HAMK REAL ESTATE BUILDING DOCUMENTATION DRAWINGS

DESIGN GUIDE

HAMK
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Abstract
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This thesis presents a comprehensive framework for creating architectural documentation drawings for building construction projects collected to be used and aligned with the overall Häme University of Applied Sciences Ltd (HAMK Oy), Real Estate office. The work covers various aspects of documentation drawing design, including the types of drawings required, the information that should be included in each drawing, according to standard and Finland´s building requirements, and the drawings required.

The process of creating accurate and comprehensive documentation drawings is an important aspect of any construction project. A planning guide designed for documentation drawing provides detailed information about the building design, and general building parts, floor, or section code used for building archiving data documentation.

It also provides guidelines on how to create the type layers naming, including the appropriate use of symbols of documentation naming according to the Finnish standard of CAD layer system classification, Talo 2000 -nomenclature.

Furthermore, the guide emphasizes the importance of clear communication between designers, architects, engineers, and other stakeholders involved in a construction project. It highlights the need for collaboration, to ensure that the documentation drawings accurately reflect the design intent and provide the necessary information for successful construction.

Keywords Drawings documentation, data models requirement, design plan guide, and uniform design
Pages 44 pages and appendices 08 pages

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1 Introduction

A building design guide is a document or set of guidelines that provides information and recommendations for the design of new or renovated buildings. These guides can cover a wide range of topics, including building layout drawings from architectural materials and construction techniques, as well as accessibility. Additionally, it can help designers to follow the global regulation and local codes, for example according to the national building code of Finland.

A building design guide is a document that provides information for the design and construction of new buildings or the renovation of existing buildings. It can be used by architects, engineers, builders, and other professionals involved in the design and all construction process phases.

The goal of this thesis is to create a building design guide that will ensure that new buildings are visually appealing and integrate well into the HAMK policy while also reflecting the unique needs and context of the community in which they are located and the surrounding environment. This guide can include information on design principles, Finnish regulation’s building codes, and sustainability practices.

2 Guide for a data model plan in HAMK

The planning guide helps to create a data model plan and identify the requirements for a data model, the goals, and the objectives. All data needs to be collected to be used and aligned with the overall HAMK Real Estate Office. By understanding the data sources, the designers determine what data is available and where it is located. Therefore, all data should be identified and determined if any additional data needs to be collected with all details of the data model.

It is essential to follow the guidelines so that HAMK Ltd (Oy), can effectively handle its real estate portfolio and associated endeavors. Implementing a data model-based approach in construction projects can bring numerous advantages. Efficient document management can overcome obstacles, allowing for the following benefits to be achieved using project banks: accurate and dependable information that is readily available when needed, a reduction in the time spent on investigating and verifying information, increased process efficiency, all relevant information is centralized in one location, and a reduction in unnecessary printing. Compliance with guidelines is crucial for HAMK Ltd to effectively manage its real estate and related projects.

Additionally, when a construction project employs a data model-based process, it can lead to improved visualization of plans for both the builder and user, the prevention of conflicts between plans during the planning phase, more efficient construction, increased reliability in final construction using mathematical calculations in design-related information models, and pre-construction verification of system balance.

2.1 Interpretations of the guidance

For the successful management and coordination of an information model project, according to Finland Common BIM Requirements 2012, COBIM, Management of a BIM project, the management of project process needs three frequently processes, which are design, execution, and supervision (Karjula & Mäkelä, 2012). Figure 1 shows the relevant phases.

A design plan is important because it lays out the blueprint for a building project and serves as a guide for all parties involved. Designing projects with standard requirement Building Information Modeling (BIM) allows collaboration between architects, engineers, and builders, and the design plan is the foundation upon which this collaboration is built. A well-designed plan is crucial for the success of a building project.

The planning and design for implementation, during the execution phase, helps to establish clear roles and responsibilities for all parties involved and to identify any potential issues or conflicts that may arise. It can also help keep the project on schedule and within budget. This way everyone is working towards the same goals and progress is being made according to the plan guides. During the supervision phase, contract management helps to monitor progress and address any problems or changes that may arise. All necessary inspections and approvals are obtained. Overall, these processes are an essential component of the project life cycle, and it helps to keep the project on track and ensure its success.

When undertaking a project, it is essential to allocate sufficient time to the planning and design stages to provide the project accuracy and ensure the progresses. The planning and design phases are essential to final documentation, as they provide the foundation for capturing the project's key details and ensuring that the project meets its goals and objectives. By investing sufficient time and effort into these stages, project teams can reduce the risk of errors, delays, and cost overruns and ensure the project (Karjula & Mäkelä, 2012, p. 6).

Figure 1. Management of project process (Common BIM Requirements 2012, COBIM, series 11 Management of a BIM project, p. 6)

2.2 Uniform format documentation

Designing a uniform format requirement for construction projects is important for ensuring that all relevant information is available in one place which reduces the amount of unnecessary data and promotes efficient use of the project bank. A uniform format can aim to produce a comprehensive and reliable document archive of buildings and management organization of the construction project more efficiently between the parties' exchange of information during the project.

The Finland University Properties Ltd "Suomen Yliopistokiinteistöt Oy (SYK Oy)" has the format requirements of the planning that have been drawn up to create uniform planning for the management of construction projects and up-to-date drawings of their university real estate office.

A uniform format of documentation allows for the initial data of changed projects to be presented in a form that is easy to use in terms of information technology. It also brings several benefits to visualizing the plans to allow the builders and user to have a better understanding of the combination models to help the design team to identify and prevent potential issues early in the planning phase (Järvinen & Mälkönen, 2016, p. 4).

2.3 Data modeling

The design guide should be based on experience and established operating methods in Finland universities, where these instructions serve as guidance and an item's outline. The guidelines apply to new construction, alteration, expansion, and basic improvement projects, as well as maintenance, repair, and updating projects, covering all design aspects. The project team must consider any special features of the buildings and any deviations from the instructions must be approved by the customer, which, in the case of this thesis, is the information manager at HAMK Ltd, the Real Estate Office, and reported to the project bank in HAMK Ltd.

Existing files in change targets are not changed without a separate order from HAMK Ltd to comply with the new guidelines, such as file names, origins, etc. No changes should be made within individual projects. However, all new designs will comply with the format requirements of the HAMK Ltd building design plan guide.

The instructions should be adapted with Autodesk -AutoCAD accordingly. For AutoCAD files in projects related to the information modeling process, the final documentation should be done based on the DWG files. AutoCAD is used in projects and for all tasks related to information modeling in all processes.

2.4 General goals of information modeling

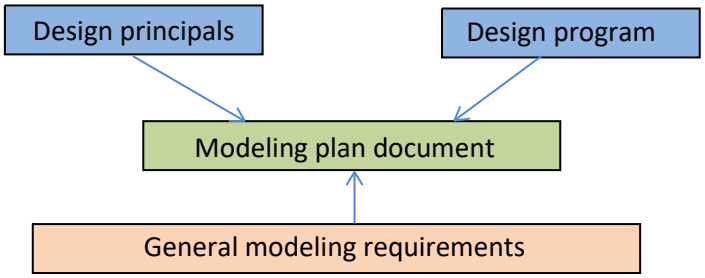
The general goals of having information modeling are essential as it allows for the allocation of resources in a way that maximizes the benefits of modeling for the project. The management and documentation of source data, other than status data, is important for the effective implementation and inspection of plans and results. A data model can be utilized for this purpose. The data model is updated throughout the planning and construction phases, and a final, up-to-date, model is created after the completion of the project.

The primary objective of information modeling in construction projects is to optimize the planning and maintenance phases by utilizing a data model. This is achieved by defining specific goals for information modeling in the project planning phase, which are aligned with the general goals of the project. Additionally, a clear schedule for information modeling is established and linked to the overall project schedule and its stages.

The goals of the guide to uniform documentation in the information model have many advantages, as the model can accompany all stages of construction. It can also be used later from a management and maintenance perspective. Due to beneficial information, a model can assess the viability of a project and detect possible design errors. The information model is a global system accessible to all parties in real time. This can be used also to enable efficient energy use (Niskanen, 2015, pp. 5-7).

It is important to document all steps of modeling according to design principles. The documentation should be clear and organized in a logical and structured way. Modeling a plan document is important to determine the project's goals and intended use. Requirements should be documented from the project's needs and instruction documentation according to design principles and modeling tasks. Figure 2 shows the definition of modeling process requirements related to the plan documents (Niskanen, 2015, p. 6).

Figure 2. Definition of design and modeling task, for modeling extent and level of accuracy. (Common InfraBIM requirements YIV 2015, MANAGING MODEL BASED PROJECT, 2015 P. 6.)



The benefits of utilizing the instructions in the technical guide are to improve the technical quality, content, and delivery of design documents. The designers must follow guidelines and get approval from the Building Control Authority before starting work. They must also keep in touch with necessary authorities and present plans to the building's original designer in major renovation projects. Programs used must be AutoCAD compatible or agreed upon with the developer (Oulun Tilapalvelut -liikelaitos, 2019, pp. 2-3).

3 Quality control of designing data models

Prior knowledge about the unit being built in structured construction allows architects and engineers to incorporate environmental, operational, and life cycle maintenance considerations into the design process effectively, building information modeling allows workplace productivity factors to be uniformly methodical on the basis for considering reliable statistical data on workplace performance. This dramatically changes the value

proposition of the buildings and the business environment regarding the benefits of design alternatives (Smith & Tardif, 2009, p. 79).

The format of the documentation should follow a widely accepted standard, by following the Finnish national CAD standard updated RT 15-10919, all CAD drawing layers are based on the Talo -2000 nomenclature.

3.1 Information model planning quality control for documentation

The quality assurance of the model is performed as described in Common BIM Requirements 2012, COBIM, series 6, Quality assurance, to guide how to coordinate the planning process and reduce error cost estimates, perform analysis, project schedule, and design quality deficiencies. Quality assurance must be carried out throughout the design phases. It can also be prepared for the comparison of the plan. Quality assurance includes the designer's spontaneous monitoring and quality assurance performed by the client. In implementing project management and other types of contracts, the contractor will participate in checking data models. BIM files should only be released following quality assurance and client satisfaction.

The Common BIM Requirements 2012, COBIM, series 6, Quality assurance, accentuates that the designers have a crucial role in ensuring the quality of BIM files, and the quality of the files delivered. The designer is responsible for any mistakes in the files in all circumstances, not the person who may have failed to discover those errors. In other words, the designer has full responsibility for the quality of their work (Kulusjärvi, 2012, p. 11).

A well-designed document can enhance its readability and make it more engaging and visually appealing to the reader, which can improve and maintain consistency in the presentation of information, that can in turn make it easier and quicker for the reader to quickly find and understand the information they need.

3.2 The guide requirements for documentation

The data model formats represent geometry according to the project types represented. They also carry object type data and relevant properties and relations between objects, and method of documentation. The object is schematically suitable for representing a building and information about its building parts, users, energy loads, or processes. A building data model may be used to represent file exchanging and supporting data. The objects must be selected based on a series of guidelines and requirements for the data model according to Common BIM Requirements 2012, COBIM buildingSMART Finland (bSF), also following standards and regulations from Building Information File (RT -File) from The Building Information Foundation (RTS), which is a rich resource for building information in Finland. For example, the relevant information is available in files RT 10-11066 – 11079 as well.

