# Action Plan for Digitisation, Ocean Space Centre

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# 1 Introduction

The project's digitisation strategy contains general principles for digital cooperation for the project, intended for the whole project lifetime. This action plan for digitisation is derived from the strategy and contains several topic related to digitisation and digital cooperation, see figure below. The action plan is reviewed before beginning of a new project phase and is included in the contract.

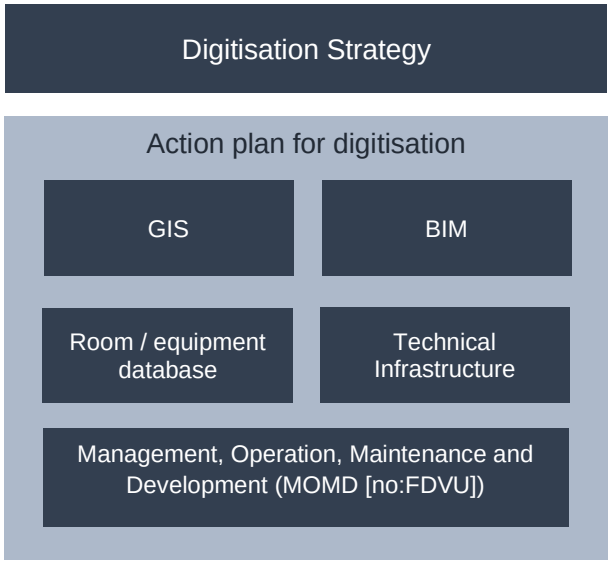


*Figure 1 – Digitisation strategy and action plan for digitisation*

The joint understanding of BIM work processes, communication and deliveries are important for a successful BIM project.

The model shall be the central base for information in design and production. All design, including user equipment, happens in the model, and the model shall always contain updated information.

This action plan describes how BIM is to be used in the project, which also have impact on methods for work and cooperation.

The purpose is to secure equal expectations, healthy cooperation and understanding between different actors in the project.

# 2 Roles and Responsibilities

The digitisation strategy shows a conceptual organisation shown in figure 2. The occupation of roles is decided in each phase. Statsbygg will always occupy the role as Project Responsible for Digital Cooperation.

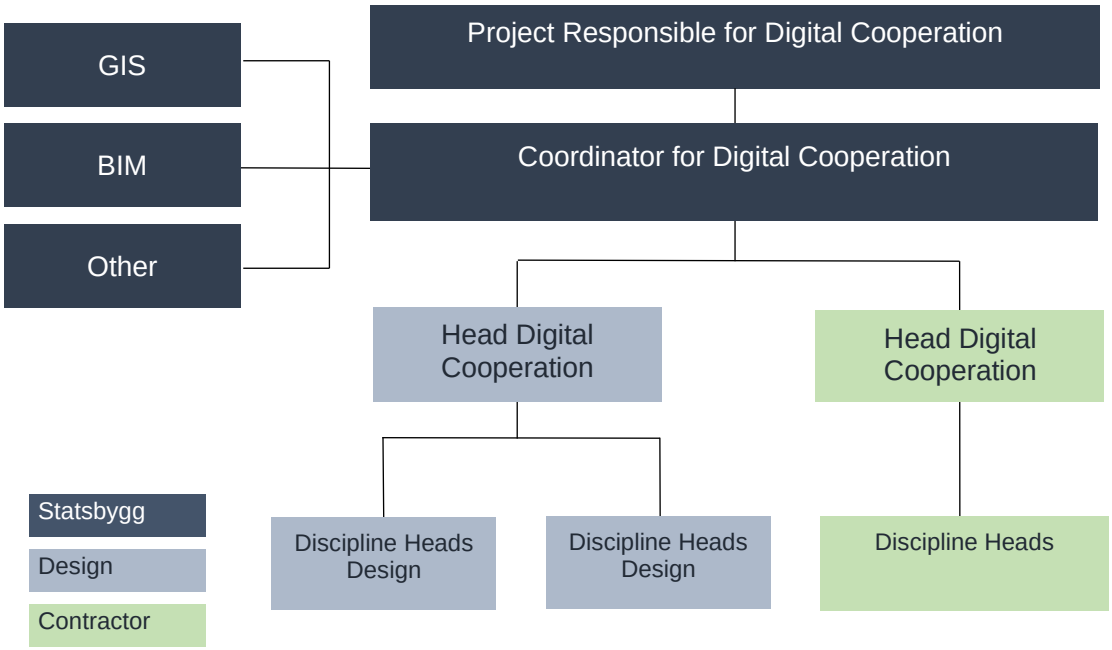


*Figure 2 – Organisation of roles related to digital cooperation in the project*

Examples of responsibilities and tasks:

