buildingSMART International

Detailed Project Plan

Project Name:

openBIM for Steel Construction Fabrication

AKA "openBIM for Steel Construction"

General Information

Domain Governance:

Building Domain (BD)

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1 GLOSSARY

Body	Abbreviation	Short summary
buildingSMART International	bSI	Please follow this link for more information: www.buildingsmart.org
Expert Panel*	EP	Brings in expert advice during the project, on a voluntary basis, during on average four meetings per year.
Building Domain*	xD	Open forum within bSI responsible for the Building domain and all developments on IFC within this domain.
Building Domain Project Steering Committee*	xDPSC	Body within the Building Domain responsible for managing the Building Domain projects, meets once a month and Project Lead presents the Project Dashboard during this meeting.
Building Domain Steering Committee*	xDSC	Steers the Building Domain and is responsible for setting out strategy, managing initiatives and liaison with other Domain and bodies.
International Standardization Organization	ISO	Please follow this link for more information: http://www.iso.org/iso/home.html
Open Geospatial Consortium	OGC	Please follow this link for more information: http://www.opengeospatial.org/
Project Leader	PL	Responsible for managing the project and ensures the project is delivered within budget and on time.
Project Team*	PT	Executes a project based on a project plan and delivers the results according to plan.
Standards Committee**	SC	The senior governance body within bSI overseeing the standards process. It will comprise representatives from members and chapters.
Standards Committee Executive**	SCE	Establishes and manages the bSI standards process and addresses procedural and programmatic issues.

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Standards Committee Technical Executive**	SCTE	Provides technical advice to the SC and SCE the bSI standards process and addresses project technical issues.
Model View Definition	MVD	Definition inside IFC to declare specific classes for special use cases, e.g. steel fabrication
CIMsteel Integration standard	CIS/2	structural steel description
Numeric Controle – Deutscher Stahlbau Verband	NC-DSTV	Definition of single pieces to be transferred to a CNC steel processing machine. Defined by German Steel Association.
Steel Detailing Neutral Format	SDNF	Exchange format to coordinate structural steel with piping.
Manufacturing Enterprise System	MES	Software to organize steel fabrication and purchase material.
Information Delivery Model	IDM	Definition of the level of information needed in different phases of a project.
Information Delivery Specification	IDS	A computer interpretable document that defines the Exchange Requirements of model-based exchange.

*** For more information please see the buildingSMART International Standards Process. This process describes the manner in which standards and other technical work is created and governed within buildingSMART International. It is available online: http://buildingsmart.org/standards/standards-process/*

2 EXECUTIVE SUMMARY

In 2012, The American Institute of Steel Construction created a task force to address the issue of automating the fabrication of structural steel. After careful and close consultation with the industry, AISC arrived at the conclusion that IFC was the ideal standard for automating the structural steel industry.

Opportunities:

- The original standard was devised with intent of covering roughly 80% of the fabrication operation of U.S. fabricators. The intention was that easiest 80% of operations would be an attainable goal for the project, and the remaining 20% could be addressed at a later time, contingent on industry demand.
- The timing is ideal to help augment the loss of qualified skilled labour in the structural steel industry.
- The timing is ideal as machinery is becoming more and more automated.
- BIM Workflows are better set up to support information flow into machinery.

Challenges:

- Industry Adaptation: Software and machinery manufactures cannot be forced to adapt standards; they are reliant on market demand.
- Potential end-users are not always familiar, on a technical level, with the standards that support the industry.
- Current file exchange works, but is not optimal, and the industry can be resistant to change.
- Industry is still utilizing a collection of older industry standards.

The Steel Construction Industry needs to upgrade from IFC2x3 to IFC4 by implementing a Model View Definition (MVD) for the following reasons:

- Implementing New Features: IFC4 introduces new features and functionalities that are not available in IFC2x3. Upgrading to IFC4 enables the Steel Construction Industry to leverage these advancements and benefit from improved capabilities for modelling and data exchange.
- Changing Technical Requirements: Technical requirements in the construction industry are constantly evolving. Upgrading to IFC4 ensures that the Steel Construction Industry stays up-to-date with the latest industry standards and best practices, allowing them to effectively meet changing technical requirements.
- Including Previous Efforts: The "last 20%" from the previous EM-11 effort in the MVD needs to be included. Upgrading to IFC4 provides an opportunity to incorporate and build upon the progress made in the previous MVD, ensuring continuity and avoiding any loss of effort or information.
- Extended Entity Types and Properties: IFC4 provides a broader range of entities, related types, and properties compared to IFC2x3. Upgrading to IFC4

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enables the Steel Construction Industry to represent and exchange a more comprehensive set of information relevant to steel construction, which was previously unavailable in IFC2x3.

- Vendor Support and Expert Usage: The previous MVD based on IFC2x3 has been widely implemented by software vendors and used by domain experts. Upgrading to IFC4 ensures that the industry can continue to receive vendor support and leverage the expertise of domain experts who are familiar with the upgraded standard.

- Relevance to the Machinery World: The upgraded MVD based on IFC4 is relevant to the machinery world, as it allows for seamless integration and data exchange between steel construction and machinery-related processes. This alignment facilitates interoperability and streamlines workflows across different industry sectors.

- Automation and Data Exchange: The expanded use of automation in steel construction necessitates robust standards for data exchange. Upgrading to IFC4 provides enhanced support for automation, allowing for more efficient and accurate data exchange between different software applications and systems.

- Verification of Information Delivery Manual (IDM): Upgrading to IFC4 provides an opportunity to verify that the Information Delivery Manual (IDM) is still valid. By aligning the MVD with the latest IFC4 specifications, the Steel Construction Industry can ensure that the IDM accurately represents the required information exchanges and workflows.

- Enhanced Specifications for Steel Fabrication: The Steel Construction Industry requires additional specifications, particularly for steel fabrication processes. Upgrading to IFC4 allows for the inclusion of these new specifications, ensuring that the MVD supports the specific needs and requirements of the steel fabrication sector.

- Integration of DSTV-NC Information: The new developed information from DSTV-NC, a standard format for exchanging data in the steel construction industry, can be incorporated into the upgraded MVD based on IFC4. This integration enables seamless data exchange and interoperability between different systems and stakeholders involved in steel construction projects.

- See Annex 2 for Analyses of the IFC-Schema.

In summary, upgrading the Steel Construction Industry's MVD from IFC2x3 to IFC4 brings numerous benefits, including access to new features, compliance with changing technical requirements, inclusion of previous efforts, enhanced entity types and properties, vendor support, relevance to the machinery world, automation support, IDM verification, improved specifications for steel fabrication, and integration of DSTV-NC information.

Proposed Solutions:

- This project will identify the missing information in MVD including IDS and will update MVD steel for future needs.

