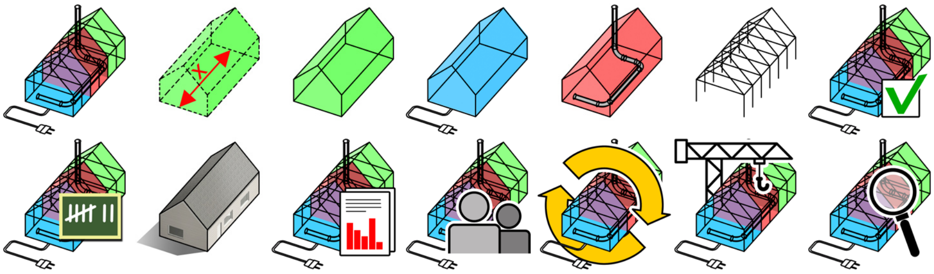
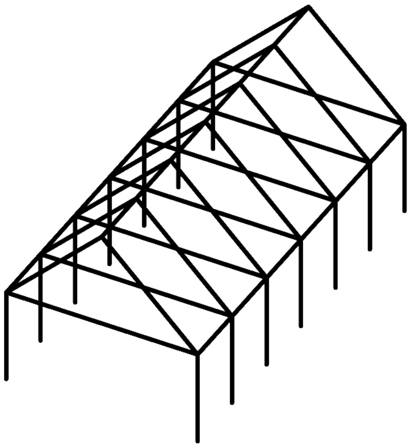


COBIM

Common BIM Requirements
2012

v 1.0



Series 5

Structural design

Foreword

The publication series “Common BIM Requirements 2012” is the result of a broad-based development project entitled *COBIM*. The need for these requirements arises from the rapidly growing use of building information modeling in the construction industry. During all phases of a construction project, the parties to the project have a need to define more precisely than before what is being modeled and how the modeling is done. “Common BIM Requirements 2012” is based on the previous instructions of the owner organizations and the user experiences derived from them, along with the thorough experience the writers of the instructions possess on model-based operations.

The parties to the project are: **Funding providers:** Aitta Oy, Larkas & Laine Architects Ltd, buildingSMART Finland, City of Espoo Technical and Environment Services, Future CAD Oy, City of Helsinki Housing Production Office, City of Helsinki Premises Centre, University of Helsinki, Helsingin Yliopistokiinteistöt Oy, HUS Kiinteistöt Oy, HUS Premises Centre, ISS Palvelut Oy, City of Kuopio Premises Centre, Lemminkäinen Talo Oy, Micro Aided Design Ltd. (M.A.D.), NCC companies, Sebicon Oy, Senate Properties, Skanska Oy, SRV Group Plc, Sweco PM Oy, City of Tampere, City of Vantaa Premises Centre, Ministry of the Environment. **Written by:** Finnmap Consulting Oy, Gravicon Oy, Olof Granlund Oy, Lemminkäinen Talo Oy, NCC companies, Pöyry CM Oy, Skanska Oyj/VTT Technical Research Centre of Finland, Solibri, Inc., SRV Rakennus Oy, Tietoa Finland Oy. **Management:** The Building Information Foundation RTS.

The requirements were approved by an executive group consisting of parties to the project. The executive group acted as committee TK 320 of the Building Information Foundation RTS, and as such, participated actively in developing the content of the requirements and asking for comments from the members of the executive group and from interest groups.

Section 5 written by Finnmap Consulting Oy Tero Kautto

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Appendix 1 – Content of the structural model
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Appendix 3 – Structural model inspection form

1 Main objectives of building information modeling

Property and construction modeling aims to support a design and construction lifecycle process that is of high quality, efficient, safe and in compliance with sustainable development. Building information models are utilized throughout the building's life cycle, starting from initial design and continuing even during use and facility management (FM) after the construction project has concluded.

Building information models enable the following, for example:

- Provision of support to the investment decisions by comparing the functionality, scope and costs of the solutions.
- Energy, environment and lifecycle analyses for the purpose of comparing solutions, design and objectives of facility management follow-up.
- Design visualization and analysis of construction feasibility.
- Enhancement of quality-assurance and data exchange and making the design process more effective.
- Utilization of building project data during use and facility management activities.

To make modeling successful, project-specific priorities and objectives must be set for models and model utilization. Project-specific requirements will be defined and documented on the basis of the objectives and general requirements set in this publication series.

General objectives of building information modeling include, for example, the following:

- To provide support for the project's decision-making processes.
- To have the parties commit to the project objectives by means of using the building information model.
- To visualize design solutions.
- To assist in design and the coordination of designs
- To increase and secure the quality of the building process and the final product.
- To make the processes during construction more effective.
- To improve safety during construction and throughout the building's lifecycle.
- To support the cost and life-cycle analyses of the project.
- To support the transfer of project data into data management during operation.

"Common BIM Requirements 2012" covers targets for new construction and renovation, as well as the use and facility management of buildings. The minimum requirements for modeling and the information content of models are included in the modeling requirements. The minimum requirements are intended to be observed in all construction projects where the use of these requirements is advantageous. Besides the minimum requirements, additional requirements can be presented on a case-specific basis. Modeling requirements and content must be presented in all design contracts in a binding and consistent manner.

The publication series “Common BIM Requirements 2012” consists of the following documents:

1. General part
2. Modeling of the starting situation
3. Architectural design
4. MEP design
5. Structural design
6. Quality assurance
7. Quantity take-off
8. Use of models for visualization
9. Use of models in MEP analyses
10. Energy analysis
11. Management of a BIM project
12. Use of models in facility management
13. Use of models in construction
14. Use of models in building supervision

In addition to the requirements in his or her field, each party to a building information modeling project must be acquainted at a minimum with the general part (Section 1) and the principles of quality assurance (Section 6). The person in charge of the project or the project's data management must have comprehensive command of the principles of building information modeling requirements.

2 Introduction

This document covers structural BIM modeling and the required information content of the BIM models produced by the structural designer.

Use of BIM models aims to achieve controlled decision-making and support of the information flow within the design group, the owner and the contractor.

This guideline covers the BIM model produced by the structural designer, and will hereafter be referred to as the structural model. The structural model develops and becomes more specific as the design process progresses.

The design phases described in the guidelines comply with the phases of the TELU 08 design task allocation list.

These guidelines do not address the division of structural design to different parties, for example the design of prefabricated concrete elements.

General requirements common to all design fields are presented in Section 1 of these modeling requirements, entitled *1.General part*.

3 General definitions

The accuracy and content requirements of the models change by the design phase. These requirements are listed under different design phases and in *Appendix1.Content of the structural model.*

3.1 The structures to be modeled

Requirements
All load-bearing structures and non-load-bearing concrete structures are modeled in the structural model. In addition, building products which size and location affects other designers should be modeled.

Guideline
For example, fire-protection sheets are modeled so that MEP designers can see clearly the bottom surface of the structure in the model. Film-type building products such as waterproofing membrane are generally not included in the structural model.

Requirements
Structures must be modeled such that the location, name/type, geometry and content of the structure will be exported within data transfer.

The structural designer must ensure that the building parts shown in the IFC model are correct – a wall is shown as a wall and a beam as a beam.

Guideline
Generally, the BIM software tools do this automatically, provided that the structures are modeled using the tools intended for modeling the structure in question – a wall is modeled using a wall tool, a beam using a beam tool, etc.

3.2 Structure types

Requirements
The structural designer defines the structural types for the project according to the task allocation list. Structure types, as such, are not included in the structural model. Structural types are printed as 2D-drawings. Architect uses the structural types defined by the structural designer in architectural BIM model.

