



# National BIM Standard - United States® Version 3

## 4 Information Exchange Standards

### 4.4 Design to Building Energy Analysis (BEA)

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#### 4.4.1 Scope

The Design to Building Energy Analysis (BEA) information exchange provides a process using a BEA analysis application to load into the Building information Model (BIM) with additional building energy modeling data and run a full building simulation of the energy that will be used by the building design. Building owner organizations are emphasizing the need for BEA and its integration with building design to improve energy efficiency. This guideline presents examples of implementation of using BIM – BEA exchanges in projects by large building owner organization driven by their BIM programs and software support.

More information about this program can be found on the GSA BIM/4D/3D Program website and in the GSA BIM Guide for Series 02 of their BIM program. More detail, including the information delivery manual (IDM) and model view definition (MVD) can be found on the IFC Solutions Factory website.

#### 4.4.2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

- Industry Foundation Classes (IFC) standard, <http://www.buildingsmart.com/>
- IFC Solutions Factory, tools for developing IDM/MVD, <http://www.blis-project.org/IAI-MVD/>
- OmniClass™ Classification, <http://www.omniclass.org/>

#### 4.4.3 Terms, definitions, symbols, units and abbreviated terms

For the purposes of this document, the following terms, definitions, symbols, units and abbreviated terms apply.

##### 4.4.3.1

##### **building energy analysis**

##### **BEA**

open, IFC-based BIM information exchange that enables designers and building owners to assess the projected energy use performance of a building design defined in a BIM

##### 4.4.3.2

##### **certification testing**

concept-based tests for every bit of data required by the MVD; a process for testing software's conformance with a given IFC release specification, and its subsets defined as views; promotes quality in IFC implementations and demonstrates to end-users that the software passing the certification implements the IFC specification in a consistent way, hence being able to exchange IFC product data with other certified software unambiguously

##### 4.4.3.3

##### **industry foundation class**

##### **IFC**

neutral and open specification that is not controlled by a single vendor or group of vendors; an object-based file format with a data model developed by buildingSMART to facilitate interoperability in the building industry, commonly used format for BIM

**4.4.3.4****Information delivery manual****IDM**

standard for processes specified when certain types of information are required during the construction of a project or the operation of a built asset; provides detailed specification of the information that a particular user (for example, architect, building services engineer) needs to provide at a point in time and groups together information that is needed in associated activities: cost estimating, volume of materials and job scheduling are natural partners

**4.4.3.5****Information exchange**

process of participants developing information and taking relevant information to share for use by other participants later in a project; information can be paper-based or in digital format

**4.4.3.6****model view definition****MVD**

standard methodology and format for documenting the software implementation requirements for standard IFC based data exchanges; structured into two main divisions 1) non-technical division to model exchange requirements for end-users and 2) technical division for software developers

**4.4.4 Design to Building Energy Analysis**

Design to Building Energy Analysis (BEA) is an open, IFC-based BIM information exchange that enables designers and building owners to assess the projected energy use performance of a building design defined in a BIM. A BEA analysis application loads the Building information Model (BIM) and adds some additional Building Energy Modeling data, and runs a full building simulation of the energy that will be used by the building design.

In 2008, buildingSMART alliance® and the Open Geospatial Consortium led a large project in which an early version of this Information Exchange was used. Dozens of industry leading companies participated in the AECOO Test bed project, which demonstrated successful exchange of a BIM and Energy Analysis of that building design in an Energy Analysis application.

The primary drivers for the Testbed and subsequent development for this Information Exchange were several building owner organizations. These building owners supported this development because of the real need to improve energy efficiency in their buildings. These organizations are beginning to use BIM exchange for BEA in their projects. These organizations include: GSA, Statsbygg, Senate Properties. Driven by these organizations' BIM programs, several software organizations have already implemented, or are now implementing support for this BIM information exchange in their products. These include: Autodesk (Revit and AutoCAD Architecture), Bentley (during AECOO), DDS (DDS-CAD), Graphisoft (ArchiCAD), Beck (dProfiler), US Dept. of Energy and Lawrence Berkeley National Lab (EnergyPlus), Granlund (RIUSKA), and Equa Simulations (IDA ICE).

More information about this program can be found on the GSA BIM/4D/3D Program web site and in the GSA BIM Guide for Series 05 of their BIM program. More detail, including the Information Delivery Manual (IDM) and Model View Definition (MVD) can be found on the IFC Solutions Factory Website.

**4.4.4.1 Information exchange**

As part of the NBIMS-US™ standard, this open, IFC-based information exchange and the products supporting it will improve the quality of building design using BIM, by providing quantitative feedback to designers and owners about the energy a proposed building will use. Driven by this feedback and

government incentives to improve energy efficiency, future buildings will be more energy efficient if this IFC BIM exchange is made a standard.

