

# Developing Standards-Based Education Modules for Building Information Modeling

Education Module 2: Industry Foundation Classes  
(IFC)

Topic #1 Fundamentals of IFC  
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# Learning Objectives

- To equip students with fundamentals of IFC
- Upon completion of this session, students will be able to:
  - Understand what IFC is and its role as an open standard in the AEC/F industry.
  - Describe the purpose and structure of IFC.
  - Identify key components and capabilities of IFC files.
  - Explain how IFC enables interoperability and data exchange across various BIM tools and disciplines.
  - Recognize the advantages of using IFC in design, construction, and facility management workflows.



# What is IFC?



# Industry Foundation Classes (IFC)

- **IFC** stands for **Industry Foundation Classes**.
- **Origin & Purpose**
  - IFC is a product of BuildingSMART International. It is an open standard file format tailored specifically for the construction sector.
- **Standardization**
  - Recognized globally by the International standard, ISO 16739.
- **Role in AEC/F**
  - It serves as a unified data format for seamless information exchange across Architecture, Engineering, Construction, and Facility Management domains.



# Industry Foundation Classes (IFC)

- **Characterization & Relationship**

- IFC captures both the physical and functional attributes of building components - from walls, roofs, and doors to their interrelationships and overall connection to the building structure.

- **Applications**

- Beyond design, IFC is instrumental in various phases of construction and facility management including analysis, simulation, operation, maintenance, and renovation.



# Industry Foundation Classes (IFC)

- **Snapshot of Original Content**
  - IFCs provide a "static" or "frozen" replica of the original BIM data.
- **Versatile Utility**
  - IFCs can be leveraged for viewing, measurements, clash detection, cost estimations, simulations, and more.
- **Limited Edit Capability**
  - Although IFCs aren't primarily designed for editing, it's technically feasible to do so.



# Industry Foundation Classes (IFC)

- **Common Software Perception**

- Most BIM software perceive IFC as a referential copy, aligning more with the original design's intent.

- **Exceptional Edit Scenarios**

- Some advanced tools permit minor edits on IFC files, like segmenting a concrete slab for distinct construction phases.



# Industry Foundation Classes (IFC)

- **Information Transmission:** IFCs encapsulate rich details, enabling various software tools to interpret and analyze the 3D spaces and components within a model.
- **Workflow in Action:**
  - **Design Stage:** An architect crafts a design model.
  - **Collaboration:** The architect exports an IFC version for the engineer's reference.
  - **Engineering Tasks:** The engineer integrates this IFC into their software for coordination and groundwork analysis.
  - **Feedback Loop:** Should modifications be required, the engineer communicates this to the architect.
  - **Refinement:** The architect adapts the design in their primary software and rolls out a fresh IFC for the engineer's use.



# Industry Foundation Classes (IFC)

- **IFC vs. DXF:**
  - IFC focuses on \*Object Mode\* exchange, representing intelligent components like walls, doors, and windows.
  - DXF emphasizes \*Graphic Entity\* exchange, detailing basic shapes such as lines, arcs, and circles.
- **Universal Accessibility:**
  - IFC is non-proprietary and globally available, allowing adoption by any software vendor in the industry.
- **Unified BIM Communication:**
  - IFC serves as a superior common language, enabling the exchange of smart objects across different disciplines throughout a building's lifecycle.



# Components of an IFC Model File

- The geometry of a model and other necessary elements are included in an IFC model file.
  - Using an IFC viewer, it's simple to see these components.
- Key Components of an IFC File:
  - **Structural Insights:** Understand the structure and interrelations of varied geometric elements.
  - **Thermodynamics:** Access calculated properties derived from specific measurements.
  - **Structural Properties:** Gain insights into value calculations for various building structures.
  - **Cost Essentials:** Obtain the necessary quantities for precise cost estimations.
  - **Environmental Impact:** Discern properties concerning their ecological influence.



# Advantages of using IFC in a Project

- **Data Organization:** IFC's data schema systematically organizes model data, fostering seamless collaboration among project stakeholders.
- **Simultaneous Collaboration:** With IFC, project participants can harness varied tools and software to collaboratively work on the same model, eliminating redundancies and enhancing productivity.
- **Overcoming Collaboration Barriers:** Without IFC, the alternative may involve tedious manual data input or even halt collaborative efforts.



# Advantages of using IFC in a Project

- **Universal Data Language:** IFC files create a Common Data Environment (CDE), enabling participants to share data in a standardized, universally comprehensible format.
- **Interoperability Assurance:** All IFC-compliant software can intuitively interpret and utilize the data within IFC files, ensuring data consistency across platforms.



# **IFC applications in the AEC/F industry and BIM**



# Interoperability

- **Universal Integration Platform:** IFC offers a platform for various software applications, ensuring integrated digital workflows for:
  - Architects
  - Engineers
  - Contractors
  - Facility managers



