POLITECNICO DI TORINO

Dipartimento di Ingegneria Strutturale, Edile e Geotecnica

Corso di Laurea Magistrale in Ingegneria Civile

Tesi di Laurea Magistrale

BIM Model Coordination and Code Checking. Paris underground station

Relatore:

Prof.ssa Anna Osello

Correlatore:

Arianna Fonsati

Canditato:

Mahmut Koray OSKAY

December 2019

ACKNOWLEDGEMENTS:

I would like to thank all the professors I have had as teacher for their help and the knowledge they shared with me and made me a civil engineer today.

My gratitudes goes to Anna Osello who taught me BIM as a methodology and accept me as her thesis student.

Many appreciations to Arianna Fonsati, for always being ready to help, share knowledge, thinking about my good will, passion for this thesis and patience.

I would like to thank Lombardi Ingegneria Srl for the materials and documents provided for the development of the thesis.

Thanks to my two precious friends, Ecem Coşan and Aslı Ürem, for always being there for me, for being supportive and sharing this Italian adventure with me.

Biggest thanks to my family, Metin Oskay, Yıldız Oskay, Sinem Oskay, thank you for your infinite love and support. Thank you for helping me living my dreams.

ABSTRACT:

In a constantly changing, progressive era of the world, as all the industries, construction industry is developing parallel to the world's needs and trends. BIM or Building Information Modelling is the last step of the evolution so far. Even though BIM exists more than a decade it is still considered as new born baby. Because it is developing every day and it is quite hard to predict the borders about where it will end up.

In this thesis, the main topic is about Construction Management with BIM by using Paris underground station model. The delivery process of a project is one of the main topic of BIM. This thesis consist the naming process of the elements, comparing and choosing the right codification system. The model is done by federated method. The coordination of the project is an essential aspect. By using certain tools, coordination of the model and the coordination between the personnel and also the employer, a method is developed and provided. Also model checking is done by comparing CAD and RVT files by the candidate and also done by using software, considering code checking and clash detections. Also a protocol is developed and provided with hierarchy, for model review, check and authorize processes.

Table of Contents

List of Abbreviations

Building Information Modelling (BIM)

Common Data Environment (CDE)

BIM Based Model Checking (BMC)

Common Data Environment (ACDat)

Level of Detail (LOD)

Industry Foundation Classes (IFC)

Solibri Model Checker (SMC)

List of Figures

List of Tables

1. Introduction

1.1 What is BIM?

In a constantly changing, progressive era of the world, as all the industries, construction industry is developing parallel to the world's needs and trends. BIM or Building Information Modelling is the last step of the evolution so far. Even though BIM exists more than two decades it is still considered as new born baby. Because it is developing everyday and it is quite hard to predict the borders about where it will end up.

The US National Building Information Model Standard Project Committee has the following definition:

"Building Information Modelling (BIM) is a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition.

A basic premise of BIM is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the BIM to support and reflect the roles of that stakeholder.

The US National BIM Standard will promote the business requirements that BIM and BIM interchanges are based on:

- *a shared digital representation,*
- *that the information contained in the model be interoperable (i.e.: allow computer to computer exchanges), and*
- *the exchange be based on open standards,*
- *the requirements for exchange must be capable of defining in contract language.*

As a practical matter, BIM represents many things depending on one's perspective:

- *Applied to a project, BIM represents Information management—data contributed to and shared by all project participants. The right information to the right person at the right time.*
- *To project participants, BIM represents an interoperable process for project delivery—defining how individual teams work and how many teams work together to conceive, design, build & operate a facility.*
- *To the design team, BIM represents integrated design—leveraging technology solutions, encouraging creativity, providing more feedback, empowering a team."* (NIBS, 2007)

1.2 What are BIM dimensions?

With the growth and development of BIM technology and methodology, BIM has various and yet unfinished, still growing aspects of use. BIM as a method has tools to be operated, that means in one hand BIM has a depending of technology. By the growth of technology and also new ideas about the use of BIM will add more dimensions. According to the use, data provided and contained, BIM has dimensions.

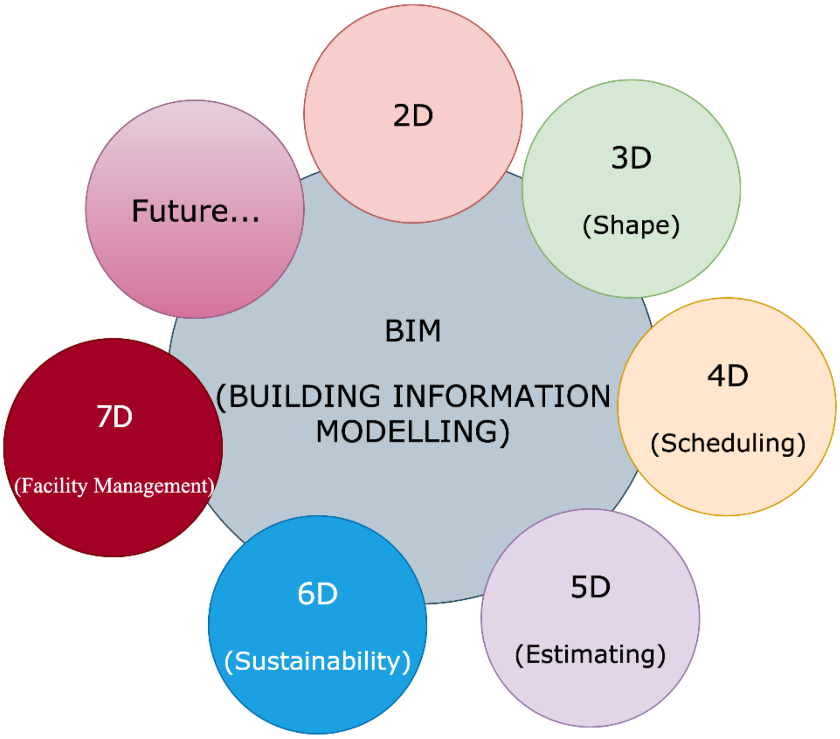


Figure 1: BIM Dimensions

3D refers to the geographical dimensions. By the growth of technology and invention of computers allows us to model 3D models. This does not mean it was not impossible to draw structures in 3D in the past but with technology, the operation has become easily operable. This dimension lets participants to design 3D and see the result of the structure even bfore starting the construction phase. 3D modelling lets participants cooperate, sharing information, checking issues and avoid the future issues in terms of modelling.

4D refers to adding new dimension to the Building Information Modelling. This dimension is related to time. Time planning is a part of construction management approach. By this way it is possible to estimate finishing date of the project. To make a bid for a construction project, it is an important aspect. Because time is also related to cost. Another use of this, is scheduling the construction phases. A well time scheduled construction leads very well execution, risk avoidance and no problems.

5D is related to the cost estimation and budget control. The estimation of the cost is extremely important for a construction project. To make bid for the construction, cost estimation must be done with high precision. Otherwise the execution of the project becomes really problematic. Also budget control is highly important for the project management. Expenditures must be planned with high sensitivity to keep the construction going on. Also the reports of expenditures must be taken after spending and it must be analysed.

6D refers to the sustainability of a construction project. Sustainability is a key issue of the modern world. For the construction projects, cost and time is not the only key issues anymore, the energy consumption has now an important role. By analysing energy consumption, the use of energy in the initial phase and also later stages of construction is accurately calculated. This also helps for reducing cost and also provides more rapid production. Effective use of instruments for construction leads a well construction operation and also it is better for the world in terms of environmental aspect. This dimension also helps for the future of the structure in terms of facility management, in terms of effective consumption of energy .

7D refers to the operations in a construction project and facility management. For the managers and owners the responsibility is not over. when the construction phase is done. Their responsibility keeps on by keeping the structure as it is like in the first days of the structure. The track of the maintenance plan, specifications, warranty information and use of them effectively during life cycles is a key aspect for facility management. 7D helps the participants to achieve this procedures.

1.3 BIM Standards

In this thesis mainly 4 standards are used to accomplish the mission. ISO 19650, PAS 1192 and UNI 11337 for the methodology of BIM coordination and validation format and BS 8300 is the standard for accessible buildings that we take the rules from.

BIM as a method has started to be used worldwide. On all over the world BIM has obligation to be used. For example many of the European countries has obligations for BIM, in England the construction projects, which has certain amount of cost, must implement BIM as method. This is not a choice anymore. For industrial needs and choices, countries already started to create their own technical specifications for Building Information Modelling method.

The International Organization for Standardisation (ISO) is made up from various national standards organization’s representatives. Their responsibility is to create standard for international use. World's first international BIM standard is published by ISO on 21 January 2019. The standard's name is ISO 19650 "Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling".

ISO 19650 was approved by European Committee for Standardization (CEN) on 24 August 2018. CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom. This standard is published in 3 languages (English, German, French) and the translation of the standard is in the responsibility of each country.

As we see ISO 19650 is recognized by nearly the whole Europe, it can certainly be said that the use of this standard will be seen a lot in the future.

ISO 19650 principles and requirements are mainly based on the UK's existing standards. BS 1192:2007+A2:2016 and PAS 1192-2:2013. It can also be said that ISO 19650 is more comprehensive, general and international version of UK's existing standards.

ISO 19650 consist of two parts. These are :

BS EN ISO 19650-1: Organization and digitization of information about buildings and civil engineering works, including building information modelling -- Information management using building information modelling: Concepts and principle.

BS EN ISO 19650-2: Organization and digitization of information about buildings and civil engineering works, including building information modelling -- Information management using building information modelling: Delivery phase of the assets.

"This document sets out the recommended concepts and principles for business processes across the built environment sector in support of the management and production of information during the life cycle of built assets (referred to as "information management") when using building information modelling (BIM)." (BSI, 2018)

On 2013 PAS 1192-2 is published by BSI. PAS 1192-2 is a national standard of UK for the use of BIM. The explanation is *"Specification for information management for the capital/delivery phase of construction projects using building information modelling."* The principals and requirements are based on the BS 1192:2007+A2:2016, which is a code of practice for the collaborative production of architectural, engineering and construction information.

The main focus of PAS 1192-2 is on project delivery. The majority of graphical data, non-graphical data and documents are accumulated from design and construction activities. The focus audiences are organization and individuals responsible for design, construction, delivery, production and maintenance of buildings and infrastructure.

And the next standard is UNI 11337 which is an Italian standard for the use of BIM. First UNI 11337 was published in 2009. In the first UNI 11337, concept of information, interoperability and identification of a work in the construction sector are introduced. The focus of this norm is focussed on all building works and any type of product of a new building or infrastructure, redevelopment of the environment or built heritage and also type of processes. The norm is divided in 10 parts and 5 of them are already published.

Part 1. Models, data and information objects for products and processes

Part 2. Criteria for the naming and classification of models, products, and processes

Part 3. Models for the collection, organization and storage of technical information for construction products

Part 4. Evolution and informative development of models, designs and objects

Part 5. Information flows in the digitized processes

Part 6. Guideline for the preparation of the information documents

Part 7. Requirements for knowledge, skills and competence of the figures involved in management and information modelling

Part 8. Integrated Processes of Information and Decision Management

Part 9. Information management during operation

Part 10. Guidelines for the digital information management of administrative practices

Part 1-4-5-6-7 are published.

In the following part all three standards is examined according to the main aspects of this thesis. They are about the actors, co-ordination and verifications.

The actors in ISO 19650 has unique names with unique roles. The hierarchy is certain. But the names are not specific for the use or it can be said that the role is not described in the name.

Type of Actor	Description
Appointing Party	The organisation or individual that leading the project. Can be asset owner
Lead Appointing Party	The actor which is responsible for co-ordinating information exchange between task teams or between appointing party and delivery team

Appointed Party	Anyone generating the information about the project

Table 1 Actors in ISO 19650

There are task teams which are performing a specific task. For example, architects.

Delivery team is a lead appointed party and its associated task teams.

Project team is everyone involved in the project.

In PAS 1192-2, the roles of the actors are the same but their name is more specific.

ISO 19650	PAS 1192
Appointing party	Employer
Lead Appointing Party	Supplier/Employer
Appointed Party	Supplier

Table 2 Actor Comparison between ISO 19650 and PAS 1192

Here in the figure below it is shown that how the terms can be used.

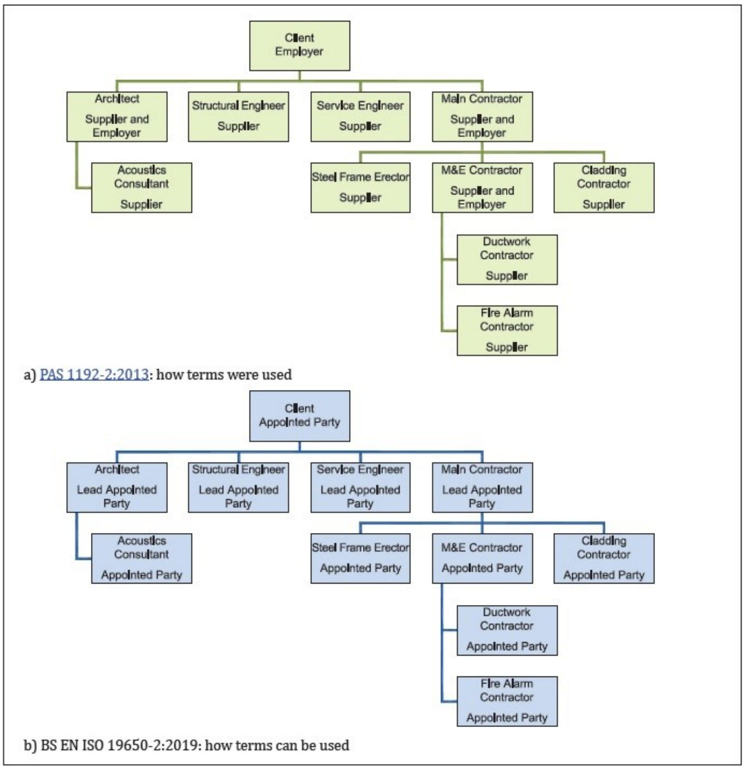


Figure 2 Example Hierarchy in ISO 19650 and PAS 1192 (BSI: 2018)

But in ISO 11337 the actors are named more specific for use. These are; Common Data Environment Manager, BIM coordinator, BIM Manager, BIM specialist.

As it is seen the actors are not totally defined in ISO 19650 and PAS 1192, as it defined as in UNI 11337. The hierarchy and the use of parties are defined in ISO 19650 but when we implement this standard to a project we should give specific names to the actors. For example; Appointed Party=BIM specialist.

In all the standards Common Data Environment is used. In ISO 19650 and PAS 1192 the common data environment is basically the same.

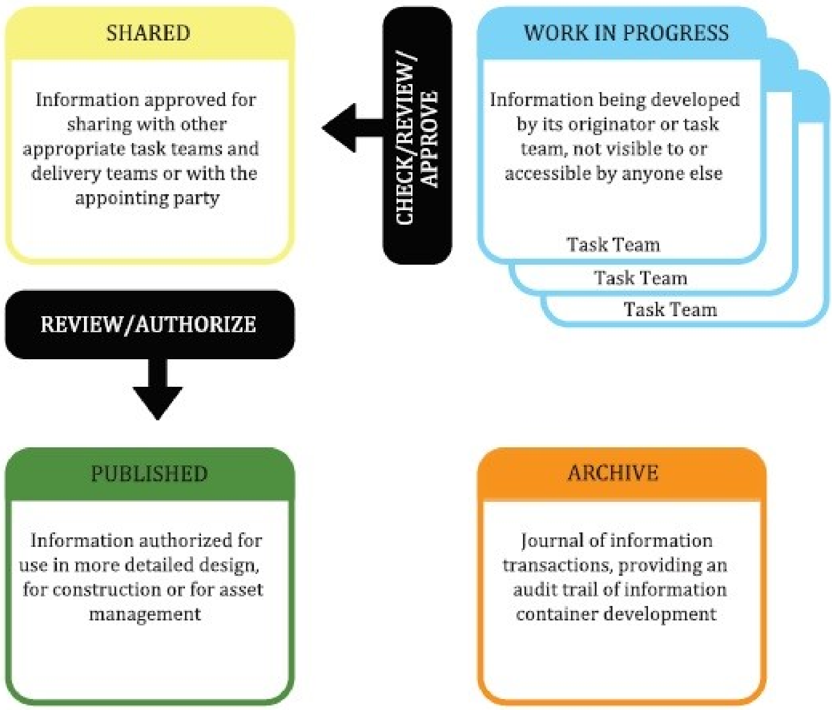


Figure 3 Common Data Environment (ISO 19650)

The summary of the definitions of the parts of common data environments can be seen in the figure.

For UNI 11337, Common Data Environment is also used. But the name is different. The definition of Common Data Environment(ACDat) is "Organized collection and sharing of data relating to models and digital documents, referring to a single work to a single complex of works".

The phases are:

L0: during processing / updating: the information content is being processed and, therefore, may still be modified or updated. The content may not be made available to other subjects outside the responsible contractor.

L1: in the sharing phase: in information content and considered complete for one or more disciplines, but still susceptible to interventions by other disciplines or other operators. The content is made available to subjects other than the responsible contractor.

L2: in the publication phase: The informative and active content, but concluded, and no interested subject beyond the responsible contractor manifests the need to make further interventions.

L4: archived: the information content is related to a non-active version linked to a completed process, which differs in:

L3.V "valid", version still effective

L3.S "passed", relative to the previous versions are effective and therefore replaced..

In ISO 19650 and PAS 1192 the status codes are defined to be able to understand and show the situation of the information in the Common Data Environment. But this does not exist in UNI 11337.

Status	Description
Work in Progress (WIP)	
S0	Initial status or WIP Master document index of file identifiers uploaded into the extranet.
Shared	
S1	Issued for co-ordination The file is available to be "shared" and used by other disciplines as a background for their information.
S2	Issued for information
S3	Issued for internal review and comment
S4	Issued for construction approval
S5	Issued for manufacture
S6	Issued for PIM authorization (Information Exchanges 1-3)
S7	Issued for AIM authorization (Information Exchange 6)
D1	Issued for costing
D2	Issued for tender
D3	Issued for contractor design
D4	Issued for manufacture/procurement
AM	As maintained
Published documentation	
A	Issued for construction
B	Partially signed-off: For construction with minor comments from the client. All minor comments should be indicated by the insertion of a cloud and a statement of "in abeyance" until the comment is resolved, then resubmitted for full authorization.
AB	As-built handover documentation, PDF, native models, COBie, etc.

Figure 4 Status Codes (PAS 1192)

On the other hand there is a definition for the information status according to its approval in the UNI standard.

Four statutes of approval of the information content are defined as follows:

A0: to be approved: the information content has not yet been submitted to the approval procedure.

A1: approved: the information content was submitted to the approval procedure and obtained a positive result

A2: approved with comment: the information content was submitted to the approval procedure and obtained a partially positive outcome, with indications relating to binding changes to be made to the content itself for subsequent project development and / or specific uses for which it is considered approved.

A3: not approved: the information content was submitted to the approval procedure and obtained a negative result, and is therefore rejected.

In all of the standards co-ordination of the model is done by the coordinator. But the preliminary check for the coordination must be done by task teams (ISO 19650/PAS 1992) or BIM specialist (UNI 11337). In UNI 11337 there are 3 levels of co-ordination.

Top-level coordination (LC1)

Coordinating data and information within a single chart model is called top-level coordination (LC1).

Second-level coordination (LC2)

Coordination of data and information between multiple individual graphical models is defined as second-level coordination (LC2) and can be done through their simultaneous aggregation or through subsequent checks of congruence of the respective information content .

Third Level Coordination(LC3)

Third-level coordination (LC3) is defined as the control and solution of interference and inconsistencies between data/information/information content generated from graphical models, and information/information/information data (digital and non-digital) not generated by graphical models (such as a elaborate CAD chart, not derived from models, or a calculation relationship, etc.)

Clash detection must be done by task teams/BIM specialist and also BIM coordinator by the definition of all the standards. There is no definition about how to identify clash detection in PAS 1192 and ISO 19650 but in UNI 11337 clash detection identified according to this levels.

- *Between projects of the same graphic model (LC1)*
- *Between a model and other graphical models (LC2)*
- *Between a graphic and processed model (LC3)*

Code checking must be done by task teams/BIM specialist by the definition of all the standards. There is no definition about how to identify code checking in PAS 1192 and ISO 19650 but in UNI 11337 code checking identified according to this levels.

- *Between the objects in a graphic model and their references to* analyse *(LC1)*
- *Between the graphic model as a whole and its references to be* analysed *(LC2)*

• *Between the graphic model and its processes, but not automatically extracted, and their references to be* analysed *(LC3)*

As it is seen in the examinations and explanation above, ISO 19650 is the most general standard which can be implemented and adjusted according to the project and it is open to interpretations. PAS 1192 is a kind of core element for ISO 19650. UNI 11337 is established as national standard and it will serve the country's industrial needs, so that it is more specific. But in the end there is no big contrast between the standards and their main principals are mainly the same.

BS 8300 is a British Standard that exhibits how buildings should be designed, constructed and maintained according to the accessible and inclusive environment for disabled people. In this thesis 2018 version is used. The standard consist of two parts and they are:

- Design of an accessible and inclusive built environment: Part 1: External environment – Code of practice;
- Design of an accessible and inclusive built environment: Part 2: Buildings – Code of practice.

BS 8300 is created to ensure that every individual can use the built environment equally. People can enter the building and move freely and exit independently. It is also ensures that in the case of emergency the escape is easy.

In this thesis, from this standard, rules for stairs, rules for doors and rules for routes are taken.

1.4 Common Data Environment (CDE)

A CDE is simply a collaborative environment that all the participants are sharing and visualizing the information according to their responsibilities, following the guidance given under PAS1192 and BS1192, to coordinate information with supply chain members on the project.

"The Common Data Environment (CDE) is the single source of information for the project, used to collect, manage and disseminate documentation, the graphical model and non-graphical data for the whole project team (i.e. all project information whether created in a BIM environment or in a conventional data format). Creating this single source of information facilitates collaboration between project team members and helps avoid duplication and mistakes". (BSI 2007)

In iso 19650 standards there is the illustration of the concept of common data environment,

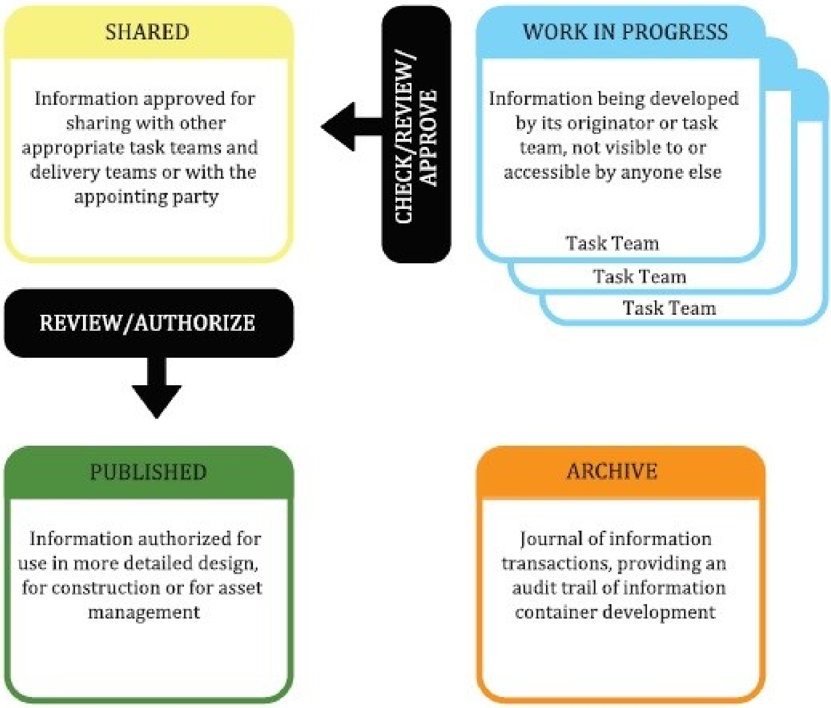


Figure 5 Common Data Environment (ISO 19650)

Work In Progress (WIP) stage is used for the information that is still in production period. That means the information is not certain bu the responsible person/team is still working on it. This information can not be seen by the other participants in this stage.

Check/Review/Approve stage is a transition stage, that the information that is created in the work in progress must be check, reviewed according to the regulations, needs, specifications and methods. If the check is done and the information is passed successfully, it is approved.

Shared stage is the stage, that the information, that is created in Work in Progress stage, is shared with the other participants. After check and reviews, which is done by task teams, the information is send to the shared area. In this are the information is ready for coordination. In this stage the information is visible and accessible but they can not be edited. To edit the information, it should be sent to the Work in Progress stage with Revision number and explanations. This stage is also visible for clients. The information is ready for authorization. It is also called client shared area.

The review/authorize is the transition stage which includes the clients approval. In this stage all the information is reviewed and checked by task teams and it is approved to be shown to the clients and take their authorization. Information exchange are done in the meetings. If the information is complete, accurate and if they meet the requirements. The information goes to published stage, but if the information is not accepted, it is sent back to the Work in Progress stage with new requirements.

The Published stage is the stage, that contains the information which is authorized for use. If the information is in this stage, it is ready for the production and it can be used and construct in real life.

The Archive stage is the stage where all the information, that is used, is kept. This stage is to hold a journal of all information that passed shared and published stages. This information is hold for construction and facility managements and also in the future it can be used as reference.

1.5 BIM Oriented processes in terms of clash detection and code checking

Clash detection

In design there are multiple problems may occur. Clash is one of them. When the components of the structure are not spatially coordinated and there is a conflict between the components. BIM solutions make it easier to examine and distinguish the clash before the construction phase starts.

In the construction project the variety of the participants is really high. It is also valid even for the design phases of the project. As the starting point, the architect's model is taken and structural, environmental, electrical and mechanical engineers design separately their own models. Each model consist of components, range of model files, documents and structured data. All these geometric and non geometric information comes together and are merged to make a digital model. This digital model is a kind of a digital replica what is going to be built and at the end what was built.

In a level 2 BIM process, individual teams designs their models and by applying federated model they integrate their model into master model. These models are kept in the Common Data Environment. In their individual models clash is possible to be occurred, between the components of the same model there can be overlapping, duplication, out of range intersection etc. Also in the master model between disciplines the clash occurrence is nearly non avoidable, because of separate design phase. Type of clashes are "*When we imagine clashes we commonly think of two components occupying the same space. These are often referred to as a 'hard clash'. A 'soft clash' occurs when an element isn't given the spatial or geometric tolerances it requires or its buffer zone is breached." (NBS)*

*"Clash detection and checking of component pairs is maybe the most known concept of checking. When merging models in interdisciplinary collaboration models, this kind of checking is very useful and often included as part of the quality assessment (QA) system. The algorithm (rule) for checking the turning circle of a wheelchair, is the same rule that can be used to check minimum / maximum distance from any object to any other object. By enabling parametric selection of object (in addition to tolerance) it is possible for the designer to check and correct other distances for example between cabinets for fire extinguisher." (*Hjelseth and Nisbet,

2014) *"The checking is based on topological relationships and Boolean algebra. These rules can also be implemented parametrically, allowing the user to adjust the "rule" by changing the min / max tolerances the components are checked against. (Borrmann, 2008).*

Code checking

Code checking is a main category of BIM Validation. It is basically, comparing rules with the references from regulations and codes, that may be technical or given by company or employer itself.

"The purpose is to check if the solutions in the model are in accordance with codes, regulations, standards and so on. Automatic management of building permit application has long been a beacon for model checking. One reason is that permitting is a critical point that all facilities have to pass." (Hjelseth and Nisbet, 2014)

The rules are generally are clustered by rulesets. Creating one rule and check individually is possible also on the other hand merging couple of rules and create a stand check them at the same time, is possible in this stage of technology.

2. Case Study

2.1 Information about Model

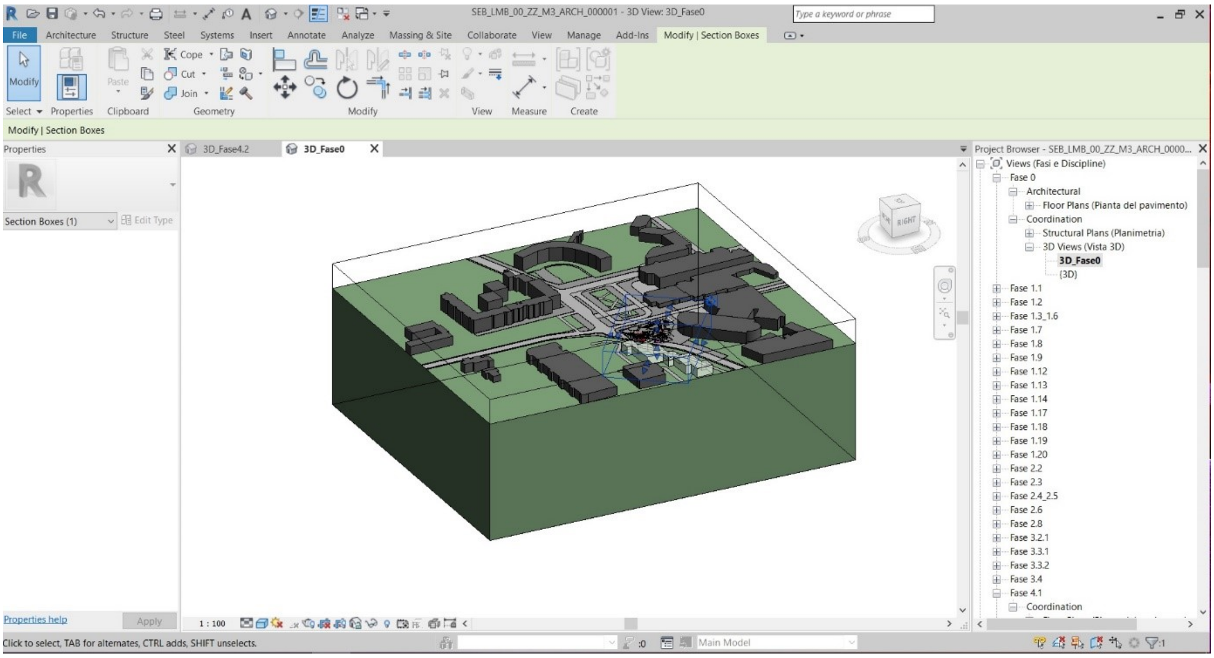


Figure 6: Project Display in Revit

"The case study refers to the project of the underground station "Sevran-Beaudottes", which is part of of the wider initiative "Gran Paris Express", a group of new underground lines planned to open in stages through 2023. The station will be connected to the existing RER B station Sevran-Beaudottes, a hub in the French transport network enabling travellers to reach the region around Sevran.

The construction method chosen to realize this infrastructure is the "cut and cover" one, where, excavation equipment dig a large trench in the ground which is then covered by a concrete deck, once the desk is in place, the construction works continue below, repeating the sequence of excavation and slab cast.

In the case of this underground station, after the consolidation of the soil realized through solid injections, the first step involves the installation of concrete diaphragm walls, before excavation starts, then soil is dug, to just below the slab level of the underground structure. Struts are then placed to support the diaphragm walls, which in turn support the soil at the sides, and roof slabs at ground and at first level underground are poured. The next levels of slab are then cast-in-place, so the process continues downwards until the base slab is complete." (Fonsati and Osello and Damiani , 2018)

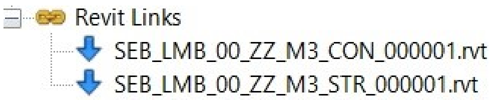


Figure 7: Revit Links

The model itself created as federated model in Revit software. 3 task teams works on it, they are “architectural”, “structural” and “constructional” teams. The work is done separately and merged by linking projects in one project file. Common data environment is used to accomplish this task. The model itself is still in the Work In Progress stage. Revit version 2018 is used to model this structure and it is upgraded while it is being worked on it for this project.

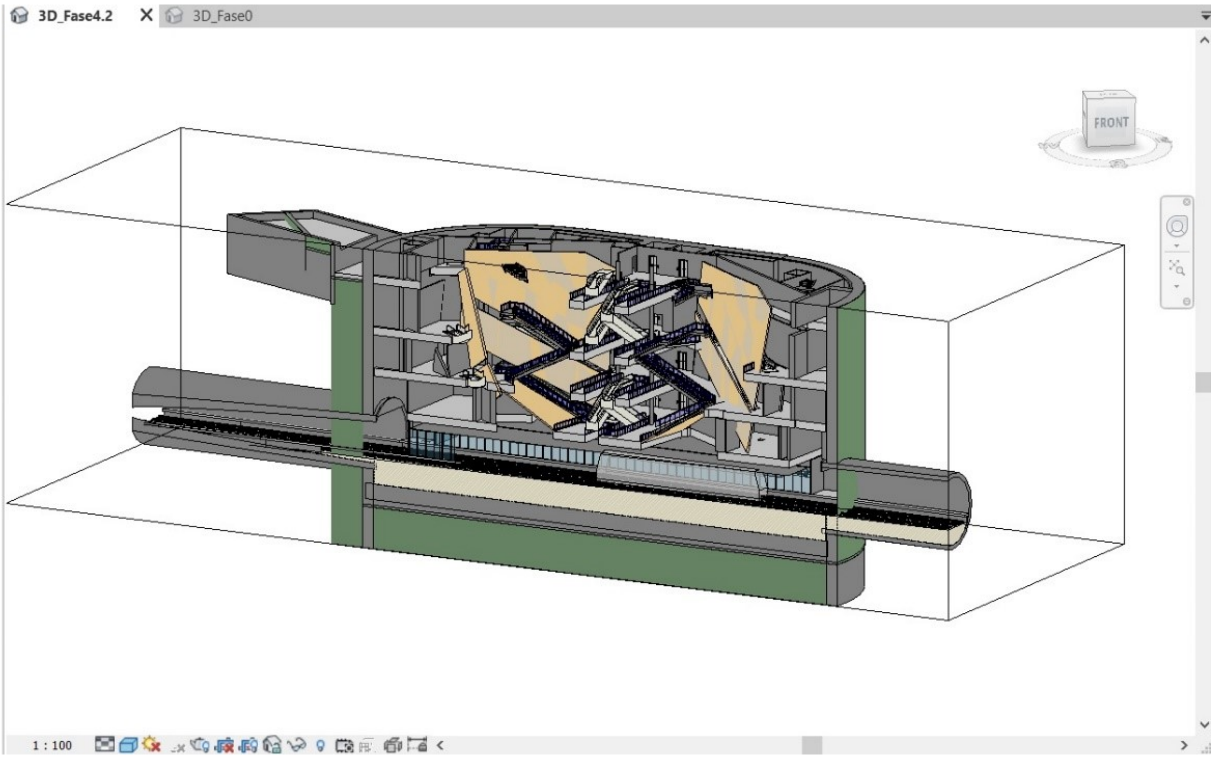


Figure 8: Inside look of Structure

The project is planned with phases, so the modelling is following these phases with the code and definitions.

Fase 0	State of fact
Fase 1.1	Preparations and pumping test
Fase 1.2	Excavation fund injections
Fase 1.3_1.6	Diaphragms
Fase 1.7	Crane installation and first excavation (up to SC1)
Fase 1.8	First strut order and second excavation arrangement (up to SC2)

Fase 1.9	RdC Level (S0) and S1 Level Carpentry, Armor and Cast Insole
Fase 1.11	(up to SC3 level)
Fase 1.12	Carpentery, armour and jet slab S2
Fase 1.13	Excavation (up to SC4 level)
Fase 1.14	Carpentery, armour and jet slab S3
Fase 1.15	Excavation (up to SC5 level)
Fase 1.17	Partial S4-level slab and second order struts provider
Fase 1.18	Excavation (up to SC6 level)
Fase 1.19	Third order of struts
Fase 1.20	Excavation (up to SC7 level)
Fase 2.1	Phase 2 shipyard
Fase 2.2	Realization of excavation bottom
Fase 2.3	Rods
Fase 2.4_2.5	West Structure Diaphragms
Fase 2.6	TBM Lock
Fase 2.8	TBM Step
Fase 3.2.1	Completion of structural infrastructure works
Fase 3.2.2	Non-structural sails
Fase 3.3.1	North Structure
Fase 3.3.2	West Structure
Fase 3.4	Connecting with the PaSo SNCD
Fase 4.1	Conclusion of structural works and beginning of minor works
Fase 4.2	Prosecution of minor works
Fase 4.3	External accommodations
Fase 5	Finishing
Fase 6	Final plants

Table 3 Project Phases

2.2 Phase 5 (Finishing)

The project is planned with phases, so the modelling is following these phases with the code and definitions. As a part of the thesis one missing phase is modelled in Revit. This phase is one of the last phase, the code is “phase 5” and definition is “finishing”. So finishing of the floor and internal walls are modelled in Revit. This phase is related to the architectural part of the model so the host model is architectural model with structural model linked into it.

Fase 0	State of fact
Fase 1.1	Preparations and pumping test
Fase 1.2	Excavation fund injections
Fase 1.3_1.6	Diaphragms
Fase 1.7	Crane installation and first excavation (up to SC1)
Fase 1.8	First strut order and second excavation arrangement (up to SC2)
Fase 1.9	RdC Level (S0) and S1 Level Carpentry, Armor and Cast Insole
Fase 1.11	(up to SC3 level)
Fase 1.12	Carpentery, armour and jet slab S2
Fase 1.13	Excavation (up to SC4 level)
Fase 1.14	Carpentery, Armor and jet slab S3
Fase 1.15	Excavation (up to SC5 level)
Fase 1.17	Partial S4-level slab and second order struts provider
Fase 1.18	Excavation (up to SC6 level)
Fase 1.19	Third order of struts
Fase 1.20	Excavation (up to SC7 level)
Fase 2.1	Phase 2 shipyard
Fase 2.2	Realization of excavation bottom
Fase 2.3	Rods
Fase 2.4_2.5	West Structure Diaphragms
Fase 2.6	TBM Lock
Fase 2.8	TBM Step

Fase 3.2.1	Completion of structural infrastructure works
Fase 3.2.2	Non-structural sails
Fase 3.3.1	North Structure
Fase 3.3.2	West Structure
Fase 3.4	Connecting with the PaSo SNCD
Fase 4.1	Conclusion of structural works and beginning of minor works
Fase 4.2	Prosecution of minor works
Fase 4.3	External accommodations
Fase 5	Finishing
Fase 6	Final plants

Table 4 Project Phases

These finishing contains floor finishing and internal walls. To model these the CAD files are used which are given by the company. Two families are created, one for walls and one for finishing.

Walls properties:

- System family : Basic Wall
- Type/Name: SEB_ARCH_Butress_Partition_200mm
- Thickness: 200mm

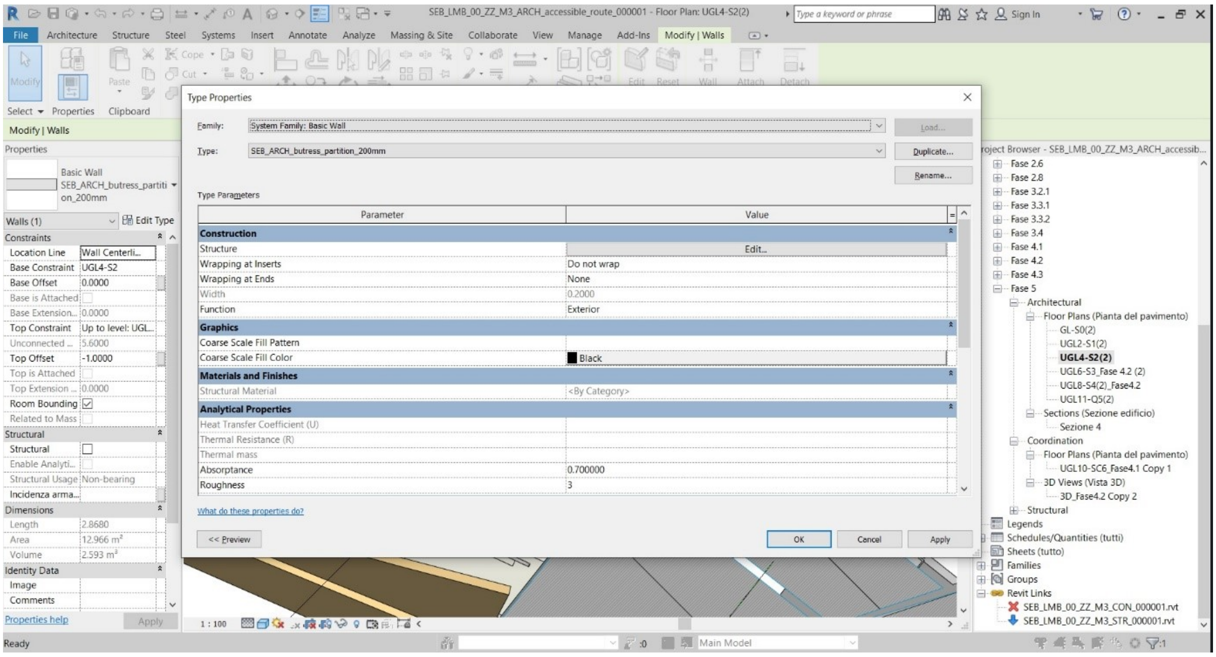


Figure 9: Type Properties

Finishing properties:

- System Family: Floor
- Type/Name: SEB_ARCH_Finishing_250mm
- Function: Interior

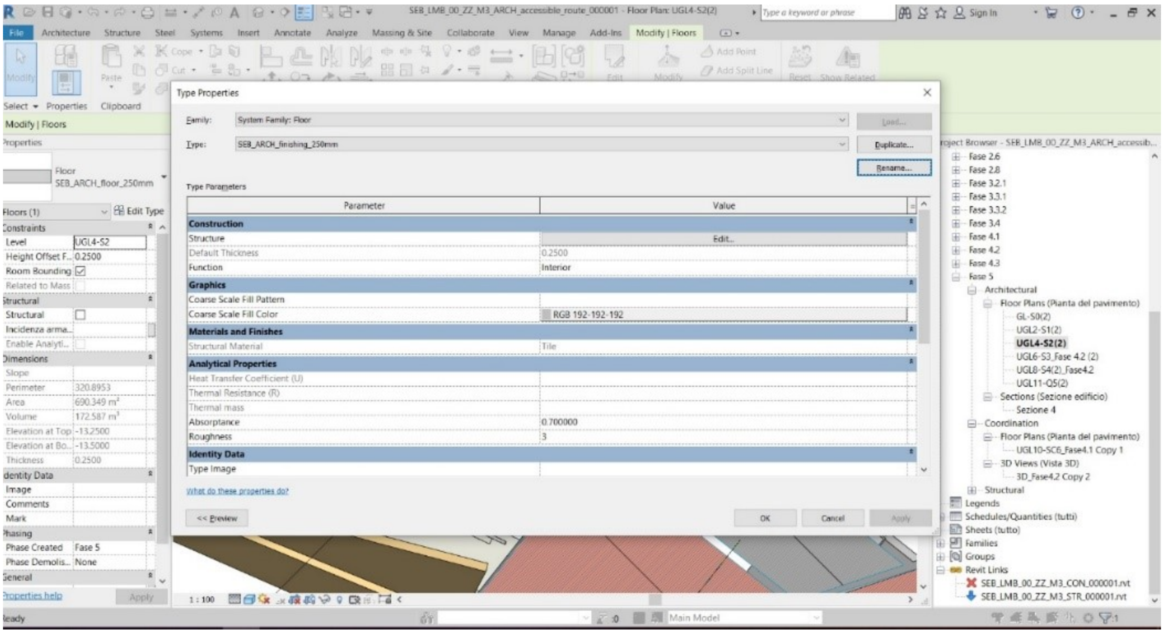


Figure 10: Finishing Properties

The material for the floor finishing are unique and there is no default material for this job in the Revit library. So it had to be create a unique material type. Name is “Tile”. To be able to do this it is clicked on edit type and then choose Structure “edit”. The chosen function is “finish 1”.

