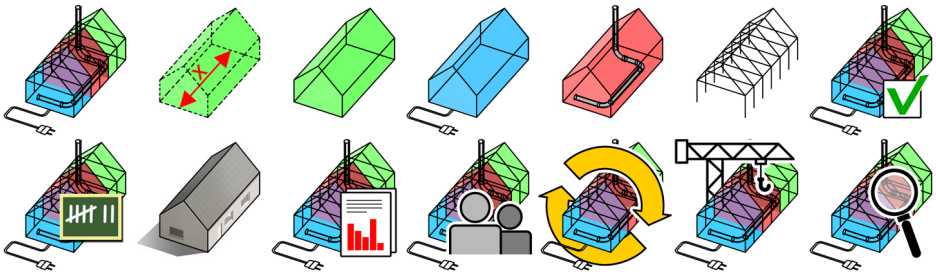
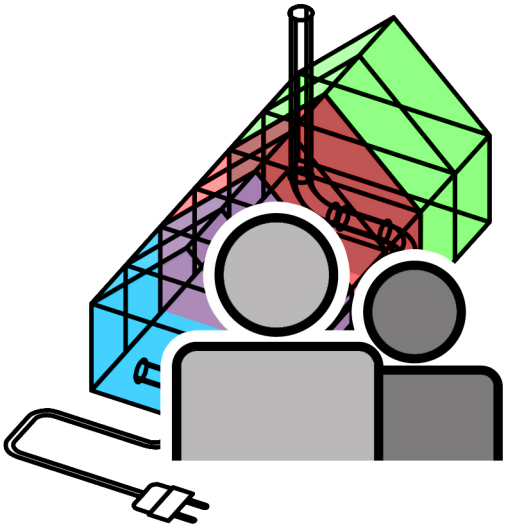


COBIM

Common BIM Requirements 2012

v 1.0



Series 11

Management of a BIM project

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.

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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 (Series 1) and the principles of quality assurance (Series 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

By ‘modeling’ it is meant the increasing of the information connected with building through a design application. It is possible to link information with building elements: for example, thermal, fire and audio technology-related characteristics, as well as materials. By means of modeled information, it is possible to plan, analyze and manage the costs of building, use and maintenance in addition to, for example, surveying the constructability of the structure. A design that is conducted on an information model basis elicits more information than through traditional design as the foundation of objective-oriented control and critical decisions, which is highly significant from the perspective of project management.

The use of modeling requires special commitment from the management of the project from its very beginning. From the perspective of project management, the use of information modeling as a method of design affects, in a fundamental manner, the lead-through of the project – for example, the organization, phasing, scheduling and coordination of the project. Information technology-based know-how is emphasized among all of the parties to the project. Advanced cooperation, active flow of information and interactive measures are required between the parties.

At the outset of the project, the added value contributed to it by building information modeling (BIM) should be assessed, as well as how the achievement of the overall project aims will be facilitated by the same. Building information modeling is well-suited as a method of design for all types of building projects. The benefits achieved through the use of information modeling are especially heightened in challenging and diversified construction projects.

Information modeling is not an intrinsic value as such but rather a means to systematically follow the implementation of set objectives during the project as well as ensure the best possible outcome. During the preparation stage of the project, a decision alongside the general investment decision should be made regarding the BIM-related goals, usage and extent as applied in the project.

The tasks of designers are specified in accordance with the task lists in the call for tenders. The tasks of building information modeling are connected with the specified duties of designers. The BIM-related basic task specifications as well as precision and quality level are presented in the design discipline-based instructions (Series 2–5). The client should, however, always check the basic specification and content for modeling, in addition to rendering the changes required on a project-by-project basis. The cost assessments, illustrations, analyses and simulations in addition to the building stage tasks are always mutually agreed on a project-by-project basis (Series 7–10, 12–14). The measures for quality assurance (Series 6) are also planned separately.

Project management that benefits from information modeling is discussed in these instructions. The purpose of these instructions is to present how building information modeling as a method of design should be examined from the perspective of the project management and BIM coordinator in the building project lead-through.

3 The principles of information model-based project management

3.1 The building information model (BIM)-based project management process

The management process is frequently divided into three sub-processes: design, execution and supervision. The successful management and coordination of an information model project require that the project-based building information modeling tasks and procedures are planned in advance. By means of agreements binding the parties, the planned tasks and measures undergo transfer within the building projects to implementation. The significance of contract management is emphasized in projects planned by means of information modeling. Contract management includes the impact of project management on the organization and coordination of the building project, via agreements that steer the work effort.

The tasks as designed are executed and organized in accordance with specified duties and a formulated plan. The performance of these tasks is monitored and supervised continuously as the project progresses, as well as at specified project-related checkpoints. The BIM design method may increase project management-related risks if the parties do not have previous experience of the process connected with building information modeling.

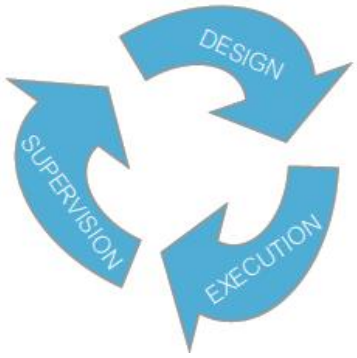

Fig. 1 Management of an information model-based project

3.2 Taking building information modeling (BIM) into consideration in project management

At the various stages of the project, it should be ensured that all parties having contractual relations with the client know that project-based building information modeling tasks are their responsibility. In connection with the initiation of design, it is ensured that all parties know the project's BIM objectives, the full extent of the information model application and modeling, schedule, information exchange and quality assurance measures, together with the reporting and documentation requirements.

During the building project, the outcome of the previous stage functions as input data for the next one. The client's procurement strategy specifies what design and analysis data can be obtained for the use of the project from the models during the various stages of the project. In applying BIM in the project being planned, effort should be applied toward goal-oriented client guidance. There should be an endeavor to minimize discontinuities, such as problems of integration in data transfer between various programs through real-time procurement agreements, and by pre-clarifying the requirements of the next stage for the information models being formulated.

3.3 Building information modeling (BIM) design

At the initial stage of the project, the client sets the goals for taking advantage of BIM in the building stage as well as in building maintenance. Planning the required content of the building information modeling in advance yields the following results:

- The parties understand and agree on the BIM-based project-, use- and maintenance-related goals, targets and applications.
- The parties understand the resources, roles, duties and responsibilities required by building information modeling.
- The required standard of know-how to lead-through the project is clarified on the basis of the plan.
- The project team is capable of designing the BIM process so that it supports the achievement of objectives.
- The coordination tasks are planned at an early stage.
- The design work interfaces, data transfer and information management requirements come to the fore in advance.
- For the parties joining the project later, the plan clearly outlines the procedures applied.
- The implementation mode/agreements and their impacts on operations can be taken into consideration.
- Set targets can be monitored during the life cycle of the project.

