3D-MODELING OF GUIDE RAIL BRACKET

Component 3D -modeling and system synchronization in accordance with Kone guide-lines

HAMK
HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

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Ilari Nykänen

HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

Tuotekehitys
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Työn ohjaaja /t	Teppo Syrjäaho, Mika Alvesalo	

TIIVISTELMÄ

Tässä työssä käsitellään johdekiinnikkeiden 3D -mallinnusta Creo Parametrics -ohjelmalla Koneen toimintaperiaatteita noudattaen.

Johdekiinnikkeiden 3D -mallinnuksen lisäksi työssä käsitellään yleisesti tietokoneohjelman avulla tehtäviä teknisiä suunnittelu- ja piirustustöitä. Työn tavoite on saada järjestelmällisesti avattua vanhentuvasta työtavasta siirtymistä nykyaikaiseen suunnittelu- ja dokumentointimalliin. Tämä työ käsittelee ensimmäisiä Koneen 3D -konvertointiprojekteja, jossa tavoitteena oli mallintaa kaikki olemassa olevat johdekiinnikkeet vanhoista 2D -piirustuksista uuteen 3D -järjestelmään. Ensin vanhoista kuvista oli tehtävä uudet 3D -mallit, jotka toimivat pohjina uusille 2D -piirustuksille. Uusi järjestelmä pitää osaltaan huolen siitä, ettei pelkkää dokumenttia ole mahdollista muokata, ellei itse mallia ole modifioitu. Koneen luomat toimintaperiaatteet pitävät huolen, että komponenttien muokkaaminen sekä niiden luominen tapahtuvat tiettyjen sääntöjen mukaan, jolloin toisen suunnittelijan on helpompi jatkaa tarvittaessa työskentelyä materiaalien kanssa. Konvertointi -projektin aikana vastaan tuli haasteita, joissa mm. kokoonpanoihin oli lisätty virheellisesti vääriä komponentteja tai esimerkiksi ohutlevyosat olivat mallinnettu vastoin Koneen ohjesääntöjä. 3D -mallin perustan ollessa heikko, koko malli toimii perustuen vääriin arvoihin ja tällöin mallista tarvittaessa haluttava data ei ole vertailukelpoista. Kyseisessä 3D -muunnosprojektissa jokaiselle johdekiinnikkeelle tehtiin lujuuslaskennat. Tämä on hyvä esimerkki projektin tarpeellisuudesta ja sen tavoitteista: Mallit on tehtävä alusta alkaen tiettyjen sääntöjen mukaisesti, jolloin voidaan olettaa, että niistä saadut tiedot ovat paikkaansa pitäviä ja silloin niitä on myös helpompi kehittää eteenpäin. Itse projekti vei paljon resursseja, mutta ottaen huomioon työn tavoitteen se on erittäin tarpeellinen. Tämä projekti oli osa isompaa kokonaisuutta, jossa tavoitteena on saada mallinnettua yksilöidysti kokonaisia hissejä, jolloin mahdolliset tilavaraukset, puutteet ja yllätykset saadaan karsittua minimiin.

Avainsanat 3D -mallinnus, Creo Parametrics, johdekiinnike, 3D-konversio

Sivut 38 sivua

ABSTRACT

Product Development
Riihimäki

Author	Ilari Nykänen	**Year** 2018
Subject	Guide rail bracket's 3D -modeling	
Supervisors	Teppo Syrjäaho, Mika Alvesalo	

ABSTRACT

This work examines 3D modeling of guide bracket with Creo Parametrics, in accordance with KONE design guidelines.

3D modeling of a guide rail bracket assignments are also studied through technical design and drawing. The aim of the project was to get systematically brought to this day outdated work methods to the modern design and documentation process. This work is based on one of the first 3D-conversion projects for KONE, which aimed at modeling all existing brackets from the old 2D drawings to the new 3D system.

First of all the old drawings had to be made with new 3D models that served as a basis for the new 2D drawing's. The new system ensured that documents alone cannot be edited, unless the 3D -model itself is modified. The design guidelines made by KONE make sure that the components are modified and created according to certain rules, making it easier for another designer to continue working with the materials if necessary.

Some challenges were encountered during the conversion project, an erroneously incorrect component was added to the assemblies or, for example, sheet metal parts malfunctioned in violation of the KONE principles. If the basis of the 3D model is not done according to the rules, the whole model is based on false values and in that case the model's needed data and the information you want is not comparable.

In this 3D conversion project, each of the brackets was subjected to strength calculations. This is a good example of the necessity of a project and its objectives: Models must be made from the beginning in accordance to certain rules, so it can be assumed that correct information is provided and that it is also easier to develop. The project itself took a lot of resources, but taking into account the project's goal this was very necessary. This project was part of a bigger entity designed to model complete elevators, whereby the possible space allowances, shortcomings and surprises could be minimized.

Keywords 3D -modeling, Creo Parametrics, Guide rail bracket, 3D -conversion

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1 INTRODUCTION

The scope of this project was to show how the specified components are brought to the 3D -world in KONE way by using the Creo CAD -software. This project shows how to correctly create a 3D -model and how to get it synchronized with databases. The 3D -model of a certain component is going to be the base of the whole system in the future and that was why there were many things that had to be done correctly. 3D -models can be created in a few different ways but the basis is always the same. To avoid unnecessary errors KONE has built a guideline that needs to be followed. The guideline ensures that every 3D -model is created according to the specified rules. Components and assemblies need to be updated anyway at some point of their lifetime and then it is critical the 3D -model follows the rules to make the modification faster and easier.

Nowadays 3D –models are important tools for product development and maintenance purposes. With 3D –models small components can be tested and especially bigger assemblies also as to space reservations. 3D-model technology makes it possible to make for example a complete elevator or escalator assembly virtually inside of the drawings of the actual building. This reduces mistakes and errors because almost everything can be secured by examining the virtual 3D –model of the building and elevator or escalator assembly. 3D –model technology makes it possible to take a look at how things are going to work in real life and also gives high value information if there is something wrong in the 3D- virtual world.

This work was commissioned by the KONE Corporation. The KONE Corporation provides escalators, elevators and automatic building doors. As global leader in the elevator and escalator industry KONE has as well as solutions for maintenance and modernization to add value for life cycle of the buildings. In 2016 KONE had over 52,000 employees and annual net sales of 8.8 billion EUR. KONE is one of the world's biggest elevator manufacturer and leader of its business. KONE uses a lot of resources for the product development which 3D -modeling is one of the things I am going to tell in this thesis. (KONE Corporation home page)

Reasons why industrial world is heading towards to the 3D -world are many. One and the biggest reason is cost efficiency. When you can look at the ready 3D -model you can notice things which can affect to manufacturing and installation. If any errors can be eliminated at the planning table it gives more possibilities to react immediately and minimize the costs.

3D -world is going to be the main system in future but still it doesn't remove the need of the 2D -drawings. 2D -drawings are still crucial for design planning and manufacturing. With 2D -drawings it is easier to give the information and data for manufacturing purposes even if modern factories do use flat pattern drawings for manufacturing. Flat pattern drawing is where example sheet metal part which has flanges is opened to flat. Flat pattern drawing usually doesn't include shown dimensions like normal 2D -drawing. Even 3D -models are coming it doesn't mean 2D -drawings are disappearing. Using 3D -models makes easier to create final 2D -drawings. When creating 2D -drawing based on 3D -model it is easier to modify because dimensions are parametric and dimensions updates automatically when modifying the 3D -model.

3D –modeling is so important because you can take a closer look for a component or complete assembly before it is actually produced. The most important thing in production development is testing the product. That functionality can be usually tested only with real model but the virtual 3D –world gives possibilities to find errors or mistakes easily before products are really manufactured. Companies are moving towards 3D-model technology because its multiple benefits, for example gained product quality, simulations, more accurate calculations and reduced lead time in product development projects.

One of the main reasons what makes 3D –models also so efficient is to making drawings for manufacturing. One of the greatest things in 3D –modeling is the feature that drawings are updating automatically when changing the model itself. There are no room for so many errors anymore. 2D drawings are more important than 3D –models but the way of looking things are changing. The reason why 2D -drawings are still so important is the documentation and manufacturing because you still need to have a look from different projections. With 3D –modeling technology first comes the 3D –model and before the design is ready and approved then comes 2D –drawings for manufacturing.

In KONE point of view why to move towards the 3D –model technology is obvious. Costs saving and efficiency. KONE needs 2D -drawings for manufacturing and documentation purposes but to create those 2D -drawings are in smaller role in future. It takes more work to create working 3D -model but it has a lot of benefits like when creating the 2D -drawings. The first thing is to check the 3D -model is created by following the KONE guide line all attributes parameters and dimensions are filled correctly. When looking assembly like elevator there are so many components and subassemblies that it is almost impossible to make those work seamlessly together if nothing is tested before. Testing will always be big part of the product development process even if there is 3D –model technology but the number of tests needs to be done will be less than before. Less testing means less costs for the product development.

2 GUIDE RAIL BRACKET

One thing you can find in every elevator ever installed is a guide rail bracket. Its main function is to keep the guide rails in the right position in the shaft. It is a crucial component between the shaft wall and the guide rail and KONE has approximately 350 different types of guide rail brackets.

Guide rails are components which make the track for the elevator car and for the elevator counterweight. Guide rails are always adjusted by brackets and that is why brackets need to be designed to have multiple features. Brackets needs to have good adjustment abilities to get the guide rail adjusted on right position. Brackets have to be designed also strong enough to hold required loads depending are those installed example on seismic active areas, are those top most brackets for machine room less elevator and so on.

There are basically four main types of guide rail brackets, a single car bracket (figure 1.), a single counterweight bracket (figure 2.), a combination bracket (figure 3.) and a double combination bracket (figure 4.).