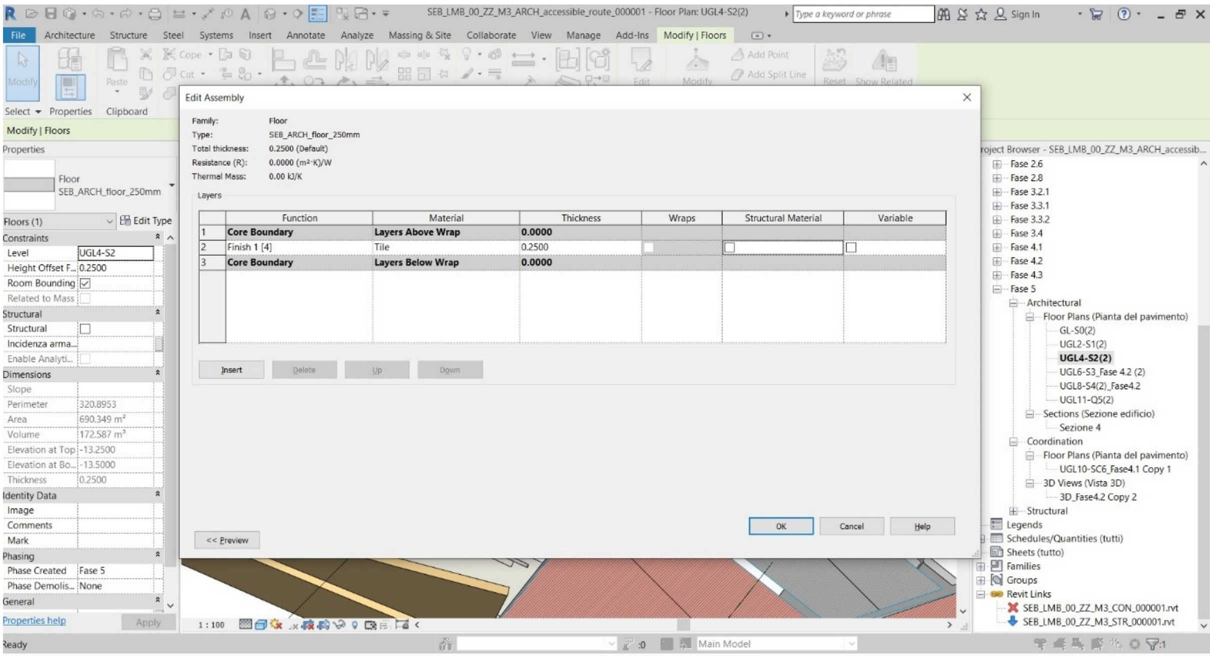


Figure 11 Finishing Material Properties

And then it is clicked on material to create our own material type. Here it can be given description, class, keywords also manufacturer, model, cost, URL information. On graphics and appearance sections, the visuals of the material can be configured.

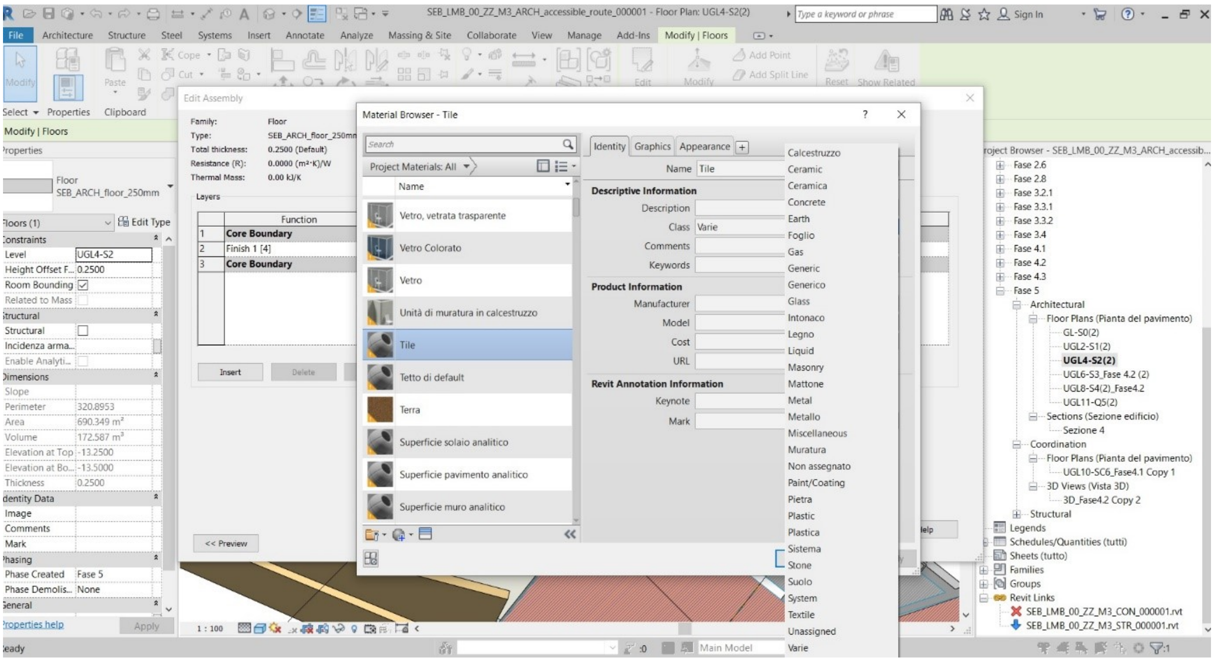


Figure 12 Material Browser

3. Methodology

3.1 Naming the Components

When it comes to Revit families, it is either used out-of-the-box content, which is online content or manufacturer site, or it is created uniquely. In any case, to be able to identify the component about where it came from or to easily locate in the browser, naming process has a major importance.

Naming order should be clear and easy to understand. In the project, naming template must be prefixed. So, any participants of the project and the model can easily understand and determine the families.

In the model the generic naming is:

XXX_YYY_ZZZ_TTT

- X part= Name of the project

- Y part= Type of model (architectural, structural etc.)
- Z part= Function of the family
- T part= Dimensions (thickness etc.)

An example for naming is “SEB_ARCH_Floor_250mm”

The operation

To be able to give name to the families, because of it is already modelled, it is clicked on one family type and click “Edit Type” from browser. Then “Rename” in the “Type Properties” section is chosen and the name is given according to its properties. Once it is federated model, the settings of the type cannot be configured which is belong to another model, for example; structural components cannot be changed if the host model is architectural.

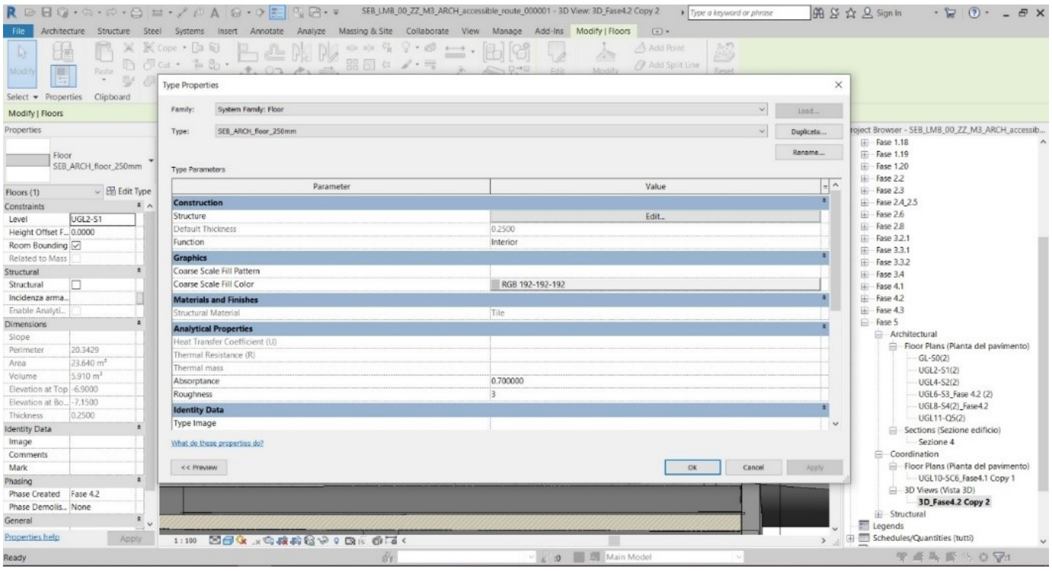


Figure 13 Type Properties

Components that are given names in the architectural model are:

- Architectural floors,
- Doors,
- Stairs,
- Finishing,
- Escalators,
- Windows,
- Architectural walls,
- Partition walls.

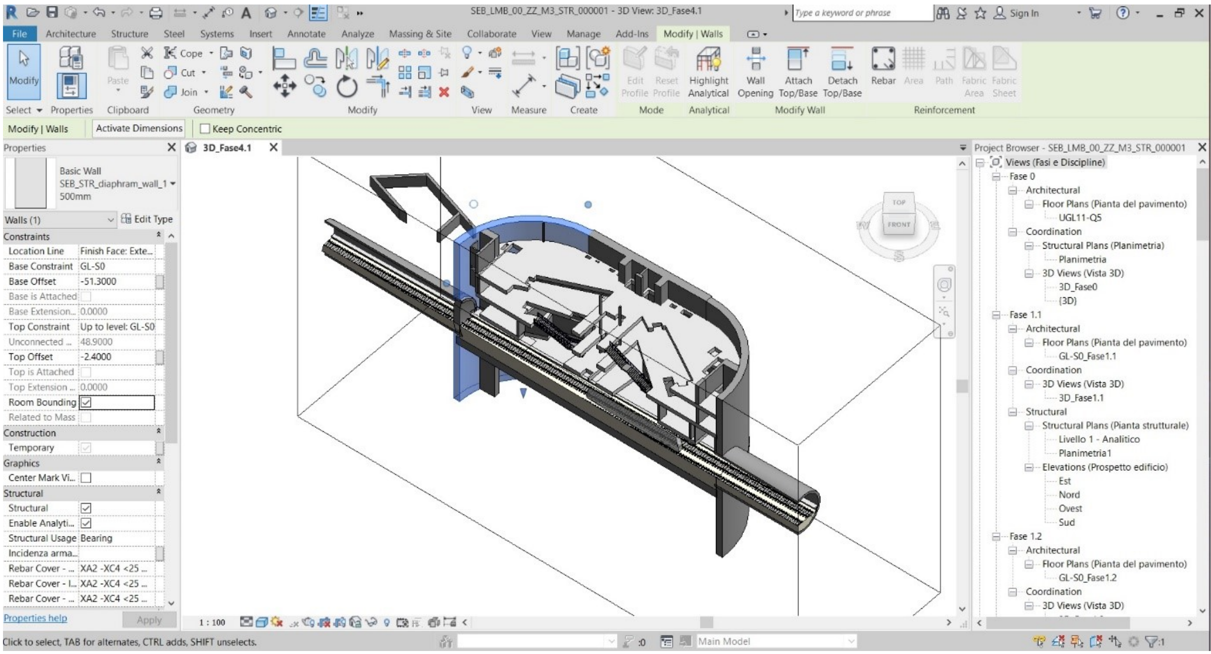


Figure 14 Structural naming Example

Components that are given names in the structural model are:

- Diaphragm walls,
- Columns,
- Structural floor,
- Railings,
- Roof,
- Structural walls.

3.2 Rooms (Space Naming)

According to Revit software room description is;

“A room is a subdivision of space within a building model, based on elements such as walls, floors, roofs, and ceilings.

These elements are defined as room-bounding. Revit refers to these room-bounding elements when computing the perimeter, area, and volume of a room.

You can turn on/off the Room Bounding parameter of many elements. You can also use room separation lines to further subdivide space where no room-bounding elements exist. When you add, move, or delete room-bounding elements, the room’s dimensions update automatically.” (Autodesk, 2019)

As a part of the modelling we should define the rooms according to the specifications given by the company. These names refer to the usage of the space and also another checking criteria as the dimensions of the room. By giving name the spaces are distinguishable easily in the other softwares as well. Later in the model checking by using Solibri Model Checker, the usage of these names will be high level.

Normally Revit uses walls as the boundaries of rooms. But federated model is used so Structural is not usable when the host model is Architectural. So an error occurs as “Room Not Enclosed”. To solve this problem the “Room Separator” tool in Revit is used. This tool is used to set boundaries for rooms. Then the names are given.

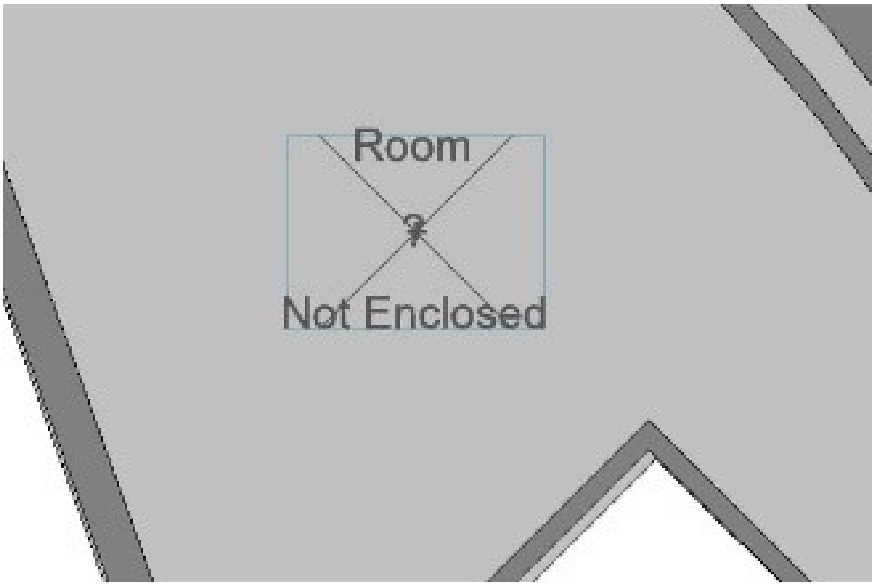


Figure 15 Room Error

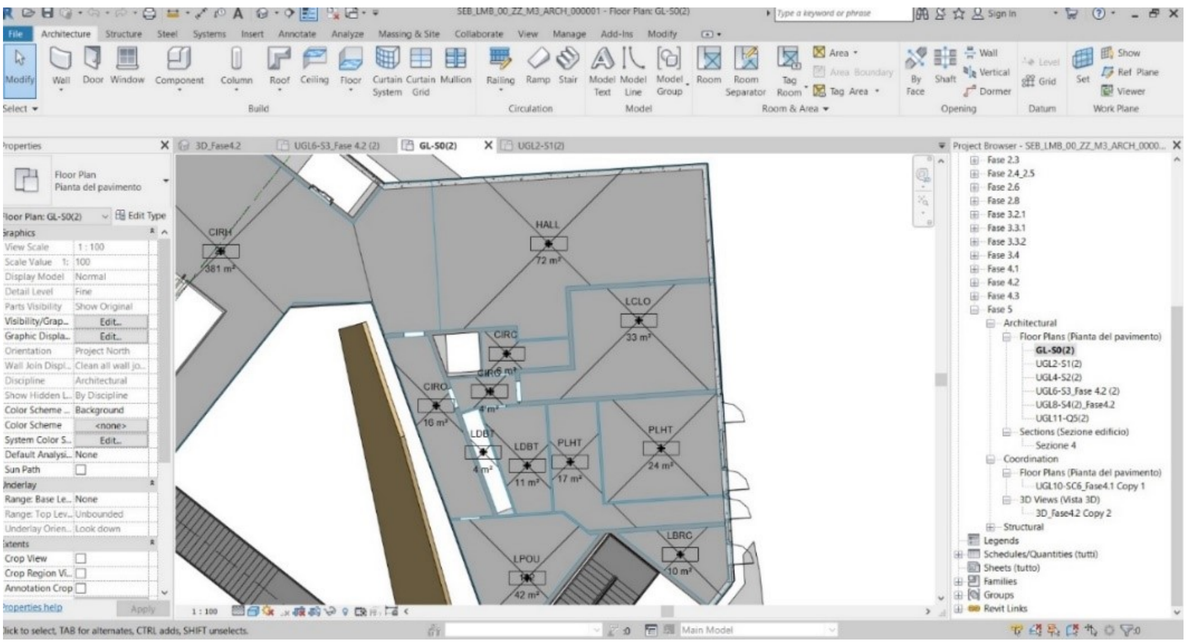


Figure 16 Rooms

3.3 Classifications

Classifying the information in BIM models refers to the components and the actions are structuring according to the agreed way, by this way all the participants can find and distinguish easily what they need and also understand and describe it in the mass of information data.

The classifications are getting more and more essential as the models and projects are getting more and more complex and also international. The names of the components vary according to the designers language but classification is not depending on the language but mostly on number, which make it more universal. By this way, generated huge datas by automated processes are more easy operable.

Different type of the classifications are developed by BIM actors and use. Some of them are; Uniclass, Omniclass, MasterFormat, UniFormat, Industry Foundation Classes (IFC) etc.

CSI Uniformat

Uniformat is standard method to classify and organize information of a construction project. It takes function of the element as the priority. The material is not a rule for the classification.

"UniFormat™, a publication of CSI and CSC, is a method of arranging construction information based on functional elements, or parts of a facility characterized by their functions, without regard to the materials and methods used to accomplish them. These elements are often referred to as systems or assemblies." (CSI, 2010)

The UniFormat has 9 major categories separated by their special functions. These are:

A Substructure

B Shell

C Interiors

D Services

E Equipment and Furnishings

F Special Construction and Demolition

G Building Sitework

Z General

There are 5 Levels of classification system. Level 1 is main. Level 2 is subcategory of level 1. Level 3 and 4 are developed by further subdividing level 2 classes. Level 5 does not have a specific regulation of use. The example of the structure is below:

A	Substructure	Level 1
A10	Foundations	Level 2
A1010	Standard Foundations	Level 3
A1010.10	Wall Foundations	Level 4
A1010.10.CF	Continuous Footings	Level 5

The datas, that are used, in this project are more about the giving codes to the components and these components and their codes are:

B1010.10	Floor Structural Frame
B1020.10	Roof Structural Frame
B1080	Stairs
B2010	Exterior Walls
C1010	Interior Partitions
C1030	Interior Doors
C1090.10	Interior Railings and Handrails
C2030.20	Tile Flooring
D1010.30	Escalators
D1010.10	Elevators

3.4 Parameters

3.4.1 Shared parameters

"Shared parameters are parameter definitions that can be used in multiple families or projects.

Shared parameters are definitions of parameters that you can add to families or projects. Shared parameter definitions are stored in a file independent of any family file or Revit project; this allows you to access the file from different families or projects. The shared parameter is a definition *of a container for information that can be used in multiple families or projects. The* information *defined in one family or project using the shared parameter is not automatically applied to another family or project using the same shared parameter.*

In order for information in a parameter to be used in a tag, it must be a shared parameter. Shared parameters are also useful when you want to create a schedule that displays various family categories; without a shared parameter, you cannot do this. If you create a shared parameter and add it to the desired family categories, you can then create a schedule with these categories. This is called creating a multi-category schedule in Revit." (Autodesk, 2015)

The operation to create shared parameters, in the Revit model “shared parameters” section is clicked on in the “manage”. Then, a new window will pop up, named “edit shared parameters”. First a shared parameter file has to be created. It is a text file that can be configured. And location of the file can be freely chosen the. It must be in a certain folder in the right phase of the modelling, because it is needed to be found anytime wanted.

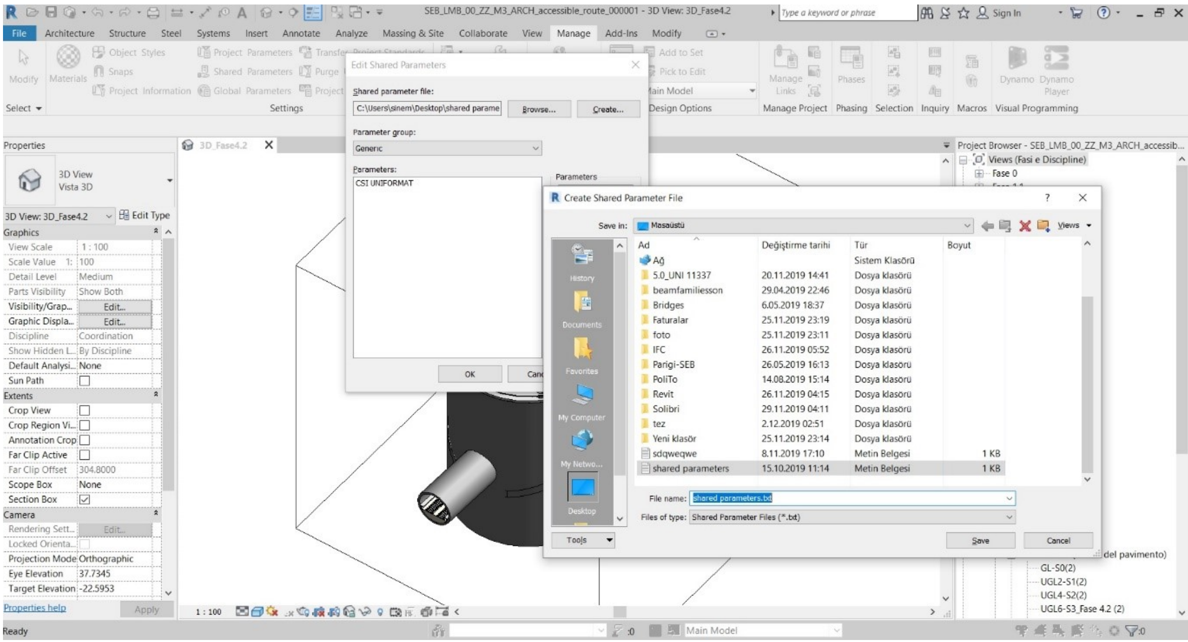


Figure 17 Shared Parameter Creating Browser

To add parameters, from the parameter group box, “New” section is selected. In the Parameter Properties dialog, the name “CSI UNIFORMAT” is entered and discipline is “common” and the Type of Parameter is “text”.

The other Disciplines, that can be chosen, are:

- Structural
- HVAC
- Electrical
- Piping
- Energy

The other Type of Parameters, that can be chosen, are:

- Text
- Integer
- Number

- Length
- Area
- Volume
- Angle
- Slope
- Currency
- URL
- Material. Allows you to select a material from the Materials dialog when you edit the parameter value in the Properties palette or Type Properties dialog.
- Yes/No. A check box appears for the parameter value in the Properties palette or Type Properties dialog.
- <Family Type>. If you select this option, the Select Category dialog opens where you can select the family type.

Then by clicking ok shared parameters are created that it can be use in all three models (structural, architectural and construction).

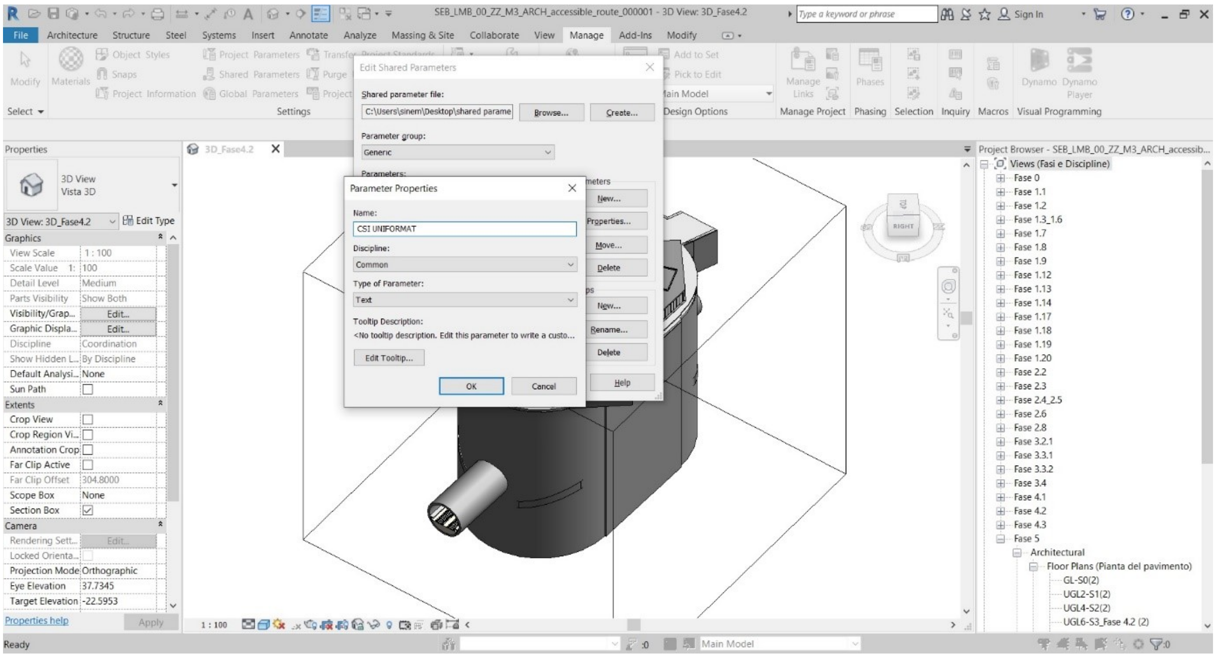


Figure 18 Parameter Properties

3.4.2 Project Parameters

In Revit, Project Parameters are defined as "Specifies the parameters that can be added to categories of elements in a project and can be used in schedules. Project parameters can not be shared with other projects or families."(Autodesk, 2019) By using shared parameters, project parameters are created.

The operation to create project parameters are starting with going to "manage" section in Revit model toolbar and click on project parameters. Here it can be "add", "modify" and "remove" project parameters. "Add" is chosen.

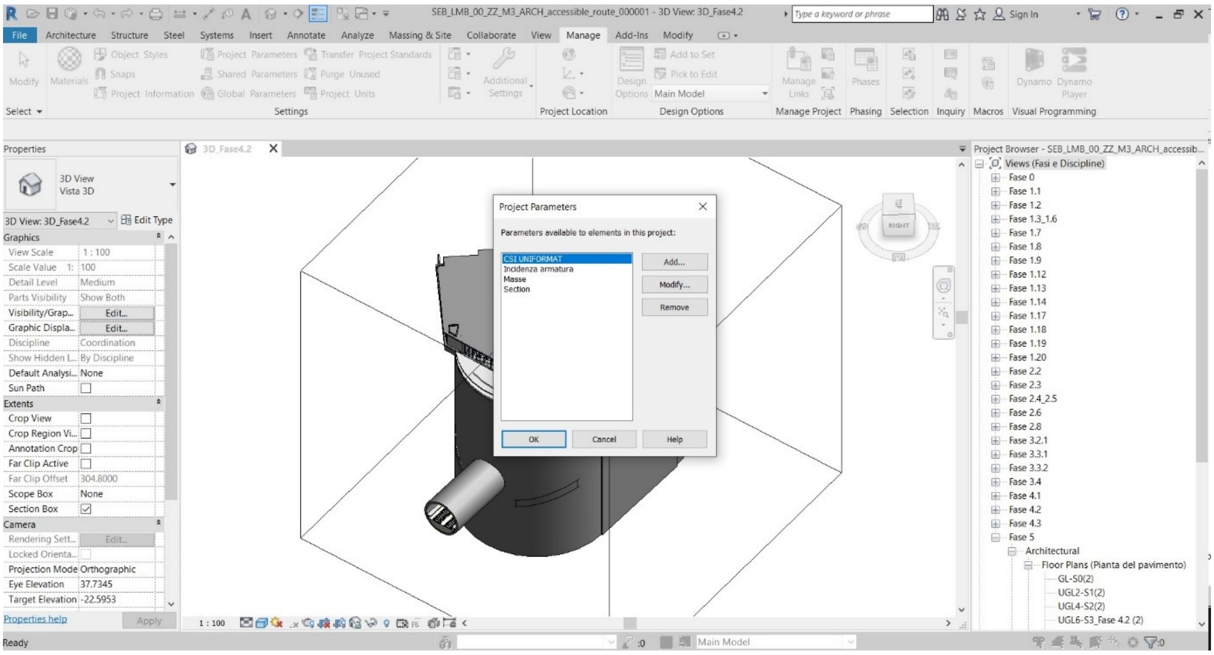


Figure 19 Project Parameters

In the new window that popped up after clicking "add" we have 2 options about "Parameter Type". First "project parameter" section allows to create and change parameter data. But in this situation "shared parameter" section is used and the shared parameter, that was created before, is chosen. (CSI UNIFORMAT)

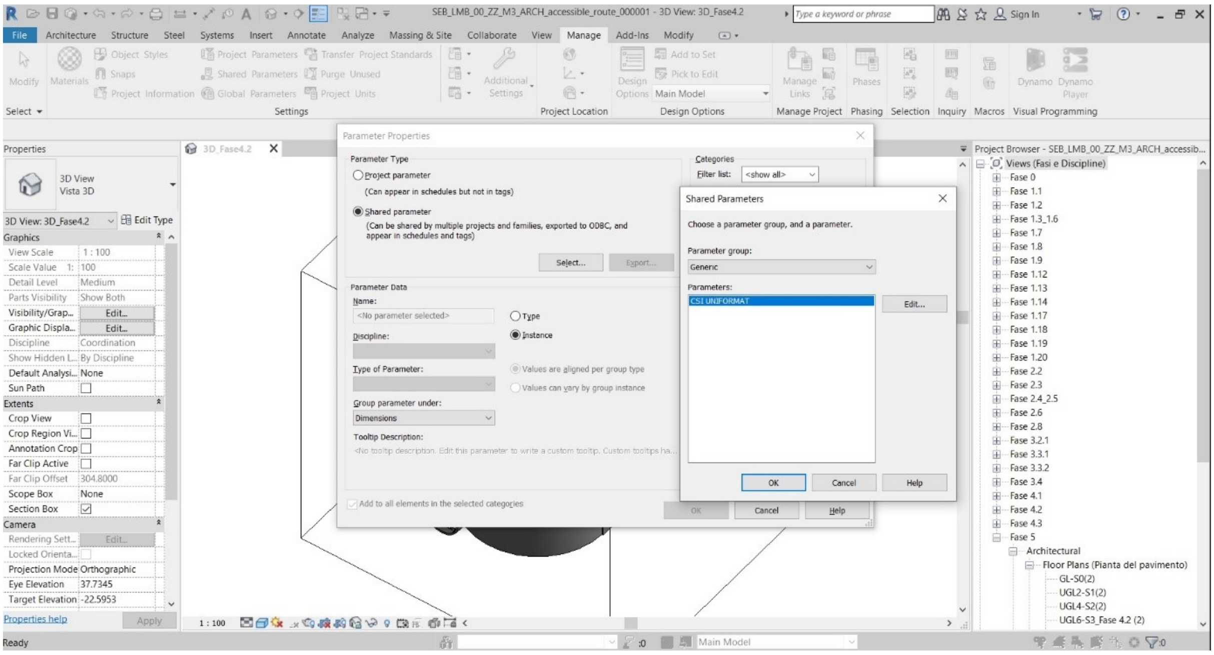


Figure 20 Creating Project Parameters

Then "data" is chosen that group parameter will be shown under this section.

Choose type for selection for components and by saying that in this type of components will have the same parameter. Then from categories, columns, walls, stairs, railings, doors, floors, roofs are chosen.

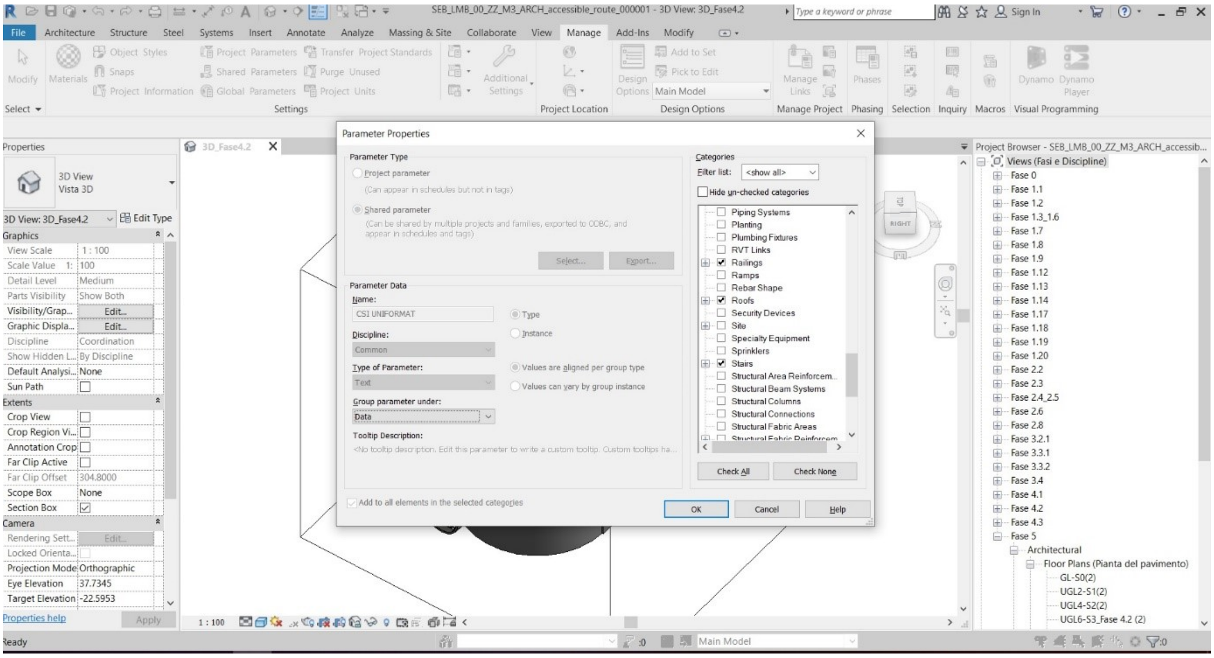


Figure 21 Project Parameter Properties

Then by choosing one of the families and click on edit type, type properties window is opened. In data section "CSI UNIFORMAT" parameter name can be seen and the parameter is configured by giving corresponding classification number to the family.

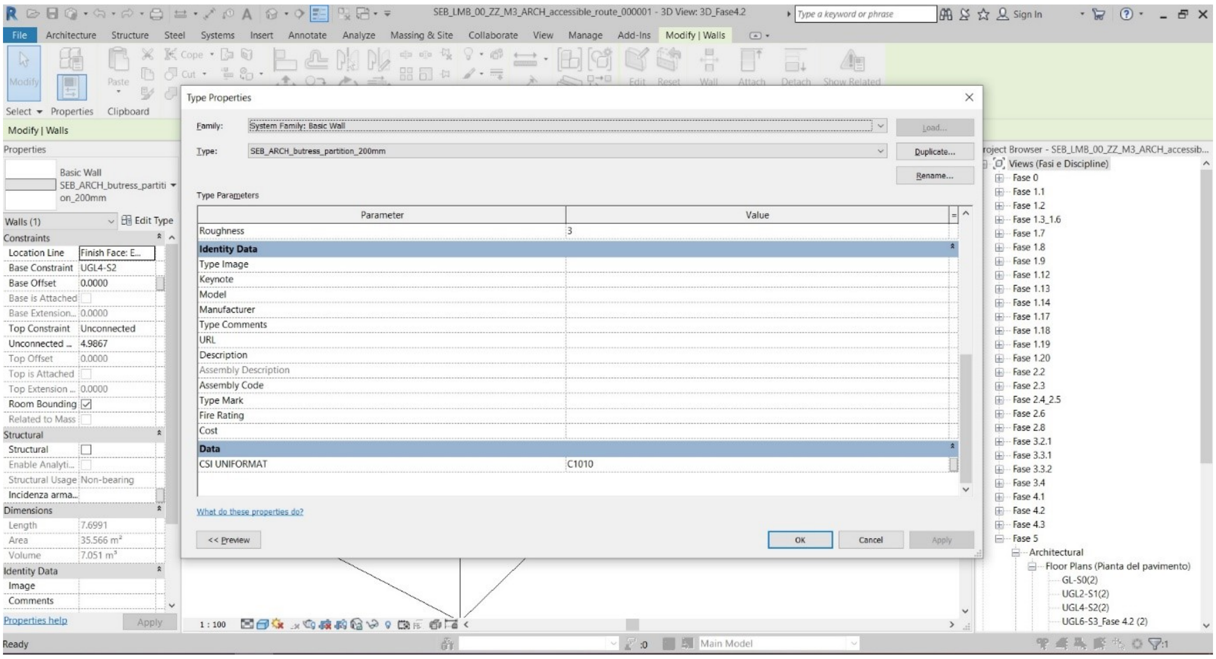


Figure 22 Project Property Example Shown in Type Properties

3.5 Coordination and Model Checking Protocol and Hyerarchy

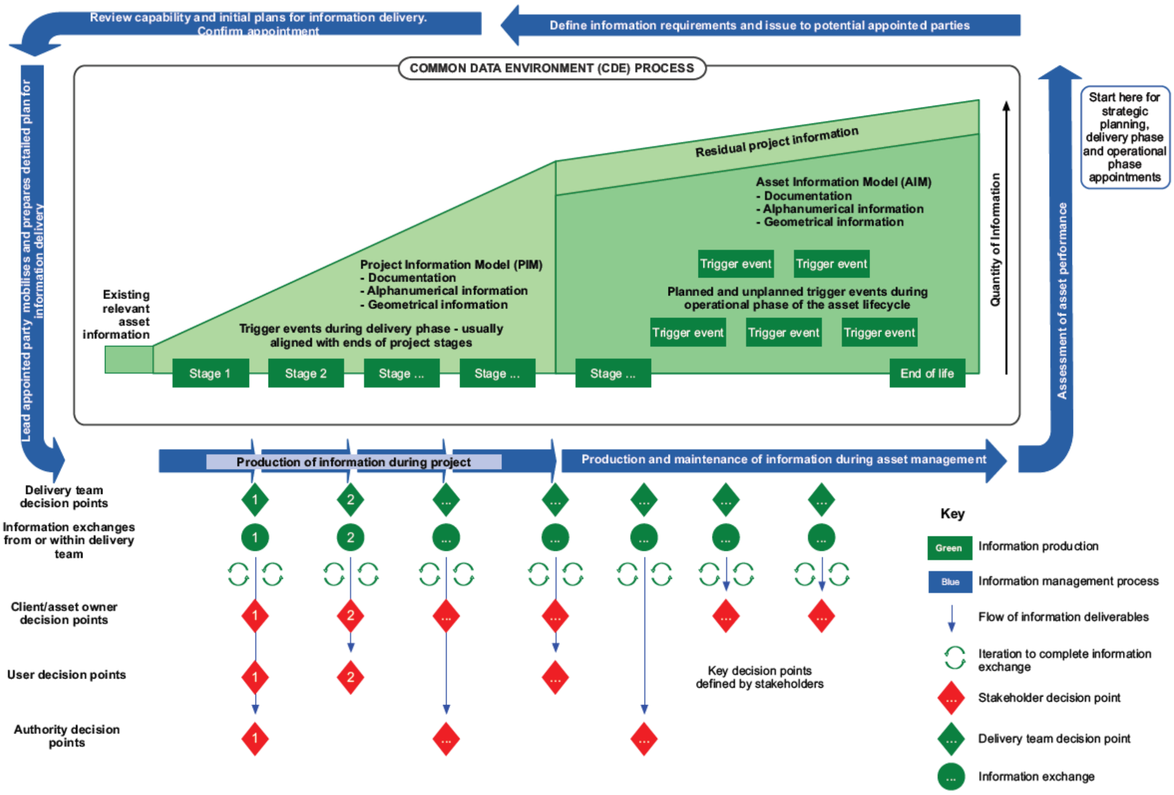


Figure 23 Information Management Process (ISO 19650)

This is the illustration of the information management process in BIM according to iso 19650. Information management process starts with a task given by appointment. This process, as see able in the illustration, contains preparation of requirements, review of appointed parties in relation to information management, detailed planning of how to deliver the information, and checking the information. Which are shown in the blue arrows:

- Define information requirements and issue to potential appointed parties
- Review capability and initial plans for information delivery-confirm appointment
- Lead appointed party mobilises and prepares detailed plan for information delivery
- Production of information during project
- Production and maintenance of information

If the older version of the standard is check, that is PAS 1192 it can be seen more specific points and definition of this cycle which may decrease adaptability of the process according to the project.

