GOOD COLLABORATIVE PRACTICE

Document to Accompany the
Luxembourg BIM Application Guide

1 Introduction

This document which accompanies the Luxembourg BIM Application Guide summarises collaborative practice in line with BIM methodology. This good practice is to be adopted to ensure that projects run smoothly and for each project phase: Programming, Basic Pre-Project, Detailed Pre-Project, Authorisation and Approval Procedures Dossier, Final Project, Contract Tendering and Awarding Dossier, General Management and Project Acceptance, Final Dossier and Facility Management.

The good practice for each phase is set out as follows:

- **Objectives and deliverables:** this section describes the phase's purpose in terms of expected deliverables.
- **Processes to be put in place**: this section describes how collaborative work is organised using BIM modelling to achieve the expected deliverables. In other words, this section explains "who does what, when and how". Reminder: the GID forms provide a reference which can be used as a basis for the modelling of models.
- **"BIM Management" responsibilities**: this section looks at the specific tasks for which "BIM Management" is generally responsible, and includes the "Information Manager" and "BIM Manager" (please refer to the description of these roles in Chapter 2.2 of the Guide).

All the descriptions given here are an ideal to be achieved in a "shared" context. Given the wide variety of projects, the processes will need to be adapted. None of these recommendations are prescriptive.

2 BIM Good Practice

2.1 Phase 1: Programming

Objective and Deliverables

The objective is to formalise the project's characteristics through a spatial, technical and functional programme. It must be possible to determine an initial provisional budget using this programme.

During this phase, the digital model does not yet exist in its graphical form; however, the programme is nothing more than part of the information which the model will need to contain. Moreover, the properties listed above can be mapped in IFC language. Using this data, the designers are able to begin producing their models in a consistent way because at any given time they have the opportunity of cross-checking the programmed data with the designed data (e.g. programmed surface / drawn surface).

Rigorous programming will enable the owner to check / compare alignment with the objectives at each of the phases which follow.

Processes To Be Put In Place

A/ The owner may be assisted by a "programme manager" to formalise the spatial and technical characteristics of the building which the owner expects to have. They can then create the roombook for the spaces that are to be designed by defining:

- Their names (it is already important that a convention for naming the spaces is created now)
- Their function
- Their dimensions (surface, net height)
- Ambiance data (temperatures, ventilation, lighting, etc.)
- Access to networks (electrical sockets, water connection points, etc.)
- Finishings (walls, floors, ceilings)
- The furnishings and possible equipment (pc, telephone, etc.) to be provided
- Requirements with respect to fire resistance, permissible loads, etc.

B/ Any other architectural, structural or technical requirements associated with specific building work may be added to this generic list depending on what the owner needs.

C/ With regard to the site, it is necessary to gather together information which will be useful for its modelling, including its dimensions and the presence of any element which could impact upon the project (roadways, networks, building structures, etc.). Additional information which is useful for the project (soil studies, current planning regulations, etc.) needs only to be entered into the digital model whenever there are specific simulations.

D/ By formalising the programme, it is possible to generate cost estimates based on surfaces and quantities and so a provisional budget can be produced.

Technically speaking, there are several methods of formalising a roombook in a structured, useable way:

- As an Excel spreadsheet (since certain functionalities allow data to be imported directly from a spreadsheet into BIM modelling software)
- Using dedicated software.

BIM Management Responsabilities

The Information Manager creates the PBB which will be associated with the architectural programme in order to contract with the design and BIM Management teams.

Each BIM Manager, who responds to the invitation to tender, will then create a pre-contract BEP, as recommended in Chapter 3.2 of the Guide.

Once the design teams and BIM Manager have been selected, the BIM Manager finalises the post-contract BEP which has to be kept updated and must be complied with throughout the project. The BIM Manager then includes in the project the architect, technical engineer, structural engineer and any other party involved with it (consultants, etc.). The BIM Manager works with each one on the finer details of the processes, scheduling for the deliverables, the EIRs, etc. so that there is consensus around all of these.

The Information Manager validates the final BEP which is put forward. Should it prove necessary, it will have to be amended.