- The value of an IFC design model for a steel fabricator depends strongly on its accuracy and the definition of relevant entities including their property sets.

This project will identify relevant information and define needed accuracy in terms of an IDM. This IDM is targeting the transition of a design model into a fabrication model.

3 BACKGROUND

3.1 HISTORY

Exchanging data for structural steel projects has a long history. CIS/2, SDNF or NC-DSTV are commonly used formats for different processes of structural steel. Nevertheless, IFC has not been implemented widely by Steel Fabricators and their machinery.

"BIMsteel" Initiative

12 years ago, a Working Group called "BIMsteel" created a process map describing processes for projects including structural steel. Requirements for different steps and 11 stages for an IFC model were defined. Each stage has been represented by an exchange model (EM). Definition of EM11 was the basis for implementation of MVD steel (see Figure 1 below).
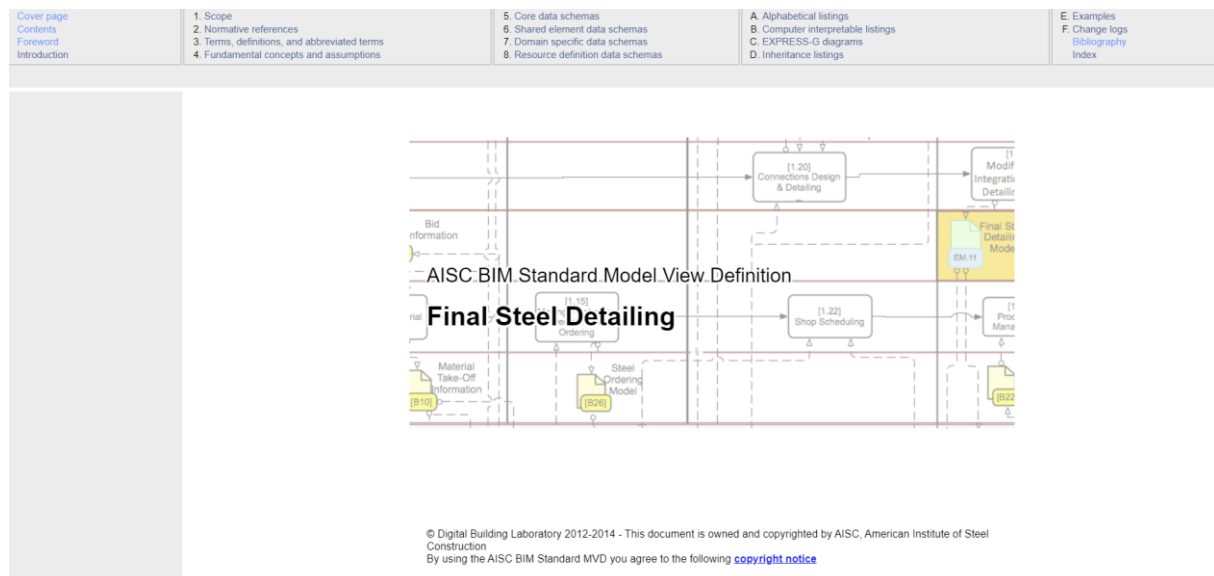
Figure 1 MVD Documentation Page for Steel Construction based on IFC2x3

This MVD, which is based on IFC2x3, is currently stored on the AISC Page: https://www.aisc.org/technical-resources/ifc/

Various stakeholders were involved in this initiative, in particular software companies like (Trimble with its Tekla Structures), production management (Steel Projects), machine supplier (FICEP), university (Georgia Tech) and professional associations like AISC – American Institute for Steel Construction.

3.2 OPPORTUNITY & INDUSTRY NEED

Steel fabrication industry today is keen to use IFC for communication and data exchange purposes. Communication between CAD, MES and CNC machines are vital for modern steel fabrication industry. Old formats such as NC-DSTV and CIS/2 are still in use, since MVD steel doesn't cover all needs for the industry.

This project will identify the missing information in MVD and will update MVD steel for future needs.

The value of an IFC design model for a steel fabricator depends strongly on its accuracy and the definition of relevant attributes.

This project will identify relevant information and define needed accuracy in terms of an IDM. This IDM is targeting the transition of a design model into a fabrication model.

In most of the cases Fabricators are facing complains about quality. The BIM-processes are not commonly agreed, and various uncertainties may still occur.

Despite the release of IFC as an ISO standard, the steel industry is still using old formats, like CIS/2 and NC-DSTV. With the introduction of IFC4 Schema this MVD missed its actuality and should be adjusted to the latest version.

3.2.1 PROBLEMS AND ISSUES

Automation is a great opportunity and challenge for the whole industry of structural steel. Steel processing machines are commonly used since the 1980's. Next generation of those machines widen the range of possible milling steps, like fixing and welding robots, complex coping and much more. Seen as an island nowadays machine become more and more part of the whole digitalization process. Reading data itself is no longer sufficient to support the required quality and efficiency for steel fabrication.

Machine suppliers for structural steel are looking into IFC to fit into the BIM processes.

Industrialized industry suffers a tremendous lack of qualified labour force. Reading a drawing becomes a qualification, which can no longer be taken as granted. Today fabrication processes were designed for IKEA level. 3D pictures support work forces on shop floor to simplify the understanding of a steel structure.

As part of BIM methodology, a 3D model offers all capabilities to utilize information for a breakdown to simplify steel fabrication processes. Fabrication processes still based on 2D produce errors and is a break in a fluent data flow.

Apart from that the process control is a vital issue for fabrication. Complaints of bad quality of delivered steel structures reveal the need of quality checks to identify the problem. Free trade of material and services worldwide intensify the need for a better quality-check process.

Industry is still using old formats, like CIS/2 and NC-DSTV. Those formats were designed to fulfill the need of data transfer to a steel processing machine. They fit for a certain task but weren't made to recognize the whole workflow.

IFC offers the capability to support data flow management through the whole supply chain.