**Project Responsible for Digital Cooperation:**

- Overall planning and control of digital cooperation in the project
- Introduce and follow up correct use of MMI (Model Maturity Index) in the project

**Coordinator for Digital Cooperation:**

- Preside over start-up meeting BIM
- Create and project adapt Statsbygg's BIM requirements
- Coordinate correct start-up of BIM, together with Heads of digital cooperation
- Facilitate for supplier's creation of BIM Execution Plan (BEP)
- Decide on MMI zones in cooperation with designers/contractors
- Technical follow-up on delivery descriptions of BIM and MMI

**Head Digital Cooperation:**

- Ensure that model exchange is according to plan
- Responsible for creation and continuous update of BEP and BIM delivery descriptions
- Ensure that BIM models maintain standards described in governing BIM documents and is usable for agreed purposes (quantities, analyses, etc.)
- Creation, adaption and updating of combined BIM model
- Responsible for follow up of interdisciplinary controls in model, included collision control and validation according to BIM requirements
- Facilitate active model use in meetings and management of design/construction
- Follow up on requirements for drawing deliverables for design

**Discipline Heads Design:**

- Ensure that model information and structure is according to the current requirements applicable
- Responsible for model placement with respect to project zero point
- Ensure correct combination and use of other discipline models in the disciplines own BIM design tools.
- Ensure conversion of discipline models to agreed formats
- Ensure that models are interdisciplinary coordinated before publishing models for collision control
- Ensure that actions from collision controls are performed, corrected and signed in collision control report
- Use BCF as exchange format for cooperation in design and use for collision control actions
- Automatic validation of IFC deliverables according to Statsbygg's BIM reguirements – SIMBA 1.3/2.0

# 3 Project BIM Requirements

## 3.1 BIM Application

Applications for use of BIM are listed below distributed by project phase.

*Table 1 - BIM application*

| | Develop/ planning | Detail design | Execution | Hand over |
|---|---|---|---|---|
| Spatial program | x | x | x | x |
| Model maturity (MMI) | x | x | x | |
| Mapping of ground conditions and mass calculation | x | x | x | |
| Interdiciplinary control | x | x | x | |
| Interdisciplinary Tag System (TFM) | | x | x | x |
| Modelling of user equipment | x | x | x | x |
| Terrain model | x | x | x | x |
| Collaborative design planning (method based on Last Planner System) | x | x | x | |
| Product information (GTIN) | | | x | x |
| Digital building application (Municipal) | x | x | x | x |
| Visualisation (VR, Video, etc.) | x | x | x | |
| Rig planning | x | x | x | |
| Detailed quantity take-offs (NS3420 element or better) | x | x | x | x |
| ICE, BIM model focused | x | x | x | |

| | | | | |
|---|---|---|---|---|
| **Digital analyses:** | | | | |
| Acoustic | **x** | **x** | | |
| Fire | **x** | **x** | | |
| Energy | **x** | **x** | | |
| Lighting conditions | **x** | **x** | | |
| LCC | **x** | **x** | | |
| Universal accessibility | **x** | **x** | | |
| Green BIM | **x** | **x** | | |
| Construction buildability review, using BIM-models | **x** | **x** | | |
| Key Performance Indicators, KPI | **x** | **x** | **x** | |
| As built - Procedure for registration and modelling of acceptable deviation from site. | | | **x** | **x** |
| Systematic Completion | | **x** | **x** | **x** |
| State's buildings. No. of employees / work-years vs. No. of m² per employee / pr. Work-years | **x** | | | |

## 3.2 BIM Execution Plan (BEP)

The project shall establish a BIM Execution Plan, describing how to operationally realise the project's digitisation strategy and action plan for digitisation. The BEP is to ensure interdisciplinary agreement about BIM-use in the project, in addition to fundamental procedures and set-up for interdisciplinary cooperation with BIM.