The building information modeling plan describes the information modeling targets and the measures for cooperation and quality assurance, as well as the BIM tasks and information content required during the various stages. The status of the BIM plan is found in the agreement document, which is updated during the project and appended to the design and contract agreements. All parties are included within its distribution during the building project. The building information modeling plan can be formulated in accordance with, for example, Appendix 1.

3.4 BIM execution

The objectives for the use of building information modeling are concretized in the design program, which is prepared during the design preparation stage at the latest, and in the BIM plan linked to or included in this. During the design preparation stage, the schedule- and information technology-related requirements for BIM are ensured. The design-based calls for tenders are appended to the design agreements, whereupon the use of the models and specified information content requirements become binding on the parties concerned.

The tasks, control, supervision and decision-making to be implemented during the various stages of the project are described in Chapter 4 from the perspective of project management.

3.5 BIM supervision

In the coordination of design, the cooperation between the various parties is ensured with respect to the matters concerning building information modeling, and the execution of tasks is monitored. The client's quality assurance measures are also realized, and the BIM plan is updated if required. During the construction preparation stage, it is ensured that the design-related materials produced during the design stage can be utilized in implementation. The requirements for the use of the models during construction are entered into the contract documents, and the procedure is specifically described with regard to transferring the changes made during the construction work into the as-built models.

3.6 Persons in charge of BIM

3.6.1 BIM coordinator

During the initial stage of the project, the task of the developer is to appoint a sufficiently competent and knowledgeable person to look after the formulation of the preliminary project-specific building information modeling plan as well as the coordination of various BIM duties linked with the various design disciplines.

The task of the BIM coordinator should be given to an experienced project individual who has adequate expertise in building information modeling and project management. The duties of the BIM coordinator comprise, together with the project management, the description of the building information modeling targets, goals and scope of use. He or she should clarify the BIM-related tasks, responsibilities and obligations to each party concerned. The appointed BIM coordinator handles BIM-related tasks as well as providing related guidelines, coordination and supervision during the project as a whole, in cooperation with the principal designer. The BIM coordinator reports to the project management and/or design management as agreed in connection with, for example, the design meetings. The reporting covers, at minimum, the status of the building information modeling, measures taken, re-

sults of the quality assurance and possible problems. The tasks of the BIM coordinator may include the production of merged models and the assurance of information technology-based integration, or these may be specified as the duty of the principal designer or other party. There is an example of the list of BIM coordinator tasks in Appendix 2.

The performer of the information model coordinator tasks can, as required, be changed in the middle of the project. However, such a change is not recommended.

3.6.2 Design discipline-based persons in charge

As the design work is initiated, the design discipline-based persons in charge are appointed with regard to the building information modeling tasks. Either of the designers responsible for the design discipline concerned or BIM specialists in the particular design discipline can function as persons in charge. An example follows hereunder of the task list of a person in charge of building information modeling:

- functions as a contact person in matters connected with building information modeling
- coordinates BIM tasks as agreed in his/her own design discipline
- provides guidelines for his/her own team on the project rules as agreed
- participates in the updating of the building information modeling plan
- effectively communicates with other design disciplines in connection with interfaces, data transfer, rules and cooperation
- takes part in BIM meetings (together with the designer responsible for the design discipline)
- looks after design discipline-based quality assurance, the formulation of BIM reports and data management
- assures and inspects, on his/her own part, the functionality of merged models and the integration of the design models.

4 BIM project management tasks from stage to stage

In the following sections, the tasks of building information modeling are divided into stages, in accordance with the project's management task list. At the beginning of each section, the general requirement of the stage is described, after which the BIM tasks during the stage concerned are described for guidance. Finally, the yields and analysis-based findings from the building information modeling in this stage are described. These are used in preparing the decision-making and need to be reported. With regard to this guideline, there has been an attempt to compile the possible yields from the various stages into lists that are as comprehensive as possible. For each project, the BIM plan determines the yields formulated at each stage and the responsibilities in their production.

Since the client's building development process and procurement strategy may be different from the model described below, the tasks of building information modeling may also vary from one stage to the next. This should be taken into account in planning the project-based tasks at the various stages.

4.1 Needs and objectives assessment

Requirements

During the needs and objectives assessment, both the need for property acquisition by the property owner and user as well as the goals of the property acquisition or requirement for change with regard to the property are surveyed and the criteria assigned. At the request of the project management, the preliminary requirements model is formulated and the input data modeling acquired. The illustrations of the initial situation for the project are also determined. The objective is the preparation of the project decision.

Guideline

The preparation of the client's preliminary requirements model is already initiated at the needs and objectives assessment stage. The input data model – the site model at a new building site and the inventory model of the building in a renovation construction project – can be ordered either as a separate assignment from a measuring service enterprise, or its performance can be included as part of some other designer's tasks (e.g. an architectural, structural or geological designer). The call for tenders respective to the input data modeling specifies the acquisition method for the input data to be modeled, the level of accuracy of the results and the distribution of tasks among the various parties (see Series 2: "Modeling of the starting situation"). Depending on the required level of precision for the modeling, the determination of the required input data may also demand the consultation of designers in special fields. On the basis of a possible inventory model, it is possible to compare the renovation site with

the current requirements or to set demands on the new volume connected with an old building. The input data model can also be applied for illustration purposes. In the future, the geo-model will be utilized in combined reviews and quality assurance. With respect to the practical performance of input data modeling, the usage circumstances of the building should be taken into consideration, as well as the work performance-related demolition work of surface structures that may be required.

The tasks to be performed at the needs and objectives assessment stage may also be part of the project planning stage assignment.

Yields of this stage:

- ◊ a preliminary requirements model (in table or database form)
- ◊ a plan for the continued use of information (for instance, data transfer)
- ◊ possible demolition work-related calls for tenders
- ◊ input data modeling call for tenders, agreement or resolution regarding having this done (method of acquisition, modeling content, measurement technique, level of precision, handling, illustrations, distribution of tasks)
- ◊ measurements and research
- ◊ site/inventory model, required measurement drawings and reports
- ◊ illustrations
- ◊ terrain model/building site and land use illustration
- ◊ Result: Project decision

4.2 Conceptual design

Requirements

During the conceptual design stage, the client prepares the project plan, which determines the project planning objectives set by the functions, owner and property upkeep. Scope-, schedule-, cost-, environment- and functionality-based objectives, as well as special targets, are set for the project. The method of implementation for the project in addition to its organization, including the BIM-related tasks and control principles, are stipulated and a risk analysis is performed. A description is formulated for the project plan of the building information modeling and its scope within the project. The BIM-based goals and uses are described in the building information modeling plan. The objective is the preparation of the investment decision.