3.2.1.1 DStV Requirements on IFC

1. IfcAnnotation is not part of of IFC4 RV 1.2:

- Therefore, a dedicated MVD definition is required, or RV 1.2 should be extended accordingly.
2. From IFC4 RV 1.2 Specs
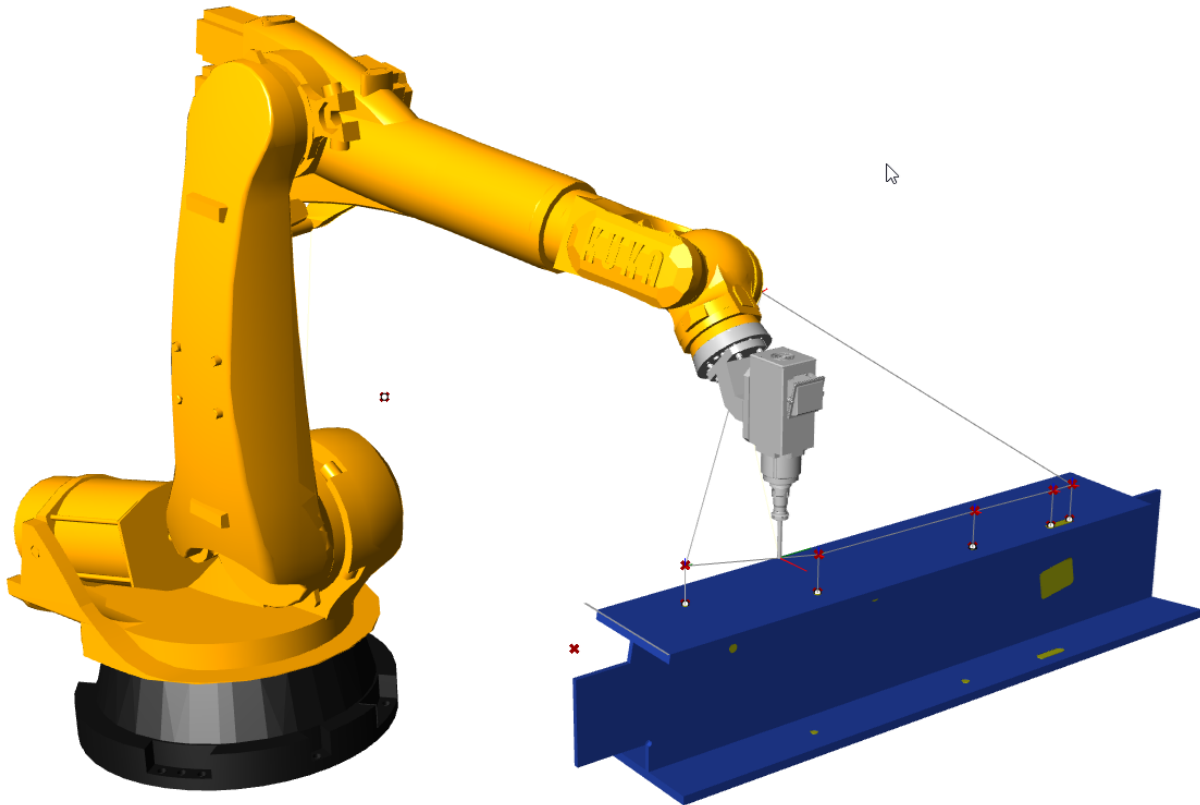
Figure 2 Exemplary Use of IfcAnnotation and VoidingFeature (Source: Karl-Heiz Häfele. KIT)

Entity IfcOpeningElement

An IfcOpeningElement has to be inserted into an IfcElement by using the IfcRelVoidsElement relationship. It may be filled by an IfcDoor, IfcWindow, or another filling element by using the relationship *IfcRelFillsElements*. Depending on the type of the IfcShapeRepresentation of the IfcOpeningElement the voiding relationship implies:

- if the IfcShapeRepresentation. = 'Body', then the Body shape representation of the opening has to be subtracted from the body shape representation of the voided element - implicit Boolean difference operation.
- if the IfcShapeRepresentation. = 'Reference', then the Reference shape representation of the opening is not subtracted, it is provided in addition to the hole in the Body shape representation of the voided element.

Entity IfcVoidingFeature

There are no recommendations in the specification for the RepresentationIdentifier of the ShapeRepresentation.

- for our use case, the RV 1.2 must be restricted in such a way, so that IfcShapeRepresentation.RepresentationIdentifier == 'Reference' is not used. Otherwise, the geometry of the object to which the opening refers is exported as a surface model (TesselatedItem).

ExtrudedAreaSolid as a required geometry

Extrusion bodies with parametric profiles (IfcParameterizedProfileDef) are required for exchange with a production machine.

- Specific MVD definition required or extension of RV 1.2

Rule check of the exchanged data sets

In order to ensure the quality of the exchanged data sets, checking rules are required that also check the geometry, among other things.
Example rules:
Geometries of type ExtrudedAreaSolid are expected and the used profile type of the attribute SweptArea must be of type IfcParameterizedProfileDef.
mvdXML:
ExtrudedAreaSolid_SweptArea[Exists]='TRUE' AND
ExtrudedAreaSolid_SweptArea[Type]='IfcParameterizedProfileDef'

- Currently, according to the state of the art, verification is only possible with mvdXML.

3.3 PROJECT GOVERNANCE

The proposed project will be executed and governed as a buildingSMART International project within the Building Domain.

In addition, the proposed project will adhere to all requirements coming from the Standards Process as described by buildingSMART International online:

http://buildingsmart.org/standards/standards-process/

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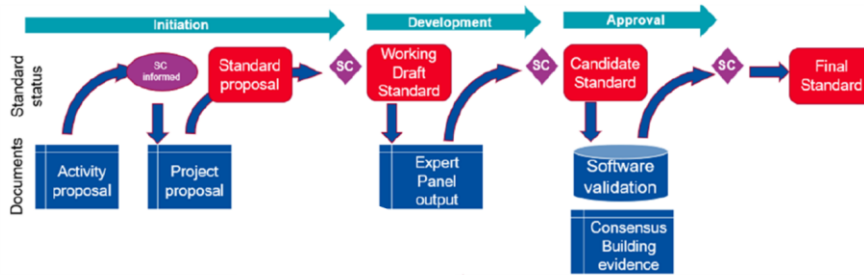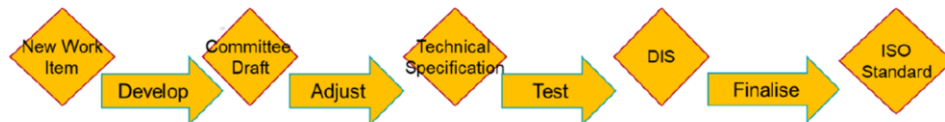
Figure 3 bSI and ISO Process (Source: bSI)

Note: The ISO Process is optional and could be considered at later stages.

A Project Management tool (Asana) is being used to assign tasks and work packages. Meanwhile project status reports will be transferred into the bSI's Monday Platform. The project Meetings and Webinars will be conducted via MS-Teams of buildingSMART Germany. A "Citrix ShareFile" will be provided for Documentation purposes by bS Germany. As as Brainstorming tool "Miroboard" has been used since the beginning of the activity.

3.4 RELATIONSHIP TO BSI STANDARDS, TECHNICAL WORK, AND ROADMAPS

openBIM is a collaborative process that enables exchange software-neutral formats and schemas (such as IFC) that also facilitates information flow not only within the domain but also between domains. With the help of MVD an Architect could be able to export a Building Model with required properties for further development by Structural Engineer or Steel Fabricator.

