Action Plan Digitization, Appendix 1 – BIM requirements Ocean Space Centre

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Contents

1 BIM Requirements in the Project

This appendix holds project specific BIM requirements for the Ocean Space Centre project. Requirements are given both for BIM as a process and deliverables.

1.1 BIM Execution Plan (BEP)

All leading contractors, herein engineering, procurement and construction contractors, must create a BIM Execution Plan (BEP) describing how the contractor operationally is going to realise goals and requirements forms by the Project's Digitalisation Strategy and Action Plan for Digitalisation. The BEP is a measure to ensure interdisciplinary agreement about BIM-use in the project, in addition to describe fundamental procedures and set-up for interdisciplinary cooperation with BIM.

The BEP must 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
- Procedures for linking, generation and synchronisation of information between BIM and other information sources (I.e. synchronisation of BIM and the dRofus tagging database)
- Other relevant procedures and routines.

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

1.2 BIM Deliverables

Deliveries to the project must follow the specification of this document, in addition to Statsbygg's BIM requirements – SIMBA 2.0.

1.2.1 Statsbygg's BIM Requirements – SIMBA 2.0

The Project's requirement for BIM models is SIMBA 2.0. This entails delivery of files on the IFC 4 format and machine validation of IFC deliveries by using machine validatable requirements on the format mvdXML.

Requirements in SIMBA 2.0 consist of two parts:

- **Machine validatable requirements:** A requirement database that can be expressed on the machine-readable format mvdXML, as well as a human readable information. Project adapted requirement sets are included in tender documents.
- **General requirements:** Spreadsheet with general requirements not expressed on a machine-readable format.

A guideline to SIMBA 2.0 and other helpful information are available at https://sites.google.com/view/simba-bim-krav/simba-2-0. (Website is in Norwegian, but documentation on general requirements and guidance is also in English)

Project specific adaptions of machine validatable requirements

The machine validatable requirements of SIMBA 2.0 has been adapted for the project. For the full overview of project adaptions, see machine validatable requirements appended to the contract in question. The purpose of this project adaption is mainly to implement the end-user's requirements for using BIM models in their future facility management.

1.2.2 Models

Requirements for BIM models, modelling practices, validation etc. are given by the general and machine validatable requirements specified in SIMBA 2.0.

BIM discipline models must, as a minimum, be delivered by the following design disciplines:

- ARK (Architecture)
- RIB (Structural)
- RIE (Electrical)
- RIV (HVAC)
- LARK (Landscape Architecture)
- RIVA (Water and Sewage
- IARK (Interior Architecture)
- RIG (Geotechnical)
- RIMASK (Special equipment)

Information from principal disciplines (Fire safety, Acoustic, building physics, security etc.) must be populated on objects modelled by the relevant disciplines. This population is the supplier's responsibility. It is allowed to deliver separate IFC models for principal disciplines, provided that they adhere to the BIM requirements in SIMBA 2.0 and other premise giving documents in the project.

The designers of BIM models are required to create models that are useable as external reference for other disciplines and for coordination in other software. This may entail adjustments to simplify object geometry or exclude geometry from IFC export.

Suppliers to the project must deliver models, drawings, and documents according to agreed design delivery schedule. IFC Model exchange for coordination models must be delivered at an agreed upon interval.

There must always be accordance between model and drawing for all drawings that can be generated from the BIM model.

Delivery of BIM models for special equipment

SIMBA 2.0 does not contain machine validatable requirement sets specifically made for special equipment, i.e. wave generation machines, current flow systems, water treatment equipment etc. It is nonetheless required that BIM deliverables adhere to the general requirements stipulated by SIMBA 2.0 as well as requirements put forward by this document and appendices.

Historically models for special equipment are produced in different software than what is customary for the classical building disciplines. It is therefore made a specification of SIMBA 2.0 requirements with respect to special equipment, only applicable to such models on agreement. These requirements are detailed in the document "OSC-SB-Å-SD-00002 BIM requirements for special equipment".

Because delivery of BIM models of special equipment has challenges beyond what is common in a building project, it is emphasised that communication between the supplier of BIM models of special equipment and Statsbygg is important with respect to delivery requirements. If a supplier discovers that that they cannot deliver the agreed upon quality of BIM models, they are obliged to notify Statsbygg without undue delay.

