application and connects to TS via the API.

3.3.4 Plugins

A plugin is a fast and intelligent piece of software that runs inside the TS process. Plugins are used to create connections between parts, details, custom parts, or any components. (Trimble).

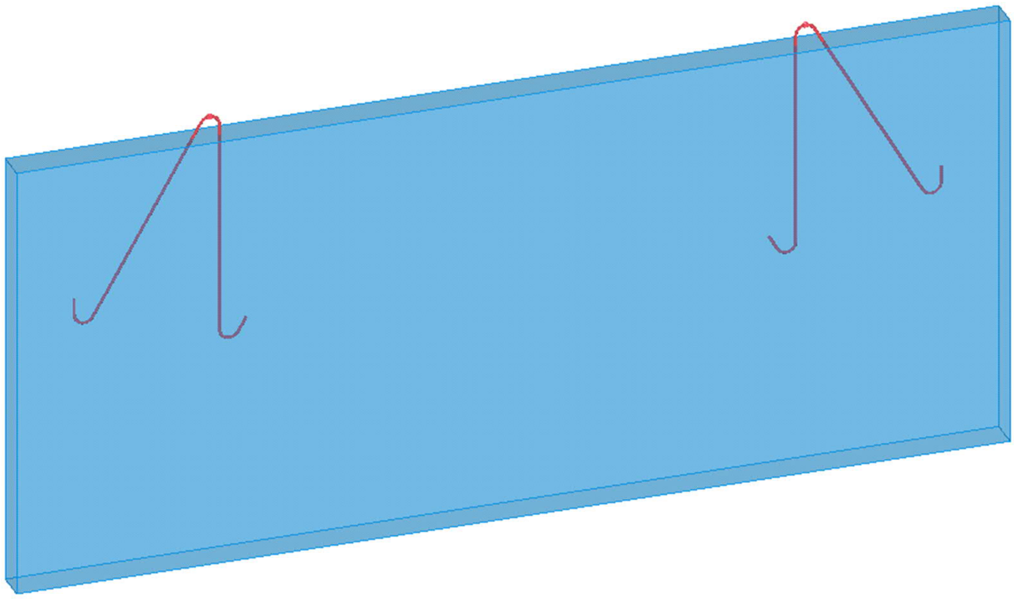

Figure 11 Example of lifting anchors plugin

From the outside perspective, plugins may be very similar to custom components. They often serve as model objects. However, since they are created with external programming, they have much more opportunities inside.

Each approach has its benefits and difficulties. A short comparison is presented in Figure 12.

	1. Macro	2. Custom Component	3. Custom property	4. External application	5. Plug-in
Description	Tekla Structures feature to record and run scripts that call commands in the Tekla Structures user interface.	Tekla Structures feature to build components that automatically adjusts to changes in the model.	Programmed plug-ins that enables external calculation of template values fields.	Programmed external applications that communicate and interact with Tekla Structures.	Fast and intelligent piece of software that runs inside Tekla Structures process.
Use cases	Macros can be used save time on routines. Macros replace multiple user interface commands in menus, dialog boxes, or shortcuts.	Custom components are used to define your own connections, parts, seams and details.	Custom properties are used to calculate template values in reports and drawings.	External applications are used for multiple purposes, like extracting data from model, creating drawings, checking or modifying objects, etc.	Plug-ins are used to create connections between parts, details, custom parts, or any components.
Easiness	Beginner	Beginner	Intermediate	Intermediate	Advanced
Coding needed	No*	No	Yes	Yes	Yes
Tools and software needed	Tekla Structures (Notepad or Notepad++, Tekla Open API) *	Tekla Structures	Tekla Structures, Microsoft Visual Studio Community (free), Tekla Open API	Tekla Structures, Microsoft Visual Studio Community (free), Tekla Open API	Tekla Structures, Microsoft Visual Studio Community (free), Tekla Open API

*) See also next chapter

Figure 12 Five different ways to enhance Tekla Structures (Trimble)

In this work, it was decided to use custom components and external application approaches, as they seem to be the most appropriate way for the goals of the work.

4 Precast detailing

4.1 Study object research

The searching process of a study object was mainly based on obtained experience during the traineeship. There were different ideas of possible objects, but it was decided to focus on a few ones that can be optimized most efficiently.

4.2 Stud connection

Wall-to-wall stud connection is a widely used type of horizontal connection between wall elements. It consists mainly of a vertical reinforcement bar with the bottom end buried on the top surface of the lower wall and a reserved for the bar top end recess on the bottom surface of the top wall.

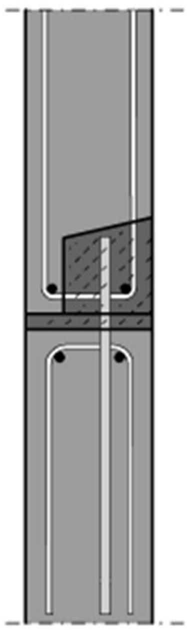

Figure 13 Wall-to-wall stud connection

The connection transfers horizontal loads applied to the walls and being placed in wall-to-wall and wall-to-slab joints along the connection line with certain spacings.

It is usual in real projects to minimize the number of design cases down to using one case per project with unified spacing values.

To define the required minimum spacing between the connections it is necessary to know the bearing capacity which is mainly defined by the shear capacity of a bar. According to

(Uimonen 2018, pp. 22–23), there are no guides in Eurocodes given for such case but there is in CEB guides. According to Leskelän (2008), the maximum shear strength can be defined by the equation:

$$V_{sd,Rd} = \frac{1.3}{\gamma_v} d^2 \left(\sqrt{1+(1.3\varepsilon)^2} - 1.3\varepsilon \right) \sqrt{f_{cd} f_{yd} \left(1-\zeta^2\right)} < \frac{A_s f_{yd}}{\sqrt{3}} \tag{1}$$

where $V_{sd,Rd}$ is a shear strength value, γ_v is a partial factor of the connection, d is a diameter of a stud, f_{cd} is a design compressive strength of concrete, f_{yd} is a design tensile strength of steel, A_s is the area of studs

ε is calculated as:

$$\varepsilon = 3\frac{e_v}{d}\sqrt{\frac{f_{cd}}{f_{yd}}} \tag{2}$$

where e_v is a distance of the load application point from the concrete surface.

ζ is calculated as

$$\zeta = \frac{\sigma_{sd}}{f_{yd}} \tag{3}$$

where σ_{sd} is a tensile stress value.

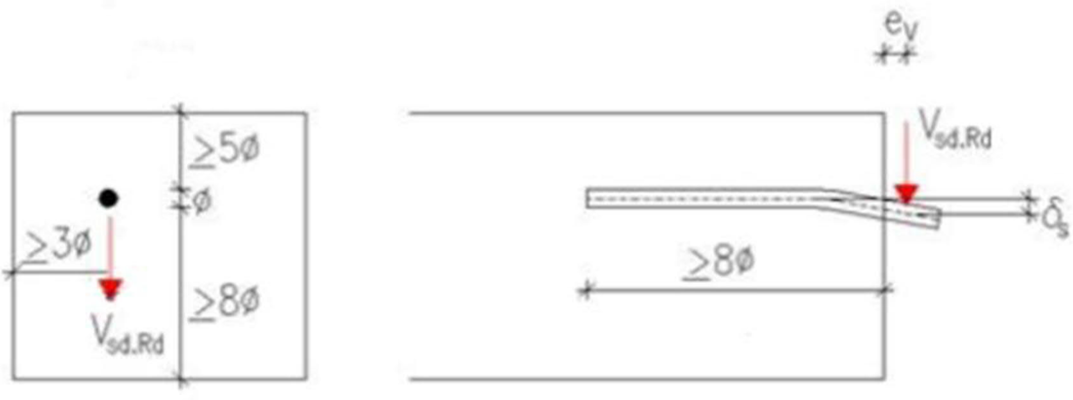

Figure 14 Minimum distances for studs (Leskelä 2008)

In practice, the required distance between neighbour studs may be regulated by local authorities and have values from 600 to 1200 mm, which is a conservative value. Due to that approach, there is no much sense in adding such calculations of spacing inside a custom component.

4.3 Safety Railing Sleeves

KAPU® Safety Railing Sleeves is an item product produced by Peikko Finland Oy company. The item consists of a steel tube and the anchors welded to it. These anchors transfer the loads on the rail to the concrete. They are used for the quick and safe installation of temporary guardrails on load-bearing and non-load-bearing concrete walls. KAPU® Safety Railing Sleeves can also be used to install permanent structural components under a static load. (Peikko 2019).

Figure 15 Installed guardrails

Guardrails are used on a construction site due to safety reasons. They form a closed railing loop along the edges of the building to prevent falling during high-altitude works (Figure 15).

Figure 16 Safety railing sleeve products

KAPU® Safety Railing Sleeves are installed in the mould before the concrete is cast. The railing sleeves are either mounted on the element's outer surface or embedded in the element to the tube's depth. Railing Sleeves can also be installed in the insulation space of a sandwich element in which case the stud anchors are anchored to the element's inner shell (Peikko).