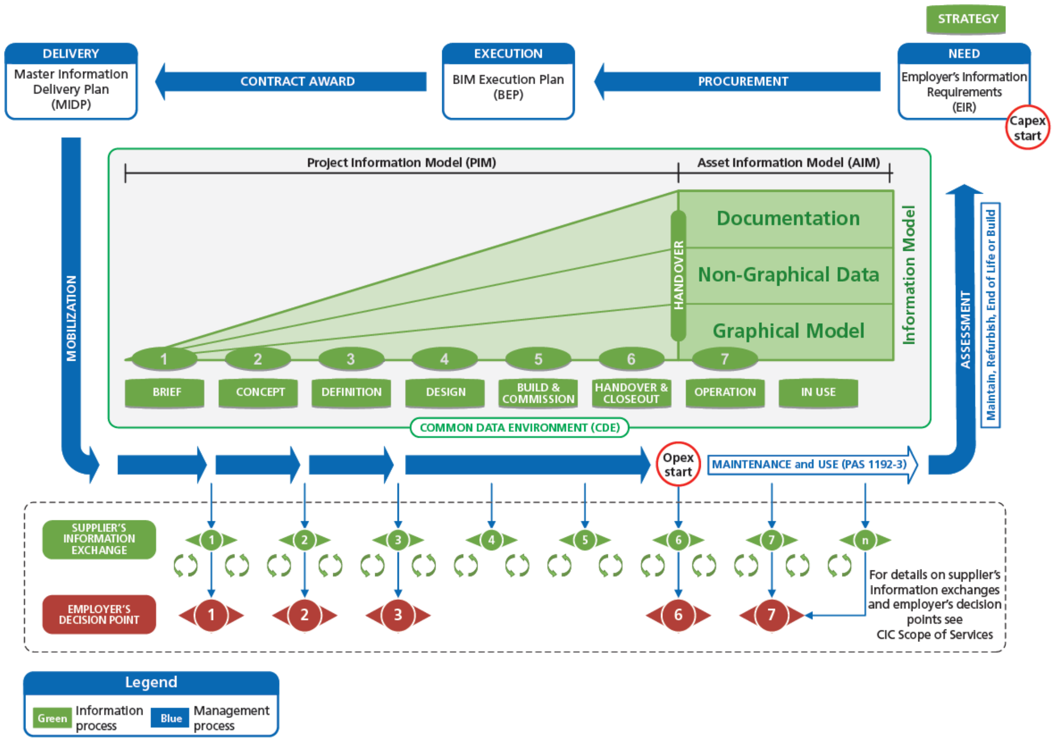


Figure 24 Information Management Process (PAS 1192)

During "production phase" of the cycle, as shown, there are checks(done by delivery team) and client/asset owner decision points.(both ISO 19650 and PAS 1192). Which shows that this phase of the information management cycle is highly interactive between parts of the project. Appointments have the key role in this phase, because information exchange is essential. In ISO 19650 it is shown how to do information exchange and make key decisions.

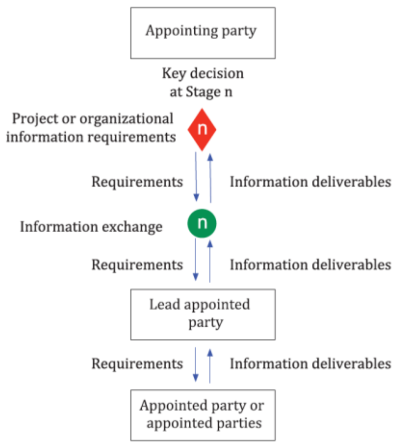


Figure 25 Information exchange and Key decision making (ISO 19650)

As shown in the figure the process is two way and it is not independent from other parts of the project. At the appointment there is information to be assessed and reviewed then there is a key decision must be taken by the appointing party according to the information. Decision is processed with the project or organizational information requirements and give as a task to lead appointed party, which delivers the requirements and information to appointed parties (it is called as "task teams"), production is made and then checks are made and information is delivered to the lead appointing party, which does its checks and bring information to the appointment to exchange. The summary of information delivery is illustrated in iso 19650;

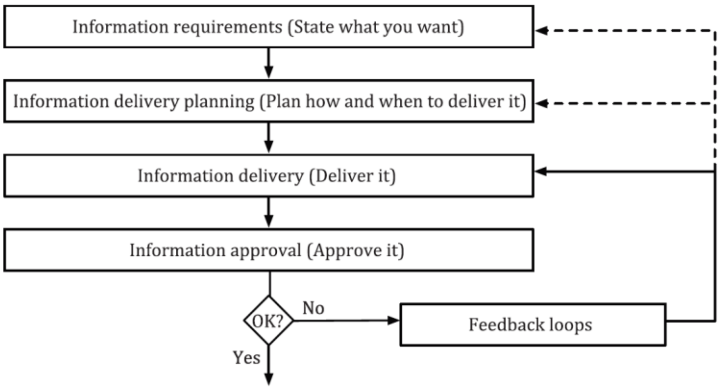


Figure 26 Information delivery process (ISO 19650)

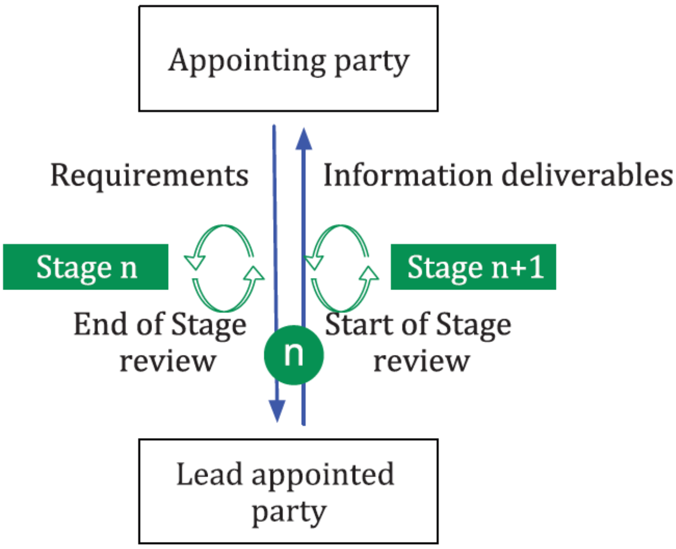
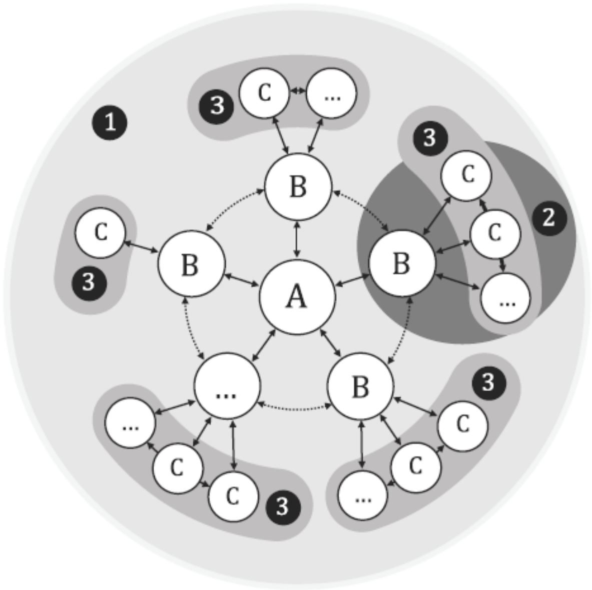


Figure 27 Information Delivery Process (ISO 19650)

In iso 19650 interfaces between parties and teams for the purpose of information management, which project is done by federated model, is explained in figure shown below;



Key
A appointing party
B lead appointed party
C appointed party
... variable amount
1 project team
2 illustration of a delivery team
3 task team(s)
↔ information requirements and information exchange
⇠⇢ information coordination

Figure 2528 Interfaces between parties (ISO 19650)

When it is applied to the current project the situation is; there are three task teams (appointed parties), which are architectural, structural and construction teams. In the hierarchy, they are led by design coordinator (lead appointed party). Design Information Coordinator (lead appointed party) shares information and receives requirements from employer (appointing party).

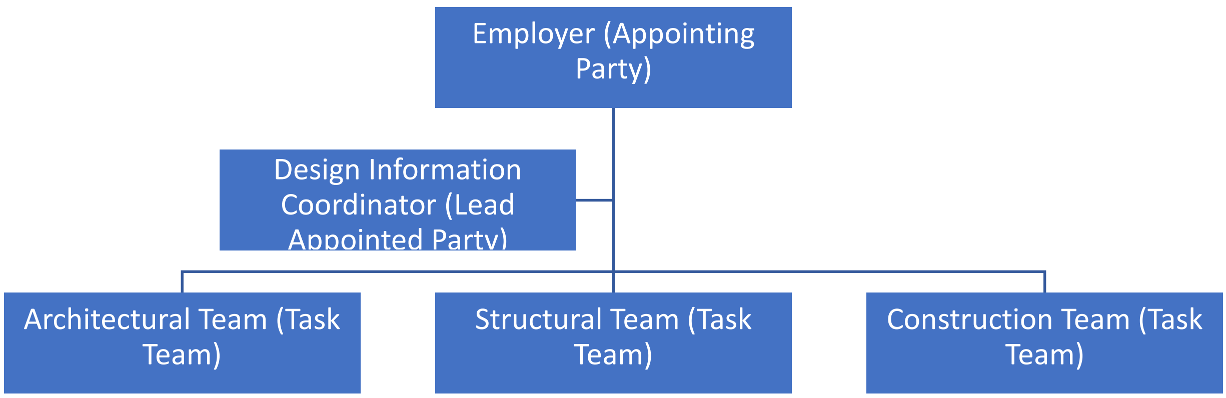


Figure 2629 Hyerarchy of parties (ISO 19650)

Status codes in the common data environment

There must be a already prepared and agreed on status codification for professional design development and coordination procedures. Status codes are provided by information originators to define how information may be used during different phases of the CDE. This helps all the participants to understand and express the status of the information by using codes.

Code (Status)	Description	Revision
	Work in Progress (WIP)	
S0	Initial Status	Preliminary revision and version
	Shared	
S1	Issued for coordination	Preliminary revision
S2	Suitable for information	Preliminary revision
S3	Suitable for review and comment	Preliminary revision
S4	Suitable for construction approval	Preliminary revision
S5	Withdrawn	
S6	Suitable for PIM authorization	Preliminary revision
S7	Suitable for AIM authorization	Preliminary revision
	Published (contractual)	
A1	Authorized and accepted	Contractual revision
B1	Partial sign-off	Preliminary revision
	Archived	
CR	As constructed record document	Contractual revision

Table 5 Status Codes

S0 is the status where task teams are working on the model according to the project requirements. Then it has to be checked and approved to reach “shared”. These checks are done by task teams, design information coordinator and accepted by employer. These checks are:

1. Checking model for stage completeness, dimensional accuracy and against modelling standards. (CODE CHECKING, done by Task Teams)
2. Check model suitability to S1 and set major revision. (Clash detection, done by Task teams and Design information coordinator)
3. Share clash rendition.
4. Check information exchange and documentation for stage completeness

5. Change information exchange and documentation suitability to S2 and set major revision
6. Approve all design deliverables to be shared for selected suitability

Each task team shall take ownership of their own WIP information and model(s) and check and review these with their task team leader before issuing the information and model(s) to the SHARED part of the CDE.
If a clash is detected which cannot be resolved by the task team interface manager then the design information coordinator shall be involved in the discussion to reach agreement and make the necessary changes to the models. To achieve spatial co-ordination when the software solutions of the individual teams are incapable of a reasonable level of interoperability then clash renditions shall be used. The clash renditions shall be made in the format of the viewing tool, which is Solibri Model Checker for this project, that has been chosen for the project. The clash rendition for each model for each discipline shall be issued to the SHARED area along with all other deliverables.

Design information coordinator shall undertake a review of the information model in accordance with the project’s information production methods and procedures.

In doing this, Design information coordinator shall consider:
— the deliverables listed in the master information delivery plan;
— Employer’s exchange information requirements;
— Design information coordinator’s exchange information requirements;
— the acceptance criteria for each information requirement; and
— the level of information need for each information requirement.

If the review is successful, Design information coordinator shall authorize the information model and instruct each task team to submit their information for Employer’s acceptance within the project’s common data environment.
If the review is unsuccessful, Design information coordinator shall reject the information model and instruct the task teams to amend the information and re-submit for lead appointed party authorization.
Partial acceptance of the information to be exchanged can lead to coordination issues, therefore it is recommended that Design Information Coordinator either authorizes or rejects the entire information model. It is illustrated the whole process below.

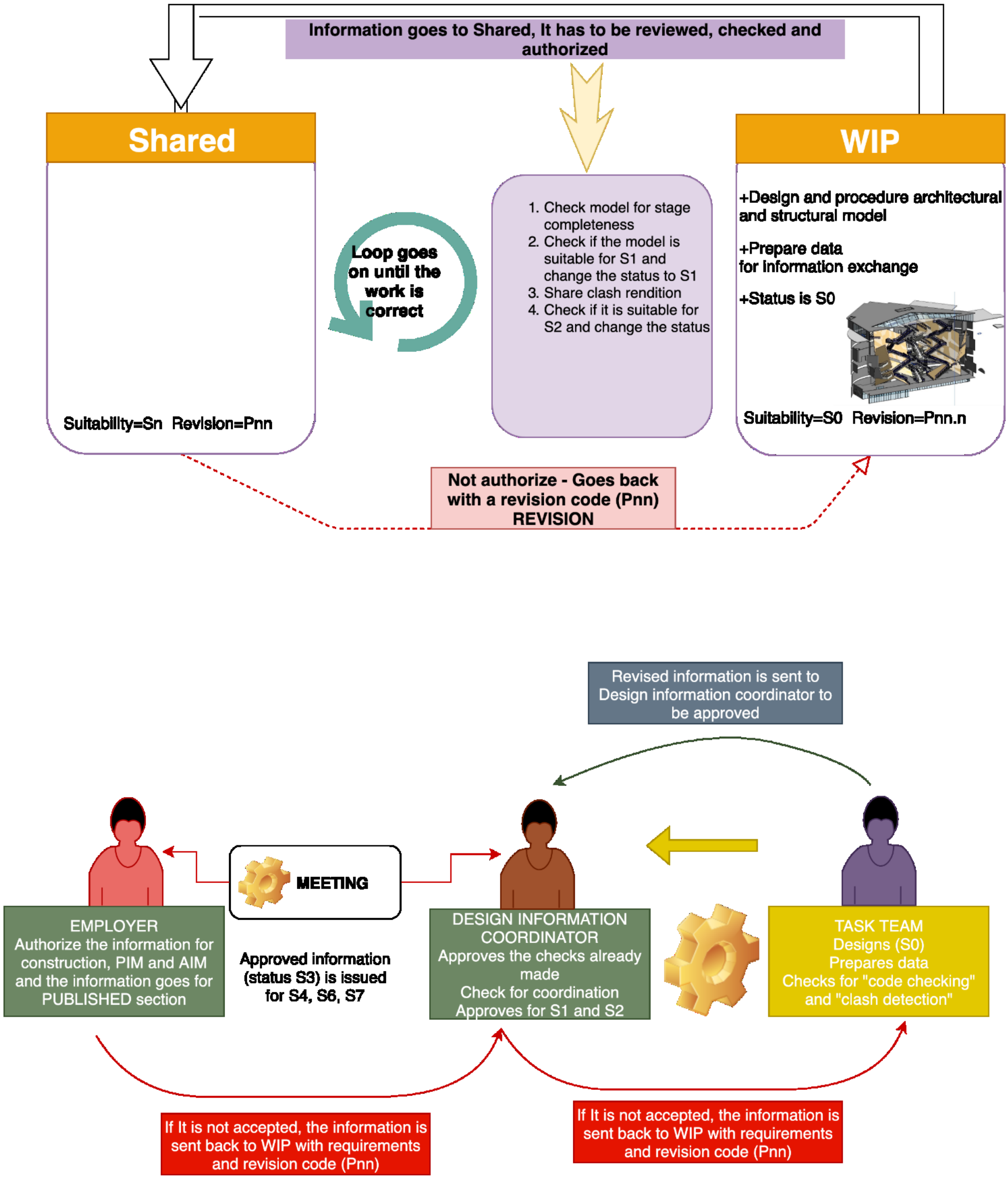


Figure 30 Workflow of the participants in common data environment in terms of model checking

4. Results

4.1 IFC Based Model Checking

In this thesis, to be able to operate the model checking, it is needed to be used a common format. Accessibility in Revit allows users to use IFC format. IFC format lets designer to export and share the file in common standards. By exporting models as IFC format, they can be uploaded to the other software. Solibri Model Checker is chosen to be used as model checking software. Between Revit and Solibri Model Checker, the interoperability is quite high.

According to Revit website IFC format has this description; "*The Industry Foundation Classes (IFC) file format is maintained by buildingSMART®. IFC provides an interoperability solution between different software applications. The format establishes international standards to import and export building objects and their properties.*

IFC improves communication, productivity, delivery time, and quality throughout the life cycle of a building. It reduces the loss of information during transmission from one application to another, with established standards for common objects in the building industry." (Autodesk, 2018)

The operation of exporting IFC file and Importing the model to Solibri Model Checker Software is starting with opening "File" section and clicking on "Export". "IFC format" can be seen, by clicking on it the window is seen about how to export file. The configurations that are used:

General

- File type : IFC
- Phase to export : Phase 5 (last phase we have created as last)
- Split walls, columns, ducts by level
- Include steel elements

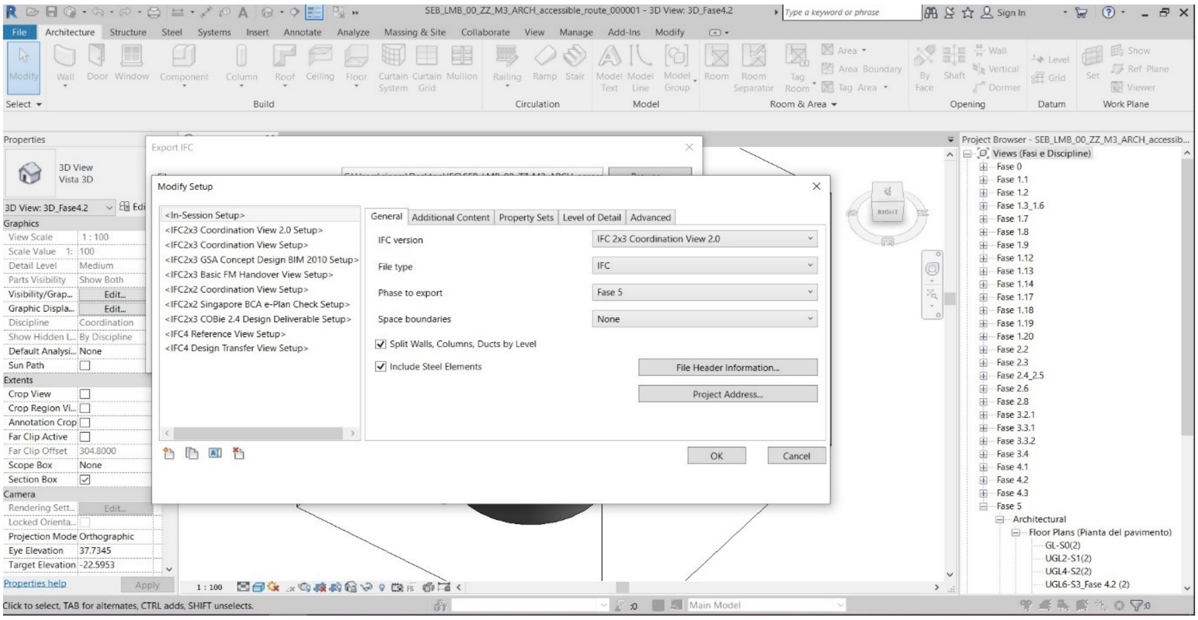


Figure 31 IFC Export-General

Additional Content

- Export 2D plan view elements

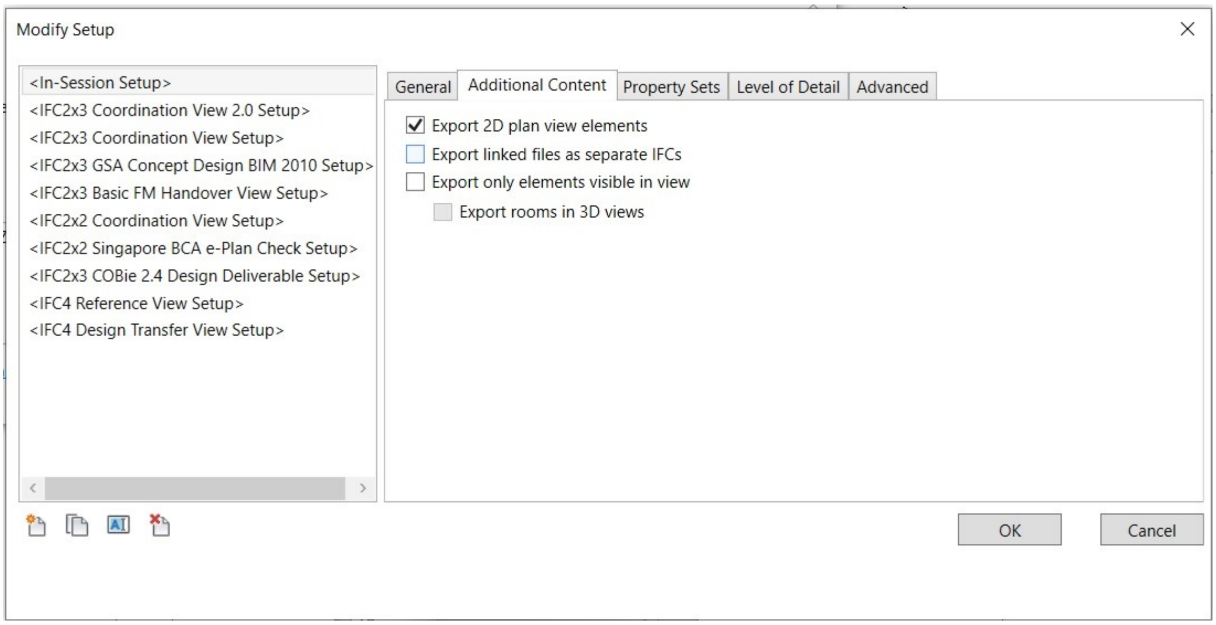


Figure 32 IFC Export-Additional Content

Property sets

- Export Revit property sets
- Export IFC common property sets
- Export base quantities

- Export schedules as property sets

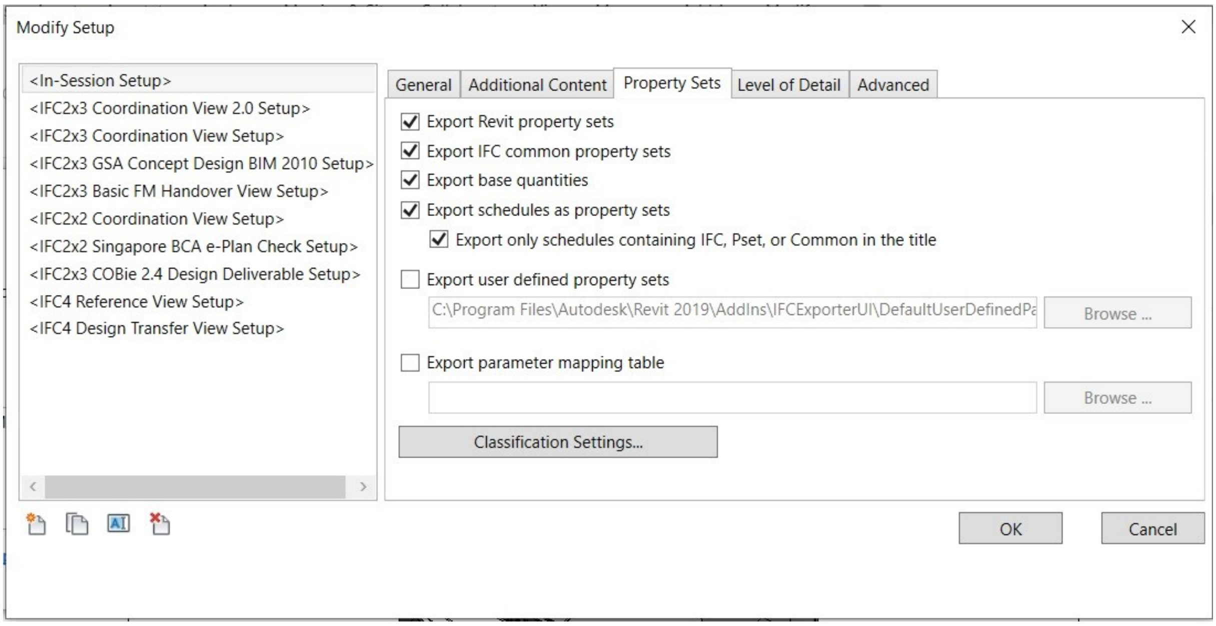


Figure 33 IFC Export-Property Sets

Level of Detail : High

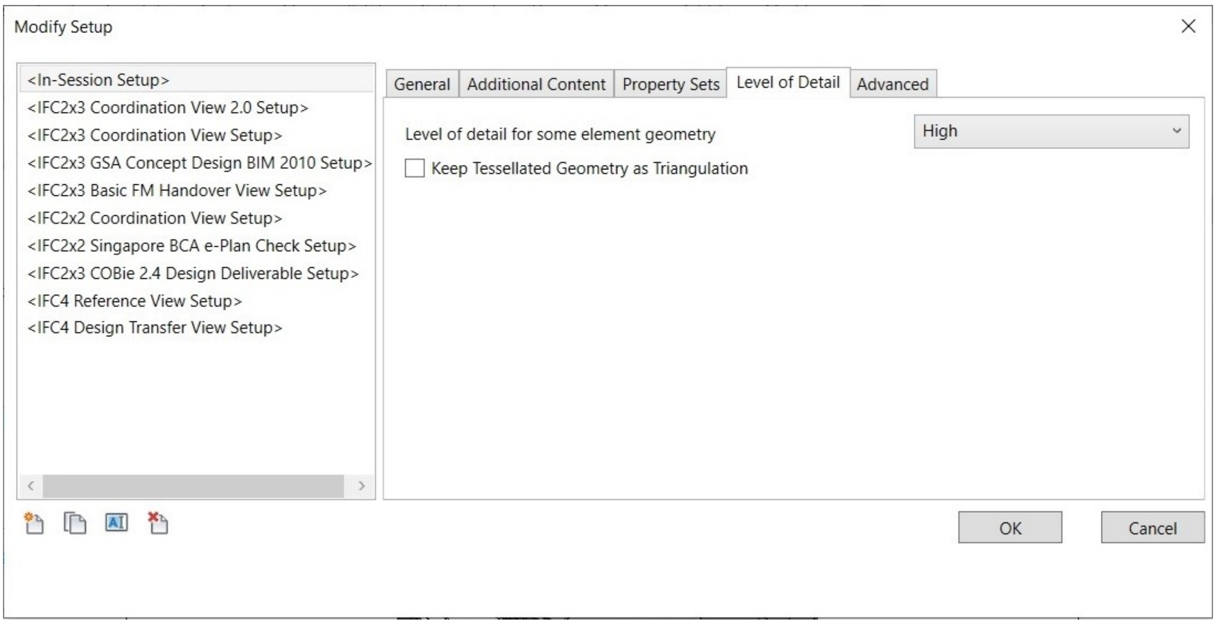


Figure 34 IFC Export-Level of Detail

Advanced:

- Allow use of mixed “Solid Model” representation
- Use family and type name for reference
- Use 2D room boundaries for room value

- Include IFCSITE elevation in the social local placement origin

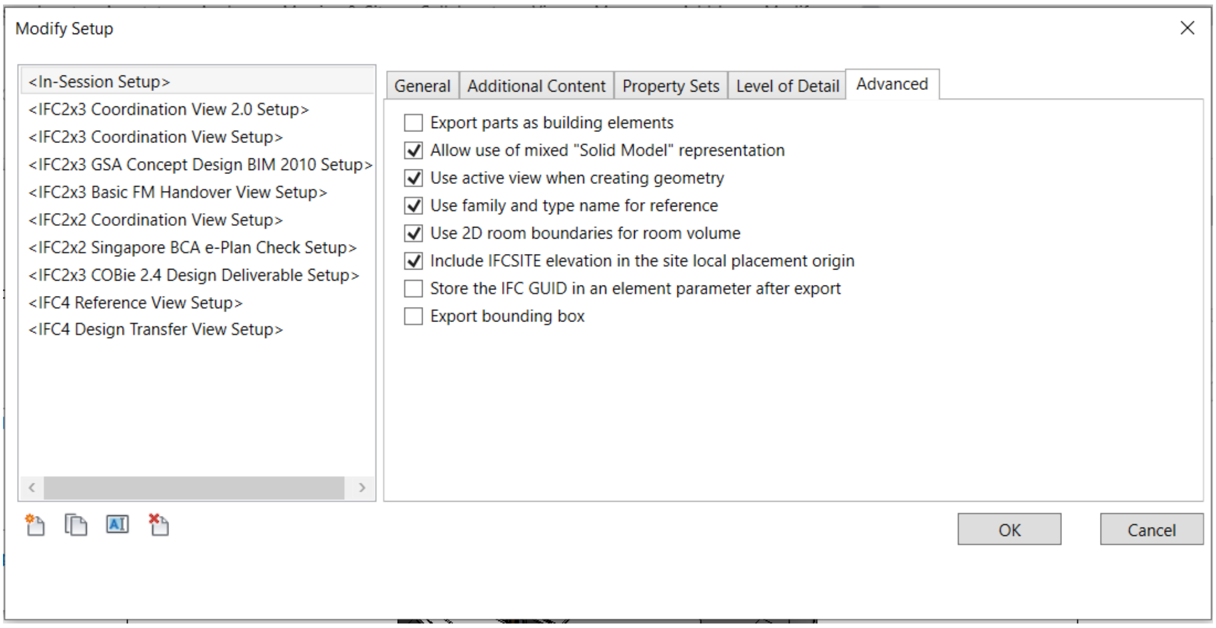


Figure 35 IFC Export--Advanced

To open the models in Solibri it is click on “Open Model” in “File” section in Solibri model checker and IFC file, that was created, is found.

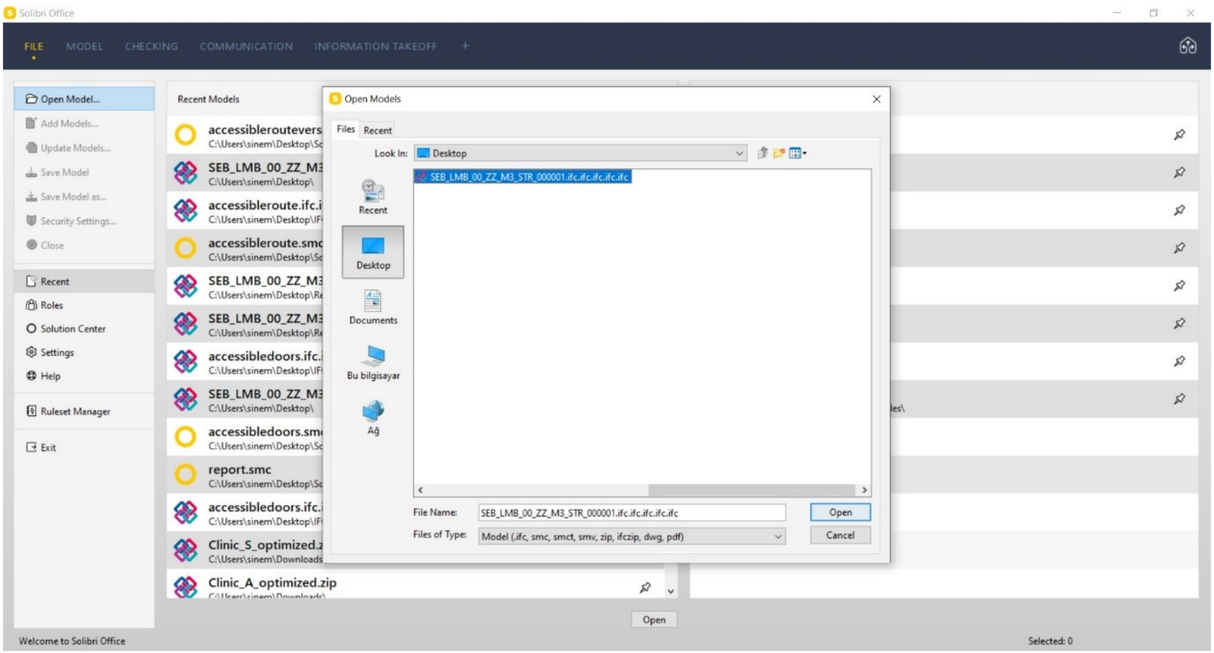


Figure 36 Solibri Import

And then type of the model has to be chosen. In this thesis' situation 2 models are uploaded, architectural and structural. It is merged automatically in the software.

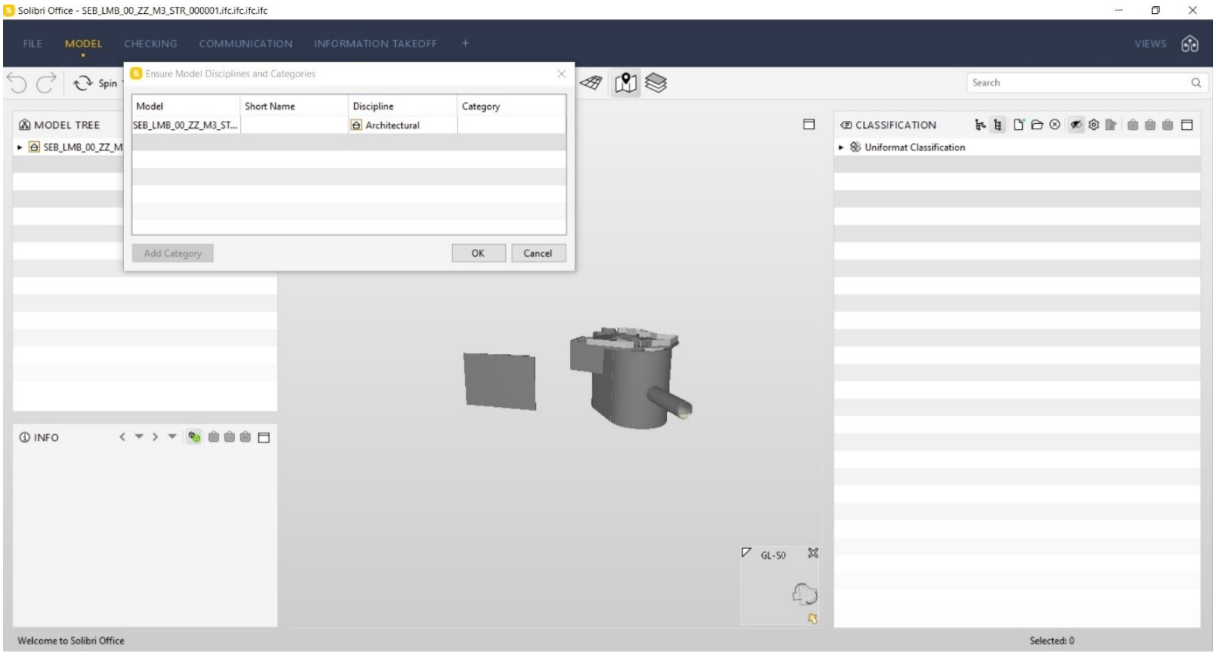


Figure 37 Solibri Import- Setting Discipline

4.2 Code Checking

4.2.1 Accessible Door Check

As a part of code checking, the stairs of the station is checked. The software, that is used is Solibri Model Checker. The guide for the requirements are taken from "Design Standards for Accessible Railway Stations-2015" (A joint code of practice by The Department of Transport and Transport Scotland) and British standards "Design of an accessible and inclusive built environment: BS 8300:2018" and European Standards PRM TSI:.

These requirements are used:

- Where thresholds are installed on a horizontal route, they shall contrast with the surrounding floor and shall not be higher than 25 mm. (PRM TSI: 4.2.1.2.1)
- Doors shall have a minimum clear useable width of 900 mm and shall be operable by a PRM. (PRM TSI: 4.2.1.3)
- Minimum 300 mm clear space between the line of the leading edge of the door (when closed) and the return wall (may be reduced if door is opened by remote automatic control) (BS 8300:2)

- The minimum space required for two wheelchair users to pass each other on an access route is 1 800 mm. (BS 8300:2)

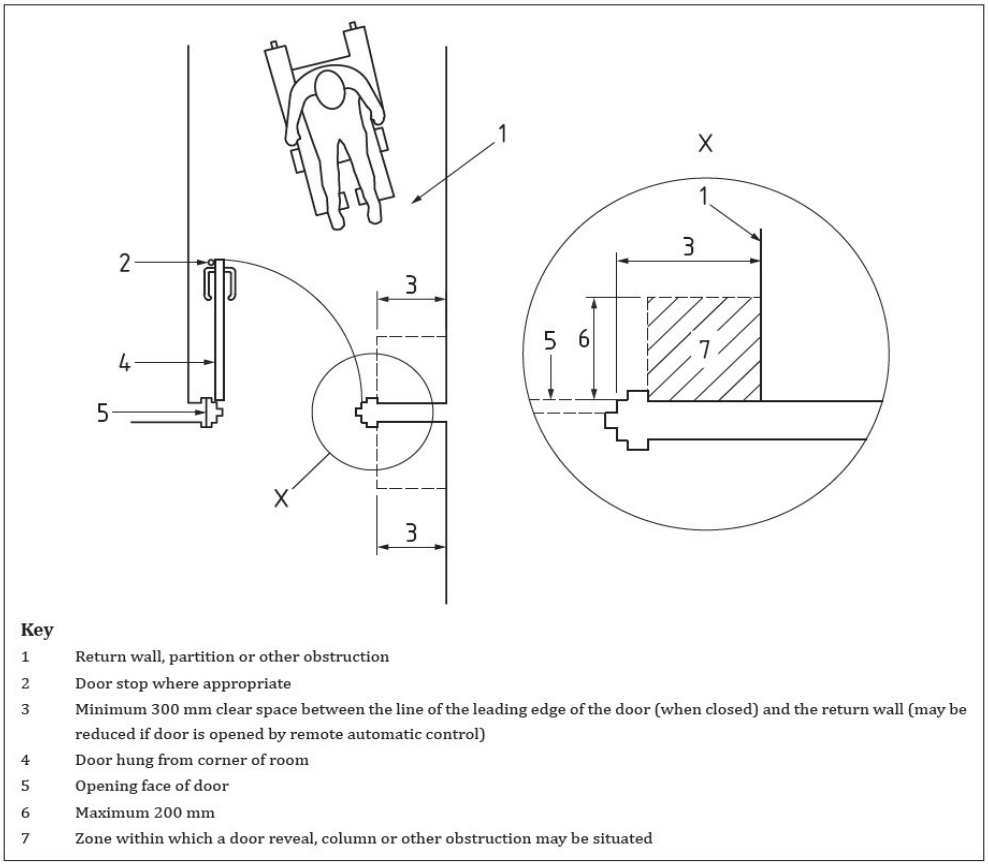


Figure 38 Accessible Door Rule (BS 8300)

The Operation

To work with Solibri Model Checker, a ruleset has to be created according to specific purpose. In Solibri new rules can be created by changing the parameters of existing default rules. To accomplish this, “**Ruleset Manager”** in “**FILE**” section is clicked. For the purpose, Solibri already has a template for “Accessible Door Rule” in the library. A new ruleset added to “**WORKSPACE**” to be able to work and configure rule.