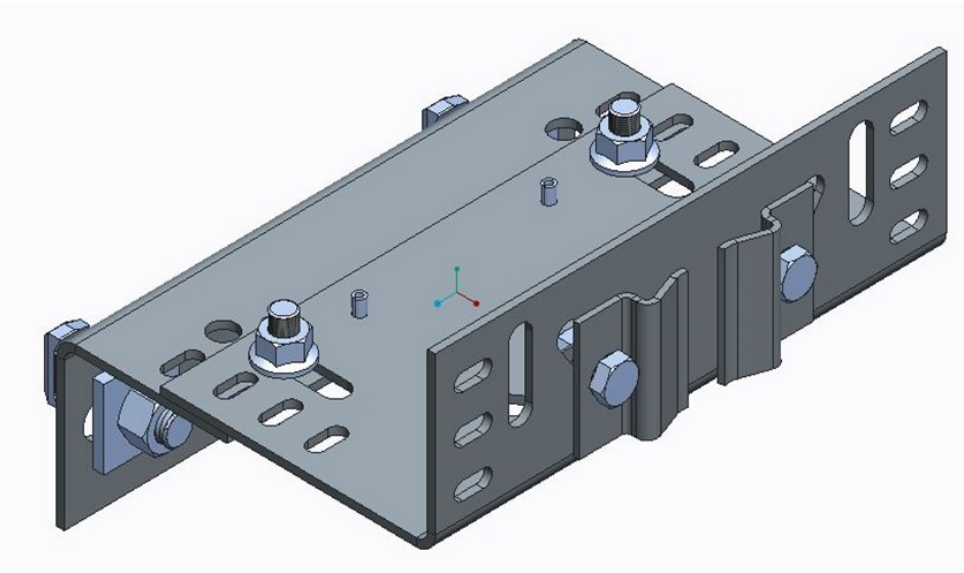


Figure 1. Single car bracket (KONE Design Components, KM657567G01)

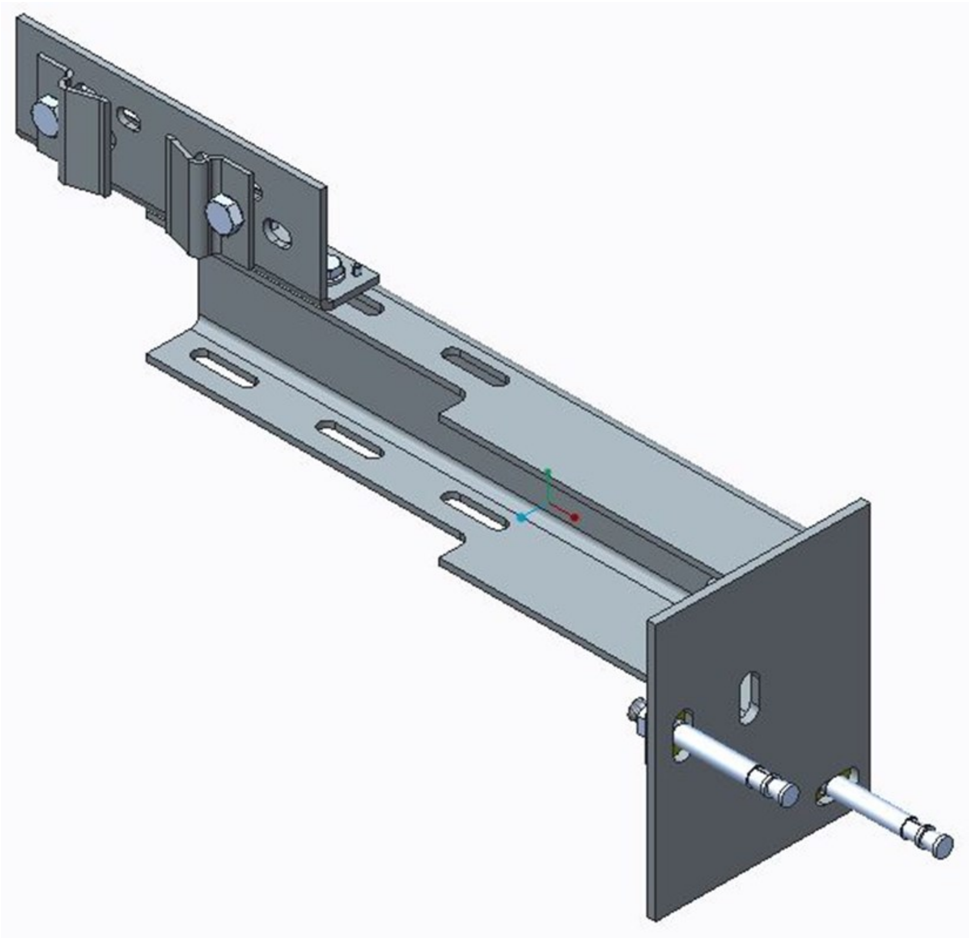


Figure 2. Single counterweight bracket (KONE Design components, KM773950G01)

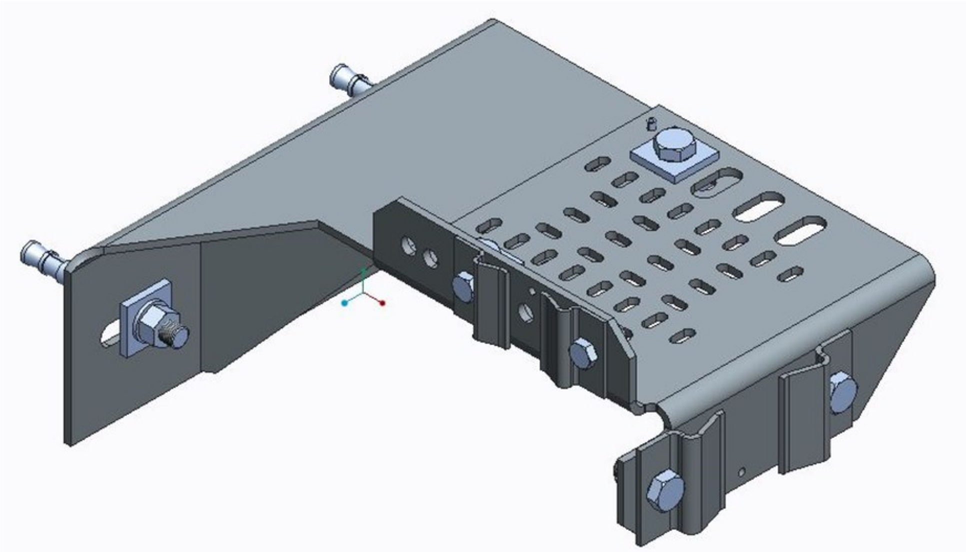


Figure 3. Combination bracket (KONE Design components, KM800909G01)

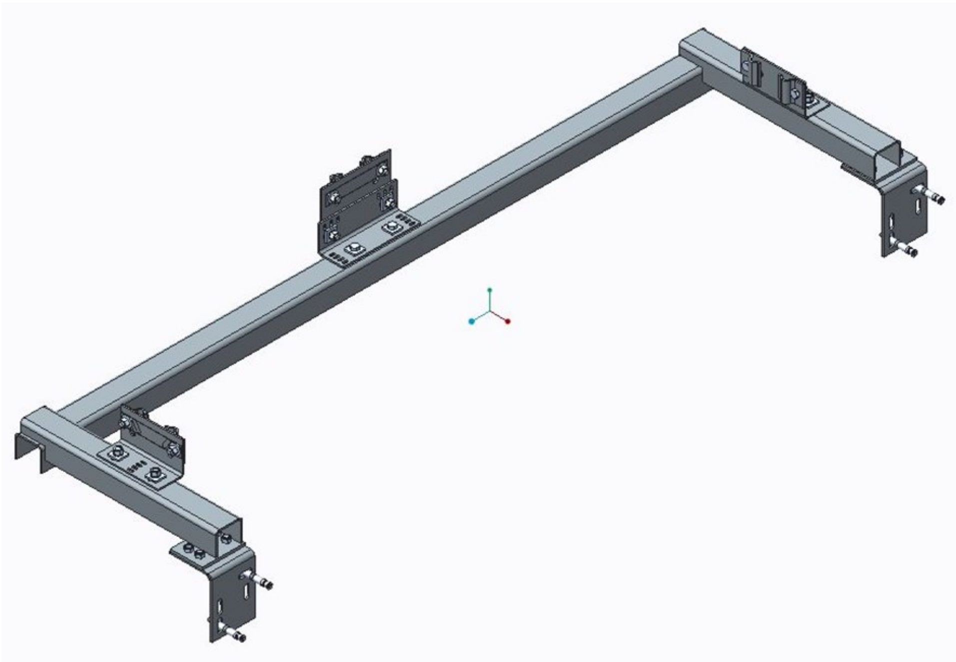


Figure 4. Double combination bracket (KONE Design components, KM757972G01)

3 PARAMETRIC MODELING

Ideology behind the parametric modeling is to get parts and assemblies driven by given values from specified characteristics. Parametric modeling is key to make the assemblies and parts working flexible way and then only one variable component or assembly can be used instead of multiple fixed ones.

3.1 Top down design

One of the design styles is top down design. If top down design is used it means the intent of the design is in main assembly and the information is linked to the subassembly levels and part levels by skeleton models. The flow of references between models in contrary to the flow shown in figure 5.

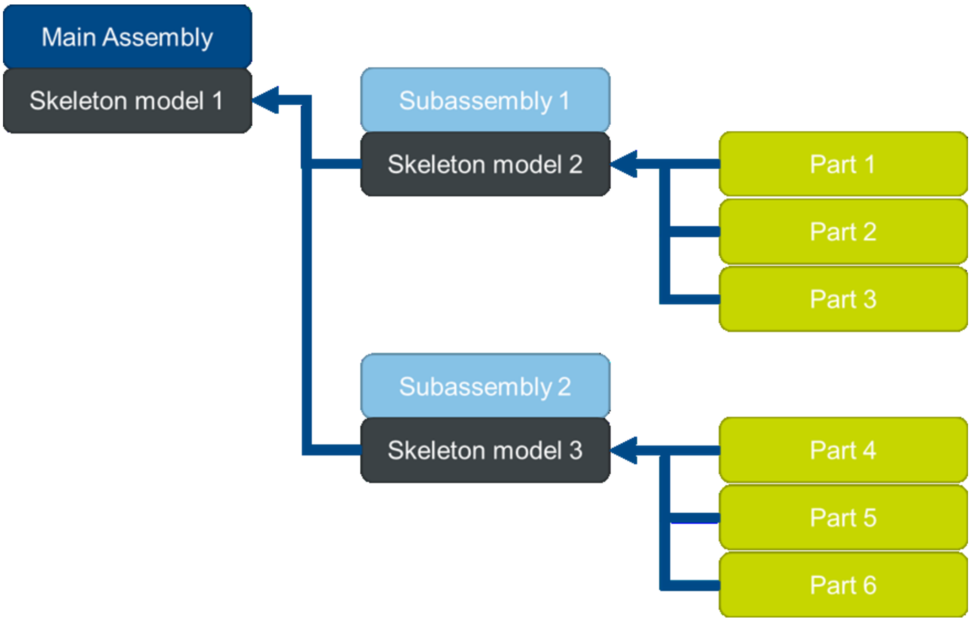


Figure 5. Flow of references between models. (Advanced Creo training material)

3.2 Bottom-up design

Bottom-up design is good option for top down design if all or most of the components already exist. With bottom-up design you first have all of the needed components which don’t have any references to the other models. In bottom-up design all the components are made separately and after that the final assembly is created and all the components brought together (Madsen & Madsen 2012, 108).

3.3 Skeleton models

Skeleton models are used when creating complex parametric parts or assemblies. There are many benefits of skeleton model usage like interfaces between components or references inside the model itself. With skeletons, it is easier to create flexible dimensions in to the parts so example the length of the specified profile is running according to the given values. Figure 6 shows an example of a new skeleton model creation and naming.

- Skeleton models are used for frame of the design work, space claims, interfaces between components and assembly references.
- Naming of the skeleton have to be done by following the default naming pact.
- As all the other materials in the product structure, skeleton models also need to follow revision principals.
- Skeleton models don’t need WT-parts (auto association).
- Only control skeleton needed in guide rail bracket’s 3D -models.