Guideline
The structural type drawings must be available for the entire project team because they are needed, for example in order to conduct energy analysis.

3.3 Definitions of sections and stories

Requirements
Structures are modeled in stories and sections according to the planned construction order and in compliance with the agreed project coordinates. The coordinates are defined in Section *1.General part.*

The story and/or section information is defined in the structural model so that it is transferred in the IFC-file. Story and section information is utilized, for example in visualization, inspections and quantity surveying.

Guideline
In large projects, it may be necessary to divide the structures into several models.

Structures are modeled as actually building elements. For example, a column that is three stories high is modeled as passing through the stories intact.

The structural model is divided into stories so that each story includes load-bearing walls/columns and the intermediate floor above. Structures that pass through several stories are attached to the lowest story on which they appear. When separately agreed, the structural designer produces an IFC model for each story based on the architectural division (load-bearing walls/columns and the intermediate floor underneath).

3.4 Numbering and labeling

Requirements
BIM software tools number the objects individually (GUID) so that they can be identified as needed throughout the project up to manufacturing and installation. Whenever possible, GUID identifiers must be retained by modifying already existing objects, instead of deleting them and creating new objects.

In addition to the automatic GUID numbering, structures are labeled and numbered logically as agreed in the project and by the owner, so that structures can be identified, for example for quantity take-off and logistics.

The labeling and numbering list used should be distributed among the project group members for the purpose of facilitating the use of the model.

3.5 Degree of readiness

Requirements
A structural model can include structures that are at different phases of design. In order to utilize model and model data, knowledge of the degree of readiness of the structures is critically important. The degree of readiness is presented in the model or recorded in the model specification. The manner in which the degree of readiness is presented is agreed on a project specific basis.

Guideline
For example, MEP designers can utilize the degree of readiness to determine the reliability of bottom elevation of the structure.

3.6 Quality assurance

Requirements
Published structural models mustn't include model objects of other designers, even if such models were used as references. Structural models may include only objects modeled by the structural designer.

Before the model is published, the structural designer must perform a quality assurance for designs according to company's quality system.

Quality assurance of the model is performed as described in this section and in *Section 6.Quality assurance*. A completed and signed structural model inspection checklist is appended to the model specification.

Guideline
The information content of the IFC model to be published can be defined according to its purpose of use. The model can be lightened, for example by leaving out reinforcements.

4 BIM modeling of a renovation project

In renovation projects, the scope of modeling should always be agreed on project-specific basis. The scope and accuracy of modeling is affected by the possible inventory model and its suitability for structural designers use.

4.1 Modeling the starting situation

If inventory model does not exist or the structural accuracy of the model is not sufficient, the structural designer may model the existing structures.

Requirements
The structural designer produces the inventory model of load-bearing structures and non-load-bearing concrete structures, complying to the degree of possibility with the modeling requirements described in *Section 2.Modeling the starting situation*. The measuring method used and the estimated accuracy of the model should be recorded in the model specification.

Guideline
The structural designer can model the starting situation also on the basis of old structural drawings.

4.2 Modeling alterations

Requirements
The structural designer models the new load-bearing structures and non-load-bearing concrete structures to the structural model. Existing load-bearing structures are modeled only if required by structural alterations. Modeling is carried out according to *Section 5.Structural design*. Information concerning the measured or estimated location of the alteration structure is added to the model specification.

Guideline
Other modeling practices can be agreed upon on a project-specific basis. For example, a certain part of the building may be modeled more precisely.

5 Definitions of different design phases

5.1 Requirements model

The requirements model of structural design presents the objectives and requirements set for structural design.

The requirements model may be presented in the form of a table, drawing, textual document, model or a combination of these.

Guideline
The structural design requirements model includes, for example:

- *The standards and instructions to be used*
- *Source information and obligations given by the owner*
- *Any other requirements and source data (spatial flexibility, free heights, etc.)*

5.2 Schematic design phase

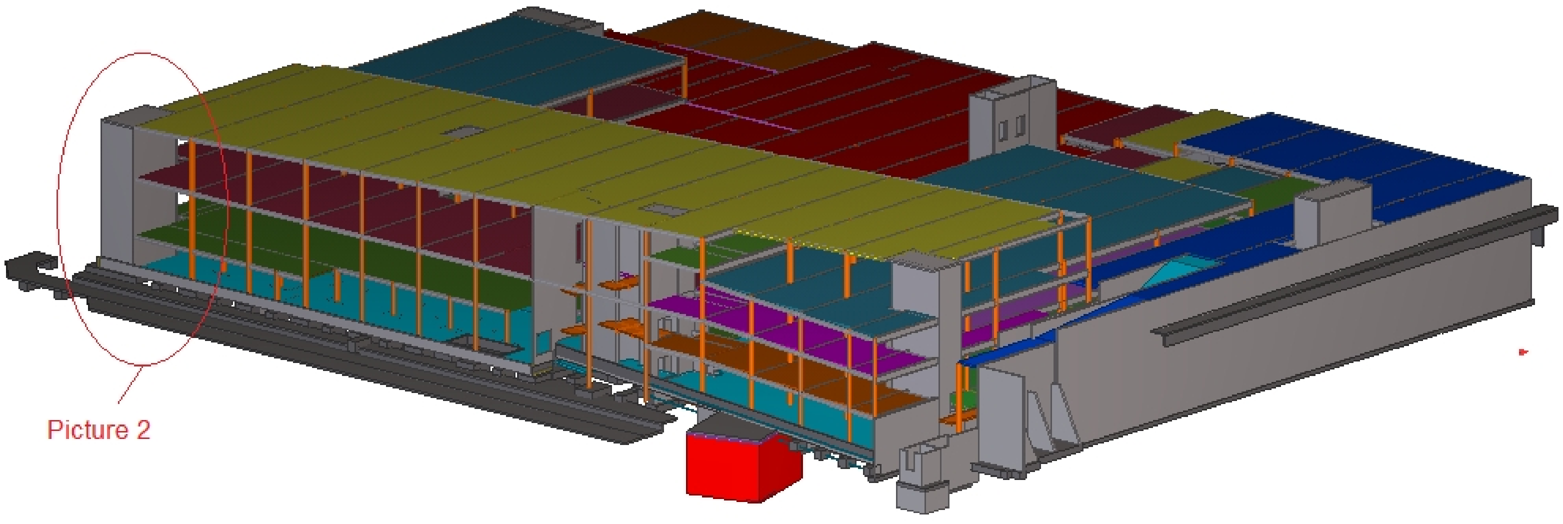
During the schematic design phase (TELU 08 – Structural C3), the structural designer evaluates the feasibility of the options presented by the architect.

Guideline
During the schematic design phase, the structural designer does not have actual modeling requirements. On a project-specific basis, it can be separately agreed upon that the structural designer models, for example, different structural frame alternatives to determine the costs. Modeling accuracy has to comply with the general design phase.

5.3 General design phase

In general design phase (TELU 08 – Structural C4) selected schematic design will be developed into a feasible general design. The contents and accuracy of the model is defined in Appendix 1.

Guideline
During this phase, the compatibility of MEP systems and load-bearing structures is examined together with MEP designers.