1.2.3 Basis

BIM models from the preliminary project are made available for future use. These are designed with respect to requirements from SIMBA 1.3, which is now replaced with SIMBA 2.0. Requirements for model structure is changed and it is therefore necessary with adaptations of models from the preliminary project if the suppliers should choose to use these models directly.

Models made of the existing facility are simplified and partly based on scan data and partly on old drawings of parts not accessible for scan. Modelling is done with idealised objects (i.e. straight walls, slabs etc.) and include assumptions, entailing that BIM models of existing building parts are inaccurate in various locations. Suppliers must therefore be prepared to use scan data, possibly supplemented with site measurements, as basis material for design operations that require high detail level of existing building parts.

1.3 Information, Attributes and Parameters

BIM models must be as the main information communication vessel in the project. This section describes some of the important requirements for important information, attributes and parameters in the project.

Model Maturity Index (MMI)

Model Maturity Index (MMI) must 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.

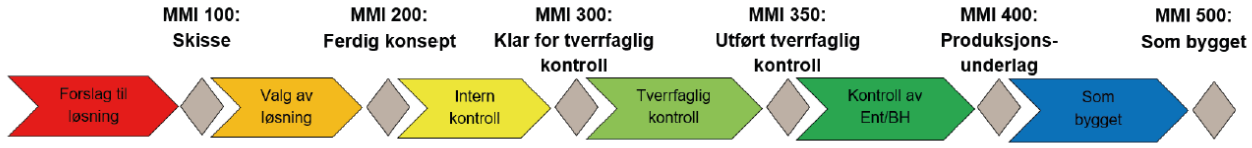

Figure 1 – Process for MMI from EBA

MMI delivery specifications must be connected to the work time schedule for design and construction.

MMI is used for continuous reporting of status and must therefore always be updated before publishing of models.

Publishing and Revisions

All BIM objects shall be marked with the date for the first time it is published with status MMI400 – For Construction.

Revision dates must be marked on an object level for all revisions of objects after they have reached MMI400.

Interdisciplinary Tag System in BIM

The interdisciplinary tag system TFM shall be used in the BIM models. All BIM objects representing a built object shall have a TFM tag. System and component structure is essential in the systematic completion and DFO software.

It is required to use TFM based on the Norwegian standard NS 3457-7, adapted to the project.

All disciplines must tag BIM-objects with TFM on code structure level 0 (one concatenated string) and Level 2 (separate parameters). Description of levels and code structure for TFM in BIM can be found in the Norwegian standard NS 8360-2.

The computer software dRofus is required as the TFM master for all disciplines and objects in the project. Suppliers must themselves have the competence for system generation and synchronisation between dRofus and BIM.

Product Type Coding (GTIN)

It is required with Global Trade Item Numbers (GTIN) for products purchased in the detail design phase. GTIN is a tag system that secures the identification of products against BIM objects. GTIN is required as part of the searchable information in product documentation.

This must be fulfilled by EITHER:

- Directly, by populating GTIN as a parameter on the BIM objects.
- Indirectly, by including a permalink to a database (i.e. coBuilder) holding GTIN (and documentation for the retail product it represents).
- Indirectly, by using a unique TFM string as a lookup key-variable to a “location” (i.e. database) holding GTIN or a permalink to the documentation.

Figure 2 - Example of Product Type Coding, GTIN

Room information

Development of room information and functions are a part of detail design. In addition to room function number (NO: Romfunksjonsnummer), numbers and names according to NTNU’s system must be added to the room objects (IfcSpace) in the BIM models.

Room objects must also be classified according to “Guidelines for classification of area types at NTNU” (NO: “Retningsllinjer for klassifisering av arealtyper ved NTNU”). This is a 4-level classification based on the Norwegian standard NS 3457-4 «Classification of construction works - Part 4: Spatial functions”. Specification for naming of attributes and parameters for the classification are found in the machine validatable requirement sets.

Requirements for the spatial extent of the room objects:

-
- The spatial extent of the room object must correspond with the net area of the room/function.
- For open areas with multiple functions (i.e. office landscape with reception, workstation functions, office support areas, social zones etc.) one space object (IfcSpace) must be created for each function, where the area of each space object covers the intended

function. The sum of all space objects of the open area shall correspond with the net area of the open space.
- Height of the space objects must correspond to the span between the upper edge of the lower constructive slab to the lower edge of the upper constructive slab for floor level connected to a space object.