Guideline

The architectural design for the project planning stage is launched. In the call for tenders, the client defines the building information modeling tasks for the architectural design of this stage as well as the BIM content in accordance with

Series 3, "Architectural design". If the input data model has not been done during the needs and objectives assessment stage, it will be done during this stage.

During the conceptual design stage, the information model may not necessarily have geometric form yet. The requirements model, in which at least the most pivotal spatial requirements are entered, is part of the building information model process. Correctly formulated, it can be used throughout the project process to check integration with the goals of the spatial requirements. As a minimal demand of the requirements model, there is a spatial program in table form, in which there are preliminary requirements focused on the building, spatial groups and premises. The requirements model can also be generated on a BIM basis if there are tools in use that support this application. The requirements model contains, for example, the requirements for the future facilities, possible environmental certificate requirements, the usage and maintenance targets for energy, objectives for the building's carbon footprint and demands set by the construction site.

The compilation of the requirements model is assigned to an architectural designer, for example. A separate requirements model for structural design or mechanical design is prepared at the latest during the alternative designs stage, or when the special designers have been chosen. The client stipulates the responsibilities for the maintenance of the requirements models. The requirements model is updated as the objectives and demands change.

Depending on the complexity of the project, it is possible to appoint a BIM coordinator already during the project planning stage, or this can be done during the design preparation stage at the latest. In any case, it is important from the perspective of modeling success that the client already specifies the BIM-based organizational principles, BIM applications and their scope within the project during the conceptual design stage, in the project plan or the preliminary BIM plan, for example.

In BIM-based design, the use of mechanical, electrical and plumbing (MEP) as well as structural specialists and the like comes up earlier, since normally more information is connected with the investment decision proposal as support for decision-making.

Yields of this stage:

- ◊ preparation and maintenance of requirements models
- ◊ an architectural design-based call for tenders, including the building information modeling content requirements, level specifications and design agreement
- ◊ requirements models
- ◊ description of project-related building information modeling and its scope within the project program
- ◊ appointment of BIM coordinator

- ◊ rough BIM plan (at minimum, the building information modeling goals and BIM-related uses)
- ◊ the building's preliminary massing
- ◊ preliminary spatial or spatial group model made by an architect for the plan and the spatial solutions, intended for illustration and visualization, scope management, traffic flow analyses, spatial efficiency, measurement, transformability and functionality reviews, as well as working environment development
- ◊ preliminary energy analyses of the spatial (group)/input data model for the purpose of setting objectives
- ◊ risk analyzes
- ◊ Result: Investment decision

4.3 Design preparation

Requirements

The design preparation stage involves checking the objectives, further specifying the design targets, organizing the design, formulating a design program, making further adjustments to the BIM plan, scheduling the design, specifying the quality assurance measures, arranging possible design competitions, participating in the required negotiations and selecting the designers for the project. Design preparation leads to the completion of design agreements.

Yields of this stage:

- ◊ updated requirements models
- ◊ planning of the organization of building information modeling and the appointment of BIM specialists
- ◊ requirements for the tasks and scope of BIM design
- ◊ building information modeling plan and BIM process
- ◊ design program, including cooperation and reporting procedures
- ◊ design schedule for the project
- ◊ designers' selection criteria
- ◊ selected designers
- ◊ design-based calls for tenders and agreements
- ◊ document management system, e.g. project bank
- ◊ updated risk analyses
- ◊ Result: Design agreements

Guideline

Organization of design

The organization of design refers to arranging the management of design, the distribution of design into appropriate parts, and the selection of an operation-

al model for the design team. The most commonly used design team operational model is principal design and the design of special fields subordinate to it. Since these are mutual working methods, the cooperation and flow of information are further emphasized in BIM projects, and one possible operational model is also integrated overall design. In integrated overall design, one party is responsible for the design of the project as a whole for the client. Overall design reduces the interface-related problems connected with the tasks of the various design disciplines as well as the software.

In the design preparation stage, the project management should consider how to achieve the objectives set during the project planning stage for the use of building information models. The organization and arrangement of design is particularly important. The design services for the project should be acquired and organized, taking the special features of building information modeling into account. What should be specifically emphasized is the various parties' know-how, experience, cooperation skills and ability to produce information in the desired manner. Together with corporate references, attention should be given to the project personnel's BIM know-how as well as sufficient resources in the organization – for instance, with respect to substitute arrangements.

For the purpose of information management, the client makes the necessary agreements with the suppliers as well as with regard to possible operational instruction training.

Calls for tenders concerning design

The developer should include the requirements that are set during the project planning stage in the calls for tenders concerning design and the tasks of designers. BIM objectives and requirements for building information modeling are given more precision in the BIM plan. The plan further specifies the uses and requirements of building information modeling, describes the BIM process and specifies the principle-based data transfer procedures and the cooperation measures. The BIM plan is a document that is updated stage by stage and in cooperation among the various parties when the project organization is supplemented. The BIM plan can be part of the design program.

Enhancing the scope of modeling set in the project planning stage involves determining the most critical information required in decisions, cost control and comparison of plan alternatives. As cooperation procedures, it is possible to use BIM meetings, designer meetings and design meetings.

Project management should specify the purpose of use of BIM, each party's building information modeling tasks in the project, BIM content and level of accuracy, as follows:

1. *The tasks specified in accordance with the designers' task lists and the BIM tasks cannot be isolated from each other: rather, they should connect and integrate with each other. With regard to the content and level of accuracy of the architectural, structural and MEP design information model, the starting point in the project can be considered to be, with respect to the ordered design tasks, "General Building Information Modeling Requirements 2012" documentation Series 3, 4 and 5 (Series 3: Architectural design, Series 4: MEP design, Series 5: Structural design). Project management should nevertheless always go through the sufficiency of the appendices in terms of the modeling content specifications. The project-related requirements are tightened in the call for tenders concerning design, as required during the negotiation stage and in the design agreements. With respect to modeling, the required additions and the enhanced specifications are made in a separate document that is a part of the agreement documents.*

2. *In the input data modeling, the content and level of accuracy of the information model is always reviewed on a project basis in accordance with Series 2: Modeling of the starting situation. With regard to the input data model, the client should perform quality assurance so that the input data model is appropriate for the continuing use of other designers.*

3. *The procedures for quality assurance are described in the BIM plan, using Series 6: Quality Assurance guidelines as support.*

4. *The project management stipulates the model-based cost assessments to be formulated and quantity take-offs in the call for tenders, using Series 7: Quantity take-off.*

5. *With respect to energy analyses (Series 10), the project management specifies to whom the tasks of formulating the analyses concerned belong and to what extent.*

6. *The project management specifies and assigns responsibility with regard to the illustrations and visualizations (Series 8) and MEP analyses (Series 9), which are formulated to support the client's decision-making at the agreed inspection points.*

7. *The contractor's BIM tasks frequently also affect the task specifications of the designers, which the project management should take into account in defining, for instance, copyright questions, tasks and responsibilities (Series 13: Use of models in construction).*

8. *The project management already takes the transfer of information models and their turn-over for the client's use and maintenance systems into account at the call for tenders stage. The information modeling connected with use and mainte-*

nance is reviewed by means of Guideline 12: Use of models during building use and facility management.