An IFC (**ISO 16739)**, which is an industry-specific data model schema plays a major role in this initiative. The previous MVD was based on IFC2x3 schema, which is commonly and widely used by the industry. However, this version misses a lot of vital entities and classes, which might be useful to this domain.

The implementation of BCF is common for BIM-Coordination and Issue Management, yet the process in Steel Fabrication most of the time doesn't include it, which actually could improve the quality of the models and communication.

An MVD, which is commonly known as a "filter" of IFC Schema will be developed further to meet current industry standards and user requirements. Its expected that MVD should be more modular, thus we propose to adapt previous Steel MVD (IFC2x3) to IFC4 Reference View and enrich/populate it with Terms/Definitions/Classifications related to Steel Construction along with their property sets via classification tools and publish further in bSDD (buildingSMART Data Dictionary).

In order to reach these goals, the project team intend to work on IDM (**ISO 29481-1**), which is methodology for defining and documenting business processes and its exchange requirements. Since Processes are part of an IDM, project team intended not only redefine existing processes but also optimize them. Since Use Cases may pre-define an IDM vs IDM can contain various Use Cases, specific use cases have to be defined and provided to broader cmmunity. For this purpose, a bSI UCM Service might play a major role in transfering all these information to a public.

The relation of existing openBIM Standards to this project is inevitable due to that fact that particularly openBIM Stanfatfs were used to create outdated version of this MVD.

The project team stresses the importance of LoIN (Level of Information Need) for specific life cycle phases. As the basis and sample BIMForum - LOD has been proposed to be used for Steel Fabrication.

Structural Engineering and Steel Construction related Software that Supports IFC Export and Import:

- Tekla Structures – (IFC Import / Export)
- SteelVis – (IFC Export)
- Advance Steel – (IFC Import / Export)
- Allplan Engineering – (IFC Import / Export)
- Autodesk Revit Steel Fabrication – (IFC Import / Export)
- AVEVA Boca Steel – (IFC Export)
- Bentley Structural Modeler – (IFC Import / Export)
- Sofistik Structural Desktop – (IFC Import)
- SAP2000 – (IFC Import / Export)
- ...

3.4.1 bSDD – buildingSMART Data Dictionary

The buildingSMART Data Dictionary (bSDD) is an online service that hosts classifications and their properties, allowed values, units and translations. The bSDD allows linking between all the content inside the database, map various classifications, national standards and norms to each other and to IFC. In addition, the project team is willing to populate Steel Construction related Property Sets in bSDD. It provides a standardized workflow to guarantee data quality and information consistency.

3.5 RELATIONSHIP TO OTHER STANDARDS AND TECHNICAL WORK

Based on previous effort on creating of life cycle process map (see Illustration below) for structural steel projects, BIMsteel Team identified an exchange model for fabrication (EM11) worthwhile to start from. Starting from the most detailed stage of a model makes it easier to downscale requirements in earlier stages of a project.

EM1 to EM7 should have covered the data exchange with architectural and design models (defined by LOD 100-300).

- EM1. Concept Model Preliminary Project Description
- EM2. Initial Structural Model Preliminary Project Description
- EM3. Initial Steel Structural Model Preliminary Project Description
- EM4. Architectural Design Model Design Development
- EM5. Structural Analysis Model Design Development
- EM6. Architectural Contract Model Construction Documentation
- EM7. Structural Contract Model Construction Documentation
- EM8. Mill Order Model Construction Documentation
- EM9. Final Structural Analysis Model Design Development
- EM10. Advanced Steel Detailing Model Product Development
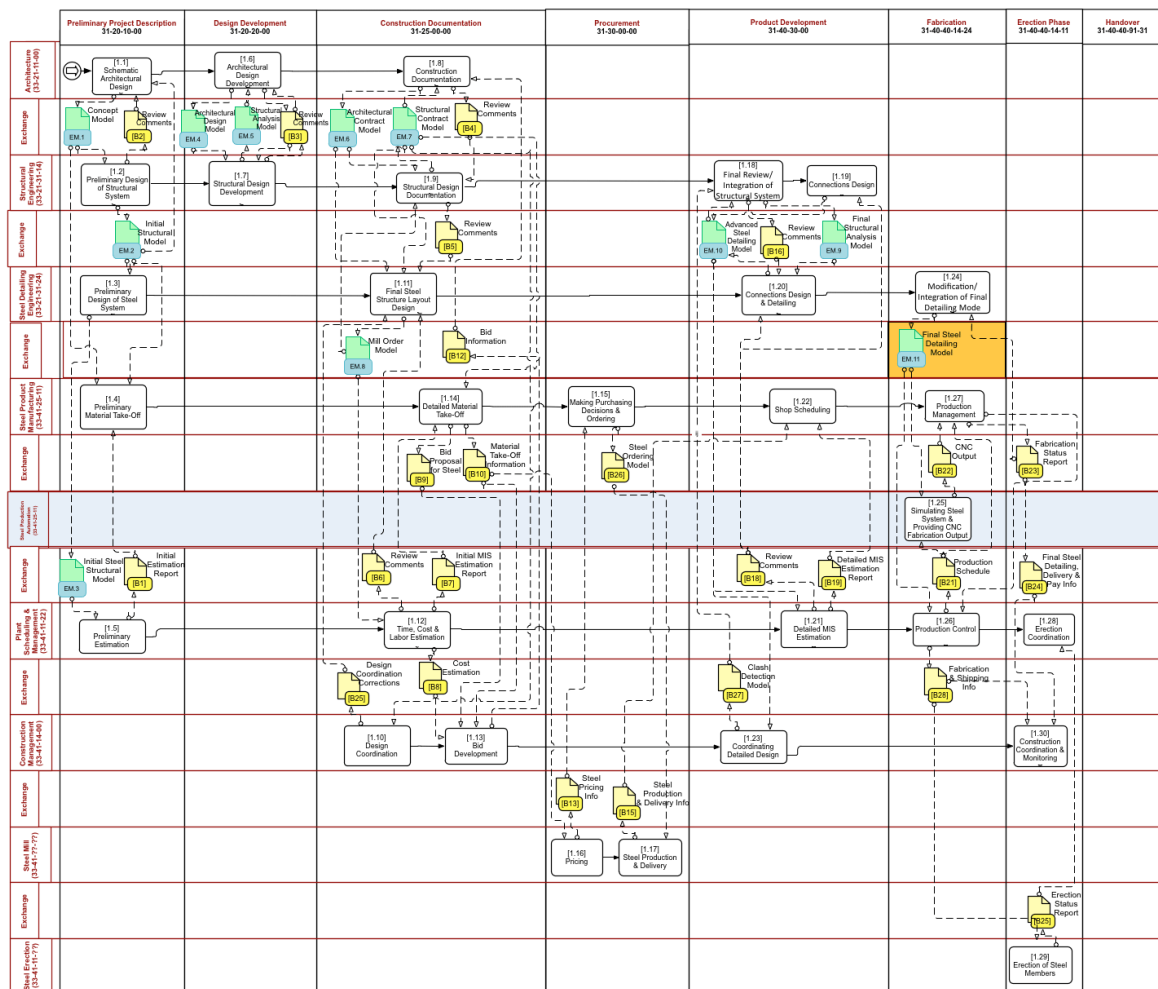- EM11. Final Steel Detailing Model Fabrication

Figure 4 Process Map

The team is intending to cover phases, since they differ not only from Country to Country, but also from Federal State to State. It is vital for End User to have common picture.