1.3.1 BIM and building permit applications

BIM is to be used as a part of the building permit application to the local municipality. BIM models that are a part of the building permit application must be configured as a separate exports corresponding with the requirements of the local municipality. BIM models attached to the building permit application **cannot** contain information that is confidential.

The BIM model requirements from the local municipality is found in the document "P13 – ebyggesak" online here: https://test-bimvalbygg.dibk.no/Home/PdfActionResult.

Models for building permit application will be required in different requirement forms and stages: (NO: rammesøknad, søknad om igangsettelse og midlertidig brukstillatelse/ferdigattest).

1.4 Project Setup

The following stipulates the basic setup for model files to ease cooperation and model workflow in the project. Further project specific guidelines for model setup are created in connection with the start-up meeting for BIM and are to be rooted in the BIM Execution Plan. Other requirements from SIMBA 2.0 applies in addition to the following.

1.4.1 Naming of Files

The scheme for naming of files is to be agreed upon in the beginning of design and must be approved by Statsbygg.

1.4.2 Co-ordinate and height reference systems

For all absolute map references the following coordinate system must be used:

Co-ordinate system: EUREF89 NTM Sone 10
Height system: NN2000
EPSG code: 5950

1.4.3 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:

Table 1: Co-ordinates for project zero, Tyholt

Description	Absolute co-ordinates, NTM10, NN2000 (m)			Local co-ordinates (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:

Table 2: Co-coordinates for project zero, Heggdalen

Description	Absolute co-ordinates, NTM10, NN2000 (m)			Local co-ordinates (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	Ingen

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.

1.4.4 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.

1.4.5 MMI control zones

The project has created the following MMI control zones, used for reporting.

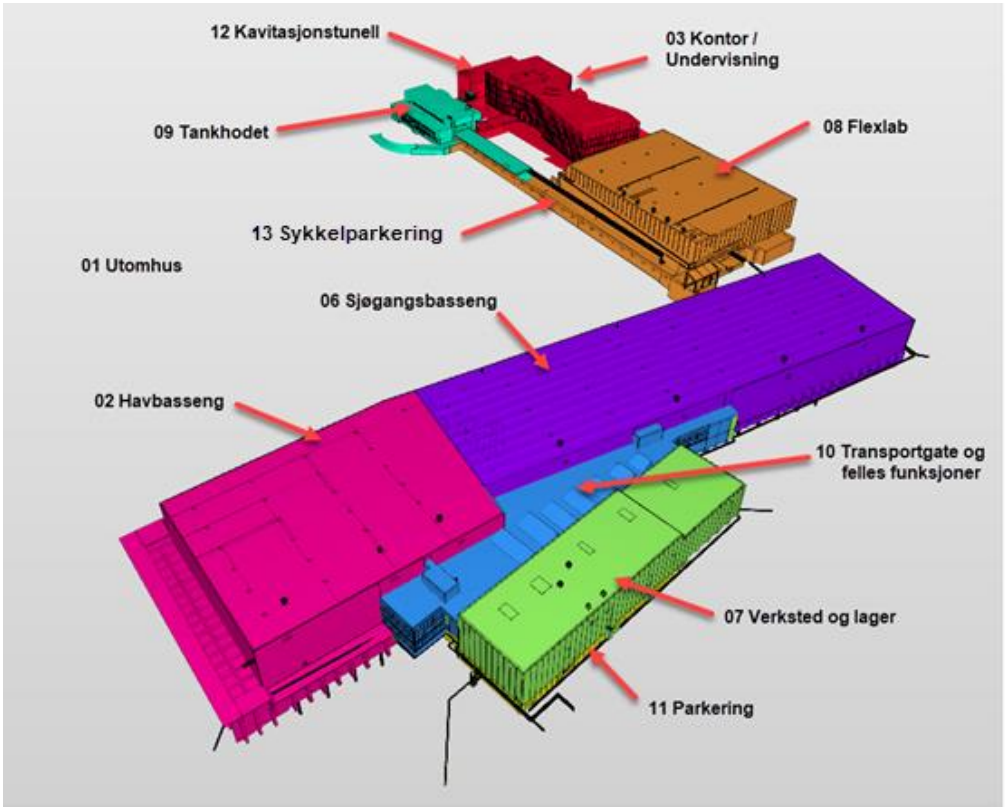

Figure 3: MMI control zones

The table below describes the values as they are to be used in BIM models:

Table 3: MMI control zones, description

Description
01 Utomhus
02 Havbasseng
03 Kontor / Undervisning
~~04 K-Lab~~ (deprecated)
~~05 M-Lab~~ (deprecated)
06 Sjøgangsbasseng
07 Verksted og lager
08 Flexlab
09 Tankhodet
10 Transportgate og fellesfunksjoner
11 Parkering
12 Kavitasjonstunell
13 Sykkelparkering

1.4.6 Building numbers

Building numbers are to be used in correspondence with the project's standard:

Table 4: Area/building codes

Location	Area/building code	Area/Building Name	Area/Building Name [Norwegian term]
Tyholt	6000	Outdoor Area and Plants	Uteareal og -anlegg
	6010	The New Building (A)	Nybygget (A)
	6020	Flexlab (C)	Flexlab (C)
	6030	Wet Labs (B)	Våte Laboratorier (B)
	6040	Bike Parking	Sykkelparkering
	6050	Tank Head	Tankhodet
	6400	Cavitation lab	Kavitasjonstanken
	6381	Towing tank, existing	Slepetank, eksisterende

1.4.7 Attributes and parameters in the project

Requirements for attributes and parameters for the main building disciplines are created on the machine-readable format mvdXML for the most common IFC entities. If other entities are used or the machine-readable requirements are not applicable for the discipline, attributes and parameters must be according to specification in the document “OSC-SB-Å-SD-00001 General attributes and properties in BIM models”.

1.5 Requirements for Process and Execution with BIM

1.5.1 Interdisciplinary Control

All building 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 at MMI 300. 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.

1.5.2 Start-Up Meting 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.

1.5.3 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.

1.5.4 Key Performance Indicators, KPI

A tool for better control and continuous improvement 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

1.5.5 Green BIM

Ocean Space Centre has ambitious goals for environmentally friendly solutions. 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.

1.6 Drawings

There shall always be consistency between drawings and BIM model

Drawings are made in accordance with the specification "PA 0603 2D DAK tegninger".

Numbering and file names shall be used according to the project's standard.

1.7 As-Built Models

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. The supplier is responsible for ensuring that the as-built BIM models is in accordance with the completed building.

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

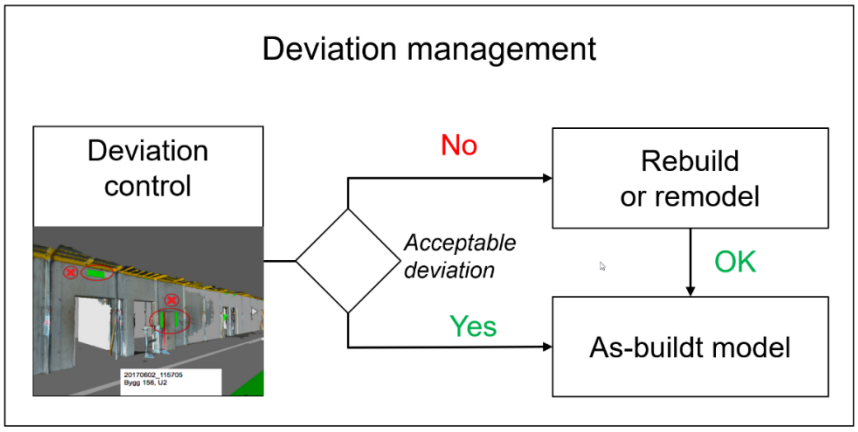

Figure 4: Workflow for BIM objects from as-designed to as-built

2 References

The following references is used in this document.

Project specific references:

- OSC-80-SB-Å-SD-00002 BIM Requirements for Special Equipment
- OSC-80-SB-Å-SD-00001 General attributes and properties in BIM models
- OSC-80-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's design regulations (Norwegian only) https://www.statsbygg.no/publikasjoner:
    - PA 0603 2D DAK-tegninger
- Norwegian standards:
    - NS 3457-4:2015 Classification of construction works - Part 4: Spatial functions
    - NS 3457-7:2021 Classification of construction works - Part 7: Identification in digital models and for labeling in built facilities
    - NS 8360-1:2021 BIM objects for construction works — Part 1: Model practice, naming, type encoding and properties
    - NS 8360-2:2021 BIM objects for construction works — Part 2: Properties for identification in digital models and marking in construction works