Picture 1: Model during the general design phase (Picture: Finnmap Consulting Oy)

Requirements

The requirements of the general design phase are outlined below:

<table>
<tr><td colspan="2">General design
Source data from other designers:</td></tr>
<tr><td>Starting situation models:</td><td>• Inventory model and/or lot model according to Section 2 “Modeling of the starting situation”
• IFC models and 2D drawings printed from them in the agreed-upon format</td></tr>
<tr><td>GEO (*)</td><td>• Soil layer, rock, excavation and pit surfaces
• In the IFC or 3D format and drawings produced from the model in the agreed-upon format</td></tr>
<tr><td>ARCH</td><td>• IFC model according to Section 3 “Architectural design”
• 2D drawings produced from the model in the agreed-upon format</td></tr>
<tr><td>MEP</td><td>• IFC model according to Section 4 “MEP design”</td></tr>
<tr><td colspan="2">Structural designer’s data model requirements</td></tr>
<tr><td colspan="2">• Modeling according to Appendix 1 “Content of the structural model” or according to project-specific requirements.
• Quality assurance according to paragraph 3 and Section 6 “Quality assurance”
• IFC model published according to paragraph 3 and Section 6 "Quality assurance"
• Filling out the model specification
• Preparation of the drawings to be printed from the model according to the owner’s drawing instructions or the general instructions</td></tr>
<tr><td>Benefits derived from the model:</td><td>Printouts:</td></tr>
<tr><td>• Visual inspection
• Preliminary quantity take-offs and cost estimation
• Preliminary structural frame scheduling
• Part of combined model
• Base for the structural designer’s analysis and design model
• Base for the next design phase</td><td>• Dimensional drawing of foundations
• Dimensional drawing of substructure
• Dimensional drawings of each story
• Elevation drawings</td></tr>
</table>

(*) = GEO modeling is not required in the 2012 Common BIM requirements

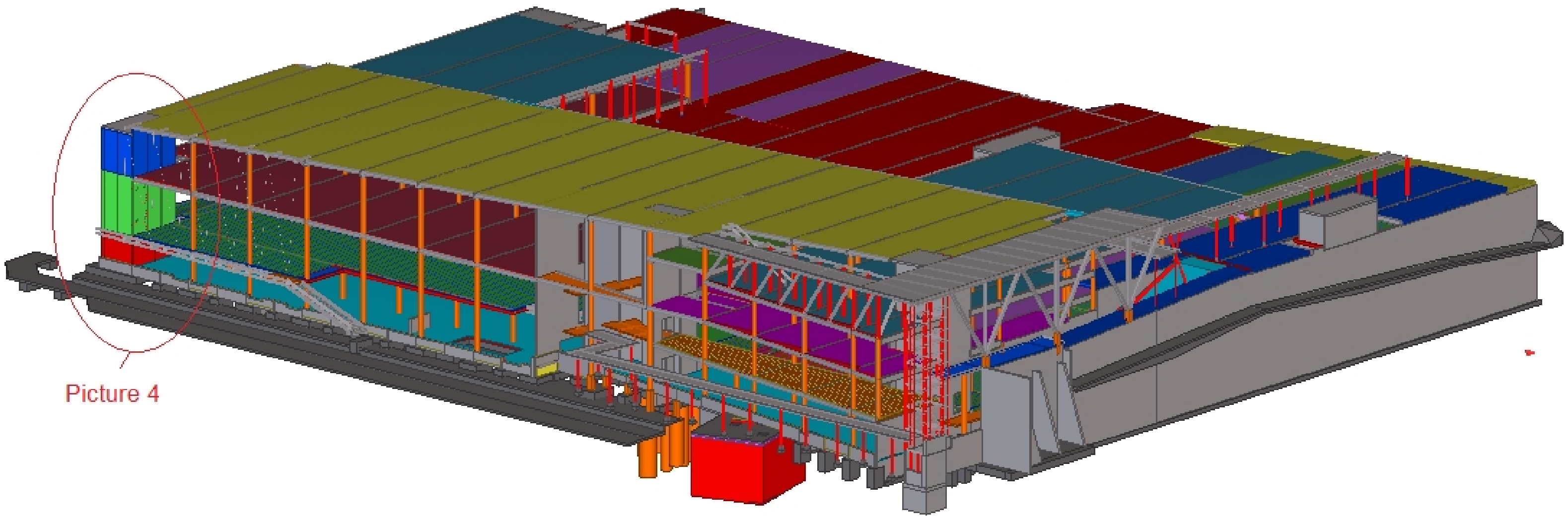
Picture 2: Example of the accuracy of a stairwell model in the general design phase (Picture: Finnmap Consulting Oy)

5.4 Tender design phase

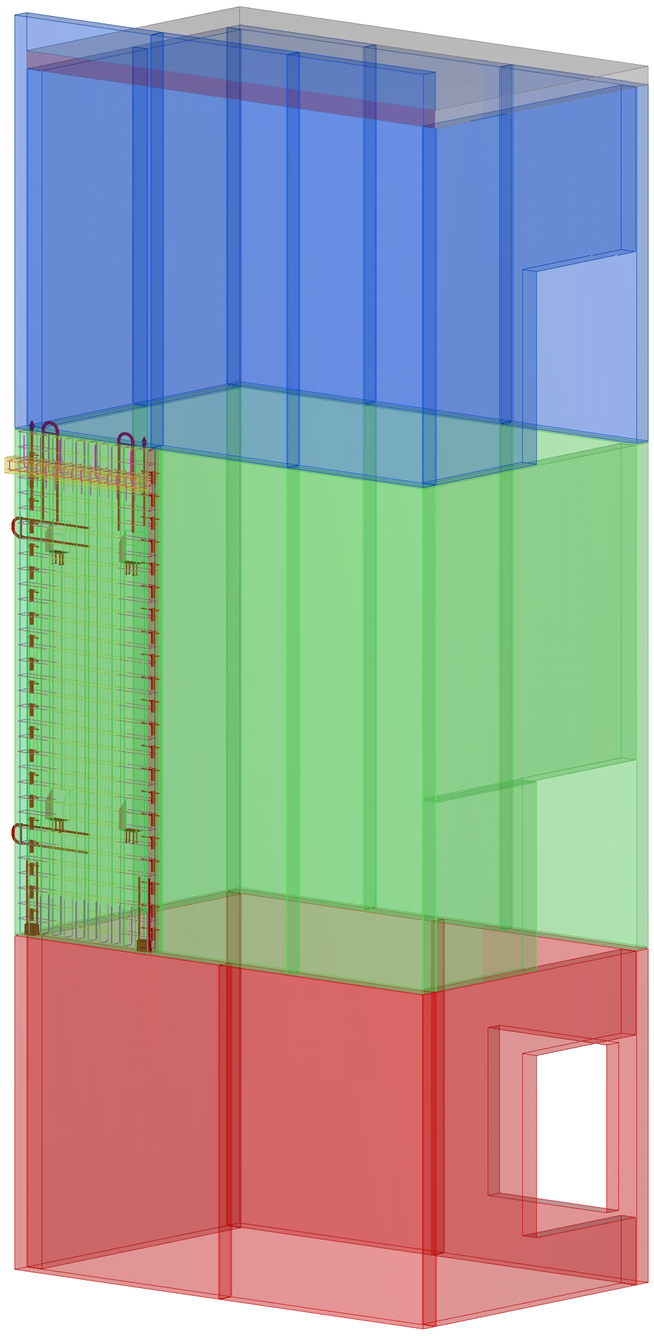
In tender design stage (TELU 08 – Structural C6), the model is developed to the level required by tender inquiries, and tender documents are drawn up for tender inquiries.

Requirements
The load-bearing and non-load-bearing concrete structures are modeled with correct the size, scope, quantity and exact location. The content of the model is defined in Appendix 1.

Guideline
As such, it also serves as base information for the MEP designer's model and void provision procedure.



