BIM

Muster - AIA

Verein zur Förderung von Ingenieurmethoden im Brandschutz

Integration of fire safety design into the overall planning process with Building Information Modeling

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1 Introduction

The ongoing restructuring of planning methods in Germany to digital information systems such as Building Information Modeling (BIM) will make it essential to advance further development with the BIM method in the field of fire safety design as well.

The high degree of work sharing in the construction planning process requires a large amount of planning information to be exchanged within a short time. Missing, incorrect or incompletely exchanged information may lead to planning errors. [16] If detected early, these planning errors lead to time delays. If not detected in time, high additional costs and long deadline overruns occur. In large projects, fire safety is often seen as the cause of those costs and deadline violations. [13]

In addition to the loss-free exchange of information, it is also necessary to increase the transparency of the overall planning process, especially for the concerns of structural fire protection measures. The planning method BIM shows promising opportunities to meet these growing requirements. [16] The use of digital information systems such as BIM allows the overall planning process to be implemented more efficiently and with greater visual attractiveness.

1.1 Objective and content of the Muster - AIA

The present Muster-**A**uftraggeber-**I**nformations**a**nforderung (Muster - AIA) serves to integrate fire safety planning into the overall planning process with BIM.

AIA refers to the information needs of the client, which are described as a requirement for the contractor. The **A**uftraggeber-**I**nformations**a**nforderung answers the questions at which moment, in which geometrical and alphanumerical level of detail, in which format, for which BIM use case and by which planner the required information has to be provided to achieve the client's objectives. [08]

The Verband Beratender Ingenieure states that the question "Why is what information needed when?" must be answered exhaustively in the AIA. The emphasis is on the definition of objectives and framework conditions and less on their technical implementation. [19]

2 Muster - AIA „BIM and fire safety design“

With the introduction of the BIM planning method, the planning effort is shifted forward (MacLeamy effect). However, this shift is in conflict with the currently applicable scopes of work. This also affects the scope of fire safety design. It may be necessary in the future to reorganize scopes for fire safety design due to the effects of BIM. However, a reorganisation of AHO is not possible without further effects on the rest of the planning process as well as the rewards and will require intensive work and expertise, which should be based in particular on - currently still missing - experience from a broad application of BIM for fire safety design.

In order to quickly standardize the BIM in fire safety design, especially in planning phases 1 to 4, this Muster-AIA is intended to supplement the scope of fire safety design according to AHO issue 17 [01] with the newly arising BIM tasks.

The following table summarizes the inputs to the particular model required in the context of fire safety design and lists the issues that are usually dealt with in fire safety as a contribution to the pre-project phase and the design and approval phase. Corresponding to the following description, attributes or components, divided into a building level, a room / compartment level, a building element level or fire protection objects, are provided by the respective expert planners. In the further progress of planning, these features are provided with the corresponding fire safety related information or values.

For project-specific fire safety design using the BIM method, coordination of review cycles, model modifications and milestones among the project participants is essential to guarantee objective-based cooperation. Furthermore, the planning process sequences must be defined in a BIM execution plan (BEP).

Information requests, tasks and objectives of the stakeholders have to be mapped in advance in previously defined milestones. The defined milestones must be used to generate model statuses throughout the project. The generated model statuses form a reliable basis for the participants for the further planning process (see also the section 3.6 and section 3.7).

The present information documents the current state of knowledge of the practical application as well as reasonable interfaces within the overall planning process. With reference to the specialist publication AHO issue 17 [01], these are additional tasks that are not (yet) included in the scope of tasks there and must therefore be considered in a supplementary charge agreement.