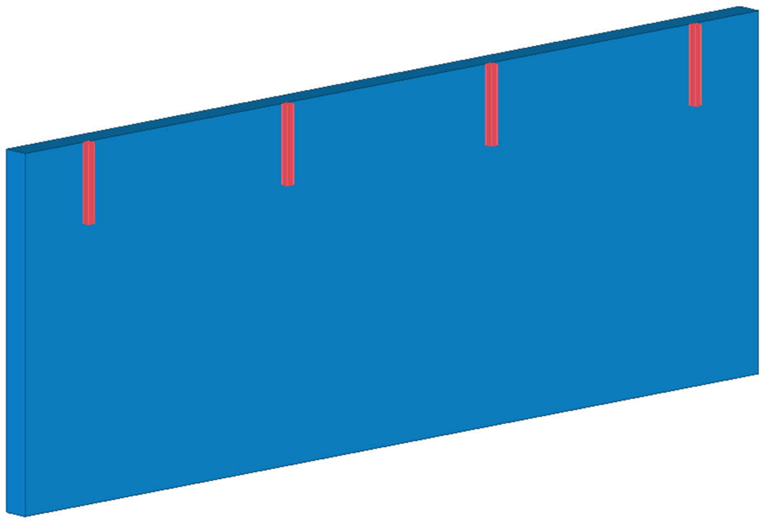

Figure 17 Safety railing sleeves on the element

5 Custom components development

5.1 Stud connection components

In order to provide modelling tools for stud connection, 6 custom components were developed to cover different variations of detailing insertion. After those components have been used in practice, it became clear that 3 of them are used in almost all the cases, as they are more convenient. This is why only those 3 made it to the final package of the components. Those are Stud detail, Hole detail and Detail array.

A detailed description of each component is written below. Short user guides and installation process are presented in the Appendix section.

5.1.1 Stud detail

Stud detail is used to model individual detailing of the stud in the bottom wall of the connection. This is used when it is necessary to manually insert the detailing in someplace. It is also used as a subcomponent in the Detail array component and Stud Connection Inserter application.

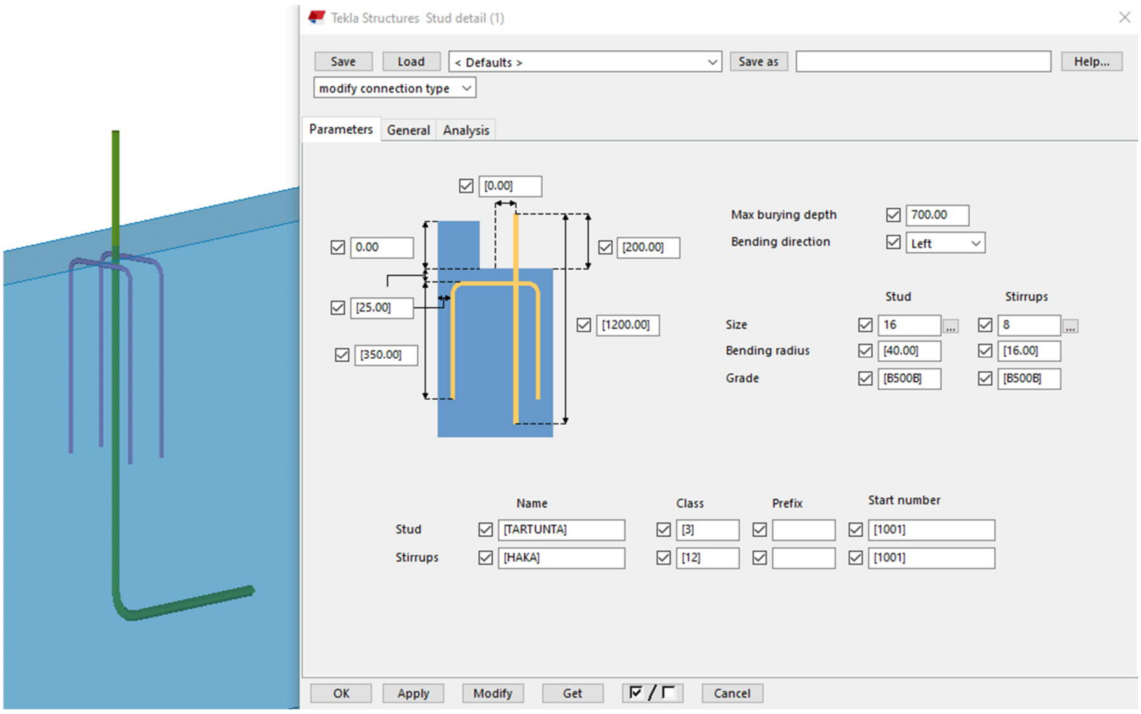

Figure 18 Stud detail model view with an attribute window

In Figure 18, you can see how the component looks in the model and the component window. Parameter values given in the figure are set as defaults. Parameters tab allow the user to change such variables as size, grade, the bending radius of the stud and stirrup rebars, concrete cover layer, length and position of the stud rebar, leg length of the stirrups. The below area contains such attributes as rebar name, class, prefix and start number. The maximum burying depth parameter represents the lower bound until which the rebar can be buried into the element (e.g., in case of restrictions caused by openings), see Figure 19. If this value is lower than the calculated buried length, the rebar is going to be bent aside. Bending direction sets which side the rebar will be bent. The component is created as a Detail Component, so it applies to part in a specified position point.

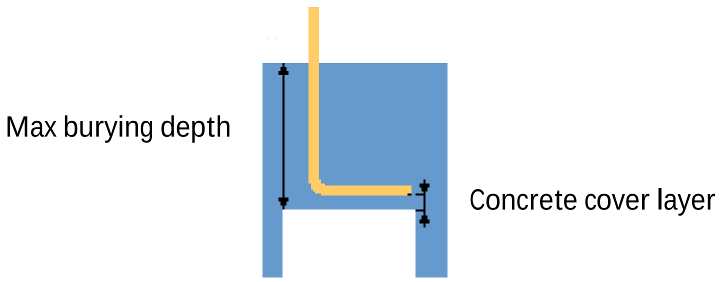

Figure 19 Calculation of the bending length

The actual buried length of the rebar depends on the Maximum burying depth parameter, leaving a gap for the concrete cover layer. Definition of the length of horizontal anchoring part depends on reinforcement bar length calculation option set in Tekla. By default, it is calculated along the centerline.

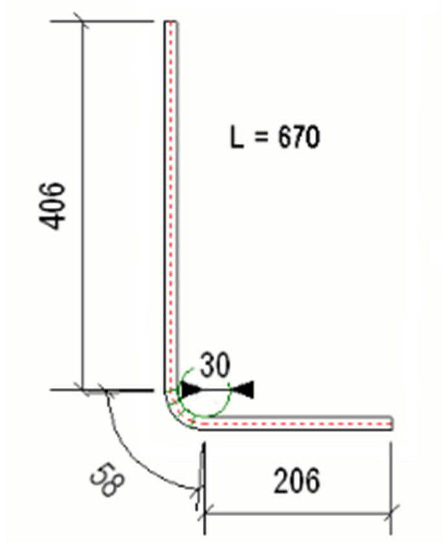

Figure 20 Calculating reinforcement bar length along the centerline

Calculations were performed in such a way that the total length of the rebar remains the same.

In bearing walls with cast edge (see Figure 21) the position of the stud in the width direction can be moved from the centre. Both the eccentricity and casting edge height parameters are provided in the attributes.

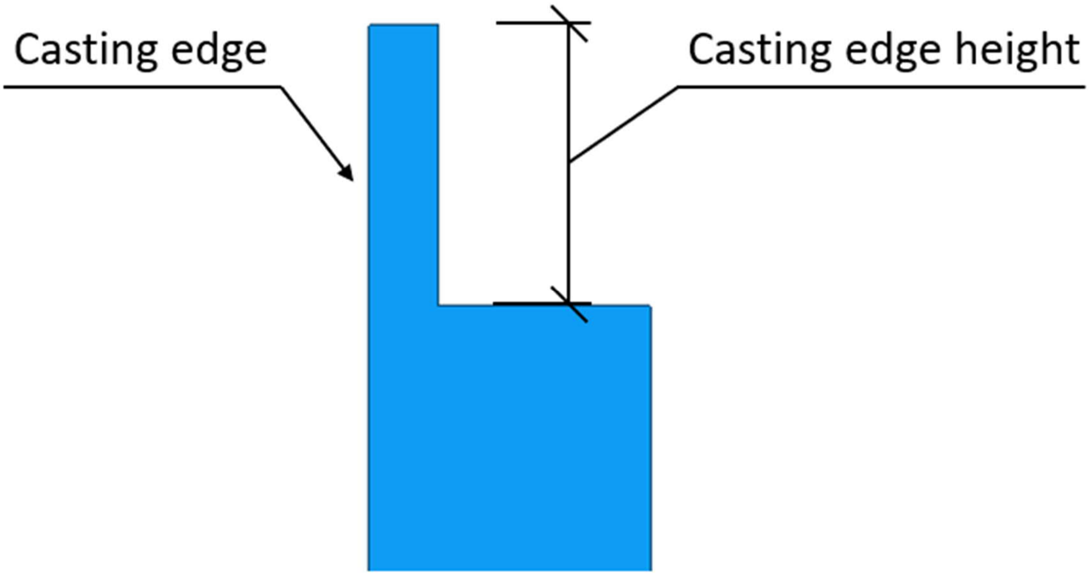

Figure 21 Casting edge in an element

5.1.2 Hole detail

The Hole detail component has the same structure as the Stud detail, but it represents the hole detailing in the top wall element of the stud connection. This component is as well used for manual usage and as a subcomponent in the Stud Connection Inserter application.