Calls for tenders concerning design are to include, for example, the following applications of the information model, information modeling tasks, responsibilities and obligations:

- *The design discipline-related modeling content requirements and level of accuracy*
- *Illustration at the site and the distribution of tasks among the various designers*
- *Modeling of the input data (also hidden parts, existent networks' modeling, yard area drainage arrangements, modeling of structures, etc.)*
- *Production of area and volume information*
- *Comparisons of alternatives*
- *Model rooms and areas (quantity and scope)*
- *Quality assurance of information models (content, integration and clash detections)*
- *Production of cost data from the models (based on spatial, building element take-off, bills of quantities and item take-off)*
- *Structural analyses*
- *The principles of penetration and reservation design, for instance, the selection of procedural methods from amongst the various alternatives presented, MEP-based scope of penetration reservation object information in addition to load-bearing structures, working method and supplier with regard to 2D penetration reservation drawings*
- *Energy analyses: Energy consumption simulations*
- *Energy analyses: Condition simulations*
- *Life cycle cost optimization and life cycle calculations (LCC)*
- *Life cycle analysis (LCA)*
- *Computational fluid dynamics (CFD) and simulations*
- *Lighting calculation and visualization*
- *Lighting simulations*
- *MEP system analyses*
- *Interior decorating visualizations*
- *Acoustic analyses*
- *Fire simulations*
- *Simulations of rescue and safety situations*
- *Review of maintenance and upkeep procedures*
- *Construction period production control*
- *Planning and description of worksite arrangements*
- *Planning of industrial plant production*

- *Cooperation between designers and various product part suppliers' designers during the implementation stage: for instance, element/machine shop production, integration and delivery of models*
- *As-built model updating and scope of delivery with contractor data (for instance, the products and components selected, penetrations and reservations)*
- *Schedule management of implementation stage*
- *Maintenance models*
- *Property systems (E-maintenance information)*
- *Spatial management systems*
- *Official and regulation reviews*

With respect to the building stage tasks, it is necessary to specify the tasks, how the models are utilized at the worksite and in industrial plant production, and how and by whom the general construction period changes and updated information are transferred to the as-built data, such as the contractor's acquired equipment and systems, channels and wiring.

Quality assurance

Information models' quality assurance generally comprises the information technology-related quality assurance of the plans as well as the clash detection of the models. In addition, quality assurance ensures the sufficiency of the model data as well as the information content in the model compared with the planning stage concerned and the information modeling requirements. In addition to the model, the information model description delivered by the designer functions as input data for quality assurance.

The BIM coordinator specifies the quality assurance measures and the quality assurance performer in advance. The person performing the quality assurance of building information models can be a principal designer/architect, BIM coordinator, developer consultant or separate consultant. From the perspective of project management, the task of the performer of quality assurance is, in the project stages specified in the BIM plan and design schedule, to perform the client's quality assurance in design discipline-based information models and merged models. (See separate guideline, Series 6 "Quality assurance".)

If the client's quality assurance is separated from the principal designer's task, it is necessary to specify the possible tasks, questions of responsibility and reporting relations between the principal designer and the performer of quality assurance. The principal designer is responsible for the tasks in keeping with the Land Use and Building Act, including in design projects utilizing building information modeling. It must be noted that the designers and the design team should implement the quality assurance for their own designs and the required integration quality assurance. The designer is always responsible for the quality of his/her own design.

Specific client quality assurance points should be entered into the project and design schedule, in which the models are reviewed more comprehensively by the appointed performer of the quality assurance. The quality assurance of the building information models functions bi-directionally; i.e., the designers receive feedback from the performer of the quality assurance about problems noted in the models. The designers perform the integration of the models continuously as the design work progresses, e.g. prior to the design meetings. The BIM coordinator should determine specific quality assurance points that generally precede client decisions. These stages are, for example, the checking of the requirements model, approval of the design alternative, approval of the general design, approval of the detailed design solutions and approval of the as-built models. (See Appendix 3.)

Design schedule

BIM-based design changes design-related routine rhythms in the project. In the construction field, there are no established measurement procedures for BIM design scheduling. In practice, it has been noted in projects that the workload requiring general design in particular grows as well as, at the same time, the time required herein for the design stage. On the other hand, the models obtained as the outcome of the general design stage already include most information required during the implementation design stage, whereupon the time required for this stage normally declines. During the implementation stage, the changes that must be made to elevations, for example, can significantly impact the building information models already formulated by other designers.

The time periods required for the integration of the models and for quality assurance during the different design stage set the rhythm for the progress of design and must be taken into consideration in preparing the design schedule. The design schedule, which is formulated by the principal designer in cooperation with the other designers, must take into account the client's decision-making points and the sufficiency of the content of the building information models, as well as the appropriate timing of deliveries for the purpose of decision-making points. The task of the client is to approve the design schedule within the conte xt of the project schedule.