According to Solibri Model Checker, “Accessible Door Rule” has this description;
This rule checks the accessibility of door from different perspectives. It checks the dimensions, glazing ratios, opening directions, and free spaces of the door. ***To use this rule the spaces you must classify spaces by usage****.*

Because of this statement “Classification” section has to be opened. The model is made unique and spaces have unique names. Normally Solibri can understand classification of the spaces and elements but in this model, spaces have names like LCVC, CIRC etc. To solve this problem the spaces have to be classified manually.

To achieve this; after uploading model, “MODEL” section is clicked. In this section it is clicked on the “VIEWS” and chosen “Classification”.

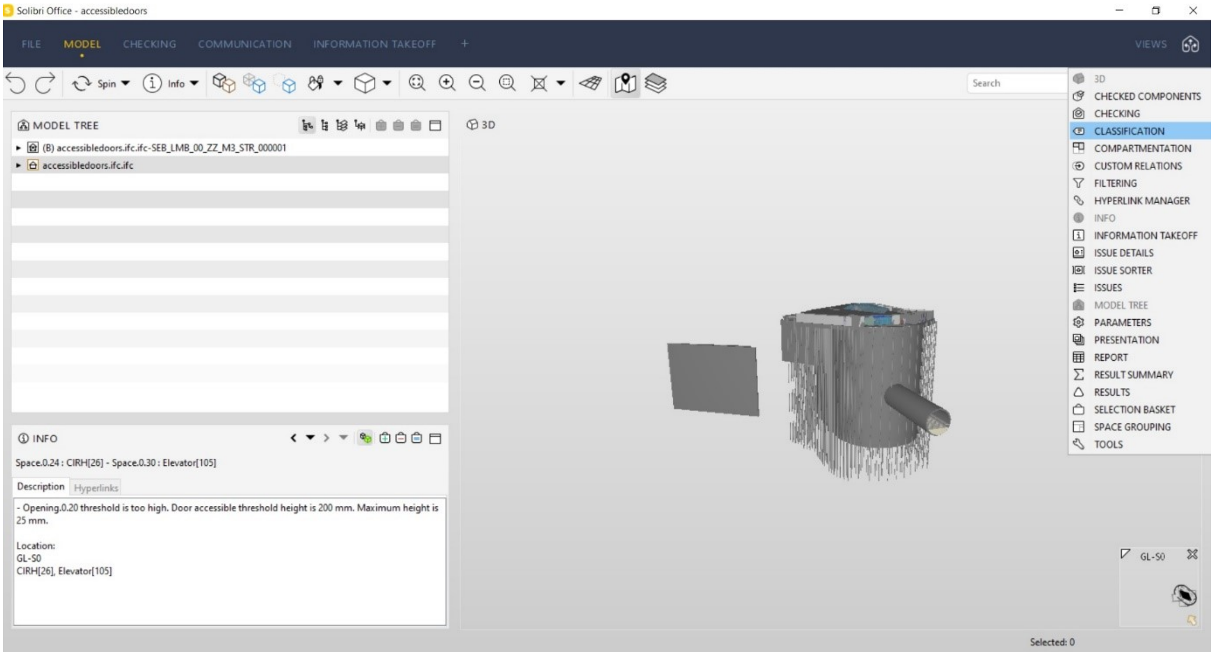


Figure 39 Solibri Classification

When “Classification” is chosen, classification section opens. It already has classification types inside, that Solibri can detect. If classification needed is not there, “Add Classification” section must be opened. Solibri has predefined classifications, such as:

- Building Element-General
- Building Element-Structural
- Building Element-Uniformat
- Exits
- Federated Model Alignment
- Fire Protecting Elements
- Furniture
- MEP Components
- Omniclass 2012-Category
- Omniclass 2012-Components
- Omniclass 2012-Spaces
- Parking

- Space Grouping
- Space Usage
- Uniclass 1.4-Category
- Uniclass 1.4-Components
- Uniclass 1.4-Spaces
- Vertical Access
- Visualization

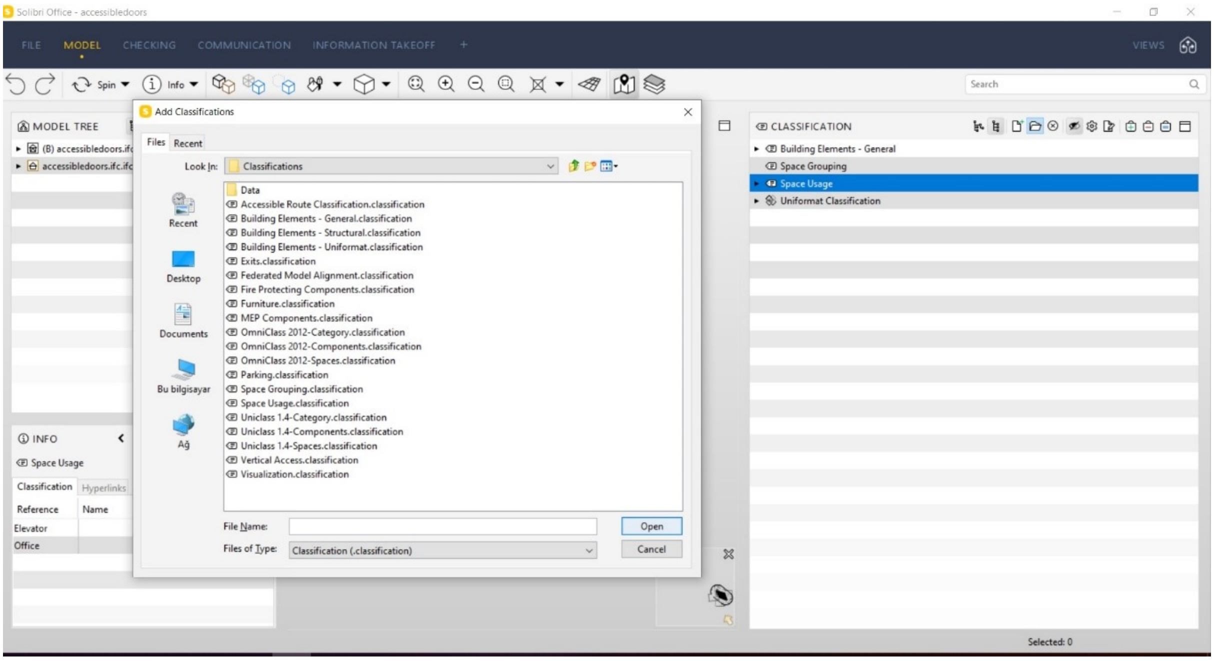


Figure 40 Add Classification

After adding the classification, by right clicking on the “Space Usage”, “Settings” is chosen to customise the classification. The description of “Space Usage” in Solibri is “*Classification is needed to organize spaces according their usage. Like office spaces, circulation spaces, technical spaces, etc.”.*

In setting Solibri has 4 main sections, that are Settings, Classification Rules, Unclassified Components, Classified Components.

In Settings section, Solibri has Name, Description (which is adjustable), Components and Default Classification Names.

In components all the settings can be configured. State, component type, property, operator and value has to be implied. According to the system that is created, the components which are architectural spaces must be included.

In default Classification Names, Solibri has predefined classification names, it is also totally adjustable by removing and adding new row and it is also can be used as it is. The colours are highly useful in terms of distinguishing components.

"Locked – When marked, the Locked checkbox disables manual classification for the classification. When locked, only automatic classification through the use of the classification rules can be used to classify components.

Allow Multiple Classification Names – When marked, the Allow Multiple Classification Names checkbox, as the name suggests, allows a user to specify more than one classification name in the tables of the Classification Rules, Unclassified Components, and Manual Classification tabs.

Show Unclassified – When marked, the Show Unclassified checkbox groups all components that haven't been automatically or manually classified under an "Unclassified" listing in the Classification view. " (Lipp)

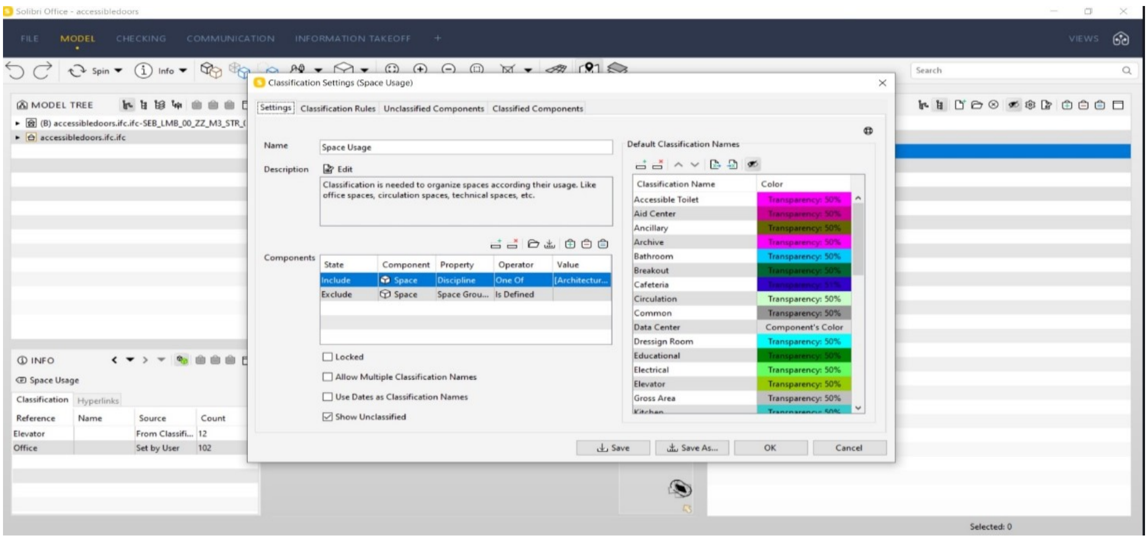


Figure 41 Classification Settings

In the "Classification Rules" section, the component names, which are predefined is assigned to the Classification Name. That means when a component has this name it has the crossing classification automatically.

In "Unclassified Components", we find the components which can not be assigned by Solibri. In this section, we have to assign classification names manually according to their usage. In this check, all the rooms are assigned as "Office" in terms of simplicity and Solibri had already assigned elevator sections as "Elevator". In "Classified Components", the components, which are already classified and also classified by "User", are found.

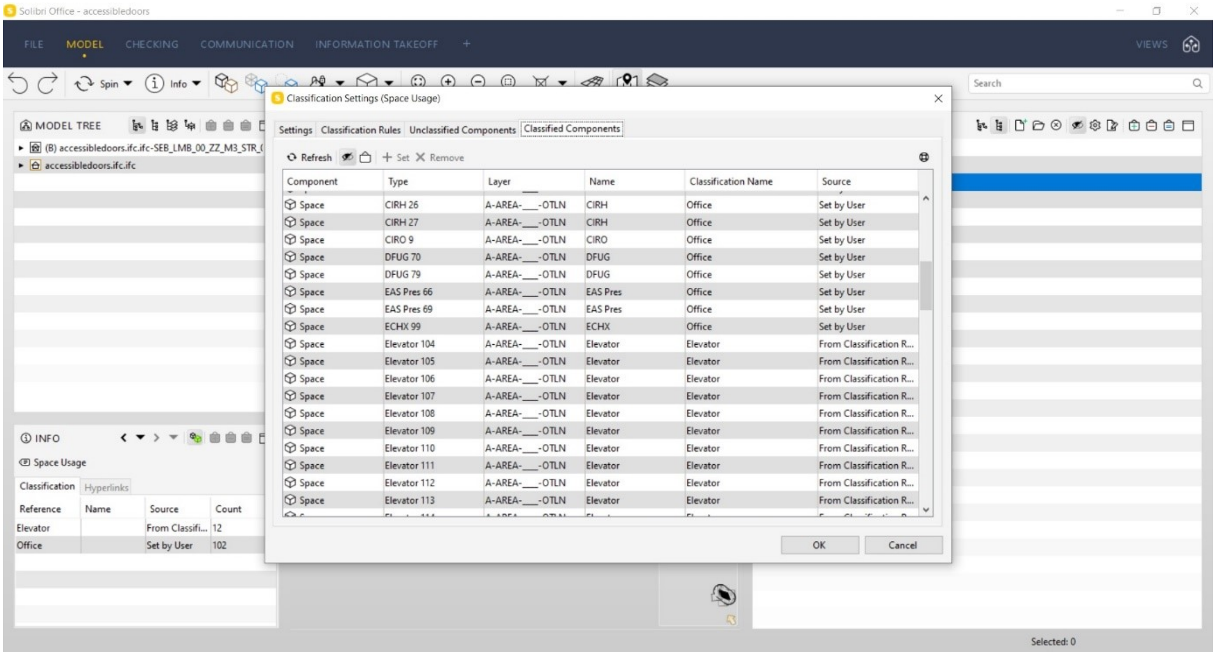


Figure 42 Classified Components

After defining the classes according to their usage. From Ruleset Manager and the rule is set. In parameters, it should be set the spaces according to their usage. Because, the doors which are connecting the spaces are checked. So our settings are between "Office" and "Office" and between "elevator" and "Office".

Door dimensions can also be defined, but it is not necessary in this check.

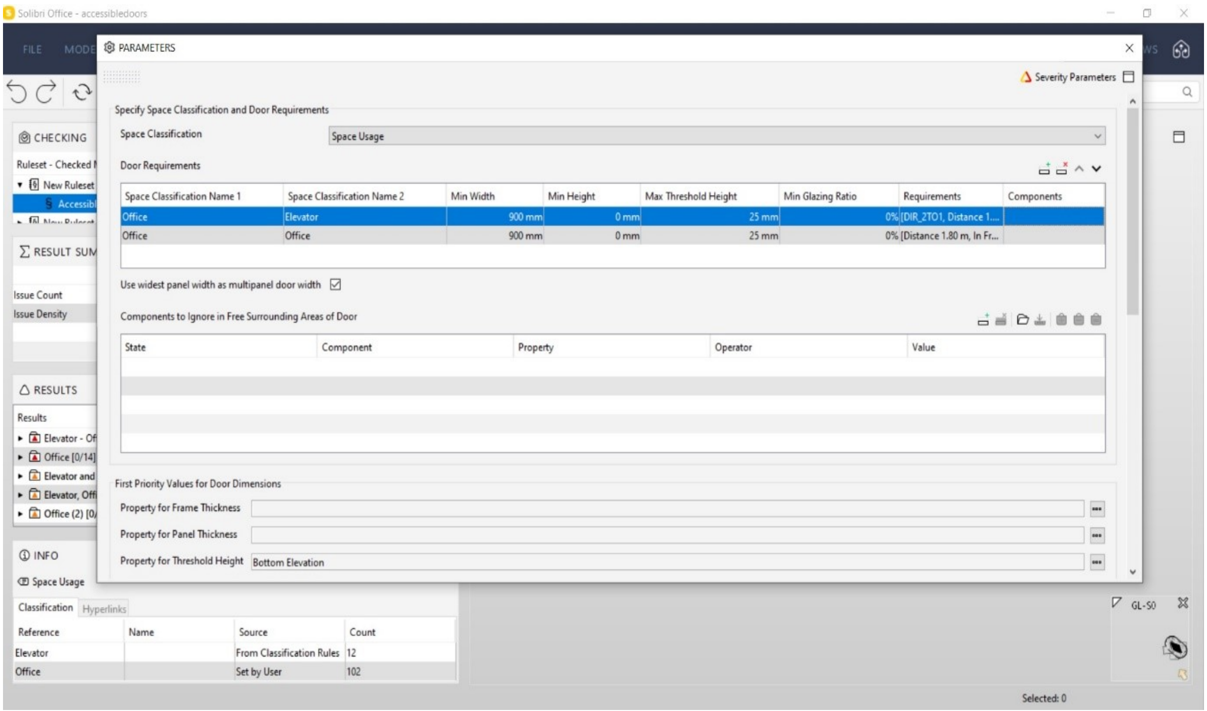


Figure 43 Accessible Door Parameters

The width and space requirements are set according to the rules shown before.

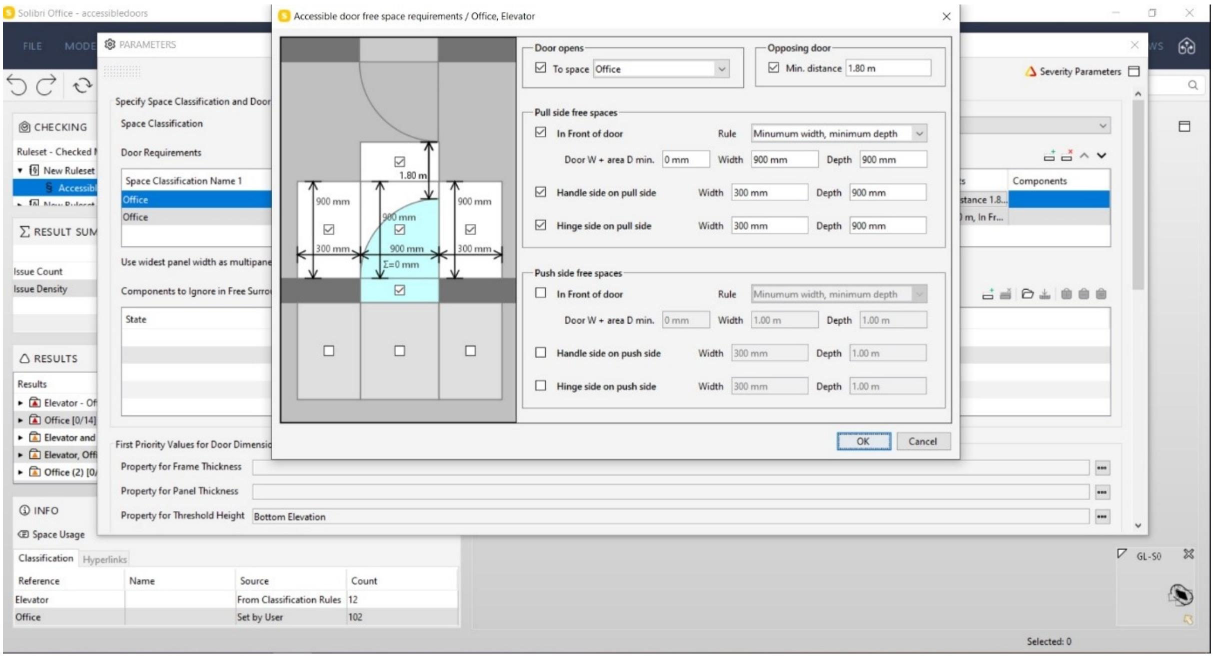


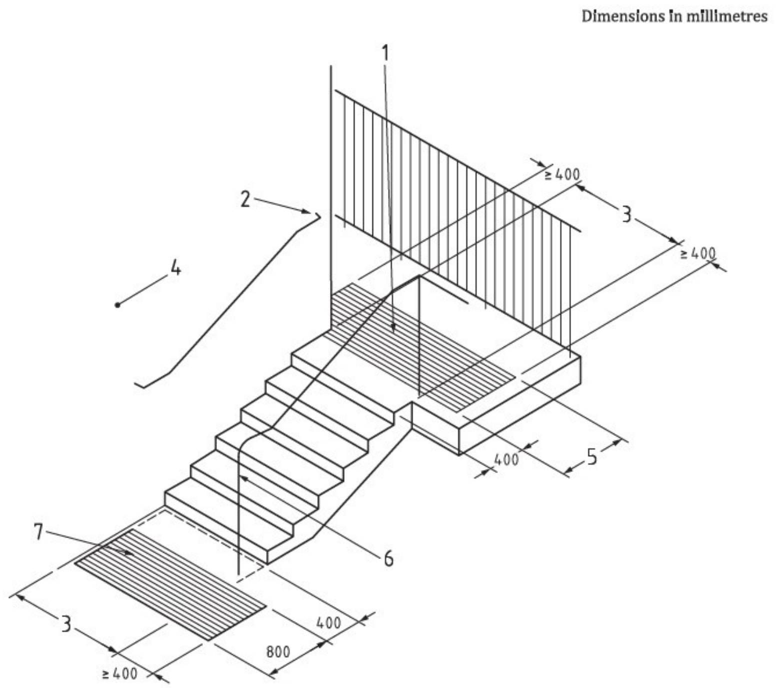
Figure 44 Accessible Door Rules

4.2.2 Acessible Stairs Check

As a part of code checking, the stairs of the station is checked. The software, that is used is Solibri Model Checker. The guide for the requirements are taken from “Design Standards for Accessible Railway Stations-2015” (A joint code of practice by The Department of Transport and Transport Scotland) and British standards “Design of an accessible and inclusive built environment: BS 8300:2018”.

These requirements are used;

- The preferred range for the rise of a step should be 150–180 mm**. BS 8300:5.9.2**
- The going for a step should be 300 mm to 450 mm. **BS 8300:5.9.2**
- No flight in a stepped access route should contain more than 20 risers and, as far as possible, the number of risers in successive flights should be uniform. **BS 8300:5.9.3**
- A handrail should be provided on each side of a ramp or stair flight, throughout its length. The top surface of the handrail should be between 900 mm and 1000 mm from the surface of the ramp or pitch line of a stair and between 900 mm and 1100 mm from the landing. **BS 8300:5.10.1**
- Preferably, a step should not overlap the one below. If there is an overlap, the nosing should not project over the tread by more than 25 mm. **BS 8300:5.9.2**
- The surface width of a stair, between enclosing walls, strings, balustrades or upstands, should be not less than 1 200 mm, and the width between handrails should be not less than 1 000 mm. **BS 8300 -2:2018**
- The provision of isolated single steps should be avoided. **BS 8300:5.9.3**



Key

1 Corduroy hazard warning surface at top of stairs to extend at least 400 mm at each side of stairs and to stop 400 mm from nosing

2 Handrail fixed to side wall and terminated with a closed end at top and bottom

3 Surface width of stair, at least 1 200 mm

4 Side wall to staircase

5 800 mm when the approach is straight on and 400 mm when a conscious turn is needed to reach the step

6 Handrail to be terminated in a way that reduces the risk of clothing being caught

7 Corduroy hazard warning surface at bottom of stairs

Figure 45 Accessible Stairs Rule (BS 8300)

The Operation

To work with Solibri Model Checker, a ruleset has to be created according to the purpose. In Solibri, new rules can be created by changing the parameters of existing default rules. To accomplish this, “**Ruleset Manager”** in “**FILE**” section is chosen. For the purpose Solibri already has a template for “Accessible Stairs Rule” in the library. A new ruleset is set to “**WORKSPACE**” to be able to work and configure rule.

According to Solibri Model Checker, “Accessible Stairs Rule” has this description;
This rule checks the accessibility of stairs from different perspectives. It checks the number of steps, dimensions of steps, dimensions of intermediate landings, free space at the beginning, and at the end of the stair. Head clearance above and under the stair are also checked.

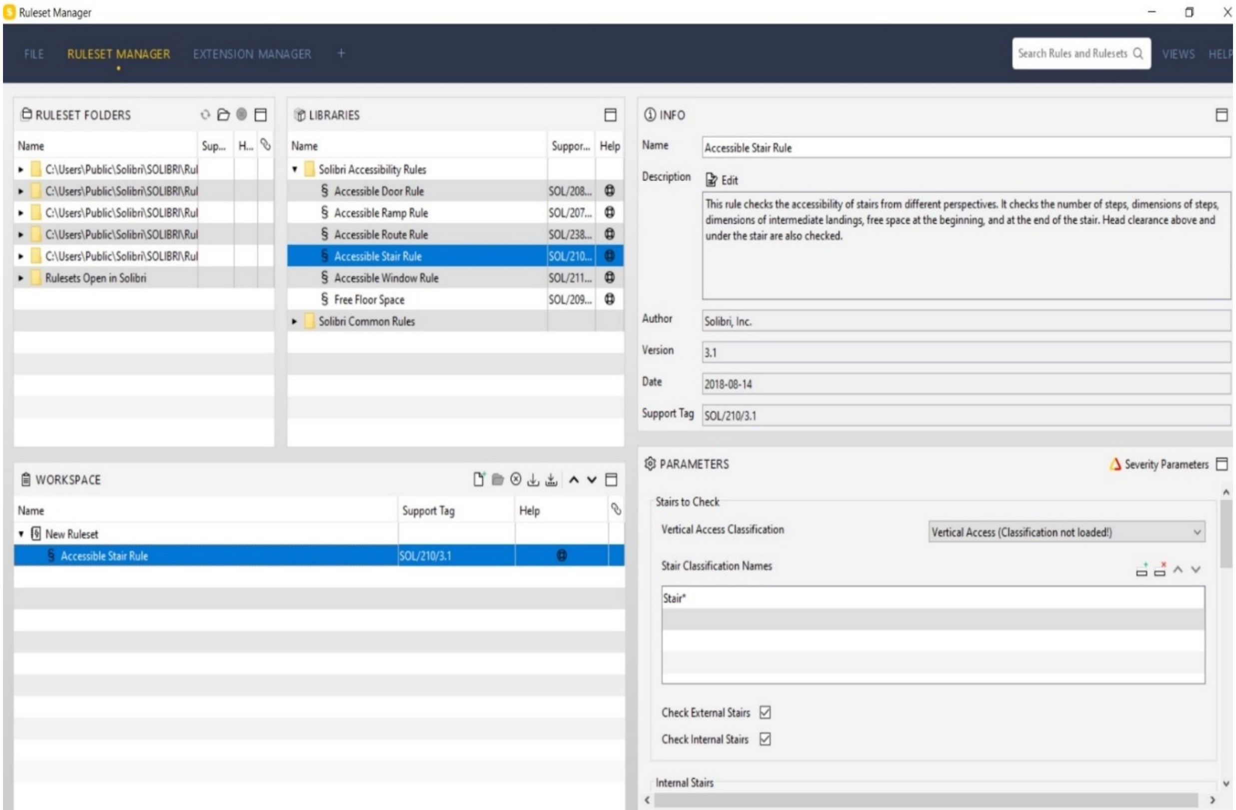


Figure 46 Accessible Stair Rule

And then the parameters are added according to the standards which was given before.

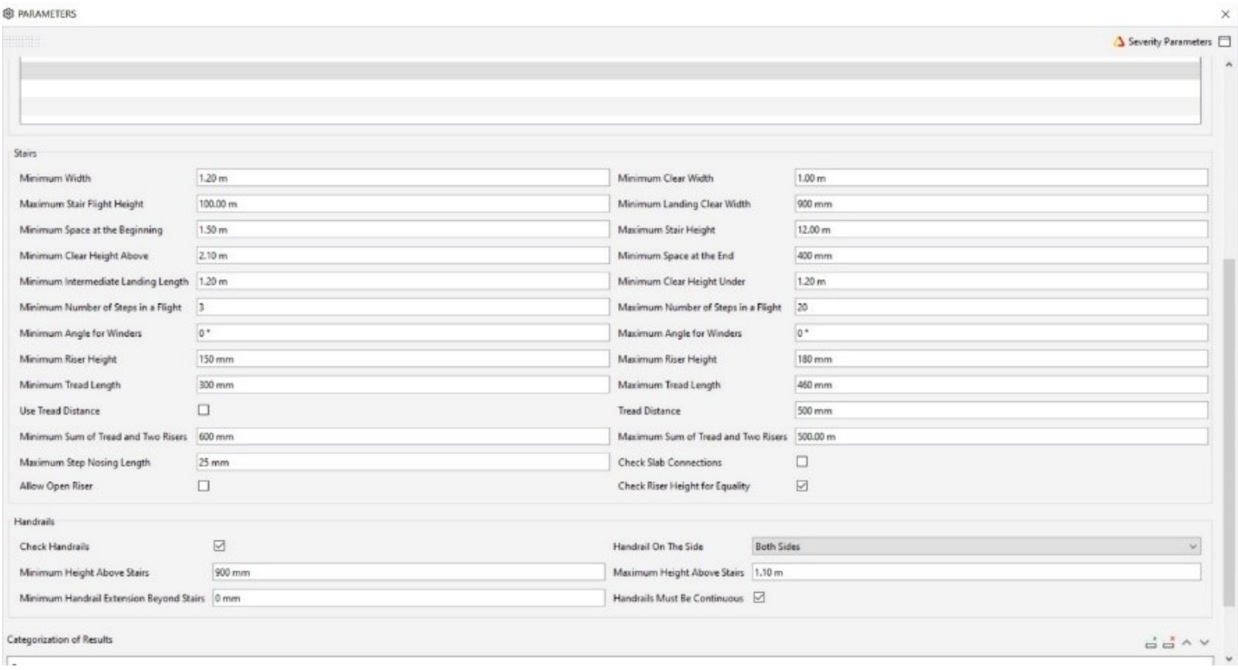


Figure 47 Accessible Stairs Parameters

After that, the model is uploaded as IFC file, in “CHECK” section ruleset is set and by clicking “Check Model”, the model is checked.

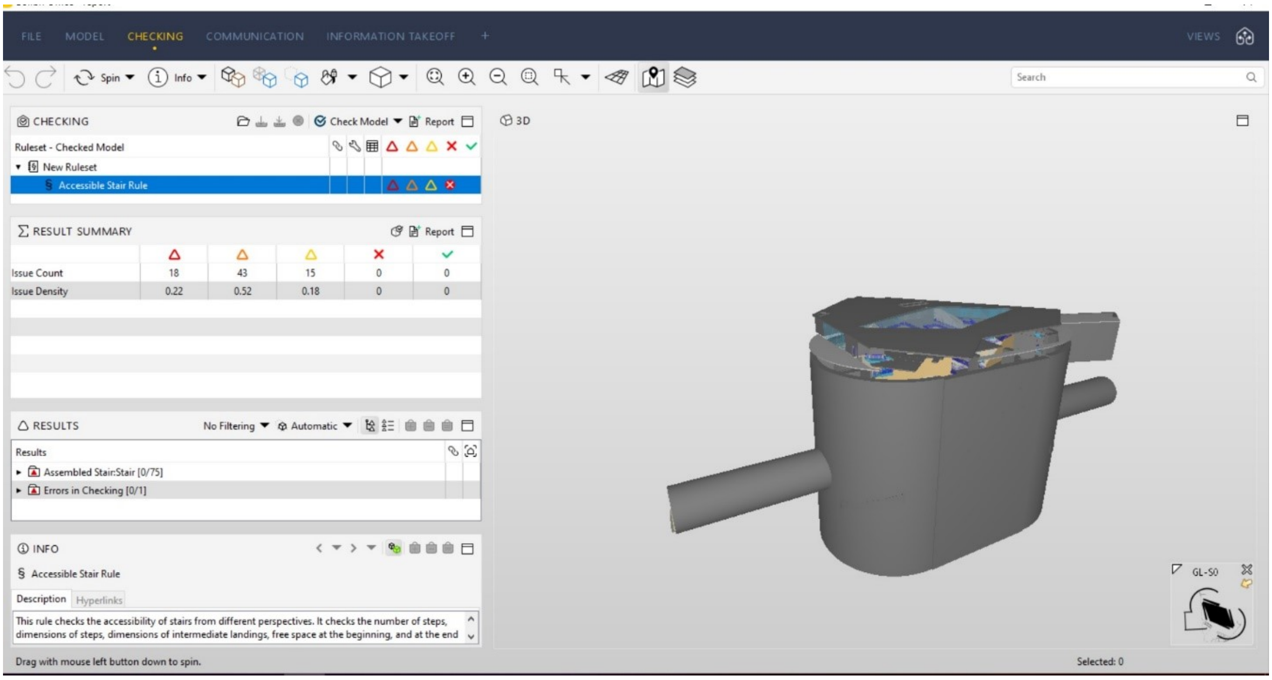


Figure 48 Checking Model

4.2.3 Accessible Route Check

As a part of code checking, the route for wheelchair in the station for is checked. The software, that is used is Solibri Model Checker. The guide for the requirements are taken from “Design Standards for Accessible Railway Stations-2015” (A joint code of practice by The Department of Transport and Transport Scotland) and British standards “Design of an accessible and inclusive built environment: BS 8300:2018” and European Standards PRM TSI.

These requirements are used:

- To be accessible, the minimum surface width of an access route (i.e. between walls, kerbs or path edgings) should be at least 1 800 mm for general routes (see Note 1), although a width of 2 000 mm is preferable to accommodate larger electric mobility scooters.
- Doors shall have a minimum clear useable width of 900 mm and shall be operable by a PRM. (PRM TSI: 4.2.1.3)
- The surface width of a stair, between enclosing walls, strings, balustrades or upstands, should be not less than 1 200 mm, and the width between handrails should be not less than 1 000 mm. **BS 8300 -2:2018**

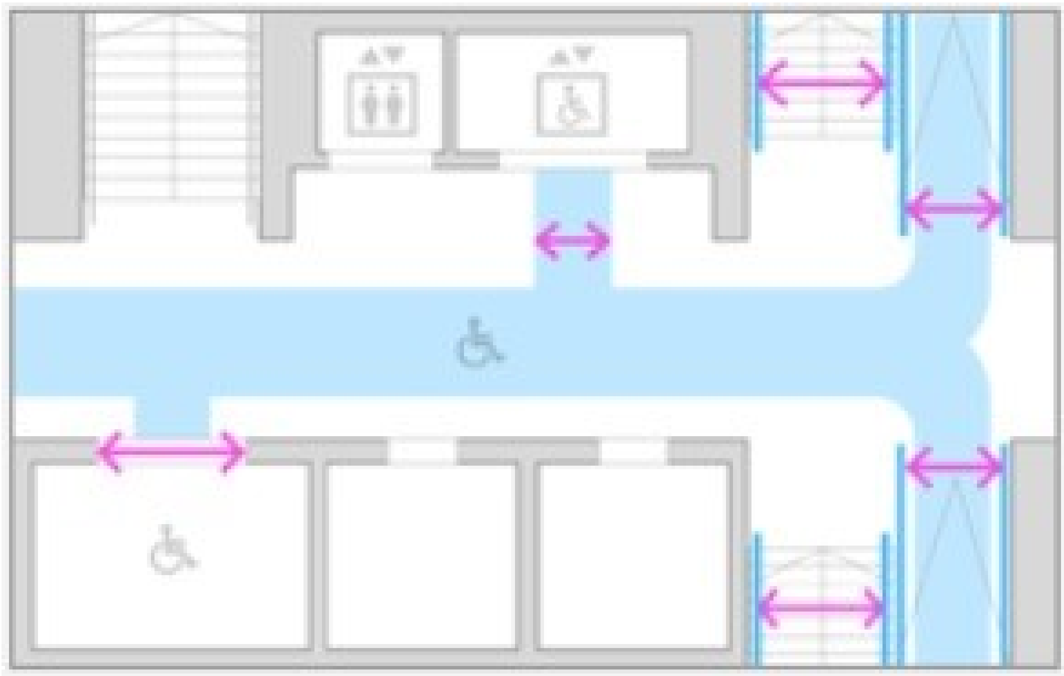


Figure 49 Accessible Route Illustration

The Operation

To be able to accomplish this check, a component must be specified as “Route”. But the model does not have any component which can be defined as “Route” and to solve this problem, Revit Model file (RVT.) is opened. Because of the route must be on the floor, a new floor (slab) family is created in the model. The parameters are not really important in terms of the check but orange colour is given to be able to distinguish the component.

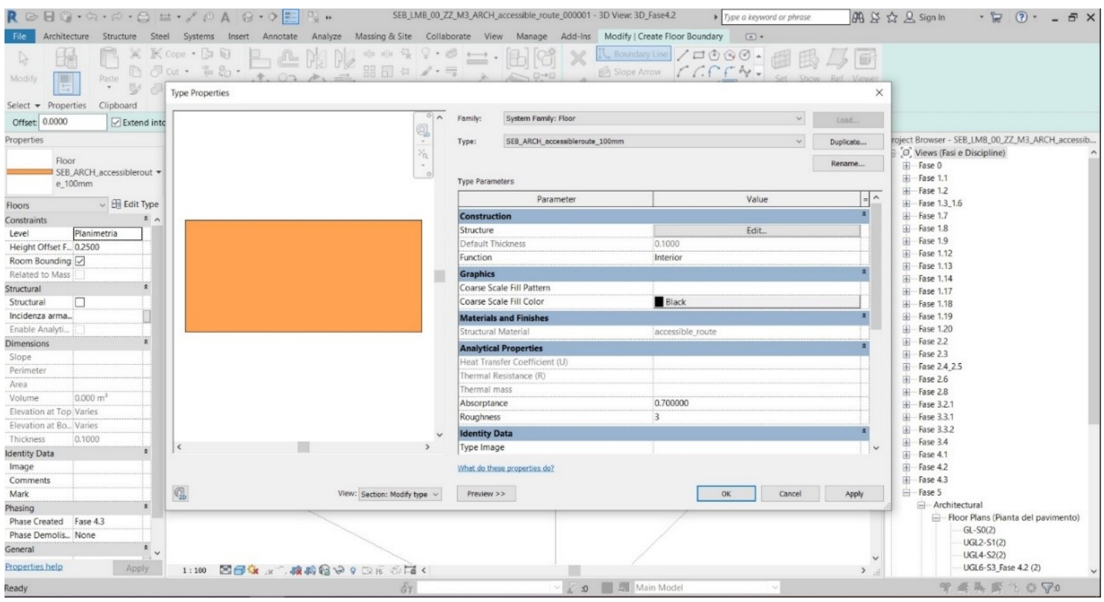


Figure 50 Revit-Type Properties of Route

And the route is created. Route is created freely because there was no reqiurements which is written in the project files.

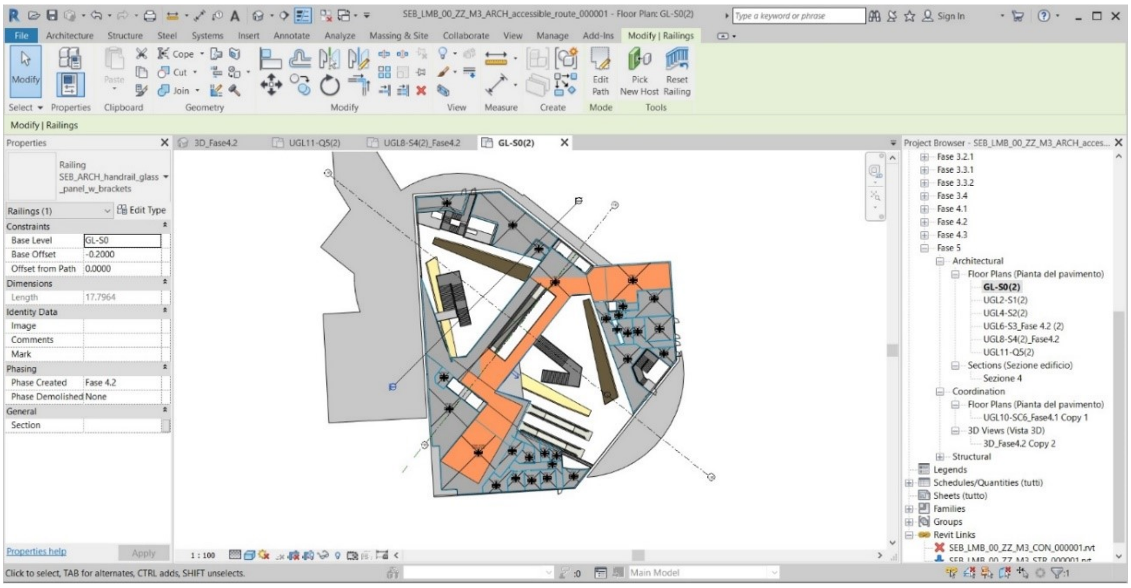


Figure 51 Route Display in Revit

To work with Solibri Model Checker, we have to create a ruleset according to our purpose. In Solibri new rules can be created by changing the parameters of existing default rules. To accomplish this, “**Ruleset Manager”** in “**FILE**” section is opened. For this purpose Solibri already has a template for “Accessible Route Rule” in the library. A new ruleset is added to “**WORKSPACE**” to be able to work and configure rule.

According to Solibri Model Checker, “Accessible Route Rule” has this description;
This rule checks the accessible routes. The checking requires the accessible route modeled as a component. The rule can check the clear width of route and components such as doors, stairs, and ramps within the route. The rule checks also the connections from accessible route to the accessible spaces and accessible elevators.

Because of this statement “Classification” section has to be opened. This model is made unique and spaces have unique names. Normally Solibri can understand classification of the spaces and elements but our spaces have names like LCVC, CIRC etc. To solve this problem we have to classify spaces manually. Also we have to classify the component (slab), we created before.

To achieve this; after uploading model, “MODEL” section is chosen. In this section it is clicked on the “VIEWS” and chosen “Classification”.