Lfd.-Nr.	Topics	Phase Modell	
		Pre-project	**Draft and approval**
		LOD 100/200, Lph 1 - 2	LOD 200/300, Lph 3 - 4
1	**Areas for fire brigade**	**Building level** Basic requirement of fire brigade access roads, fire brigade ring roads and fire brigade areas	**Room / compartment level (here: Outdoor facilities)** Entry of areas for the fire brigade in the outdoor facilities planning model (e.g. area, location) **Fire protection objects** Entry of the accessibility of the property and building (e.g. access roads, building access, fire brigade key depot)
2	**Fire-fighting water supply**	**Building level or room / compartment level (here: Fire compartment)** Determination of the amount of fire-fighting water required (quantity), identification of possibilities for covering any shortfalls.	**Fire protection objects** Entry of facilities for fire-fighting water supply (e.g. fire-fighting water tapping points and their capacity)
3	**Fire-fighting water retention**	**Building level or room / compartment level** Determination of general requirement; if necessary, required fire-fighting water retention volume	**Building element level** Entry of possibly required ground sills, door sills **Fire protection objects** Entry of fire-fighting water retention facilities (e.g. volume of retention, dimensions and location of mobile barriers)

Lfd.-Nr.	Topics	Phase Modell	
		Pre-project	**Draft and approval**
		LOD 100/200, Lph 1 - 2	LOD 200/300, Lph 3 - 4
4	**System of external and internal compartmentation**	**Building level** Determination of required distances or boundary walls of buildings (external separation) Determination of required structural fire resistance of loadbearing structures (if necessary also on room / compartment level) **Room / compartment level** Attributes with values for rooms: BS_Brandabschnitt (1/2/…) BS_Nutzungseinheit (1/2/…) BS_Raum_besondere_Brandgefahr (ja/nein) BS_Änderung (KW/yyyy)	**Room / compartment level** Attributes with values for rooms: BS_Raum (Schacht) BS_Änderung (KW/yyyy) **Building element level** Detailed entry of the room enclosure (now also due to the utilisation of the room) for all room-enclosing fire rated building elements, not: fire dampers and bulkheads. Attributes with values for walls: BS_Feuerwiderstand (rd/fh/hfh/fb/fb-m/bw) BS_Baustoffklasse (nbr/sfl/nfl/br) BS_Änderung (KW/yyyy) ceilings or roof in front of rising facades: BS_Feuerwiderstand (fh/hfh/fb) BS_Baustoffklasse (nbr/sfl/nfl/br) BS_Änderung (KW/yyyy) columns (if in space-enclosing wall): BS_Feuerwiderstand (rd/fh/hfh/fb/fb-m/bw) BS_Baustoffklasse (nbr/sfl/nfl/br) BS_Änderung (KW/yyyy) balustrades: BS_Feuerwiderstand (rd/fh/hfh/fb/fb-m/bw) BS_Baustoffklasse (nbr/sfl/nfl/br) BS_Änderung (KW/yyyy)

Lfd.-Nr.	Topics	Phase Modell	
		Pre-project	Draft and approval
		LOD 100/200, Lph 1 - 2	LOD 200/300, Lph 3 - 4
			doors: BS_Tür_Brand (fh/hfh/fb) BS_Tür_Rauch (d/rd) BS_Tür_Schließ (ja/nein) BS_Tür_Breite (> 0,0 m) BS_Änderung (KW/yyyy) portals: BS_Tor_Brand (fh/hfh/fb) BS_Tor_Rauch (d/rd) BS_Tor_Schließ (ja/nein) BS_Tor_Breite (> 0,0 m) BS_Änderung (KW/yyyy) Glasswork: BS_Feuerwiderstand (fh/hfh/fb) BS_Strahlungsdurchgang (ja/nein) BS_Änderung (KW/yyyy)
5	**means of escape**	**Building level** General determination of the allocation and width of necessary stairwells and necessary corridors (including the need for sluices or anterooms) as well as main corridors if required Coarse check of the permissible escape route lengths, required number of exits and required widths **Room / compartment level** Attributes with values for rooms: BS_Raum (SiTr/nTr/nFl/Schleuse/Vorraum) BS_Änderung (KW/yyyy)	**Room / compartment level** Proof of the escape lengths and route widths. Specification of the requirements regarding the flammability of building materials. Attributes with values for rooms: BS_Wandbekleidung_Baustoffklasse (nbr/sfl/nfl/br) BS_Bodenbelag_Baustoffklasse (nbr/sfl/nfl/br) BS_Unterdecken_Baustoffklasse (nbr/sfl/nfl/br) BS_Systemböden_Baustoffklasse (nbr/sfl/nfl/br) BS_Sicherheitsbeleuchtung (ja/nein) BS_Änderung (KW/yyyy)