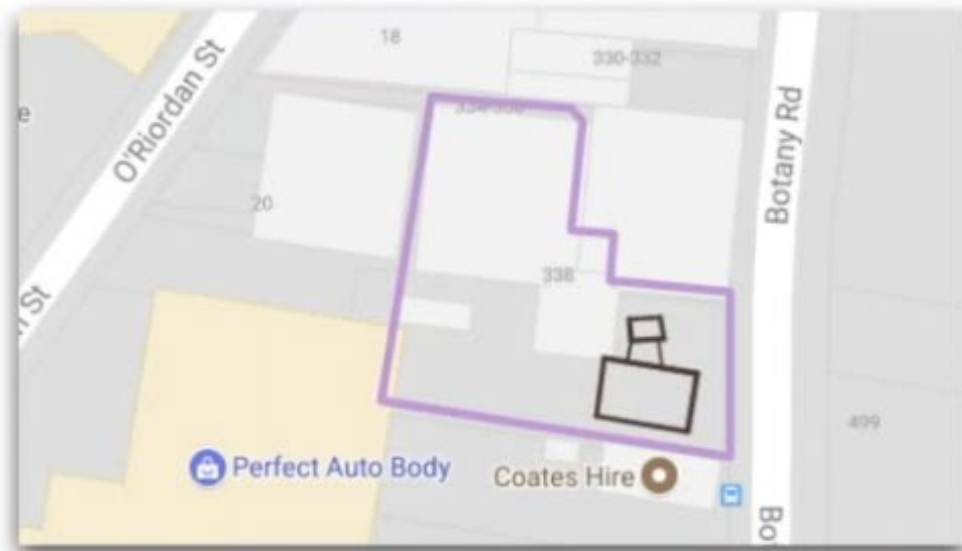
# Interoperability

- **The “USB” of the BIM World:** Much like how a Universal Serial Bus (USB) standardizes data transfers across diverse computer brands, IFC ensures smooth BIM data transfer across different software packages.
- **Efficiency & Accuracy:**
  - Drastically reduces chances of data loss and miscommunication errors during exchanges.
  - Eliminates the tedious process of manual re-entry, ensuring both time-saving and error reduction.



# There is so much software...





```
#13= IFCLOCALPLACEMENT($,#12);  
#14= IFCGEOMETRICREPRESENTATIONCONTEXT(*,'Model',3,0.0000100000000000,#11,$);  
/* definition of coordinate reference system (CRS) */  
#15= IFCPROJECTEDCRS('EPSG:28356','BILT Developments Setout','GDA94','AHD','EPSG:28356','56',$);  
/* definition of geo-referencing Helmert parameters */  
#500= IFCMAPCONVERSION(#14,#15,333745.832,6246590.531,1.759,0.989810776056595,-0.142389000987578,  
0.999941534120026);  
#16= IFCOWNERHISTORY(#5,#6,$,.NOTDEFINED.,$,,$,1526267506);  
#17= IFCSIUNIT(*,.LENGTHUNIT.,$,.METRE.);
```

# IFC Compatible Software

- Revit
- Plannerly
- Trimble Connect
- Revizto
- BIMcollab
- Dalux
- Autodesk Construction Cloud/BIM 360
- Graphisoft ArchiCAD
- Solibri Model Checker (SMC)
- BricsCAD BIM
- Many Other Open-Source Programs



# Checking Quality and Viewing Models

- **Advanced BIM Quality Checks:**

- Utilize specialized applications like SMC to set and execute intricate rule-based checks on BIM models.
  - Example: Ensure all doors in the model adhere to ADA compliance.
  - Example: Validate if stairs meet specific code requirements.

- **Efficient Model Viewing with IFCs:**

- Easily import IFCs into a variety of model viewers.
- Benefit: IFCs are typically leaner than native BIM files, consuming fewer resources, ensuring smoother operation and faster performance.



# Collaboration and Data Sharing

- **Centralized Collaboration Platform:**
  - All stakeholders access and contribute to one unified database or model.
- **Benefits of Unified Collaboration:**
  - **Enhanced Communication & Coordination:** Streamlines decision-making processes.
  - **Operational Efficiency:** Facilitates faster and more accurate data exchanges.
  - **Cost Efficiency:** Minimizes overheads and reduces potential for errors.
  - **Optimized Project Outcomes:** Ensures everyone operates from a consistent knowledge base, leading to better project results.
- **Integration with Autodesk Services:**
  - Leverage IFC with tools like Autodesk's Construction Cloud and BIM 360 for holistic project management.



# Sustainability and Innovation

- **Virtual & Augmented Reality Integration:**
  - Opt for plugins like **BIMxplorer** for instantaneous IFC file views in VR.
    - [Visit BIMxplorer](#)
- **BIM & GIS Symbiosis:**
  - Enrich analytics & visualization by importing IFC files into **ArcGIS Pro**.
  - This fusion allows the geolocation of models and facilitates deeper, location-based analytics.



# Other Applications

- Clash Detection
  - Example using Visicon: [https://www.youtube.com/watch?v=4y-C5bKt\\_6Q](https://www.youtube.com/watch?v=4y-C5bKt_6Q)
- Cost Estimating
  - BIMvision is a program that allows users to quickly perform quantity take off using a developed model.
- Asset Management
- Energy Analysis



# Summary

- IFC (Industry Foundation Classes) is a global, open, ISO-certified standard for BIM data exchange.
- It supports interoperability across diverse AEC/F software and disciplines.
- IFC captures both physical and functional aspects of building components, enabling use in design, simulation, cost estimating, and more.
- The format facilitates collaborative workflows by providing a Common Data Environment (CDE).
- Tools like Revit, ArchiCAD, Solibri, and others support IFC, allowing for wide accessibility.
- IFC integration enhances efficiency, accuracy, and project outcomes by eliminating manual data re-entry and reducing miscommunication.



# Assignment

- Watching Video: Introduction to IFC
  - <https://www.youtube.com/watch?v=5ncTjexvk9E>
- Reading assignment:
  - <https://aecmag.com/opinion/ifc-what-is-it-and-why-is-it-needed/>
  - <https://www.infotechinc.com/blog/the-structure-of-bim-understanding-the-importance-of-ifc-standards/>
  - <https://www.midasbridge.com/en/blog/importance-of-ifc-in-bim>
  - <https://aecmag.com/bim/inside-buildingsmart/>
  - <https://nzangimuimi.com/blog/ifc-in-construction/>



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