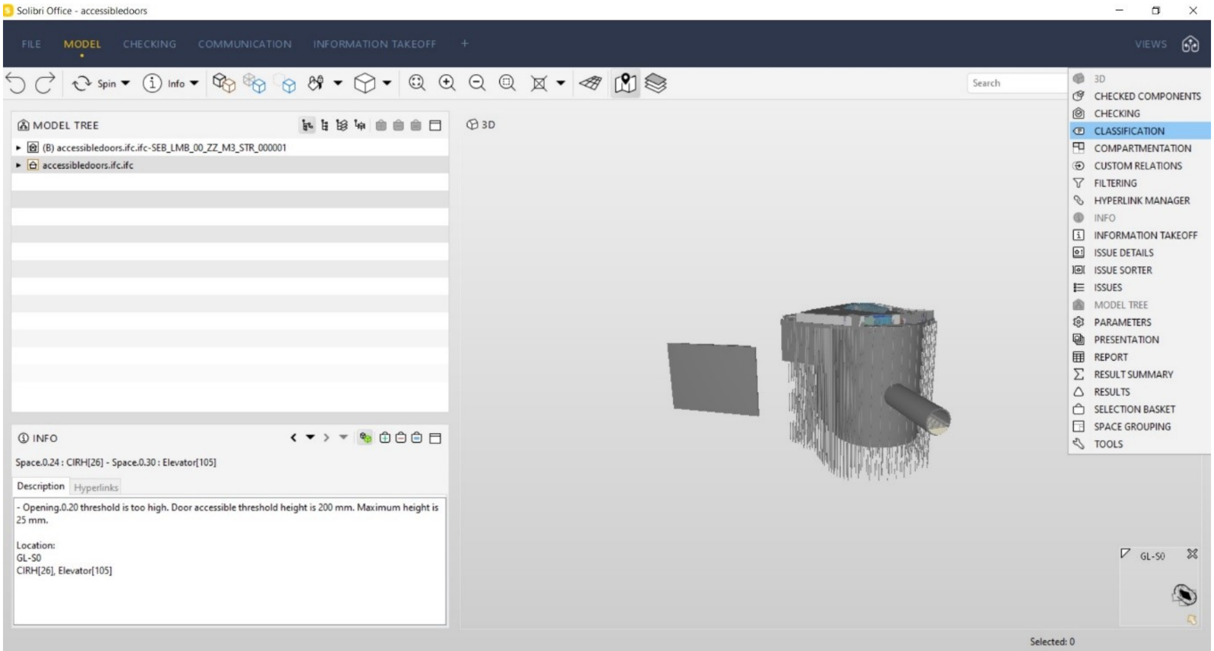


Figure 52 Classification

When “Classification” is chosen, classification section opens. It already has classification types inside, that Solibri can detect. If the classification needed does not exist, “Add Classification” is chosen and the window is opened. Solibri has predefined classifications, such as:

- Building Element-General
- Building Element-Structural
- Building Element-Uniformat
- Exits
- Federated Model Alignment
- Fire Protecting Elements
- Furniture
- MEP Components
- Omniclass 2012-Category
- Omniclass 2012-Components
- Omniclass 2012-Spaces
- Parking
- Space Grouping

- Space Usage
- Uniclass 1.4-Category
- Uniclass 1.4-Components
- Uniclass 1.4-Spaces
- Vertical Access
- Visualization

But in this case unique classification system has to be created . To do this it is clicked on the "New Classification".

In setting Solibri has 4 main sections, that are Settings, Classification Rules, Unclassified Components, Classified Components.

In Settings section, Solibri has Name, Description, Components and Default Classification Names.

In components all the settings can be configured, the state, component type, property, operator and value have to be implied. According to the system, the components which are architectural spaces must be included.

In default Classification Names, Solibri has predefined classification names, it is also totally adjustable by removing and adding new row and it is also can be used as it is. The colours are highly useful in terms of distinguishing components.

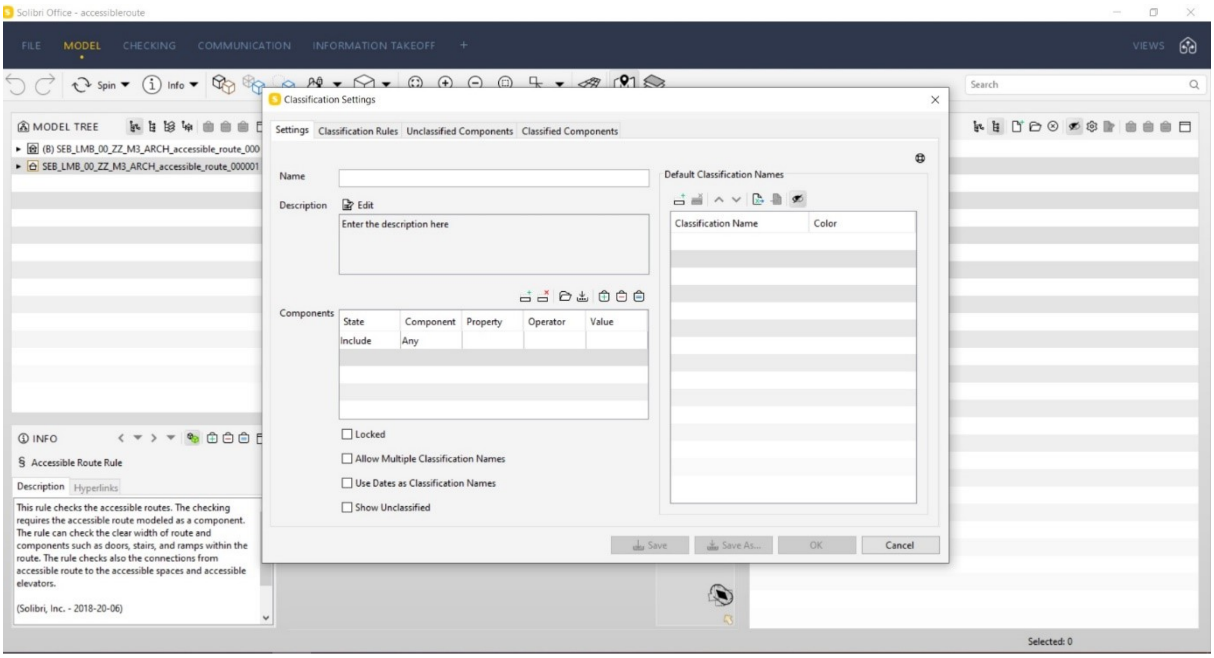


Figure 53 Classification Settings

In this section the classification is named as “Accessible Route Classification”. To identify the components; there are two type of components, that are “Slab” and “Space”. So they are identified as “include one of architectural slab” and “include one of architectural space”. Classification names are set as “Accessible Space” and “Accessible Route” with the green and orange coloured as in order.

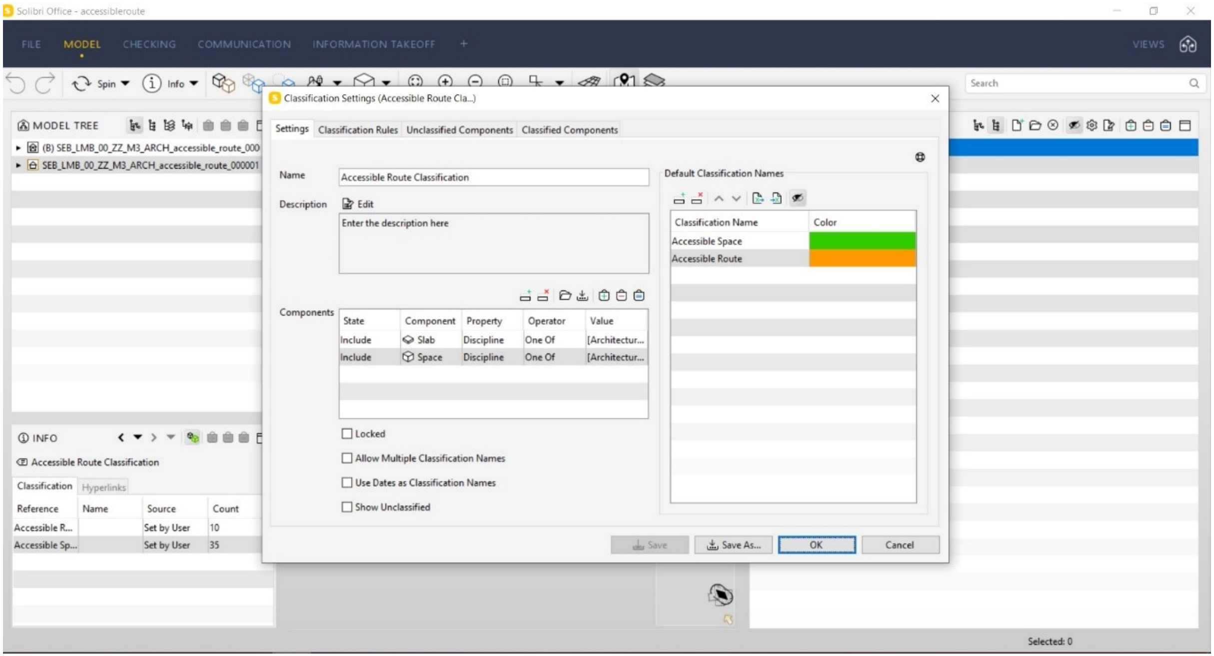


Figure 54 Classification Configuration

Then “ Accessible Route” is assigned to the slab that created before only for this check and “Accessible Space” assigned to the rooms which are not able to identified by Solibri.

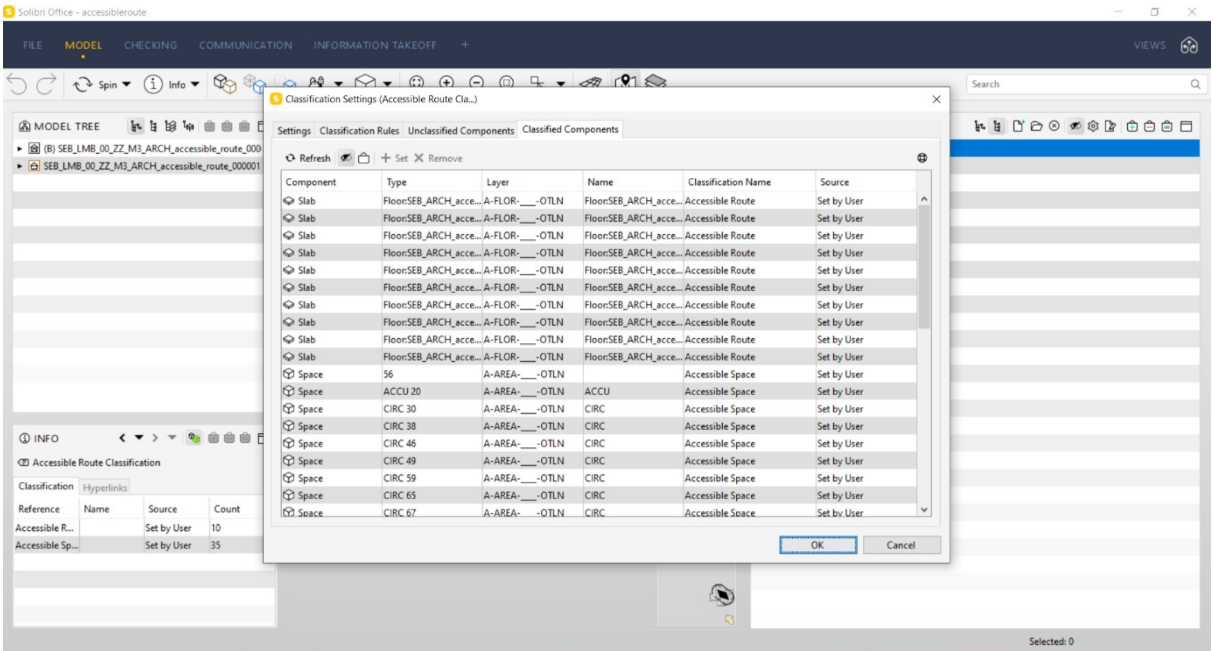


Figure 55 Classified Components

In the classification section, in the classes the components which are assigned are visible. From here the components in the model (visual) can be seen as total, one by one, selected ones.

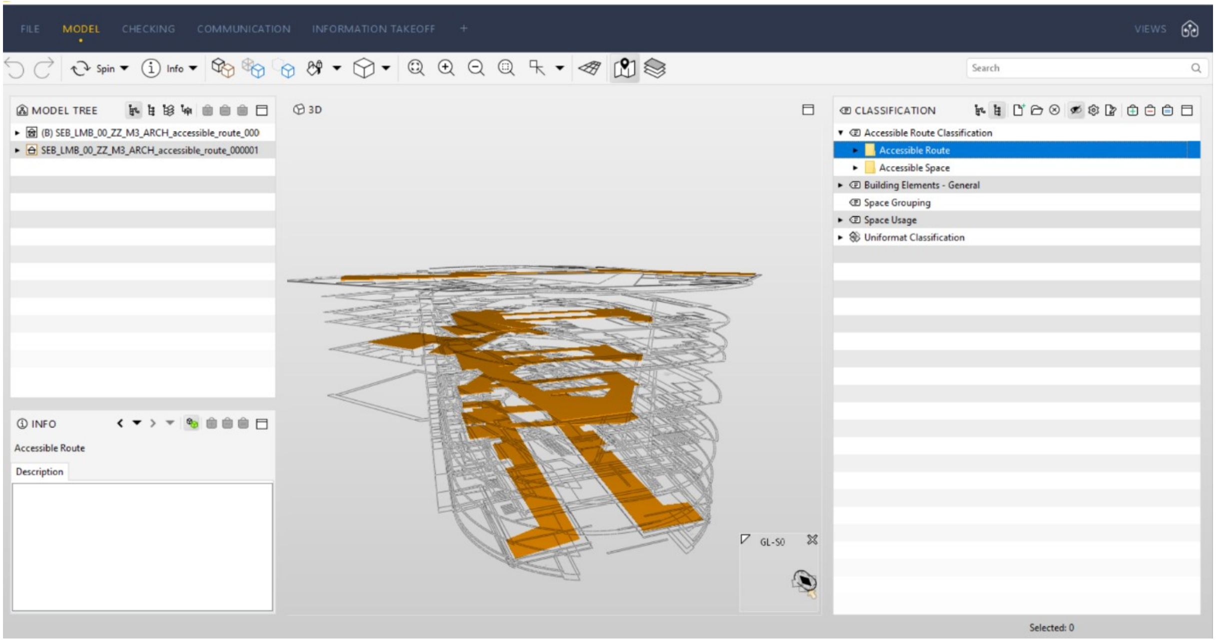


Figure 56 Accessible Route Display

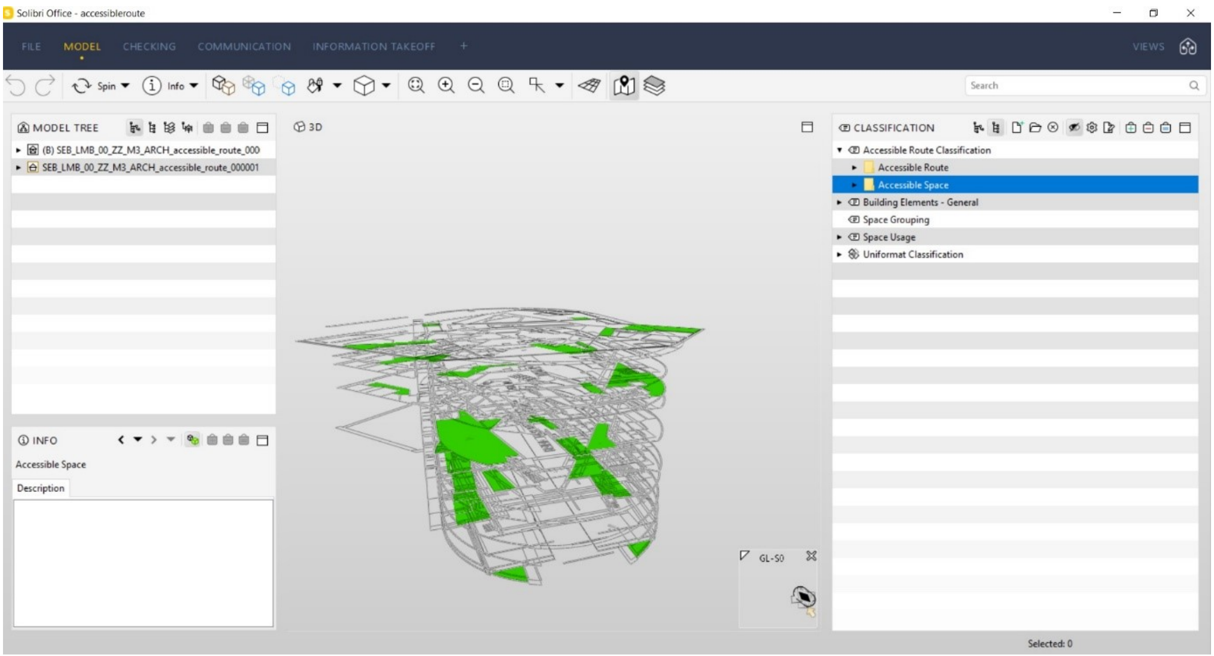


Figure 57 Accessible Space Display

4.3 Clash Detection

4.3.1Stairs Clash Detection

The goal to do this check is determine if stairs are touching the slabs. The procedure is parallel to “Accessible Stair Check”. But in this check even though the same ruleset is used, the parameters are adjusted according to not to give any code checking issue but only for if the slab-stair connection is maintained.

Parameter needs user to specify the “Vertical Access Classification” which refers to vertical movement inside or outside of the structure. The options, “Check External Stairs” and “Check Internal Stairs”, are checked. And then “Internal Stairs” must be specified according to space usage and the name is “INTSTAIRS”.

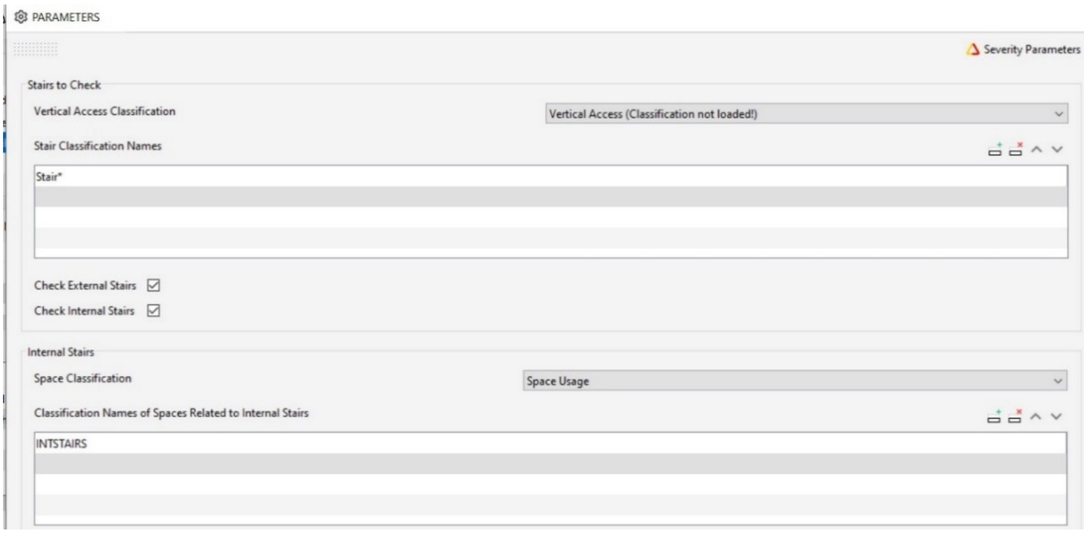


Figure 58 Stair Rule Parameters

The main goal here is checking the stair-slab connection. So the other parameters are maximized and minimized according to not to have a code checking issue.

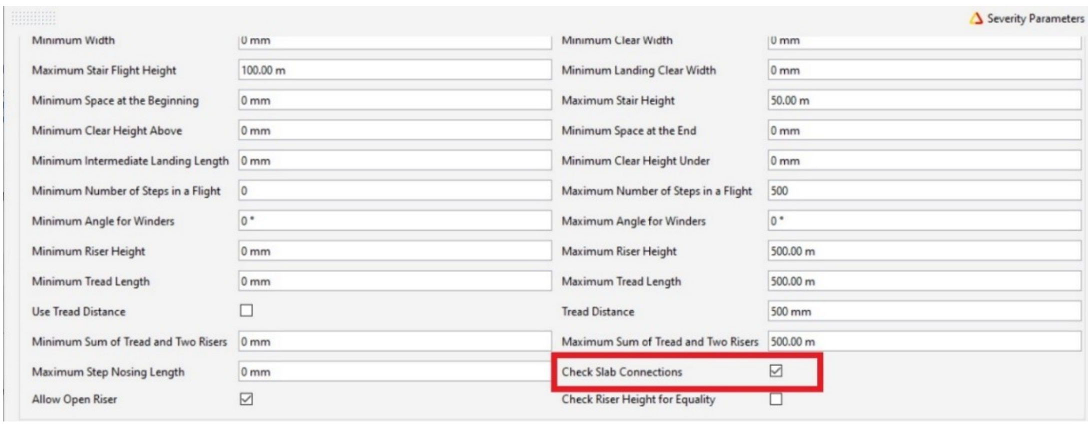


Figure 59 "check slab connections"

After that the checking is generated.

4.3.2 Finishing (arc) – Slab (str) Clash Detection

In this check the goal is to determine if the finishing, that are modelled before, touch the structural slab or not. If the coordination of the models are done right this should pass. Because when it is being worked on architectural model, even though structural model is linked, structural components are not adjustable. Structural model can be used as the reference visual for modelling.

To be able to do this operation first the finishing has to be classified in Solibri. For this we only need Slabs to be defined as components. Name of the classification is "Tiles", which is the material of our finishing and the colour given is green.

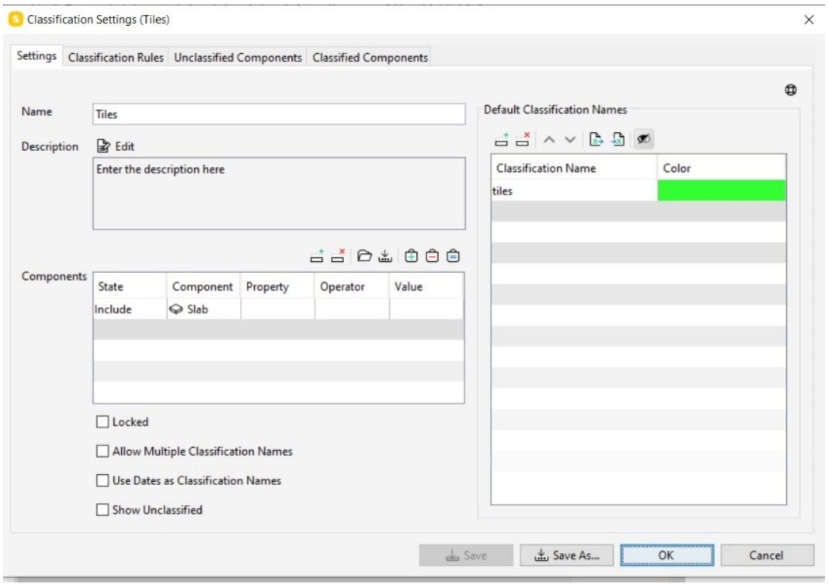


Figure 60 Classification Settings

Then the classification is assigned to the components which were not classified. Now finishing can be distinguished separately from other slabs.

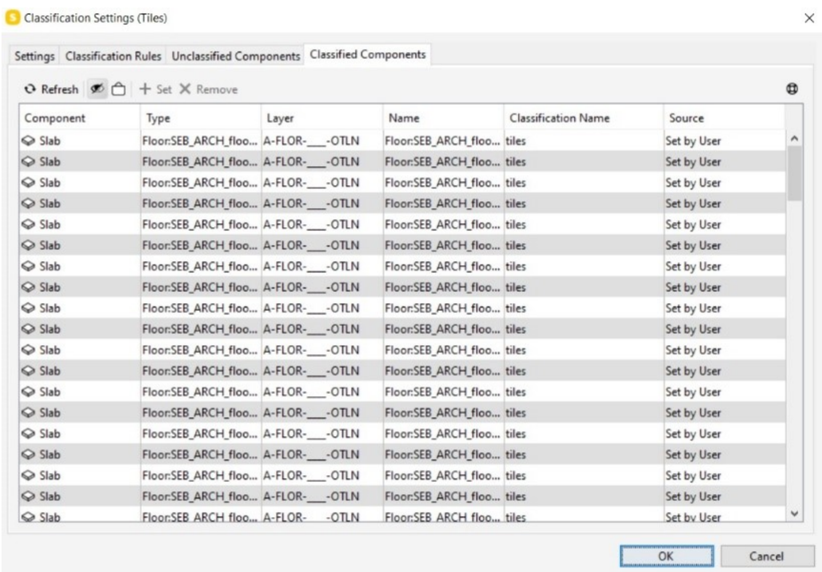


Figure 61 Classified Components

Then “Ruleset Manager” is chosen to create our ruleset. As the template “component must touch other components” rule is chosen. The description is “This rule checks that components touch surfaces of other components above or below them.”

After that the parameters are set in the rule. As the summary “finishings must touch structural slab from bottom surface” command is given. Acceptable space is 10 mm and acceptable intersection is set 10 mm.

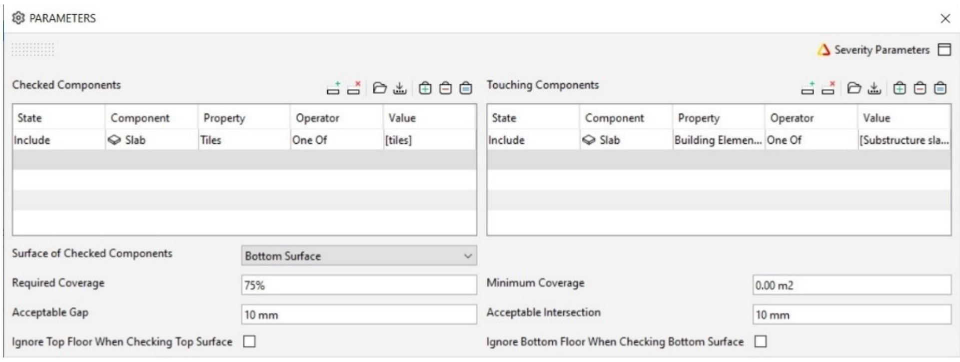


Figure 62 Rule Parameters

After that the check is generated

4.3.3 Wall Intersection Clash Detection

The goal of this check is, if the walls intersects in the defined boundaries of intersection lengts, if there is a duplication, overlapping or one wall is designed in another wall. To be able to do this check, ruleset manager section is chosen and the rule in the “Example rulesets→General Intersection Rule→Wall-Wall intersections” is chosen. The description is, “This rule checks wall - wall intersections.”

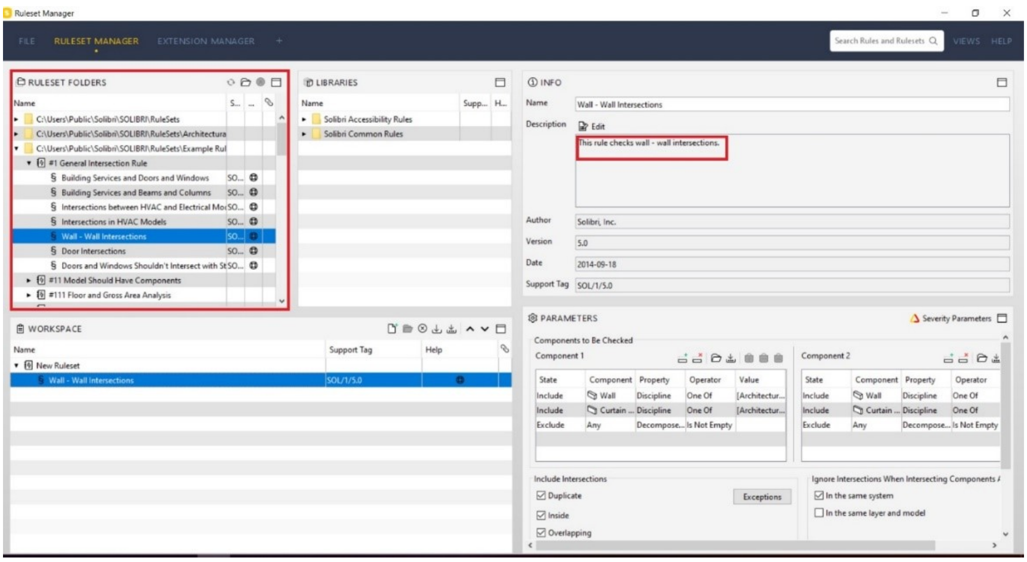


Figure 63 Wall Intersection Ruleset

The components to be checked are “walls” and “curtain walls”. The intersection tolerances are 200 mm because the thickness of interior doors are 200 mm.

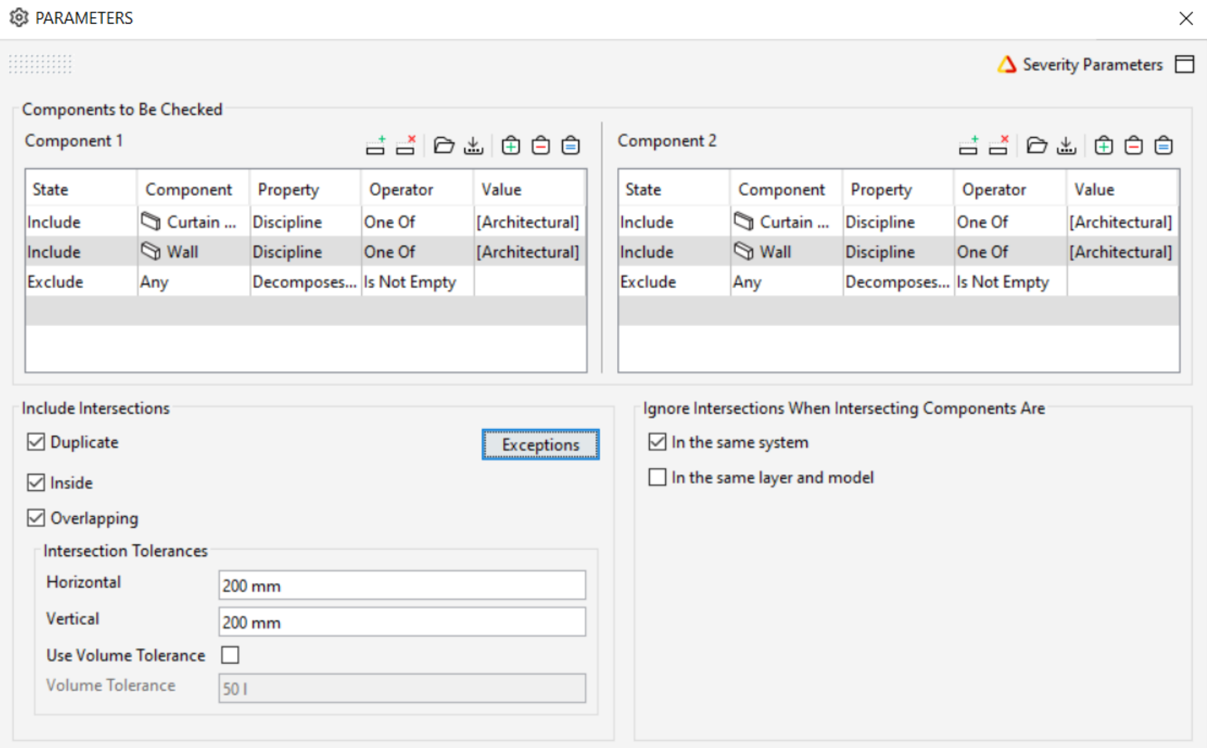


Figure 64 Rule Parameters

After that check is generated.

4.4 Result Summary

Result Reports

In Solibri Model Checker, after the rules are set and the checks are done, errors are shown in checking window. If the check is passed, it is represented with green check icon. If the check is not passed, it is represented with a triangle icon and according to its severity it has certain colour code. This severity can be changed in the rule settings. Red is for issue with critical severity, orange is issue with moderate severity and yellow is issue with low severity.

In Ruleset Section it is shown that chosen ruleset that is used in checking.

In Result Summary issues are counted and measured in terms of issue density. Issue density is issues counted per 1000 m^3.

In Result section, the results are sorted with severities. When it is clicked one of the issue it can be seen the display of the issue and the components in the model.

In Info section, when one of the issue in Result menu is clicked, the description of the issue appears. For example; *Stair Stair.-2.2 riser height is 2.30 m. The maximum height for the risers is 180 mm.*

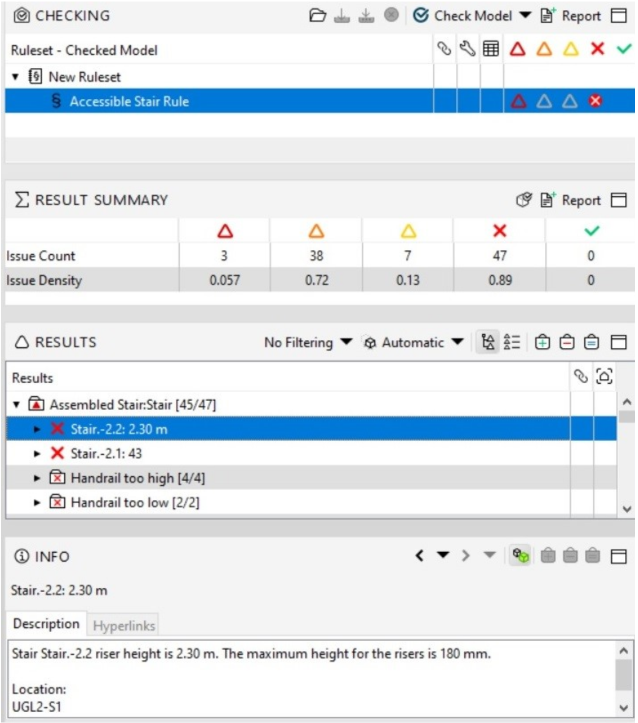


Figure 65 Check Browser

When it is clicked on the issue it appears on 3d model and it has a red colour to mention it.

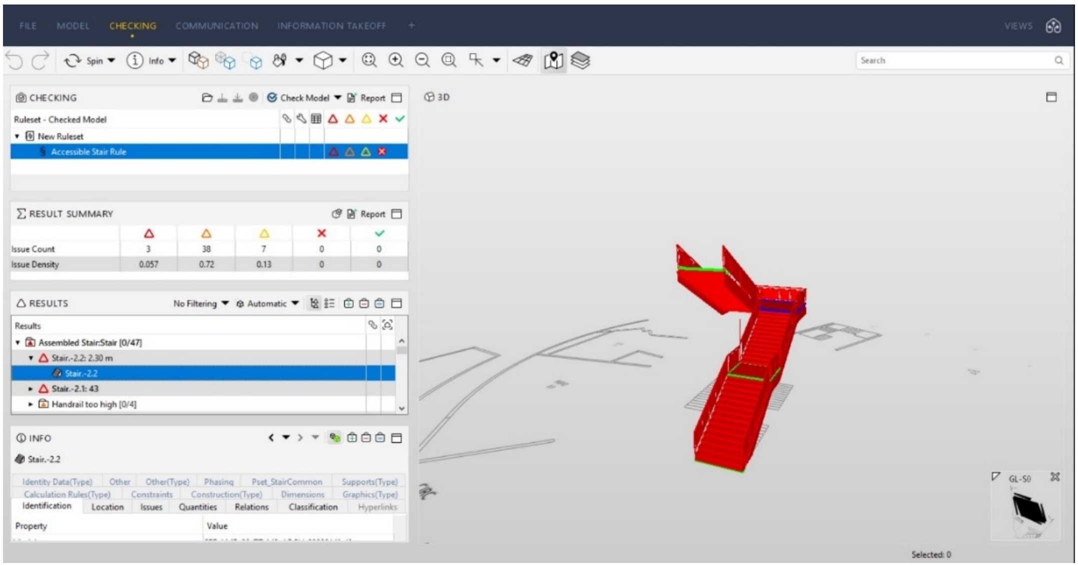


Figure 66 Issue Display

It is possible to make reports of issues in Solibri Model Checker. The formats are PDF, BCF, Excel and RTF. To accomplish this presentation has to be made in Solibri. The first step is right-clicking on the issue and click “Add Slide”. “Issue Details” window is opened when we click. First the name and description of the issue have to be configured. Description can be done automatically, it is the description in the “INFO” section.

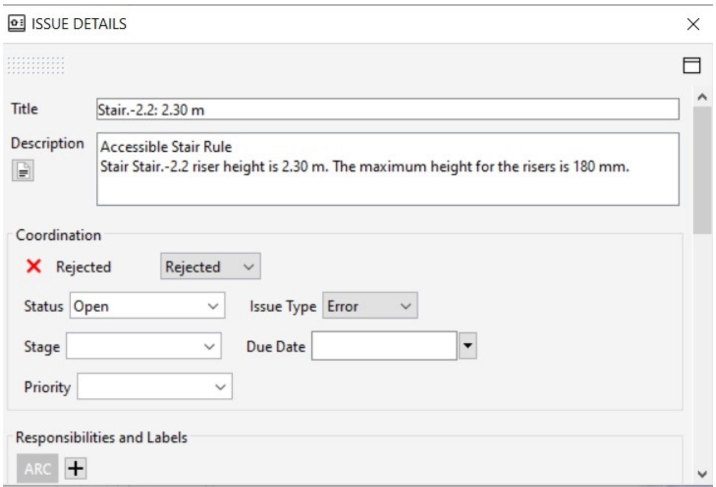


Figure 67 Issue Details Browser

Then in “coordination” section it is set that if the issue is “rejected”, “accepted” or “unknown”. The section in status the options are “open”, “closed”, “assigned” and “Resolved”. Due date can be added to resolve this issue and priority level. The issue type is set as “Error”, “Warning”, “Info” or “Unknown”.

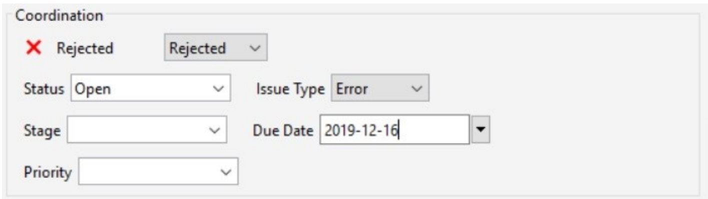


Figure 68 Coordination

Then type of responsibility and who is responsible for the issue to solve is chosen. In this example it is an ARC (architectural) and the responsible is architect.

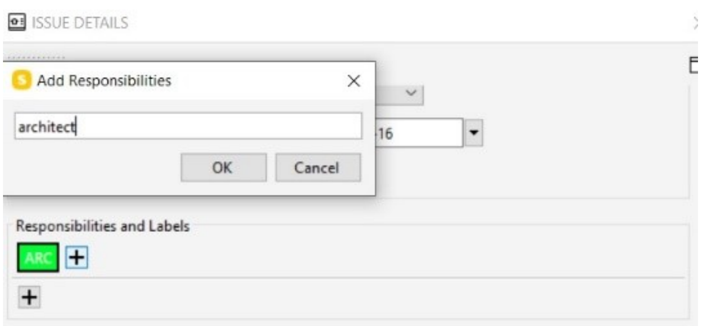


Figure 69 Adding Responsibilities

Then in the communication section the issued component is seen and comments can be added to the issue . In component section, the components are described which are caused the issue. And in the and the location of the issue can be seen in the model. Time of the execution and author is described at below.

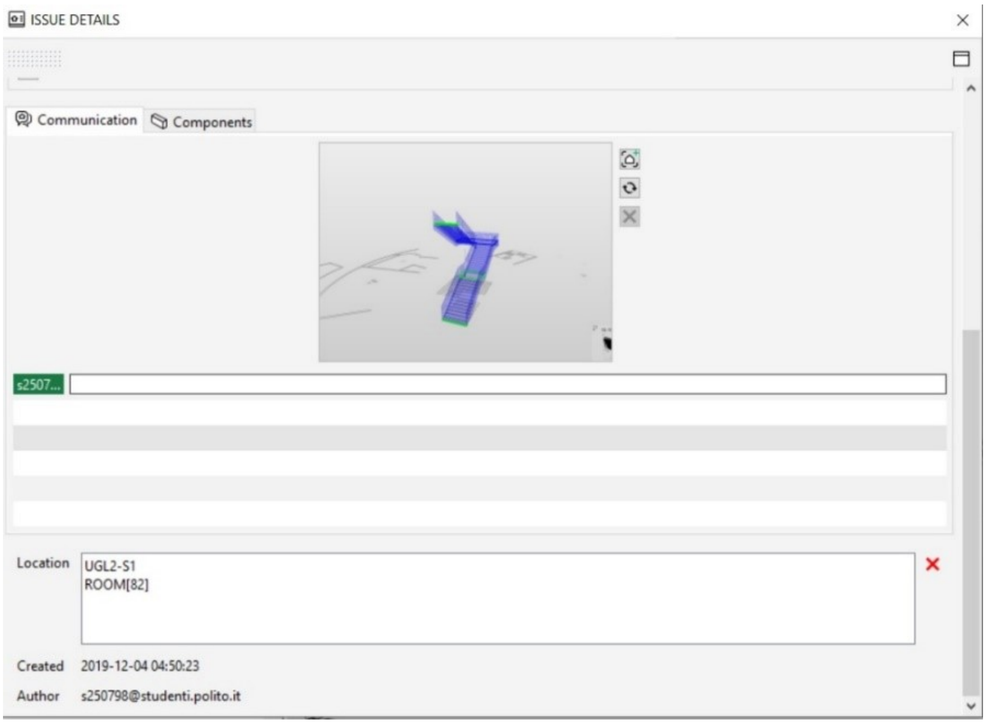


Figure 70 Communication, Components, Time, Location

After adding all or the issues that report will be made. In the communication section in solibri it is made presentation with the slides.