Lfd.-Nr.	Topics	Phase Modell	
		Pre-project	Draft and approval
		LOD 100/200, Lph 1 - 2	LOD 200/300, Lph 3 - 4
			Building element level Detaillierte Eintragung des Raumabschlusses (nun auch aufgrund der Raumnutzung) für alle raumabschließenden brandschutztechnisch qualifizierten Bauteile. Ebenfalls Eintragungen brandschutzrelevanter Anforderungen von Fluchtwegtüren und (Sicherheits-)beleuchtung. Attributes with values for room-enclosing building elements: see Lfd.-Nr. 4 Attributes with values for escape route doors: BS_Fluchttür_Anforderungen (Panik/AutSchRL/ elekr. Verriegelung) BS_Änderung (KW/yyyy) **Fire protection objects** Entry of escape routes (e.g. location and direction of 1st and 2nd escape route, walking line etc.)
6	**Maximum permitted number of occupants; occupancy-specific building design**	**Building level** Determination of maximum number of occupants, special requirements for evacuation in case of fire	**Room / compartment level** Determination of the maximum number of occupants (if necessary, for various utilization cases) Attributes with values for occupants: BS_Nutzerzahl (> 0) BS_Änderung (KW/yyyy)

Lfd.-Nr.	Topics	Phase Modell	
		Pre-project	Draft and approval
		LOD 100/200, Lph 1 - 2	LOD 200/300, Lph 3 - 4
7	**building technical systems**	**Building level** Coordination of location and placement of building automation central units; general requirements and reference to relevant building regulations; reference to MLAR	**Room / compartment level** Entry of the material requirements for building automation central units, electrical equipment rooms Attributes with values for rooms: see Lfd.-Nr. 5 **Building element level** Entry of the requirements for the building automation central units and electrical equipment rooms on the respective building elements (e.g. walls, ceilings, doors) Attributes with values for room-enclosing building elements: see Lfd.-Nr. 4 **Fire protection objects** Entry of voltages for electrical equipment rooms (e.g. for fire brigade plans)

Lfd.-Nr.	Topics	Phase Modell	
		Pre-project	**Draft and approval**
		LOD 100/200, Lph 1 - 2	LOD 200/300, Lph 3 - 4
8	**Elevator**	**Building level** Coordination of position and placement of elevators; general requirements and reference to relevant building regulations; reference to MLAR	**Room / compartment level** Entry of the requirements for the elevator shaft. Attributes with values for elevator shaft: BS_Lüftungsöffnung (≥ 0,1 m²) BS_Anzahl_Aufzüge (≤ 3 St) BS_Raum (FwAZ) BS_Änderung (KW/yyyy) **Building element level** Entry of the requirements for elevators and elevator shafts on the respective building elements (e.g. walls, ceilings, doors) Attributes with values for room-enclosing building elements: see Lfd.-Nr. 4
9	**Ventilation system**	**Room / compartment level** Entry ventilation stations with reference to M-LüAR Attributes with values for rooms: BS_Raum (LüZ) BS_Änderung (KW/yyyy)	**Room / compartment level** Entry of the material requirements for ventilation stations Attributes with values for rooms: see Lfd.-Nr. 5 **Building element level** Entry of the requirements for ventilation stations on the respective building elements (e.g. walls, ceilings, doors); not: Fire dampers and pipes with fire resistance

Lfd.-Nr.	Topics	Phase Modell	
		Pre-project	**Draft and approval**
		LOD 100/200, Lph 1 - 2	LOD 200/300, Lph 3 - 4
			Attributes with values for room-enclosing building elements: see Lfd.-Nr. 4
10	**Smoke and heat exhaust**	**Room / compartment level** Requirement for smoke and heat exhaust measures, definition of dimensioning principles Attributes with values for rooms:: BS_Raum_Rauch-/Wärmeabzug (ja/nein) BS_Änderung (KW/yyyy)	**Room / compartment level** Entry of requirements for natural or mechanical smoke and heat exhaust systems with regard to location, placement and dimensioning Attributes with values for: MRA (mechanical smoke exhaust): BS_Volumenstrom (> 0,0 m³/h) NRA (natural smoke exhaust): BS_Öffnungsfläche_geo (> 0,0 m²) BS_Öffnungsfläche_Aw (> 0,0 m²) Air supply: BS_Nachströmung (> 0,0 m²) BS_Änderung (KW/yyyy) **Fire protection objects** Entry of the devices with their position and required performance criteria (opening areas, volume flows or air exchange rates), other components of the system such as activation points