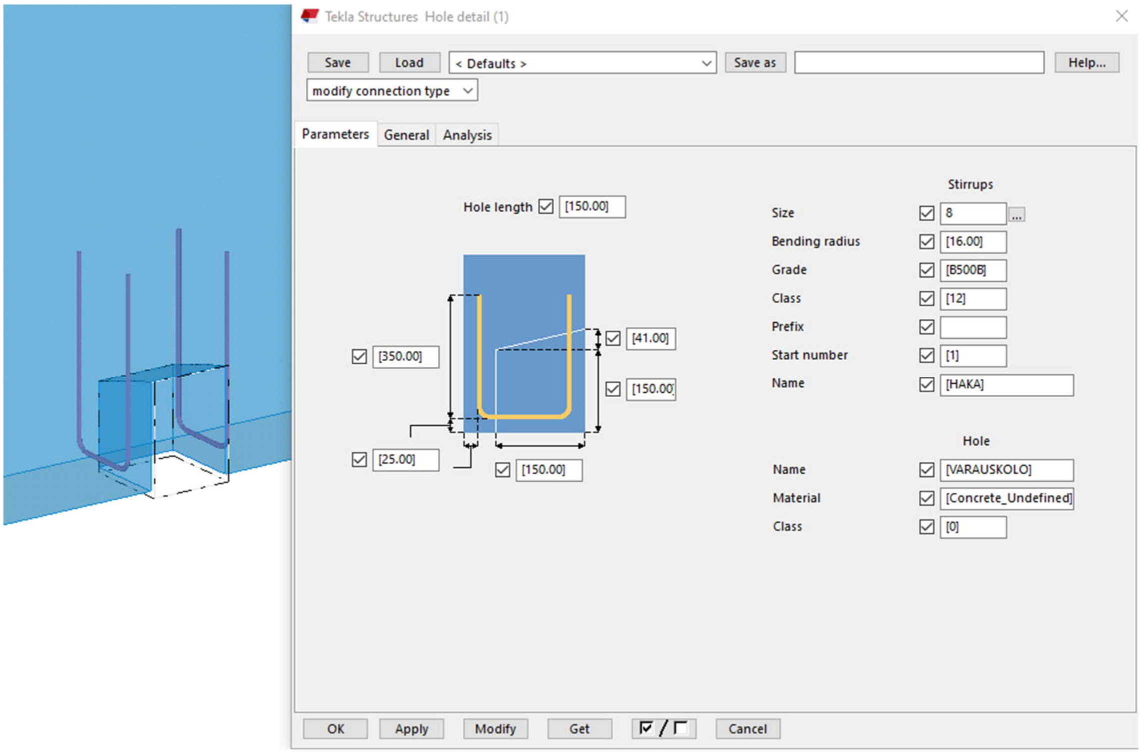

Figure 22 Hole detail model view with attribute window

In Figure 22, you can see how the component looks in the model and the component window. The parameter tab allows changing the hole size and attributes of stirrup rebars. Parameter values given in the figure are set as defaults.

5.1.3 Detail array

The Detail array is an extension of the above components to a row of objects. The position of the Detail array component is defined by corresponding parts and 2 points. The component includes studs and reservation holes as subcomponents. This approach, due to software reasons, does not allow to directly modify subcomponent's attributes, that is why the properties for the subcomponents are taken from the beforehand created attribute files. However, this way has a significant advantage as well. It is easier to set the same settings for those groups. This way it is easier to manage all the connection in the model, especially in large-scale projects. The array component can easily be exploded into separate subcomponents. This is a very useful feature in practice when you face situations that require manual changes.

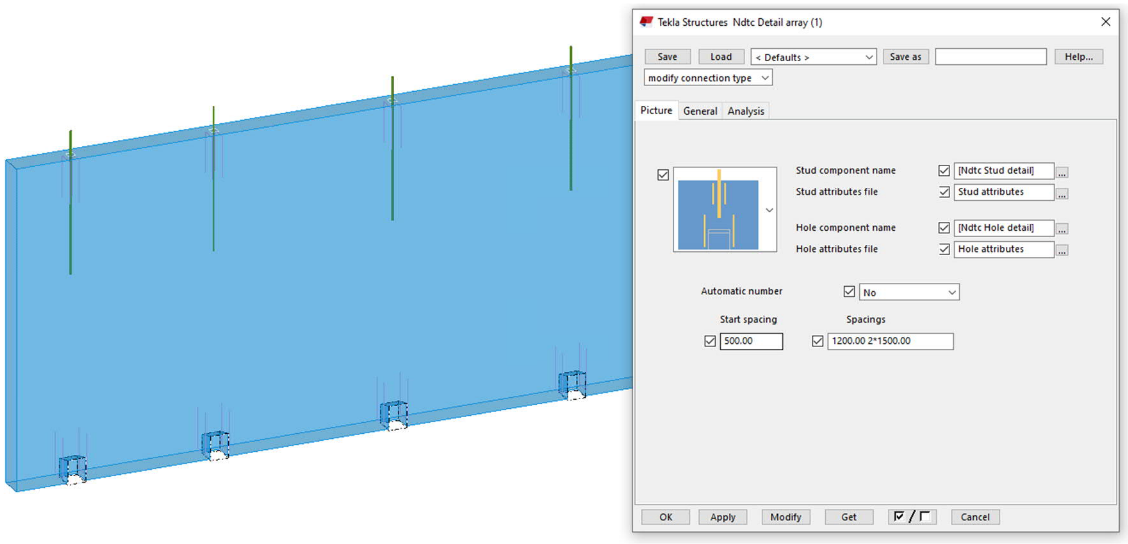

Figure 23 Detail array component model view with attribute window

In Figure 23, you can see how the component looks in the model and the component window. The component includes 3 configurations of arrangement of details that can be chosen from a dropdown list., see Figure 24. Those configurations are 1) only stud details, 2) only hole details, 3) both stud and hole details.

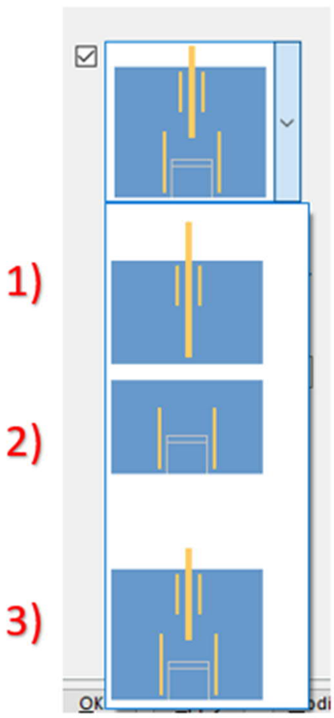

Figure 24 Detailing arrangement configurations

Stud and hole subcomponent names define the components that will be used on stud and hole positions. By default, the subcomponents are Stud detail and Hole detail presented above, but generally, any detail type components can be chosen, which makes that component more customizable. Stud and hole subcomponent attribute file define attribute setting applied to every stud and hole. Applying individual settings to subcomponents is not available, for that purposes it is required to explore the Detail array component. Start spacing defines the position of the first component instance from the start point of the component. Spacing values can be written as a standard distance list type as shown in Figure 23. There is also an option to automatically define the number of components and their positions if only one spacing value is defined.

5.2 Safety Railing Sleeve components

In order to provide a sufficient level of information in a model, the detail must be modelled with appropriate accuracy. Considering such a standardised part as Guardrails all the parametrized attributes should be considered.

For the purposes of modelling and manufacturing it is enough to only model the main part of the detailing – a tube. It gives information about the position and modelled tube allows to make a check for geometry conflicts. Whilst the number and position of anchors and rebars can be defined by the product name. Besides these parameters can be individually changed which is why it is easier to have a separate detail drawing attached to the precast drawing.

Two components were developed for this detailing: Railing detail and Railing array. A detailed description of each component is written below. Short user guides and installation process is presented in the Appendix section.

5.2.1 Railing detail

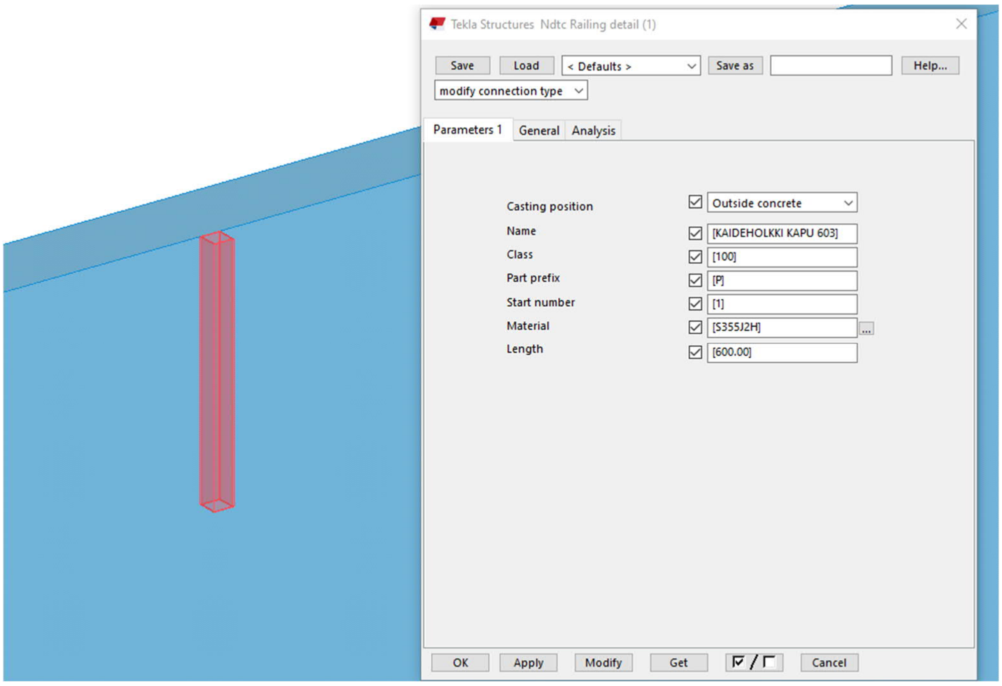

Figure 25 Railing detail component model view with attribute window

In Figure 25, you can see how the component looks in the model and the component window. The component includes 2 configurations of arrangement of the detail: outside the concrete volume, inside the concrete volume, see Figure 26.