2.2 Phase 2: Basic Pre-Project

Objective and Delivrables

The objective of the basic pre-project phase is to put forward a response to the programme, initially in the form of a sketch and then by laying down a certain number of elements which will define the project in outline. The expected deliverables are as follows:

- 1:500 ground plan, or smaller, in pdf format
- Various 3D views in a useable format (pdf, jpeg, png, etc.)
- Technical diagrams/schemes
- Basic sketches of plans, cross-sections and facades (scale 1:200) + single-line diagrams/schemes for the networks, in pdf format
- Partitioning plan, in pdf format
- Cost projections (ideally summarised in a spreadsheet)

Processes To Be Put In Place

A/ Working from topographical surveys, the structural engineer creates the model of the project site. As a minimum, the following information must be entered: the dimensions of the land, its topography and the direction in which it is facing, any building structures in the immediate vicinity and which have an impact on the project (shade, noise and light disturbance, etc.). Depending on what is required, it may be useful to add to the model any other element identified as causing restrictions on the site and which should be taken into consideration when it is being designed (roads and networks). However, technical diagrams overlaid onto the model may be sufficient.

B/ The architect creates the model for the building so as to calculate the volumetric aspects and allocate the spaces and openings (doorways, windows, etc.) which represent the proposed building. The architect therefore creates generically the walls, slabs, doors, windows, walkways, etc., without any detail regarding their implementation: all that is important here is their position and size. The architect identifies the spaces which have been created following the nomenclature which has been already defined. The architect's proposal takes into account the programme (the owner's objectives), planning restrictions (access, views, storey height, floor space, total height) and an assessment of its impact on the environment. With the aim of presenting the model, adding graphical elements such as textures and information about furnishings to certain areas means that it can be used to produce different views (ranging from representative views to photo-realistic ones depending on the level of detail added). Another option is to export these views without adding any information to the model and to attach graphics to it a posteriori.

Please note: Whenever a project is part of an existing building, it is necessary to retrieve or create the model of this existing building, so that the new project can then be structured based on this existing building. The level of detail required for the existing building will depend on which studies need to be carried out on it. In all cases, it is important that each existing element is identified as such on the models, so that they are differentiated from anything that is new.

C/ Based on the architectural model and the owner's constraints (in particular permissible loads depending on how the building will be operated) the structural engineer defines the project's structural

concept by creating their own model. The load-bearing elements are identified, as well as the foundations, and are sized appropriately.

PLEASE NOTE: It is important that the architect's model is then frozen to avoid running any risk of making the engineer's work obsolete because it is incompatible with an architectural proposal which in the meantime has changed.

D/ The architect retrieves the information provided by the engineer then updates the architectural model: adding "load bearing" information to any walls which are load-bearing and altering their dimensions. When this information is added it must show up visually on the 2D wall representation on plans (e.g. load-bearing walls are differentiated by highlighting them with a specific colour). Any post-and-beam type load-bearing systems are added to the model, which also includes foundation elements.

E/ The architect adds the "partitioning" information to the walls and doors, based on work shared with the engineers. Spaces belonging to the same compartments are grouped together in the form of "zones". Once again, by using specific colours, information such as this which is added must show up visually on the 2D representation.

F/ Technical data may also be added to the building work to carry out initial simulations, such as for example, outer wall U-value thermal transmittance or a window's shading coefficient. The architect remains in charge of the model when this information is being added, even if the engineers are providing it.

G/ Recommendations from the technical engineer for the main networks and service ducts can be made by simply sending the information about the dimensions or as 2D diagrams which the engineer creates based on views from the 3D model of the building. It is also possible to start working now in 3D to prepare for the next phase; however, this is not a fundamental step since at this stage the expected deliverables are single-line diagrams. The technical engineer also issues an opinion about the project's energy consumption assessment and defines the general criteria which need to be complied with.

H/ The architect amends their model (technical rooms, false ceilings, glazed surfaces, etc.) based on the technical engineer's recommendations.

I/ At the stage now reached, it is possible to export from the model an initial, consistent statement showing the surfaces and volumes of the designed building. (It is already possible now to export the early stages of the designed spaces' roombook and compare its information with that of the programmed spaces' roombook).

J/ Based on this information, and using an appropriate calculation method (price ratios/surface), each member of the project management team can calculate cost projections for the construction and maintenance of the particular section of the building work for which they are responsible.

BIM Management Responsabilities

The Information Manager checks the information provided and that it complies with the BEP. This means that the Information Manager can guarantee the owner that the information requested has been duly provided.

The BIM Manager updates the BEP to include any change decided upon by consensus and which involves altering the BEP (actors, EIRs, etc.). The BIM Manager runs the BIM coordination meetings, evaluates the processes, makes any comments needed and validates the deliverables at each milestone. Accordingly, the BIM Manager makes sure that the information to be provided complies with the owner's expectations. As part of this monitoring, the specific tasks which are the BIM Manager's particular responsibility are checking the model and sending out comments via BCF.