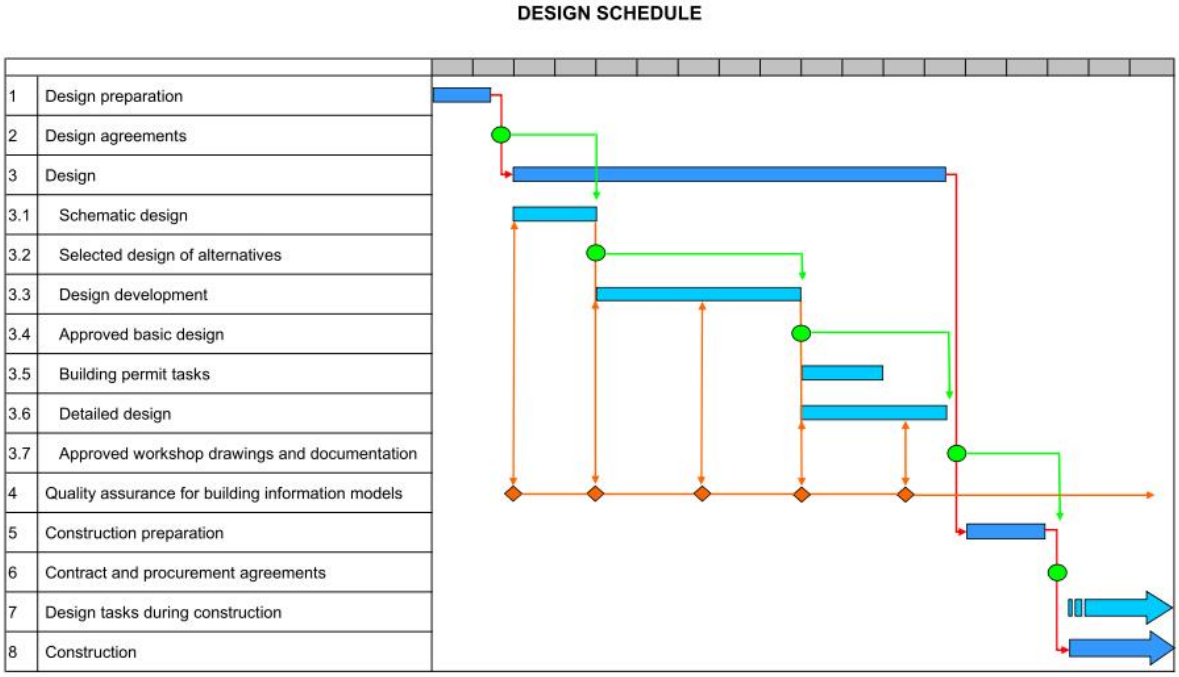

Fig. 2 *Example of a BIM design schedule. The schedule rhythm is set by the decisions of the client as well as, with the progress of design, the integration performed for the building information models and the technical quality assurance. The quality assurance measures for the building information models are also continued during the construction stage.*

Rights to the use of building information models

As the project ends, all models are relinquished to the client as original models of the software and in the agreed IFC format, in addition to the designs. The client has the right to use the models in accordance with the KSE proposals in effect in each case. In order to utilize the models in construction preparation and general construction, this must be mentioned in the calls for tenders concerning design. For example, the structural designer's model already includes a large part of the machine shop design work frequently assigned to the contractor and, as a result, the turnover of the model to a third party must absolutely be agreed on in the manner described above. In addition, it is stipulated as to whether the original files of the design programs will be utilized during the construction stage.

If the designer considers that the relinquishment of the libraries and objects used in the models either to other parties during the project or to the client at the end of the project links with copyright-related, designer competition privilege-based or other similar legal problems, the designer should mention these in his/her tender. As an appendix to the tender, there should be a proposal

about how the problems concerned may be resolved so that the designer can relinquish the models required by BIM-based cooperation to other parties during the project as well as, with regard to building use, maintenance and repairs, the usable models to the client at the end of the project. The matter should be agreed on prior to signing the design agreement.

The client may expand his/her rights to use the building site concerned in accordance with the KSE terms with regard to designs, building information models and merged models, if the deviating use and change rights are separately mentioned in the calls for tenders and agreements. With respect to possible property sales, the transfer of operational rights to the transferee must be separately entered.

4.4 Design control

Requirements

BIM design is initiated with respect to all of the design disciplines. Design control includes the inspection of project design objectives, comparison of objectives with the requirements models, and supervision of conformity of the designs with the targets during the design of alternatives, general design and implementation design stages. The design stage-specific yields stipulated in the BIM-based design and derived from the building information models are compiled as support for decision-making by the client. In controlling the design work, cooperation is arranged between the designers and other parties with regard to, for example, quality assurance, and the design reviews, approval and reporting procedures are mutually agreed. Supervision of the design ensures the achievement of design solutions that are mutually integrated and in keeping with the objectives.

Guideline

During the design stage, utility is sought through the use of building information models, particularly for the client's decision-making. Later, during the construction stage, considerable advantages are achieved when the significant conflicts are eliminated in advance from the designs. By means of building information models, illustrations are obtained and a comparison is made with various design and spatial alternatives, on the basis of which the client and user find it easier to assume a position on, for instance, visual, qualitative, functional, technical/economic and ecological features. The management of the project's scope and transformability as well as review of the adequacy of spatial reservation is facilitated by the use of spatial, building element, structural and system models. Energy, condition, lighting, flow, fire, rescue and acoustics simulations function as part of design-related control and quality assurance. Their results function as design input data and decision-making support.

The building's life cycle and energy economy is optimized via spatial-, structure- and equipment systems alternatives-based simulation, life cycle and operational life analyses. The management of costs may also be intensified by means of using building information models when cost assessments and life cycle calculations are based on spatial and quantity data produced from the models.

The inspection process of building information models aims to bring about a higher quality realization with fewer errors. During the design stage, the precision of the model with regard to the management of the client's property and maintenance use is ensured in the manner agreed.

Through the use of building information models, it should be clearly ensured that the results of the formulated analyses correspond to the set requirements model and determined objectives. Reporting should be required from the BIM coordinator and design team as the design work progresses, as based on the data obtained from the models. If there is a need to do so, the requirements model/models are updated in the manner agreed.

In the design or separate BIM kick-off meeting, the BIM plan, mutual rules, organization, schedule, cooperation measures, client's quality assurance, documents/project management and modeling progress are reviewed as they apply to building information modeling. The enhanced reporting methods of the design team with respect to modeling are agreed on. The updating and approval procedures affecting the BIM plan are to be mutually agreed on.

Yields of this stage:

- ◊ The enhanced design schedule of the building information model project (the client's decision-making points are taken into consideration)
- ◊ BIM plan kick-off meeting
- ◊ BIM plan updating
- ◊ cooperation measures: building information model meetings, design team meetings, design meetings
- ◊ quality assurance measures: designer, design team, client
- ◊ building information model documentation
- ◊ building information model design reports
- ◊ Result: Mutually agreed BIM plan rules

4.4.1 Control of schematic design

Requirements

In the schematic design phase, the alternative design solutions are formulated to fulfill the set objectives. The result is a selected plan of design alternatives.

Guideline

During the schematic design stage, the most suitable basic solution is sought by means of alternative architectural spatial models (or spatial group models). By means of models, the scope-, cost- and life cycle-based features are compared in cooperation with the client and user. An attempt is made to ensure the energy economy of the building by means of energy simulations and life cycle calculations. Alternative design solutions are compared with the requirements model.

During the schematic design stage, the architectural spatial model can be used to check the spatial program as well as to visualize the building site and to ensure the fulfillment of the various operational and efficiency objectives. In addition, it is possible to formulate a space-based objective price estimate and compare it to the traditionally generated objective price estimate. The use of MEP specialists already at this stage makes it possible for the spatial reservations to be planned while preserving the architectural requirements.