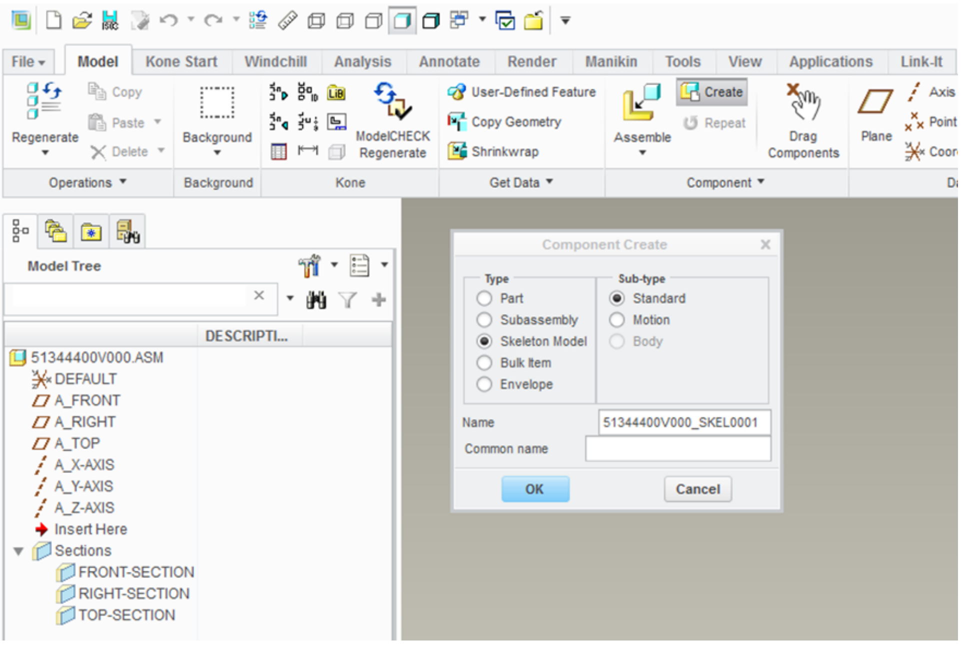


Figure 6. Creating and naming of a new skeleton model.

3.4 **Control Skeleton**

Control skeletons are the frame for the parametric modeling. By using control skeleton model's parts or assemblies can be driven to the different kind of configurations defined be the intent of the design. According to the Kone guidelines, planes needs to be named by using clear and short descriptions to make later modifications easier for the designer. Figure 7 illustrates a welded frame of one type double combination bracket.

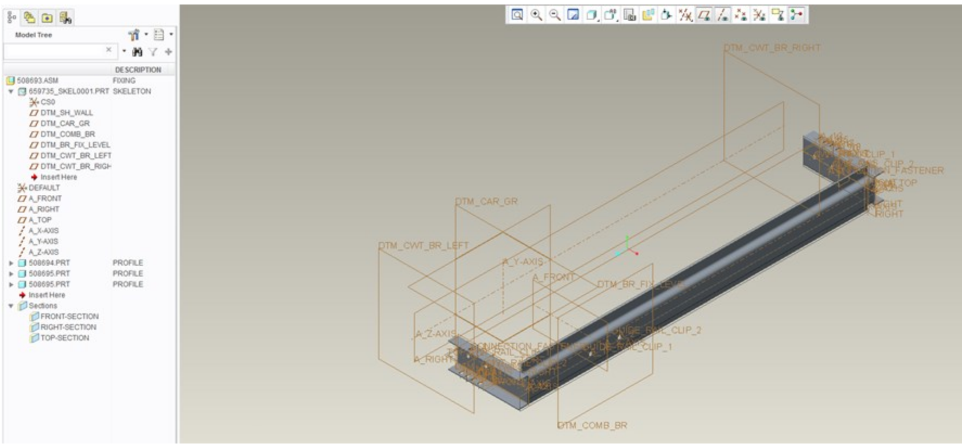


Figure 7. An example of a control skeleton in use.

3.5 Space reservation skeleton

Space reservation skeletons are used to show simplified shape of the design to avoid unnecessary heavy models in big assemblies. If the main assembly like elevator level assembly, includes complete models with all the smallest details and features example screws, nuts, rounding's or chamfers it becomes too slow because of the heaviness of the models. Space reservation skeleton can be used to create skeleton which shows only critical dimensions for the upper level assembly. When moving down to subassembly or part level it is easier to design proper products to fit and function point of view when there are already defined dimensions for the part or subassembly. There is a space reservation skeleton for over speed governor in figure 8.

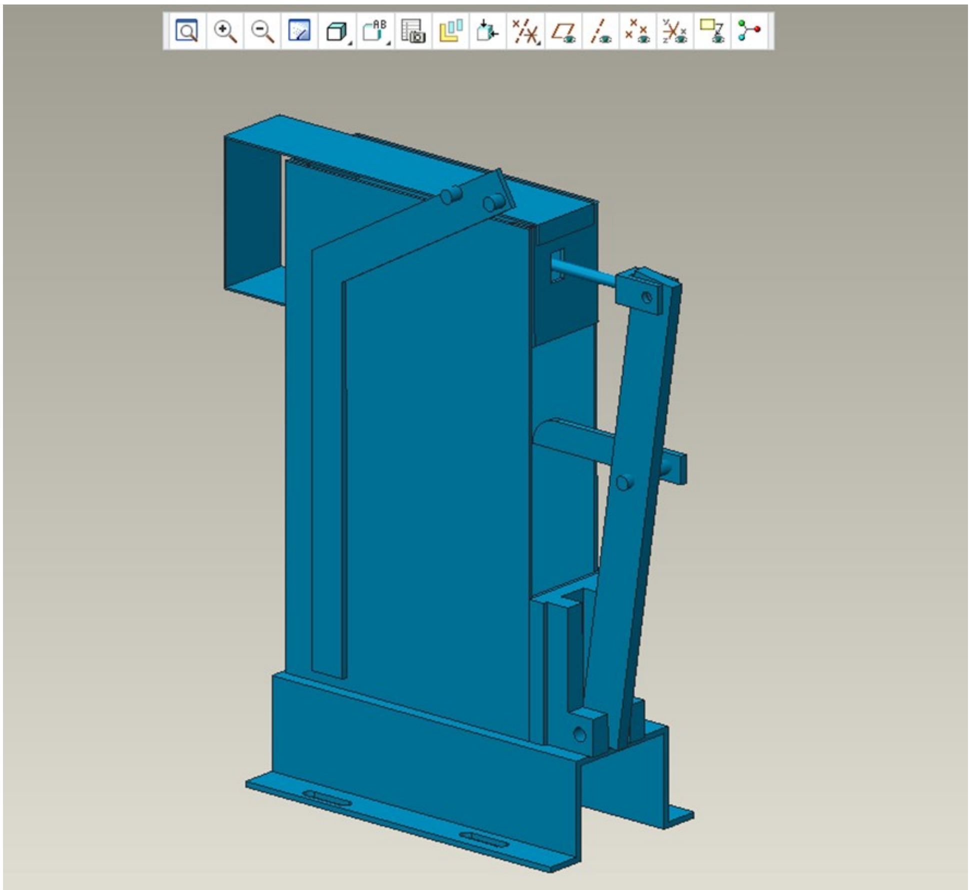


Figure 8. Example of a space reservation skeleton model.

3.6 Motion skeleton

With motion skeleton different moving functions can be shown. Example roller guide shoes which includes moving components those can be shown by motion skeleton how much those needs space to correct function. Motion skeletons naming are done exactly the same way as control skeletons and space reservations skeletons according to the default naming pact as shown in figure 9.

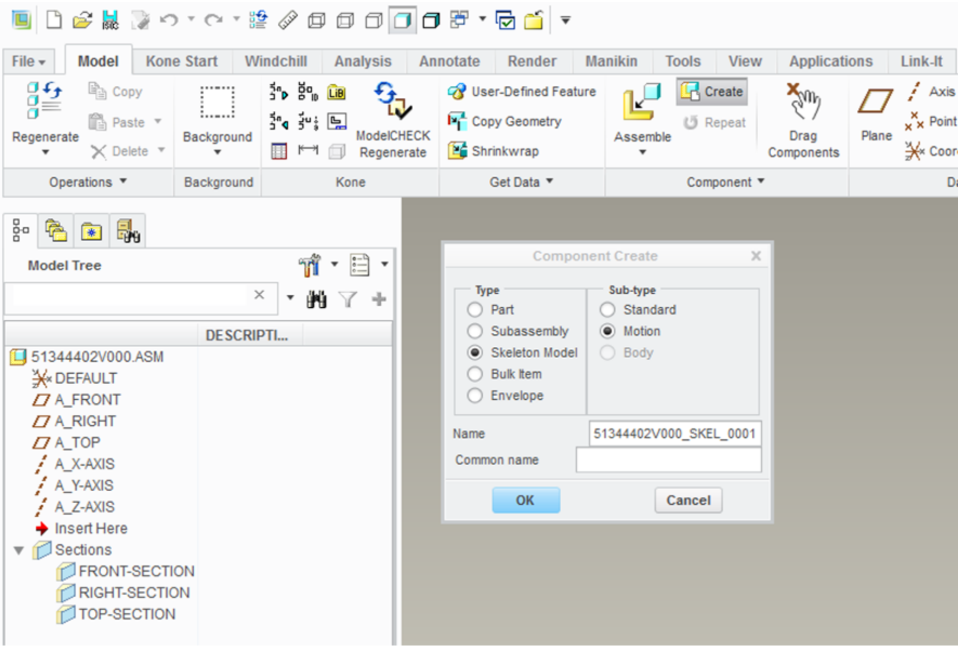


Figure 9. Creating and naming of new motion skeleton model.

There can be created only one motion skeleton for each assembly. If there is need for more than one motion skeleton in one assembly then it is possible to create a temporary assembly for another motion skeleton. In figure 10 there is an example of motion skeleton assembly tree shown.

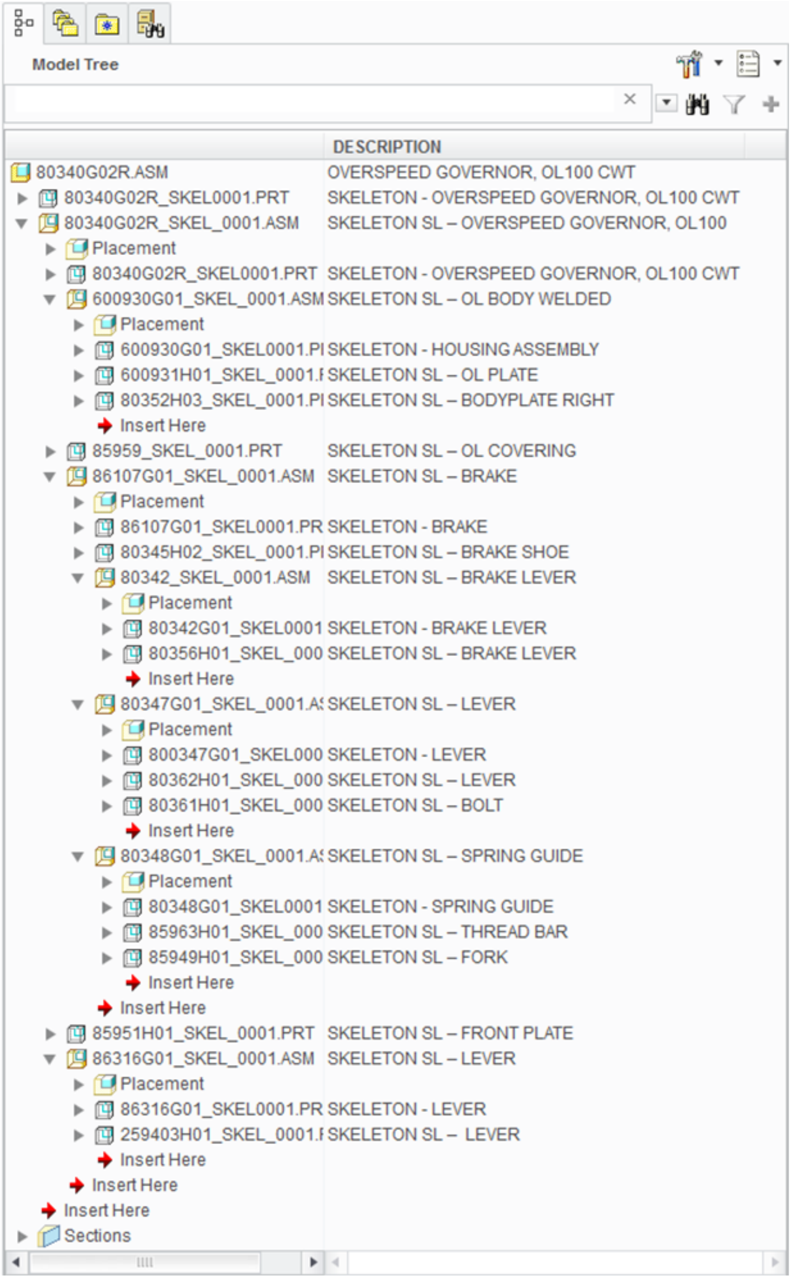


Figure 10. Motion skeleton assembly tree.