2.3 Phase 3: Pre-project

Objective and Deliverables

The objective of this detailed pre-project phase is to finalise the architectural response so that it can be submitted for various authorisations and be sent to the owner for approval. The design team develops the models to the point that the different views produced (whether these are 2D scale drawings or 3D views) represent what the project will actually be like. The expected deliverables are as follows:

- Plans, cross-sections and facades (scale 1:100) + structure and network plans in pdf format
- Partitioning plan in pdf format
- Various 3D views in a useable format (pdf, jpeg, png, etc.)
- Simulations
- Cost estimates
- Roombook (designed spaces)

Processes To Be Put In Place

A/ If this has not already been done, the structural engineer models the site to be able to stop using the 2D background plans and to incorporate modifications arising from the project. For example, if roadways have to be created (or a watercourse), this could be incorporated into the model to generate the plans which will be needed for the corresponding planning application (please refer to the next phase). Achieving a great level of detail is unnecessary; by using the correct dimensions a sufficiently representative visualisation of the project can be obtained.

B/ The architect adds/completes details for implementing the building such as:

- the composition of the walls, slabs, roofing etc., including finishings, cavity spaces, service ducts and where joinery will be installed, etc.
- design for the staircases, lifts, etc.
- design for the furnishings

C/ The technical engineer specifies the modelling for the various networks, in particular where equipment is to be positioned, the designs for the ducts with their correct sizing and the design for the various connections, etc. Consequently, the technical engineer no longer designs schematic diagrams but instead creates a completely separate technical model. Potential problems of interaction can be identified by overlaying the architectural model and the technical model (BIM Use: “Clash prevention”) so that these problems can be solved.

D/ The structural engineer places on their model implementation details from their surveys, while at the same time checking the structural system’s overall compatibility with the architectural proposal AND the technical proposal, which is also done by overlaying models.

E/ Consequently, each of the models must also:

- Contain information which makes it possible to evaluate the project in terms of its performance (technical information) and its management (scope of the cost, availability, lifespan, etc.)
- Be associated with the relevant reference documents, in particular photos and technical data sheets.

F/ As far as safety is concerned, the objective is to produce an outline plan with partitioning (data normally defined in the detailed pre-project phase) and the positioning of smoke extraction systems, sprinklers and fire hose cabinets. These elements may also be added:

- As the room's parameters, and then this information must appear on the plan.
- As objects which may then be modelled and placed in an approximate fashion and associated with the data produced to manage them.

G/ Consequently, when the Roombook gets updated it will incorporate all the various data attributed to the spaces and building work designed in each of the models. The challenge is to be able to compare this version with the one produced in the programming phase in order to check that there has been full compliance with the requirements. As a reminder here is a consistent, but non-exhaustive, list of the data which comprises the Roombook:

- Finishings for the walls, floors and ceilings
- Fire resistance for the walls, floors, ceilings
- Fire resistance and smoke control for the doors
- Permissible load for the slab
- Room net height
- Stipulated temperatures
- Humidity
- Stipulated ventilation
- Lighting
- Number of electrical, telephone, data sockets, etc.
- …

H/ The extent to which the models have now been developed means that a realistic statement can be exported of the designed building's surfaces and volumes as well as the building work, and selected equipment and furnishings. Based on this information, more accurate bills of quantities and estimates can be put forward to be fed into the project's cost calculations. Simulations not carried out during the basic pre-project phase because the information was missing then can now be done in this detailed pre-project phase since the model has become much more accurate. If some parameters are missing, they must be added. Given the current accuracy of the model, it is also possible to generate more realistic presentation models. Cost effectiveness studies are based on operating alternative solutions, which must be managed with the same level of detail as defined previously.

BIM Management Responsibilities

The Information Manager checks the information provided and that it complies with the BEP. This means that the Information Manager can guarantee the owner that the information requested has been duly provided.

The BIM Manager updates the BEP to include any change decided upon by consensus and which involves altering the BEP (actors, EIRs, etc.). The BIM Manager runs the BIM coordination meetings, evaluates the processes, makes any comments needed and validates the deliverables at each milestone. Accordingly, the BIM Manager ensures that the information which has to be provided complies with the owner's expectations. As part of this monitoring, the specific tasks which are the BIM Manager's particular responsibility are checking the model and sending out comments via BCF.