Lfd.-Nr.	Topics	Phase Modell	
		Pre-project	**Draft and approval**
		LOD 100/200, Lph 1 - 2	LOD 200/300, Lph 3 - 4
			Attributes with values for: NRA (natural smoke exhaust): BS_Geräteanforderung (Mindestwerte nach MVVTB/ sonstige Einzelwerte für Re, SL, T, WL, B) BS_Auslösung (a/b/c/d nach DIN EN 12101), BS_Änderung (KW/yyyy) MRA (mechanical smoke exhaust): BS_Geräteanforderung (Mindestwerte nach MVVTB/ sonstige Einzelwerte für Temperaturbeständigkeit) BS_Änderung (KW/yyyy)
11	**Fire alarm systems**	**Building level** General requirement of alarm systems, type of alarm (speech, light, signal tone)	**Room / compartment level or Fire protection objects** Entry of the type of alarm system. BS_Alarmierung (Sprache, Leuchte, Signalton) BS_Änderung (KW/yyyy) **Fire protection objects** Entry of the speaking station.

Lfd.-Nr.	Topics	Phase Modell	
		Pre-project	**Draft and approval**
		LOD 100/200, Lph 1 - 2	LOD 200/300, Lph 3 - 4
12	**Systems and facilities for fire fighting**	**Building level** General requirement of extinguishing systems, wall hydrants, risers or fire extinguishers	**Building level** Definition of allocation and extinguishing agent units Fire extinguishers **Room / compartment level** Definition of areas with automatic fire extinguishing systems BS_Löschanlage (ja/nein/Auslegungsstandard) BS_Änderung (KW/yyyy) **Fire protection objects** Entry of the approximate location and performance criteria of wall hydrants (e.g. type, quantity of fire extinguishing water and design standard DIN 14461-1 or risers with feed and tapping points). Attributs: BS_Wandhydrant (F/S) BS_Änderung (KW/yyyy)
13	**Safety power supply**	**Building level** Requirement of a safety power supply, relevant consumers; design standard (MLAR)	**Building level** Definition of requirements for preservation of functionality **Room / compartment level** see Lfd.-Nr. 7 **Building element level** see Lfd.-Nr. 7

Lfd.-Nr.	Topics	Phase Modell	
		Pre-project	Draft and approval
		LOD 100/200, Lph 1 - 2	LOD 200/300, Lph 3 - 4
14	**Fire detection systems**	**Building level** Basic requirement of fire alarm systems and design standard e.g. DIN 14675	**Building level** Fire indicators, design standard and control functions **Room / compartment level** Definition of areas to be monitored BS_BMA (ja/nein/Auslegungsstandard) BS_Änderung (KW/yyyy) **Fire protection objects** Entry of infrastructure of the fire alarm system (e.g. BMZ, FBF, FAT, FSE, FSK etc.)
15	**Corporate fire prevention measures**		**Building level** Filing of information as a general concept (e.g. what is required, fire protection instructions, fire safety officer, escape and rescue plans, fire brigade plans)

3 Explanations

3.1 Fire safety design

Fire safety design differs from other design disciplines such as structural design or the design of technical building equipment in terms of the degree to which its own design activities are self-contained. While the planning disciplines mentioned above as examples aim at a self-contained design with clarification of the interfaces to other planning disciplines, fire safety design usually only provides the object-specific requirements and design standards to be implemented through other planning disciplines. For example, the requirement for a fire-resistant separation wall is implemented within the architectural model and the requirement for a fire alarm system is implemented within the model for technical building equipment.