Picture 3: The model is specified to suit the tender design phase. (Picture: Finnmap Consulting Oy)

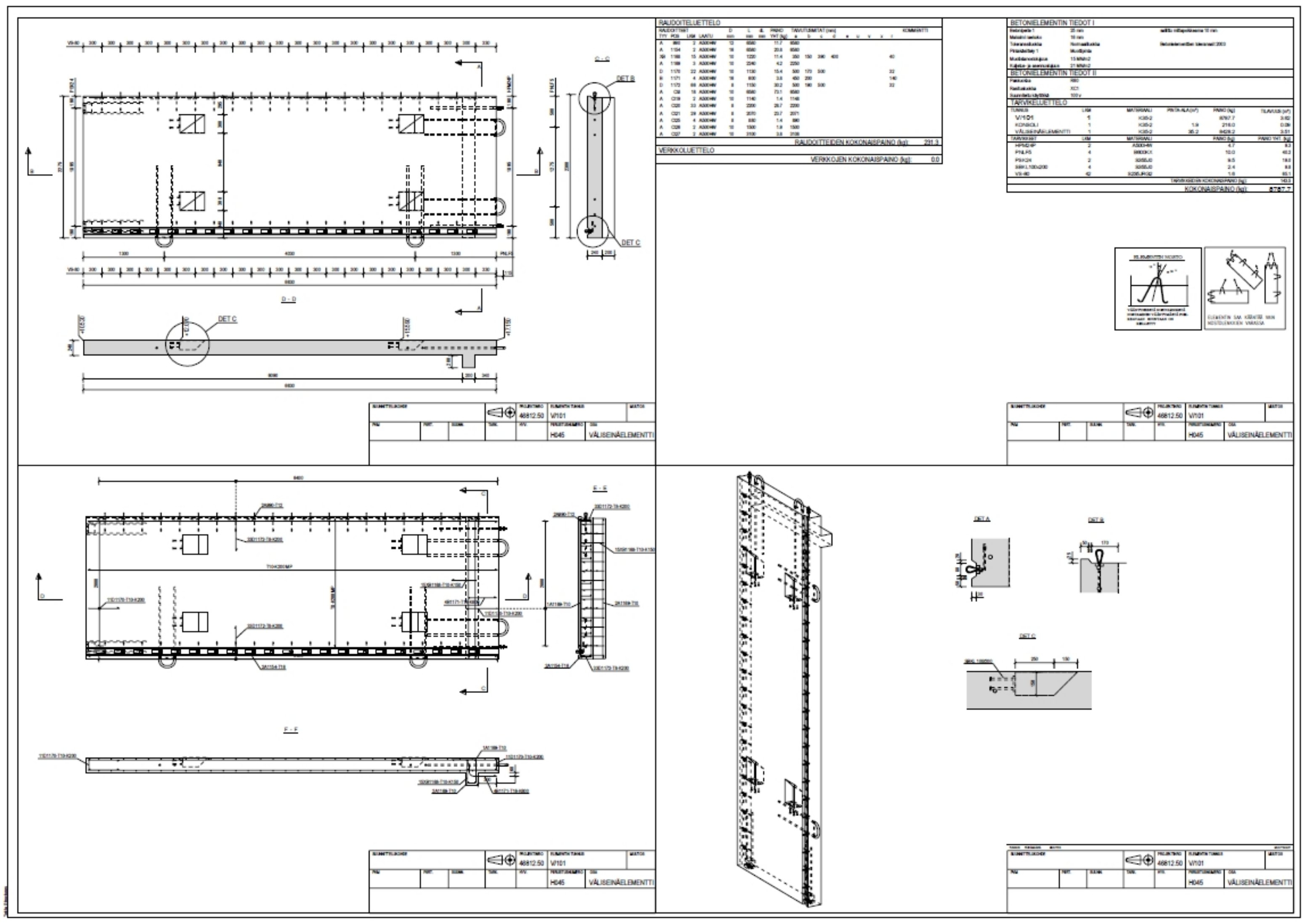


Picture 4: The accuracy of the stairwell and the model element in the tender design phase. (Picture: Finnmap Consulting Oy)

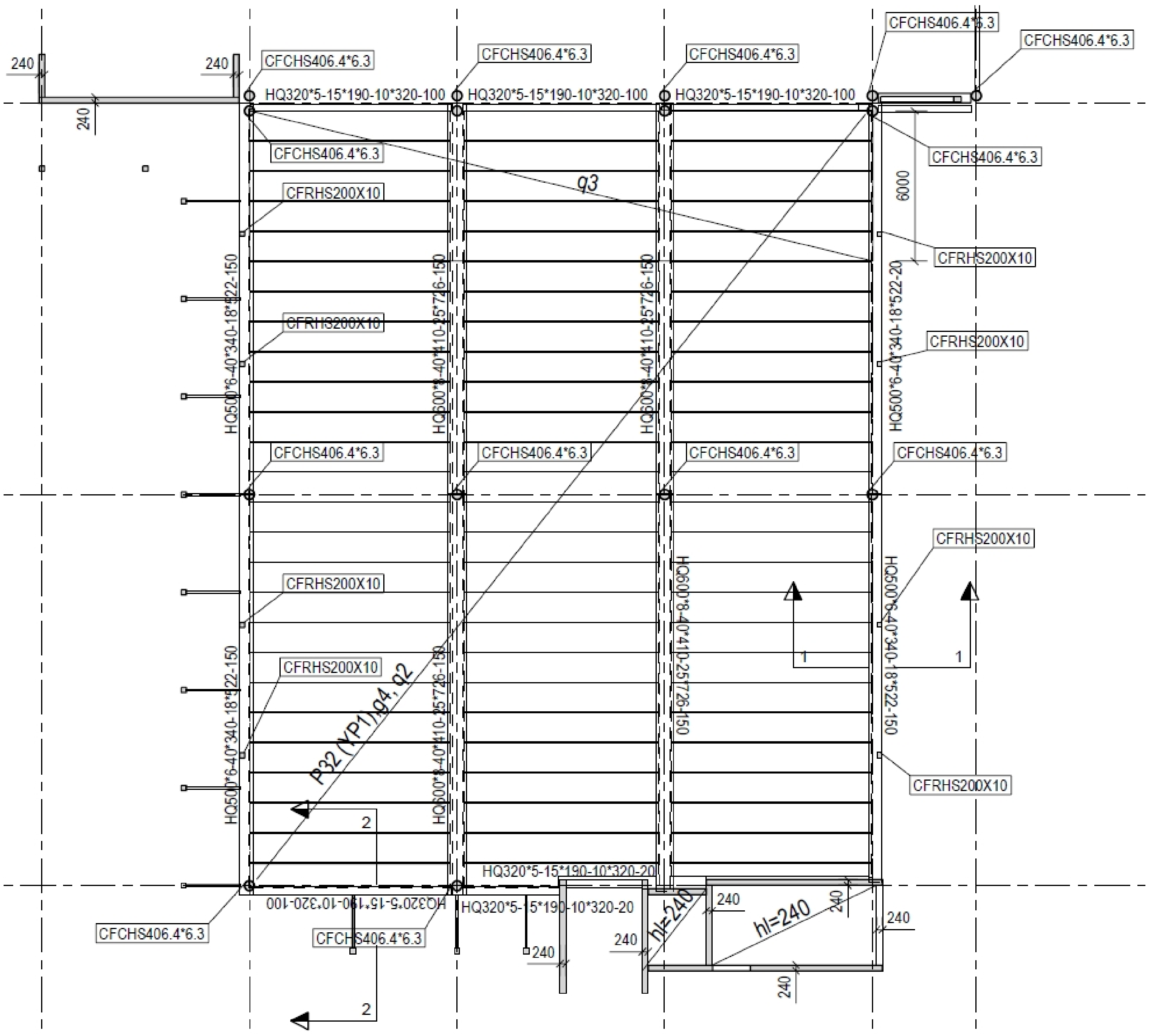
Requirements

The requirements of the tender design phase are outlined below:

<table>
<tr><td colspan="3">Design in service of procurement
Structural design source data:</td></tr>
<tr><td>ARCH</td><td colspan="2">• IFC model according to Section 3 “Architectural design”
• 2D drawings produced from the model in the agreed-upon format</td></tr>
<tr><td>MEP</td><td colspan="2">• IFC model according to Section 4 “MEP design”
• IFC void reservation model within the agreed-upon scope, see paragraph 5.2.4</td></tr>
<tr><td colspan="3">Structural designer’s data modeling requirements</td></tr>
<tr><td colspan="3">• Modeling according to Appendix 1 “Content of the structural model” or according to project-specific requirements.
• Quality assurance according to paragraph 3 and Section 6 “Quality assurance”
• IFC model published according to paragraph 3 and Section 6 "Quality assurance"
• Model is issued to the MEP designer for void provision modeling according to paragraph 5.2.4
• Filling out the model specification
• Preparation of the drawings to be printed from the model according to the owner’s drawing instructions or the general instructions</td></tr>
<tr><td colspan="2">Benefits derived from the model:</td><td>Printouts:</td></tr>
<tr><td colspan="2">• Visualization of design
• Quantity take-off
• Part of combined model
• Planning of occupational safety and construction area
• Planning and visualization of the construction schedule
• Planning the installation and work schedules
• Base for the next design phase</td><td>• List of piles
• Pile drawings
• Dimensional drawing of foundations
• Tender drawings of footings and other foundations
• Dimensional drawing of substructure
• Dimensional drawings of each story
• Elevation drawings
• Element diagrams
• Dimensional drawing of shelter
• Tender drawings of concrete element
• Tender drawings of steel assemblies
• Quantity and material lists of steel structures</td></tr>
</table>



Picture 5: Tender drawing produced from the model element in the picture 4 (Picture: Finnmap Consulting Oy)



Picture 6: Printout of a plan drawing based on the model during the tender design phase (Picture: Finnmap Consulting Oy)

5.4.1 Void Provisions

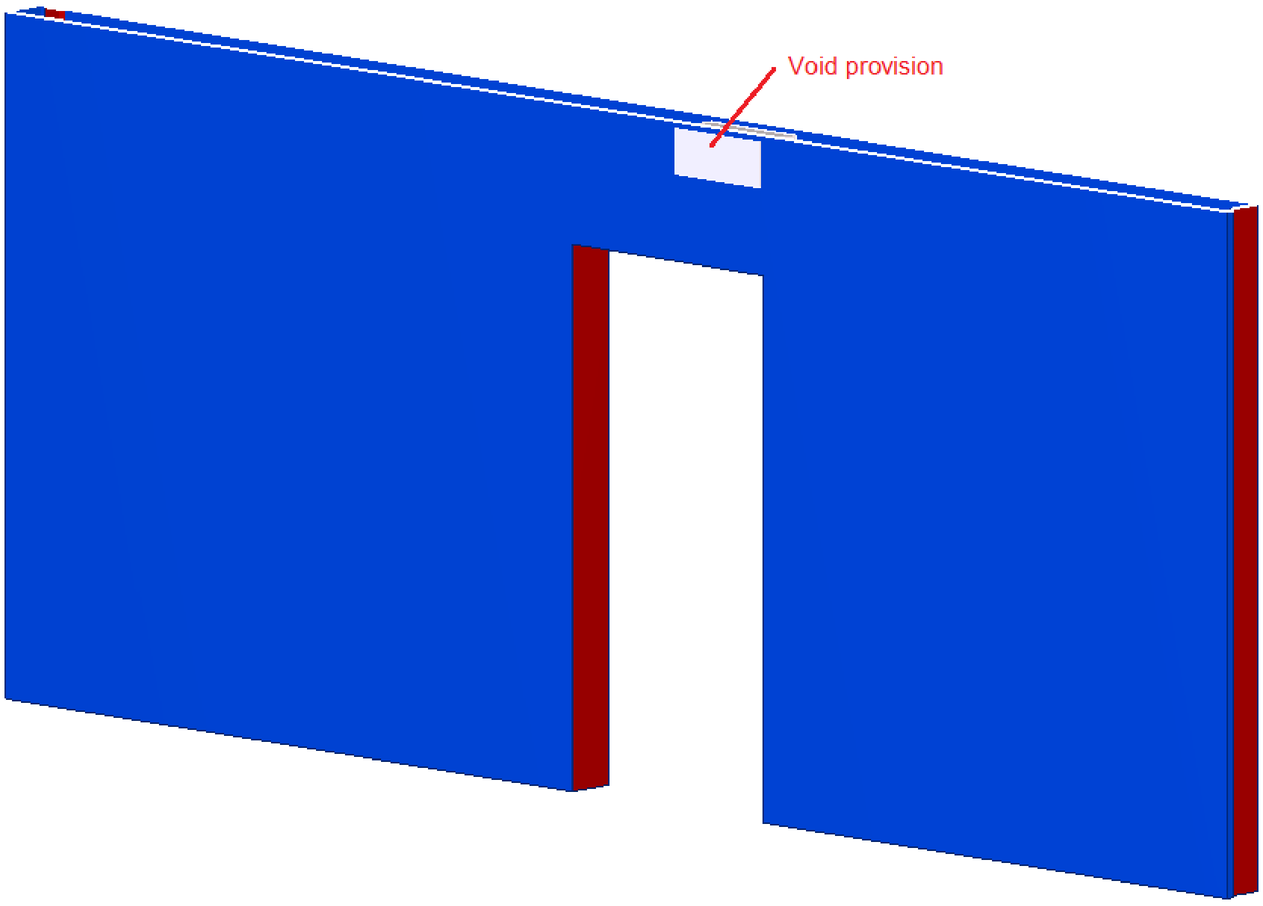
The use of a void provision model and the preparation and responsibility for creating the void provision drawings should always be agreed upon on a project-specific basis.

Guideline

Merging the MEP System BIMs and the structural designer's BIM, and the architect's Building Element BIM, as needed, allows the use of the BIM-based clash-detection procedure to facilitate the location and design of voids.

In BIM-based provisions, the structural designer produces the model in the agreed format. The MEP designer uses the model to create void provisions. The model should be story-specific, including the slabs above and the related load-bearing walls.

The MEP designer prepares an IFC-based void model which includes provisions objects only. This void model IFC is submitted to the structural designer in a story-specific format



Picture 7: Void provision in the structural designer's model. (Picture: Finnmap Consulting Oy)

Each provision object must indicate whose provisions object it is. The size and IDs of the provisions should be included in the provision object as attribute data. The provisions are modeled in the void model such that they are correctly placed in terms of their size and location.

Absolute elevation is used as elevation

To facilitate visual examination and the preparation of the provisions by the structural designer, the provisions objects should be modeled thicker than the structures they penetrate.

The structural designer uses the data from the provisions voids objects to prepare the voids and other provisions in the structures, if structurally possible. If preparation of a void is structurally impossible, the structural designer should *inform the MEP designer to that effect. The MEP designer then prepares a new version of the provisions void objects based on the structural designer's suggestions and delivers them to the structural designer.*

From the technical perspective, it is recommended that when altering already prepared provisions voids objects, the provisions object is not removed and replaced with a new one. Instead, the object already modeled is altered (for example, by altering its size or location). The reason is that in this way, the software tools identify the provisions void object as an altered provision void object, and not as a new object.