3.7 Parametric dimensioning

By using parametric modeling designer is able to edit the model parameters for example the length of a component or even change the component which is required in each configuration. “You can manipulate parameters assigned to sketch and feature geometry, parts and assemblies to explore alternative design options or to adjust a model according to new or different information” (Madsen & Madsen 2012, 108).

3.7.1 Relations

When creating relations, it is important to use comments to clarify the meaning behind the relations as shown in figure 11. Even if there is only few relations comments are critical to make later update or modification work easier and faster.

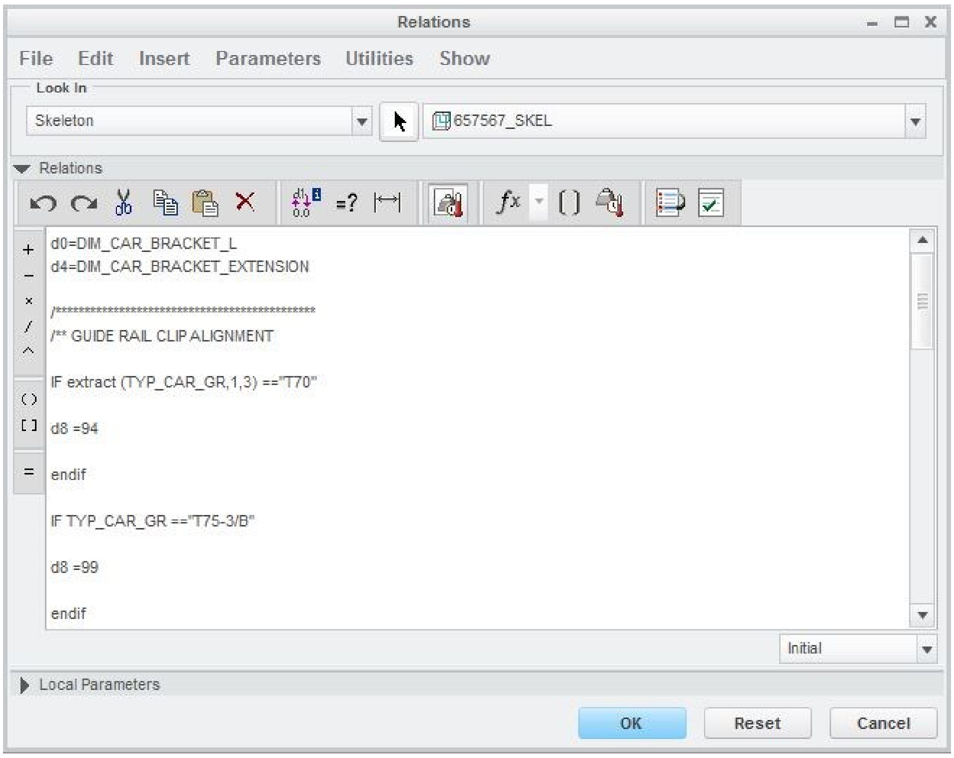


Figure 11. Use of relations in a control skeleton model.

3.7.2 Parameters

Parameters can include multiple amount of information in 3D -models and the information can be linked to several purposes (figure 12.). User defined parameters can be created as many as needed but when there is situation that some of the parameters are already specified by Kone global characteristics then it is mandatory to follow Kone guidelines.

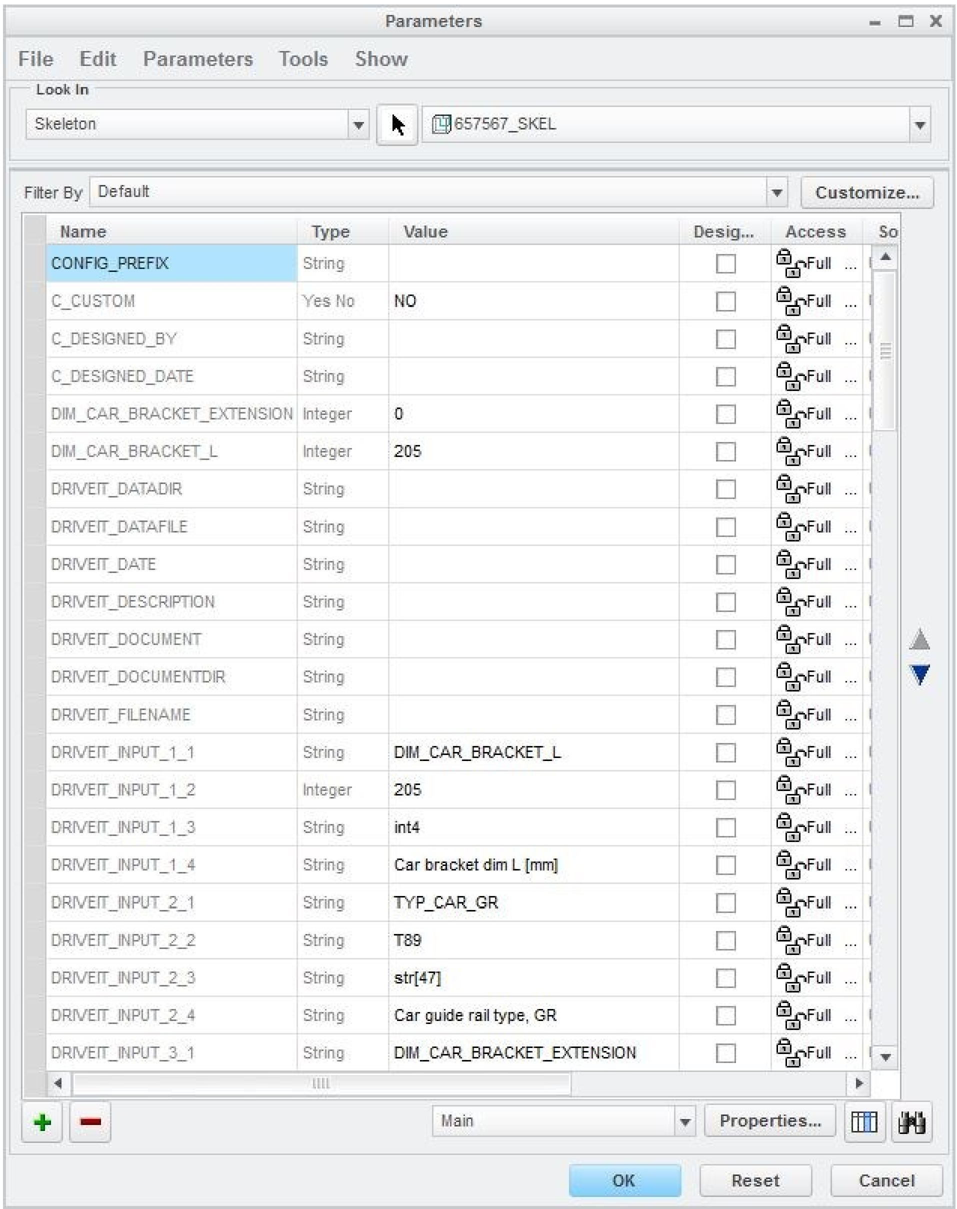


Figure 12. An example of using parameters in a control skeleton model.

3.7.3 Global characteristics

In Kone environment global characteristics are one of the features to ensure uniform usage of different parameters and their values. It is important to make sure the used characteristics are corrected for each purpose. All of the global characteristics can be found from the Kone PDM database and if some of the needed characteristics are not in the database then it is mandatory to follow global characteristics request process. This is important for seamless synchronization example with PDM and SAP and easier to follow when there is only official characteristic used.

Below there are instructions for adding global characteristics in to the model. If global characteristics are not applied in correct order the system will not recognize the characteristics.

A The first thing is to enable the use of global characteristics. After opening the Drive Documents click apply as shown in figure 13.

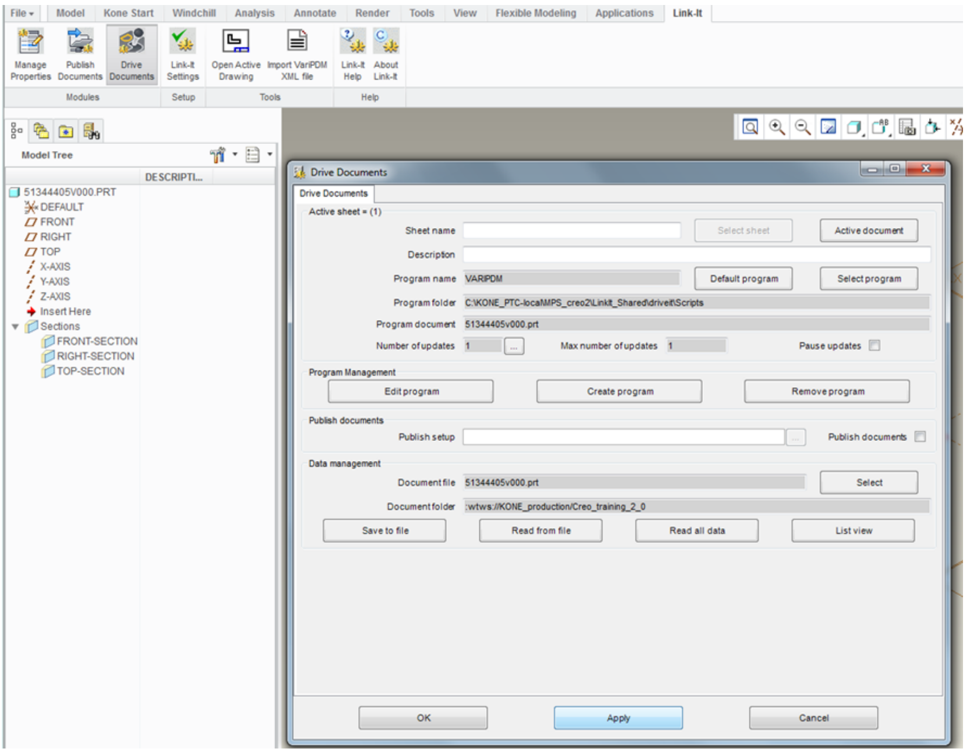


Figure 13. Global characteristics.