The Figure 4 indicates Phase Linage for related country.

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bSI Phases	bSI IDM	ISO 12006-2	HOAI (Germany)	HOAI (Germany) English	LOD	ÖNORM	2017 Phases	RIBA (UK)	CSI / CSC OmniClass (Canada / USA)
Design	Portfolio Requirements	Inception / Procurement					Requirement	Strategic Definition	31-10 00 00 / Inception Phase
Design	Conception of Need						Need		
Design	Outline Feasibility	Feasibility	LP1: Grundlagenermittlung	Pre-design	100		Feasibility	Preparation & Brief	31-20 00 00 / Conceptualization Phase
Design		Outline Proposals, Programme Preparation							
Design	Substantive Feasibility							Concept Design	
Design	Outline Conceptual Design	Scheme Detail / Costing	LP2: Vorplanung	Schematic Design	200		Concept	Developed Design	31-30 00 00 / Criteria Definition Phase
Design	Full Conceptual Design		LP3: Entwurfsplanung	Design Development	300				Design Phase
Design			LP4: Genehmigungsplanung	Approval Planning					
Procure	Coordinated Design and procurement	Detail design / costing	LP5: Ausführungsplanung	Construction Documents	400		Coordination	Technical Design	31-40 00 00
Procure	Production Information	Production information and Bills of Materials	LP6: Vorbereitung der Vergabe	Tender Documents, BOQs			Production		31-50 00 00 / Coordination Phase
Procure		Tender Action	LP7: Mitwirkung bei der Vergabe	Negotiations					
Assemble	Construction	Construction Preparation	LP8: Objektüberwachung	Construction Managing	500		Construction	Construction	31-60 00 00 / Implementation Phase
Assemble		Construction operations on-site							
Assemble		Completion						Handover & Closeout	31-70 00 00 / Handover Phase
Operate	Operations & Maintenance	Feedback	LP9: Objektbetreuung	Documentation, Controlling			O&M	In Use	31-80 00 00 / Operations Phase
Operate	Disposal								31-90 00 00 / Closure Phase

Figure 5 Phase Linage (Source: buildingSMART International, adapted by Mirbek Bekboliev, 2018)

4 SCOPE & OBJECTIVES

4.1 SCOPE STATEMENT

A MVD steel fabrication based on IFC 2x3 already exists and is already used in several companies to fabricate structural steel.

Industry is strongly looking for a seamless workflow of fabricating and delivering steel construction around the world. More than other discipline in construction industry structural steel project is done on an international base. There is an evident need for defined interfaces on any stage of a project. Starting from predesign to operation phase.

This project is concentrating on IDM for giving architects and design engineers a guideline to fill an IFC4 with appropriate information about what a steel fabricator needs to produce structural steel.

This project doesn't include any definition to exchange model data with analysis model definition.

The scope of this project is to define clear descriptions for exchanging IFC models between different LoIN (see above).

4.2 OBJECTIVES

This project aims integrate openBIM Standards, in particular IFC, and optimize BIM-Processes within the steel construction as well as foster wide implementation of IFC4 and Steel Fabrication MVD by respective vendors.

4.3 APPROACH

- Establish International Working Group
- Gather Experts and Resources
- Collaborate with Industry Organisations and Chapters
- Analize existing MVD, based on IFC2x3 Schema
- Analize existing Software Solutions
- Specify current Industry Requirements via IDM and with the help of IDS
- Optimize Processes and related Process Maps
- Create Demo Solutions
- Update MVD (mvdXML and MVD Documentation) from IFC2x3 to IFC4 Basis
- Extend bSDD with related Dictionary (Domain)
- Adapt and derivate to national / regional IDMs.
- Gain Feedback from Domain Experts and Software Vendors for Deliverables
- Implement MVD and IDS by Software Vendors
- Run Workshops with End-Users

4.4 CHALLENGES

This sub-section should clearly state the feasibility and challenges of the proposed project to address the objectives within the scope, as stated above. This may include technical and/or resource challenges, as well as conflicts with other standards and/or technologies inside and outside bSI. Also include assumptions being made and any risks involved in the execution of the project. It is optional for any other projects than Technical Room projects.

4.4.1 Feasibility

Prior to start of this initiative, the industry representatives were invited to several Expert Panels to gather issues and requirements as well as current needs on openBIM workflow capabilities in particular IFC-based Model exchange for Machinery and Steel Fabrication.

As a result, there are some notes provided in Annex-2. Further recommendations for extensions to the core IFC Schema will follow.

Moreover, most of the software vendors and machinery as well as fabricators have expressed their commitment to implement proposed solutions.

4.4.2 Assumptions and Risk Assessment

- Industry Adaptation: Software and machinery manufactures cannot be forced to adapt standards; they are reliant on market demand.
- Potential end-users are not always familiar, on a technical level, with the standards that support the industry.
- Current file exchange works, but is not optimal, and the industry can be resistant to change. Thus, difficulties in achieving consensus.

Industry is still utilizing a collection of older industry standards.

5   DELIVERABLES

IDM

IDM steel construction will be defined as a guideline for the design of steel construction. Based on a process map different exchange requirements are needed. The IDM steel construction will give a guideline for architects, engineers, and fabricator to define different level of information to be transferred from one to another party. This project will collect existing IDM concerning steel and will find common requirements and tries to find a common definition.

The aim of the work is to supplement national IDMs with consolidated and industry proven workflow.

Upgraded MVD (based on IFC4 Add2 TC1 Schema) on top of IFC4 Reference View

MVD steel construction will be updated and extended to the need of construction industry. The work will be based on IFC4 Reference View.

As a result of MVD Development an IDS would be also delivered (as an option).

IDS

In order to proof User defined specifications one could use IDS (Information Delivery Specification), which could be used to check IFC-Models against Client's requirements.

Rule Sets

Quality check of data from software provider. Certification process can be done by Stakeholder or Sub-contractor. It is a vital part of this project to ensure quality of MVD data from different software provider, machine supplier need reliable data for production.