By means of the energy analyses generated by MEP specialists and energy consultants, the project management and the designers ensure that the energy efficiency, energy consumption, condition and environmental objectives are reasonable. In formulating the MEP requirements model for the project, the entire life cycle affordability with the usage and maintenance costs are taken into account.

During the schematic design stage, the special designers also study the structural and MEP-related solution alternatives to the scope agreed on.

The requirements model is updated in accordance with the decisions.

Yields of this stage:

- ◊ MEP requirements model
- ◊ preliminary spatial or spatial group model made by an architect for the plan and the spatial solutions, intended for scope management, traffic flow analyses, spatial efficiency, measurement, transformability and functionality reviews, as well as working environment development
- ◊ preliminary spatial or spatial group model for MEP reviews, such as for energy efficiency, energy consumption, amount of household water and carbon footprint, analyses of environmental impacts and environmental classification
- ◊ reports on quality assurance, clash detections and integration of designs
- ◊ building information model specification
- ◊ alternative spatial group, spatial and massing solutions
- ◊ efficiency of spatial use
- ◊ spatial lists
- ◊ space-based cost assessments
- ◊ illustration and visualization of design solutions

- ◊ marketing material for rental of premises, etc.
- ◊ preliminary base structure solutions
- ◊ preliminary MEP-based spatial reservations
- ◊ preliminary type space MEP modeling
- ◊ energy analyses: preliminary energy analyses (comparison of alternatives)
- ◊ energy analyses: preliminary condition analyses (comparison of alternatives)
- ◊ preliminary lighting visualizations and calculations
- ◊ lighting simulations
- ◊ preliminary life cycle calculations (LCC)
- ◊ preliminary flow analyses, simulations (CFD)
- ◊ preliminary life cycle analyses (LCA)
- ◊ required special simulations (acoustics, etc.)
- ◊ objective comparisons
- ◊ requirements model maintenance
- ◊ Result: Approval decision for the design of alternatives/selected design solution as the basis of design development

4.4.2 Control of design development

Requirements

In design development stage, the selected design of alternatives plan is developed in the design team as a basic plan suitable for implementation. If needed, a procurement strategy is also agreed on.

Guideline

During the design development stage, model-based preliminary architectural, structural and MEP-related building information models for the control of planning is used, in addition to previous information models-based data. During the design development stage, in addition to individual design discipline-based sub-models, special attention is given to the integrated review of models, e.g. the structural model and rock surface model. Moreover, design solutions and the client's decisions are guided by the achievement of objectives and the results of the analyses of the models.

The models obtained as a result of the design development stage already include most of the data required in the detailed design stage.

Yields of this stage:

- ◊ illustration and visualization of design solutions
- ◊ preliminary building element model and structure model, spatial reservation model and preliminary system model
- ◊ preliminary MEP-based site model
- ◊ building information model specifications

- ◊ reports on quality assurance, clash detections and integration of designs
- ◊ scope comparisons (between spatial program and designs as well as net/gross area comparisons)
- ◊ enhanced space-based cost assessment
- ◊ preliminary building element-based cost estimates
- ◊ functional analyses
- ◊ illustration of design solutions: for instance, model rooms and areas, service area charts, engine rooms
- ◊ base and foundation alternatives
- ◊ structural analyses
- ◊ service life analyses
- ◊ preliminary 4D scheduling
- ◊ animations
- ◊ description of virtual environment
- ◊ marketing materials
- ◊ energy analyses: energy analyses (review of solution)
- ◊ energy analyses: condition simulations (review of solution)
- ◊ life cycle cost analyses (LCC)
- ◊ energy and environmental impact analyses (LCA)
- ◊ lighting visualizations and calculations
- ◊ lighting visualizations
- ◊ flow simulations (CFD)
- ◊ MEP system analyses
- ◊ fire simulations
- ◊ other required special simulations
- ◊ objective comparisons
- ◊ maintenance of requirements models
- ◊ Result: Decision for the approval of basic design

4.4.3 Control of building permit tasks

Requirements

In building permit tasks, the competence of the designers is ensured as well as the acceptability of the general plan, the main drawings are compiled, and the permit documents and information models required are prepared and deposited for official handling.

Guideline

Project management should launch negotiations already at the initial design stage with officials on the possible utilization of the model at the building permit stage. The authorities can benefit from the building information models at least in the future in seeking a building permit, in CE marking for building products, as an inspection document, as support for special procedures for

structures, in the remote monitoring of the worksite, and in reviewing the installation plan at the construction kick-off meeting. During the building permit stage, the fulfillment of the official regulations will be ensured by means of the models. By means of the simulations generated from the models, it is possible to verify compliance with regulations with respect to, among other things, the scope, accessibility, fire and rescue safety and energy efficiency. The documented building permit stage information models are delivered for storage with building supervision. In addition, the as-built models are delivered to building supervision at the end of the project.

Yields of this stage:

- ◊ documented building information models in the building permit stage
- ◊ building information model specifications
- ◊ BIM cooperation measures with the authorities
- ◊ illustrative images (e.g. support for environmental report)
- ◊ scope information
- ◊ compliance with the regulations: e.g. accessibility, fire and rescue safety
- ◊ energy analyses: energy report
- ◊ Result: Building permit documents/Decision on the application for a building permit

4.4.4 Control of the detailed design

Requirements

In the detailed design, a plan is developed into the dimensioned plans and product specifications that are required for construction. Product and system sub-planning is included in the implementation design.

Guideline

During the detailed design stage, models are developed to meet the precision level required by construction, so that they can proceed to the offer calculation stage. On the whole, all paper documents produced for contract calculations and later implementation must be based on the building information models. Due to the BIM precision level, part of the calculation materials are not, however, based on the building information models. These may include, for example, part of the structural details.

The detailed design carried out by building information modeling is supplemented at the building stage together with the designers and/or contractors within the project in the manner agreed. The tasks to be performed by the designer in the construction stage must be defined at the planning-related call for tenders stage, and the contractor's tasks are stipulated during the construction preparation stage.

Yields of this stage:

- ◊ illustration and visualization of design solutions
- ◊ building element models, structural models and system models
- ◊ site models for the purpose of calculation and implementation
- ◊ building information model specifications
- ◊ dimensional drawings
- ◊ reports on quality assurance, clash detections and integration of designs
- ◊ penetration reservations for the purpose of implementation
- ◊ building element-based cost estimate
- ◊ building information model-based bills of quantities
- ◊ functional analyses
- ◊ animations
- ◊ virtual environments
- ◊ 4D scheduling
- ◊ system models for calculation
- ◊ enhanced cost assessment
- ◊ energy analyses (implementation stage enhancements)
- ◊ life cycle cost analyses (LCC)
- ◊ energy and environmental impact analyses (LCA)
- ◊ lighting visualizations and calculations
- ◊ flow simulations (CFD)
- ◊ MEP system analyses
- ◊ MEP sound calculations
- ◊ objective comparisons
- ◊ updated requirements models
- ◊ updated risk analyses
- ◊ Result: Approved detailed design plans/workshop drawings for construction

4.5 Construction preparation

Requirements

Construction preparation involves organizing the construction, specifying the tasks supporting the contractor's BIM-related objectives, responsibilities and obligations, establishing procurements for bidding, engaging in agreement negotiations and making procurement agreements.