B Search for the needed characteristic by typing the name in name column. After confirmation that the result of the search is correct choose the characteristic and click select when done. Make sure you are using the right characteristics that it is done by following global request process (figure 14).

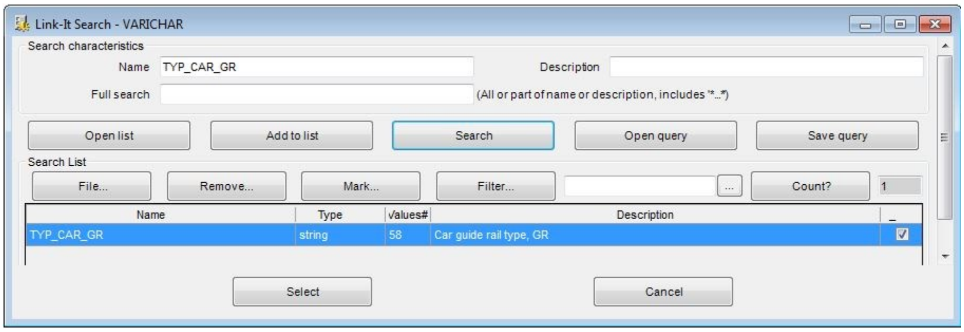


Figure 14. Searching global characteristics.

C After successful adding of the characteristics the tentative value can be given (figure 15). If there are many characteristics those can be saved by using Save to file and opened in new assembly if needed. Then there is no need to pick every characteristic one by one every time.

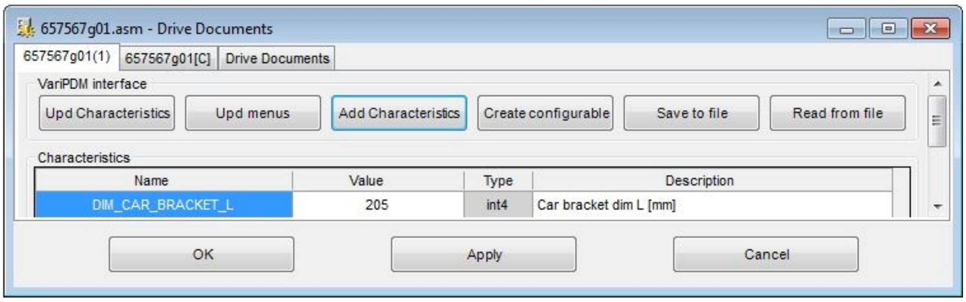


Figure 15. Drive Documents.

D To get wanted result to the model from configuration go to Link It and select Drive Documents and under the Drive Documents tab change the regeneration times to 2 (figure 16). Sometimes number of updates have to be bigger depending on how the relations are made example if the information is moving back and forth between the assembly, subassembly or part levels.

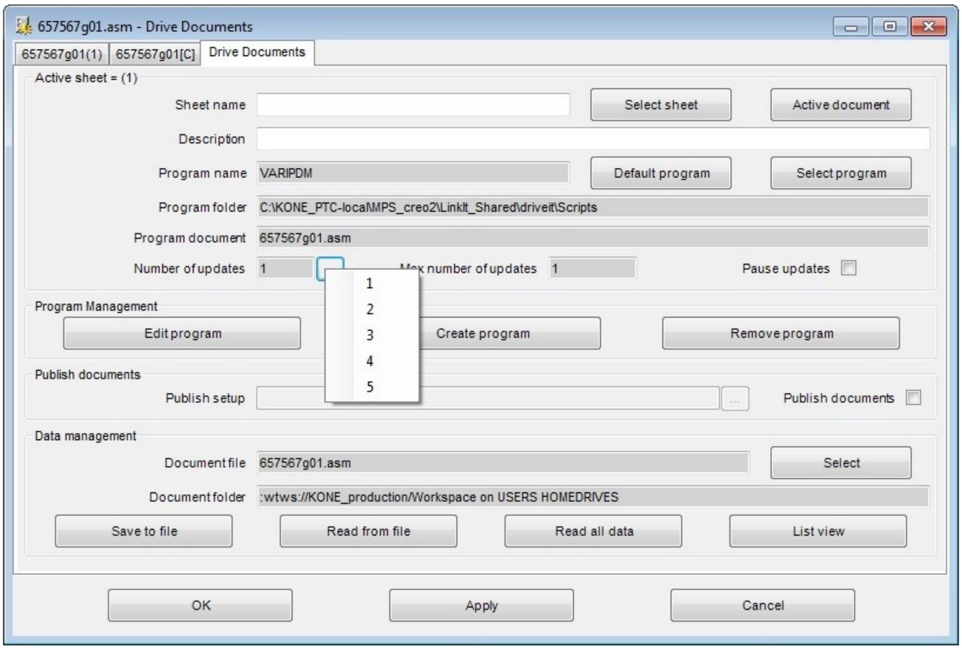


Figure 16. Drive Documents.

3.8 Creo Program

One of the main use for Creo Program is to manipulate models inside the assembly. By using Creo Program it is also possible to execute different kind of functions between assemblies, subassemblies and parts. Creo program can be used example to add or suppress specified components like in different variations of length. It is important to follow the desired commenting when creating commands in Creo Program.

3.8.1 Syntax

Below there is a table of commands used in Creo Program. All commands listed below and most used in guide rail bracket 3D -models in blue color (figure 17).

Command	Description	Example
ADD PART … END ADD	Adds part to assembly. Instead of PART, SUBASSEMBLY or COMPONENT is used in corresponding cases..	ADD PART xxxxx.prt or ADD PART (parameter_name)
CEIL(xxx.yyy)	The smallest integer value not less than the real value	CEIL(10.2) evaluates to 11 CEIL(-10.2) evaluates to -10
EXECUTE … END EXECUTE	Execute statement forms a link to the next-lower-level component. To the next-lower-level component INPUT statement must be added.	EXECUTE PART xxxxxx dim_a=dim_b name_a=name_b END EXECUTE Where dim_a and name_a are next-lower-variable names and dim_b and name_b are current-level-variable names
EXTRACT(string, position, length)	Extracts characters from string-type parameters	EXTRACT(abcdef, 2, 3) evaluates bcd
FID_*	Feature ID	
FLOOR(xxx.yyy)	The largest integer value not greater than the real value	FLOOR(10.2) evaluates to 10 FLOOR(-10.2) evaluates to -11

IF…
ELSE…
ENDIF
	Comparison	IF a>b
		b=c
		ELSE
		b=d
		ENDIF

INPUT … END INPUT	Input statement. Program stops and asks correct values unless EXECUTE statement is used next-upper-level assembly.	INPUT dim_a number name_a string END INPUT Where dim_a and name_a are a parameters and number and string are parameter types
ITOS(xxx)	Converts number to string parameter	ITOS(10) evaluates "10"
RELATIONS … END RELATIONS	Relations statement	RELATIONS dim1=dim2+1 END RELATION
SUPPRESSED	To suppress a part or assembly feature or components, add word SUPPRESSED immediately following the word add.	ADD SUPPRESSED PART xxxx
/*	Comment line	/* DESCRIBE THE PRO/PROGRAM /* BY USING COMMENT LINES
\	Backslash is used to interrupt a line (maximum 80 characters in one line) and to continue the expression on the next line	dim1=dim2+dim3 \\ +dim4

Figure 17. Commands for Creo Program.

Below the table of operators which can be used both in Creo Program and Relations (figure 18).

Operator	Description	Example
+	Addition	a+b
-	Subtraction	a-b
/	Division	a/b
*	Multiplication	a*b
^	Exponentiation	a^b
( )	Parenthesis for grouping	(a+b)
=	Equal to, arithmetic	c=a+b
==	Equal to, comparison	IF a==”abc”, where “abc” is string type parameter IF b==5, where 5 is number type parameter
>	Greater than	IF a>b
>=	Greater than or equal to	IF a>=b
!=, <>, ~=	Not equal to	IF a<>b
<=	Less than or equal to	IF a<=b
|	Or	IF a>b | b<c
&	And	IF a>b & b<c
~, !	Not	IF a!b
cos ( )	Cosine function	
tan ( )	Tangent function	
sin ( )	Sine function	
sqrt ( )	Square root	
asin ( )	Arc sine function	
atan ( )	Arc tagent function	
sinh ( )	Hyperbolic sine function	
cosh ( )	Hyperbolic cosine function	
tanh ( )	hyperbolic cosine function	
log ( )	Base 10 logarithm	
ln ( )	Natural logarithm	
exp ( )	E to an exponential degree	
abs ( )	Absolute value	

Figure 18. Commands for Creo Program and Relations.

Below there are instructions to get advantage of Feature ID (figure 19). To make easier to find individual components during programming there is a button for getting Feature ID's shown.

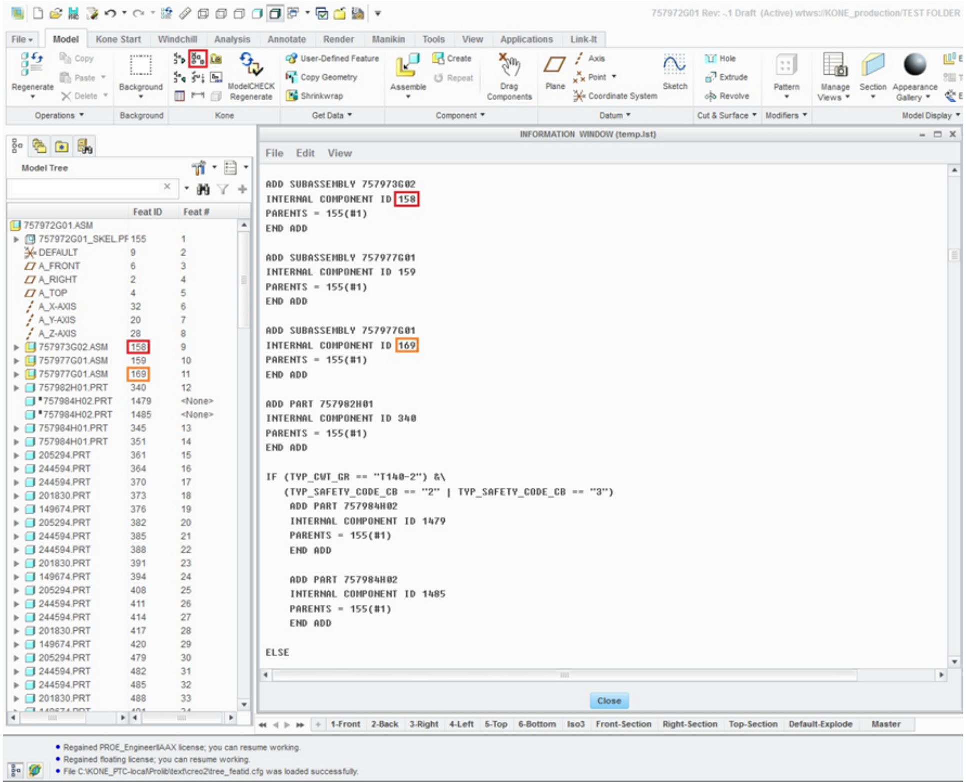


Figure 19. Feature ID.

3.8.2 Relations

Created relations are also shown in the Creo Program (figure 20.) and relations can be also created and modified from there but It is easier to keep those two separated to avoid unnecessary errors.