The fire safety concept is a central component of fire safety design and an important building document in the approval process. It contains the identified relevant legal bases and the essential requirements of fire protection under building law as well as the planning objectives and any necessary deviations from building regulations. The various options for fire safety measures (e.g. fire water supply) and the requirements for technical measures (e.g. sprinkler systems) are incorporated into the basic features of the fire safety concept.

The project-specific fire safety requirements are becoming more and more concrete according to the planning progress (preliminary planning, design planning, approval planning, implementation planning). Deviations from building regulations and, if necessary, the equivalent replacement by technical equipment (e.g. fire alarm systems) as a compensation measure are described and explained.

The visualization of the fire protection concept is carried out in addition to the textual part and presents the structural and plant-related measures in terms of planning.

Whereas the visualization of the fire safety concept can be reproduced via BIM, the fire safety concept can still be created independently of the building model as a building approval document.

3.2 Aspects and Levels

The present sample AIA is intended to show a reasonable integration of the fire safety related information content into the BIM model. The integration of fire safety design in the different aspects of the planning process in BIM is done as follows:

3.2.1 3D-Model

A three-dimensional model of a building with geometrical, physical properties and functional attributes is created. It is the basis of the construction planning. [07] An example of this is the implementation of the fire resistance rating of building elements such as ceilings, walls and doors. A further approval-relevant topic in the third dimension is the implementation of fire safety parameters, which concern the design of the technical building equipment (e.g. ventilation and pipe systems, fire alarm systems, fire extinguishing systems).

The input of the fire safety parameters is mainly done in the 3D model. Different entry levels are considered in the present AIA:

- **Building level**
  Information at building level is usually linked to the model as separate files. As a rough fire safety concept in text or list form, they contain the essential fire safety requirements and design standards that must be taken into account by all planning disciplines in further planning (e.g. maximum permissible escape route length, required fire resistance of the load-bearing and bracing components).
- **Raum-Ebene oder Raumgruppen-Ebene**
  Information on room / compartment level is directly assigned to the respective rooms or room groups (e.g. units of use, fire compartments) frequently referred to for fire protection planning (e.g. unit of use receives fire alarm system category 1 according to DIN 14675, corridor is a necessary corridor according to MBO).
- **Building element level**
  Information at building element level is assigned to the respective building elements (families) as attributes (e.g. fire resistance of doors)
- **Fire protection objects**
  Fire protection objects are families inserted into the BIM model especially for fire safety design. These families, which are usually represented as symbols, contain detailed information for the specific design (for example, the location and design of wall hydrants) and are also used for representation in the fire safety plan.

3.2.2 4D-Model and 5D-Model

In the 4D model, the 3D model is extended with schedule and execution processes. This enables a 4D construction process simulation. The simulation integrates the dependence of the processes on resources (man, machine, materials). The 5D-model extends the 3D-model with mass calculations using databases. Cost planning and calculation information are linked to this. [07] This allows a time-dependent calculation of costs. For this purpose it is not necessary for the fire safety engineer to provide information. The fire safety engineer has already entered all his information in the third dimension. However, the information from the third dimension is processed by other participants in the execution in the fourth and fifth dimension. The different planning disciplines create mass- and/or cost-based capacity plans based on the fire safety properties defined in the 3D model. These flow into the schedules for the construction process planning. In the best case, this information can be further processed in the fourth and fifth dimension by other parties involved in the construction process. The fire safety engineer has only an advisory or supervisory role in this process.

3.2.3 6D-Model and 7D-Model

Starting with the sixth dimension, life cycle aspects are added. These aspects are of particular interest for Facility Management. In the seventh dimension, the building model is linked to the operating data for traceability of maintenance and repair measures. Here, facility management can also benefit from a BIM model. In this case, life cycle aspects, operating data and maintenance intervals of fire protection systems are specified by the manufacturing companies and are transferred to the BIM model by the executing companies. Examples of fire protection systems are smoke detectors, fire protection doors or flaps or sprinkler systems. Again, the fire safety engineer provides the foundation in the third dimension and is also active in an advisory capacity in the sixth and seventh dimension.