Guideline

During the construction preparation stage, the contractors are hired and the construction work in the project is organized. During the contract calculation stage, information models or bills of quantities may be relinquished to contractors for use in IFC format if agreed on with the designers. Questions of responsibility are connected with relinquishment concerning, for instance, the accura-

cy of models and quantities, by reason of which the models and derived bills of quantities have often been delivered without obligation for the use of contractors. This has slowed the use of models during the construction stage. If the contractor is required to use information models in worksite implementation, the models should be delivered in this respect as binding on the client and designer. It is important that the inspection minutes are also given to the contractors together with the information model reports, which clarify the precision, scope and level of readiness of the information models.

The building information models turned over to the contractors are labeled as contract agreement-related technical documents, and they are assigned mutual competence priority relative to the other documents. The building information models and related reports are itemized in a similar manner as the other technical documents.

The contractor's tasks and itemized obligations in BIM implementation are entered in the contract program (see Series 13: "Use of models in construction"). The requirements affecting the contractor's costs should already be presented in the call for tenders. The contractor's right to relinquish the information model to a third party is entered in the contract documents, e.g. in connection with a subcontracting-based call for tenders or for a company implementing subcontracting. The contractor is obliged to transfer the restrictions on the use of the building information model and its relinquishment to the subcontractor. It is noteworthy that the selected form of contract affects the tasks and responsibilities of the various parties.

In the selection of the contractor, the competence and experience of the person taking care of the contractor's BIM tasks should be taken into account. The contractor is given the possibility to review the building information models prior to signing a contract agreement. The models are turned over to the contractor in such a form that the scheduling for construction is possible for this task with the commercial software available. The designers' schedule tasks with regard to modeling should be agreed on separately if these are required from them.

The following options wanted by the client shall be agreed on separately in accordance with the project:

- *construction schedule presentation in the building information model*
- *presentation of the construction as-built situation in the building information model*
- *modeling of the use of the building area (worksite area plan)*
- *verification of the occupational safety solutions of the construction stage by means of the building information model*

- *documentation of changes and installations at the time of construction work, e.g. by laser scanning, video or photographing*
- *MEP-based performance of balancing listing, control images and room-specific checklists, etc.*

Changes are frequently made to the plans during the construction for production-related reasons, for example. At the latest during the preparation stage of construction, one should agree on how and by whom the changes occurring during construction can be reliably documented and taken from implementation to the corresponding building information models. The extent of service handbook materials and the production of other relinquishment-related materials, as well as the roles concerned, are stipulated by the project management, and they are included in the contract agreements made. Delivery of the contractor's as-built data is addressed in Series 13. For the utilization of the building information models later as a tool for maintenance, upkeep and subsequent repair and modification work, it is important that the model corresponds in all respects to, for example, the finished building with regard to MEP systems and equipment.

Yields of this stage:

◊ contractors' BIM tasks and their scope and obligations
◊ construction and structural element models for the purpose of contract calculation
◊ system models for contract calculation
◊ bills of quantities derived from the models
◊ building information models and information model reports
◊ selection criteria pertaining to competent contractors
◊ contract calls for tenders and agreements
◊ use of document/project management system
◊ Result: Contract and procurement agreements

4.6 Control of construction

Requirements

A building is built ready in the manner that is indicated by the documents and building information models in accordance with the modifications decided on during the construction period. BIM operational methods and cooperation are coordinated. Building control ensures that the implementation is in compliance with the agreement, performance of BIM tasks during the construction work, an outcome that fulfils the objectives and the required operational and maintenance readiness. Completion of the building in accordance with the plans is noted upon acceptance. The BIM coordinator ensures that all of the responsible parties have supplied the as-built data required in the agreements.

Guideline

It is possible to reinforce various worksite processes via the building information models. The contractor can utilize building information models on the worksite, for example:

- *in delineating the entity as well as spatial use*
- *in the kick-off meetings for the work stages*
- *in procurement*
- *in location-based quantity take-offs*
- *in the review of measurements and elevations*
- *in worksite area use planning (e.g. fences, worksite facilities, worksite traffic, parking, storage, electricity and lighting)*
- *in logistics planning such as planning lifting and transfers (e.g. the dimensions of tower cranes and placement of construction site hoists)*
- *in machine shop and element production*
- *in the enhancing of external measurements of equipment with respect to the required hauling routes, for instance*
- *in occupational safety planning and risk assessment (e.g. protection against falls; railings, mounts and anchoring)*
- *in scaffold planning*
- *in contractor meetings and kick-off meetings for the work stages*
- *in 4D schedule maintenance between the parties (design, assembly, installation)*
- *in visualization.*

The building information models relinquished for production use are itemized and their application and quality assurance are verified in the parties' mutual review. The procedures and measures connected with the use of the models are presented to the contractor.

The duty of the client is to facilitate the delivery of the information models in accordance with the agreed on scope and schedule.

Yields of this stage:

◊ construction stage BIM kick-off review
◊ BIM-related cooperation measures during the construction stage
◊ reports on quality assurance, clash detections and integration of designs with respect to building information models modified during construction
◊ printouts as an option of the contractors' ordered procedures
◊ as-built data
◊ energy analyses: normal-use energy consumption target (level 1 or level 2)
◊ documentation whilst construction is in progress
◊ service handbook information
◊ Result: Acceptance decision

4.7 Commissioning, handover and takeover

Requirements

In commissioning, the functions of the systems are tested and the instruction on their use is given.

Guideline

On the whole, the procedure of the contractors and the designers in relation to the handover documents in the project utilizing BIM is in accordance with the traditional building project procedures. In the procedures of the commissioning stage, what is new is that at the end of the construction work, the designers relinquish the corresponding building information models of the implemented building to the client (the as-built models). The models that are relinquished are described in the design and contract agreements. In the operational instruction given in connection with the handover and takeover of the building, it is possible to use the building's information models as support, by which means it is possible to illustrate the building for the coming users better than with traditional drawings.

The utilization of the building project information models in facility management is discussed in more detail in Series 12. The potential possibilities are in many operational fields from operational property control to the maintenance and upkeep of the buildings' technical systems, user services, cleaning, etc. Building information model-based property maintenance applications are already offered and being developed with respect to office space and space management in general, the monitoring of energy and environmental impacts, budgeting for upkeep, long-term planning and service handbook management, etc.