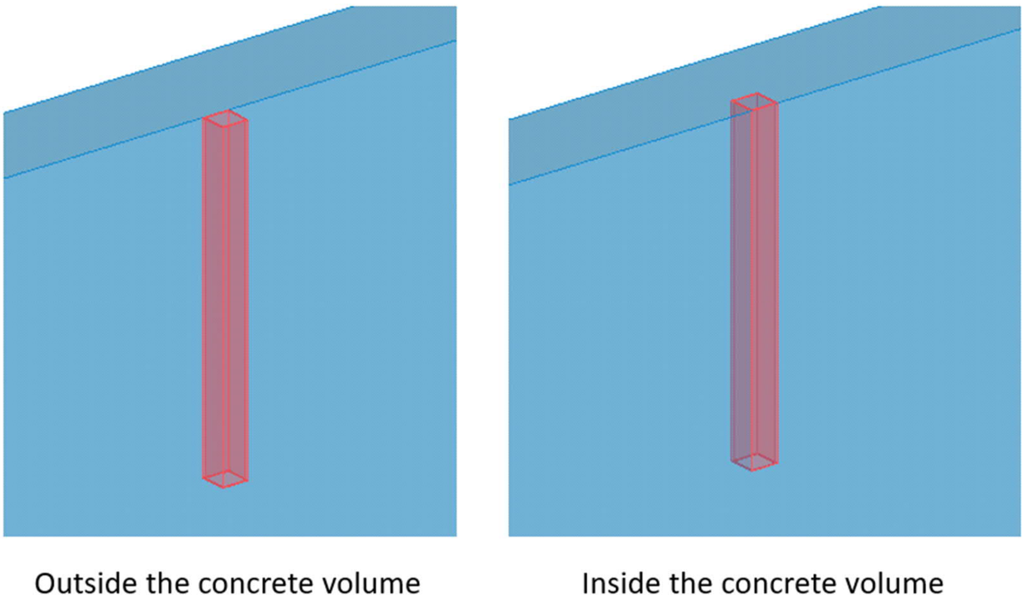

Figure 26 Configurations of arrangement

Other parameters are part name, class, part prefix, start number, material, part length. The component binds the position of the part to the top and front surfaces of the element.

5.2.2 Railing array

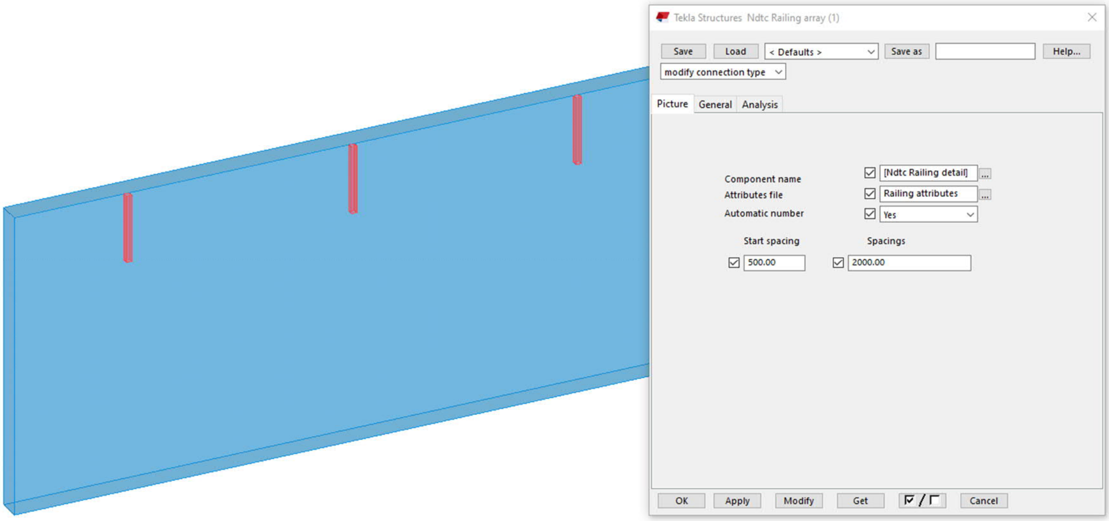

Figure 27 Railing array component model view with attribute window

In Figure 27, you can see how the component looks in the model and the component window. The component's structure is similar to the Detail array component. It includes component name and attributes file options, start spacing, spacing values and automatic number option. For more information see the description of the Detail array component.

6 External application development

The process of modelling stud connections is based on finding good positions where to place the connectors. During working with this type of detailing it became clear that this process can be programmable to some degree.

Stud Connection Inserter is an external application tool developed using Tekla Open API with the purpose to perform that task. In general, the program analyses the input objects (wall elements picked by a user), defines the most optimal position of connection detailings and inserts corresponding detail components in these positions.

The application mainly consists of one script. As input information, it obtains a collection of wall elements selected by a user. It is assumed that the walls are modelled using a wall panel tool or wall layout component. The selection can be rough. All the unnecessary entities are going to be filtered out. In order to provide a possibility of adjustment of parameters, the following user input attributes were used:

3. Target spacing – the maximum allowed spacing between the detailings.
4. Cover thickness.
5. Max search height – the minimum vertical length of solid material from the connection surface required to place the detailing.
6. Edge spacing – the minimum horizontal distance from a detailing insertion point to end faces of an element.
7. Grid density – the distance between neighbour points.

All length attributes are set in millimetres.

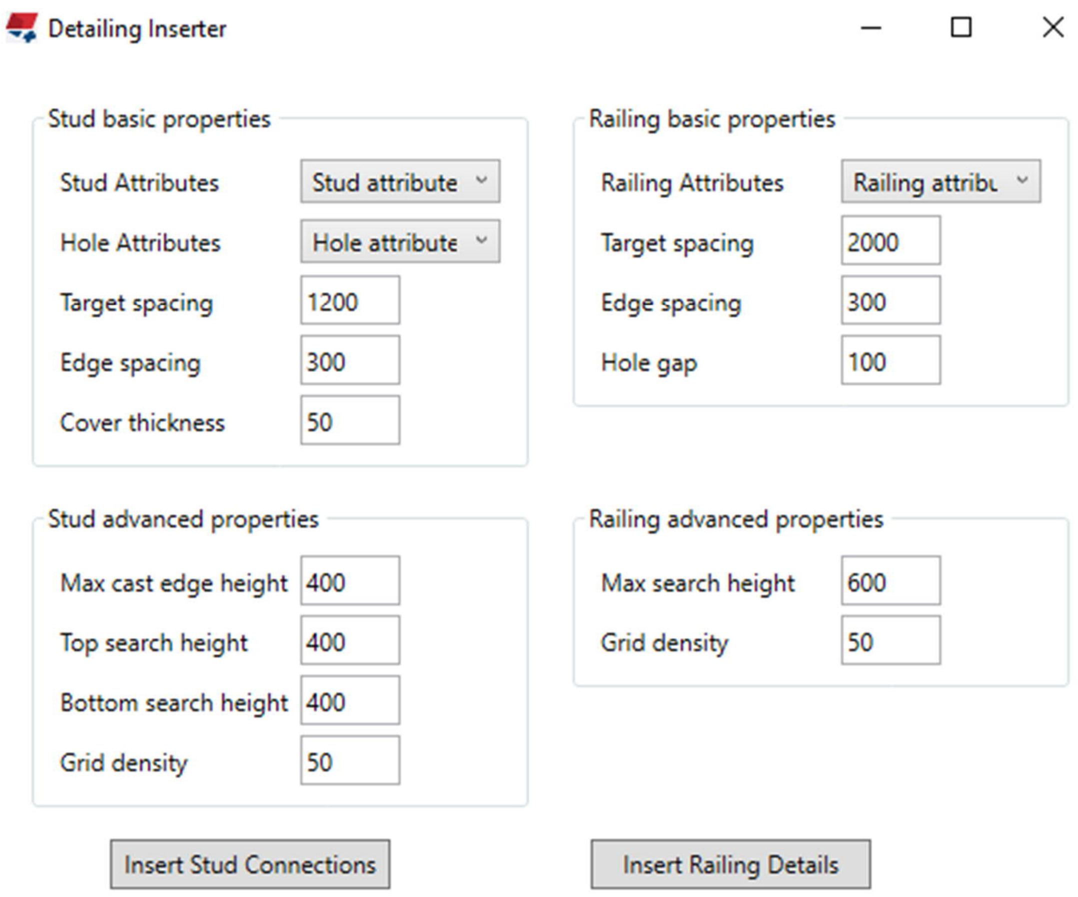

Figure 28 Application window view

Stud details, Hole details and Railing details follow very similar principles of insertion, which is why it was reasonable to combine them in one application. As the Stud detail is the most complex example, the description of the work of the application is based on it.

The application is looking for allowed placement positions following the rules described below.

The allowed placement positions for stud and hole reservation details are defined along the top and bottom edges of wall elements correspondingly. The areas around end faces in the distance of the Edge spacing attribute are excluded.