The BEP should at least describe:

- Project purpose and goals for BIM
- BIM organisation, roles, and responsibilities
- Georeferencing and map resources
- Naming of models and drawings
- Building partitions, storey heights and system for axes.
- Naming of objects
- Object attributes and parameters
- Description of quality control system for BIM models
- Procedures for file exchange, coordination model, and deliverables
- Execution of interdisciplinary controls
- Use of process status coding (MMI)
- Description of deliverables in terms of BIM objects linked to MMI-status. Descriptions should at least be produced according to the Norwegian standard "NS 3457-7 bygningsdelstabellen" at 2-digit level and describe object properties.
- Description of relevant KPIs and procedures for aggregation of these
- Other relevant procedures and routines.

The BEP is to be continuously updated with routines and procedures throughout the project's lifetime.

## 3.3 BIM Deliverables

### 3.3.1 Statsbygg BIM requirements – SIMBA 1.3/2.0

The project's requirements for BIM models for the clarification and planning phase is SIMBA 1.3. At 1st of July 2021 new requirements, SIMBA 2.0, were made compulsory for all new projects in Statsbygg.

SIMBA 2.0 requirements will apply for all BIM in the execution phase of the project. This entails, among other requirements, that the suppliers of BIM models are to use machine validation of IFC-files with respect to requirements found in the projects requirement database.

The requirement database in SIMBA 2.0 contains fundamental requirements for IFC files on the format IFC 4, but requirements can be specified to the project and altered on agreement.

For more information about SIMBA, practical execution of model validation and the generic requirement sets visit (mostly in Norwegian):

SIMBA 1.3: https://sites.google.com/view/simba-bim-krav/simba-1-3
SIMBA 2.0: https://sites.google.com/view/simba-bim-krav/simba-2-0

### 3.3.2 Models

Deliverables shall during the detail design phase be on the IFC 4 format. BIM on the Native format shall be delivered after finished project and/or at specified milestones (typically .rvt files for Revit and .pla files for ArchiCAD). Library objects used in the project shall be delivered with the Native format.

All model designers shall use an object-based design tool, including user equipment. The design tool shall be able to export models to IFC format and drawings to DWG format. All disciplines, including user equipment, shall deliver BIM models that with a level of detail that enables the generation of drawings and material take-offs directly from the model.

BIM deliverables shall be produced in such a manner that designers continuously can load models as reference in their design tools. Reference models shall be updated frequently to keep other project participants up to date on changes in the design. The model designers are themselves responsible to ensure that their models have acceptable performance when used as reference or combined in other software. This may entail adjustments to simplify or exclude geometry from IFC export.

Modelling of building elements shall as the main rule be as they are built. I.e., an external wall is modelled as the model object external wall, with correct layers and divided by building storey. A column is modelled with the column object with real height etc.

Delivery of models, drawing and documents shall be according to planned progress in the project. The exchange of IFC files for cooperation shall be delivered at agreed time and frequency.

Drawings and models should be consistent for all drawings that can be generated from the models.

**Delivery of Outdoor Work**

All design of the outdoors, i.e., Landscape, Water supply and sewage, Electrical etc. shall be performed in BIM and comply with requirements and regulations for BIM in the project.

Designed terrain shall be modelled. This includes designed building pit.

**Delivery of Mechanical Models of Special Equipment**

Simba 2.0 does not include machine interpretable requirement sets for mechanical models of special equipment, i.e., wave generation units, current flow systems, water treatment facilities,

etc. It is nonetheless required models that comply with the general requirements in SIMBA 2.0, in addition to requirements in this document.

Because models from suppliers of mechanical special equipment historically are produced in software different from classical building disciplines, specifications to the SIMBA 2.0 requirements have been developed, only valid for agreed models. Description of these specifications can be found in the attachment “OSC-SB-Å-SD-00002 BIM Requirements for Special Equipment”.

It is emphasised that communication about requirements for model deliverables, between the supplier of mechanical models of special equipment and Statsbygg is important, due to the uncommon challenges it represents. If the supplier discover that they cannot deliver quality to the BIM models as agreed upon, they shall give notice without unfounded delay.