5.1   INTELLECTUAL PROPERTY RIGHTS

All products created during the execution of the project, as well as resulting deliverables are owned and copyrighted by buildingSMART International Ltd. with all rights reserved and granted as determined on a case-by-case basis.

The deliverables for this project are/aren't subject to licensing restrictions related to…

The deliverables for this project will be available per the licensing criteria of MIT.

6 RESOURCES & PROJECT EXECUTION

6.1 RESOURCES & SKILLS

The proposal project team contains following experts:

- Steel Fabricators
- Structural Engineers
- Architects
- Civil Engineers
- IFC, IDS, MVD, bSDD-Experts
- Project Manager/Coordinator
- Product Manufacturers
- Software Vendors CAD & MIS
- Machine supplier for steel processing machines

6.1.1 Personnel / Participants

Stakeholders (approx. 45 Experts):

Chapters

- buildingSMART Danmark?
- buildingSMART France
- buildingSMART Germany
    - Joint buildingSMART/bauforumstahl Working Group "BIM & Steel Construction"
- buildingSMART Italy?
- buildingSMART Portugal
- buildingSMART USA?

Domain Organisations

- AISC - American Institute of Steel Construction
- bauforumstahl e. V.
    - WG IT-Arbeitsausschuss - Ad-Hoc-Gruppe DStV-NC Schnittstelle

Research Organisations

- DTU - Technical University of Denmark

- iabi - Institute of Applied Building Informatics
- KIT - Karlsruher Institut für Technologie
- RWTH Aachen

Experts

- Adam Peterson, SDS2 Allplan
- Adrian Koss, Lamparter GmbH
- Andreas Geiger and Karl-Heinz Häfele, KIT - Karlsruhe Institut for Technology
- Anke Niedermaier Allplan GmbH
- Bernhard Wiefel, Ing. -Büro Wolf-Logic
- Carlos Dias, buildingSMART Portugal
- Carlos Vasquez, Trimble
- Daan van Dee, HGG Group?
- David Lash, Trimble
- Didier Bonner, Ficep / Steel Projects
- Dr. Andre Bubner, Christmann & Pfeifer Construction GmbH & Co. KG
- Dr. Michael Huhn, Huhn-EDV
- Enrico Prataviera, AMV s.r.l.?
- Frédéric Grand, cobuilder and buildingSMART France
- Hannu Lahtela, Trimble Inc.
- Ingo Schnock, Leica
- Jakob Grave, Unternehmensgruppe Bung
- Jan Karlshøj, DTU, buildingSMART Danmark
- Jose Carlos Lino, buildingSMART Portugal
- Klaus Linhard, iabi
- Lorenz Erfurth and Harald Mueller, Trimble Solutions Germany GmbH
- Luke Faulkner, AISC - American Institute of Steel Construction
- Michael Evans, Trimble
- Mirbek Bekboliev, buildingSMART Germany
- Patrick Rhein, Behringer GmbH
- Ronald Kocker and Sharan Vijayagopal, bauforumstahl
- Rui Gavina, buildingSMART Portugal
- Stefan Jaud and Sergej Muhic, The Hard Code GmbH
- Stefan Stiegeler, Kaltenbach GmbH
- Thori Kwast, Ficep / Steel Projects
- Victoria Jung, RWTH Aachen
- Yoshiya Takemura, Kobelco?

Manufacturers / Fabricators / Machinery

- Behringer GmbH
- HGG Group?
- Kaltenbach GmbH
- Kobelco?

- Lamparter GmbH

6.1.2 Software Developers / Vendors

- Allplan GmbH (SDS2)
- <mark>Autodesk (Advance Steel)?</mark>
- Cobuilder
- Ficep/Steel Projects
- The Hard Code GmbH
- Trimble Solutions (Tekla Structures)
- …

6.1.3 Tools / Technology

- Asana (in-Kind Support by bS Germany)
- BIMcollab (License, in-Kind Support by bS Germany)
- BIMQ + bSDD (in-Kind Support by bS Germany)
- Citrix ShareFile (in-Kind Support by bS Germany)
- FZK Viewer (open source, advanced in-Kind support by KIT)
- IDS Creator and Validator (open source)
- ifcDoc Tool + GitHub (open source)
- Miroboard (in-Kind Support by bS Germany)
- MS-Teams (in-Kind Support by bS Germany)
- Process Mapping Tool (open source)
- Sketchup + bSDD API (License, in-Kind Support by bS Germany)
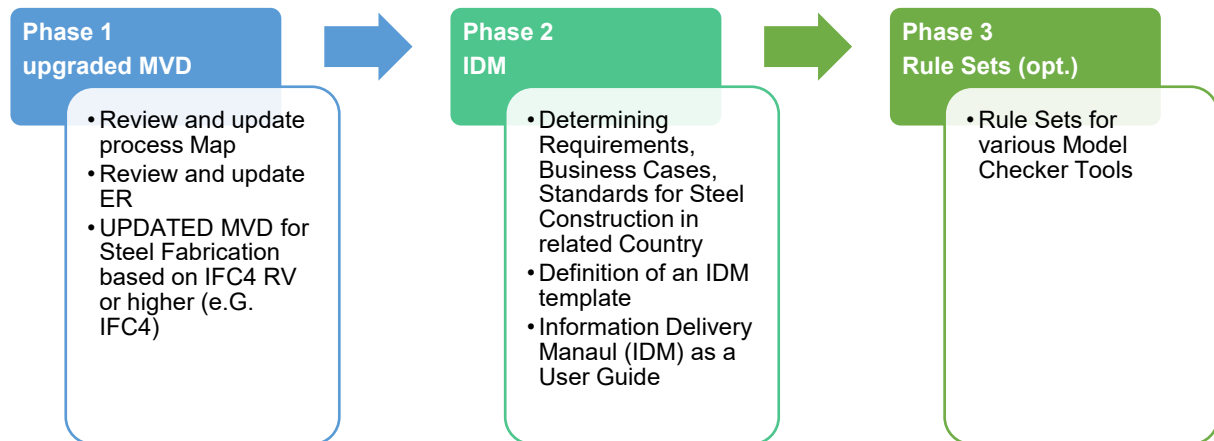- Tekla Structures (by Vendors)

6.1.4 Other

Demo Project Tools (in-Kind support by vendors)

6.2 PROJECT EXECUTION & MANAGEMENT

The project will be coordinated by Project Leaders and reported to bSI Building Domain Steering Committee and SCTE. As soon as deliverables would be available Expert Panels would be organized to gather industry feedback and comments.