A particular challenge here is to plan ahead for future controls during the approvals procedures phase by setting up “automatic checking rules” on the models (e.g. checking the height of all the railings). Doing this now helps to gain time by avoiding approvals procedures that take too long because of errors occurring.

2.4 Phase 4: Autorisation and Approval Procedures Dossier

Objectives and Deliverables

At the end of the detailed pre-project phase, the coordinated models and the deliverables generated contain (in theory) all the information necessary for submitting the various applications for authorisations and to request the owner's approval. This includes Law Commodo-Incommodo authorisations based on safety plans and the Energy Performance Certificate based on thermal simulations, which are derived from the different characteristics of the building and the materials.

IF, depending on the project, the detailed pre-project phase has been completed but the GID levels have still not achieved the requisite "threshold", then it is time to complete them.

Processes To Be Put In Place

The detailed pre-project phase processes need to be repeated so that any missing data required for the authorisation procedures is filled in.

The architect sends the deliverables which have been requested to the bodies concerned.

BIM Management Responsibilities

These are the same as for the previous phase.

2.5 Phase 5: Final Project

Objective and Deliverables

At this stage the models should only contain elements which comply with the expectations and prescriptions relating to future construction so that submission plans can be generated for each party involved “such that the execution can be carried out in accordance with these plans”. This means that beforehand, any information not known in the detailed pre-contract has now been filled in and that all the choices have been validated in the authorisations phase.

The deliverables are the same as for the detailed pre-contract phase, but on a larger scale, and are supplemented by:

- Cavity plans
- Layout plans
- False-ceiling plans
- Details (1:10 / 1:20)
- Workshop or pre-fabrication plans

Processes To Be Put In Place

A/ The models are combined so that:

- The technical engineer checks and produces cavity plans for the building work
- The structural engineer checks the openings and their static impact

Should specific details be requested, the team concerned may update the model by adding

2D drawings to the various views, or by using specific 3D modelling if this is deemed useful.

B/ The architect draws up the final plans by incorporating data from the engineers. The architect adds details to the model of the false ceilings (2D drawing showing how the sheets will be cut + basic 3D modelling of the structure to avoid any overlaying problems with the technical team) and details of the tiling (2D layout drawing) to produce the corresponding plans.

C/ Integrating the models provides an overall view of the project for each party involved and a way of checking for any final inconsistencies and, if necessary, altering the models to take account of these. If inspection organizations, accredited bodies and the health and safety inspectorate can have access to the models, this will ensure that they are able to properly visualise the project.

BIM Management Responsibilities

The Information Manager checks the information provided and that it complies with the BEP. This means that the Information Manager can guarantee the owner that the information requested has been duly provided.

The BIM Manager updates the BEP to include any change decided upon by consensus and which involves altering the BEP (actors, EIRs, etc.). The BIM Manager runs the BIM coordination meetings, evaluates the processes, makes any comments needed and validates the deliverables at each milestone. Accordingly, the BIM Manager ensures that the information which has to be provided complies with the owner’s expectations. As part of this monitoring, the specific tasks which are the BIM Manager’s particular responsibility are checking the model and sending out comments via BCF.

2.6 Phase 6 : Contract Tendering and Awarding Dossier

Objective and Deliverables

The models such as they were completed in the "Final Project" phase contain all the information required for generating the documents for submission dossiers, calls to tender, negotiated contracts (plans, framework schedule, quotes).

During the submission phase, as in the Final Project phase, the model's elements have recommended elements with characteristics to be achieved. To guarantee that calls to tender are fair and unbiased, under no circumstances should there be any reference to existing products (no product or brand name).

PLEASE NOTE: The proposals put forward by companies do not involve any alteration being made to the models during this phase. However, if subsequently they are modified and this is part of the companies' work (whether by producing plans or simply providing BIM objects), these companies must guarantee when submitting their tenders that they have the relevant expertise to do this.

Processes To Be Put In Place

A/ The architect and engineers work together to coordinate the drawing up of specifications. Supervised by the BIM Manager (and with their support) if necessary, they update their respective models so that they can manage the deliverables required. The processes for producing, exchanging and coordinating models remain the same as during the detailed pre-contract and Final Project phases.

B/ Assisted by the engineers, the architect produces the construction site planning schedule which is sent out as part of the call for tender process. If this has been agreed (Use 13), by associating the phases from this planning schedule with the elements in the digital models, the engineers and architect can build a virtual simulation for the construction site in both time and space ("4D") to structure what will happen when on the site.