### 3.3.3 Model Maturity Index (MMI)

Model Maturity Index (MMI) shall be used in the project. MMI describes the maturity of a BIM object. The system developed by EBA (Contractors Association for Building and Infrastructure) is used as a basis, see figure 3.

MMI codes in the project shall be harmonised between actors. Codes can be adapted beyond descriptions in the MMI guide. Custom MMI codes shall be defined in the BEP.

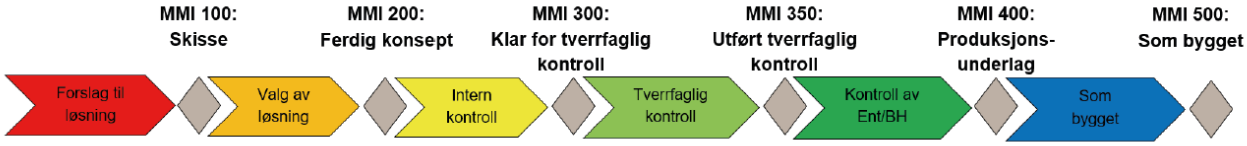


*Figure 3 - Process MMI from EBA*

Model MMI statuses shall be used in the design progress plan.

Partitioning of MMI zones have been applied for the development and planning phase. These zones should be reviewed, and if beneficial revised, in the beginning of the detail design phase. The zones shall be harmonised throughout the project and defined in the BEP.

Each zone should plan with separate progression for the MMI statuses. This enables zone-based collision and interdisciplinary quality controls.

Zones shall be harmonised in the project before a detailed progress plan is made.

MMI is first and foremost a method for communication in the design process. It is possible to better manage the design process with tools available through BIM, by deliberate planning of MMI statuses for a building or part of a building. It is therefore important that all objects are tagged with MMI status from start, through design and completion of the project.

### 3.3.4 Interdisciplinary Tag System, TFM

The Interdisciplinary Tag System TFM shall be used in the detail design phase. All BIM objects representing a built object shall have a TFM tag. System and component structure is essential in the systematic completion using Statsbygg’s standard software PIMS365. TFM is also essential in Statsbygg’s facility management software.

The TFM tag system used in the development and planning phase is based on the new Norwegian standard NS 3457-7. Some systems and components in the projects are outside the norm for “ordinary” codes used for buildings. Supplementary system and component codes are developed for the project where appropriate standard codes do not exist. See the document “OSC-SB-O-SD-00002 TFM-Amendment TFM-tagging of User Equipment” for further details.

NS 3457-7 shall be used for both building elements and user equipment. All disciplines shall tag BIM objects with TFM code at level 0 (one concatenated string) and level 2 (separate properties). Description of levels and structure of TFM codes in BIM can be found in the guidance to SIMBA 2.0. Description of holder properties for TFM codes on levels 0 and 2 are found in the attachment “OSC-SB-Å-SD-00001 General attributes and properties in BIM models".

DRofus shall be used as TFM Master for all disciplines and objects in the project.

### 3.3.5 Product Type Coding (GTIN)

Global Trade Item Number (GTIN) will be required for chosen products in the detail design phase. GTIN is a tag system that ensures identification of products in BIM. The GTIN number shall be a searchable parameter in the product documentation.

This is done EITHER:

- Directly by enriching BIM objects with GTIN numbers.
- Indirectly by a permalink to a database (i.e., coBuilder) holding the GTIN number (and documentation of the commercial product it represents).
- Indirectly by using a unique TFM tag to query a location (database or similar) holding GTIN (and documentation or permalink to documentation).


*Figure 4 – Example of product type coding, GTIN*

### 3.3.6 Green BIM

Ocean Space Centre has ambitious goals for environmentally friendly solutions, including a building producing more energy than it consumes. Green BIM is employed by using material take-offs to derive numbers for the project’s environmental impact. It is important to, as early as possible, define which materials and parameters that are being used for this purpose. Documentation of routines and parameters shall be included in the BEP.

## 3.4 Project Set Up

The following regulates the basic set up of model files in the project to ensure that cooperation and model flow is executed as easy as possible. Additional project specific guidelines for model set up are developed in relation to the start-up meeting for BIM and defined in the BEP. Other requirements in SIMBA 2.0 are applicable in addition to the following requirements.