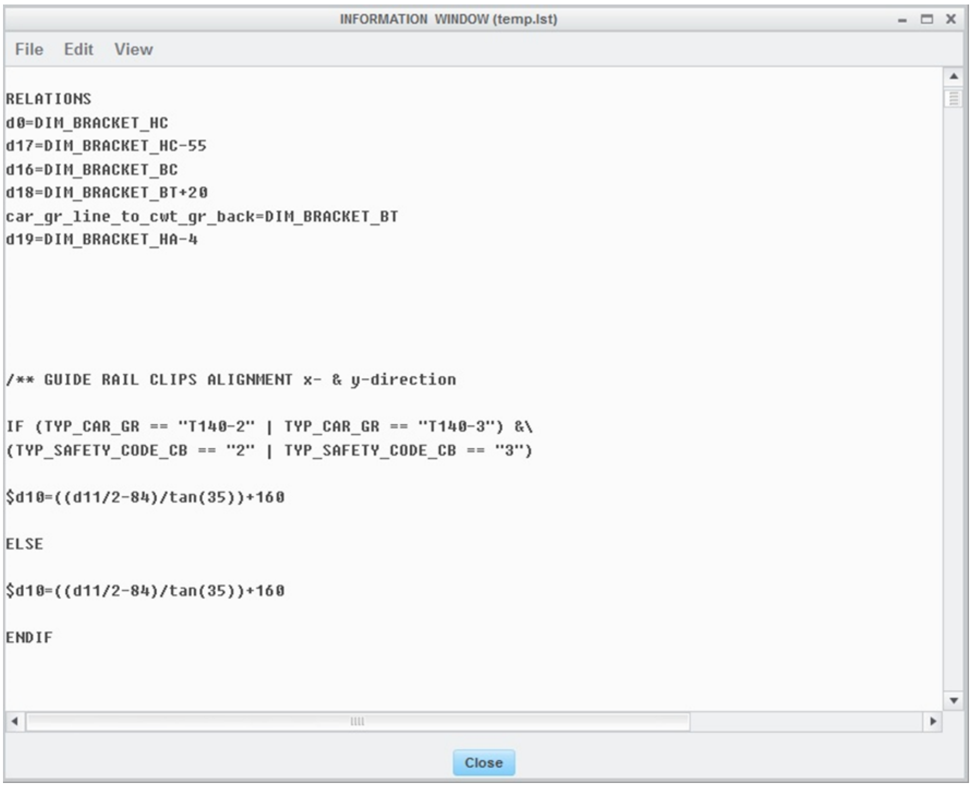


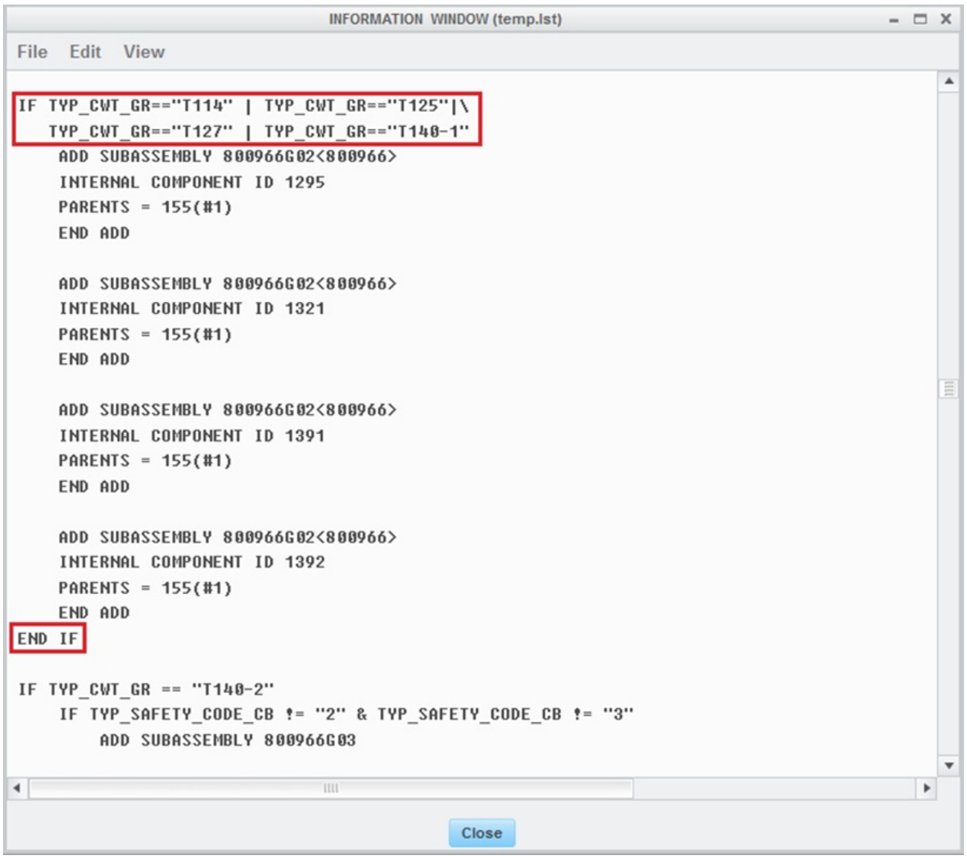
Figure 20. Relations in Creo Program tool.

3.8.3 Suppressing models

In the picture below, there is an example how to suppress models by using Creo Program. By using Creo Program it is also possible to suppress and add features as well.

If the value of a global characteristic ‘TYP_CWT_GR’ is exactly T114, T125, T127 or T140-1 then component 800966G02 are added to the assembly otherwise those are suppressed (figure 21.). In this example suppressing is done by giving values when specified components wanted to be added to the assembly.

If EXTRACT command used then program reads all given characters which are between 1 and 6 like shown in figure 22.



INFORMATION WINDOW (temp.lst)

File Edit View

```
IF TYP_CWT_GR=="T114" | TYP_CWT_GR=="T125"|\
   TYP_CWT_GR=="T127" | TYP_CWT_GR=="T140-1"
    ADD SUBASSEMBLY 800966G02<800966>
    INTERNAL COMPONENT ID 1295
    PARENTS = 155(#1)
    END ADD

    ADD SUBASSEMBLY 800966G02<800966>
    INTERNAL COMPONENT ID 1321
    PARENTS = 155(#1)
    END ADD

    ADD SUBASSEMBLY 800966G02<800966>
    INTERNAL COMPONENT ID 1391
    PARENTS = 155(#1)
    END ADD

    ADD SUBASSEMBLY 800966G02<800966>
    INTERNAL COMPONENT ID 1392
    PARENTS = 155(#1)
    END ADD
END IF

IF TYP_CWT_GR == "T140-2"
    IF TYP_SAFETY_CODE_CB != "2" & TYP_SAFETY_CODE_CB != "3"
        ADD SUBASSEMBLY 800966G03
```

Close

Figure 21. 3D -content suppress.

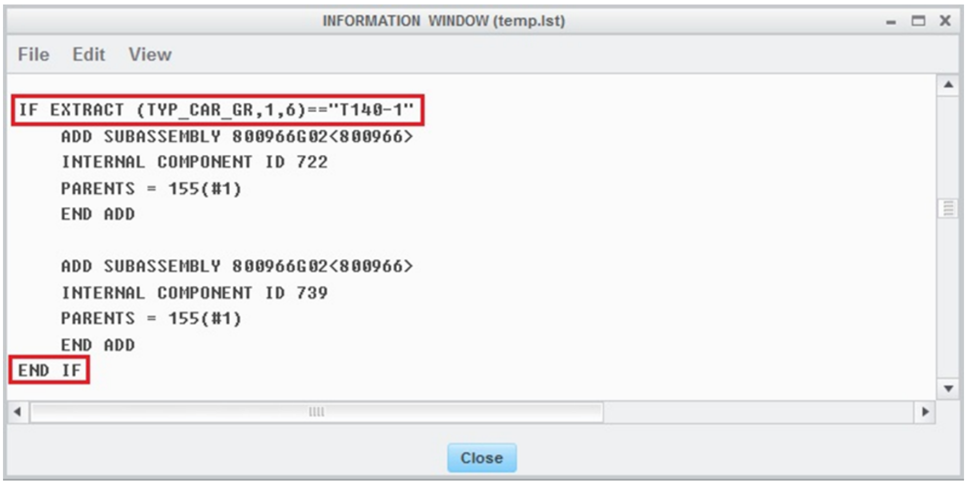


Figure 22. An example for EXTRACT command.

3.9 Family Table

Family table models can be used when needed. Family table map key should be used when creating the table in order to have the necessary parameter values preset (figure 23.).

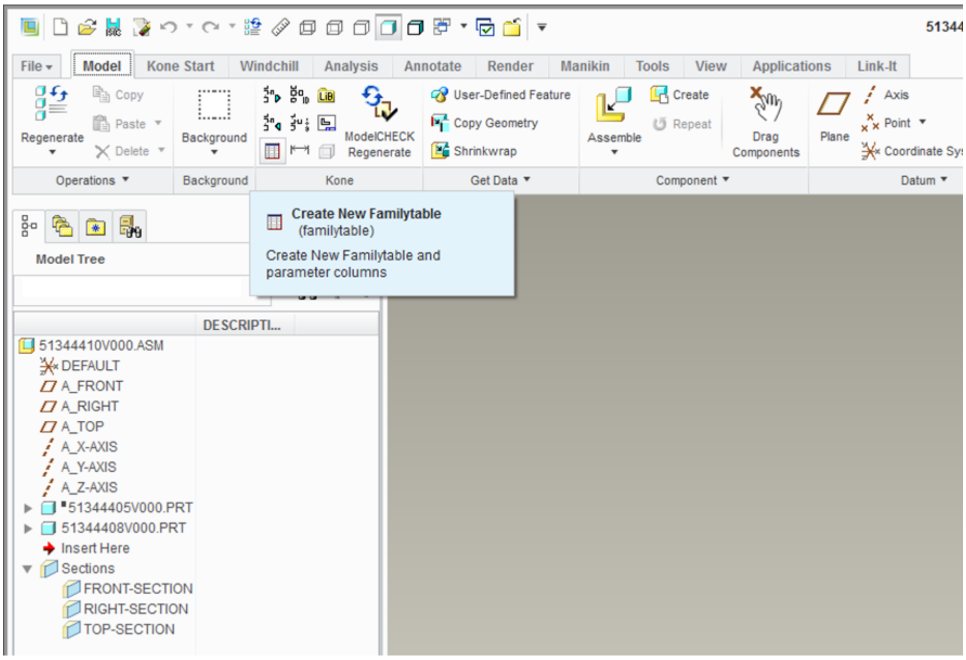


Figure 23. Family Table creation.