To make successful data modeling must be set for models and model utilization with project-specific requirements, they should be defined and documented based on the objectives. The general requirements set in the publication series of Common BIM Requirements 2012, COBIM, The requirements of the general design phase, series 1 General part (Henttinen, 2012, p. 5).

The accuracy and content requirements of the models' objectives are dependent on the design phases. The construction project should be modeled according to planned construction in order and project coordinates. This also includes information transferred in all Computer-Aided Design (CAD) files to the Industry Foundation Classes (IFC) file for visualization, inspections, and quantity surveying.

In larger projects, it is advisable for structural modeling to divide the structures into multiple models such as actual building elements, including load-bearing walls, columns, and all floors in between. The IFC appearance model produced for each store is based on the architectural division if agreed upon separately (Kautto, 2012, p. 9-19).

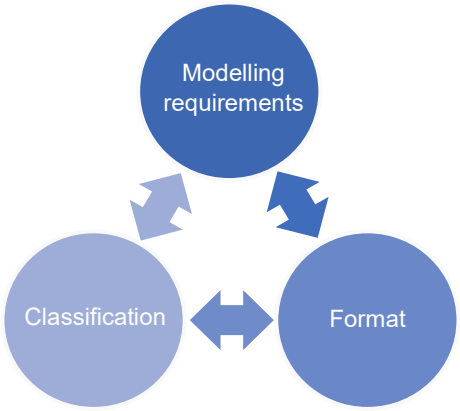
According to the Common BIM Requirements 2012, COBIM, series 5, Structural Design, the requirements for different design phases, which are the Schematic design phase, General

design phase, Tender design phase, and Detailed design phase. Each design phase should prepare in the field of drawings, modeling start level inventory, and requirements for modeling information in 2D or 3D dimensional format (Kautto, 2012, p. 9-10).

3.3 Data management

The development of data management models requires consideration of exchange data management delivered for all secure baseline design data. Figure 3 shows the three pillars of data management. The modeling requirements, format, and classification are required to be in uniform format for data management. The Common InfraBIM Requirements YIV buildingSMART Finland provide a standardized approach to modeling, where requirements are essential for effective information management in projects, ensuring that information is accurate, consistent, and available to all stakeholders. This can provide a common language and framework for all stakeholders, with everyone working towards the same goals and objectives (Common InfraBIM Requirements YIV, 2019, p. 5).

Figure 3. Three pillars of information management (Common InfraBIM Requirements YIV, 2019, p. 5)



3.4 Data-modeled objects

The information modeling standards require accuracy established in the project for the geometry and data content of the data models. The guidance is aimed at architectural designers and users who master the use of the basic features of data modeling software.

A requirement for data modeling for standard modeling systems in a project and any specific instructions, as the same principle for operating methods, is presented in BuildingSMART Finland, Common BIM Requirements 2012, COBIM. By planning and modeling in AutoCAD, 3D architectural modeling and the architectural model of energy and condition simulations are used as a basis of Industry Foundation Classes (IFC).

3.5 BIM Maturity levels

The BIM Maturity levels show the rise through the levels of technology tools and drawings applications. This is important to know for data and processing management documentation, when climb more with all project and asset information and documentation. The levels show how to supply the ability progressing to exchange information from CAD to generate and collaborate progression to building information models and data being electronic and creating digital information modeling, as shown in Figure 4.

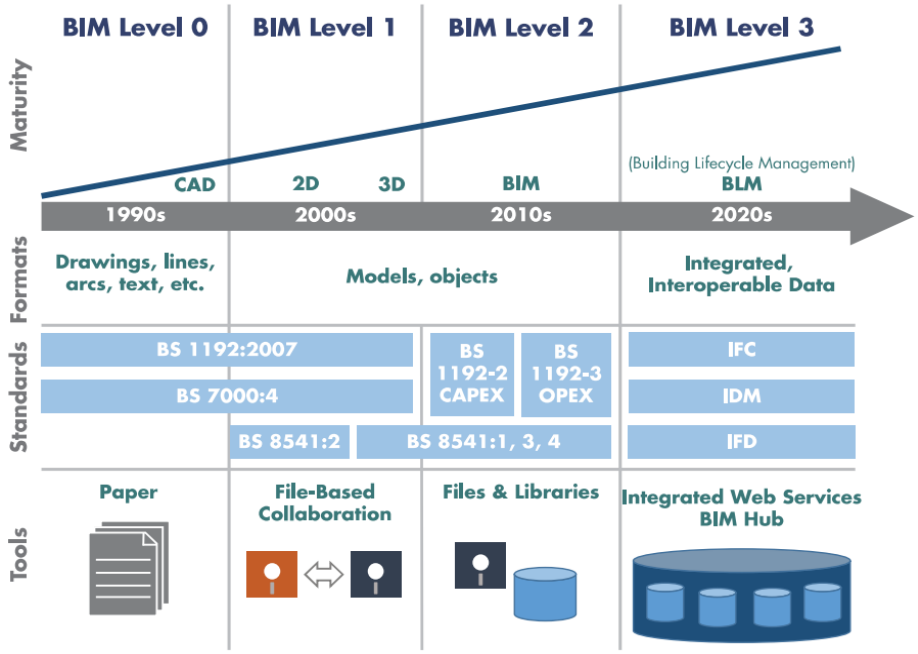
According to BIM maturity levels, Level 0 is starting to step up to generate drawings traditionally, basic CAD with computer design by aiding IT software and paper drawings (PAS 1192-5:2015, p. iv). Level 1 is to illustrate drawings and manage CAD in 2D or 3D. Level 2 represents managed 3D environment with data attached, and discipline models in standard formats. Files are based on collaboration and environmental data and have library management drawings in objects and modeling. At this level, the information can be controlled and received from other sources of reference models, because the information is developed with software discipline databases. Level 3 is where full integration and interoperable data represent a fully hosted project information model via web services. The project modeling covers sequencing, cost, and life-cycle management and collaborative

information (A report for the Government Construction Client Group, Building Information Modelling (BIM) Working Party Strategy Paper, 2011, p. 16).

BIM maturity levels define BIM levels progression, in information technology in construction, which expresses the extent of the levels of sophistication of the use of individual tools in the process. In this perspective, BIM is seen as a series of different stages in a journey, starting from computer drawing to the digital age. The UK government has adopted the concept of BIM levels from Level 0 to Level 3, this consists of four levels, shown in the level chart (Sacks et al., 2018 p. 15). This has also become a broad criterion for a BIM project.

Basically, at Level 0, BIM Information is shared by traditional paper drawings or in some cases digital PDF. Currently, most project models in the construction industry are way ahead of this level. Many companies currently operate at BIM Level 1. This typically involves a combination of 2D and 3D CAD for conceptual work to drafting legal approval documentation. Project models are driven by electronic data. At BIM Level 2, all parties work together, and the partners use a 3D model to collaborate and exchange information. Working as an organization to investigate all the design information to combine that data into a uniform common file format to create a federated BIM mode. The UK government has set this level as a minimum target by 2016. BIM Level 3, This level is a full collaboration, all parties can access and modify the shared project model. The project is disciplined and stored in a single common project model (Sacks et al., 2018 pp. 15-16).

Figure 4. BIM Maturity level model, by Mark Bew and Mervyn Richards (Sacks et al., 2018 pp. 15)



The Finnish National Archives Strategy 2025 aims to promote and digitize public and private documents through the electronic format to the diversification of cultural heritage documents, and data management based on artificial intelligence, achieved in modern ways digital formats for accessing data (The National Archives of Finland Strategy 2025, 2020, p. 5).

3.5.1 BIM Content Levels

According to the Common BIM Requirements 2012, COBIM, series 3 Architectural design, the BIM content levels can be divided into three groups, the requirement of the content level depends on the phase of the project and prospective usage of the various buildings. In Level 1, it is to coordinate the model and collaborate with the designers, as well as description of the location, model geometry, and accurate labeling of building parts according to requirements. Level 2 includes a typical use of a model in architecture or engineering which is used for energy analysis, essential information quantity, and cost estimation. Accurately positioning, naming, and modeling correctly according to the

requirements of building parts and types should be done. Level 3 is used for construction scheduling and purchasing. The accurate position and geometry of the model are according to the requirements with relevant information for purchasing added to model objects.

The BIM content level for each project phase should be agreed upon at the start of the project. The guideline mentions two separate versions of an architect's model may be needed for simulation and quantity take-offs. One model is set to level 2 for energy simulation, which is because the simulation model needs specific requirements of energy simulation and requirements for models are a bit different (Henttinen, 2012, p. 8).

4 CAD software and file formats

Building Information Models (BIM) is intelligent geometry, and it is complex. Computer-Aided Design (CAD) applications and visualization tools only generate geometric shapes, resulting in a frame model of a 2D or 3D building. Important information created during the design and construction process, valuable to facility managers, is scattered in various sources such as construction specifications, and countries with required national codes, certificates requirement, and maintenance manuals. Information relevant to facility managers in construction documents must then be extracted, making it an inefficient and time-consuming task.

Due to the core technology behind BIM, it is more like a relational database in CAD application, making building information accessible to various users via familiar interfaces. This includes building owners, operators, constructors, facility managers, and emergency responders, for example, the fire brigade.

The utilization of the DWG file format for CAD drawings can be optimized by adhering to established standards and guidelines. It can provide several benefits including enhanced compatibility and accessibility of the CAD files. It is crucial to adhere to standardization guidelines. This is particularly important for real estate building plans, the design plans where the implementation of HAMK Ltd guide format instructions can guarantee the accessibility and compatibility of CAD files. The standardization of the DWG format facilitates

the exchange of 2D CAD data and information between designers, ensuring that the CAD files can be opened even if the original software used to create the files is no longer available, and still be able to access those files. This also promotes seamless collaboration and compatibility with future design projects.

4.1 3D modeling

Building information modeling is more about attempting consciously to use three-dimensional visualization to remedy modeling projects. The use of 3D visualization in BIM provides a more technical and precise representation of building designs, allowing for improved more effective communication among all stakeholders involved in the project, especially with team members, maintenance workers, and clients. Most untrained individuals presented with 2D drawings are unable to fully comprehend and accurately visualize the intended physical outcome of the design without assistance. This issue is effectively addressed using 3D visualization in BIM, as it provides a more comprehensive and accessible representation of the building design, allowing for improved collaboration and understanding among project stakeholders (Smith & Tardif, 2009, p. 79). In data model-based planning, it is crucial that the CAD software utilized supports the IFC format, which has become a widely adopted standard in the construction industry. The IFC format allows the integration and exchange of building design data between different software and platforms, enabling improved cooperation and information management throughout the project life cycle.

It is an important principle to consider when preparing a building format, for energy and condition simulations using IFC file format, and this can provide a common data exchange format for construction professionals. To ensure that the IFC file is suitable for transfer to simulation software, it is important to correctly model the space boundaries and spatial objects and consider the height of the space between objects.