### 3.4.1 Coordinate and Height Systems

The following coordinate and height systems shall be used for all absolute map references:

| | |
|---|---|
| Coordinate system: | EUREF89 NTM Zone 10 |
| Height system: | NN2000 |
| EPSG code: | 5950 |

### 3.4.2 Project Zero Point and Rotation

All models shall have shared point for project zero. Model deliverables shall **not** be rotated.

Ocean Space Centre has determined the following point for project zero for models located at Tyholt:

| Description | Absolute Coordinates, NTM10, NN2000 (m) | | | Local coordinates (m) | | | Rotation |
|---|---|---|---|---|---|---|---|
| | X(Ø) | Y(N) | Z | X(Ø) | Y(N) | Z | |
| *Project Zero, Tyholt* | *96450,50 m* | *1604005,60 m* | *0* | *0* | *0* | *0* | *None* |

The following zero point is determined for project locations at Heggdalen:

| Description | Absolute Coordinates, NTM10, NN2000 (m) | | | Local coordinates (m) | | | Rotation |
|---|---|---|---|---|---|---|---|
| | X(Ø) | Y(N) | Z | X(Ø) | Y(N) | Z | |
| *Project Zero, Heggdalen* | *92200,00 m* | *1606000,00 m* | *0* | *0* | *0* | *0* | *None* |

All design disciplines shall model a project zero object visible in BIM. The disciplines are assigned separate parts of this object, which clearly shall state which discipline it belongs to. This object shall be modelled to enable easy visual control of correct zero-point, height, and rotation with respect to the BEP.

### 3.4.3 Axis Plan

The Architect is responsible for establishing shared axes. Axes are to be modelled in a separate IFC file usable for collaboration models.

Separate axis plans for local and global (EUREF89 NTM10) coordinates shall be made.

Axis plan in local coordinates shall include:

- Annotated and named axes for the buildings
- Visible placement of the project zero point (X=0, Y=0)
- Visible global coordinates for the local zero point (EUREF89 NTM10)

Axis plan in global coordinates (EUREF89 NTM10) shall include:

- Annotated and named axes for the buildings
- Visible placement of the project zero point (X-coordinates, Y-coordinates in EUREF89 NTM10)

The axis plans shall be distributed as official drawings with own drawing numbers. The files are to be published in pdf (dwf) and dwg. They shall define minimum three axis intersections with coordinates in EUREF 89 NTM10. All axes shall be uniquely named without possibility for misinterpretation.

### 3.4.4 General Attributes and Properties in the Project

Machine interpretable requirements for attributes and properties on mvdXML format are made for the most frequently used IFC entities in the main disciplines. If other entities are used or the discipline does not have access to machine interpretable requirements, attributes and properties shall be used as defined in the document attachment “OSC-SB-Å-SD-00001 General attributes and properties in BIM models”.

## 3.5 Requirements for process/execution with BIM

### 3.5.1 Interdisciplinary Quality Control

All disciplines are responsible for interdisciplinary control in BIM. This entails that designers are responsible for overall control of their discipline models against other disciplines and to detect possible conflicts. Although interdisciplinary quality control is an ongoing task throughout the design phases, an overall control is to be made before MMI 350. Interdisciplinary control shall be completed, and errors corrected at MMI 350. Each discipline shall document this control and sign at completion. A plan for interdisciplinary controls shall be produced and coordinated with the design progress plan.

The designers are responsible for the buildability of their design.

### 3.5.2 Start-up Meeting BIM

Guidelines for BIM processes are important to achieve a healthy climate for coordination and cooperation. A start-up meeting for BIM, where ambitions for the project's BIM use and BEP are reviewed shall take place at the beginning of each project phase. The meeting is of a BIM-technical nature and it is important for designers/suppliers to be represented with persons with high competence in BIM.

### 3.5.3 Construction / Design Review

A design/construction review meeting with the production team, using BIM as a basis, should be held before drawings and models for are published for construction. This ensures a joint understanding between the designers and production team. This review is to take place before model elements reach MMI 400 – Basis for production.