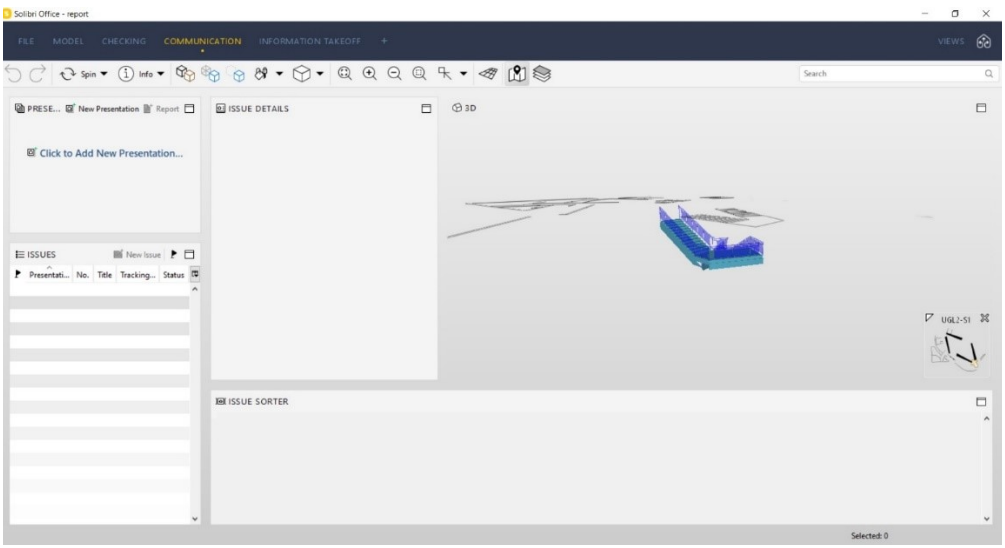


Figure 71 New Presentation

Then “New presentation” is clicked and “From checking results” is chosen. The presentation is displayed.

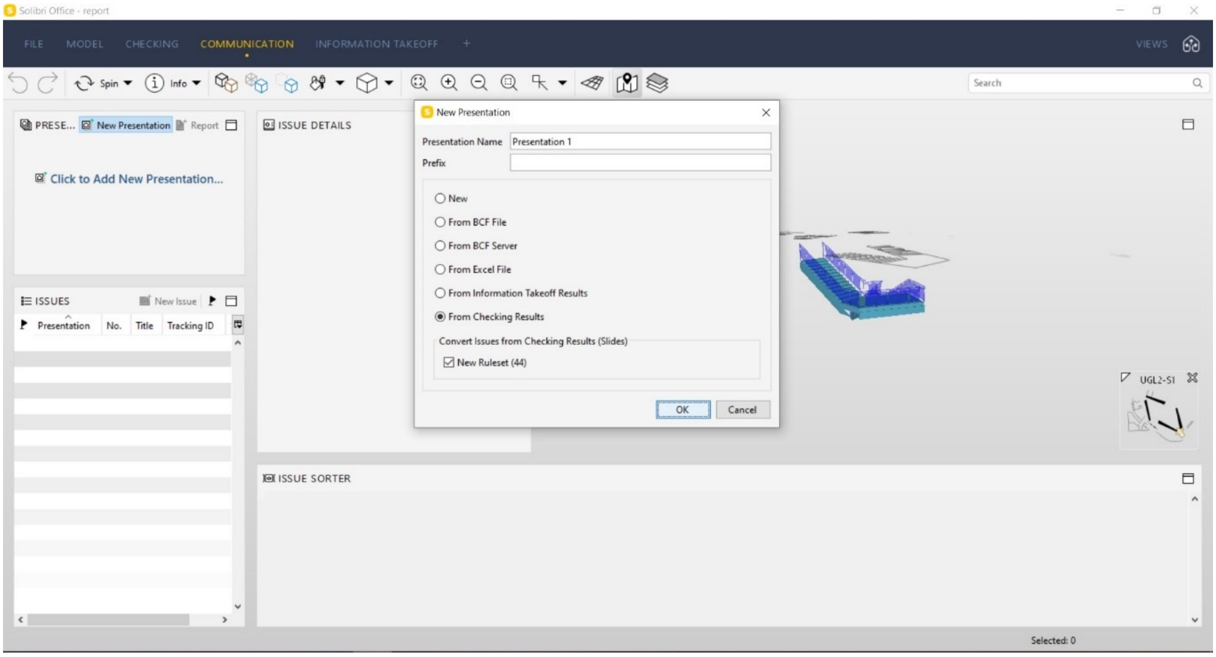


Figure 72 Presentatin Settings

In “issues” all the issues can be seen listed and “issue sorter” they appear as slides. When it is clicked on one of them on the “issue sorter”. All the information is displayed on the screen and “issue details” can be changed.

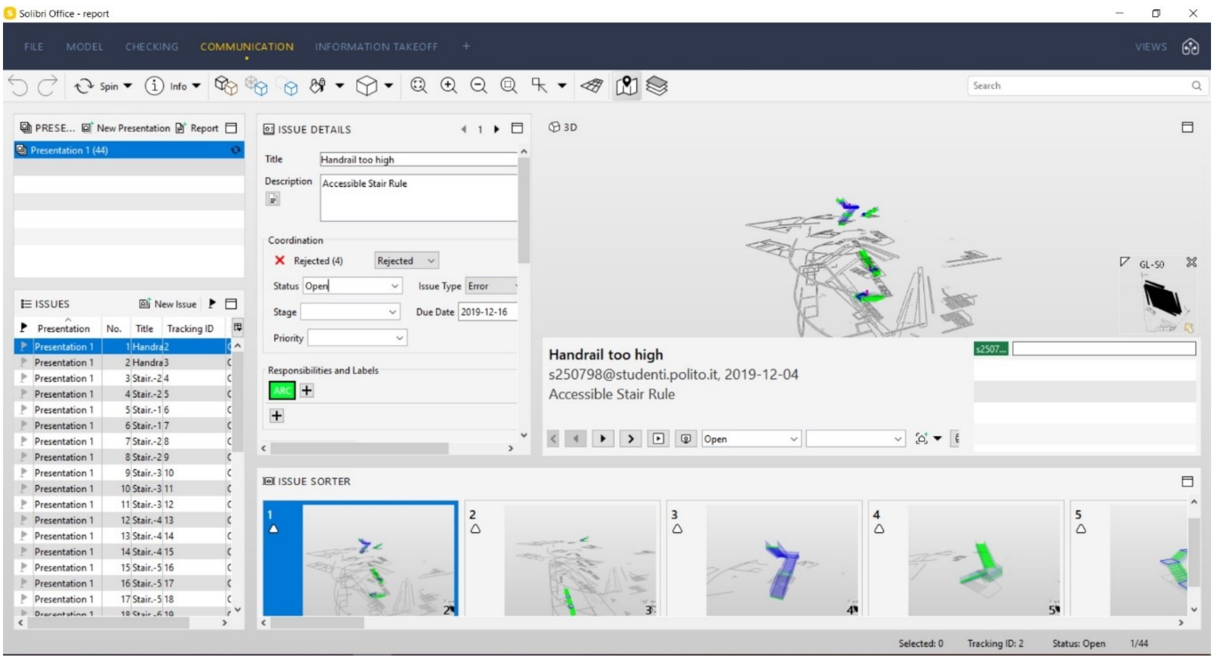


Figure 73 Presentation of Issues

Then by selecting “Report”, report can be created. The formats are BCF, PDF, RTF and excel. A template can be set for report according to the use of report.

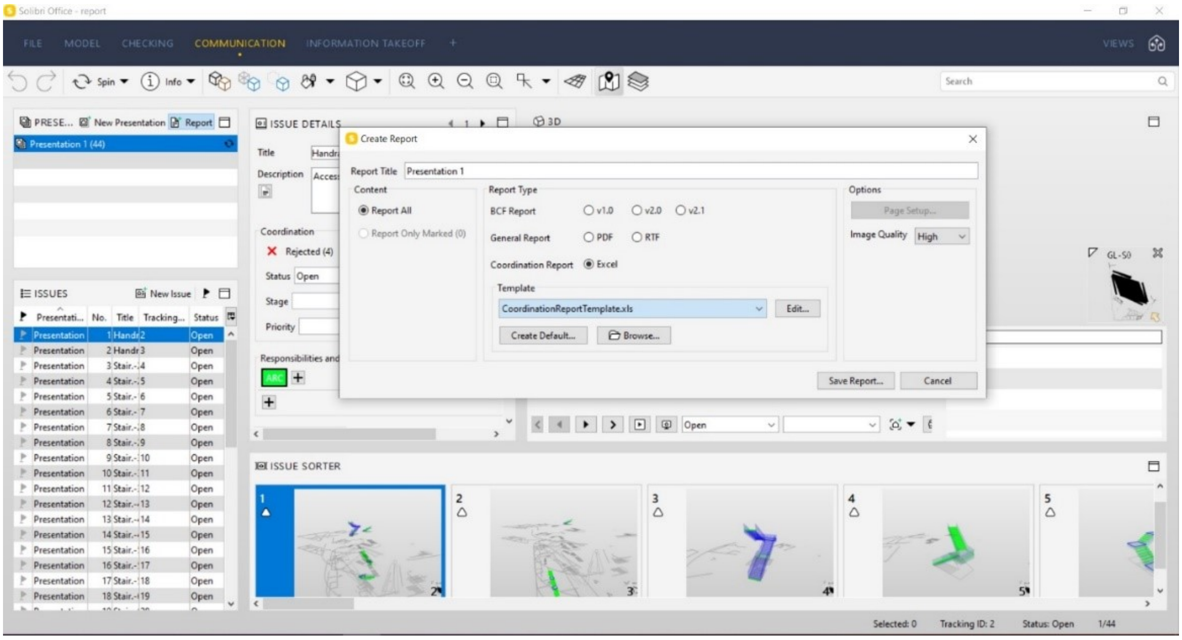


Figure 74 Issue Report

Result Summary

The detailed reports of the check results are given in the “attachments” in this thesis. Result summary part contains only a summary of the type and quantities of the issues and also extreme situations

Accessible Stairs Check

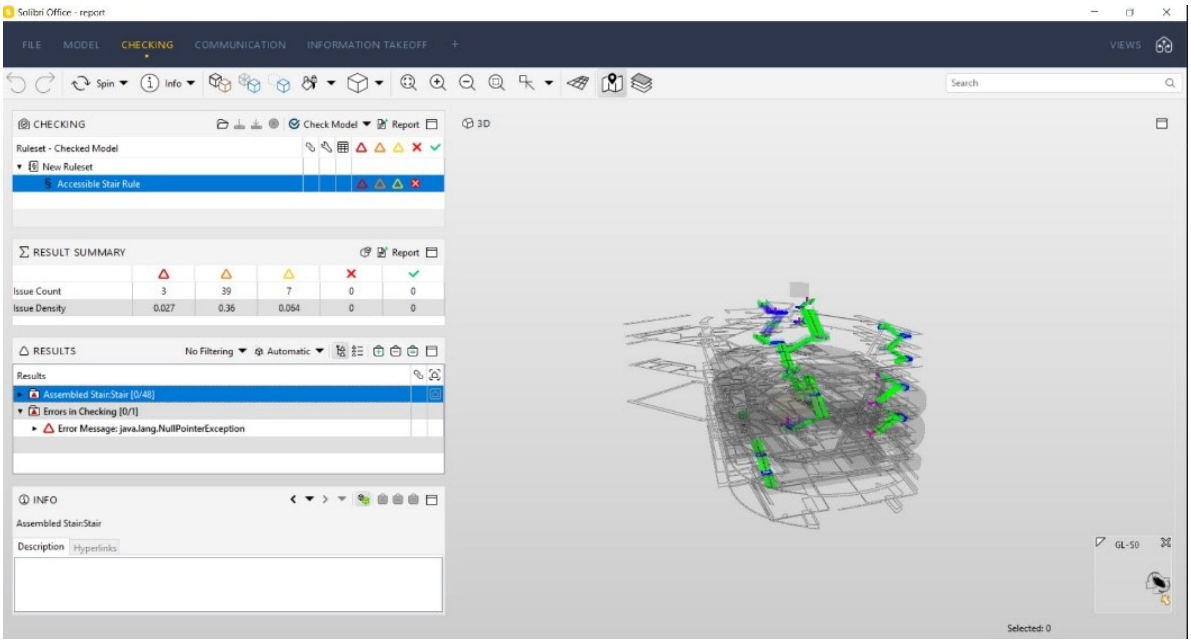
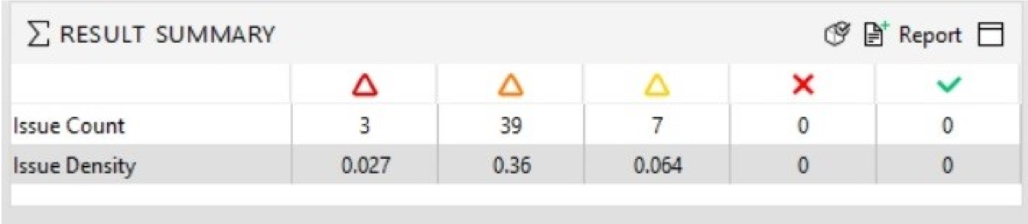


Figure 75 Accessible Stairs Check

According to the check 49 issued is found. 2 of them with the high severity, 1 of them is about error in checking, 39 of them moderate severity and 7 of them are low severity.



RESULT SUMMARY

	△	△	△	✕	✓
Issue Count	3	39	7	0	0
Issue Density	0.027	0.36	0.064	0	0

Figure 76 Result Summary

In S1 floor, stair 2.2 has riser height as 2.30m but the maximum height for the risers is 180 mm.

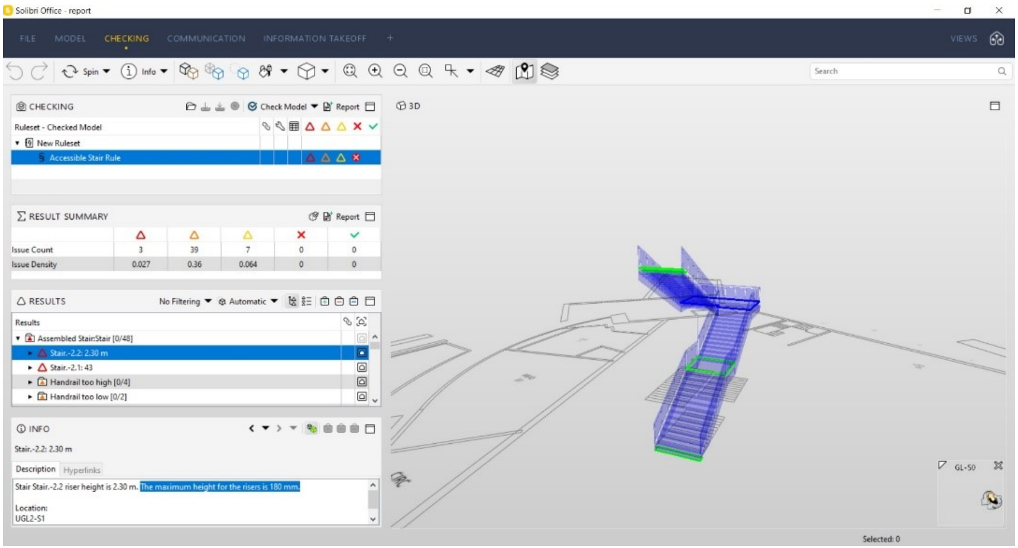


Figure 77 Issue Details

In S1 floor, 2.1 has 43 steps. The maximum number of steps is 20 steps.

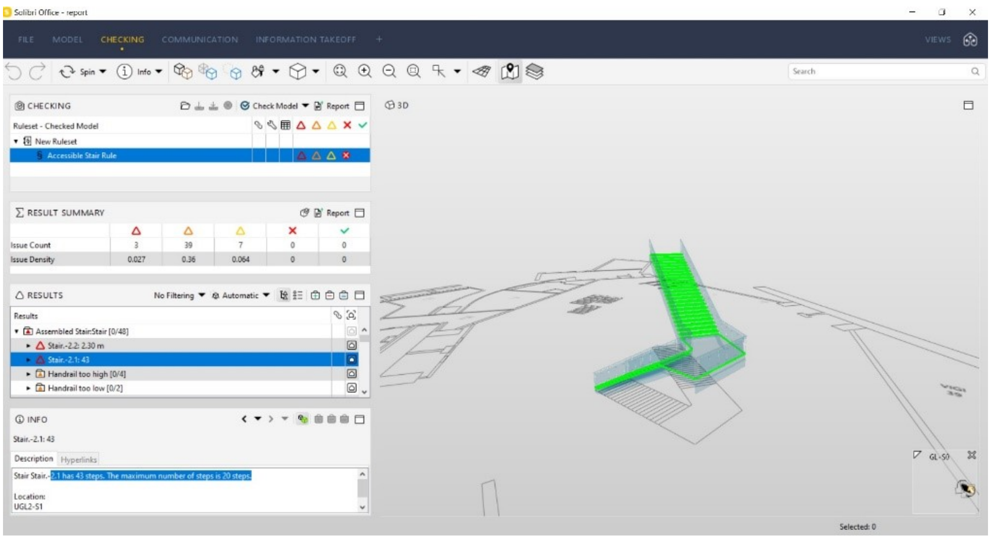


Figure 78 Issue Details

4 of the stairs' handrails height are higher than 1100 mm and 2 of the stairs' handrails height are lower than 900 mm.

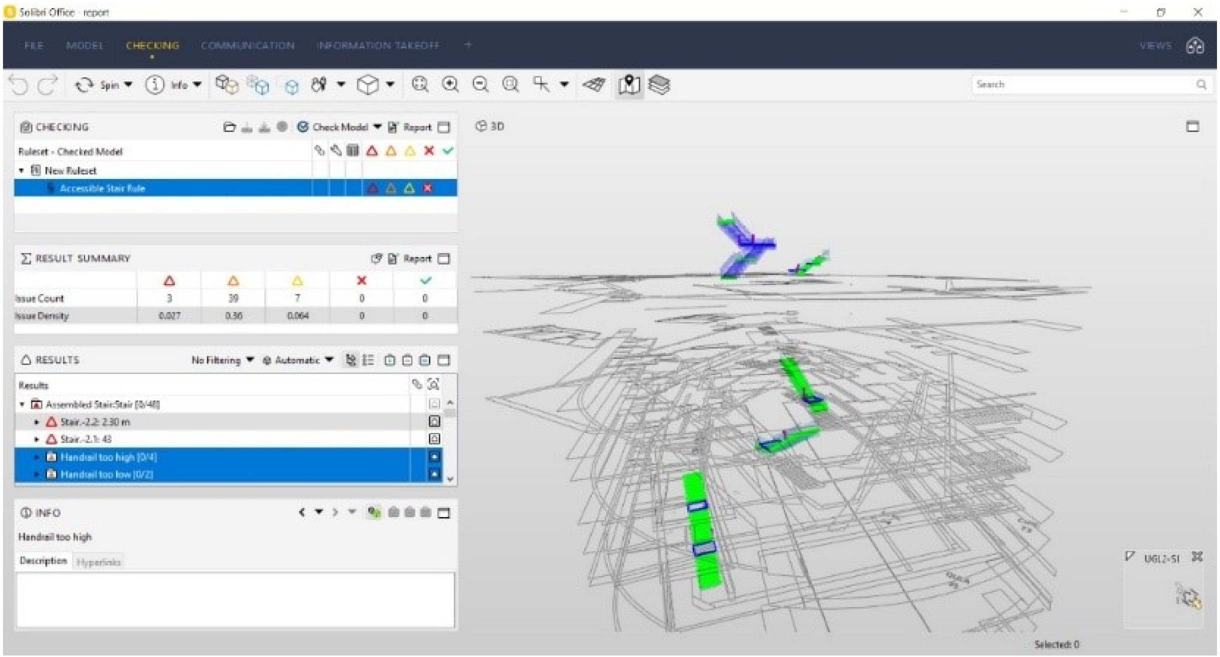


Figure 79 Issue Details

8 of the stairs does not have handrails both sides.

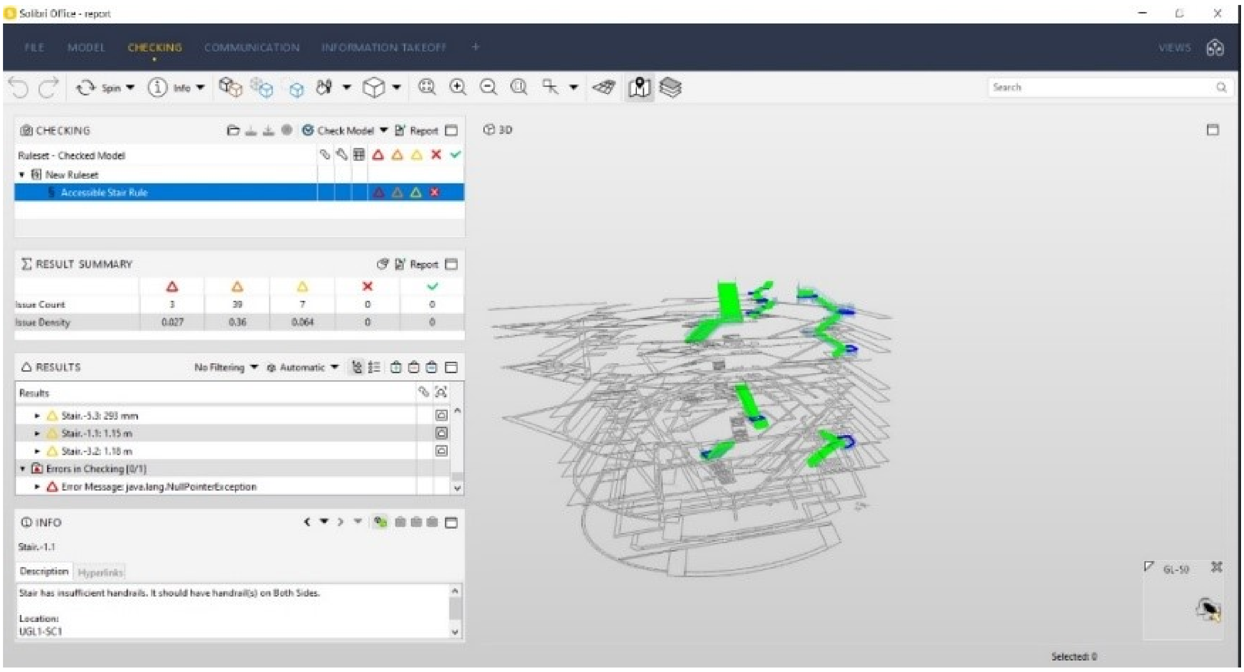


Figure 80 Issue Details

2 of the stairs has the width less than 1.20m.

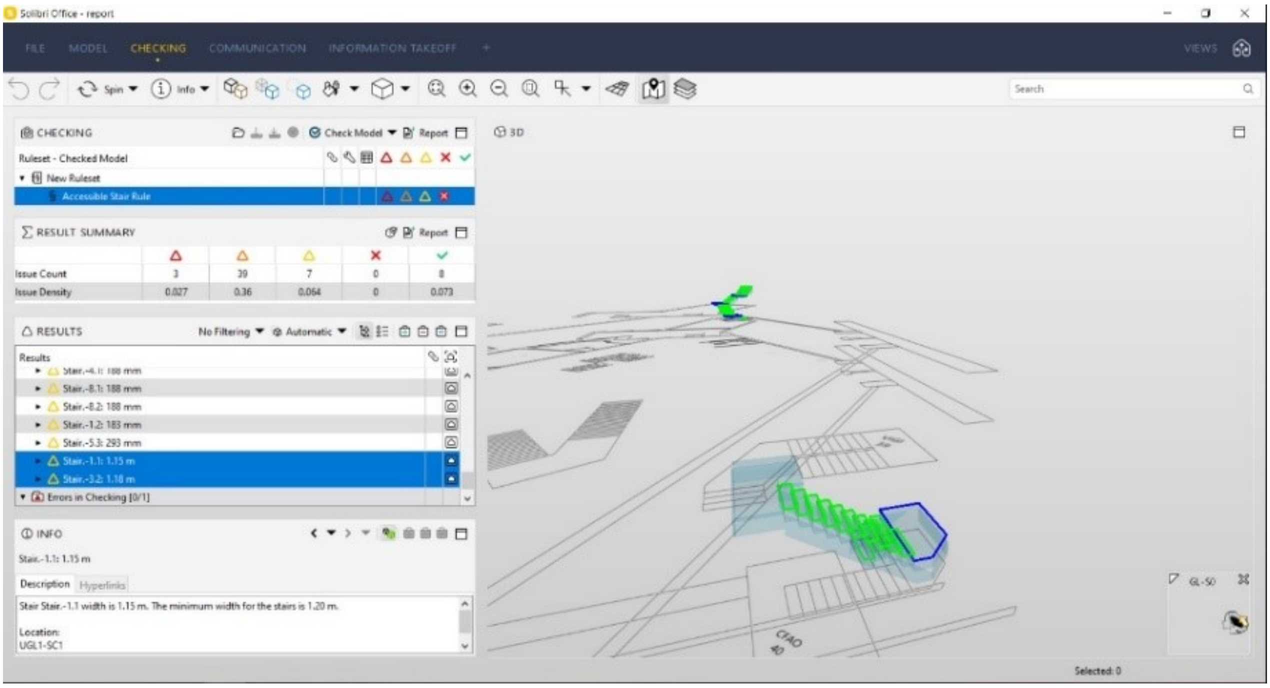


Figure 81 Issue Details

6 of them have riser height more than 180mm.

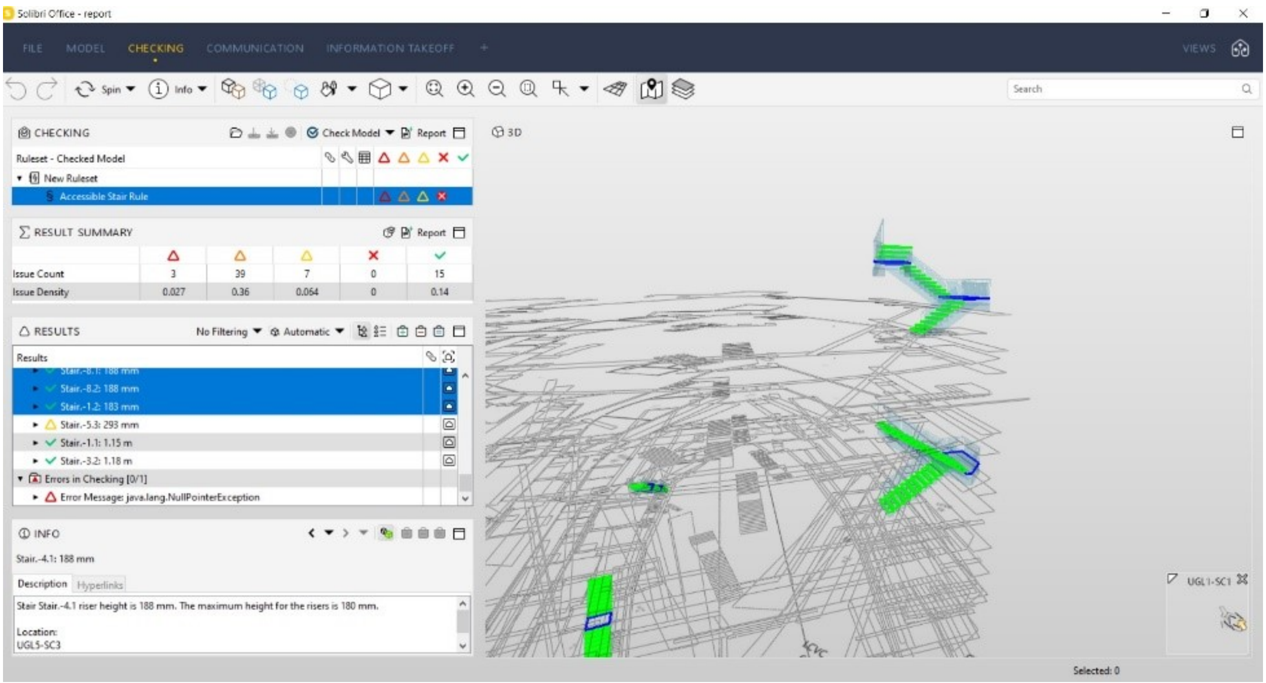


Figure 82 Issue Details

11 of them have length for the thread less than 300 mm.

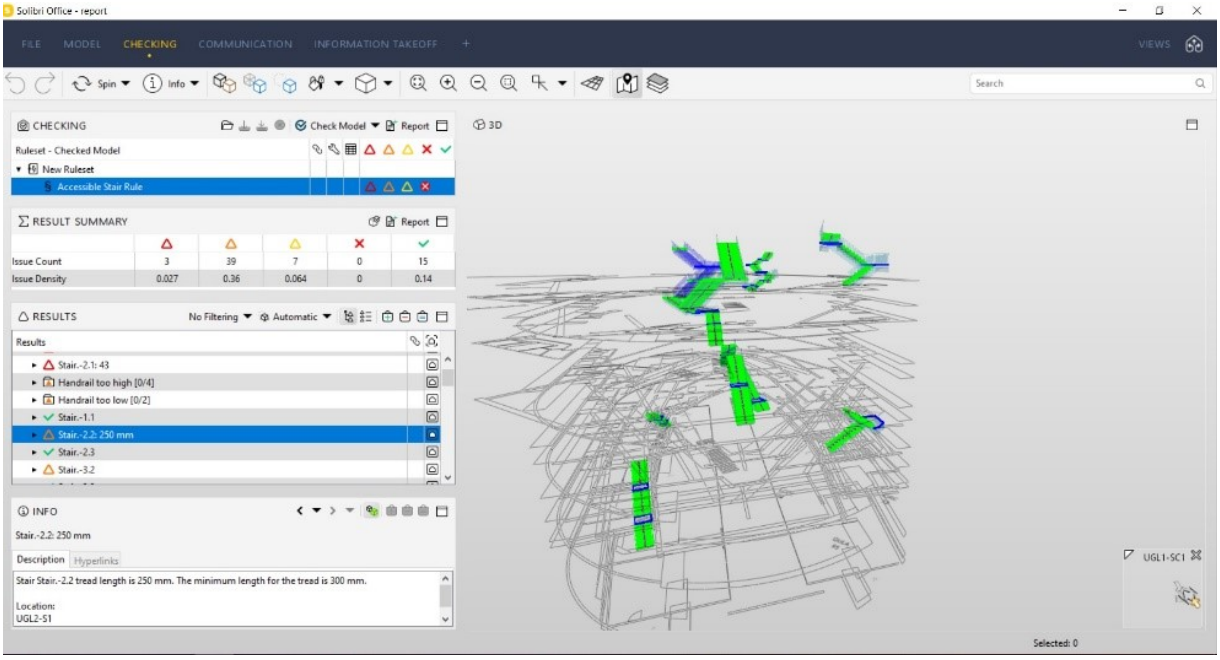


Figure 83 Issue Details

Accessible Door Check

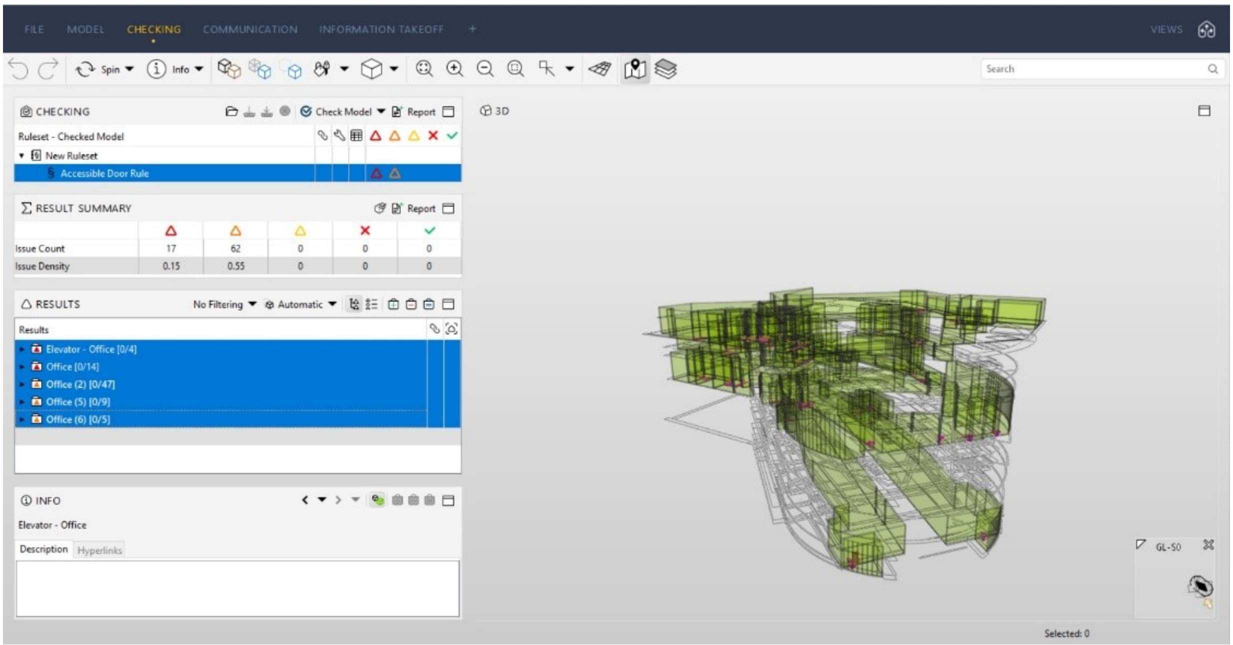


Figure 84 Accessible Door Check

According to the check 79 issued is found. 17 of them have the high severity, 62 of have moderate severity. 4 of them are related to the doors between Elevator and Office. 75 of them are related to the doors between offices.

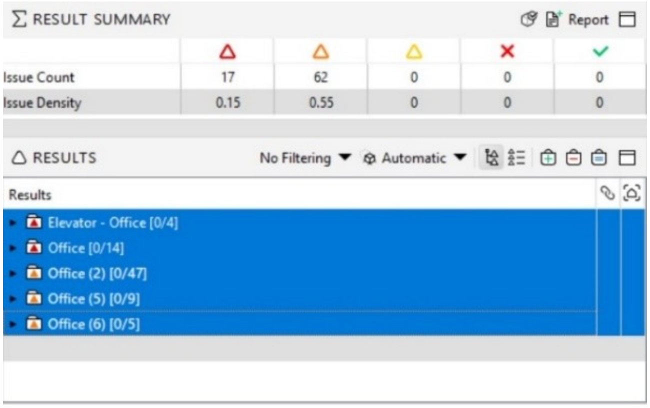


Figure 85 Result Summary

13 of the issues are related to the threshold, they are more than 25 mm.

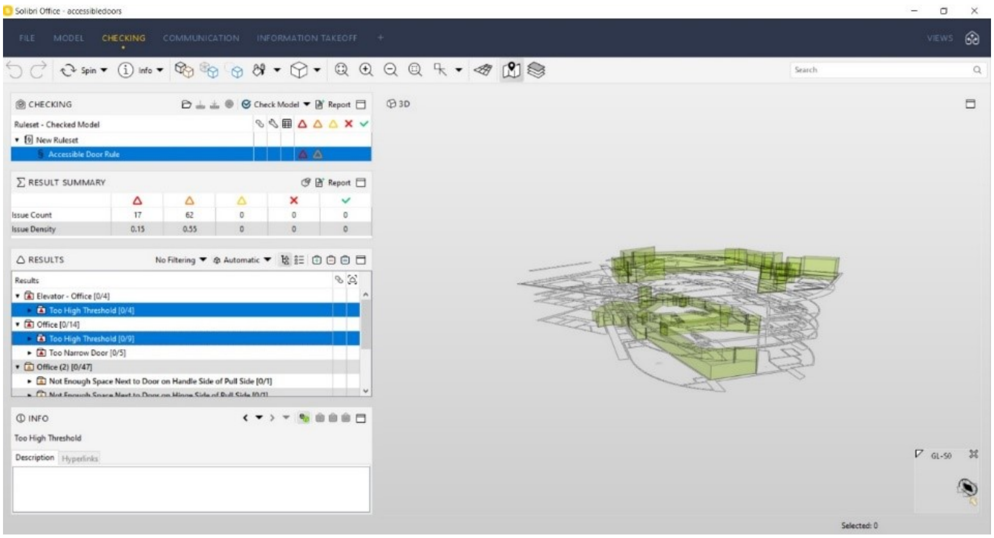


Figure 86 Issue Details

5 of issues are too narrow door, which means less than 900 mm.

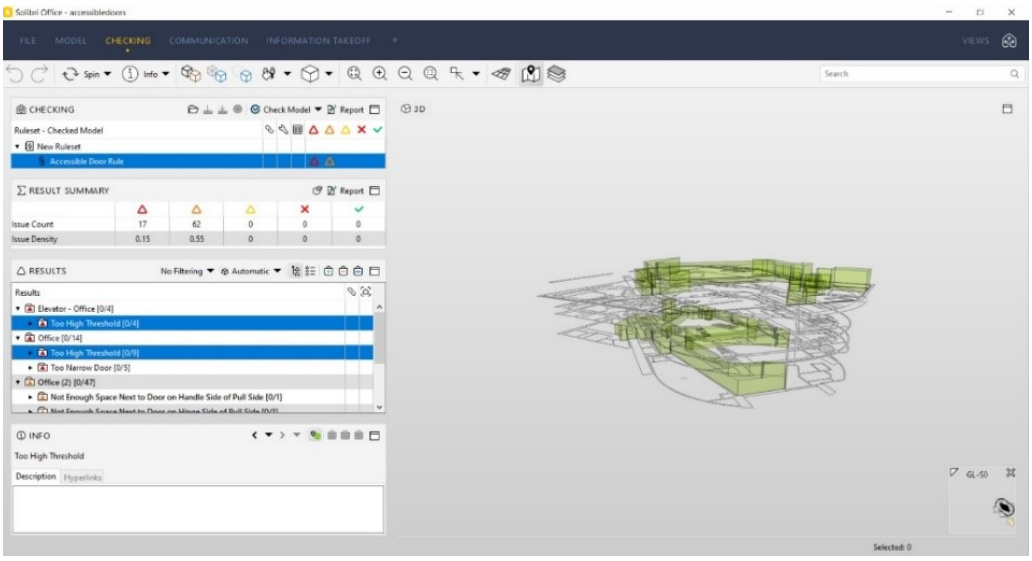


Figure 87 Issue Details

2 of the issues are; not enough space next door on handle side of pull side and not enough space next to door on hinge side of pull side.

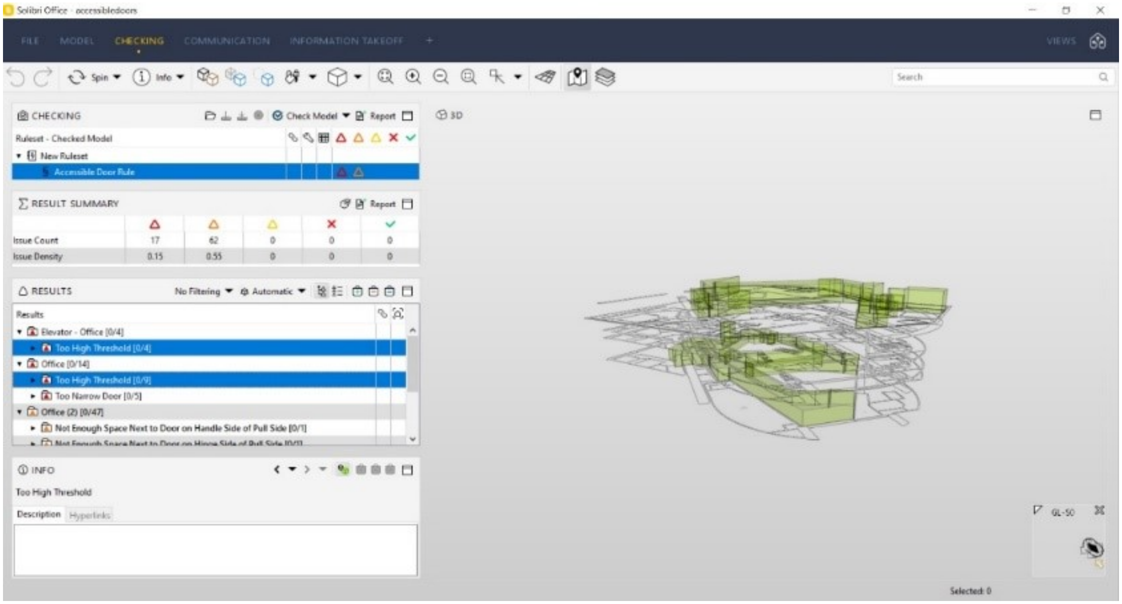


Figure 88 Issue Details

54 of the issues are described as “not enough space in front of door on pull side.