In construction projects, browsing integrated models helps with technical visualizations and quality assurance for compatibility and clash detection. To visualize IFC models, there are 3D viewing tools and facility management software available, Figure 5 shows a visualization of

spaces of combined models. These tools allow for technical visualization of models from architects, structural designers, and combined models. In facility management, 2D and 3D viewing can be used to locate spaces, equipment, and maintenance objects, and to show hidden maintenance and repair construction objects (Jokela et al., 2012, pp. 10-11).

Figure 5. An example of visualization of spaces, 2D and 3D combined models (Common BIM Requirements 2012, COBIM, series 12 Use of models in facility management, p. 11)

4.2 Naming

HAMK buildings were constructed for different purposes over a period of several years, and the buildings project designs were created by various different companies and by using different techniques, thus naming conventions and labeling of layers in the drawings can vary significantly. Managing and communicating the different components of the designs effectively can be a challenging task due to the differences in techniques, naming conventions, and labeling of layers across the designs.

Without the same uniform approach name, it can be difficult to ensure consistency and accuracy in the design data. A proposed system to standardize the naming convention and organization of design data for real estate projects across HAMK's different campuses and floors is utilized. By using advanced tools, the implementation of a uniform naming system

and file structure can be achieved seamlessly. It can simplify the process of managing and accessing design data.

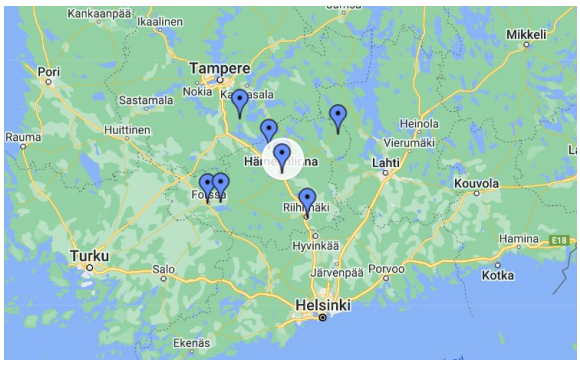
To implement this system, it is recommended to base it on storage in the HAMK Real Estate office database. Consider utilizing tools such as project management software, and data management software, which also needs to provide implement a standardized naming convention and file structure for design data.

Following a uniform naming convention and file structure can have several benefits for real estate projects. It can improve efficiency by making it easier to find and access relevant design data, which can reduce the time and resources it takes to complete a project. This can help to streamline the design process and increase the efficiency of standard ways. It also can help to ensure that everyone involved in the project can easily understand and work with the design data, regardless of the origin of the design.

Häme University of Applied Sciences campuses are located in Häme Region and Pirkanmaa area in Finland Figure 6. The university operates at seven different campus locations, including Evo, Forssa, Hämeenlinna (University Center), Lepaa, Mustiala, Riihimäki, and Valkeakoski. Only the Valkeakoski campus is in Pirkanmaa Province (Pirkanmaan Lääni), the other six HAMK camps are in the Häme Region (Kanta-Häme).

It is important to note that the campus of the university center in Hämeenlinna is also referred to as Visamäki or Hämeenlinna but according to the university's new updated name formatting, it is now called Korkeakoulukeskus. This name refers to the center of the university, and it is the primary location of The Real Estate office.

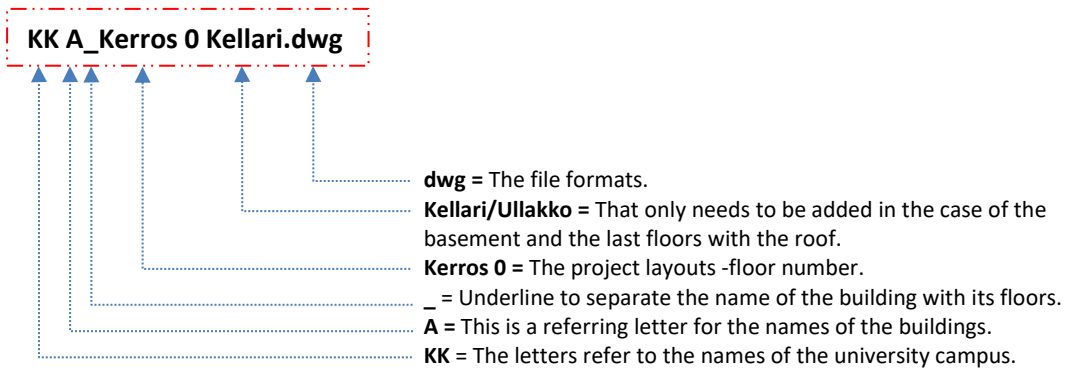
Figure 6. HAMK campuses and maps (https://www.hamk.fi/ campuses and maps, n.d.)



Organizing and arranging the names as city names of campus is a good idea to file and folder associated data with all design-related data and storage.

The plan drawings are based on drawings from original campus names describing a system for organizing plan drawings based on their location within a building or campus. By determining the different floor levels and buildings names within each campus, each drawing is given a name that includes the campus names and floor level it corresponds to, and there is a letter-based system for ordering the drawings. The guide plan uses the two first letters of the campus name and the first letter of the building name or building name. Figure 7 shows an example to determine the building's names within the campus and different floor levels.

Figure 7. An example of the drawings file naming and their repository files and for their storage, by determining the campus name and floor levels.



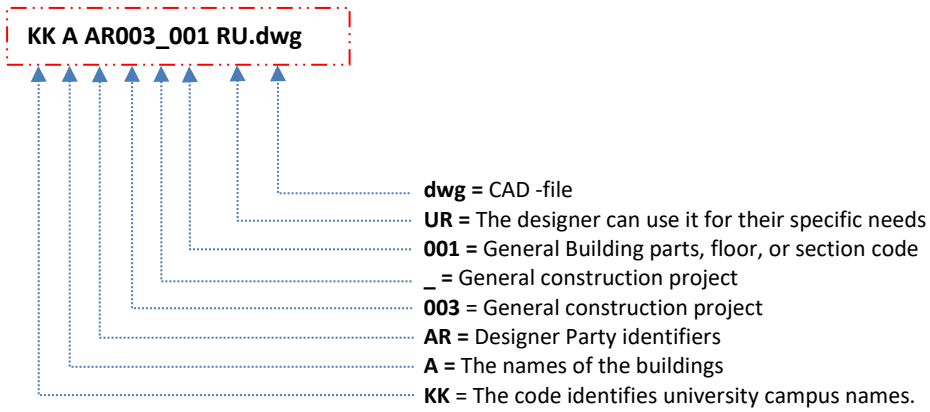
KK	=	Korkeakoulukeskus
A	=	A -building
_	=	Underline
Kerros 0	=	Floor 0

Kellari	=	Basement or the last floors with the roof need it.
dwg	=	CAD file format

4.3 Document list files naming according to RT Files - Building Information

According to the Finland RT-Files, Building Information (RT-kortisto, Rakennustieto), the files must be equipped with a design partner identification with a position at the beginning of the file name. The file name after the design party identity can be defined by the designers, by following a standard way. An example of the naming of specified files in more detail is shown in Figure 8 according to RT -Talo 2000 (RT 15-10956, 2009, pp. 1-4).

Figure 8. Naming floor plans and sections



KK = The code identifies university campus names

Example:	Ev	=	Evo
	Fo	=	Forssa
	KK	=	Korkeakoulukeskus (University Center)
	Le	=	Lepaa
	Mu	=	Mustiala
	Ri	=	Riihimäki
	Va	=	Valkeakoski

A = The names of the buildings

Example:	A	=	A -building
	B	=	B -building

AR = Designer Party identifiers

Example:	AR	=	Architectural designer
	KS	=	Urban planner
	PR	=	Process designer
	PT	=	Fire safety designer
	RA	=	Structural designer
	LV	=	HVAC, water, and drainage designer
	SJ	=	Designer of electrical systems

((Appendix 4) Catalog of the party codes in the drawings design and building nomenclature codes. According to RT 15-10956, 2009, p. 4. TALO 2000).

003 = General construction project

Example:	001	=	General documents related to construction
	002	=	Area and schematic drawings (layout drawings)
	003	=	Base drawings (master drawings)

(The classification codes for general drawings and drawings files are shown in the general description of the Talo 2000 -nomenclature, of the building. According to (RT 15-10956, 2009, p. 3)

_ = General construction project

	_	=	Underline, to make reading clearer

001 = General Building parts, floor, or section code

Example:	000	=	Architectural designer
	001	=	General documents related to construction
	002	=	Area drawings (yard drawings)
	003	=	Floor plans (working drawings)
	004	=	Sections (working drawings)
	11	=	A-A Sections
	00 kellari	=	Basement
	01 Kerros	=	1st floor
	02 kerros	=	2nd floor

(The basement floors' following numbering to the floor ID, If the property has several basement floors, sometimes from Talo 90 and older, drawings are used (00, -01 or K1, K2, etc).

UR = The designer can use it for their specific needs

Example:	RU	=	General specific code related to building

dwg = file format

Example:	DWG	=	CAD file, AutoCAD

4.4 Layers

Layers in the CAD drawings are important because the implication for using them is based on communicating data. This can be between each of the participant's architects, drafters, associates, and structural engineers. Using standard titles for layers in CAD drawings is important for easy identification and organization of the drawings. The standard titles for layers in CAD drawings are to aid in identification. This is especially important when working on large and complex projects where there may be many different layers and elements within the drawing. This can help to ensure that all drawings are organized and labeled, by following standard titles, and everyone in the office will understand the purpose and content of each layer, which can save time and prevent errors. It also makes it easier to locate specific elements within the drawing and to make changes or updates as needed (Osamu & Richard, 2003, p. 86).

Layers in CAD data files are organizational attributes used to categorize and separate different objects in a drawing or model. By assigning the project plotted drawings specific

layers, the designers and engineers can control visibility, manage, and editing of different parts of the design separately, and to communicate the data (ISO 13567-1, Second edition 2017, p. 1).

By utilizing the organizational attributes of layers and developing a standardized naming convention for the layers and their components, it is possible to simplify the process of managing and communicating the design data.

The data types on project drawings and its specification can be used as needed, depending on the required level of precision for the project. The data type is represented by a letter, which can be further refined with additional numbers. Also, the other characters can be used to denote text portions related to building elements or multiple picture layers for different display methods. According to RT 15-10919, data type and their specification are divided into two data types of which the main level is divided into the model (M) and drawing (P), which comes from the first letters of the Finnish words "Malliin" and "Piirustukseen". This means that the data can be split into two main groups: one group containing information related to the model, and another group containing drawing markings (RT 15-10919, 2008, p. 5). An example of the use of drawings layers in connection with floor plan shown in Appendix 1 CAD drawings plane system.

4.5 Set up layers

In CAD, each layer produces a different part of the floor plan. One advantage of producing a drawing on a CAD system is that the layers can complete the illustration of the component on the screen. Moreover, they can reposition some parts if space permits, to avoid congestion. The outline of the drawing sheet will be taken from the database separated by layers and placed over the drawing layout.