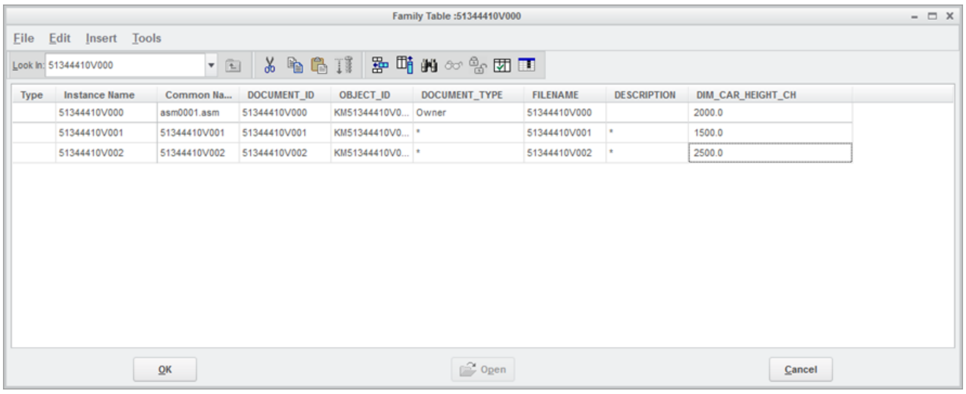


Figure 24. An example of a family table.

3.9.1 Adding parameters

The most valuable feature of family table is that there can be added several rules for multiple models at the same time. There is no need to program every single model separately which makes modeling easier and faster. Good example of this are standard commercial parts like screws and nuts. Programming of family table is always done in the generic model which controls every variation of the model.

Family table is highly not recommended to use in KONE environment unless the component is commercial or if there is very major reason for family table. If there is need to modify component which is created by using family table there are many things to consider. When modifying one variant of the family table the whole family table with all its variants needs to be modified or at least to do some changes so the system recognizes that something is changed so it is not possible to update or modify just one variant of the component. Otherwise the system doesn’t allow the checking between workspace and database if nothing is changed and that may cause major issues during the modification work. Working with family table after it is created could be very laborious and then we are far away from cost efficiency.

3.10 Flexible dimensions

It is possible to make the model flexible if component includes features the dimensions are not fixed and if it is used in many different assemblies with different dimensions. Example if there are need for different length guide rails for multiple assemblies.

A Go to model properties under the component which needs to use flexible dimensions (figure 25.).

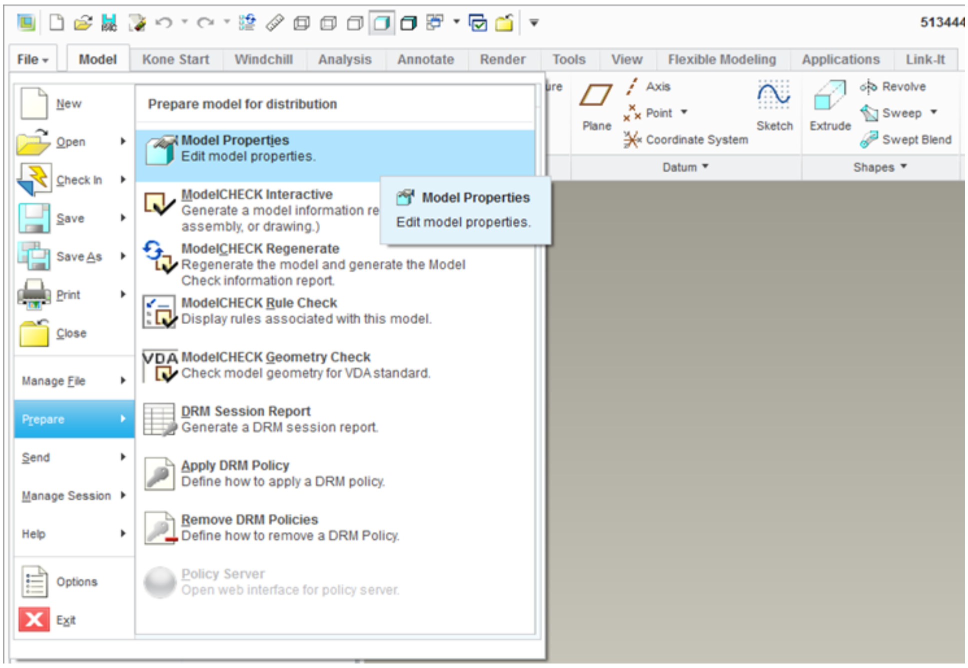


Figure 25. Flexible dimensions.

B Under the Tools find Flexible and click change (figure 26.).

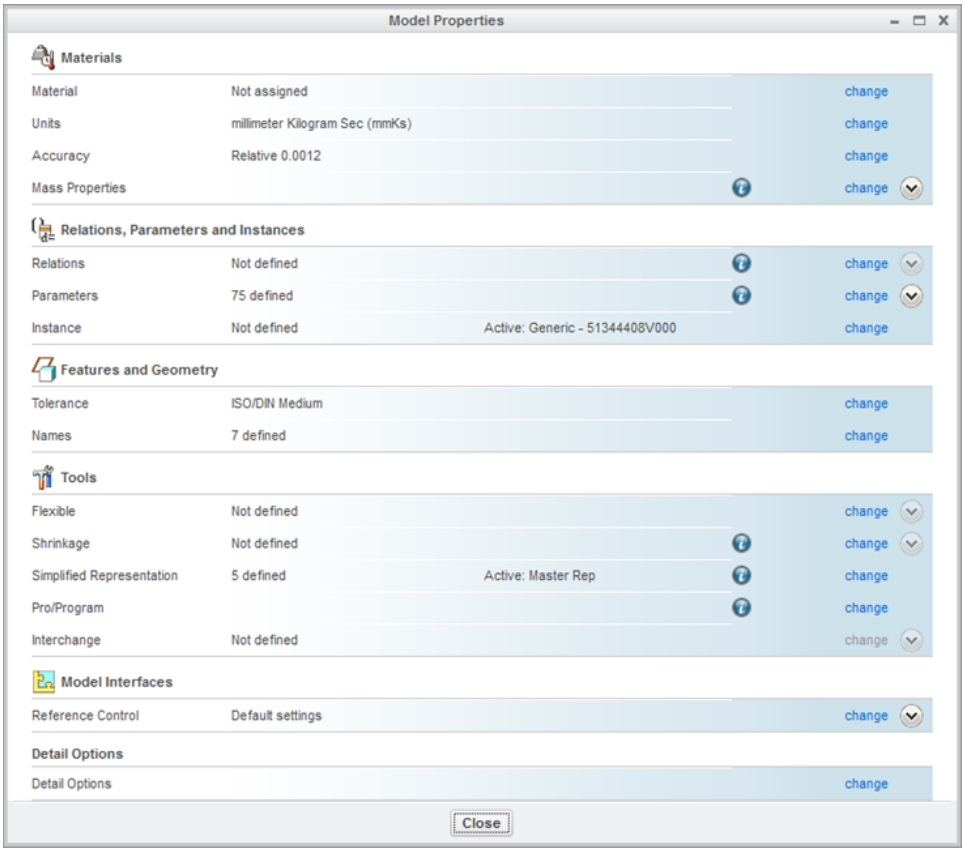


Figure 26. Flexible dimensions.

C Choose dimension to be modified as flexible and click OK (figure 27.).

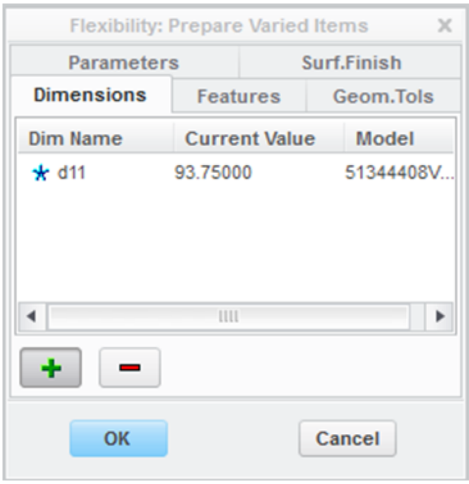


Figure 27. Flexible dimensions.

4 SYNCHRONIZING MATERIAL IN TO THE DATABASE

Before anybody else can modify or even see the created material it needs to be uploaded in to the database. Windchill is the main database for 3D -models and it includes multiple different folders example for each team, each platform and even for individual designers. Every folder has its own security system to restrict users who are not allowed to handle or even see the material.

4.1 Windchill Check In

To get active materials to the Windchill choose Custom Check In like shown in picture below (figure 28.).

Figure 28. Check In process.

After choosing Custom Check In program opens a different window. In this point no modifications needed (figure 29.).

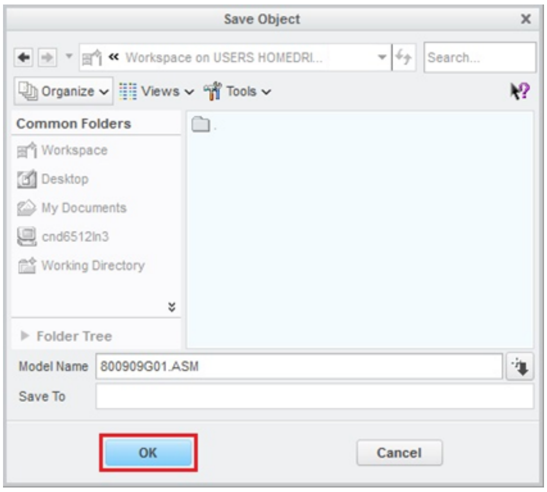


Figure 29. Check In process.

Choose Models and Viewables and click OK (figure 30.).

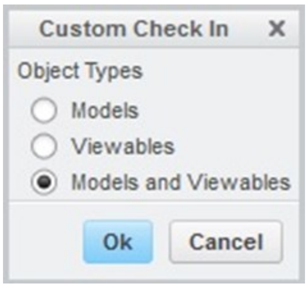


Figure 30. Check In process.

If the Check In operation is executed from drawing it automatically picks the reference model to be checked in. In the example (figure 31.) the check in operation is done from 3D -model and if the drawing needs to be uploaded at the same time you need to choose the assembly (A.) and then click Collect related drawings (E.).

When executing Check In operation at the first time the location needs to be defined. First pick the material which location needs to be defined (A.) and then click Choose location folder (F.). In the example (figure 31.) there is row after every material where the location is shown.

If the material already exists in Windchill and executing the Check In process then you don't need to choose each Checked out -materials separately and you can just click next (G.).

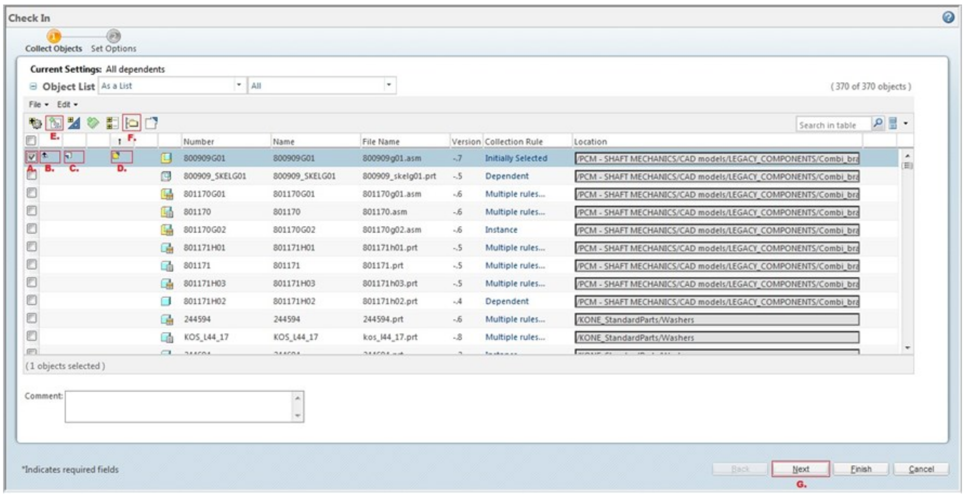


Figure 31. Select row (A.), Modifications needs to uploaded (B.), Checked out by user X (D.), Collect related drawings (E.), Choose location folder (F.).