In the preparation of element provision drawings, BIM-based provision void design is not required for electro-technical piping systems, box holes or other routes traversing the element (lack of MEP application software support for processing element holes). However, provisions which penetrate the element completely must be delivered as provision void objects. The MEP designer presents the holes and other provisions to the structural designer by means of conventional design methods.

5.4.2 The preparation process of void drawings

Requirements

When using BIM-based void provision design, void provision drawings, areas of responsibility and operating methods between Structural design and MEP design must be agreed upon on a project-specific basis. The author of 2D void provisions drawings should be cleared with the client at the point of entering into a design contract.

The compatibility of the application programs used by the structural and MEP designers must also be verified on a project-specific basis.

Guideline

BIM-based void provision design can be utilized in different ways in making 2D void drawings.

These operating methods or variations thereof can be considered for use when 2D void drawings are needed in a building. Operating as described in Section 5.4.1 is the starting point for all operating methods.

Alternative 1:

- *The structural designer delivers 2D and 3D void drawing templates to MEP.*
- *MEP utilizes the void provision objects it has created as the basis for compiling a 2D drawing, including grid lines.*
- *Void Provisions are dimensioned primarily in the module network; another alternative used in renovation projects is to dimension them in the existing structures.*
- *2D void provision files are delivered to the structural designer.*
- *The structural designer prints them out and sends the images to be distributed.*

Alternative 2:

- *The structural designer delivers the 3D void drawing templates to MEP in a story-specific format, using absolute elevation.*
- *MEP prepares the void provision objects for the elevation used in the model, and delivers them to the structural designer in the IFC format.*
- *The structural designer prepares 2D penetration drawings, including grid lines and dimensions, based on the void provision objects delivered by MEP. The structural designer prints out the drawings and sends them to be distributed.*

Alternative 3:

- *The structural designer delivers the 3D void drawing templates to MEP in a story-specific format, using absolute elevation.*
- *MEP prepares the void provision objects for the elevation used in the model, and delivers them to the structural designer in the IFC format.*
- *The structural designer prepares the 2D void image templates showing the penetration reservations delivered by MEP.*
- *The structural designer places the void provision information grid line in the images (e.g. ”IU, 300x200, KP=+25.3”). This information is taken from the void provision objects delivered by MEP.*
- *The structural designer places in the 2D image a dimension line level for the different design disciplines, using the preferred color for the printouts of the dimension lines (= line thickness in a black and white printout).*
- *The structural designer delivers the above-mentioned 2D void image templates to MEP.*
- *MEP prepares the dimension lines at the level indicated by the structural designer, using the regular grid line tools in the CAD software program.*
- *Void Provisions are dimensioned primarily in the module network; another alternative used in renovation projects is to dimension them in the existing structures.*
- *2D void provision files equipped with grid lines are delivered to the structural designer.*
- *The structural designer prints them out and sends the images to be distributed.*

5.5 Detailed design phase

The content and accuracy of the structural model in the detailed design phase (TELU – Structural C7) are defined by the scope of the structural designer’s tasks. The contents of the model are defined in Appendix 1.

Requirements

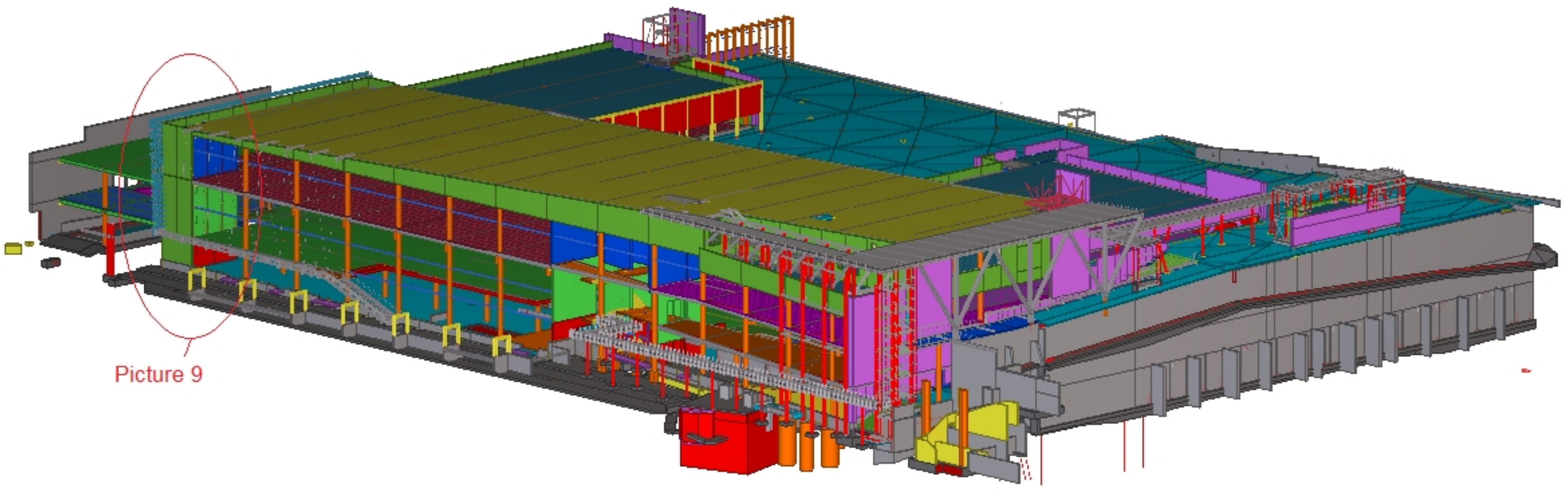
When the structural designer is also the project’s concrete element detailer and/or steel workshop detailer, and if the design agreement does not stipulate otherwise, all elements and/or assemblies shall be modeled to match the level of accuracy of the model elements and/or assemblies in the preceding design phase.

If concrete element design and/or steel detailing are performed by parties other than the structural designer, the structural designer shall continue developing other structures of the model. In that case, the cooperation between different structural designers, and sharing and combining of models shall be agreed upon on a project-specific basis.

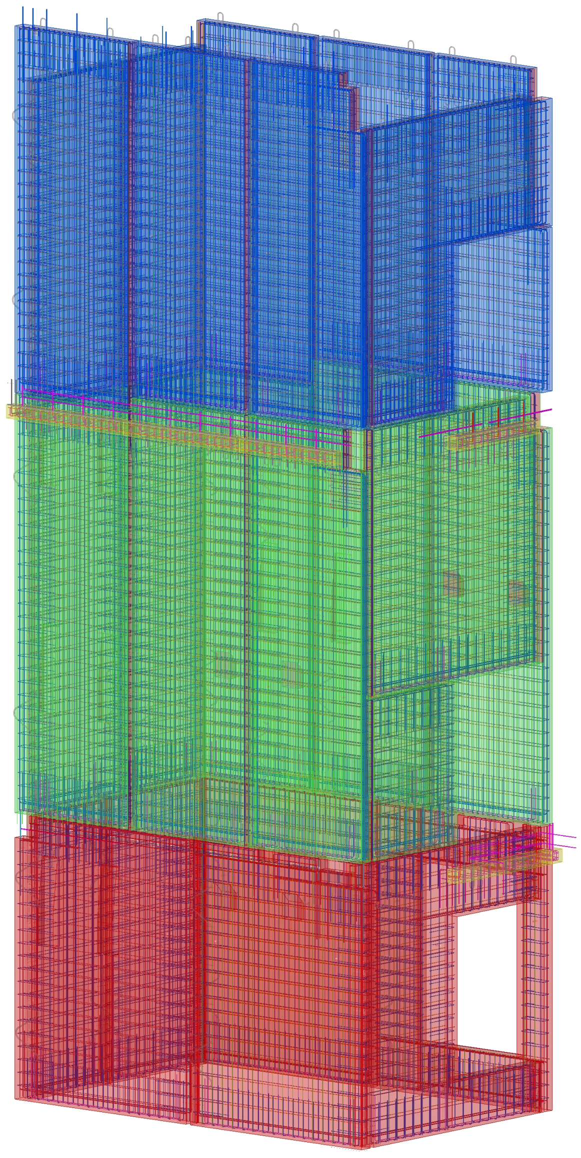
Requirements

The overall requirements of the implementation design phase are outlined below:

Implementation design **Structural design source data:**	
ARCH	• IFC model according to Section 3 “Architectural design” • 2D drawings produced from the model in the agreed-upon format • Details
MEP	• IFC model according to Section 4 “MEP design” • IFC void reservation model within the agreed-upon scope, see paragraph 5.2.4
Structural designer’s data modeling requirements	
• Modeling according to Appendix 1 “Content of the structural model” or according to project-specific requirements. • Quality assurance according to paragraph 3 and Section 6 “Quality assurance” • IFC model published according to paragraph 3 and Section 6 "Quality assurance" • Filling out the model specification Preparation of the drawings to be printed from the model according to the owner’s drawing instructions or the general instructions	
Benefits derived from the model:	**Printouts produced from the model:**
• Visualization of design • Quantity take-off • Part of combined model • Planning of occupational safety and construction area • Presentation and visualization of the construction schedule and as-built situation • Planning of the installation and work schedules	• As-built drawing of piling • Dimensional drawing of foundation • Dimensional drawing of shelter • Dimensional drawings of on-site concrete structures <u>To be decided upon on a project-specific basis:</u> • Reinforcement drawing of foundation • Reinforcement drawing of shelter • Reinforcement drawings of on-site concrete structures • Reinforcement lists of on-site concrete structures



Picture 8: Model during the detailed design phase (Picture: Finnmap Consulting Oy)



Picture 9: Accuracy of the stairwell model in the detailed design phase (Picture: Finnmap Consulting Oy)

6 Commissioning and facility management

Construction is guided by the structural model prepared by the structural designer during the detailed design phase. Structural changes occurring during the construction phase are included in the model in order to product new erection drawings. Because of this, the structural model is usually up-to-date at the conclusion of the project, and there is no need to prepare a separate as-built model.

Guideline
If structural changes have occurred during construction, and these changes have not been included in the structural model during detailed design phase, the updates are recorded in the as-built model.

Updating void provision in the as-built model is agreed-upon on a project-specific basis.

Adding the information content of separately detailed concrete elements and/or steel assemblies in the common as-built model is agreed upon separately.

The as-built model can function as a virtual model of the building and work along with the maintenance manual as facility management model. Model updating according to facility management changes must be agreed upon separate.

Appendix 1 – Content of the structural model

x = will be modeled

(x) = modeling to be agreed upon separately

General design

Structure	Building part	x/(x)	Accuracy
Foundations	Piling	(x)	
	Footings	x	Modeled accurately in terms of basic geometry and location
	Foundation walls	x	Modeled accurately in terms of basic geometry and location
	Foundation columns	x	Modeled accurately in terms of basic geometry and location
	Base beams	x	Modeled accurately in terms of basic geometry and location
	Thermal insulation	(x)	
Substructure	Substructure slabs	x	Modeled accurately in terms of basic geometry of and location of the load-bearing portion
	Substructure canals	(x)	
	Special base floors	(x)	
	Thermal insulation	(x)	
Structural frame	Shelter	x	Modeled accurately in terms of basic geometry and location
	Load-bearing walls	x	Modeled accurately in terms of basic geometry and location
	Columns	x	Modeled accurately in terms of basic geometry and location
	Beams	x	Modeled accurately in terms of basic geometry and location
	Intermediate floors	x	Modeled accurately in terms of basic geometry and location of the load-bearing portion
	Ceiling	x	Modeled accurately in terms of basic geometry and location of the load-bearing portion
	Special frame structures	(x)	
Facades	Exterior walls	(x)	Can be modeled, for example, as a continuous wall object to get quantity reports
	Special facade structures	(x)	
Exterior decks	Balconies	x	Modeled accurately in terms of basic geometry and location
	Canopies	(x)	
	Special exterior decks	(x)	
Roofs	Roof structures	(x)	
	Eaves structures	(x)	
	Glass roof structures	x	Load-bearing structures are modeled accurately in terms of basic geometry and location

Structure	Building part	x/(x)	Accuracy
Space-dividing components	Non-load-bearing concrete partition walls	(x)	
Other spatial parts	Structural components that require space, for example fire-retardant plates	(x)	
	Walkways and passage routes	(x)	

Tender design phase

Structure	Building part	x/(x)	Accuracy
Foundations	Piling	x	Piles are modeled for the proper location and length according to design
	Footings	x	• Examples of footing types are modeled accurately in terms of geometry and location, including connections, reinforcements and embedded objects. • Other footings are modeled accurately in terms of basic geometry and location so that collisions are avoided and the total amount of structures can be reported from the model.
	Foundation walls	x	Load-bearing structures are modeled accurately in terms of basic geometry and location so that collisions are avoided and the total amount of structures can be reported from the model.
	Foundation columns	x	• Examples of foundation-column types are modeled accurately in terms of geometry and location, including connections, reinforcements and embedded objects. • Other foundation columns are modeled accurately in terms of basic geometry and location so that collisions are avoided and the total amount of structures can be reported from the model.
	Base beams	x	Load-bearing structures are modeled accurately in terms of basic geometry and location so that collisions are avoided and the total amount of structures can be reported from the model.
	Thermal insulation	(x)	Are modeled accurately in terms of basic geometry and location so that the total amount of material can be reported from the model.
Substructures	Substructures slabs	x	Load-bearing structures are modeled accurately in terms of basic geometry and location so that collisions are avoided and the total amount of structures can be reported from the model.
	Substructures canals	x	Load-bearing structures are modeled accurately in terms of basic geometry and location so that collisions are avoided and the total amount of structures can be reported from the model.

Structure	Building part	x/(x)	Accuracy
Substructures	Special base floors	x	Load-bearing structures are modeled accurately in terms of basic geometry and location so that collisions are avoided and the total amount of structures can be reported from the model..
	Thermal insulation	(x)	These are modeled accurately in terms of basic geometry and location so that the total amount of material can be reported from the model.
Structural frame	Shelter	x	Load-bearing structures are modeled accurately in terms of basic geometry and location so that collisions are avoided and the total amount of structures can be reported from the model.
	Load-bearing walls	x	• Examples of load-bearing wall types are modeled accurately in terms of geometry and location, including connections, reinforcements and embedded objects. • Other elements and on-site concreting structures are modeled accurately in terms of geometry and location, so that collisions are avoided and information regarding the total amount of structures can be reported from the model.
	Columns	x	• Examples of concrete column types are modeled accurately in terms of geometry and location, including connections, reinforcements and embedded objects. • Other elements and on-site concreting structures are modeled accurately in terms of geometry and location, so that collisions are avoided and information regarding the total amount of structures can be reported from the model. • Examples of steel column types are modeled accurately in terms of geometry and location, including connections. Composite columns should include reinforcements.
	Beams	x	• Examples of concrete beam types are modeled accurately in terms of geometry and location, including connections, reinforcements and embedded objects. • Other elements and on-site concreting structures are modeled accurately in terms of geometry and location so that collisions are avoided and information regarding the total amount of structures can be reported from the model • Examples of steel beam types are modeled accurately in terms of geometry and location, including connections.