The maturity of the model is very important and must be documented in order to find different parties. When setting up layers for CAD drawings, it is important to follow standard conventions, such as those outlined in the national CAD standards. The use of consistent and correct layer titles, naming along with letter designations for different disciplines

architectural, structural, and electrical, helps ensure that all the different components of a building are properly cross-referenced and coordinated (Osamu & Richard, 2003, p. 86).

In general, the number of layers can produce composite drawings layout. Therefore, a well-organized layers system with appropriate titles, naming, and designations can help improve the accuracy of the documentation process of the design. Appendix 2 shows an example of CAD drawings layers naming with floor plan, with drawing markings and information related to the model.

4.5.1 Duplicated objects

A block is a group of objects that can be saved as a single object and reused in multiple places within a drawing or across different drawings. Since drawing blocks have their own layers, when inserting a block into a drawing, the layers associated with the block will also be added to the layer list of the project drawing. This can result in a crowded layer list, especially if you are using a large number of blocks with many layers required to avoid and manage layers properties states in AutoCAD. To simplify the layer lists that are not needed for a particular view, while still maintaining the original layer structure of the block.

In AutoCAD, creating Blocks is a way to group multiple objects into a single object. This can reduce the number of layers by combining similar objects into a single block. Using External references (Xrefs) in AutoCAD can help avoid crowded drawings with many layers. When creating external references in AutoCAD, the external file or drawing is not actually inserted into the current drawing. Instead, it is linked to the drawing and can be viewed or edited separately, making it easier to manage.

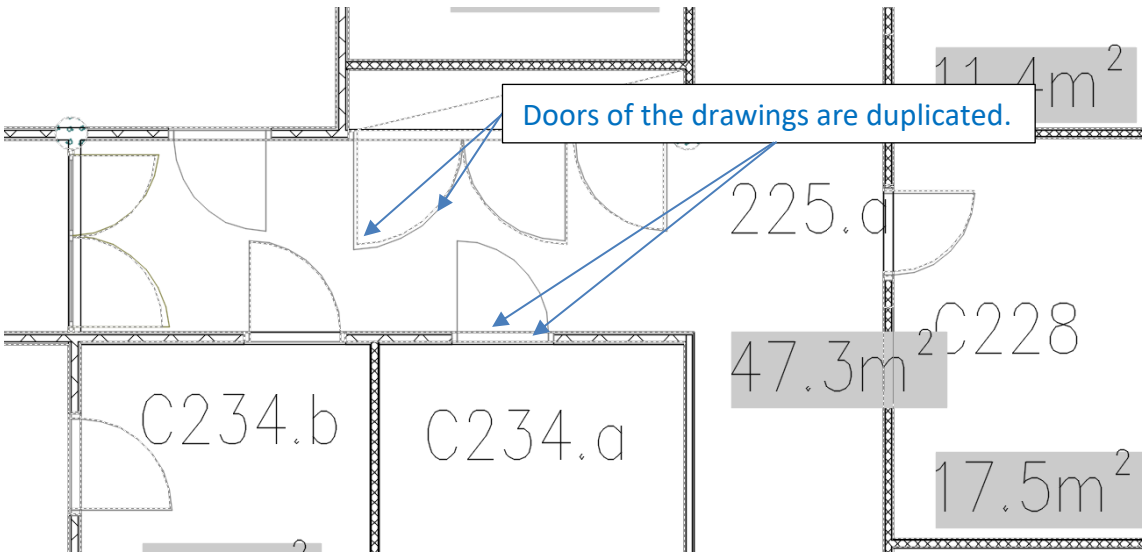
The External References palette is very efficient to able to organize, displays, and managing referenced and attached different types of files (Allen & Onstott, 2007, p. 251).

4.5.2 Duplicated layers

It appears that there are duplicate parts in the DWG files for buildings, which occurs when the layout drawings are done by several different design companies. When architects add new parts to drawings, sometimes the joined intersection points between new and old drawings when extended into layouts, become duplicates, such as double elements, walls, windows, doors, etc. For example, from the DWG files of the university center of buildings C, D, E, and N, some parts of the drawings are duplicated, shown in Figure 9. This occurs because the architects regularly update, extend, and add new layouts as one block to the old DWG files. After the explosion, those are updated in drawings, by using the explode command in AutoCAD, which will separate the compound objects into their individual components.

This will enable the modification of each component separately and more layers to drawings or duplication. When exploding a block, AutoCAD will promptly choose the objects it will break down into their individual components, including any layers that were duplicated. This means that the duplicated layers will also be included to be added to the drawing project layout. Before exploding any block, it is better to make sure to avoid adding unnecessary parts and layers to the original DWG file project layout.

Figure 9. Some parts of the drawings are duplicated, from the university center on the second floor of buildings C, D, E, and N.



It also can be managed to clean out drawings in AutoCAD, In the Toolbar ->> Manage ->> "Cleanup" by using the command of the buttons (Purge, Overkill, Audit, and Find Non-Purgeable Items), to remove unused items, and duplicate or overlapping lines also such as block definitions and layers, from the drawing.

4.6 The origin of the coordinate

Typically, each building is modeled on the plot in the same XY coordinate system, and it is recommended to draw the entire modeling project area be determined on the positive side of the XY-axis to be the origin of the coordinate located near the drawing area. Most of the design software would create problems if used in a municipality or state coordinate system with a base point far from the modeling area, which is recommended to not be used same base point (Henttinen, 2012, p. 8).

4.7 Use of reference files

When the project needs some updating, the models are composed of 2D CAD and references, and raster images can be copied and cropped to edit with the grip mode and adjust to the project contrast, according to the format of the attached reference files. Transparent files can be grayscale or colored. The transparency must be set on the clear background pixels which are treated as transparent. Used reference files should be saved in the same folder as the attached connected layer drawings.

4.8 Area drawing plans for building spaces and data definitions

HAMK real estate management wants to use Haahtela- TilaWelho software (Haahtela KT), to calculate the surface areas of the building and its premises using defined concepts. All measurable concepts are room areas, building components areas with sub-concepts, apartment areas, floor areas, gross areas, and usable areas. All measurable concepts must be followed according to the requirement to be constrained by the room area calculation rules of SFS Standard 5139 RT 12-11055. It is important to use the same format as other management of facility services and real estate offices in Finland add to DWG -files and has

been proven by Oulu City Real Estate, Tampere City Real Estate (Tampereen Tilapalvelut Oy), and Finland University Real Estate “Suomen Yliopistokiinteistöt Oy (SYK)” all use the same application (TILARAJAUSOHJE, 2018, pp. 1-11).

The building floor areas and location dividing connections, size, and other characteristics of area should be calculated according to the standard requirement above the floor areas according to Law 812/2017 Land Use and Building Act sections, 115 § Floor area (Laki Maankäyttö- ja Rakennuslain Muuttamisesta 115 § Kerrosala, 2017).

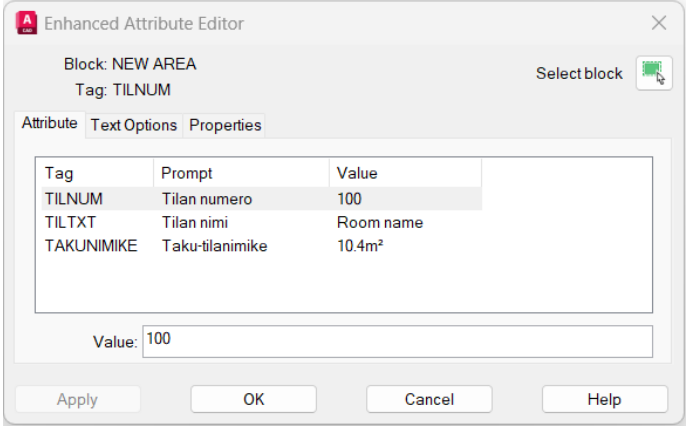
The HAMK Real Estate Office is required to have space and data definitions layers of drawings in DWG files for floor plans and should be applied to the entire building drawing layouts. The file must be in the same format. HAMK Ltd requests designers to add recommended layers to drawings layouts, so that the Haahtela- TilaWelho software can read them, the required drawing layers are shown in Table 1. Spatial boundaries should be created with a polyline and a feature to identify the specific location and room number and calculate the area of each room. HAA_AUKKO, act as an opening space from the building by drawings a polyline of the boundary lines of openings and building parts to be subtracted from the room area or space for example in the case of an opening area in the floor or subtracted area from the room area. HAA_KERROS_UL is for determining floor area in the layout of the drawing by drawing a polyline to its boundary lines. HAA_TILA, is the defined line of the room space boundary area.

To get information and specify these layers for drawing modeling, need to create an attribute label to attach data to a block, to be used to extract information into a database or table format, an example of an AutoCAD block is shown in Figure 10. The AutoCAD software can provide attribute values for each of the values that are associated with the block to the modeling drawing project. An example of the model drawing contains the spatial boundaries of the layer data definitions, shown in Appendix 5.

It is important to note, regarding the boundary line for the column to define the area of the columns and subtract from the entire area of the room where the columns are located. especially in some industry projects while the project has many columns, Appendix 5. The

Real estate, facilities, and housing policy property management of the City of Tampere from their space limitation instructions documents has taken into consideration as well, “PILARIN RAJAVIIVA” the boundary line for the column area (TILARAJAUSOHJE, LIITE 2, 2018, p. 11).

Figure 10. An example of an AutoCAD block -information about the new room and its definition.



The features of their attributes with tags must be found in the characterize features the following to identification. However, the point of placement of the symbol must be in the area, exactly within the cavity area.

HAA_TILANIM = Space name

HAA_TILANUM = Space number

HAA_TILANIMIKE = Area of the space in square meters or retrieved from the space nomenclature title

Table 1. Drawing layers for space reservations and data definitions.

LAYAER NAME	LAYAERS CONTENT	COLOR
HAA_AUKKO	Boundary lines of openings and building parts are to be subtracted from the room area	8 (gray)
HAA_KERROS_UL	Floor level boundary line	yellow
HAA_TILA	The boundary line of the space's room area	blue
HAA_TILANIM	Space name	white
HAA_TILANUM	Space number	magenta
HAA_TILANIMIKE	Space area in square meters / Or retrieved from the space nomenclature title	red

4.9 Space Identification

Identifying spaces is an important aspect of building planning. Space Id, data such as floor area, and other information can be added to a database. The essential information linked to a space includes its space identification (room number), function, and descriptive name, also known as the room number, which may include letters and special characters. It is essential to identify every room with a unique uniform way of Space Identification. The HAMK Real Estate wants to identify spaces area according to Talo 2000 -nomenclature, to the descriptive name given to spaces, Appendix 6. Space Identification can be used for the room number, space function to describe the function of the room, and name of the space to descriptive the name of the space (Henttinen, 2012, p. 13).