7 WORK & TIME SCHEDULE

Phase 1
upgraded MVD
- Review and update process Map
- Review and update ER
- UPDATED MVD for Steel Fabrication based on IFC4 RV or higher (e.G. IFC4)

Phase 2
IDM
- Determining Requirements, Business Cases, Standards for Steel Construction in related Country
- Definition of an IDM template
- Information Delivery Manaul (IDM) as a User Guide

Phase 3
Rule Sets (opt.)
- Rule Sets for various Model Checker Tools

Phase 1:

Deliverable 1 (D1) Model View Definition (MVD)

Deliverable 1 (D1) Model View Definition (MVD)

D1. I-WP4 Review of existing MVD (Documentation and mvdXML)

D1. II-WP1 Review and Update Process Maps

D1. III-WP2 Review and Update ERs

D1. IV-WP3 IFC4-Models (for improvement of Exchanges) "DEMO"

D1. V-WPX UPDATED MVD for Steel Fabrication based on IFC4 RV

D1. VI-WP5 Rule Sets

Phase 2:

Deliverable 2 (D2) Technical Guidance (IDM as a user guide)

D2. WP1. Optimisation of Processes

D2. WP2. Determining Requirements, Business Cases, Standards for Steel Construction in related Country

D2. W3. Definition of an IDM template

D2. WP4. Information Delivery Manual (IDM) as a User Guide

Phase 3:

Deliverable 3 (D3) IDS (Information Delivery Specification)
IDS Creation

Test and Validation

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7.1   PROJECT MANAGEMENT / GOVERNANCE MEETINGS

Project meetings are held online and recorded. The Miroboard will be used to track changes as well as Asana Project Management Tool including Monday Tool.

7.2   MILESTONES

- End of Phase 1
- End of Phase 2
- End of Phase 3
- bSI Candidate Standard
- bSI Final Standard

Detailed timeline could be seen within the project:

https://app.asana.com/read-only/bSI-Steel-Construction/411381418715857/6f347d8a56f86fbfb577f19c38ca98bf/timeline

BD-2023-0002-DPP

8   BUDGET & FUNDING

The whole work could be covered within 154 600 €. From which 144600 € is covered by In-kind sponsorship by voluntary project participants and chapters (e.g., bS Germany).

In order to avoid travel and venue costs, meetings and collaboration will be conducted online.

Additional funding in amount of 10k USD will be provided by AISC which could cover the rest of the budget for administrative purposes.

Additional search for Funding Opportunities will be proceeded.

8.1   WORK EFFORT BREAKDOWN

Name	Manpower	Manhours
Deliverable 1 (D1) Model View Definition (MVD)		
D1. I-WP4 Review of existing MVD (Documentation and mvdXML)	3	9
D1. II-WP1 Review and Update Process Maps	5	7
D1. III-WP2 Review and Update ERs	45	75
D1. IV-WP3 IFC4-Models (for improvement of Exchanges) "DEMO"	14	31
D1. V-WPX UPDATED MVD for Steel Fabrication based on IFC4 RV	5	45
D1. VI-WP5 Rule Sets	2	16
Deliverable 2 (D2) Technical Guidance (IDM as a user guide)		
D2. WP1. Optimisation of Processes	5	7
D2. WP2. Determining Requirements, Business Cases, Standards for Steel Construction in related Country	45	90
D2. W3. Definition of an IDM template	3	3
D2. WP4. Information Delivery Manual (IDM) as a User Guide	7	12
Deliverable 3 (D3) IDS (Information Delivery Specification)		
IDS Creation	2	16
Test and Validation	2	8
Expert Panel	100	100
Review und Feedback	5	10
If necessary Update	3	9
Review Feedback	40	40
If necessary Update	3	9

8.2   FINANCIAL DISTRIBUTION

Name	Budget (in Kind)
Deliverable 1 (D1) Model View Definition (MVD)	
D1. I-WP4 Review of existing MVD (Documentation and mvdXML)	900
D1. II-WP1 Review and Update Process Maps	700
D1. III-WP2 Review and Update ERs	7500
D1. IV-WP3 IFC4-Models (for improvement of Exchanges) "DEMO"	3100
D1. V-WPX UPDATED MVD for Steel Fabrication based on IFC4 RV	4500
D1. VI-WP5 Rule Sets	1600
Deliverable 2 (D2) Technical Guidance (IDM as a user guide)	
D2. WP1. Optimisation of Processes	700
D2. WP2. Determining Requirements, Business Cases, Standards for Steel Construction in related Country	9000
D2. W3. Definition of an IDM template	9000
D2. WP4. Information Delivery Manual (IDM) as a User Guide	8400
Deliverable 3 (D3) IDS (Information Delivery Specification)	
IDS Creation	1600
Test and Validation	800
Expert Panel	100000
Review und Feedback	1000
If necessary Update	900
Review Feedback	4000
If necessary Update	900

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8.3 FUNDING ALLOCATION

The project is fully funded by in-Kind support through chapter and its members.

Additional funding will be provided in ca. amount of 10k USD.

ANNEX 1: DETAILED GANTT CHART

Detailed Gantt Chart could be viewed under the Asana Project Management Platform

https://app.asana.com/read-only/bSI-Steel-Construction/411381418715857/6f347d8a56f86fbfb577f19c38ca98bf/timeline

ANNEX 2: ANALYSES OF THE SCHEMA

Option 1

- Using **IfcVoidingFeature** for each process step which removes material from the main part instead of IfcOpeningElement

  Why?

- **Entity Definition:** A voiding feature is a modification of an element which **reduces** its **volume**. Such a feature may be **manufactured** in different ways, for example by **cutting**, **drilling**, or **milling** of members made of various materials.

- **MVD:** The entity IfcVoidingFeature is part of the official **bSI IFC4 Reference View Definition**

- **Predefined Types:** CUTOUT, NOTCH, HOLE, MITER, CHAMFER, EDGE

  Disadvantages:

- Tests have shown that not all software supporting IFC4 Reference View is able to import IfcVoidingFeature

Option 2

- Using **IfcAnnotation** to establish links between IfcVoidingFeature and reference planes.

  Why?

- **Entity Definition:** An annotation is a graphical representation within the geometric (and spatial) context of a project, that adds a note or meaning to the objects which constitutes the project model.

- **Recommended ObjectTypes:** SurveyPoint, ContourLine etc.

- **Predefined Types:** (Ifc4x3): ASSUMEDPOINT, ASBUILTAREA, ASBUILTLINE, NON_PHYSICAL_SIGNAL, ASSUMEDLINE, WIDTHEVENT, ASBUILTPOINT etc.

  Disadvantages:

- IfcAnnotation is not part of bSI IFC4 Reference View 1.2

- Tests have shown that not all software supporting IFC4 Reference View is able to import IfcAnnotation

Option 3

- Using **IfcRelAssignsToProduct** to establish links between IfcAnnotation and IfcVoidingFeature

- **Why?**

- **Entity Definition:** The objectified relationship IfcRelAssignsToProduct handles the assignment of objects (subtypes of IfcObject) to a product (subtypes of IfcProduct).