### 3.5.4 Co-location

By co-locating the design group, a more effective flow of information and less waste can be achieved. The projects shall co-locate involved parties for some days in every week.

### 3.5.5 Key Performance Indicators, KPI

Continuous improvement is important to enhance flow efficiency, avoid waste and ensure achievement of project goals. This require that the project know status, what can be improved and the effect of implemented measures. A tool for this is to use Key Performance Indicators (KPIs). At the beginning of each project phase key performance indicators and method for collection of these shall be defined. Agreed KPIs related to BIM shall be defined in the BEP.

# 4 GIS in The Project

## 4.1 GIS Archive

A GIS archive with relevant available data sets for common use in the project will be established. I.e., technical base maps (FKB), ortho photos, cadastre, zoning maps etc.

## 4.2 Simplified Model

It shall in the design be prepared a simplified model used for visualisation and other GIS-purposes. This is mainly required by disciplines Architect, Structural and Landscape, but inclusion of other disciplines may occur.

## 4.3 Terrain Model

It is expected that design will include models of designed terrain and building pit. These models must be made available on a format readable for GIS tools.

# 5 Room and Equipment Database

The software dRofus is used in the Ocean Space Centre Project as room and equipment database. This is a cooperation tool for requirement, planning, data manipulation and use of BIM for construction projects. dRofus contributes to access to core data throughout the building's lifetime for all actors. It is a server database with good performance regardless of project size, complexity, or type.

The software is used to maintain overview over requirements and design for rooms and equipment, and link and synchronise information with BIM models.

## 5.1 Room and Functional Program

dRofus is to be used and kept up to date with respect to designed areas and requirements for rooms and areas. This entails that suppliers in upcoming project phases takes possession over and develops the underlying material from the previous phase. This is valid for room lists and requirements in the Room Function Program (RFP).

The detailing of the underlying material from the development and planning phase is different with respect to contract form. It is therefore variation in the extent of how much the underlying material, and hereby the dRofus database, need to be developed.

## 5.2 Equipment Database

dRofus is used for equipment list for planning and communication of requirements of user equipment in the project. dRofus is also used for generation of code for interdisciplinary tag system (TFM) for equipment. The equipment is linked to designed rooms in the database.

## 5.3 TFM Master

dRofus is used to automatically generate TFM tags for user equipment in the project.

The requirement that all BIM objects shall have TFM coding also enables the use of dRofus as "master" for all objects. In an early phase of the execution phase, it shall be decided how TFM tags are to be generated for all disciplines. Automatic generation from dRofus shall be considered in an assessment of the alternatives.

# 6 Technical Infrastructure

The appropriate support for seamless cooperation between different parties shall be supported by the technical infrastructure. A review of the structure and platforms for technical infrastructure shall therefore be done at phase transitions.

The project has, in the clarification and planning phase, used a solution where the BIM design exchange has been done on the platform BIM360 and other all other interaction has been done through the platform Interaxo.

Statsbygg's standard platform for construction project interaction has been changed in 2021 to Microsoft Office 365 (Teams, Sharepoint, etc.), which will be used in a larger degree.

Statsbygg's standard tool for systematic completion and MOMD (Management, operation, maintenance, and development) documentation collection is PIMS365 from Omega AS.

# 7 Management, Operation, Maintenance and Development (MOMD) [no: FDVU]

A complete set of models for Archive is required at phase completion: Conceptual design, detail design and As-built design. As-built models must satisfy the clients requirements for MOMD so that the models can be used in MOMD work and processes.

Objects in BIM models are to be used to geographically locate documentation by making connections between relevant BIM objects and MOMD documentation, including product documentation. Such connections can be obtained in multiple methods, i.e., using object's TFM tag as a key property in the CMMS (computerized maintenance and management system), or directly using the object GUIDs, if these are considered stable. Model can in addition be enriched with GTIN number for direct reference against a commercial product. The use of serial GTIN (S-GTIN) to identify occurrence of a commercial product shall be evaluated when relevant.

A plan for contents and delivery of MOMD documentation must be prepared. Maintenance personnel must assess the MOMD information as complete before handover – a list of agreed minor discrepancies with descriptions of further actions (with responsible party for action and a deadline for correction) can be accepted.