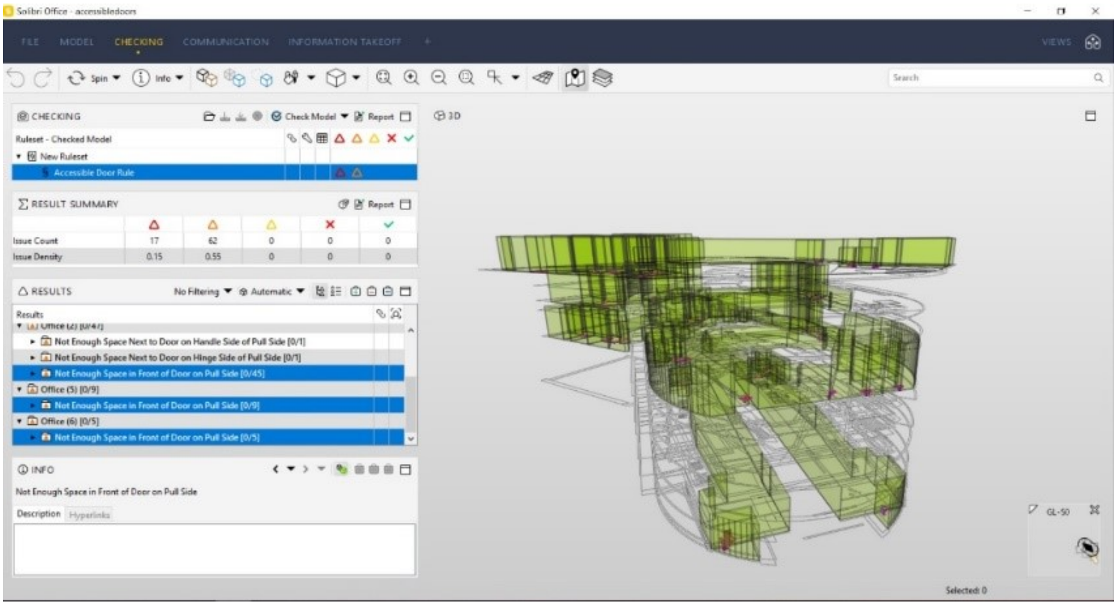


Figure 89 Issue Details

Accessible Route Check

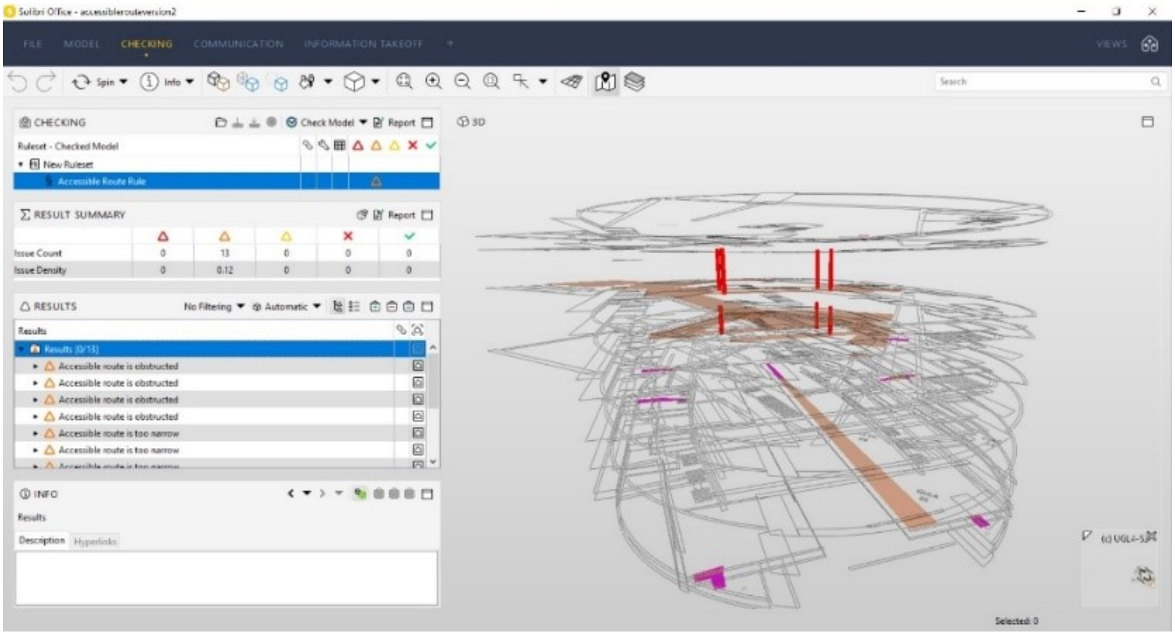
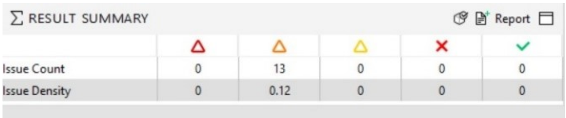


Figure 90 Accessible Route Check

According to the check 13 issued is found. All of them are with the moderate severity.



RESULT SUMMARY

	Critical	Moderate	Low	Rejected	Accepted
Issue Count	0	13	0	0	0
Issue Density	0	0.12	0	0	0

Figure 91 Result Summary

4 of the issues are related to the obstruction on the route. And these obstructions are caused by columns.

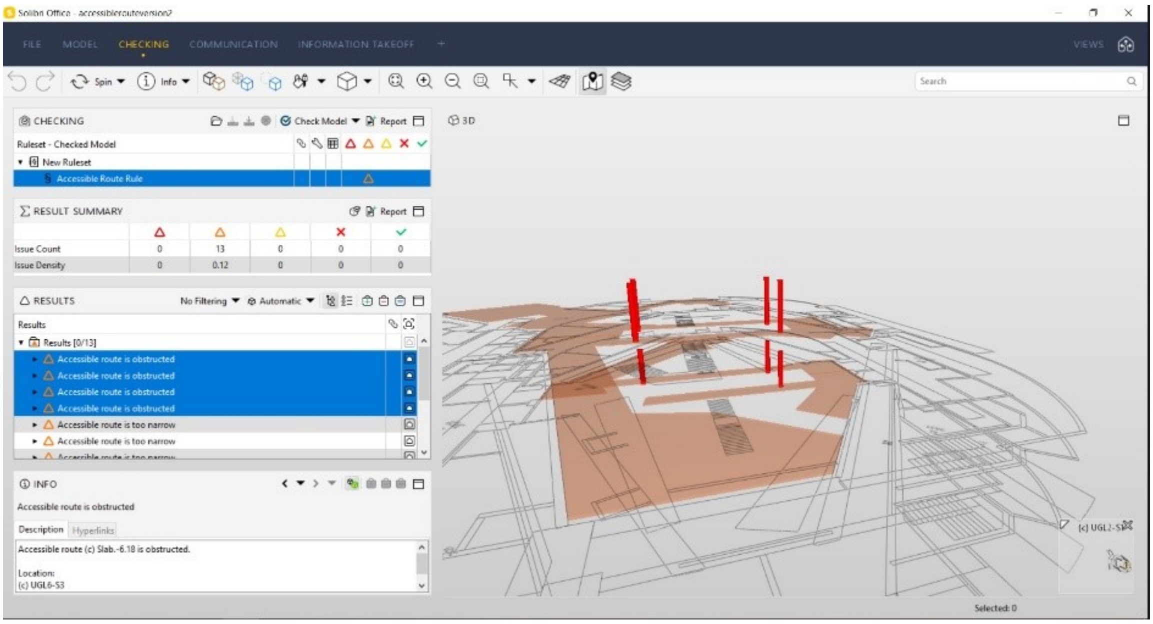


Figure 92 Issue Details

9 of the issues are related to the route being too narrow when it is compared to the requirements (1.8m). Narrow parts are colored in purple.

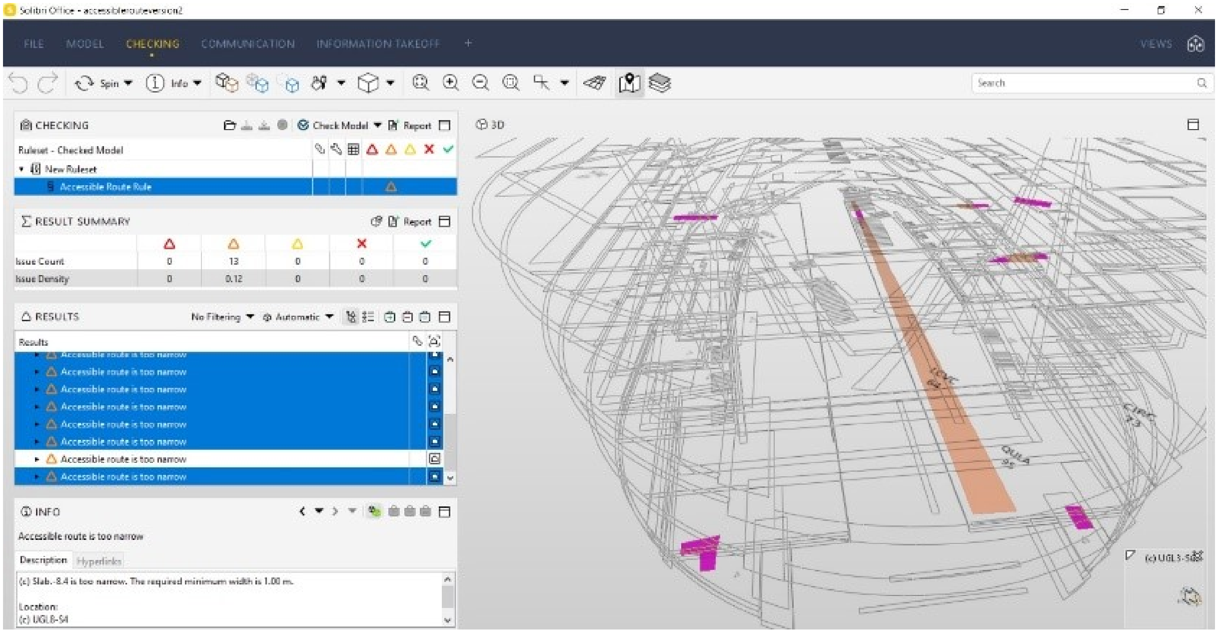


Figure 93 Issue Details

Finishing (arc) – Slab (str) Clash Detection

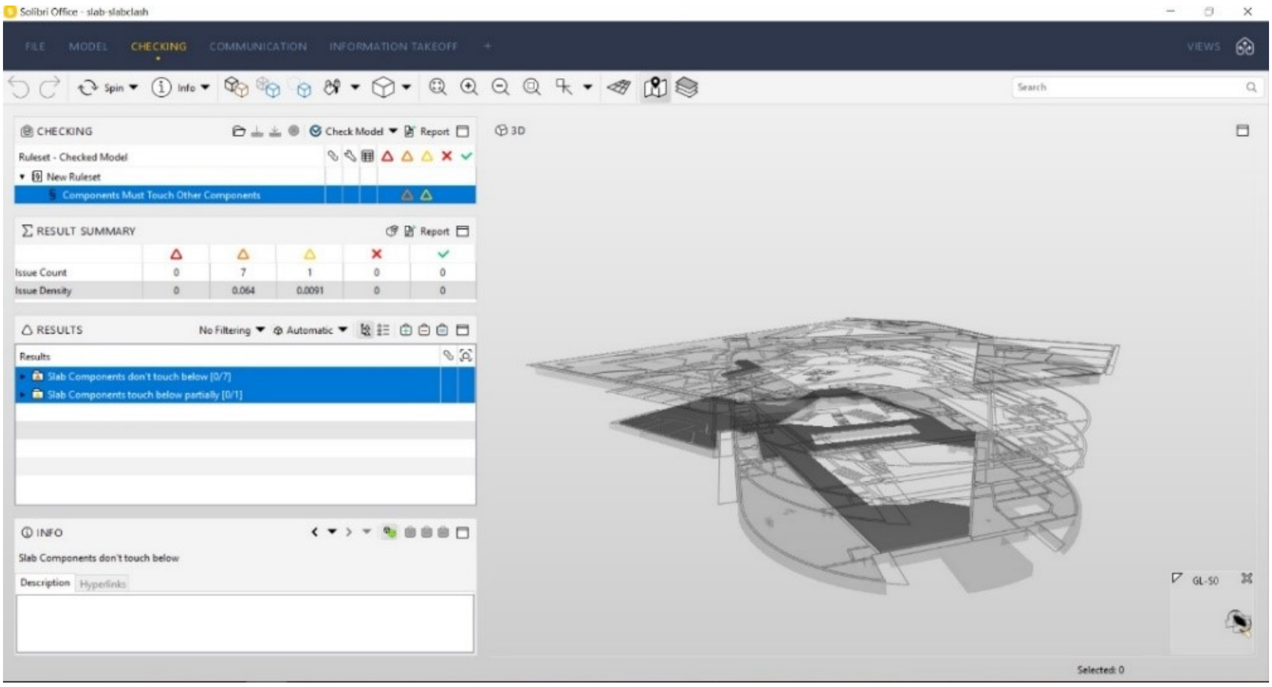


Figure 94 Finishing (arc) – Slab (str) Clash Detection

According to the check 8 issued is found. 7 of them have moderate severity and 1 of them has low severity.

∑ RESULT SUMMARY					Report
	△	△	△	✕	✓
Issue Count	0	7	1	0	0
Issue Density	0	0.064	0.0091	0	0

Figure 95 Result Summary

7 of the issues are described as the finishing do not touch to the component below. 2 of them is on floor S0 and 5 of them are on S2.

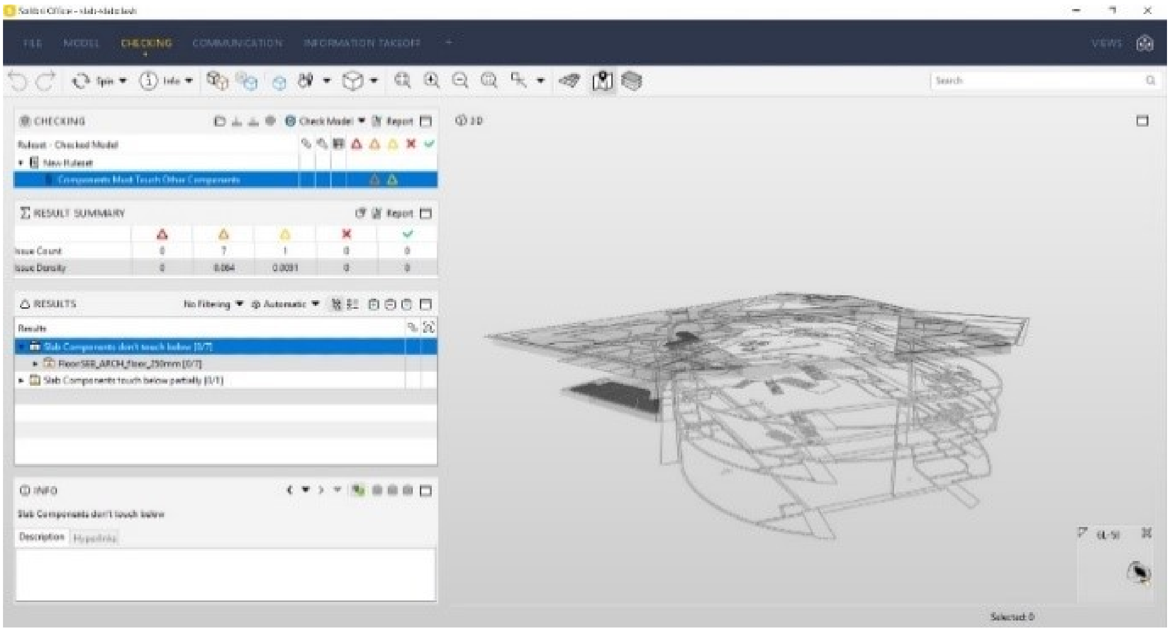


Figure 96 Issue Details

The other issue is the finishing on S2 floor does touch the component below partially (%72).

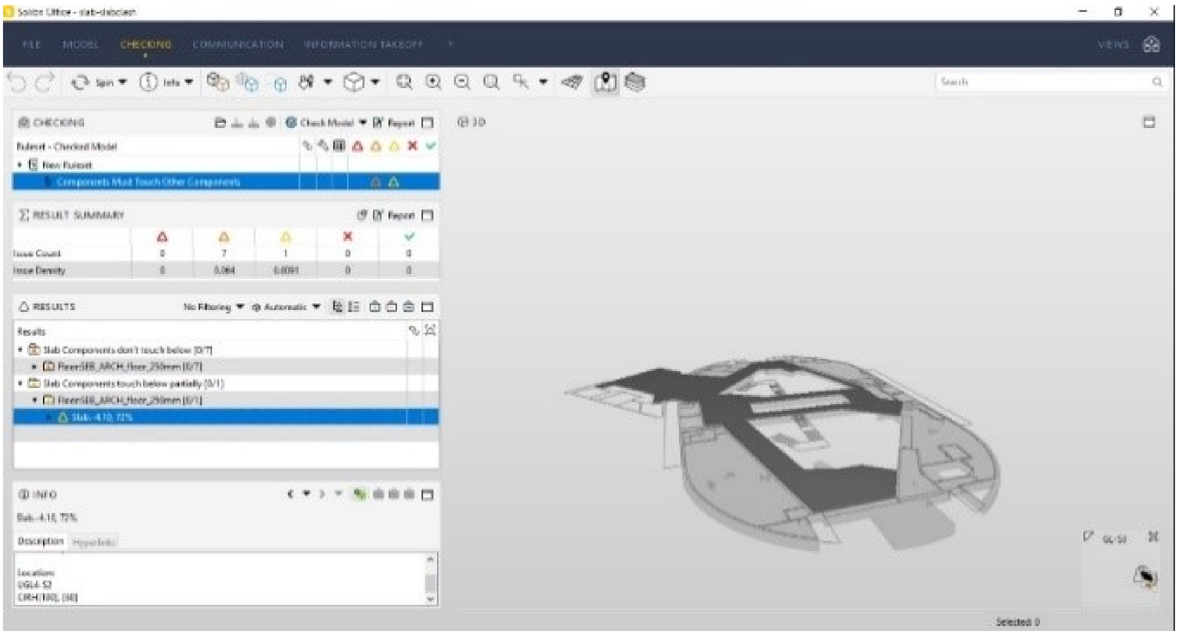


Figure 97 Issue Details

Stairs Clash Detection

According to the check 6 issued is found. 5 of them have high severity and 1 of them has error about checking. The issue is “slab does not touch any slab”.

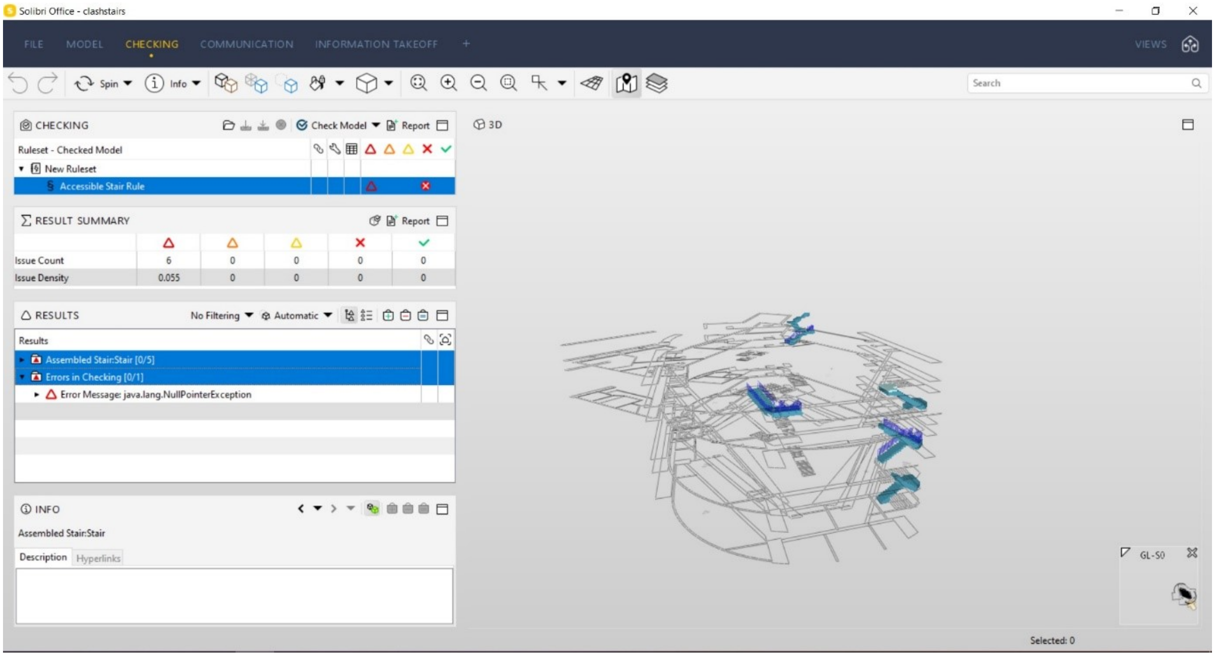


Figure 98 Stairs Clash Detection

Wall Intersection Clash Detection

In this check there is only one issue with moderate severity.The issue has this description “Intersecting Components in Different Floors”.

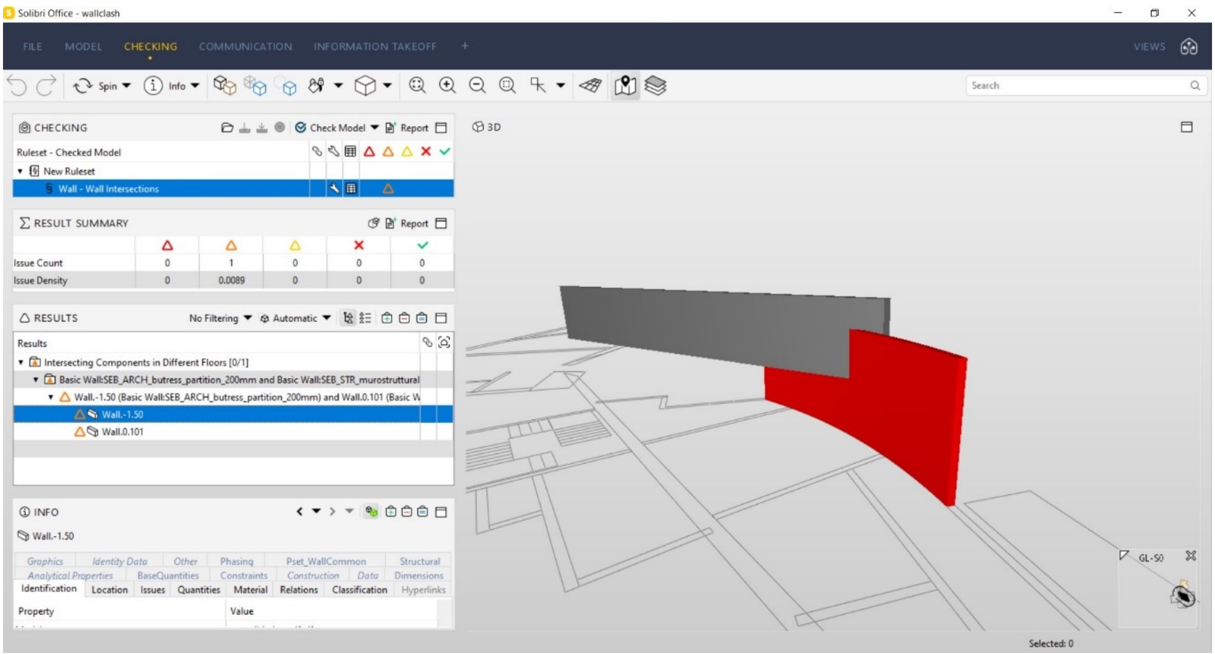


Figure 99 Wall Intersection Clash Detection

4.5 Result Sharing

As a part of the BIM based model checking, the results have to be shared with the participants of the project. For this thesis Design Information Coordinator and task teams should check the model and if it is not passed it should be sent back to the Work In Progress stage. While sending the result, the description must be done clearly and if there is a comment about issue it should be added in the file. The issue should have a revision number. A task team or member should be assigned according to its responsibility.

In this thesis BIMcollab is chosen as a issue management platform. The platform is open source, free to use and cloud based. But to reach all the settings the account should be upgraded to paid version. The advantage of cloud based platforms, they are reachable anywhere that has internet connection. BIMcollab is a platform, which works with Bim Collaboration File (bcf.) format.

It is already represented how to create reports in Solibri Model Checker. After creating report with BCF format it can be uploaded to BIMcollab platform. BCF (BIM Collaboration Format) is an open file format that allows the addition of textual comments, screenshots and more on top of the IFC model layer for better communication between coordinating parties. It separates the communication from the actual model. (BIMcollab)

First the user should sign up to the BIMcollab platform. After log in, a new project is created. The name, start date, end date, description and photo of the project is added to the platform.

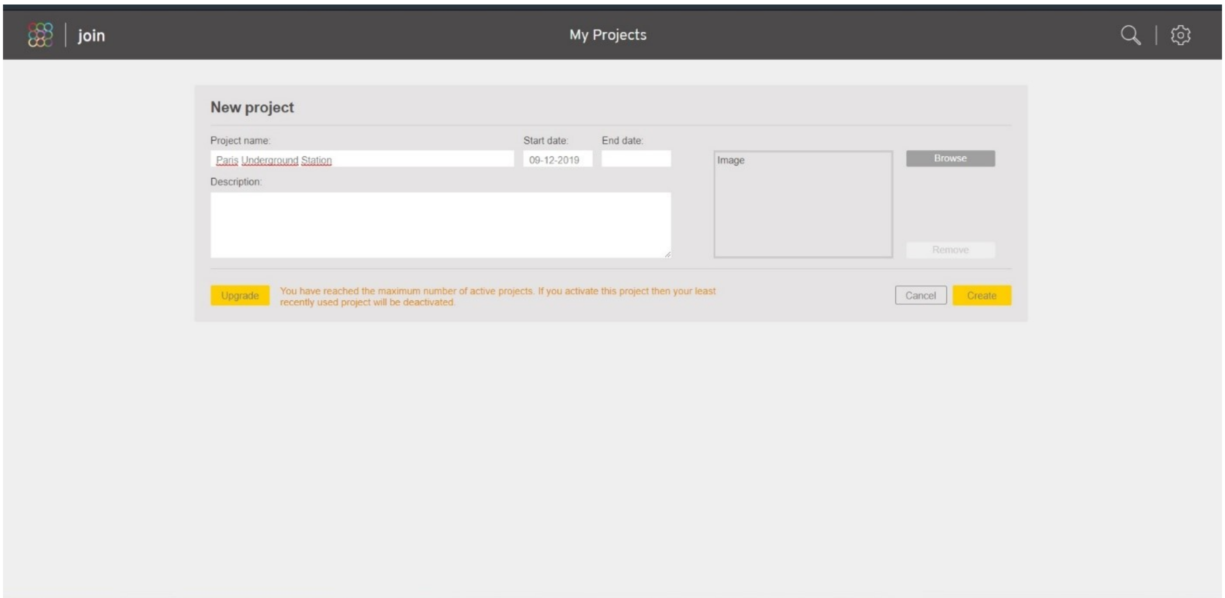


Figure 100 Creating New Project

After creating the project, the settings menu appears in the window. In this section we can add new members. By giving e-mail address, the invitation is sent to the person. In this area it can be chosen, which group the person is belong to, member role (viewer, Reviewer, editer), whether he/she can be assigned, if he/she is allowed to import BCF files.

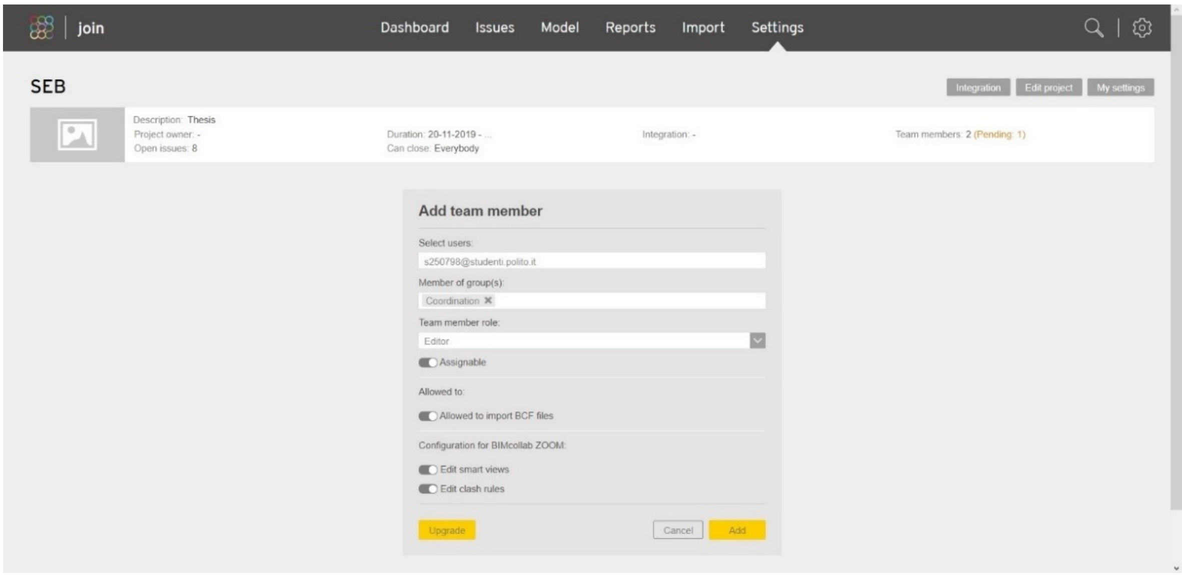


Figure 101 Adding team member

Other sections are; Milestones, Areas, Labels, Types, Priorities, Groups. Milestones means the phases of the project. Design phase is added with start and end dates.

Areas: The areas which all the issues will be assigned.

Labels: The label which will be added to the issue to show which discipline of the project it belongs. Labels can be added and removed.

Type: Type of the issue. (Clash, Fault, Request etc) A new type can be added.

Priorities: It represents the priority of the problem. The selections are Critical, Major, Normal, Minor, On Hold.

Groups: To give order to the members and issues there are groups. For example; an architect is in the architects group.

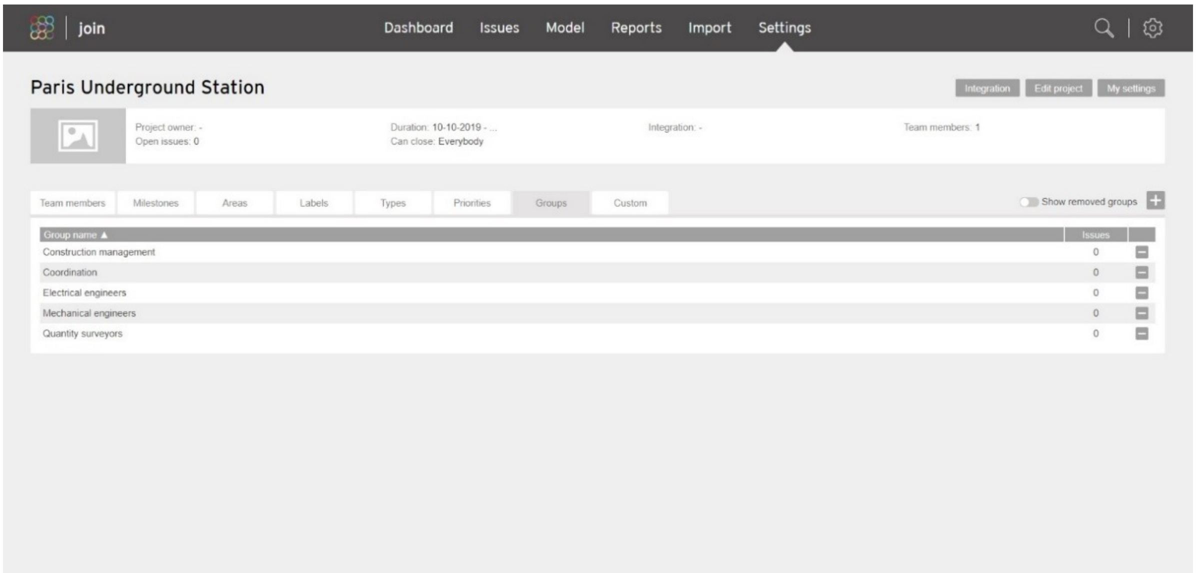


Figure 102Project Settings

To import BCF file. The “import” section is opened. Type, label, area, priority, milestone and assigned person is selected, and then by selecting “browse” the file is uploaded.

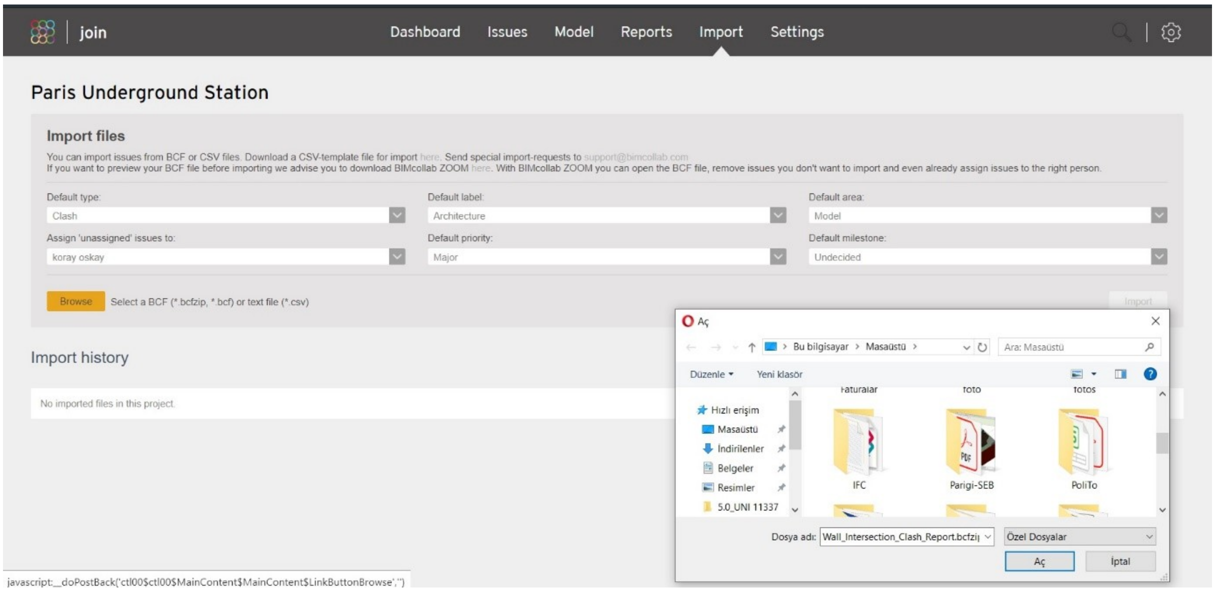


Figure 103 Importing Report

After importing files, the issues can be seen in the “issues” section as configured settings. Here all the issues can be seen if the member is allowed to see the issue. 3D model is also there. When it is checked the information about issues, it is seen that the issue keeps the information coming from the report that is created in Solibri.

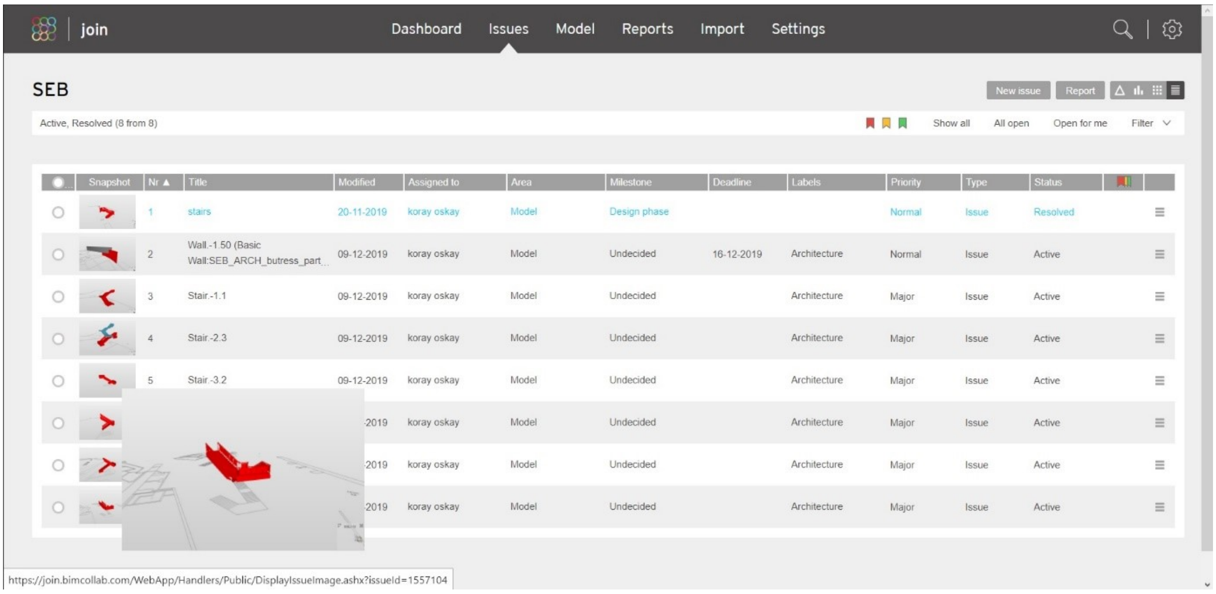


Figure 104 Issue Section

It is also possible to edit issue information and also in the issue there is a section for resolving, by clicking on it the status is changed to “Resolved”.

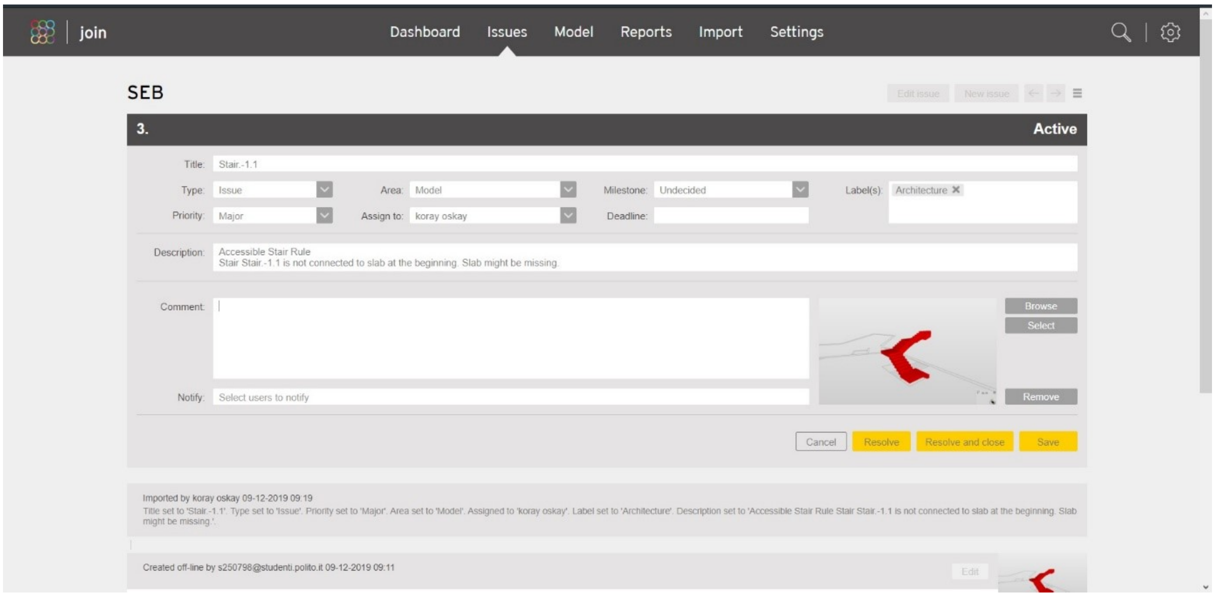


Figure 105 Editing Issue

In “Dashboard” section there is the summary of whole situation. It is shown how many issues waiting for you to resolve and issues waiting for your approval, total issues, average time to close, average open issues age. There is also charts which summarizes the situation. They are issue per status, open per milestone, open per area, open per type, open per priority.