3.3 Level of development LOD

3.3.1 General

The level of development (LOD) of a BIM model is used to describe the information content of the model. The level of development must correspond to the content of the technically necessary planning information and the planning activities commissioned for the respective phase. [09]

The level of development LOD is made up of the information of the level of geometry (LOG) and the information level of information (LOI).

The level of geometry LOG is the geometric level of detail of a model and the level of information LOI represents the non-geometric information of a model.

The specifications of the LOG and LOI should usually be expressed in the form of the present Muster - AIA. Thereby it is important to pay attention how detailed the modeling should be in order to create the best cost-benefit ratio of modeling effort and information gain. Especially in large projects, it is important to clearly specify the level of detail in the interdisciplinary coordination to avoid reaching the performance limits of commercially available hardware. The LOG should be set in conjunction with the LOI so that a minimum of performance is required while the level of information remains the same. With a lower LOG and a higher LOI, the same level of information or level of development can be achieved for both the planning and the planning exchange.

The levels of development LOD 100 - LOD 500 were defined by the American Architects Association (AIA, 2008) in document E202-2008. They have been further developed by the NATSPEC BIM Paper (NATSPEC, 2013).

Picture 1: Example of different level of development [20]

The levels of development differ as follows:

3.3.2 LOD 100

„The model element can be represented graphically in the model with a symbol or other general representation, but it does not yet meet the requirements of LOD 200. Information about the model element (e.g. cost per unit area, ventilation system volume) can be obtained from other model elements.“ [09]

According to the BIM guidelines for Germany, the LOD 100 is targeted in the preliminary design. [09]

3.3.3 LOD 200

„The model element is represented graphically in the model as a general system, object or assembly with approximate quantities, size, position and orientation. Non-graphical information can also be added to the model element. [09]

According to the BIM guideline for Germany, the LOD 200 is aimed for in the draft design. [09]

3.3.4 LOD 300

"The model element is represented graphically in the model as a system, object, or assembly with specific quantities, specific size, position and orientation. Non-graphical information can also be added to the model element.” [09]

According to the BIM guidelines for Germany, LOD 300 is the target for approval design. [09]

3.3.5 LOD 350

„The model element is represented graphically in the model as a system, object or assembly with specific size, position and orientation and interfaces to other building systems. Non-graphical information can also be added to the model element.“ [09]

LOD 350 is an intermediate level between LOD 300 and LOD 400, introduced to represent interfaces between disciplines.

According to the BIM guidelines for Germany, LOD 350 is the target for approval design. [09]

3.3.6 LOD 400

„The model element is represented graphically in the model as a system, object, or assembly with specific quantities, specific size, position and orientation, and specific quantities, and is accompanied by information on detailing, fabrication, assembly, and installation. Non-graphical information can also be added to the model element.“ [09]

According to the BIM guidelines for Germany, the LOD 400 is to be used in the execution design. [09]

3.3.7 LOD 500

„The model element is a verified representation of what was built in in terms of size, appearance, position, quantities and orientation. Non-graphical information can also be added to the model element.“ [09]

According to the BIM guidelines for Germany, the LOD 500 is used in the object documentation. [09]

3.4 3.4 Model phases following the Muster - AIA

In the present Muster - AIA, two model phases are defined on the basis of the special features in fire safety design described in Section 3.1. The corresponding levels of development are assigned to the model phases:

- Pre-project: corresponds to LOD 100 - 200 and planning phase 1 - 2 (AHO Heft 17)
- Draft and approval design: corresponds to LOD 200 - 300 and planning phase 3 - 4 (AHO Heft 17)

Further services within the scope of fire safety design, such as the performance of collision checks by the fire safety engineer or the documentation of any faults within the scope of object monitoring directly in the BIM model are not included in this Muster - AIA and must be agreed separately if necessary.

3.5 Collision checks

As part of the execution design and construction supervision, architects and other specialist planners (e.g. for technical building equipment) are advised on the necessary implementation of the fire safety requirements up to the construction-ready solution. Within the scope of the execution design, collision checks can be performed if the models contain the appropriate information, which can be carried out either by the respective planning disciplines themselves or by the fire safety engineer.