  Disadvantages:

- IfcRelAssignsToProduct is not part of bSI IFC4 Reference View 1.2

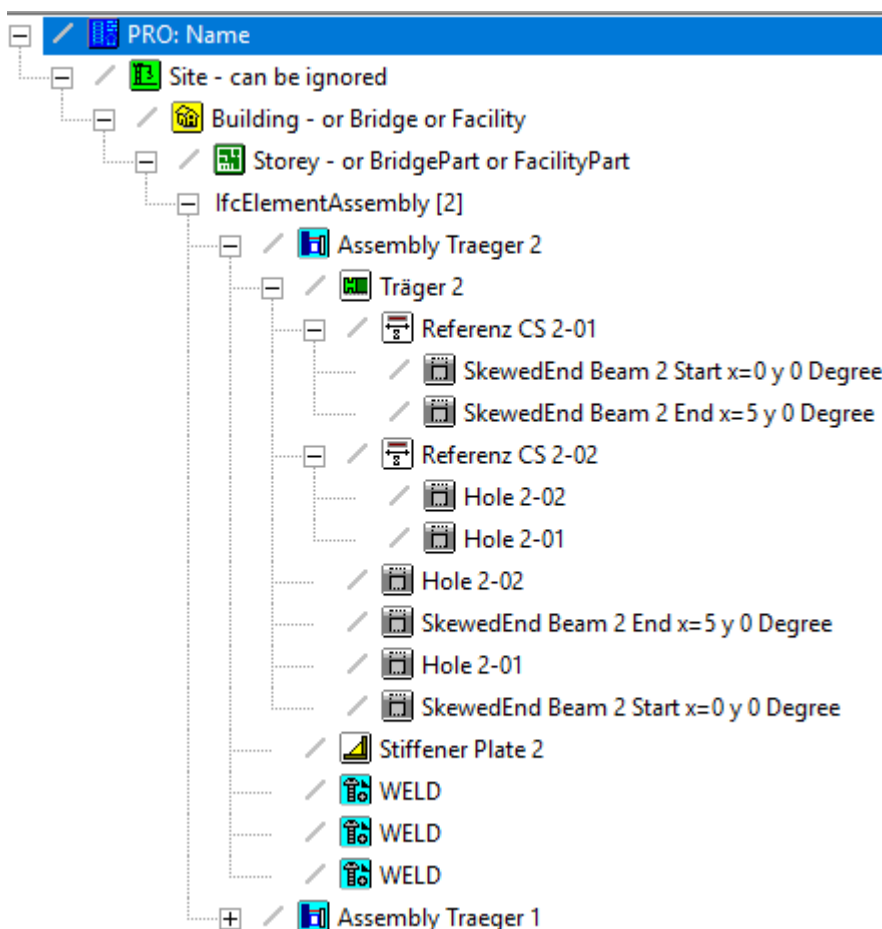- Tests have shown that not all software supporting IFC4 Reference View is able to import IfcVoidingFeature

Figure 6 Source: Karl-Heinz Häfele (KIT)

Option 4

- Defining material **IfcMaterial** or **IfcMaterialProfileSet** should be used for the material as planned. The material as fabricated should be defined in AISC_EM11_Pset_Material

  Why?

- **Entity Definition:** IfcMaterial is a homogeneous or inhomogeneous substance that can be used to form elements (physical products or their components).

- **MVD:** The entity IfcMaterial is part of the official **bSI Reference View Definition**

- **General:** IfcMaterial (Name, Description, Category) must have a name and a category. Name must be the material grade (Stahlsorte and Güte) (e.g. S355JR). A description is optional and can contain any text. Category must be material (Steel, Aluminium etc.).

    Disadvantages:

- **IfcMaterialProfileSet** is not part of bSI Reference View 1.2. So it is recommended to use IfcMaterial
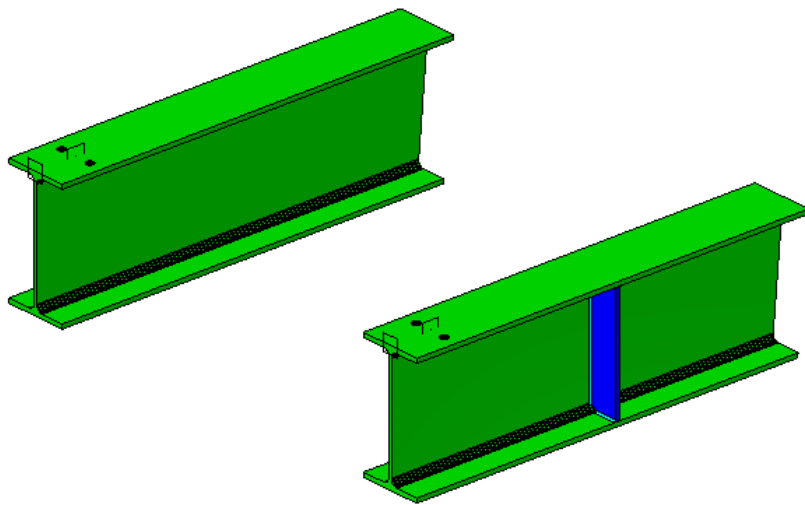

Figure 7 Assembly, Annotation, Voiding Feature, Plate with Assembly Properties, Relations, Material (Source: Karl-Heinz Häfele, KIT)
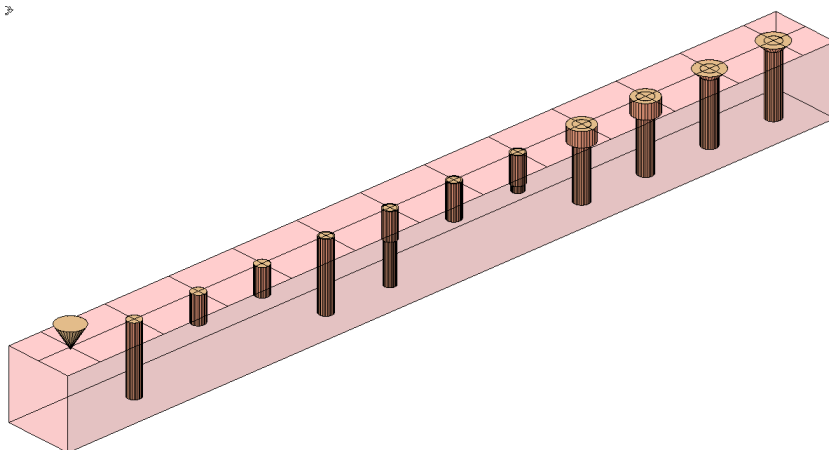

Figure 8 Voiding Feature, Plate with Voiding Feature Properties (Source: Karl-Heinz Häfele, KIT)