C/ The architect and engineers work together to coordinate the drawing up of a detailed quotation for the project, working from the bills of quantities extracted from the digital models. They can then adopt a so-called "5D" approach by associating the costs with the designed building work. They will then be able to compare their quotation with those received from the various tenderers.

BIM Management Responsibilities

These are the same as for the previous phase.

The BIM Manager may also be entrusted with the task of "4D planning".

Please note: companies which have to be "BIM-ready" must guarantee that they have BIM expertise, especially if they are then asked to produce AS-BUILT models.

2.7 Phase 7: General Management and Project Acceptance _ Preparatory Phase

Objective and Deliverables

For the construction site phase, the digital model is fine-tuned so that it changes from being a building model such as has been prescribed and becomes a model such as can be built by asking everyone to collaborate:

- Owner
- Project management team
- Pilot coordinator
- Health and safety coordinator
- Companies awarded the tenders
- Facility Manager
- And any other party involved in the project.

The deliverables which have to be generated are the execution plans, the construction site installation plans, the site schedules and any other document which can be used to run the construction site.

Processes To Be Put In Place

A/ When the execution models are produced, the exchange processes follow the same arrangements as the project management team's exchanges when the project was being designed: the project management team's models are used as a basis from which the companies can work, but they are not altered by the companies directly. If the companies work with BIM software, then the model created will be used to generate execution documents and to produce the AS-BUILT model. If need be, the plans and other documents produced can be used by the project management team to update the corresponding models. In both cases, any model produced must comply with the level of information requirement specified by the owner for delivering the AS-BUILT model.

B/ The schedule is fine-tuned after the tenders have been awarded, and once the companies have been incorporated into the project and the dates when they start work can be included. If a 4D model has been created, it is now made more accurate.

C/ The cost estimates which have been extracted can also be made more accurate by including the detailed quotations received from the companies.

BIM Management Responsibilities

These are the same as for the previous phase.

2.8 Phase 8 : General Management and Project Acceptance _ Construction Site

Objective and Deliverables

In terms of organisation and responsibilities, this phase follows on absolutely from the previous one. However, the more the previous phase was able to forward plan for any potential problems arising on the construction site, the less actual work on the site will impact on the updating of models.

Processes To Be Put In Place

A/ The companies must share information in the CDE about how to use their respective building work (installation date, warranty dates, technical data sheets, maintenance manuals, etc.).

B/ It may occasionally be a good idea to give further details of the models to illustrate specific details of how the building work is to be implemented (according to what is needed).

BIM Management Responsibilities

These are the same as for the previous phase.

2.9 Phase 9: Final Dossier

Objective and Deliverables

In this phase, the digital model and its associated deliverables are delivered to the owner, in compliance with the owner's requirements. The project management team or companies are responsible for updating the information (models and others deliverables) to comply with the owner's requirements.

The deliverables which have to be generated are the plans and any other documentation required to produce the AS-BUILT dossier.

Processes To Be Put In Place

In accordance with what has been described for both construction site phases, the project management team and the companies must jointly, and according to their responsibilities, set down out in the contracts:

- Update any models which have not yet been updated
- Share information in the CDE about how to use their respective building work (installation date, warranty dates, technical data sheets, maintenance manuals, etc.)

BIM Management Responsibilities

The BIM Manager is responsible for approving the information (models and other deliverables) before they are delivered, and does this while taking into consideration the delivery requirements and acceptance criteria which contractually bind the owner and the design / construction teams. This way, the project management team can avoid being exposed to the owner's refusal to accept delivery of the project (via the Information Manager's verifications).

If applicable, the Information Manager may consider that the information provided does not comply and request that the necessary adjustments are made.

2.10 Phase 10 : Facility Management

Objective and Deliverables

The project information model now becomes the asset information model: all the information provided during the previous phase is now going to be used to manage the building (asset) and will consequently get updated. The parties involved are:

- The project management team
- The Facility Manager
- The teams who carry out the maintenance
- Any new design / execution team which will be involved whenever changes are made to the project

Processes To Be Put In Place

A/ The Facility Manager uses the models and other project deliverables as input, so that they can set up their CMMS system.

B/ The maintenance teams provide the Facility Manager with the information needed to update the CMMS, and this happens after each piece of work that requires it.

C/ Should there be any major alterations to the building (e.g. space needs to be re-divided, equipment has to be changed), the Facility Manager, or the team in charge of this work, must update the building model (depending on the contractual context).