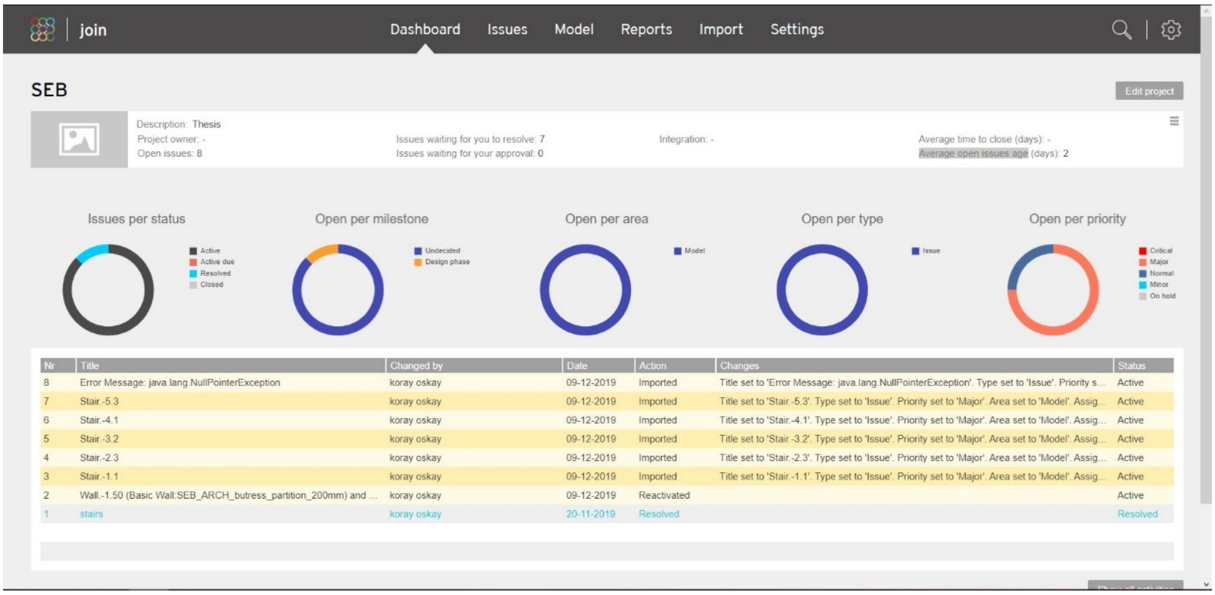


Figure 106 Dashboard

5. Conclusion and Future Developments

In the modern world with the effect of the daily growing technology, automatization of the processes has the major importance in the production processes. In construction industry, Building Information Modelling is leading the way of digitalization and automatization.

In thesis, firstly it is dealt with the missing phases of the particular project's phase by using Revit. Modelling with software and computer tools give extra boost and speed to the design phase of construction projects.

The main topic for this thesis is BIM Based Model Checking. First British, Italian and international standards is examined and compared. According to the examination a methodology and hierarchy is established. The standardization of the processes are essential, because if the process is related to the individuals, they cannot be ensured about the consistency and accuracy. Model checks are done with the software named Solibri Model Checker in two aspects. These aspects are Code Checking and Clash Detection. 3 rules for each aspects are chosen and check is done. Before these checks it is tried to examine the clashes and checks with naked eye and only using CAD files and Revit tools. Using BMC solutions are much more fast and accurate. Solibri Model Checker is able to detect the issue and it is also useful for identification and reporting the issues. The interoperability is quite high with the IFC format. For reporting, it has BCF, PDF, Excel formats, that enable the variety of information sharing. In Solibri Model Checker, the user should follow the rulesets to create a new rule. It is quite adequate, because Solibri Model Checker has a big library in terms of that. But it is still impossible to create rule from zero. This limits the independency of the user. As the last phase, the report is shared by using BCF format in BIMcollab platform. In this platform participants can see and edit the issues according to their responsibility. It is an easy platform to use. It is only for visualization of the issue and the status of the issue. Editing the model inside is not possible. Another problem is only BCF format and text file can be uploaded, so the model file cannot be sent.

For future works about this thesis; only one BMC tool is used to do the checks. By using another tool it can be compared with other softwares and the accuracy will be learned. Another aspect is, using other collaboration platforms such as BIM360. Comparing different companies solution will give more information about collaboration solutions.

Normally, as it is seen in Solibri Model Checker, it is not possible to "create" rules. Solibri allows us to configure its rules. But this rule is still not in a independent platform. An algorithm can be developed and the creation of one rule will be enough to use it in multiple BMC softwares. Instead of creating different rules for different softwares, one rule which is operable with (at least) many software will be more accurate, stable and faster solution.

References

American National Institute of Building Sciences, 2007. *National Building Information Modelling Standard.*

Autodesk, 2019. *Autodesk Revit- Learn & Explore- About Rooms* [Online]. Available at : https://knowledge.autodesk.com/support/revit-products/learn-explore/caas/CloudHelp/cloudhelp/2018/ENU/Revit-Model/files/GUID-DD74A51D-A0B0-4461-A4BA-0F9CCC191CDB-htm.html

Autodesk, 2015. *Autodesk Revit- Learn & Explore- Shared Parameters* [Online] Available at: https://knowledge.autodesk.com/support/revit-products/learn-explore/caas/CloudHelp/cloudhelp/2015/ENU/Revit-Model/files/GUID-E7D12B71-C50D-46D8-886B-8E0C2B285988-htm.html

Autodesk, 2019. *Autodesk Revit- Learn & Explore- Project Parameters* [Online] Available at: https://knowledge.autodesk.com/support/revit-products/learn-explore/caas/CloudHelp/cloudhelp/2020/ENU/Revit-Model/files/GUID-24033B80-62D4-4E04-AC15-FA8A6194A64F-htm.html

BIMcollab. *About BCF. [Online] Available at : https://www.bimcollab.com/en/Resources/OpenBIM/BCF*

Borrmann, 2008. *Using Geometrical and Topological Modelling Approaches in Building Information Modelling*

BSI (British Standards Institution), 2018. *BS EN ISO 19650, Organization and digitization of information about buildings and civil engineering Works, including building information modelling (BIM) – Information management using building information modelling.*

BSI (British Standards Institution), 2013. *PAS 1192 Specification for information management for the capital/delivery phase of construction projects using building information modelling*

BSI (British Standards Institution), 2018. *BS 8300 Design of an accessible and inclusive built environment*

CSI, 2010. *UniFormat: A Uniform Classification of Construction Systems and Assemblies*

Ente Italiano di Normazione, 2017. *UNI 11337*

Fonsati, Arianna; Osello, Anna; Damiani, Alessandro 2018. *A BIM-based infrastructural project approach for time and cost estimation- RAPPRESENTAZIONE/MATERIALE/IMMATERIALE*

DRAWING AS (IN)TANGIBLE REPRESENTATION ROMA. Editor: Gangemi Editore Spa International

Hjelseth and Nisbet, 2014. *Overview of concepts for model checking.*

Hjelseth, E ,2009*. Foundation for development of computable rules.* Norway October 2009

Lipp, John. *Creating Classifications in SMC* [Online] Available at: https://solibri.wordpress.com/2015/06/30/creating-classifications-in-smc/

NBS. *Clash Detection in BIM* [Online]. Available at : https://www.thenbs.com/knowledge/clash-detection-in-bim

Attachments

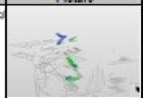
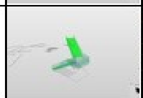
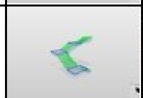
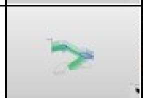
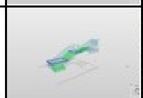
Accessible Stairs Check Report

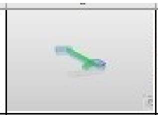
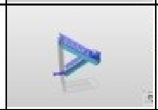
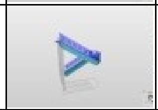
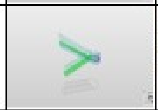
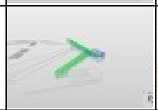
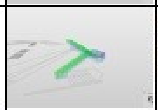
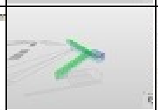
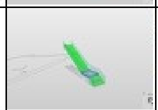
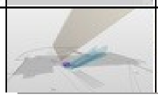
SOLIBRI A NEMETSCHEK COMPANY

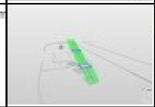
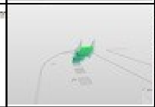
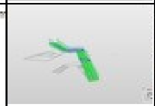
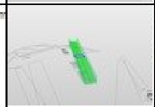
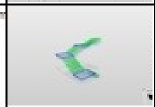
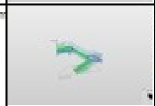
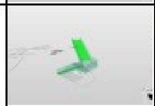
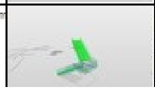
AccessibleStairsRepor

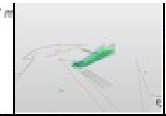
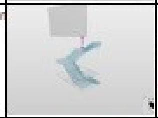
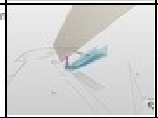
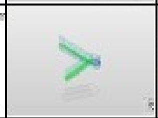
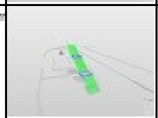
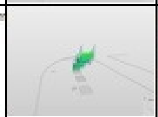
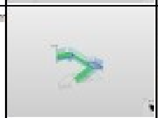
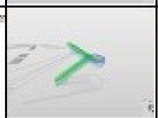
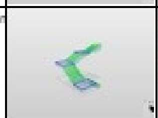
Model Name	report Version: 9.10
Checker	s250798@studenti.polito.it
Organization	DrawingTOthefuture
Date	December 4, 2019
SEB_LMB_00_Z2_M3_ARCH_000001.ifc	Date: 2019-10-30 02:39:18 Application: Autodesk Revit 2019 (ENU) IFC: IFC2X3

Presentation 1

Number	Id	Location	Date	Author	Title	Picture	Issue Description	Issue Comment	Responsibilities	Stage	Due Date	Labels	Action Required	Action Taken	Status	Priority
1	2	UGL2-S1, UGL8-S4 ROOM[82], ROOM[74], LSSI[34], PEFO[33]	4-Dec-2019	s250798@stude	Handrail too hig		Accessible Stair Rule		ARC		2019-12-16				Open	
2	3	UGL2-S1, UGL11-Q5 STEM[93], LSSI[34], PEFO[33]	4-Dec-2019	s250798@stude	Handrail too low		Accessible Stair Rule				2019-12-17				Open	
3	4	UGL2-S1 ROOM[82]	4-Dec-2019	s250798@stude	Stair.-2.2: 2.30 r		Accessible Stair Rule Stair Stair.-2.2 riser height is 2.30 m. The maximum height for the risers is 180 mm.		ARC		2019-12-16				Open	
4	5	UGL2-S1 LCLO[26]	4-Dec-2019	s250798@stude	Stair.-2.1: 43		Accessible Stair Rule Stair Stair.-2.1 has 43 steps. The maximum number of steps is 20 steps.		ARC		2019-12-16				Open	
5	6	UGL1-SC1 CIRC[38], PEFO[33]	4-Dec-2019	s250798@stude	Stair.-1.1		Accessible Stair Rule Stair has insufficient handrails. It should have handrail(s) on Both Sides.				2019-12-16				Open	
6	7	UGL1-SC1 VIGI[39]	4-Dec-2019	s250798@stude	Stair.-1.2		Accessible Stair Rule Stair has insufficient handrails. It should have handrail(s) on Both Sides.		ARC		2019-12-16				Open	
7	8	UGL2-S1 ROOM[82]	4-Dec-2019	s250798@stude	Stair.-2.2: 250 m		Accessible Stair Rule Stair Stair.-2.2 tread length is 250 mm. The minimum length for the tread is 300 mm.				2019-12-16				Open	
8	9	UGL2-S1 PEFO[33], LSSI[34]	4-Dec-2019	s250798@stude	Stair.-2.3		Accessible Stair Rule Stair has insufficient handrails. It should have handrail(s) on Both Sides.				2019-12-16				Open	
9	10	UGL4-S2 VIGI[39], CFAC[40]	4-Dec-2019	s250798@stude	Stair.-3.2		Accessible Stair Rule Stair SStair.2089 has a landing with clear width of less than the required 900 mm.				2019-12-17				Open	

10	11	UGL4-S2 VIGI[39], CFAC[40]	4-Dec-2019	s250798@stud	Stair.-3.2		Accessible Stair Rule Stair has insufficient handrails. It should have handrail(s) on Both Sides.				2019-12-16				Open	
11	12	UGL4-S2 VIGI[39], CFAC[40]	4-Dec-2019	s250798@stud	Stair.-3.2: 189 m		Accessible Stair Rule Stair Stair.-3.2 riser height is 189 mm. The maximum height for the risers is 180 mm.				2019-12-16				Open	
12	13	UGL5-SC3 LCVC[54], CIRC[55], [56]	4-Dec-2019	s250798@stud	Stair.-4.1		Accessible Stair Rule Not enough space at the beginning of Stair.-4.1. - Component Wall.-3.56 intersects the required free area with dimensions 734				2019-12-16				Open	
13	14	UGL5-SC3 LCVC[54], CIRC[55], [56]	4-Dec-2019	s250798@stud	Stair.-4.1		Accessible Stair Rule Not enough space at the end of Stair.-4.1. - Component Wall.-3.57 intersects the required free area with dimensions 1.00				2019-12-16				Open	
14	15	UGL5-SC3 LCVC[54], CIRC[55], [56]	4-Dec-2019	s250798@stud	Stair.-4.1		Accessible Stair Rule Stair SStair.1843 has a landing with clear width of less than the required 900 mm.				2019-12-16				Open	
15	16	UGL6-S3 LCVC[75]	4-Dec-2019	s250798@stud	Stair.-5.3		Accessible Stair Rule Stair SStair.3075 has a landing with clear width of less than the required 900 mm.				2019-12-16				Open	
16	17	UGL6-S3 LCVC[75]	4-Dec-2019	s250798@stud	Stair.-5.3		Accessible Stair Rule Stair has insufficient handrails. It should have handrail(s) on Both Sides.		ARC		2019-12-16				Open	
17	18	UGL6-S3 LCVC[75]	4-Dec-2019	s250798@stud	Stair.-5.3: 189 m		Accessible Stair Rule Stair Stair.-5.3 riser height is 189 mm. The maximum height for the risers is 180 mm.		ARC		2019-12-16				Open	
18	19	UGL8-S4 ROOM[82], ROOM[74]	4-Dec-2019	s250798@stud	Stair.-6.1		Accessible Stair Rule Stair has insufficient handrails. It should have handrail(s) on Both Sides.		ARC		2019-12-16				Open	
19	20	UGL8-S4 ROOM[82], ROOM[74]	4-Dec-2019	s250798@stud	Stair.-6.1: 24		Accessible Stair Rule Stair Stair.-6.1 has 24 steps. The maximum number of steps is 20 steps.		ARC		2019-12-16				Open	
20	21	UGL8-S4 ROOM[82], ROOM[74]	4-Dec-2019	s250798@stud	Stair.-6.1: 277 m		Accessible Stair Rule Stair Stair.-6.1 tread length is 277 mm. The minimum length for the tread is 300 mm.		ARC		2019-12-16				Open	
21	22	UGL8-S4 ROOM[82], ROOM[74]	4-Dec-2019	s250798@stud	Stair.-6.2		Accessible Stair Rule Not enough space at the beginning of Stair.-6.2. - Component Wall.-5.28 intersects the required free		ARC		2019-12-16				Open	

22	23	UGL8-S4 ROOM[82], ROOM[74]	4-Dec-2019	s250798@stude	Stair.-6.2		Accessible Stair Rule Stair has insufficient handrails. It should have handrail(s) on Both Sides.		ARC		2019-12-16				Open	
23	24	UGL8-S4 ROOM[82], ROOM[74]	4-Dec-2019	s250798@stude	Stair.-6.2: 24		Accessible Stair Rule Stair Stair.-6.2 has 24 steps. The maximum number of steps is 20 steps.		ARC		2019-12-16				Open	
24	25	UGL11-Q5 STEM[93]	4-Dec-2019	s250798@stude	Stair.-8.1: 250 m		Accessible Stair Rule Stair Stair.-8.1 tread length is 250 mm. The minimum length for the tread is 300 mm.		ARC		2019-12-16				Open	
25	26	UGL11-Q5 LSCA[63]	4-Dec-2019	s250798@stude	Stair.-8.2: 250 m		Accessible Stair Rule Stair Stair.-8.2 tread length is 250 mm. The minimum length for the tread is 300 mm.		ARC		2019-12-16				Open	
26	27	UGL2-S1 PEFO[33], LSSI[34]	4-Dec-2019	s250798@stude	Stair.-2.3: 274 m		Accessible Stair Rule Stair Stair.-2.3 tread length is 274 mm. The minimum length for the tread is 300 mm.		ARC		2019-12-16				Open	
27	28	UGL4-S2 ROOM[82]	4-Dec-2019	s250798@stude	Stair.-3.1: 274 m		Accessible Stair Rule Stair Stair.-3.1 tread length is 274 mm. The minimum length for the tread is 300 mm.		ARC		2019-12-16				Open	
28	29	UGL6-S3 ROOM[82]	4-Dec-2019	s250798@stude	Stair.-5.1: 274 m		Accessible Stair Rule Stair Stair.-5.1 tread length is 274 mm. The minimum length for the tread is 300 mm.		ARC		2019-12-16				Open	
29	30	UGL6-S3 ROOM[82]	4-Dec-2019	s250798@stude	Stair.-5.2: 274 m		Accessible Stair Rule Stair Stair.-5.2 tread length is 274 mm. The minimum length for the tread is 300 mm.		ARC		2019-12-16				Open	
30	31	UGL1-SC1 CIRC[38], PEFO[33]	4-Dec-2019	s250798@stude	Stair.-1.1: 275 m		Accessible Stair Rule Stair Stair.-1.1 tread length is 275 mm. The minimum length for the tread is 300 mm.		ARC		2019-12-16				Open	
31	32	UGL1-SC1 VIGI[39]	4-Dec-2019	s250798@stude	Stair.-1.2: 277 m		Accessible Stair Rule Stair Stair.-1.2 tread length is 277 mm. The minimum length for the tread is 300 mm.		ARC		2019-12-16				Open	
32	33	UGL2-S1 LCLO[26]	4-Dec-2019	s250798@stude	Stair.-2.1		Accessible Stair Rule Stair has insufficient handrails. It should have handrail(s) on Both Sides.		ARC		2019-12-17				Open	
33	34	UGL2-S1 LCLO[26]	4-Dec-2019	s250798@stude	Stair.-2.1: 277 m		Accessible Stair Rule Stair Stair.-2.1 tread length is 277 mm. The minimum length for the tread is 300 mm.		ARC		2019-12-16				Open	

34	35	UGL8-S4 ROOM[82], ROOM[74]	4-Dec-2019	s250798@stude	Stair.-6.2: 277 m		Accessible Stair Rule Stair Stair.-6.2 tread length is 277 mm. The minimum length for the tread is 300 mm.		ARC		2019-12-17				Open	
35	36	UGL1-SC1 CIRC[38], PEFO[33]	4-Dec-2019	s250798@stude	Stair.-1.1: 1.38 m		Accessible Stair Rule The head clearance height above the stair Stair.-1.1 is 1.38 m. The minimum height for the stairs is 2.10 m.		ARC		2019-12-16				Open	
36	37	UGL8-S4 ROOM[82], ROOM[74]	4-Dec-2019	s250798@stude	Stair.-6.2: 1.86 m		Accessible Stair Rule The head clearance height above the stair Stair.-6.2 is 1.86 m. The minimum height for the stairs is 2.10 m.		ARC		2019-12-16				Open	
37	38	UGL5-SC3 LCVC[54], CIRC[55], [56]	4-Dec-2019	s250798@stude	Stair.-4.1: 188 m		Accessible Stair Rule Stair Stair.-4.1 riser height is 188 mm. The maximum height for the risers is 180 mm.		ARC		2019-12-16				Open	
38	39	UGL11-Q5 STEM[93]	4-Dec-2019	s250798@stude	Stair.-8.1: 188 m		Accessible Stair Rule Stair Stair.-8.1 riser height is 188 mm. The maximum height for the risers is 180 mm.		ARC		2019-12-16				Open	
39	40	UGL11-Q5 LSCA[63]	4-Dec-2019	s250798@stude	Stair.-8.2: 188 m		Accessible Stair Rule Stair Stair.-8.2 riser height is 188 mm. The maximum height for the risers is 180 mm.		ARC		2019-12-16				Open	
40	41	UGL1-SC1 VIGI[39]	4-Dec-2019	s250798@stude	Stair.-1.2: 183 m		Accessible Stair Rule Stair Stair.-1.2 riser height is 183 mm. The maximum height for the risers is 180 mm.		ARC		2019-12-16				Open	
41	42	UGL6-S3 LCVC[75]	4-Dec-2019	s250798@stude	Stair.-5.3: 293 m		Accessible Stair Rule Stair Stair.-5.3 tread length is 293 mm. The minimum length for the tread is 300 mm.		ARC		2019-12-17				Open	
42	43	UGL1-SC1 CIRC[38], PEFO[33]	4-Dec-2019	s250798@stude	Stair.-1.1: 1.15 m		Accessible Stair Rule Stair Stair.-1.1 width is 1.15 m. The minimum width for the stairs is 1.20 m.		ARC		2019-12-16				Open	
43	44	UGL4-S2 VIGI[39], CFAC[40]	4-Dec-2019	s250798@stude	Stair.-3.2: 1.18 m		Accessible Stair Rule Stair Stair.-3.2 width is 1.18 m. The minimum width for the stairs is 1.20 m.		ARC		2019-12-16				Open	
44	45	UGL4-S2 QULA[96]	4-Dec-2019	s250798@stude	Error Message:		Accessible Stair Rule Please send this error message and application information to <a href="mailto:support@solibri.com">support@solibri.co				2019-12-16				Open	

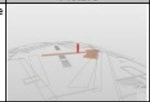
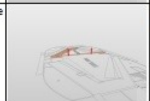
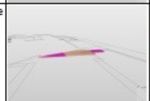
Accessible Route Check Report

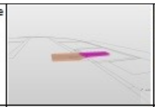
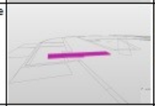
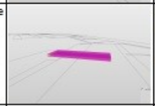
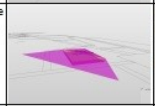
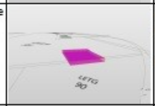
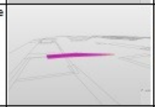
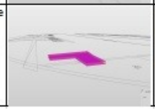
SOLIBRI A NEMETSCHEK COMPANY

accessibleroute

Model Name	accessiblerouteversion2 Version: 9.10
Checker	s250798@studenti.polito.it
Organization	DrawingTOthefuture
Date	December 4, 2019
accessibleroute.ifc.ifc	Date: 2019-12-03 02:45:43 Application: Autodesk Revit 2019 (ENU) IFC: IFC2X3
SEB_LMB_00_ZZ_M3_STR_000001.ifc.	Date: 2019-12-03 02:17:34 Application: Autodesk Revit 2019 (ENU) IFC: IFC2X3

Presentation 1

Numbe	Id	Location	Date	Author	Title	Picture	Issue Description	Issue Comment	Responsibilities	Stage	Due Date	Labels	Action Required	Action Taken	Status	Priority
1	1	(c) UGL6-S3 ROOM[82]	4-Dec-2019	s250798@studen	Accessible route		Accessible Route Rule Accessible route (c) Slab.-6.18 is obstructed.		STR		2019-12-16				Open	
2	2	(c) UGL4-S2 [60], CIRH[100]	4-Dec-2019	s250798@studen	Accessible route		Accessible Route Rule Accessible route (c) Slab.-4.9 is obstructed.		STR		2019-12-16				Open	
3	3	(c) UGL6-S3 ROOM[82]	4-Dec-2019	s250798@studen	Accessible route		Accessible Route Rule Accessible route (c) Slab.-6.3 is obstructed.		STR						Open	
4	4	(c) UGL4-S2 CIRH[100]	4-Dec-2019	s250798@studen	Accessible route		Accessible Route Rule Accessible route (c) Slab.-4.11 is obstructed.		ARC		2019-12-16				Open	
5	5	(c) UGL8-S4 ROOM[74]	4-Dec-2019	s250798@studen	Accessible route		Accessible Route Rule (c) Slab.-8.4 is too narrow. The required minimum width is 1.00 m.		ARC		2019-12-16				Open	
6	6	(c) UGL11-Q5 QULA[95]	4-Dec-2019	s250798@studen	Accessible route		Accessible Route Rule (c) Slab.-11.2 is too narrow. The required minimum width is 1.00 m.		ARC		2019-12-16				Open	

7	7	(c) UGL8-S4 ROOM[74]	4-Dec-2019	s250798@studen	Accessible route		Accessible Route Rule (c) Slab.-8.3 is too narrow. The required minimum width is 1.00 m.		ARC		2019-12-16				Open	
8	8	(c) UGL8-S4 ROOM[74]	4-Dec-2019	s250798@studen	Accessible route		Accessible Route Rule (c) Slab.-8.1 is too narrow. The required minimum width is 1.00 m.		ARC		2019-12-16				Open	
9	9	(c) UGL6-S3 LCVC[75]	4-Dec-2019	s250798@studen	Accessible route		Accessible Route Rule (c) Slab.-6.2 is too narrow. The required minimum width is 1.00 m.		ARC		2019-12-16				Open	
10	10	(c) UGL2-S1 SANA[37]	4-Dec-2019	s250798@studen	Accessible route		Accessible Route Rule (c) Slab.-2.1 is too narrow. The required minimum width is 1.00 m.		ARC		2019-12-16				Open	
11	11	(c) UGL11-Q5 QULA[95], LETG[90]	4-Dec-2019	s250798@studen	Accessible route		Accessible Route Rule (c) Slab.-11.4 is too narrow. The required minimum width is 1.00 m.		ARC		2019-12-16				Open	
12	12	(c) UGL8-S4 ROOM[74]	4-Dec-2019	s250798@studen	Accessible route		Accessible Route Rule (c) Slab.-8.2 is too narrow. The required minimum width is 1.00 m.		ARC		2019-12-16				Open	
13	13	(c) UGL11-Q5 QULA[96], LETG[94]	4-Dec-2019	s250798@studen	Accessible route		Accessible Route Rule (c) Slab.-11.3 is too narrow. The required minimum width is 1.00 m.		ARC		2019-12-16				Open	

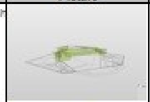
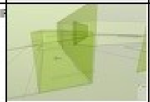
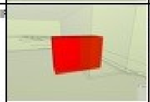
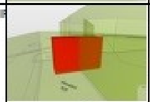
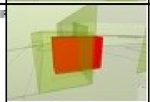
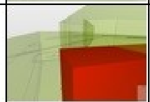
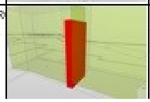
Accessible Door Check Report

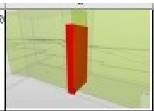
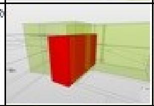
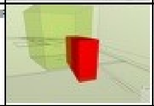
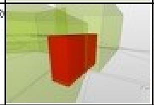
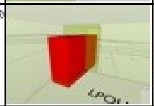
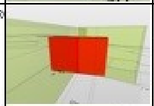
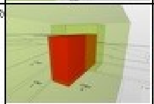
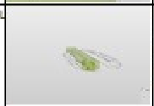
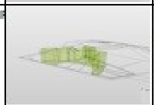
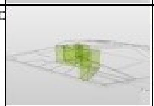
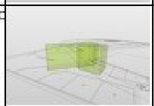
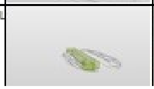
SOLIBRI
A NEMETSCHEK COMPANY

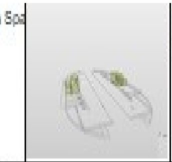
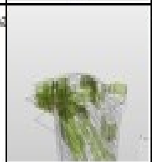
accessibledoor

Model Name	accessibledoors Version: 9.10
Checker	s250798@studenti.polito.it
Organization	DrawingTOthefuture
Date	December 4, 2019
accessibledoors.ifc.ifc	Date: 2019-11-26 05:52:01 Application: Autodesk Revit 2019 (ENU) IFC: IFC2X3
accessibledoors.ifc.ifc-	Date: 2019-11-26 05:52:22 Application: Autodesk Revit 2019 (ENU) IFC: IFC2X3

Presentation 1

Number	Id	Location	Date	Author	Title	Picture	Issue Description	Issue Comment	Responsibilities	Stage	Due Date	Labels	Action Required	Action Taken	Status	Priority
1	1	GL-S0 CIRH[26], Elevator[105], Elevator[104]	4-Dec-2019	s250798@stud	Too High Thresh										Open	
2	2	CIRH[26], Elevator[104]	4-Dec-2019	s250798@stud	Space.0.24 : CIR		Accessible Door Rule - Opening.0.37 threshold is too high. Door accessible threshold height is 200 mm. Maximum height is 25 mm.		ARC		2019-12-16				Open	
3	3	CIRH[26], Elevator[104]	4-Dec-2019	s250798@stud	Space.0.24 : CIR		Accessible Door Rule - Opening.0.38 threshold is too high. Door accessible threshold height is 200 mm. Maximum height is 25 mm.		ARC		2019-12-16				Open	
4	4	CIRH[26], Elevator[105]	4-Dec-2019	s250798@stud	Space.0.24 : CIR		Accessible Door Rule - Opening.0.20 threshold is too high. Door accessible threshold height is 200 mm. Maximum height is 25 mm.		ARC		2019-12-16				Open	
5	5	CIRH[26], Elevator[105]	4-Dec-2019	s250798@stud	Space.0.24 : CIR		Accessible Door Rule - Opening.0.21 threshold is too high. Door accessible threshold height is 200 mm. Maximum height is 25 mm.		ARC		2019-12-16				Open	
																
6	6	UGL4-S2 CIRH[100], CIRC[49]	4-Dec-2019	s250798@stud	Space.-4.11 : CI		Accessible Door Rule - Opening.-4.20 threshold is too high. Door accessible threshold height is 141 mm. Maximum height is 25 mm.		ARC						Open	
7	7	GL-S0 CIRC[10], LCLO[7]	4-Dec-2019	s250798@stud	Space.0.9 : CIR		Accessible Door Rule - Opening.0.12 threshold is too high. Door accessible threshold height is 200 mm. Maximum height is 25 mm.		ARC						Open	
8	8	CIRC[10], LCLO[7]	4-Dec-2019	s250798@stud	Space.0.9 : CIR		Accessible Door Rule - Opening.0.14 threshold is too high. Door accessible threshold height is 200 mm. Maximum height is 25		ARC						Open	

8	8	CIRC[10], LCLO[7]	4-Dec-2019	s250798@stude	Space.0.9 : CIR		Accessible Door Rule - Opening.0.14 threshold is too high. Door accessible threshold height is 200 mm. Maximum height is 25 mm.		ARC						Open	
9	9	CIRC[10], CIRC[8]	4-Dec-2019	s250798@stude	Space.0.9 : CIR		Accessible Door Rule - Opening.0.8 threshold is too high. Door accessible threshold height is 200 mm. Maximum height is 25 mm.		ARC						Open	
10	10	CIRH[26], SANV[25]	4-Dec-2019	s250798@stude	Space.0.24 : CIR		Accessible Door Rule - Opening.0.19 threshold is too high. Door accessible threshold height is 200 mm. Maximum height is 25 mm.		ARC						Open	
11	11	CIRH[26], CIRO[9]	4-Dec-2019	s250798@stude	Space.0.8 : CIR		Accessible Door Rule - Opening.0.7 threshold is too high. Door accessible threshold height is 200 mm. Maximum height is 25 mm.		ARC						Open	
12	12	CIRO[9], LPOU[102]	4-Dec-2019	s250798@stude	Space.0.8 : CIR		Accessible Door Rule - Opening.0.9 threshold is too high. Door accessible threshold height is 200 mm. Maximum height is 25 mm.		ARC						Open	
13	13	CIRO[9], CIRC[10]	4-Dec-2019	s250798@stude	Space.0.9 : CIR		Accessible Door Rule - Opening.0.6 threshold is too high. Door accessible threshold height is 200 mm. Maximum height is 25 mm.		ARC						Open	
14	14	CIRC[10], LDBT[4]	4-Dec-2019	s250798@stude	Space.0.9 : CIR		Accessible Door Rule - Opening.0.10 threshold is too high. Door accessible threshold height is 200 mm. Maximum height is 25 mm.		ARC						Open	
15	15	UGL11-Q5 QULA[96], LETG[94]	4-Dec-2019	s250798@stude	Space.-11.11 : L		Accessible Door Rule - Door.-11.6 is too narrow. Door accessible width is 84 mm. Required width is 900 mm		ARC						Open	
16	16	GL-S0 LREC[18], CIRC[12]	4-Dec-2019	s250798@stude	Space.0.13 : CIR		Accessible Door Rule - Opening.0.17 is too narrow. Door accessible width is 51 mm. Required width is 900 mm		ARC						Open	
17	17	GL-S0 ACCU[19], CIRC[12]	4-Dec-2019	s250798@stude	Space.0.15 : AC		Accessible Door Rule - Opening.0.24 is too narrow. Door accessible width is 95 mm. Required width is 900 mm		ARC						Open	
18	18	GL-S0 ACCU[20], ACCU[19]	4-Dec-2019	s250798@stude	Space.0.15 : AC		Accessible Door Rule - Opening.0.16 is too narrow. Door accessible width is 184 mm. Required width is 900 mm		ARC						Open	
19	19	UGL11-Q5 LETG[94], QULA[96]	4-Dec-2019	s250798@stude	Space.-11.11 : L		Accessible Door Rule - Opening.-10.1 is too narrow. Door accessible width is 890 mm. Required width is 900 mm		ARC						Open	

20	20	UGL11-Q5 ROOM[83], Elevator[114], ROOM[88], Elevator[115]	4-Dec-2019	s250798@stud	Not Enough Spa		Not Enough Space in Front of Door on Pull Side		ARC		2019-12-16				Open	
21	21	GL-S0 CIRH[26], Elevator[105], HALL[6], ACCU[20], Elevator[104],	4-Dec-2019	s250798@stud	Not Enough Spa		Not Enough Space in Front of Door on Pull Side		ARC		2019-12-16				Open	
22	22	UGL11-Q5 LETG[94], OULA[96]	4-Dec-2019	s250798@stud	Not Enough Spa		Not Enough Space Next to Door on Handle Side of Pull Side		ARC		2019-12-16				Open	
23	23	UGL11-Q5 LETG[94], OULA[96]	4-Dec-2019	s250798@stud	Not Enough Spa		Not Enough Space Next to Door on Hinge Side of Pull Side		ARC		2019-12-16				Open	
24	24	UGL8-S4, UGL4-S2, GL-S0, UGL11-Q5, UGL6-S3, UGL2-S1	4-Dec-2019	s250798@stud	Not Enough Spa		Accessible Door Rule								Open	
25	25	UGL4-S2 LCVC[57], LCVC[54], CIRC[55], CIRC[59], ROOM[101],	4-Dec-2019	s250798@stud	Not Enough Spa		Not Enough Space in Front of Door on Pull Side		ARC						Open	
26	26	GL-S0 CIRH[26], ACCU[19], CIRO[9], HALL[6], ACCU[20], LREC[18], ZONE	4-Dec-2019	s250798@stud	Not Enough Spa		Not Enough Space in Front of Door on Pull Side		ARC						Open	

Stairs Clash Detection Report

SOLIBRI
A NEMETSCHEK COMPANY

Stairs_Clash_Report

Model Name	clashstairs Version: 9.10
Checker	s250798@studenti.polito.it
Organization	DrawingTOthefuture
Date	December 9, 2019
SEB_LMB_00_ZZ_M3_ARCH_000001.if	Date: 2019-10-30 02:39:18 Application: Autodesk Revit 2019 (ENU) IFC: IFC2X3
SEB_LMB_00_ZZ_M3_STR_000001.ifc.	Date: 2019-12-03 02:17:34 Application: Autodesk Revit 2019 (ENU) IFC: IFC2X3

Presentation 1

Numbe	Id	Location	Date	Author	Title	Picture	Issue Description	Issue Comment	Responsibilities	Stage	Due Date	Labels	Action Required	Action Taken	Status	Priority
1	1	UGL1-SC1 PEFO[33], CIRC[38]	9-Dec-2019	s250798@studen	Stair.-1.1		Accessible Stair Rule Stair Stair.-1.1 is not connected to slab at the beginning. Slab might be missing.		ARC, STR		2019-12-16				Open	
2	2	UGL2-S1 LSSI[34], PEFO[33]	9-Dec-2019	s250798@studen	Stair.-2.3		Accessible Stair Rule Stair Stair.-2.3 is not connected to slabs at the end. Slab might be missing.		ARC, STR		2019-12-16				Open	
3	3	UGL4-S2 VIGI[39], CFAO[40]	9-Dec-2019	s250798@studen	Stair.-3.2		Accessible Stair Rule Stair Stair.-3.2 is not connected to slab at the beginning. Slab might be missing.		ARC, STR		2019-12-16				Open	
4	4	UGL5-SC3 [56], CIRC[55], LCVC[54]	9-Dec-2019	s250798@studen	Stair.-4.1		Accessible Stair Rule Stair Stair.-4.1 is not connected to slabs at the end. Slab might be missing.		ARC, STR		2019-12-16				Open	
5	5	UGL6-S3 LCVC[75]	9-Dec-2019	s250798@studen	Stair.-5.3		Accessible Stair Rule Stair Stair.-5.3 is not connected to slabs at the end. Slab might be missing.		ARC, STR		2019-12-16				Open	
6	6	UGL4-S2 QULA[96]	9-Dec-2019	s250798@studen	Error Message: j		Accessible Stair Rule Please send this error message and application information to <a href="mailto:support@solibri.com">support@solibri.com		ARC		2019-12-16				Open	

Wall intersection Clash Report

SOLIBRI
A NEMETSCHEK COMPANY

Wall_Intersection_Clash_Report

Model Name	wallclash Version: 9.10
Checker	s250798@studenti.polito.it
Organization	DrawingTOthefuture
Date	December 9, 2019
accessibledoors.ifc.ifc	Date: 2019-11-26 05:52:01 Application: Autodesk Revit 2019 (ENU) IFC: IFC2X3
accessibledoors.ifc.ifc-	Date: 2019-11-26 05:52:22 Application: Autodesk Revit 2019 (ENU) IFC: IFC2X3

Presentation 1

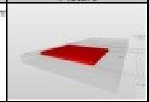
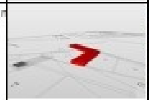
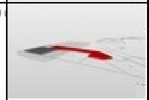
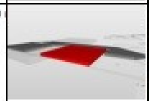
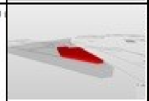
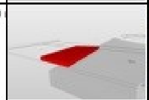
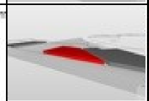
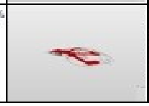
Numbe	Id	Location	Date	Author	Title	Picture	Issue Description	Issue Comment	Responsibilities	Stage	Due Date	Labels	Action Required	Action Taken	Status	Priority
1	1	UGL1-SC1 SANA[37], LSSI[34], PEFO[33]	9-Dec-2019	s250798@studen	Wall.-1.50 (Basic		Wall - Wall Intersections The depth, width, height, and volume of the intersections are: Wall.0.101, Wall.-1.50, 1.46 m, 208 mm, 1.50 m, 310 l		STR		2019-12-16				Open	

Finishing (arc) – Slab (str) Clash Detection Report

Slab-Slab Check

Model Name	slab-slabclash Version: 9.10
Checker	s250798@studenti.polito.it
Organization	DrawingTOthefuture
Date	December 9, 2019
asdqwe.ifc.ifc	Date: 2019-12-05 02:40:19 Application: Autodesk Revit 2019 (ENU) IFC: IFC2X3
SEB_LMB_00_ZZ_M3_STR_000001.ifc.if	Date: 2019-12-03 02:17:34 Application: Autodesk Revit 2019 (ENU) IFC: IFC2X3

Presentation 1

Number	Id	Location	Date	Author	Title	Picture	Issue Description	Issue Comment	Responsibilities	Stage	Due Date	Labels	Action Required	Action Taken	Status	Priority
1	1	UGL4-S2 LAES[45]	9-Dec-2019	s250798@stude	Slab.-4.1, 220 m		Components Must Touch Other Components Slab.-4.1 doesn't touch components below itself. Distance to the nearest is 220 mm.		ARC, STR		2019-12-16				Open	
2	2	GL-S0 CIRC[12]	9-Dec-2019	s250798@stude	Slab.0.23, 200 m		Components Must Touch Other Components Slab.0.23 doesn't touch components below itself. Distance to the nearest is 200 mm.		ARC, STR		2019-12-16				Open	
3	3	UGL4-S2 CIRC[46]	9-Dec-2019	s250798@stude	Slab.-4.17, 120		Components Must Touch Other Components Slab.-4.17 doesn't touch components below itself. Distance to the nearest is 120 mm.		ARC, STR		2019-12-16				Open	
4	4	UGL4-S2 PEFB[43]	9-Dec-2019	s250798@stude	Slab.-4.18, 120		Components Must Touch Other Components Slab.-4.18 doesn't touch components below itself. Distance to the nearest is 120 mm.		ARC, STR		2019-12-16				Open	
5	5	UGL4-S2 MENT1[41]	9-Dec-2019	s250798@stude	Slab.-4.21, 120		Components Must Touch Other Components Slab.-4.21 doesn't touch components below itself. Distance to the nearest is 120 mm.		ARC, STR		2019-12-16				Open	
6	6	UGL4-S2 LETG[44]	9-Dec-2019	s250798@stude	Slab.-4.25, 120		Components Must Touch Other Components Slab.-4.25 doesn't touch components below itself. Distance to the nearest is 120 mm.		ARC, STR		2019-12-16				Open	
7	7	UGL4-S2 ment1[42]	9-Dec-2019	s250798@stude	Slab.-4.3, 120 m		Components Must Touch Other Components Slab.-4.3 doesn't touch components below itself. Distance to the nearest is 120 mm.		ARC, STR		2019-12-16				Open	
8	8	UGL4-S2 [60], CIRH[100]	9-Dec-2019	s250798@stude	Slab.-4.10, 72%		Components Must Touch Other Components Slab.-4.10 touches components below itself, but the touching area is only 494.57 m2, which is		ARC, STR		2019-12-16				Open	