Auto Associate Parts to CAD Documents needs to be selected (figure 32.). It creates the WT-Parts in to the system and those are crucial in former phase of material usage. After this selection is done then select Finish.

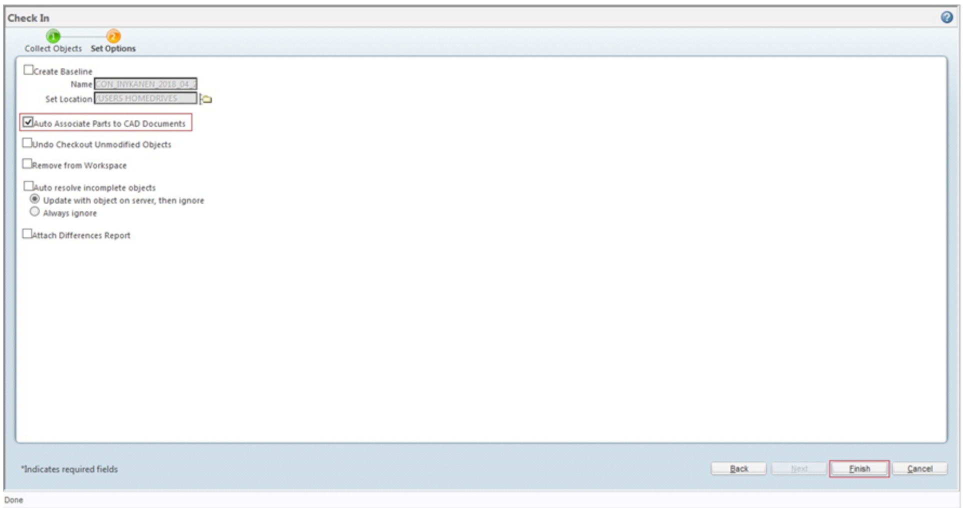


Figure 32. Check In process.

4.2 Windchill Check Out

To get any material modified the material needs to be checked out to workspace. This ensures that everybody else can see from Windchill the status of the material that it is already under update process. Each material can be checked out only for one designer or workspace at the time to avoid any unnecessary errors during the modifications.

After the materials are uploaded to the wanted workspace location choose Check Out (figure 33.).

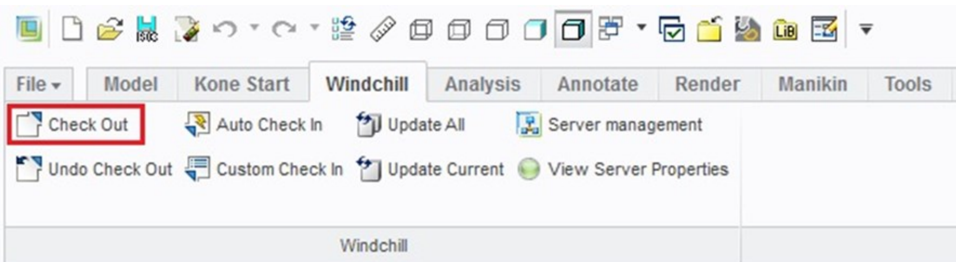


Figure 33. Check Out process.

After that no needed actions for modifications. Click OK for next two steps (figure 34.).

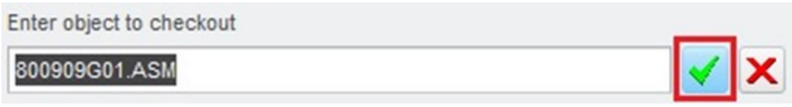


Figure 34. Check Out process.

You can ensure the status of the Check Out process from down bar of Creo (figure 35.).

Figure 35. Check Out process.

5 RESULTS

The conversion work itself is done strictly following the guide lines defined by KONE. KOS-000065 Design Guide Line -document is the base of 3D -modeling in KONE environment and that's why the specified principles cannot be found from other sources. During this time, about three years I've been working for Kone the 3D -modeling and the database are developed a lot which makes the everyday design work and the whole process much more efficient. Requirements of material creation in system level are growth and are growing still. Even if the base work is much more harder and takes a little bit more time and concentration comparing the old guide lines the combined time is notably decreased. Example the time of getting layout drawings done is decreased approximately from few days to few hours with the new system.

In the beginning of 2015 when the guide rail bracket 3D -modeling project started I had only a little touch on Creo Parametric CAD program. It was the best way to get into Kone environment to get started from the basics. Then there weren't so strict guide lines which could define different feature usage in 3D -models. We had a team including five design engineers and the total amount of different guide rail brackets and their variants was close to 350 pieces. The project had a quick start and it went thru in couple of months. The main target in the project was to get all brackets calculated in strength point of view to confirm the offered values which are specified in the documents.

5.1 Findings from basics of 3D -modeling in KONE environment

I started with the easiest component, with single car guide rail bracket. I can say I could finish the bracket without asking any help but there are many things you need to notice for the former use of the 3D -model. That is the reason I was asking from more experienced colleague all the time how things should be in this environment. By asking a lot of questions gave me the first base of knowledge of 3D -modeling in KONE environment based on experiences of skilled designers. Nowadays KONE is updating the Guide Line of 3D -modeling and it is going to be more detailed in the future.

In the starting phase of the project there were only three different types of skeleton template. One for the single car bracket guide rail bracket, one for the single counterweight bracket and one for the combination guide rail bracket. In the later phase I moved on to create the 3D -models of double combination brackets and there wasn't any template for those. The situation was that I needed to create skeletons by myself for those double combination brackets. Because of the good basics of skeletons creating more complex skeleton didn't cause any bigger problems. The main idea with the skeletons is quite simple you just repeat the same ideology like adding planes and axles and then dependencies and rules between those according to how those should function. For me the first more complex skeleton I created was very useful in educational point of view and gave me a lot of important information for future with 3D -modeling.

5.2 Avoiding errors in earlier use with sheet metal 3D -models

In some point of the project there came up a finding in a way of 3D -modeling sheet metal parts. Because this project was one of the first 3D conversion jobs done there came up things what haven't been thought beforehand. On good example is in sheet metal parts when creating flanges. To avoid failures and misleading measurements in 2D -drawing creation the first shape of sheet metal part needs to be sketched with all flanges if possible. The way of doing one flat first and then create flanges afterwards is strictly prohibited because of the measurements. The main idea in released manufacturing drawing is to show the part or component and its dimensions as it is as completed after manufacturing processes.

5.3 Uniqueness of KM -number

When creating 3D -model based on existing model by doing copy of that is very important to remember check all the dependencies and references between the old and new material because there are usually no errors until trying to get the material in to the database. There might be some warnings to designer during the modeling work if there are left some old KM -numbers in new material. All copied materials need to have new unique Kone Material number.

5.4 Skeletons

Skeletons are as the name says the frame of the model. All parts and components are built in the skeleton and in brackets there are used mainly only control skeletons. In some point of the project there was a separate team who created space reservation skeletons for brackets but the project was shut down before it finished. One of the reasons was the new Building Information Modeling which is coming to take its place in new modeling process. BIM modeling requires different type levels of details which is called LOD. Different level of details is defined in new updated version of modeling guide line and those are used besides of the space reservation skeletons. By using LOD same and even more features can be defined compared to the space reservation skeleton. With different LOD definition specified parts or features of the part or the component can be excluded and that makes the 3D -model itself much easier to handle if the model is really complex. Even if the component or part itself doesn't include a lot parts or features example screws and nuts or holes and flanges it makes the bigger assembly heavy to handle if it includes hundreds of those so called small components.

In every assembly needs to be own skeleton named as the assembly itself if skeleton is needed. Usually skeletons are not used in parts because that causes an unnecessary assembly or subassembly of part and that affects former use of the component.

5.5 Program

Using program, you can example define when part or feature are included in the model to show. It is very important to be careful with this to avoid unnecessary errors. If something goes wrong with writing a rule in program it doesn't give you a hint what is wrong it just says it is wrong. That's why you can't leave any extra marks in there if it is not done by comment.

5.6 Adding material in to the database

When adding material in to the database the model needs to be checked that there are no unwanted references or dependencies because if there are then the Windchill Check In process would not be completed. Also, the folder where materials are supposed to be added needs to have correct kind of limitations of user accesses according to the material.

Windchill is going to be the master for all 3D -models and materials. Some of the materials still has different master systems because of the age of the materials so these are not updated yet. The old materials could have example wcimport or edms as their master system depending how or from where those materials added in to the existing database.

5.7 **The big picture**

In the big picture 3D -modeling has taken a huge step in KONE during these three years. We are still speaking mainly about brackets but in this kind of system with an enormous size the base is everything. If there is something wrong with the base it would make the whole system useless.

The complete elevator system level 3D -models are built by combining small parts and assemblies and that is why these really need to fit seamlessly together to give the results and materials which are the key for the system.

Moving towards a 3D -based system will save a lot of time and money when everything is done according for the KONE way. Then almost every aspect can be checked beforehand example when designing an elevator for an already specified elevator shaft. When 3D -models work as they should it is easy to create Building Information Models and from these all the needed layout drawings and manufacturing drawings can be generated by using automation.

6 CONCLUSION

Taking a closer look to the development of companies around the world and around the industries visualization is growing rapidly. Customers want to know beforehand in a more detailed manner what they are buying, for example many customers already require complete BIM models of the products they have bought. Customers are not only ones who requires BIM models, building contractors can also get a major benefit of these by reduced building time because of more accurate designs and plans. One of the biggest reasons for this is to reduce the costs in product development and the delivery process is not so heavy anymore either.

Starting from the bottom a part level 3D -model is the key for building such a big and complex item as a BIM model. The system is a bit fragile what comes to 3D -modeling if there is something which is not done accordingly to the guidelines. It is enough if one part or subassembly has a missing reference and the whole assembly is useless and the fixing is always difficult and takes extra time afterwards.

Now when the major alignment of the future has been performed for the 3D -technology at a company level it is easier to move towards to the goal. When this guide rail bracket modeling project started there were no specified rules for some issues in the model creation and that is why in these models there is still something to modify to meet the requirements. One of the targets for the project was to get all the guide rail brackets calculated from a strength point of view as well as to get these components brought to the Kone 3D -environment.

After each part includes all the required information and after these parts are 3D -modelled strictly according to the guidance it is easy to create subassemblies and assemblies to get the correct final product to the company use as well as for the customers. A good example of where the company is aiming is to get a complete BIM model generated after inserting building information into the system and it automatically calculates and regenerates the brackets, slings, machinery etc., whatever is needed in individual cases. After the regeneration of 3D -materials is done the layout drawings can be created automatically as well, based on the models these are key issues which are reducing the costs significantly. Nowadays, in special delivery cases layout drawings are done by hand by a layout engineer and after automatization these drawings need only to be checked for errors.

Paying more attention in early phase of product development takes more time in the beginning but will give a huge effort in further phase of the project. That same works and should be remembered with 3D -model creation. These things ensure the customer is going to have as finalized and error free product as possible.

SOURCES

Etteplan’s Advanced Creo training, Etteplan intranet

KONE Design Components, KM657567G01, Kone PDM database

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