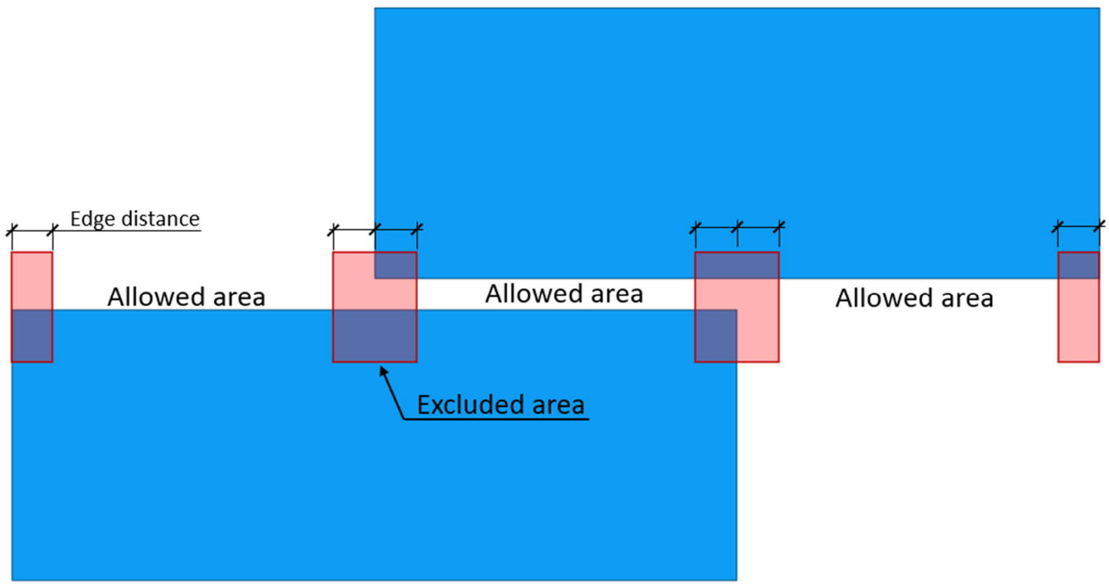

Figure 29 Basic allowed placement areas

If an element contains openings, the area above and below them is checked for the ability to place the detailing. The detailing cannot be placed if the vertical distance from the edge to the opening is lower than the Max search height attribute. Vertical distance is calculated considering cast edge height in bearing walls. The distance from the ends of an opening is as well defined by the Edge spacing attribute.

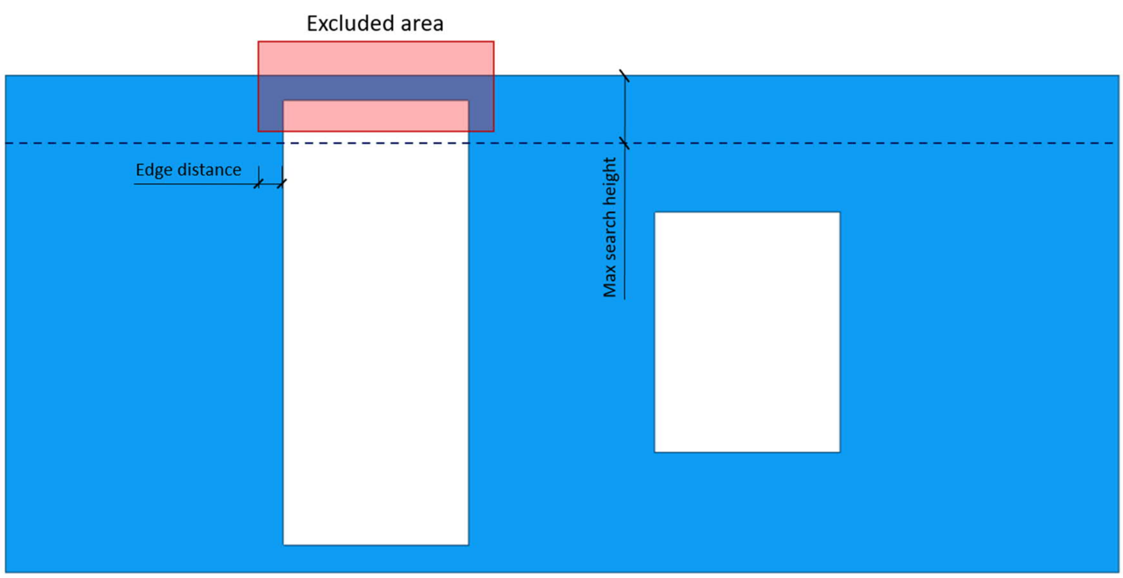

Figure 30 Openings can exclude allowed placement position areas

If an opening allows to put a detailing above it but the stud's buried part cannot fit it will be bent aside. The Maximum burying length is automatically calculated. Stirrups may as well be shortened in that case.

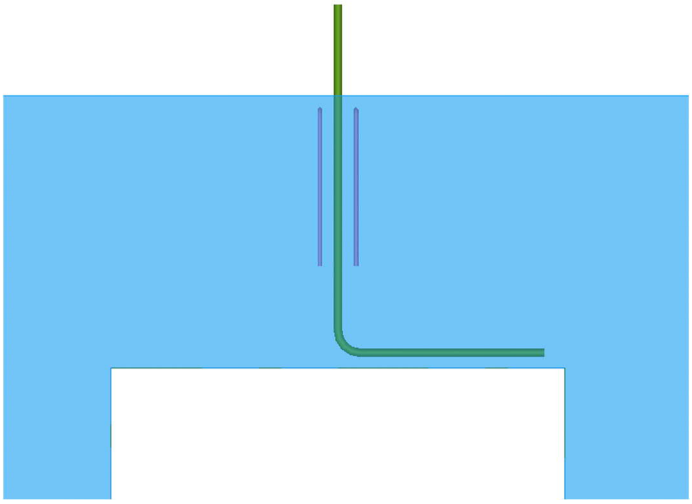

Figure 31 Automatic bending of the stud

In bearing walls with cast edge (see Figure 21) the position of the stud in the width direction can be moved from the centre which is why for that case a different set of component attributes can be provided

The obtained allowed areas represented with a set of lines. These lines then are being discretized into a set of points with the spacing equal to the Grid density attribute. Obtained point sets are used to create component placement position sets with a distance aiming to Target spacing, see Figure 32.

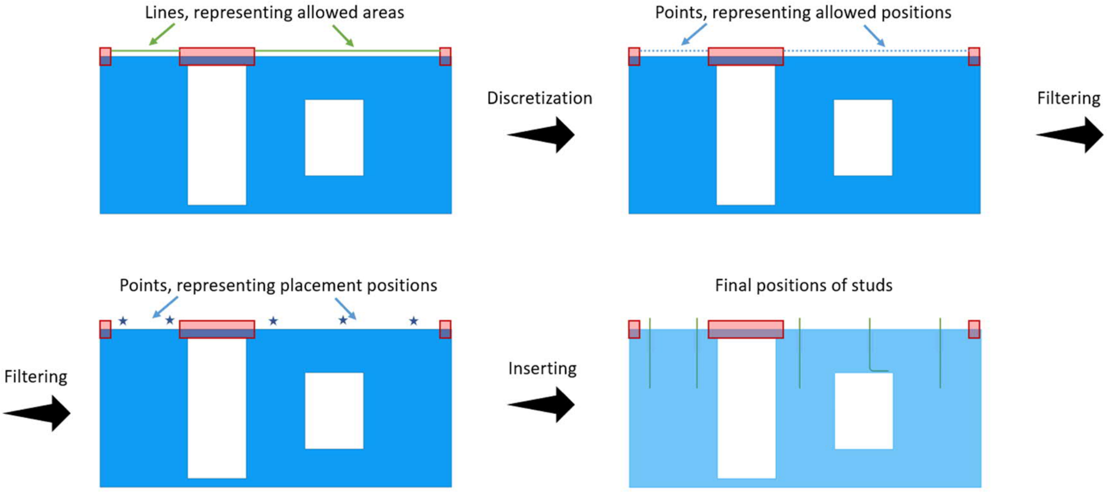

Figure 32 Process of searching components positions

After all the placement points are defined the components are inserted in corresponding positions. The application includes the procedure to define whether there is an opening below the stud that would force it to bend and if there is, the maximum burying length is calculated and applied to the component (see Stud detail component description).

7 Summary

As a result of work 5 custom components and 1 external application were developed to provide operating with stud connection and safety railing detail. These tools significantly improve the efficiency during modelling of these details. The thesis has been done under the supervision of the Nodetec Oy company Director of Technology and BIM Patrik Laakso and the instructor of thesis work at LAB University of Applied Sciences Heikki Vehmas.

The theoretical part includes brief general information about Tekla Structures software, its customization options and general structural information about stud connection and safety railing detailing.

This thesis shows the example of using TS custom components and constitutes a guide explaining how to create an external application using Tekla Open API. The process of creation of the application is presented as a “step-by-step” guide. Short user guides are attached in the Appendix section.

The results can be improved by thorough elaboration of the applications and components. For example, improving the algorithm of defining the positions of the components. The components might be replaced by Plug-ins as this tool provide much more flexibility and possibilities.