## 7.1 Systematic Completion and MOMD Documentation Collection

Statsbygg works after the principle of Systematic Completion and MOMD collection, ref. PA 0701 and PA 0702 (Norwegian only). It must be able to actively work with the BIM model in systematic completion and documentation collection in the projects, by BIM model connection to the collected documentation.

Statsbygg's standard tool for systematic completion and MOMD (Management, operation, maintenance, and development) documentation collection is PIMS365 from Omega AS.

## 7.2 As-built Model

BIM models must be delivered in correspondence with SIMBA 2.0 and other governing documents. Extract from SIMBA 2.0 guidance:

> *Minimum requirements for as-built models are:*
>
> - *Model corrected for all building changes from the approved detail design model to project completion. This applies for changed concepts, types, positions beyond accepted tolerances.*

- *Properties specified for as-built delivery in the requirement database is included. I.e., unique, quality assured TFM strings and updated process status codes (MMI) reflecting as-built maturity. Product type codes (GTIN) is included if agreed in the project.*

It is required, as the SIMBA 2.0 guidance states, that a joint work group responsible for handling registered discrepancies and agreed actions is established. The group agrees on how non-allowed discrepancies shall be handled. The model gains status As-Built when all non-allowed discrepancies are corrected and only allowed discrepancies remains.

Discrepancies are uncovered continuously and handled in the work group in agreed intervals in the project.

Conceptual workflow from designed to as-built is shown in the figure below.

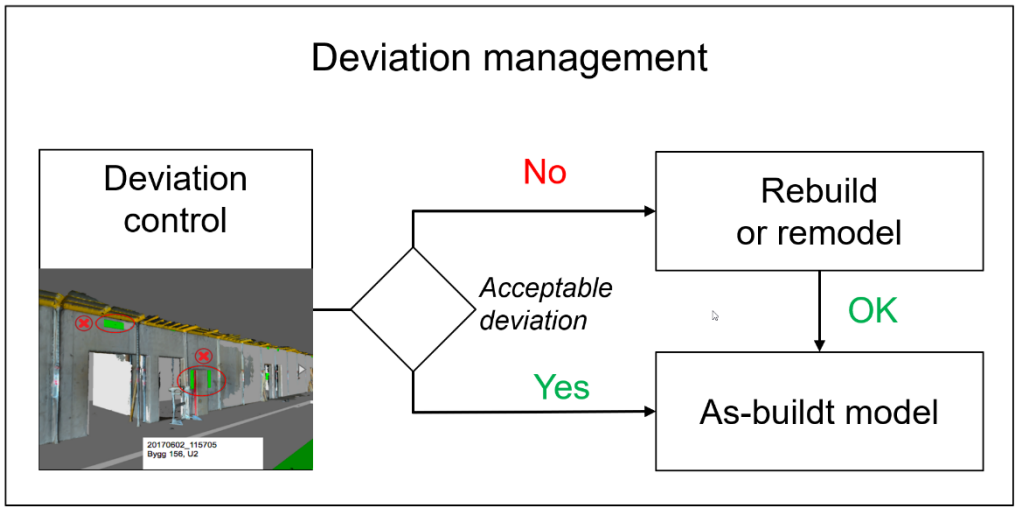


*Figure 5: Workflow for BIM objects from designed to as-built.*

# 8 References

The following references is used in this document:

**Project specific references:**

- OSC-SB-Å-SD-00002 BIM Requirements for Special Equipment
- OSC-SB-Å-SD-00001 General attributes and properties in BIM models
- OSC-SB-O-SD-00002 TFM-Amendment TFM-tagging of User Equipment

**General references:**

- SIMBA 2.0: Machine interpretable requirement sets, General requirements and guidance to requirements: https://sites.google.com/view/simba-bim-krav/simba-2-0
- Statsbygg design regulations (Norwegian only): https://www.statsbygg.no/publikasjoner
  - PA 0701 Systematisk ferdigsstillelse
  - PA 0702 Systematisk FDVU-innsamling
- Norwegian Standards:
  - NS 3457-7:2021 Klassifikasjon av byggverk — *Del 7: Identifikasjon i digitale modeller og for merking i byggverk* angir et tverrfaglig merkesystem (TFM) for identifikasjon i digitale modeller og merking i byggverk