#### 4.4.4.1.1 IDM submission requirements

1. Process Maps - [http://www.blis-project.org/IAI-MVD/IDM/GSA-003/PM\\_GSA-003.pdf](http://www.blis-project.org/IAI-MVD/IDM/GSA-003/PM_GSA-003.pdf)
2. Exchange Requirements - [http://www.blis-project.org/IAI-MVD/IDM/GSA-003/ER\\_GSA-003.pdf](http://www.blis-project.org/IAI-MVD/IDM/GSA-003/ER_GSA-003.pdf)
3. Exchange Requirements Model Description - <http://www.blis-project.org/IAI-MVD/MVDs/GSA-003/Overview.pdf>
4. Exchange Requirements Model - <http://www.blis-project.org/IAI-MVD/reporting/browseMVD.php?MVD=GSA-003&BND=Generic&LAYOUT=H>
5. For convenience, the ERM can be downloaded in PDF format from: [http://www.blis-project.org/IAI-MVD/Snapshots/GSA-003\\_ERM\\_\(BEA\)\\_Design\\_to\\_BuildingEnergyAnalysis.pdf](http://www.blis-project.org/IAI-MVD/Snapshots/GSA-003_ERM_(BEA)_Design_to_BuildingEnergyAnalysis.pdf)

#### 4.4.4.1.2 MVD submission requirements

1. Model View Definition Overview - <http://www.blis-project.org/IAI-MVD/MVDs/GSA-003/IFC2x3.pdf>
2. Model View Diagrams - <http://www.blis-project.org/IAI-MVD/reporting/browseMVD.php?MVD=GSA-003&BND=IFC2x3&LAYOUT=H>
3. For convenience, the MVD can be downloaded in PDF format from: [http://www.blis-project.org/IAI-MVD/Snapshots/GSA-003\\_MVD\\_IFC2x3\\_\(BEA\)\\_Design\\_to\\_BuildingEnergyAnalysis.pdf](http://www.blis-project.org/IAI-MVD/Snapshots/GSA-003_MVD_IFC2x3_(BEA)_Design_to_BuildingEnergyAnalysis.pdf)

##### 4.4.4.1.2.1 Implementation specifications

Each MVD concept in the MVD diagrams is hyperlinked to the Implementation Guidance for that concept. Simply click on the MVD Concept box in the diagrams (either online web pages or the PDF download) to link to the implementation specifications web page in your browser.

#### 4.4.4.2 Software implementation requirements

##### 4.4.4.2.1 Implementation support

As described above, several vendors have already implemented support for BEA in their products, as part of their implementations supporting the Concept Design BIM 2010 (CDB-2010). CDB-2010 rolls together the requirements of four IDMs into a single composite MVD. Implementations began in September 2009. Vendors have been supported through the implementation process through a bi-weekly meeting in which questions are addressed, results are reviewed, and issues resolved. Implementing vendors and products include:

##### 4.4.4.2.2 Exporting applications:

- Autodesk – Revit 2012 and AutoCAD Architecture 2012
- Beck Technologies – DProfiler
- Graphisoft – ArchiCAD 15

- Data Design Systems – DDS-CAD

#### 4.4.4.2.3 Importing application:

- DOE/National Labs (LBNL, NREL, PNNL) – EnergyPlus
- Granlund Oy – RIUSKA
- Equa Simulations – IDA ICE

#### 4.4.4.3 Certification test program

Certification testing began in October 2009. We expect that most of these applications will be certified for correct support of BEA in 2011 (as currently defined). Certification testing is MVD concept-based, and takes the unit testing approach. This means that there are tests for each and every bit of data required by the MVD. These tests are specific enough to ensure that the IFC BIMs being exported by certified applications are absolutely consistent and can be predictably loaded and analyzed by any certified BEA analysis application.

Sample Certification Test Results Package – [http://www.blis-project.org/IAI-MVD/testing/GSA-005/DProfiler\\_CDB-2010\\_TestResults\\_02-Jun-11\\_3.zip](http://www.blis-project.org/IAI-MVD/testing/GSA-005/DProfiler_CDB-2010_TestResults_02-Jun-11_3.zip)

This package includes:

- Submitted IFC BIM file
- Certification Test Results Summary Report
- Certification Test Results Detailed Reports – 37 of these – one for each high-level MVD Concept (e.g. wall, door, window)

#### 4.4.4.4 Use of this information exchange in industry projects

##### 4.4.4.4.1 Pilot projects using BEA

- AECOO Testbed Project – Use of BEA exchange in this project began in late 2008 and was completed in early 2009. The BIM authoring application was ArchiCAD 13. The BEA analysis Application was EnergyPlus. Results of the project were widely publicized by buildingSMART alliance® and the Open Geospatial Consortium.
- Van Buren Land Port of Entry - Use of BEA exchange in this project began in late 2010 and is expected to conclude successfully by end of summer 2011. The BIM authoring application is ArchiCAD 14 and 15. The BEA analysis application is EnergyPlus.
- O'Mahoney Federal Courthouse -- Use of BEA exchange in this project began in late 2010 and is expected to conclude successfully by end of summer 2011. The BIM Authoring application is Beck Technologies' dProfiler. The BEA analysis application is EnergyPlus.

##### 4.4.4.4.2 BEA BIM validation for end users

An online BIM Validation service is being developed and will be made public by end of 2011. This online service will enable end users to upload their IFC BIM to be checked for conformance to exchange standards defined by IDMs and MVDs. Checking IFC BIMs for conformance to the BEA information exchange will be supported by this service. Testing with Vendors has already begun.

#### 4.4.4.4.3 Reference standards

- Industry Foundation Classes (IFC) standard – see <http://www.buildingsmart.com/>
- IFC Solutions Factory – tools for developing IDMs/MVDs – see <http://www.blis-project.org/IAI-MVD/>
- OmniClass™ Classification – see <http://www.omniclass.org/>

#### 4.4.5 Bibliography

IFC, IDM, <http://www.buildingsmart.com/>

MVD, <http://www.blis-project.org/IAI-MVD/>