The BIM Collaboration Format (BCF) serves as an aid to the rapid coordination of interdisciplinary content. It is platform independent and thus supports the BIG Open BIM concept. "A BCF file is usually generated when a model check reveals a problem, e.g. a missing opening, which is detected as the result of a collision check between the building equipment model and the structural model". [03] In fire safety engineering the following collision result is thinkable:

A model checker detects a cable or line opening in a wall with requirements for fire resistance. A screenshot of the problem in the model and the corresponding camera position are then summarized in BCF format. Optional BCF contents are textual problem descriptions and suggested solutions, responsibility and status. Now communication can take place using issue tracking programs such as BIMCollab. This is where the existing collaborations are organized, assigned and processed. In this case, the object planner and the TGA planner are assigned the collision for solution. If both parties open the BCF file, they are led directly to the problem area in the model and are informed about the existing collision with the help of the description. They can now discuss the problem and determine further action steps.

3.6 BIM-Communication

3.6.1 BIM-Exchange formats

For the consistent exchange, organization and structure of BIM data is based on the worldwide applied exchange standard for data - Industry Foundation Classes (IFC) - in the BIM process for building construction.

“IFC is a manufacturer and software-independent interface that allows all geometric and alphanumeric BIM data to be exchanged.” [09]

As an international standard IFC is registered in DIN EN ISO 16739. "For each model element, the characteristic specifications such as material data, manufacturer data, technical specifications and classifications can also be transmitted.” [09]

By using IFC, a free and independent data format, the BIM method can be applied by all parties involved.

For project-specific fire safety design with BIM, recommended work specifications and hints for an objective-oriented cooperation with regard to the BIM exchange formats have been developed at this point (see section 3.7).

3.6.2 BIM-Workflow

When working with the BIM method, it is essential to start by defining the workflow in the planning process using a BIM execution plan (BEP). During the planning process, domain models (BIM data) are generated from the main model. The BIM data, in this case, the fire safety domain model, is then exchanged with the main planner in a defined cycles. Subsequently, the domain models must be checked separately and in combination for data consistency and completeness. In the coordination model, these specialist models are merged to an up-to-date status. This ensures that planning errors and possible conflicts are detected at an early stage and can then be discussed and corrected. Further revision levels of the BIM data are to be exchanged in the same way. A coarse timeline with milestones must be defined in advance with all parties involved in the project for the exchange of the generated BIM data. This timeline must be continuously adapted and fine-tuned in the further process according to the planning conditions. The BIM execution plan (BEP) ensures that agreed objectives such as phase completion or intermediate stages are met or can be adjusted if necessary.

3.7 Notes and recommendations for collaboration with BIM

For a more objective-oriented collaboration with BIM, project-specific agreements should be made on the following topics:

- Application of specification of BIM Muster-AIA – Basic scopes as defined in section 2
- The basic scopes according to BIM Muster-AIA as wells as the range of "fire safety design in BIM" form the basis for the "BIM project execution plan (BEP)".
- Import and Export of BIM-Data: The exchange of BIM data takes place at previously defined milestones (data transfer points) in a previously defined format between the participants. Corresponding exchange cycles must be defined between the participants. At present, it is apparent that the rvt file format of the Autodesk REVIT program and BIM data lists (e.g. Excel lists or database formats) are advantageous for the import, export and utilization of BIM data for fire safety design in BIM and the exchange of this data.
- At each milestone, the domain models are compared and checked for consistency by the BIM Manager. The results of the analysis are communicated using the BIM Collaboration Format (BCF).
- The general planner is responsible for the architectural model he has created, uses import options to enter fire safety specific information into his BIM model or adopts changes resulting from fire safety design.
- The IDs of building elements (e.g. of walls, doors, rooms, etc.) are not changed during the entire project, thus enabling a consistent workflow and a quick comparison of the domain models with each other.
- Coordination in the continuous planning process: The platform-independent BIM collaboration format is recommended to support the rapid coordination of interdisciplinary content. Coordination during the planning process should be based on the BIM model. Coordination via BCF should be used for this purpose, so that issues can be created and assigned to relevant actors, and documentation of the exchange and coordination should be stored on a central server.

4 Bibliography

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