5 Final documentation

When making important projects at the official point of a building permit application, BIM and its associated documents are essential tools, and should follow a BIM-based design process. Documents should be based primarily on the BIM and be published simultaneously with or before the documents, with also the building specification and other material that is related to the model. The project schedule should include time for quality assurance at each release point as described in COBIM, series 6, Quality assurance. This means the schedule for publications in all stages should be agreed upon at the beginning of the project with sufficient time and resources reserved for quality assurance at each release point (Henttinen, 2012, p. 11).

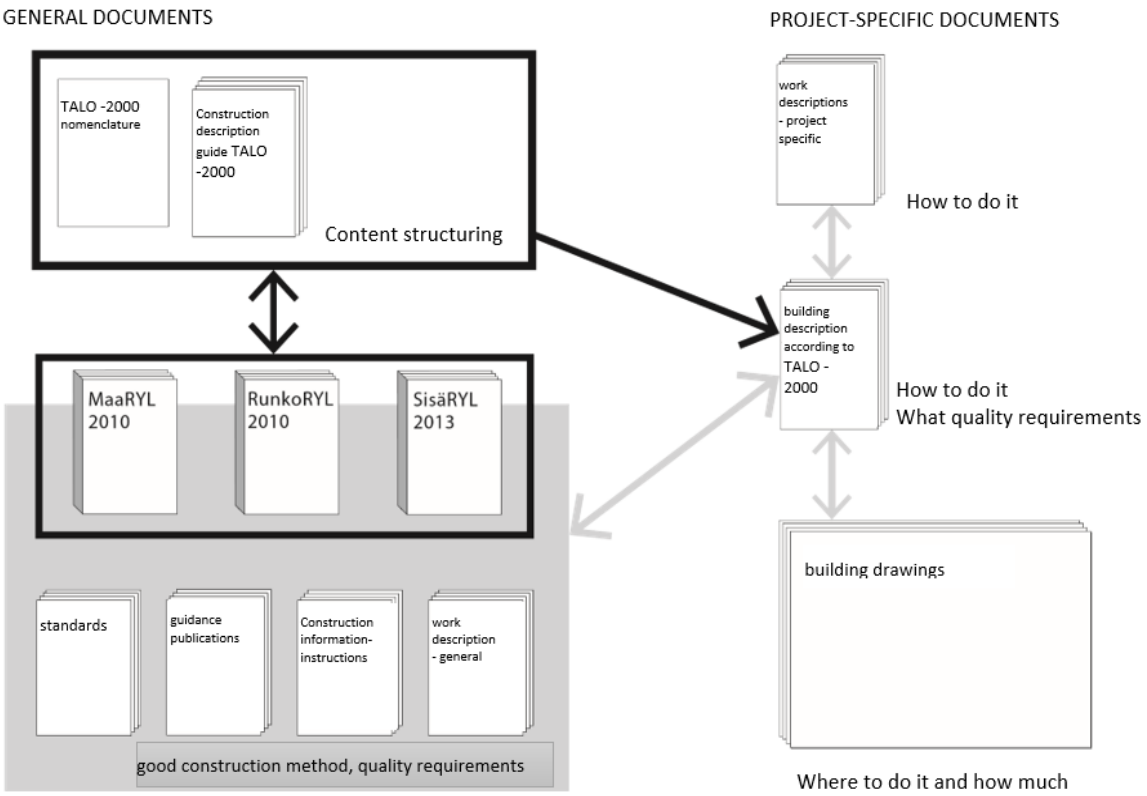
This approach allows for the active use of the BIM during the design development phase, and deliverables from the original model. Also, the use of IFC models in design allows for more systematic examination and analysis of up to 60% of the data in architectural design, compared to only 5-10% in traditional design. This leads to a higher quality of BIM delivery and better outcomes (Kulusjärvi, 2012, p. 4).

5.1 Classifications according to building report guide Talo 2000

The building guide reports Talo 2000 -nomenclature is a document used to identify the construction quality of the building site. The construction report is a technical document, its purpose is to describe the intended building parts classification and to arrange construction project document. The guide methods required to achieve and identify construction documentation parts, the form of implementation, and the contractual arrangements that define them in according to quality requirements, and the way to do them. Figure 11 shows the connection of the construction report to general documents to get the proper building permit under Talo 2000.

The building guide reports will prepare individual working methods for each building part that will be projected within specific document drawings, dimensional characteristics, shape, and location, to ensure the integrity of the qualification, and the construction description documentation drawings (RT 15-11176, 2015, p. 1).

Figure 11. The connection of the construction report to general documents (RT 15-11176, 2015, p. 1).



*TALO -2000= HOUSE -2000, according to building 2000s classification.
*RYL = General quality requirements for construction works.
*MaaRYL= General quality requirements for construction works, - Earthworks for building a house.
*RunkoRYL= General quality requirements for construction works -Building frame and external envelope
*SisäRunko = General quality requirements for construction works -Interior works of the building.

5.2 Filing documentation

To determine in what form and how the documents used in the approval of contracts are kept. Documents that should be used in contract approval are commonly stored in the project bank as PDF files. The developer takes care of the final archiving so that all the building's documentation is related to the building project. According to RT 10-11302, all documents must contain at least the following information (RT 10-11302, 2018, p. 3).

The information that must be in the documentation includes:

- The name of the company or organization whose employee made the document.
- The name of the author of the document

- The date the document was made.
- A name describing the content of the document.
- The page numbering and number of pages
- The date when the tasks in the content of the document took place.
- The necessary content.
- Space for the approver's name, signature, and date of signature.

5.3 Checkpoints of Documentation

Necessary corrections must be made by the designers to quality assurance steps to check the documents produced from the original BIM models before delivering them to the project data bank (Kulusjärvi, 2012, p. 9-11).

5.4 Scale, line types, and text

The instruction file, RT 103396, offers guidance on how to present and submit construction drawings for building designers, particularly those in the field of architectural design. The instruction establishes consistent principles for presenting building drawings across all design areas. The instruction file provides a guide plan based on the use of CAD software, and the guide shows the ways of building drawings, scaling Table 2 to be used, line types, and text present display of the drawings (RT 103396, 2021, pp. 4-10). In Appendix 3 shows the scales used in building permit plans with an origin table in the Finnish language, and according to the guide building information file, RT 103396, sections 4.

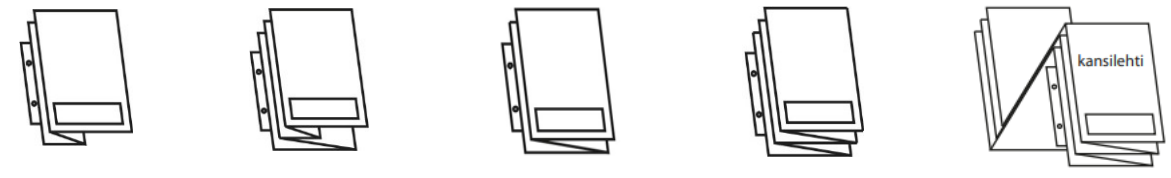
Table 2. Scales used in building permit plans (RT 103396, 2021, p. 6).

drawing	scale/ basic use	scale/possible use	
Layout plan of Main and demonstration drawings	1:200 1:500	1:1000 1:2000	Required, from large items
Site plan, plan for the use of demonstration drawings, and location drawing	1:500	1:200	Required
The main drawings and ground, sectional, and facade drawings	1:100	1:50	Required for small items
Documentations of drawings, and floor plans. cut section and facades.	1:100 1:500	1:200 1:400	
Attach and layout plan and section drawings	1:50	1:200 1:100 1:20	

6 Handling of files

Considering the level of BIM maturity, banking the project according to that level of planning, and collaboration data to drafting legal approval documentation, as nowadays project models are driven by electronic data, but to archives and use the project bank to view the plans with different perspectives. The set of final paper drawings should be delivered to the property caretaker in HAMK Real Estate, as well. The final paper drawings should be in archive folder A4-sized paper-based. So, the drawing sheet is folded to A4 size, so that the title block and label remain visible in the reading direction at the bottom of the cover sheet. Figure 12 shows the papers size sheet folded (RT 103396, 2021, p. 12).

Figure 12. Drawings papers sheet folded (RT 10336, page 12).



6.1 Title block

A title block is a section on a drawing sheet that contains essential information about the drawing, such as its title, author, date, and other relevant information. It provides a set of guidelines for creating a title block for a drawing sheet. Figure 13 shows an example of a

cover sheet and a drawing of the distribution space placed on the page and the order to be handed over. The title block should be placed in the lower right corner of the sheet, with the name placed 7mm from the cut edge of the sheet. The minimum text size for the title should be 1.8 mm, and the maximum width for the name is 178 mm. The title block should include information about the building site, the official location, the designer, the drawing number, the drawing phase, scales, and any other relevant information. In Figure 14 there is an example of a title block that shows where the information content is placed in the appropriate, in accordance with RT 103396 Building drawings submission guidelines (RT 103396, 2021, p. 13).

Figure 13 The details of the drawing are placed on the sheet (RT 103396, 2021, p. 13).

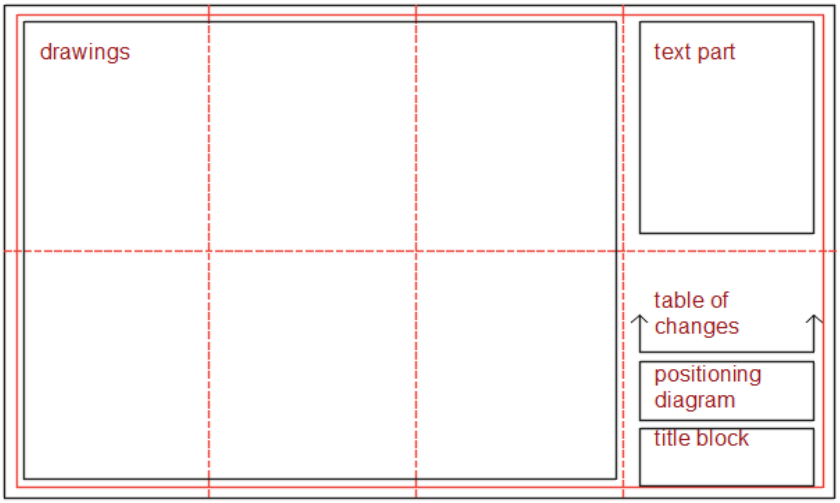


Figure 14. An example of a title block, in accordance with RT 103396 Building drawings submission guidelines, translated into English.

District/village KYLÄNNIMI	Block/space 1	Plot/Rn:o 1	For markings by the authorities		
Construction measure NEW BUILDING	Plane coordinate system ETRS-GK25	Altitude system N2000	Type of drawing THE MAIN DRAWING		serial. No 1 (7)
The name and address of the construction site KIINTEISTÖ oy RAKENNUSKOHDE Talotie 3 12345 Taajama			Content of the drawing SITE PLAN		Scales: 1:500
Designer, Contact information, The date ARCHITECTURE OFFICE LTD Toimistokatu 1 A, 01 234 City 012-345 678 email@office.fi PLACE, DATE DESIGNER RESPONSIBLE, THE DEGREE			Design area, Work, and Drawing number ARK 0101		Change

The drawings building and drawings to permit application must contain sufficient information to assess whether the rules and regulations regarding construction and good building practice requirements apply. Each drawing should include a title block, which includes information identifying the plan and information about the designer. The drawings should also include the material symbol and the symbols used should be explained if necessary, according to RT YM1-21639 The regulation of the Ministry of the Environment on plans and reports on construction, § 2 Content and presentation of master drawings (RT YM1-21639, 2015, p. 1).

If the drawing permission is submitted as a paper version, the title block must include the signature and clarification of the name of the responsible designer. In electronic permit processing, if required, the signature needs to be done electronically, and the plans comply with the law on electronic transactions in official activities. Paper versions of drawings should be made according to official techniques, drawings folded to A4 size (RT 103397, 2021, p. 2).

6.2 Files to be handed over as final documents

The project specifications are important in driving the implementation. However, the specific requirements for BIM can differ greatly from project to project. BIM documentation for facility management purposes is important, therefore, it is important to carefully consider and clarify the BIM requirements for each project to ensure success during the implementation project. The contractor is obligated to maintain fully coordinated CAD files to the model of the construction design. It is required that the documents be submitted in DWG format as DWG -based files, alongside other CAD submittals. According to the specifications for the project, it is mandatory for the contractor to uphold a fully coordinated final documentation (Sacks et al., 2018 pp. 567-568).

Electronic transactions have largely replaced paper-based drawing processing and paper document archiving. The drawings are required to be clear and legible in print size and

appropriate scale. The main drawings should be in black and white, while colored documents, for example, facade drawings, can be included as attachments (RT 103397, 2021, p. 3). RT 18-11243 requires designers and contractors to receive all necessary documents in a format with data that complies with the agreements, such as PDF, DWG, and IFC (RT 18-11243, 2016, p. 3).

HAMK Real Estate requests the designer and contractor to submit final documentation of As-Built documents through the CAD-DWG submission. The Contractor should use the BIM system to coordinate, document, and submit all construction-related materials. Data reliability requirements are delivered in full to the receiver so that it can be opened with a specified software version (RT 13-11143 en, 2014, p. 1). BIM requirements should be included in the project specifications and according to the Finland Building Information File (RT-kortisto) for clarity and standardization.

The RT 103397 Preparation of main drawings is provided to create the primary drawings that should be included in construction drawings (RT 103397, 2021, p. 2).

The main drawings are included:

- Site plan
- Floor plan
- Roof drawing (if necessary)
- Cross-section plan
- Drawings of structural types

6.3 Content of the design file

HAMK Ltd Real Estate requests by following RT 103253 ARK18 to define architectural design the contract document is used to manage the design entity, ensure quality assurance, and define the design contract. The list applies to all procurement and individual task contributions. The tasks may be completed and documented differently (RT 103253, 2020, p. 1).

7 Ownership and usage rights of plan files

The final drawing shows the building project systems and products installed and configured. All models and electronic documents will be handed over. This should include the final drawings and changes presented in the detailed drawings and other changes made during the work. The drawings need to be submitted electronically to the project's bank database and transmitted to the HAMK Real Estate registry.

Final drawings typically should include all information models of the building or systems in the form specified in the planning documents or the developer's separate instructions, floor plans, and elevation sections. as well as the work reports and energy reports also including an energy certificate (RT 10-11301, 2018, p. 8).

7.1 Comprehensive and reliable document archiving

A comprehensive document is used to guide and manage different types of documents that are related to a building project. These documents can be classified based on their intended purpose. Project-specific documents are those that are directly relevant to the construction and design of a building, while party-specific documents are those that are related to the various parties involved in the project, such as the construction team's site plan or the client's interior design plans. The general documents apply to the entire construction project, including laws, regulations, and standards (RT 15-10956, 2009, p. 2).

8 The documentation of the construction project and maintenance

To effectively manage documents related to the design, construction, and maintenance of a building throughout its entire life cycle, a compiled list can be created. It is important for each document to have a specific identifier and for the documents to be easily searchable and sorted. Using a quantitative identification system and open databases management of documents. The Project master list refers to a compiled list of documents maintained by each party involved in the project, including project-specific and building-specific documents (RT 15-10956, 2009 p. 2).

8.1 Managing up-to-date drawings construction project and maintenance

Upon completion of a construction project, models must be updated and modified to conform with the alterations made during construction and commissioning documentation. Updated models are referred to as as-built BIMs files and comprise, as-built BIMs drawings must be provided to the property for archival purposes and to meet the operational and facility management requirements. All information should be stored in database format, with a list of spaces in the design documents such as Excel, or PDF. (Karppinen et al., 2012 p. 21). The main goal of this is to create maintenance registers from data models and to know all date changes during updated of drawings.

9 Conclusion

A building drawings documentation includes additional information which allows the project to be precisely bid and built, including a full dimensional layout and elevations, complete quantification, and the proprietary identification of materials, components, and systems.

The building documentation requirements will be determined to have a guide plan. The other objective is to create an archive of the maintenance list with details. This is achieved by transferring relevant information for building data models and ensuring that all updates are provided to the building owner, keeping the data current and up to date. This is done to ensure the upstage benefit, which will help to get ordinary standards guide plan for data management in HAMK Real Estate.

It is suggested that if core competency is building design a firm's main expertise in building design, the information and knowledge should be evident in the design itself and not in the documentation. The format of the documentation should follow a widely accepted standard, such as the ISO 13567, International Organization for Standardization (ISO), and the Talo 2000 which is now in operation or national CAD standard, from Building Information Files for example RT 15-10919, to ensure that contractors can easily access and understand the information.

Designing a uniform format for construction project drawings is important for ensuring that all relevant information and reducing unnecessary data and efficient use of the project bank. Achieved by defining classification-specific goals for information modeling in the project planning phase, which are aligned with the general goals of the project. The guide to uniform documentation in the information model can accompany all stages of construction. It can also be used later from a management and maintenance perspective.

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Appendix 1: CAD drawings plane system. (RT 15-10919, 2008, p. 5)

Esimerkki kuvatasojen käytöstä pohjapiirroksen yhteydessä.

P	**Piirustusmerkinnät**
P**B**	Piirustusrajaukset
PB**F**	Rajaviivat
PB**O**	Muut arkkimääritykset
P**V**	Tekstit
PV**W**	Nimiö
PV**N**	Huomautukset
P**I**	Taulukkoinformaatiot
PI**L**	Piirustusmerkintöjen selitykset
PI**S**	Jakelu- ja muutostaulukot
PI**Q**	Muut taulukot

M	**Malliin liittyvät tiedot**
M**E**	Rakennusosat
M**A**	Merkinnät
MA**H**	Rasterointi
MA**T**	Tekstit
MA**D**	Mitoitus
MA**J**	Leikkaus- ja detaljimerkinnät
MA**K**	Muutosmerkinnät
M**G**	Moduulit
MG**Y**	Moduuliviivoitus
MG**Z**	Moduulimitoitus
M**U**	Käyttäjän merkinnät
MU**R**	Punakynämerkinnät
MU**C**	Apuviivat
MU**X**	Luonnos

Tietotyypin hierarkia vastaa tavallaan *Talo2000-hankenimikkeistön* numeerista luokittelua.Viereisessä luettelossa rakennetta on korostettu esittämällä laihalla kirjasintyypillä myös ylempiä luokkia kuvaavat kirjaimet, mutta **tietotyypissä käytetään vain viimeistä kirjainta.**

Tietotyyppiä X ehdotetaan käytettäväksi luonnos- ja detaljiviivoille, joita ei ole tarpeen sitoa tiettyyn rakennusosaan.Tällöin viivan merkitys on pelkästään graafinen. Tämän RT-ohjekortin tasoluetteloissa on ehdotus tietotyypin X käytöstä eri viivanpaksuuksille nimetyissä tasoissa.

Translated into English:

An example of the use of drawings layers in connection with floor plan.

P	**Drawing markings**
P**B**	Drawing limits
PB**F**	Boundary lines
PB**O**	Other sheet specification
P**V**	Texts
PV**W**	Label
PV**N**	Notes
P**I**	Information table
PI**L**	Explanations of drawing markings
PI**S**	Distribution and tables of changes
PI**Q**	Other tables

M	**Model-related information**
M**E**	Building parts
M**A**	Markings
MA**H**	Rasterization
MA**T**	Texts
MA**D**	Dimensioning
MA**J**	Cutting and detailing markings
MA**K**	Change notes
M**G**	Modules
MG**Y**	Module dash
MG**Z**	Module dimensioning
M**U**	User Notes
MU**R**	Red pen markings
MU**C**	Guide lines
MU**X**	Draft

The data type hierarchy corresponds in a way Numerical classification of the *Talo2000 project nomenclature*. In the adjacent list, the structure has been emphasized by showing the letters describing higher categories in a thin font, but only **the last letter is used in the data type**
.
Data type X is proposed to be used for sketch and detail lines that do not need to be tied to a specific building part. In this case, the meaning of the line is purely graphic. In the layer lists of this RT instruction card, there is a suggestion to use data type X in layers named for different line weights.

Appendix 2: An example of CAD drawings layers naming with floor plan.

GENERAL VIEW OF LAYERS

	Part identification		Marking				Refinement		Information type	Data type specification	Data type specification	Status		Explanation section	Drawing plane	Description
DRAWING SHEET																
	A	R	_						P				_	PIIRROS (LAYOUT)	AR-P_PIIRROS	DRAWING MARKS ASSOCIATED WITH THE SHEET
SHEET MARKINGS																
	A	R	–						B				_	DRAWER	AR-B_DRAWER	Drawing limits
	A	R	–						F				_	LINE	AR-F_LINE	Boundary lines
	A	R	–						O				_	SHEET	AR-O_SHEET	Other sheet specifications and positioning diagrams
	A	R	–						V				_	SHEET-TXT	AR-V_SHEET-TXT	Texts
	A	R	–						W				_	LABEL	AR-W_SHEET-LABLE	Label
	A	R	–						N				_	NOTE	AR-N_NOTE	Notes
	A	R	–						I				_	TABLE	AR-I_TABLE	Information table
	A	R	–						L				_	EXPLANATION	AR-L_EXPLANATION	Explanations of drawing markings
	A	R	–						S				_	DISTRIBUTION	AR-S_DISTRIBUTION	Distribution and a table of changes
	A	R	–						Q				_	CHANGE BOARD	AR-Q_CHANGE BOARD	Other tables
DRAWING																
	A	R	_						M				_	MALLI (MODEL)	AR-M_MALLI	DRAWING MARKS RELATING TO THE PLAN
BUILDING FIELDS																
	A	R	–						E				_	BUILDING PARTS	AR-E_BUILDING PARTS	Building parts
	A	R	–						A				_	MARK	AR-A_MARK	Markings
	A	R	–						H				_	RASTER	AR-H_RASTER	Rasterization
	A	R	–						T				_	TEXT	AR-T_TEXT	Texts
	A	R	–						D				_	MEASURE	AR-D_MEASURE	Dimensioning
	A	R	–						J				_	BOOKMARK	AR-J_BOOKMARK	Cutting and detailing markings
	A	R	–						K				_	CHANGE	AR-K_CHANGE	Change notes
	A	R	–						G				_	MODULE	AR-G_MODULE	Modules
	A	R	–						Y				_	MODULELINE	AR-Y_MODULELINE	Module dash
	A	R	–						Z				_	MODULEMEASURE	AR-Z_MODULEMEASURE	Module dimensioning
	A	R	–						U				_	USER NOTES	AR-U_USER NOTES	User Notes
	A	R	–						R				_	RED PEN	AR-R_ RED PEN	Red pen markings
	A	R	–						C				_	LEDGER LINE	AR-C_ LEDGER LINE	LEDGER LINE
	A	R	–						X				_	DRAFT	AR-C_ DRAFT	Draft

Appendix 3: Scales used in building permit plans.

The original version in the Finnish language, is a table of scales used in building permit plans, according to the building information guide File (RT 103396, 2021, p. 6).

Taulukko 1. *Rakennuslupasuunnitelmissa käytettävät mittakaavat.*

piirustus	**mittakaava/ peruskäyttö**	**mittakaava/mahdollinen käyttö**	
pääpiirustusten ja esittelypiirustusten asemapiirros	1:200 1:500	1:1000 1:2000	tarvittaessa suurista kohteista
kvv-asemapiirros, esittelypiirustusten käyttösuunnitelma ja sijaintipiirros tms.	1:500	1:200	tarvittaessa
pääpiirustusten pohja-, leikkaus- ja julkisivupiirrokset	1:100	1:50	tarvittaessa pienistä kohteista
esittelypiirustusten piirrokset ja kaaviot pohjista, leikkauksista ja julkisivuista	1:100 1:500	1:200 1:400	
liite- tai erityispiirustusten pohja- ja leikkausp iirrokset	1:50	1:200 1:100 1:20	

The scales used in building permit plans, translated into English, and according to the building information file guide RT 103396.

drawing	**scale/ basic use**	**scale/possible use**	
Layout plan of Main and demonstration drawings	1:200 1:500	1:1000 1:2000	Required, from large items
Site plan, plan for the use of demonstration drawings, and location drawing	1:500	1:200	Required
The main drawings and ground, sectional, and facade drawings	1:100	1:50	Required for small items
Documentations of drawings, and floor plans. cut section and facades.	1:100 1:500	1:200 1:400	
Attach and layout plan and section drawings	1:50	1:200 1:100 1:20	

Appendix 4: Catalog of the party codes in the drawings design and building nomenclature codes (RT 15-10956, 2009, p. 4).

Original version RT 15-10956, PIIRUSTUS- JA ASIAKIRJALUETTELO, TALO 2000. Page 4.

Suunnittelualan kaksikirjaimiset osapuolitunnukset.

AR Arkkitehtisuunnittelija
GE Geosuunnittelija
RA Rakennesuunnittelija
RK Rakennuttaja
SI Sisustussuunnittelija
TT Talotekniikkasuunnittelija
AK Akustiikkasuunnittelija
HA Hankesuunnittelija
HI Hissi- ja muu siirtolaitesuunnittelija
EL Elementtisuunnittelija
KS Kaupunkisuunnittelija
KA Kaavoittaja
LV LVI-vesi- ja viemärisuunnittelija
LI LVI-Ilmastointisuunnittelija
LJ LVI-Jäähdytyssuunnittelija
L LVI-Lämmityssuunnittelija
MA Maisema-arkkitehti
ML Määrälaskija
MS Maisemasuunnittelija
MT Mittaaja
PR Prosessisuunnittelija
PT Paloturvasuunnittelija
SJ Sähköjärjestelmien suunnittelija
SH Sähkösuunnittelija
UR Urakoitsija
PU Pääurakoitsija
SU Sivu-urakoitsija
AU Aliurakoitsija
TV Turvasuunnittelija

Talo 2000 -nimikkeistön Yleisselosteen rakennusosat ja tekniikkaosat. www.rts.fi Talo-nimikkeistö.

1 RAKENNUSOSAT

11 Alueosat
111 Maaosat
1111 Raivausosat
1112 Kaivannot
1113 Kanaalit
1114 Täyttöosat
1115 Penkereet
1116 Kuivatusosat
1117 Erityiset maaosat
112 Tuennat ja vahvistukset
1121 Paalut
1122 Tuennat
1123 Vahvistukset
1124 Erityiset tuennat ja vahvistukset
113 Päällysteet
1131 Liikennealueiden päällysteet
1132 Paikoitusalueiden päällysteet
1133 Oleskelu- ja leikkialueiden päällysteet
1134 Kasvillisuus
1135 Erityisalueiden päällysteet
114 Alueen varusteet
1141 Talovarusteet
1142 Oleskeluvarusteet
1143 Leikkivarusteet
1144 Alueopasteet
1145 Erityiset aluevarusteet
115 Alueen rakenteet
1151 Pihavarastot
1152 Pihakatokset
1153 Aidat ja tukimuurit
1154 Alueen portaat, luiskat ja terassit
1155 Alueen pysäköintirakenteet
1156 Erityiset alueen rakenteet

12 Talo-osat
121 Perustukset
1211 Anturat
1212 Perusmuurit, peruspilarit ja peruspalkit
1213 Erityiset perustukset
122 Alapohjat
1221 Alapohjalaatat
1222 Alapohjakanaalit
1223 Erityiset alapohjat
123 Runko
1231 Väestönsuojat
1232 Kantavat seinät
1233 Pilarit
1234 Palkit
1235 Välipohjat
1236 Yläpohjat
1237 Runkoportaat
1238 Erityiset runkorakenteet
124 Julkisivut
1241 Ulkoseinät
1242 Ikkunat
1243 Ulko-ovet
1244 Julkisivuvarusteet
1245 Erityiset julkisivurakenteet
125 Ulkotasot
1251 Parvekkeet
1252 Katokset
1253 Erityiset ulkotasot
126 Vesikatot
1261 Vesikattorakenteet
1262 Räystäsrakenteet
1263 Vesikatteet
1264 Vesikattovarusteet
1265 Lasikattorakenteet
1266 Kattoikkunat ja luukut
1267 Erityiset vesikattorakenteet

13 Tilaosat
131 Tilan jako-osat
1311 Väliseinät
1312 Lasiväliseinät
1313 Erityisväliseinät
1314 Kaiteet
1315 Väliovet
1316 Erityisovet
1317 Tilaportaat
1318 Erityiset tilajako-osat
132 Tilapinnat
1321 Lattioiden pintarakenteet
1322 Lattiapinnat
1323 Sisäkattorakenteet
1324 Sisäkattopinnat
1325 Seinien pintarakenteet
1326 Seinäpinnat
1327 Erityiset tilapinnat
133 Tilavarusteet
1331 Vakiokiintokalusteet
1332 Erityiskiintokalusteet
1333 Varusteet
1334 Vakiolaitteet
1335 Tilaopasteet
1336 Erityiset tilavarusteet
134 Muut tilaosat
1341 Hoitotasot ja kulkurakenteet
1342 Tulisijat ja savuhormit
1343 Muut erityiset tilaosat
135 Tilaelementit
1351 Kylpyhuone-elementit
1352 Kylmähuone-elementit
1353 Saunaelementit
1354 Talotekniikan tilaelementit
1355 Hormielementit
1356 Erityiset tilaelementit

2 TEKNIIKKAOSAT
21 Putkiosat
22 Ilmanvaihto-osat
23 Sähköosat
24 Tiedonsiirto-osat
25 Laiteosat
251 Siirtolaitteet
2511 Hissit
2512 Kuljettimet
2513 Erityiset siirtolaitteet
252 Tilalaitteet
2521 Keittiölaitteet
2522 Pesulalaitteet
2523 Väestösuojalaitteet
2524 Allaslaitteet
2525 Erityiset tilalaitteet

Catalog of the party codes in the drawings design and building nomenclature codes. RT 15-10956, 2009, p. 4. Translated into English.

The double letters party identifiers in the design industry

AR	Architectural designer	KS	Urban planner	PR	Process designer
GE	Geodesigner	KA	Planner	PT	Fire safety designer
RA	Structural designer	LV	HVAC, water, and drainage designer	SJ	Designer of electrical systems
RK	The constructor	LI	HVAC-Air conditioning designer	SH	Electrical designer
SI	The interior designer	LJ	HVAC-Refrigeration designer	UR	Contractor
TT	Building engineering designer	L	HVAC-Heating designer	PU	Main contractor
AK	Acoustics designer	MA	Landscape architect	SU	Subcontractor
HA	Project designer	ML	Quantity calculator	AU	Subcontractor
HI	Elevator and other transfer equipment designer	MS	Landscape designer	TV	Safety designer
EL	Element designer	MT	Surveyor		

House 2000 nomenclature. General statement of the construction parts and technical parts. www.rts.fi Nomenclature of the house.

1 BUILDING PARTS

11 Area sections

111 Continents
1111 Clearing parts
1112 The trenches
1113 Channels
1114 Filling parts
1115 Embankments
1116 Drying components
1117 Special regions

112 Support and confirmations
1121 Piles
1122 Support
1123 Confirmations
1124 Special supports and reinforcements

113 Pavements
1131 Road pavements
1132 Paving of parking areas
1133 Paving of living and playing areas
1134 Vegetation
1135 Pavements of special areas

114 Area equipment
1141 Housewares
1142 Stay Equipment
1143 Play equipment
1144 Area signs
1145 Special area equipment

115 The construction area
1151 Yard storage
1152 Yard canopies
1153 Fences and retaining walls
1154 Stairs, ramps, and terraces in the area
1155 Parking structures in the area
1156 Special constructions area

12 House parts

121 Foundations
1211 Soles
1212 Basic walls, basic pillars, and basic beams
1213 Special foundations

122 Sub soles
1221 Subfloor tiles
1222 Lower floor channels
1223 Special underlays

123 Frame
1231 Civil defense shelter
1232 Bearing walls
1233 Pillars
1234 Beams
1235 Midsoles
1236 Upper soles
1237 Frame stairs
1238 Special Frame Structures

124 Facades
1241 Exterior walls
1242 Windows
1243 Exterior doors
1244 Facade accessories
1245 Special facade structures

125 Exterior levels
1251 Balconies
1252 Roofs
1253 Special external levels

126 Water roofs
1261 Water roof structures
1262 Eaves structures
1263 Water covers
1264 Water roof equipment
1265 Glass roof structures
1266 Skylights and hatches
1267 Special water roof structures

13 Space parts

131 Space dividers
1311 Partitions
1312 Glass partition walls
1313 Special partitions walls
1314 Balusters
1315 Intermediate doors
1316 Special doors
1317 Farm stairs
1318 Special partitioning parts

132 Space surfaces
1321 The floors surface structures
1322 Floor surfaces
1323 Interior roof structures
1324 Interior ceiling surfaces
1325 Wall surface structures
1326 Wall surfaces
1327 Special spatial surfaces

133 Space equipment
1331 Standard fixed furniture
1332 Special fixed furniture
1333 Equipment
1334 Standard equipment
1335 Mode instructions
1336 Special space equipment

134 Other parts of the premises
1341 Treatment levels and transit structures
1342 Fireplaces and chimneys
1343 Other special space parts

135 Spatial elements
1351 Bathroom -elements
1352 Cold room -elements
1353 Sauna elements
1354 spatial elements of all technique
1355 Chimney elements
1356 Special space elements

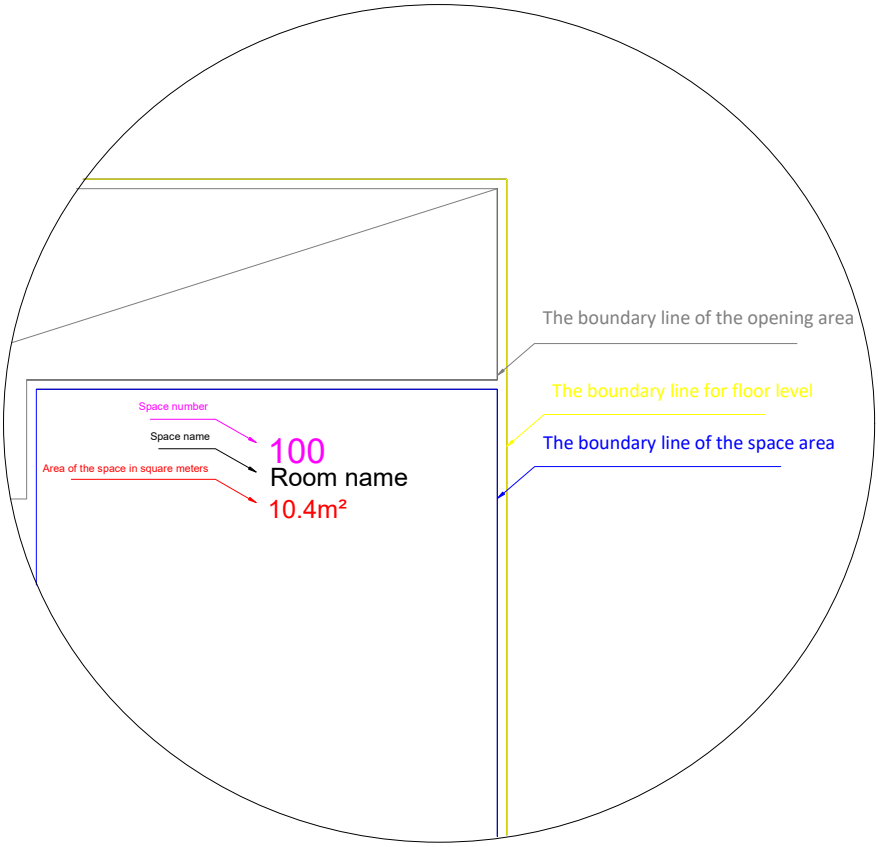
2 TECHNICAL PARTS

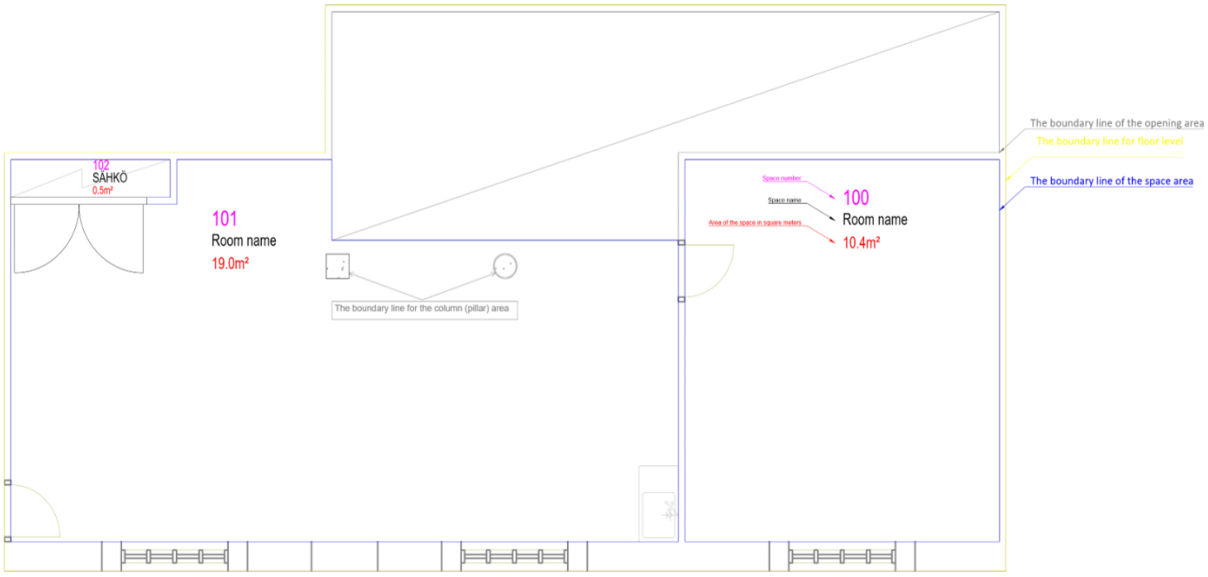
21 Pipe parts
22 Ventilation parts
23 Electrical parts
24 Data transfer parts
25 Equipment parts

251 Transfer equipment
2511 Elevators
2512 Conveyors
2513 Special transfer equipment

252 State devices
2521 Kitchen appliances
2522 Laundry equipment
2523 Population protection equipment
2524 Pool equipment
2525 Special state devices

Appendix 5: An example, the model drawing contains the spatial boundaries of the layer data definitions.





Appendix 6: The Original version in Finnish language, Nomenclature of space types according to Talo 2000. Talo 2000 Tilanimikkeistöt

https://www.rakennustieto.fi/nimikkeistot/talo-2000-nimikkeistot

Tilatyyppien nimikkeistö

1 Asuin- ja majoitustilat
11 Asunnot huoneluvun mukaan
12 Asuinhuoneet erillisinä
13 Majoitushuoneet,
14 Palveluasuntojen huoneet
15 Asuntolahuoneet
16 Hotellihuoneet
17 Kasarmituvat
18 Makuusalit
19 Erittelemättömät asuintilat

2 Hallinto- ja liiketilat
21 Toimistotilat
22 Liiketilat
23 Liiketilojen aputilat
29 Erittelemättömät liiketilat

3 Opetus- ja tutkimustilat
31 Luokkatilat
32 Opetustilat
33 Luentosalit
34 Auditoriot
35 Ammattioppilaitoksen työhallit
36 Laboratoriotilat
38 Valvomot
39 Erittelemättömät opetustilat

4 Huoneistotyyppikohtaiset erityistilat
41 Tuotantotilat
42 Terveydenhoitotilat
43 Sairaalatilat
44 Päiväkotihuoneiston tilat
45 Sakraalitilat
46 Kulttuurilaitosten tilat
47 Liikuntatilat
48 Virkistys- ja huvitilat
49 Erittelemättömät huoneistotyyppikohtaiset erityistilat

5 Säilytystilat
51 Vaatenaulakkotilat
52 Varastot
53 Arkistot
55 Autosuojat
59 Erittelemättömät säilytystilat

6 Ruokailu- ja keittiötilat
61 Ruokailutilat
62 Työpaikkaruokailutilat
63 Yleisöruokailutilat
64 Keittiötilat
65 Keittiön kylmäsäilytystilat
69 Erittelemättömät ruokailu- ja keittiötilat

7 Sosiaali- ja virkistystilat
71 Pukutilat
72 Pesutilat
73 WC-tilat
74 Löylyhuoneet
75 Taukotilat
77 Kerho- ja askartelutilat
78 Terveydenhoitajan tila
79 Erittelemättömät sosiaali- ja virkistystilat

8 Yhteistilat
(Suunnitteluohjelmaan sisältyvät koko kohdetta palvelevat tilat)
81 Väestönsuojatilat
82 Kiinteistökohtaiset varastotilat
83 Sisäänkäyntitilat
84 Yleisön palvelutilat
85 Pesulatilat
86 Siivoustilat, huoltotilat
87 Jätehuoltotilat
88 Kiinteistökohtaiset erityistilat
89 Erittelemättömät yhteistilat

9 Liikenne- ja tekniset tilat
(Suunnitteluohjelmaan sisältymättömät tilaratkaisusta riippuvat tilat)
91 Vaakaliikennetilat
92 Pystyliikennetilat
94 Lämmitys- ja vesihuoltotilat
96 Ilmanvaihtotilat
97 Sähkötekniset tilat
98 Ulkotilat
99 Erittelemättömät liikenne- ja tekniset tilat

Nomenclature of space types according to Talo 2000. Translated into English.
https://www.rakennustieto.fi/nimikkeistot/talo-2000-nimikkeistot

1	**Living and accommodation facilities**	**6**	**Eating and kitchen areas**
11	Apartments by number of rooms	61	Dining facilities
12	Separate living rooms	62	Workplace Canteens
13	Accommodation rooms,	63	Audience Dining facilities
14	Rooms in service apartments	64	Kitchen spaces
15	Dormitory rooms	65	Cold storage facilities in the kitchen
16	Hotel rooms	69	Unspecified dining and kitchen areas
17	Barracks		
18	Dormitories	**7**	**Social and recreational spaces**
19	Unspecified living spaces	71	Dressing rooms
		72	Laundry facilities
2	**Administrative and business premises**	73	WC facilities
21	Office premises	74	Sauna rooms
22	Business premises	75	Break spaces
23	Auxiliary premises of business premises	77	Club and craft rooms
29	Unspecified business premises	78	State of the health nurse
		79	Unspecified social and recreational spaces
3	**Teaching and research rooms**		
31	Classroom spaces	**8**	**Common spaces**
32	Teaching facilities		(The planning program includes the facilities serving the entire site)
33	Lecture halls		
34	Auditoriums	81	Shelters for the population
35	Vocational schoolwork halls	82	Property-specific storage rooms
36	Laboratory facilities	83	Entrance spaces
38	Controls	84	Public service premises
39	Unspecified teaching facilities	85	Laundry facilities
		86	Cleaning rooms, maintenance rooms
4	**Special spaces for apartment type**	87	Waste disposal facilities
41	Production premises	88	Property-specific special rooms
42	Healthcare premises	89	Unspecified communal spaces
43	The hospital premises		
44	The premises of the daycare apartment	**9**	**Traffic and technical premises**
45	Sacral premises		(Spaces not included in the planning program, spaces that depend on the solution)
46	Premises of cultural institutions		
47	Exercise facilities	91	Horizontal traffic facilities
48	Recreation and entertainment facilities	92	Vertical traffic facilities
49	Unspecified special facilities specific to apartment type	94	Heating and water supply premises Ventilation Facilities
		96	Electrotechnical premises
5	**Storage rooms**	97	The outdoor spaces
51	Clothes rack premises	98	Unspecified traffic and technical spaces
52	Stock	99	Erittelemättömät liikenne- ja tekniset tilat
53	Archives		
55	Car protections		
59	Unspecified storage space		