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Appendix 1. Installation guide

All the components are packed in a single file “Nodetec Catalog v1.4.uel”. This file must be inserted into a TS model. Steps as follows:

1. Open a TS model.
2. Open Applications & component menu.
3. In the options menu choose ***Import custom component.***
4. Select “Nodetec Catalog v1.4.uel” and click ***Open.***

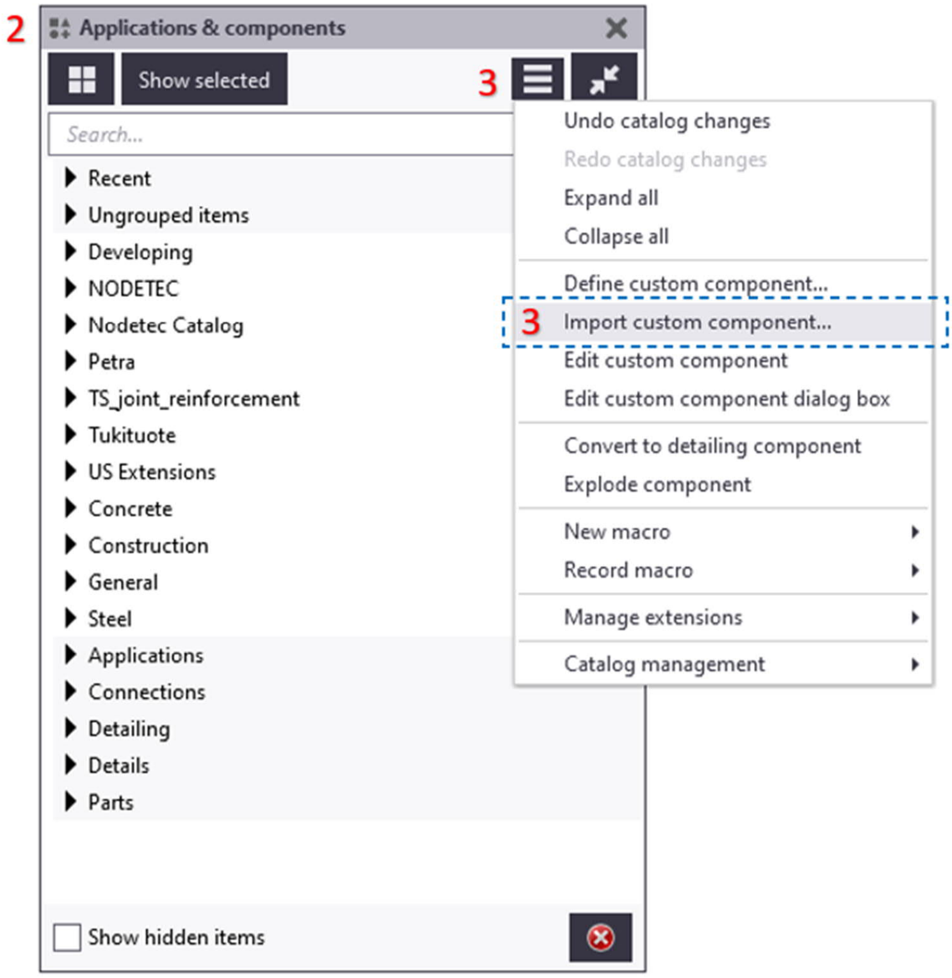

Figure 33 Component installation process.

Appendix 2. Stud Detailing and Railing components. User manual

All stud detailing components can be easily found in the Applications & components menu by typing “Ndtc…” in the search panel as all the component names start with that abbreviation.

For the component to work correctly, it must be applied to a part. Make sure you have “Select objects in components” or “Select objects in assemblies” selection options.

Ndtc Stud detail

Workflow as follows:

1. Select “Ndtc Stud Detail” in the Applications & components menu.
2. Pick a part with part selection.
3. Pick position point of the detail.

Note that the point only defines the position of the component along the longitudinal axis of a wall. Position in cross-section view is defined by component properties.

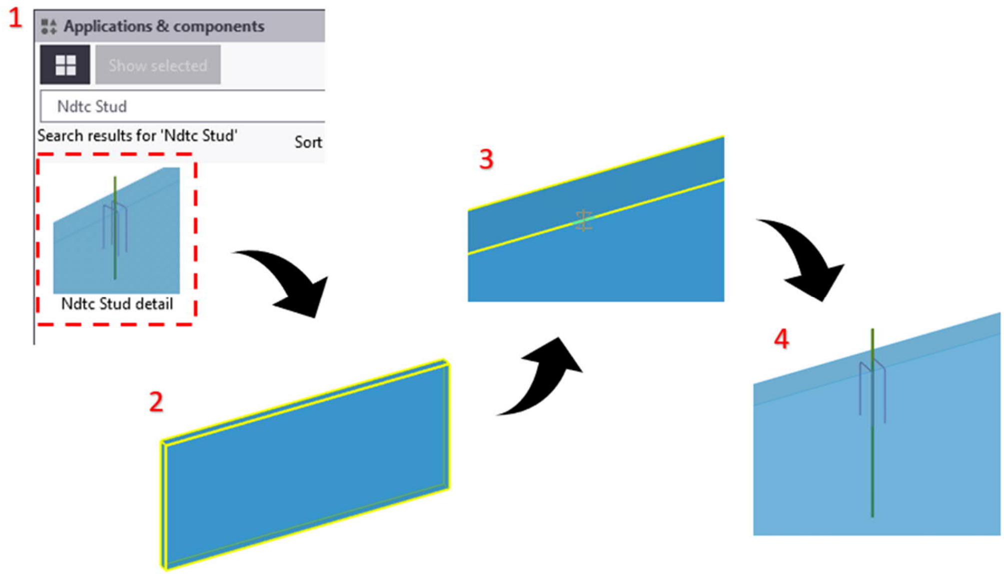

Figure 34 Applying Stud detail component

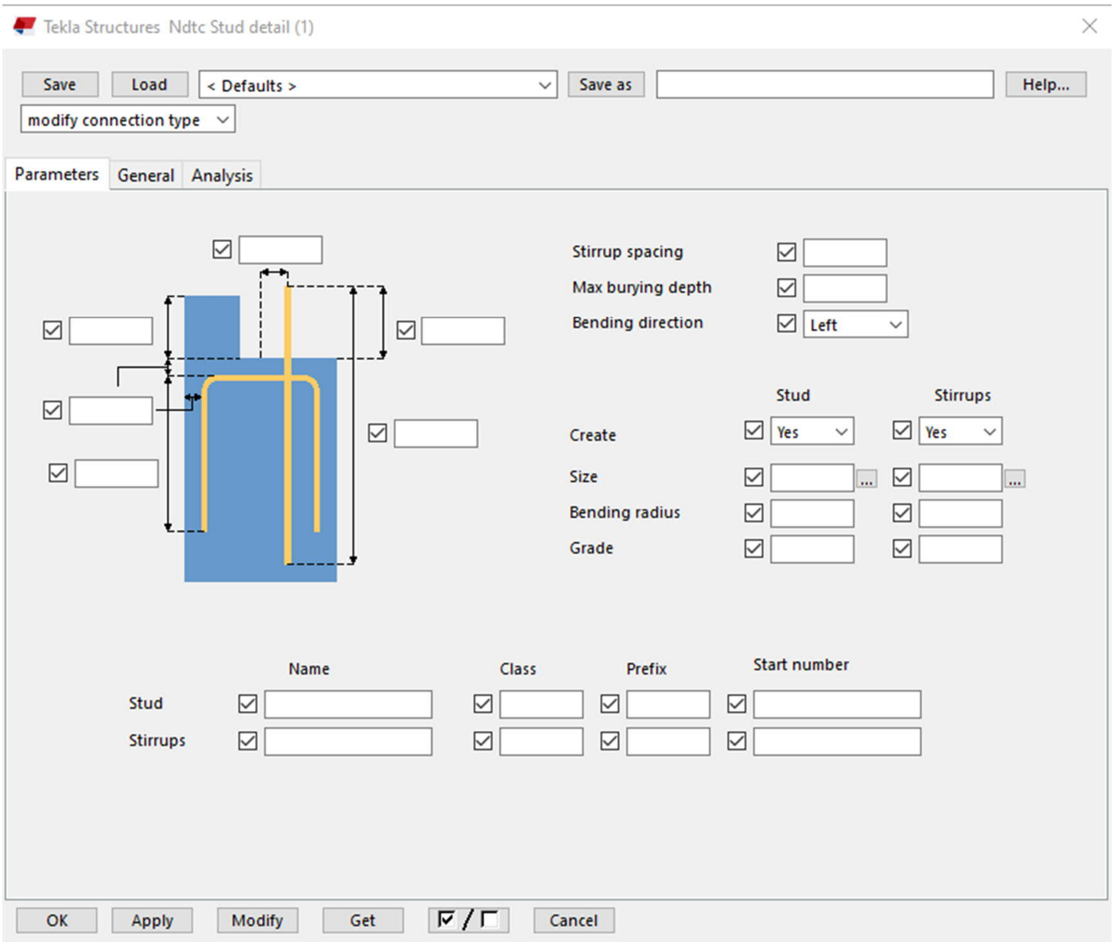

Figure 35 Stud detail attributes window

Max burying depth defines the distance from the component plane to the nearest obstacle below that require the bar to bend, see Figure 19. Stud and stirrups dimensions are rounded off to the nearest ten.

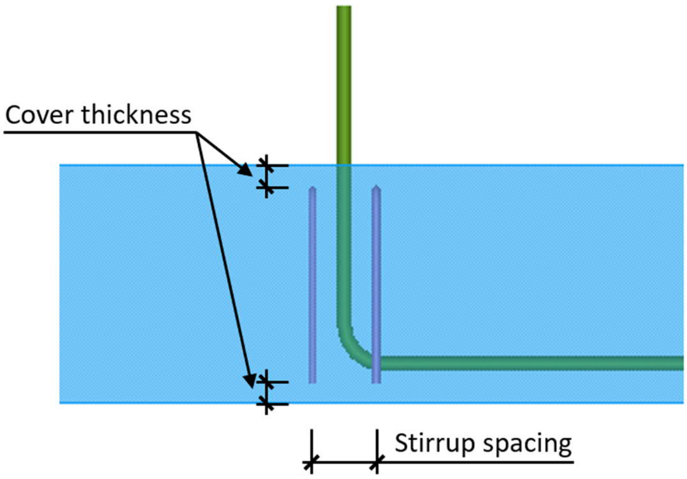

Figure 36 Stud bending

Ndtc Hole detail

Workflow as follows:

1. Select “Ndtc Hole Detail” in the Applications & components menu.
2. Pick a part with part selection.
3. Pick position point of the detail.

Note that the point only defines the position of the component along the longitudinal axis of a wall. Position in cross-section view is defined by component properties.

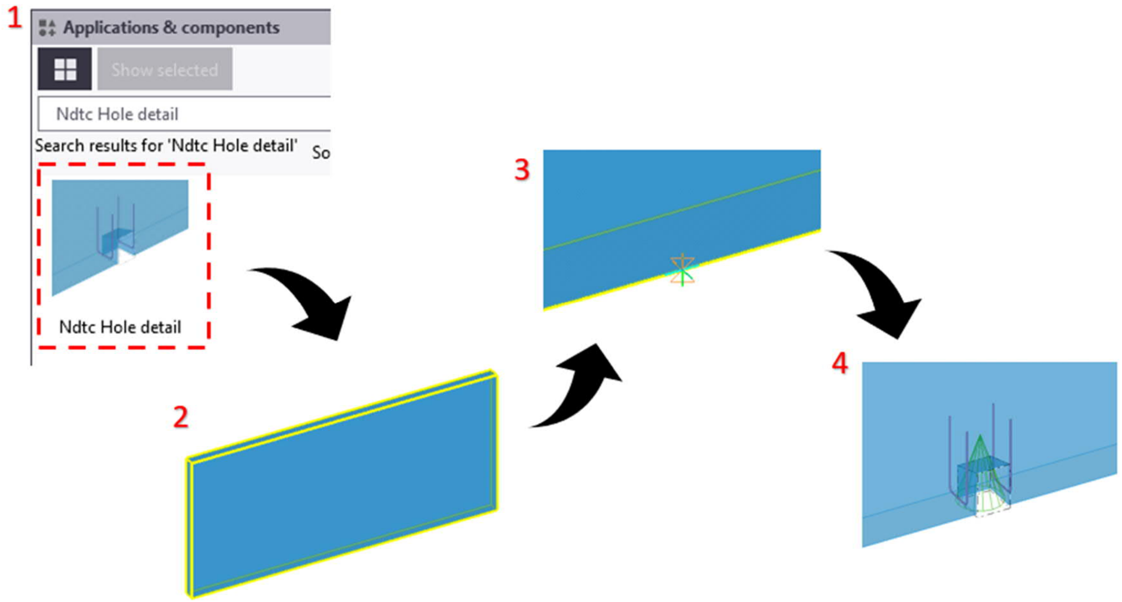

Figure 37 Applying Stud detail component

Attributes of the component are shown in Figure 38. The Hole length parameter defines hole size in the longitudinal direction. Stirrup spacing defines the spacing between stirrups in the longitudinal direction.

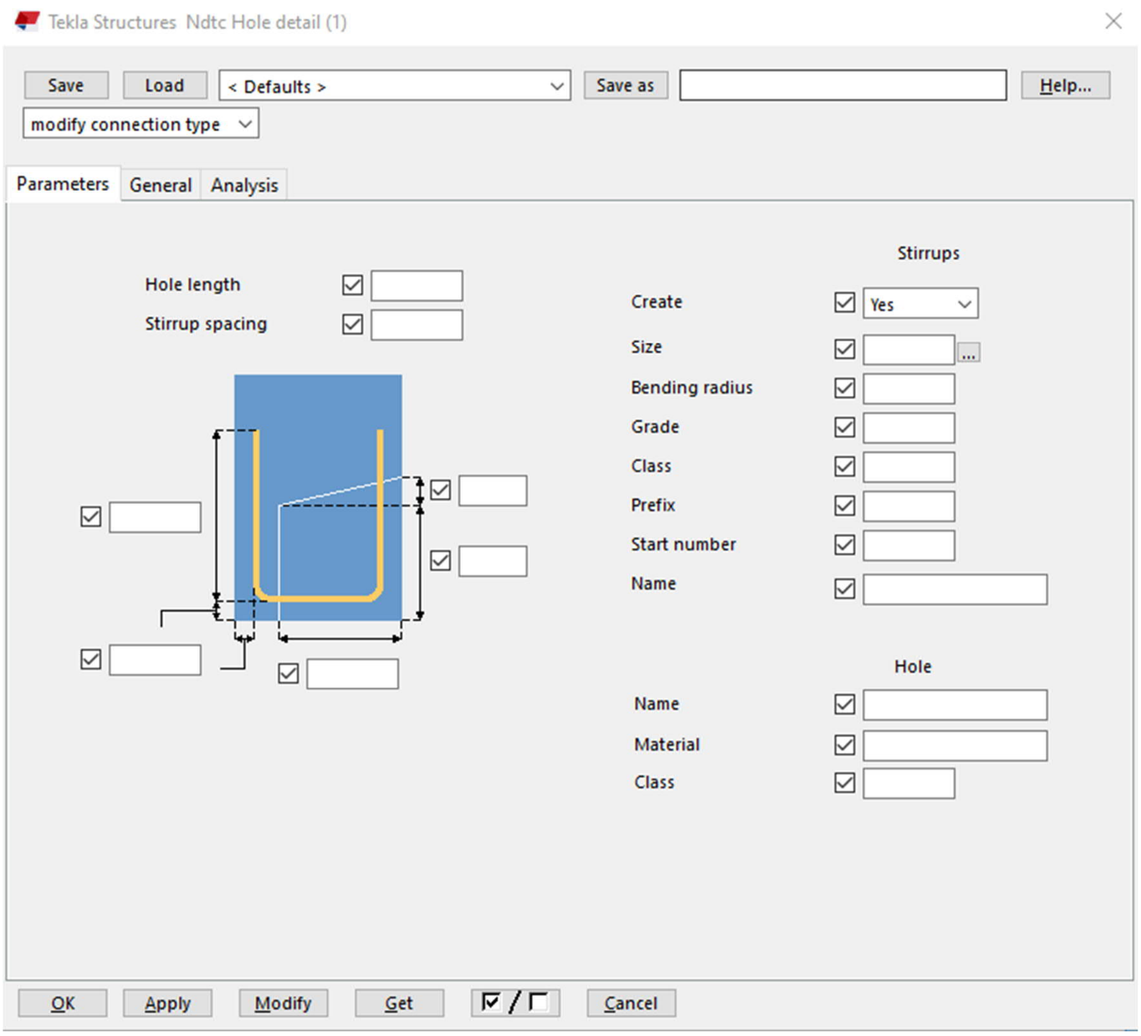

Figure 38 Hole detail attributes window

Attributes allow changing the parameters of the hole object and reinforcement quite freely providing the same fields as standard objects.

Ndtc Detail array

Workflow as follows:

1. Select “Ndtc Detail array” in the ***Applications & components menu.***
2. Pick a part with part selection.
3. Pick two position points defining the start and end of the array. The points must be parallel to the wall’s longitudinal axis.

Note that the points only define the position of the component along the longitudinal axis of a wall. Position in cross-section view is defined by component properties.

Position points must lie on the line parallel to the wall axis line for the component to work correctly.

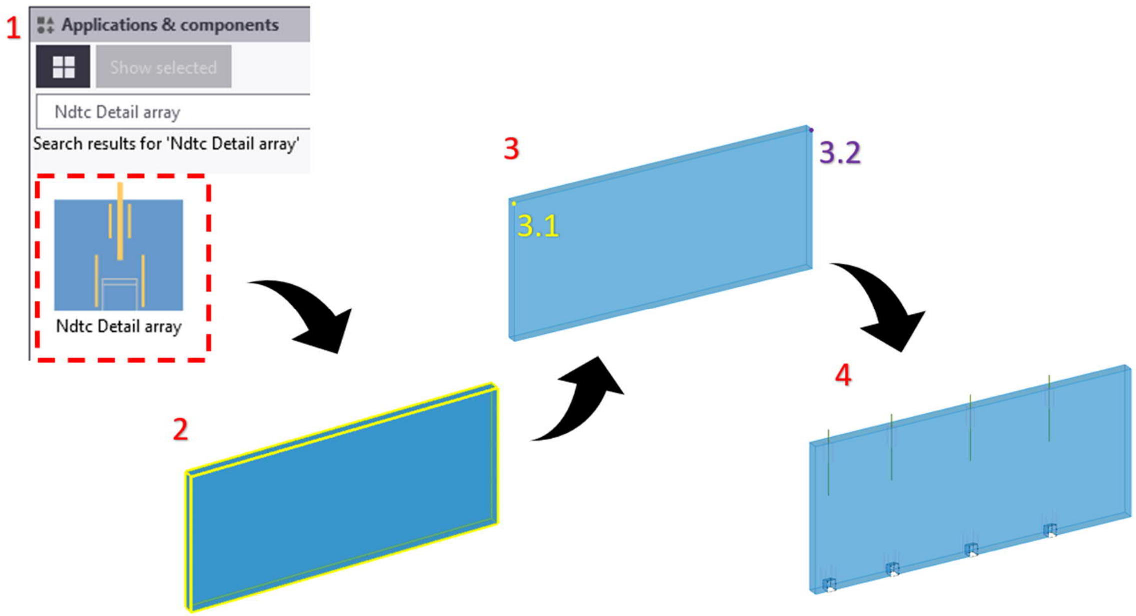

Figure 39 Applying Stud detail component

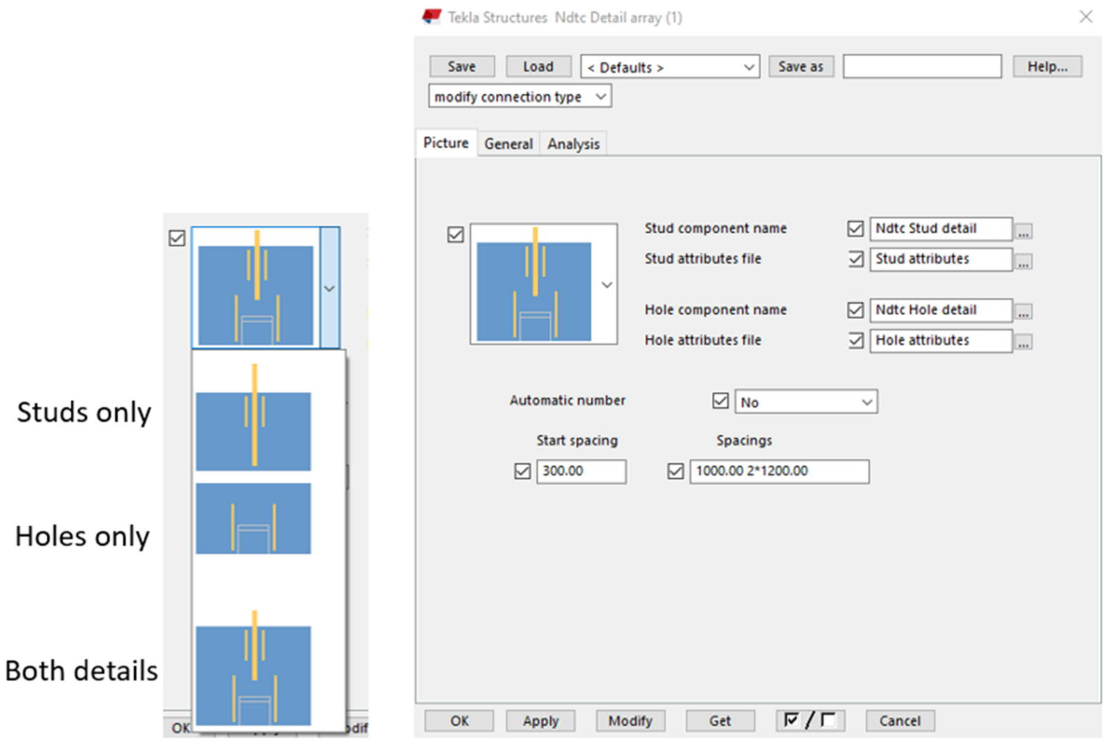

Figure 40 Detail array attributes window

The component supports three configurations of detailing: studs only, holes only, both details.

Parameters:

- Component names and attributes – define the subcomponent and their attribute files to be used. The components are Ndtc Stud detail and Ndtc Hole detail, and they cannot be replaced by any other components.
- Start spacing – defines the distance from the first component anchor point to the first instance of the subcomponent.
- Spacings – distances between subcomponents in an array. Values can be defined as distance list type.
- Automatic number – if only one spacing value is defined, it automatically calculates the number of components and places them centrally.

Appendix 3. Detail Inserter application. User manual

Workflow as follows:

1. Open DetailInserterTS18.exe.
2. Choose the setting in the application window.
3. Pick wall elements in the model as parts.
4. Click Insert Stud Connections/Insert Railing details.

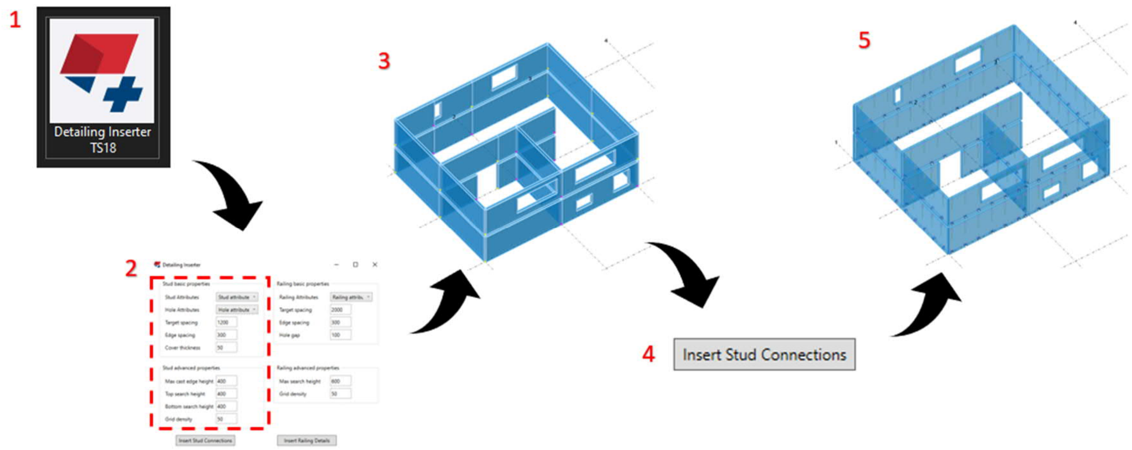

Figure 41 Applying Detail Inserter application

The application automatically defines the positions of Stud and Hole details and inserts corresponding components. If there are openings, the maximum burying depth is calculated (see Ndtc Stud detail manual).

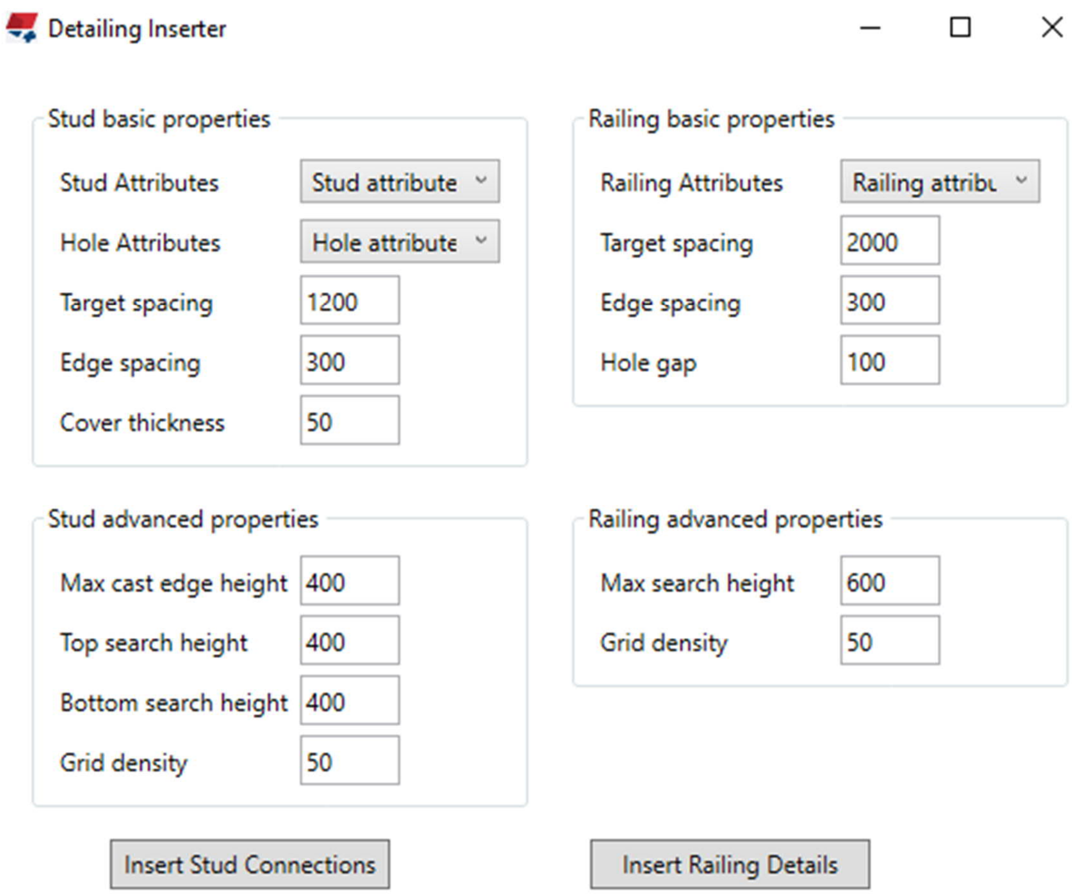

Figure 42 Detail Inserter application window

Basic parameters:

- Stud Attributes, Hole attributes – attribute files should be chosen from a dropdown list. The application looks for a model folder as well as a firm folder set by XS_FIRM advanced option.
- Target spacing – maximum spacing between neighbour details, see.
- Edge spacing – distance from the edge of the element to the nearest component instance.
- Cover thickness.
- Hole gap – minimum distance from an internal opening and the railing component.

Advanced parameters define the internal parameters of the application procedure. It is recommended to use default parameters.