Project management should appoint a person to coordinate the service handbook obligations for the building project. The BIM coordinator should ensure, in cooperation with this person, that the models that are relinquished to the property regarding design and construction also contain the information in accordance with the property's service handbook requirements.

Yields of this stage:

- ◊ as-built models
- ◊ energy analyses: normal-use energy consumption target (level 1 or level 2, building stage inspection)
- ◊ building information model specifications
- ◊ reports on quality assurance, clash detections and integration of designs
- ◊ ready service handbook
- ◊ Result: Takeover decision

4.8 Warranty period, operation and maintenance

Requirements

The transfer of the building information models to the applicable operational systems and maintenance systems is ensured.

Guideline

After the building project, the building information models remain specified in accordance with the agreements in the custody of the client, and they can be utilized as exact input data in designing the conversion and repair work directed to the building later. The purpose is that the building information models generated during the project will be updated in the future and will follow the building during its entire life cycle. Energy consumption and conditions are compared with the set objectives. The utilization of building project-based building information models during use and maintenance is discussed in more detail in Series 12.

APPENDIX 1: BUILDING INFORMATION MODELING PLAN, TEMPLATE

1 GENERAL

- Purpose of the information modeling plan in the project
- Procedures connected with updating the information modeling plan

2 GOALS AND APPLICATIONS OF INFORMATION MODELING

- The goals and applications of information modeling during the project, as well as during its period of use and maintenance (for instance, energy analyses and clash detections) in the various stages (project clarification, planning, building and maintenance)

3 ORGANIZATION OF INFORMATION MODELING

- The persons in charge on a role-by-role basis (for instance, an information model coordinator, persons in charge of specific design disciplines, persons in charge of quality assurance)
- The persons in charge in accordance with the application of the information models (for instance, energy analyses and clash detections)

4 COOPERATION MEASURES AND COMMUNICATIONS

- Cooperation measures, meeting procedures and reporting

5 QUALITY ASSURANCE

- Quality assurance measures

6 MERGING MODELS

- Merging measures of the models, principles of publication and approval

7 REQUIREMENTS MODELS

- Preparation measures for requirements models and related updating

8 PRINCIPLES OF INFORMATION MODELING

- Standards and instructions to be observed
- Modeling method (sections, layers, etc.)
- Data transfer mode
- Naming the models, drawing layers, units of measurement, coordinate system, identifiers, etc.
- Information management

9 SOFTWARE

- The parties' programs in accordance with the application

10 MODEL PROCESSES

- Measure descriptions for the persons in charge as separate appendices in accordance with the use cases

11 PREPARATION OF PERFORMANCE MODELS

- Principles and responsibilities for the preparation of performance models

12 PROJECT TERMINATION

- Handover of models
- Maintenance models

APPENDIX 2: DUTIES OF A BIM (BUILDING INFORMATION MODEL) COORDINATOR, MODEL

Mark the appropriate boxes to select the BIM-related duties included in the BIM project

	NEEDS AND OBJECTIVES ASSESSMENT
☐	Assistance in ordering input data model
☐	Assistance in ordering terrain model
☐	Arranging for preparation of preliminary requirements model
☐	Other tasks:
	CONCEPTUAL DESIGN
☐	Arranging for preparation of requirements models
☐	Preparation of preliminary information modeling plan
☐	Project schedule checking
☐	Other tasks:
	DESIGN PREPARATION
☐	Preparation of building information modeling (BIM) risk assessment
☐	Supervision of BIM tasks
☐	Reporting on BIM situation
☐	Arranging for updating of requirements models
☐	Further specification of BIM plan
☐	Planning the organization of building information modeling
☐	BIM quality assurance plan
☐	Checking the design schedule
☐	Design-related BIM tasks
☐	Checking of designers' selection criteria
☐	Checking of calls for tenders concerning design
☐	Checking of design agreements
☐	Specification of the document management system
☐	Other tasks:
	SCHEMATIC DESIGN, DESIGN DEVELOPMENT AND DETAILED DESIGN
☐	Arranging of BIM kick-off meeting
☐	Further specification of BIM plan
☐	Arranging for updating of requirements models
☐	Updating of BIM risk assessment
☐	BIM scheduling
☐	Supervision of BIM tasks
☐	Supervision of design-related quality assurance
☐	Client's quality assurance tasks
☐	Supervision of BIM documentation
☐	BIM meetings and reviews
☐	Preparation and checking of merged models
☐	Reporting on BIM situation
☐	Other tasks:
	CONSTRUCTION PREPARATION
☐	Supervision of BIM documentation
☐	Arranging of BIM reviews
☐	Client's quality assurance tasks
☐	Contractors' BIM tasks
☐	Checking of contractors' selection criteria
☐	Checking of contract calls for tenders
☐	Checking of contract agreements
☐	Reporting on BIM situation
☐	Other tasks:
	CONSTRUCTION
☐	Arranging of information model kick-off review
☐	Updating of BIM plan
☐	Updating of BIM risk assessment
☐	Agreeing on cooperation measures
☐	Arranging of BIM meetings
☐	Supervision of BIM tasks
☐	Supervision of as-built information updating
☐	Supervision of as-built information updating
☐	Reporting on BIM situation
☐	Other tasks:
	COMMISSIONING, TAKING-OVER, WARRANTY PERIOD AND MAINTENANCE
☐	Assurance of BIM-based service handbook
☐	Verification of delivery with regard to as-built models
☐	Transfer of BIM maintenance to client organization
☐	BIM-based final report
☐	Other tasks:

APPENDIX 3: PROJECT SCHEDULE, TEMPLATE

PROJECT SCHEDULE

1	**Needs and objectives assessment**
2	**Project decision**
3	**Decision to use BIM planning in the project**
4	**Conceptual design**
4.1	Site/inventory models
4.2	Requirements model
5	**Investment decision**
6	**Design preparation**
6.1	Design programme
6.2	BIM plan
6.3	Selection of designers
7	**Design agreements**
8	**BIM-design**
8.1	Schematic design
8.2	Selected design of alternatives
8.3	Design development
8.4	Approved basic plan
8.5	Building permit tasks
8.6	Detailed design
8.7	Approved construction documentation and workshop drawings
9	**Quality assurance for building information models**
10	**Construction preparation**
11	**Contract and procurement agreements**
12	**Design tasks during construction**
13	**Construction**
14	**Quality assurance for building information models (implementation models)**
15	**Quality assurance for building information models (as-built models)**
16	**Handover decision**
17	**Takeover decision**
18	**Operation**
19	**Warranty period and maintenance**