Structure	Building part	x/(x)	Accuracy
Structural frame	Intermediate floors	x	• Examples of concrete element types are modeled accurately in terms of geometry and location, including connections and embedded objects. • Other elements and on-site concreting structures are modeled accurately in terms of geometry and location, so that collisions are avoided and information regarding the total amount of structures can be reported from the model
	Ceiling	x	• Examples of concrete element types are modeled accurately in terms of geometry and location, including connections and embedded objects. • Other elements and on-site concreting structures are modeled accurately in terms of geometry and location, so that collisions are avoided and information regarding the total amount of structures can be reported from the model.
	Special frame structures	(x)	Load-bearing structures are modeled accurately in terms of basic geometry and location, so that collisions are avoided and the total amount of structures can be reported from the model.
Facades	Exterior walls	x	• Examples of concrete wall element types are modeled accurately in terms of geometry and location, including connections, reinforcements and embedded objects. • Other elements and on-site concreting structures are modeled accurately in terms of geometry and location, so that collisions are avoided and information regarding the total amount of structures can be reported from the model.
		(x)	• Modeling of façade structures with light-structural frames is decided on a project-specific basis. For example, a wall can be modeled as a continuous for quantity survey. • Modeling of surface finishing of wall elements is decided upon on a project-specific basis.
	Special façade structures	(x)	
Exterior decks	Balconies	x	• Examples of concrete element types are modeled accurately in terms of geometry and location, including connections, reinforcements and embedded objects • Other elements and on-site concreting structures are modeled accurately in terms of geometry and location, so that collisions are avoided and information regarding the total amount of structures can be reported from the model.

Structure	Building part	x/(x)	Accuracy
Exterior decks	Canopies	x	Load-bearing structures are modeled accurately in terms of basic geometry and location so that the total amount of structures can be reported from the model.
	Special exterior decks	x	Load-bearing structures are modeled accurately in terms of basic geometry and location so that the total amount of structures can be reported from the model.
Roofs	Roof structures	x	These are modeled such that the MEP designer can see from the model the space available for use.
	Eaves structures	(x)	
	Glass roof structures	x	Load-bearing structures are modeled accurately in terms of basic geometry and location so that the total amount of structures can be reported from the model.
Space-dividing components	Non-load-bearing concrete partition walls	x	• Examples of concrete element types are modeled accurately in terms of geometry and location, including connections, reinforcements and embedded objects • Other elements are modeled accurately in terms of geometry and location so that collisions are avoided and information regarding the total amount of structures can be reported from the model.
Other spatial components	Structural parts that require space, for example, fire-retardant plates	x	These are modeled such that the MEP designer can see from the model the space available for use.
	Walkways and passage routes	(x)	

Detailed design phase

Structure	Building part	x/(x)	Accuracy
Foundations	Piling	x	Piles are modeled according to the as-built data.
	Footings	x	Footings are modeled precisely in terms of geometry, including connections and embedded objects.
		(x)	Cast-in-place reinforcements
		(x)	Elements are modeled according to the design contract
	Foundation walls	x	Foundation walls are modeled precisely in terms of geometry including connections and embedded objects.
		(x)	Cast-in-place reinforcements
	Foundation columns	x	Foundation columns are modeled precisely in terms of geometry, connections and embedded objects.
		(x)	Cast-in-place reinforcements

Structure	Building part	x/(x)	Accuracy
Foundations	Base beams	x	Base beams are modeled precisely in terms of

			geometry, connections and embedded objects.
		(x)	Cast-in-place reinforcements
	Thermal insulation	(x)	Thermal insulation is modeled accurately in terms of basic geometry and location so that the total amount of structures can be reported from the model.
Substructure	Substructure slabs	x	Substructure slabs are modeled accurately in terms of geometry, connections and embedded objects.
		(x)	Cast-in-place reinforcements
		(x)	Elements are modeled according to the design contract
	Substructure canals	x	Substructure canals are modeled accurately in terms of geometry, connections and embedded objects.
		(x)	Cast-in-place reinforcements
	Special base floors	x	Special base floors are modeled accurately in terms of geometry, connections and embedded objects.
		(x)	Cast-in-place reinforcements
	Thermal insulation	(x)	Thermal insulation is modeled accurately in terms of basic geometry and location so that the total amount of structures can be reported from the model.
Structural frame	Shelter	x	Modeling of on-site concreting structures includes connections and embedded objects
		(x)	Cast-in-place reinforcements
	Load-bearing walls	x	Modeling of on-site concreting structures includes connections and embedded objects
		(x)	Cast-in-place reinforcements
		(x)	Elements are modeled according to the design contract
	Columns	x	Modeling of on-site concreting structures includes connections and embedded objects
		(x)	Cast-in-place reinforcements
		(x)	Elements and assemblies are modeled according to the design contract.
	Beams	x	Modeling of on-site concreting structures includes connections and embedded objects
		(x)	Cast-in-place reinforcements
		(x)	Elements and assemblies are modeled according to the design contract.
	Intermediate floors	x	Modeling of on-site concreting structures includes connections and embedded objects
		(x)	Cast-in-place reinforcements
		(x)	Elements are modeled according to the design contract.

Structure	Building part	x/(x)	Accuracy
Structural frame	Ceiling	x	Modeling of on-site concreting structures includes connections and embedded objects
		(x)	Cast-in-place reinforcements
		(x)	Elements are modeled according to the design contract.
	Special structural frame structures	(x)	Modeling of on-site concreting structures includes connections and embedded objects
Facades	Exterior walls	x	Modeling of on-site concreting structures includes connections and embedded objects
		(x)	Cast-in-place reinforcements
		(x)	Elements are modeled according to the design contract.
	Special facade structures	(x)	
Exterior decks	Balconies	x	Modeling of on-site concreting structures includes connections and embedded objects
		(x)	Cast-in-place reinforcements
		(x)	Elements are modeled according to the design contract.
	Canopies	(x)	According to the design contract
	Special exterior decks	(x)	According to the design contract
Roofs	Roof structures	(x)	According to the design contract
	Eaves structures	(x)	
	Glass roof structures	(x)	According to the design contract
Space-dividing parts	Non-load-bearing concrete partition walls	(x)	Elements are modeled according to the design contract.
Other spatial components	Structural parts that require space, for example, fire-retardant plates	x	These are modeled such that the MEP designer can see from the model the space available for use.
	Walkways and passage routes	(x)	

Location:	
Time:	
Auditor:	
Target Model:	
Version:	
Date of Model Version:	

Checklist for Structural Building Element BIM	Passed	Issues	Not Relevant	Comments
BIM Specification				
Models are in Agreed File Formats (IFC and other agreed files)				
Models are Located in Correct Coordinate System				
There Is (Mainly) One Building in One Model				
Model has Floors				
Building Elements Belong to Correct Floor				
Building Elements Have Unique Numbering				
Agreed/Required Building Elements are Modeled (Part 5 - Appendix				
Building Elements are Modeled Using Correct Tools				
Builing Elements are Named as Agreed				
Model Doesn't Have Extra Building Elements				
Model Doesn't Have Building Elements Inside Each Other or Duplicate Building Elements				
Model Doesn't Have Significant Intersections Between Building Elements				
Conformity Between Architectural and Structural Models				
Conformity Between Openings in Architectural and Structural Models				
Structures are Supported				
Spatial Reservations for MEP Systems Have Been Done				

Signature: