



L1.1 Introduction to BIM-GIS Integration

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Learning outcomes

At the end of this lecture, the learner is expected to be able to:

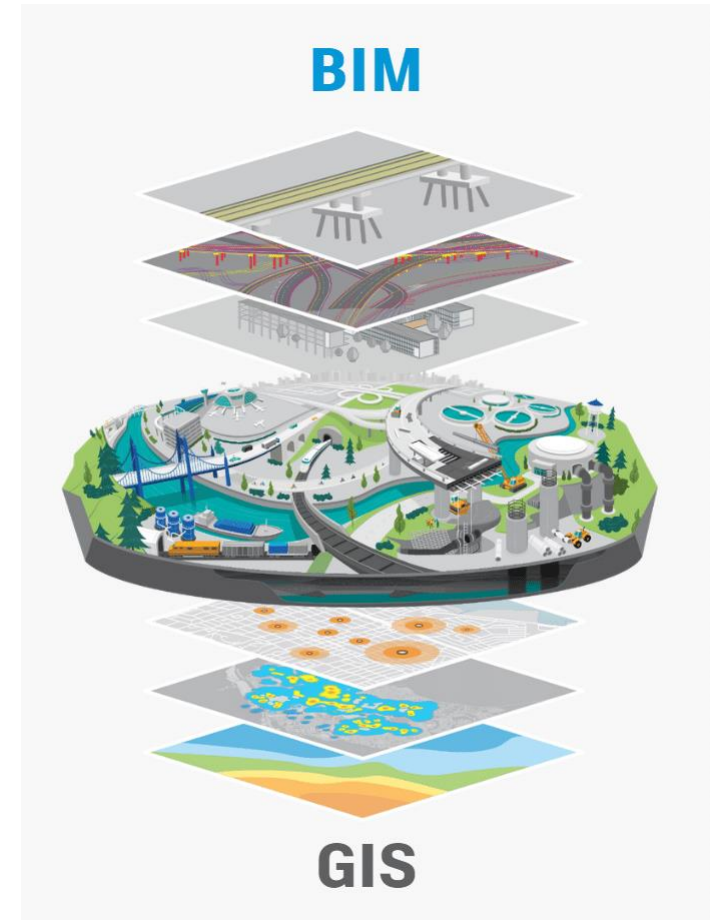
- Explain why to integrate BIM and GIS based on their main concepts
- Understand differences between interoperability and full integration
- Know the differences between BIM and GIS that challenge the integration

Course-block overview (L1.1 – L1.3)

Both BIM and GIS provide 3D data

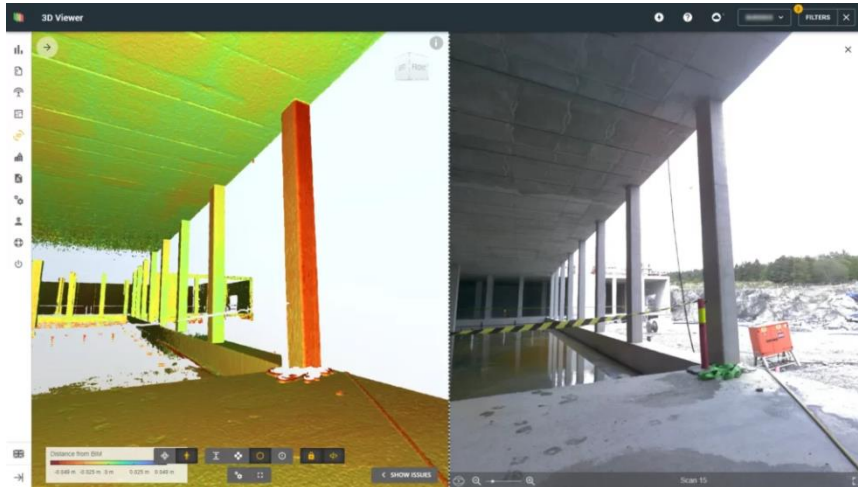
- How easy or complicated is to use the data together?
- What are the benefits and the challenges?
- How does the process proceed?

[BIM-AND-GIS.png \(1233×919\) \(constructionplacements.com\)](#)



Why to use BIM?

- Building Information Modelling
- Detailed digital 3D models of newly designed buildings, process for whole life-cycle



<https://bimcorner.com/augmented-reality-in-aec-industry/>

WHAT IS BIM?

BIMCORNER.COM



3D Model

Carrier of information and the dependencies of objects among each other



Technology

Used in Architecture Engineering & Construction



Information

Closely connected to the 3D model, allowing them to be easily found and accurate



Process

Starting from the investor's requirements, through design, construction stage, to the facility management during its lifetime



Documents

Appropriately named and placed in the CDE



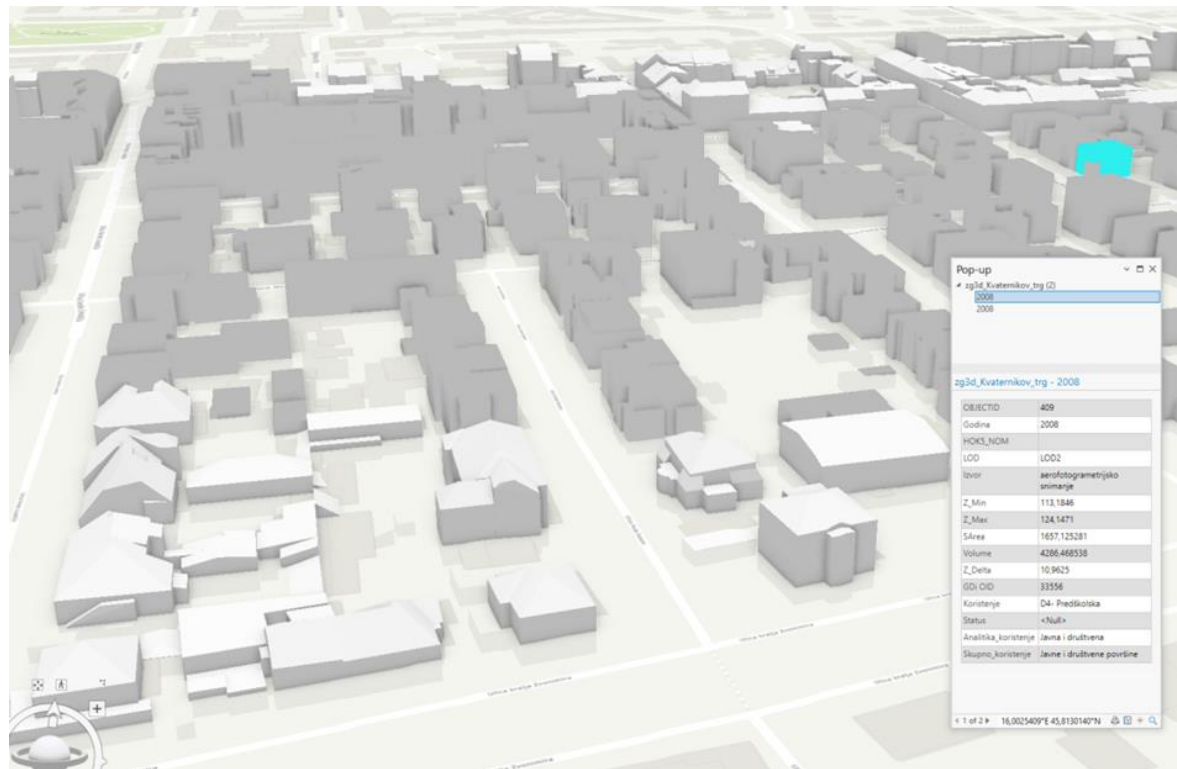
Common Data Environment

As a disk space for information sharing available for all stakeholders

[Everything You Should Know About Basics of BIM Technology – Bim Corner](#)

Why to use GIS?

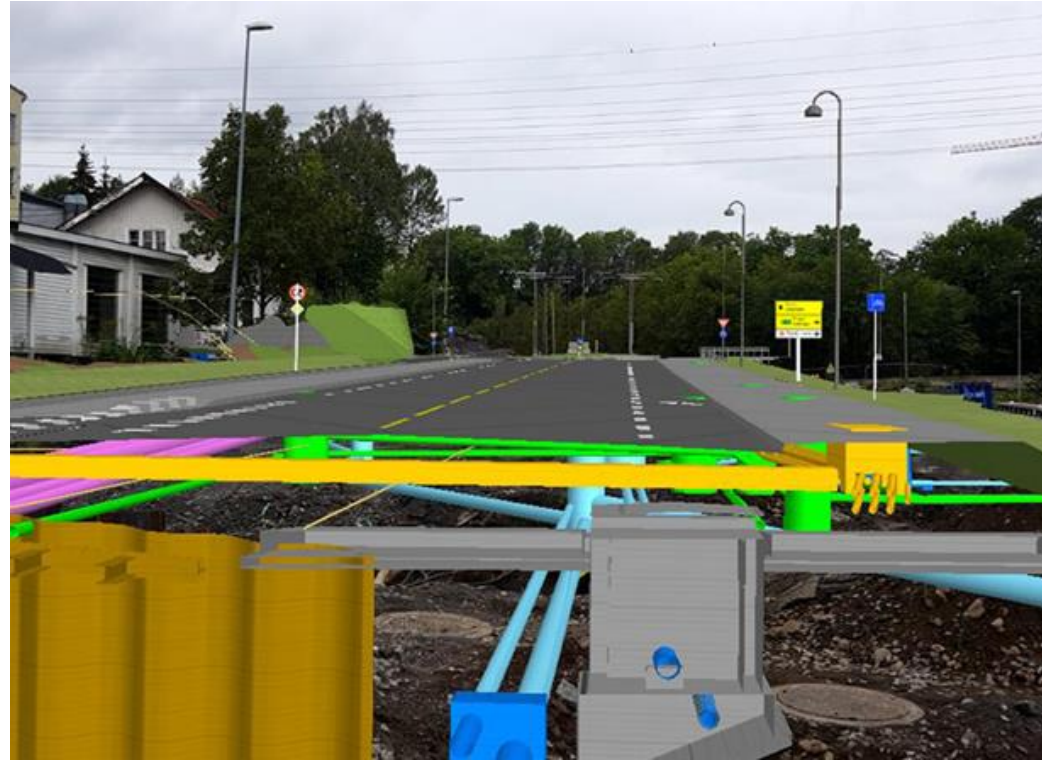
- Semantic 3D city models in our context
- Each building is an individual object
- Can include attributes, interactions, environmental data etc.
- Can be completed by many other GIS data



Semantic 3D model of Zagreb, Croatia. Screenshot from ArcGIS Pro.

Why to Integrate BIM and GIS?

- GIS informs BIM i.e. GIS provides the context to the detailed BIM models, such as surroundings, environment, population
- Environment influences the buildings and vice-versa
- New insights which would remain hidden without the integration



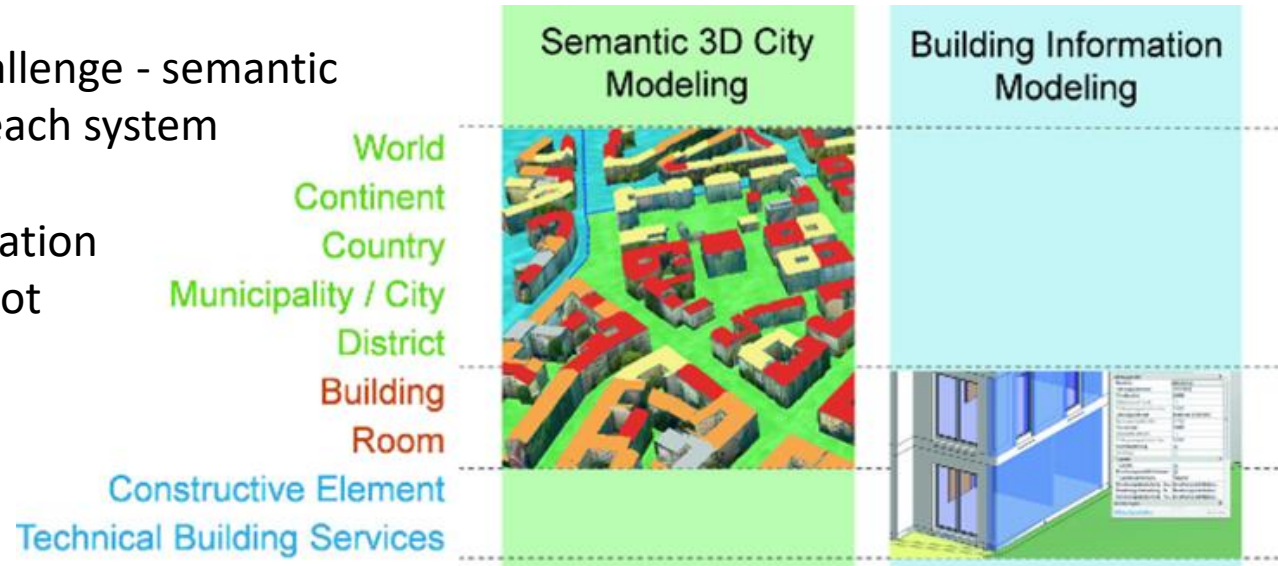
<https://bimcorner.com/smarter-faster-better-7-ai-tools-that-impact-the-aec/>

BIM-GIS Interoperability

- BIM and GIS data are not completely compatible
- Semantics is the main challenge - semantic information is unique in each system
- Some parts of this information can be translated, some not

- Interoperability is ability to exchange and use information between different software tools

Relation of semantic 3D city modelling and BIM modelling with respect to scope and scale. From Kolbe and Donaubauer (2021) [Semantic 3D City Modeling and BIM](#) | SpringerLink



BIM-GIS Integration

- Integration is the next level above interoperability
- Defined as “Progressive combining of system components into an overall system” = not only the ability to use information in different software
- Aggregating BIM and GIS data into a single unified database, sharing of information in it



BIM model used in a city model. Esri's training data, screenshot from ArcGIS Pro.

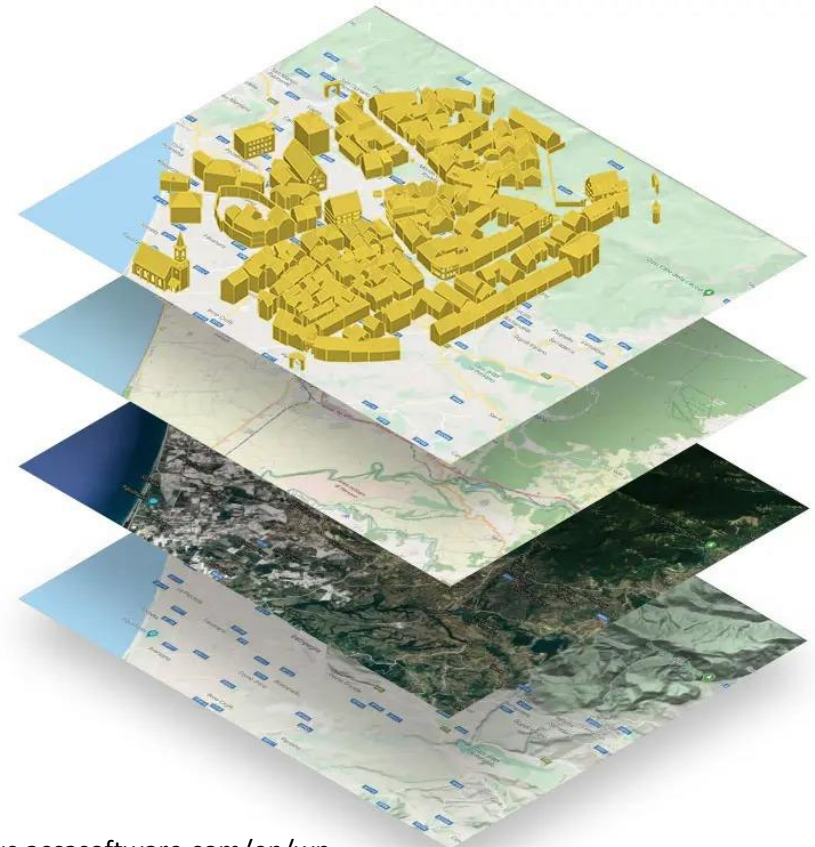
Different Scope and Scale of BIM and GIS

BIM

- Typically new buildings
- AEC industry
- Specific individual buildings
- Thousands of properties

GIS

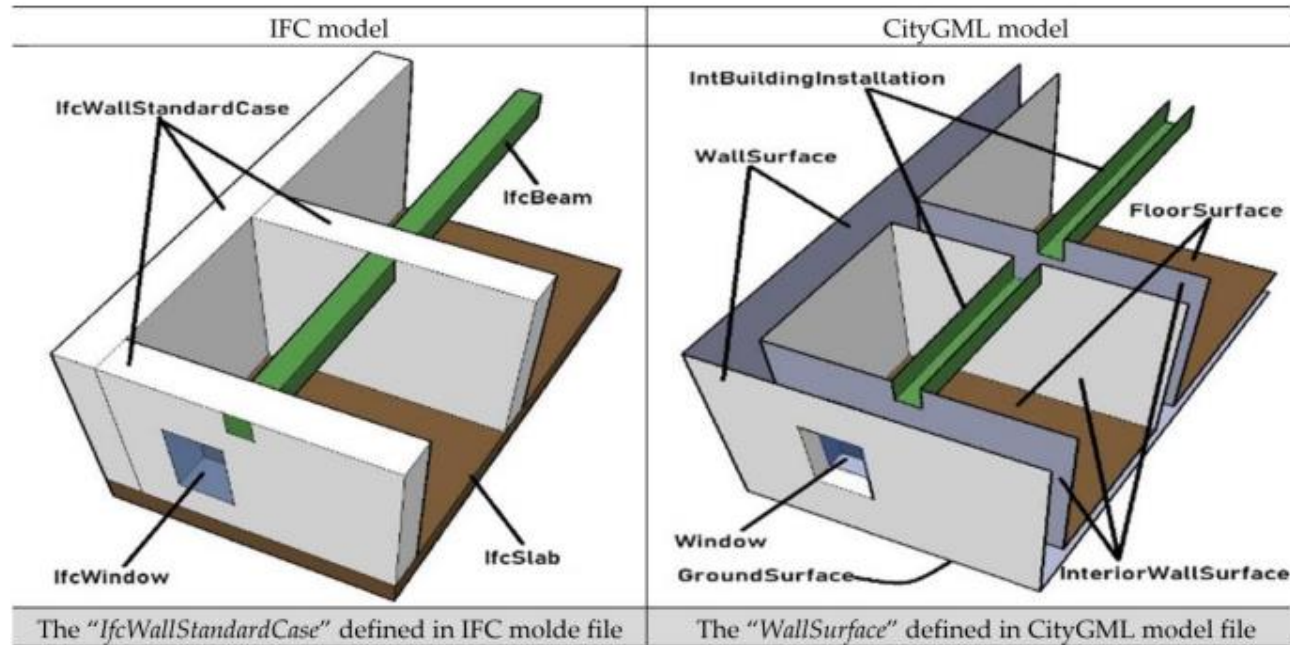
- Large built areas
- Often public sector
- Many buildings with less properties
- Surrounding of buildings as well



<https://biblus.accasoftware.com/en/wp-content/uploads/sites/2/2022/10/usBIM-GIS.jpg>

Different Formats - IFC and CityGML

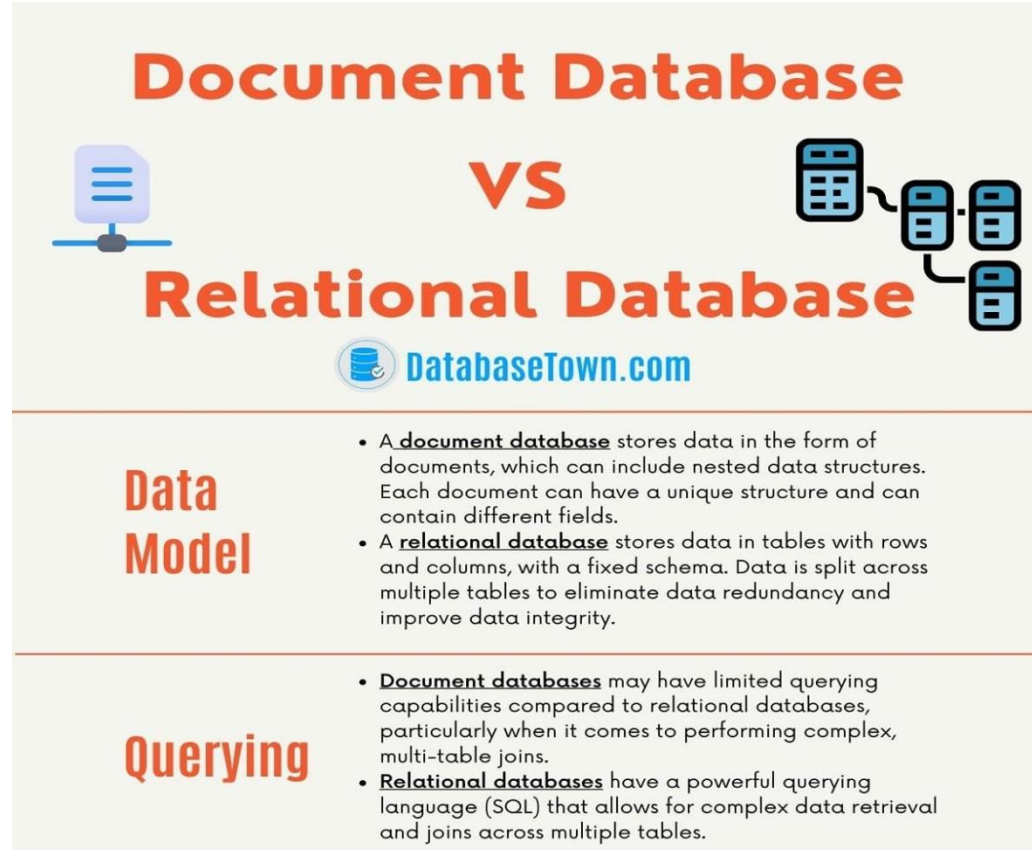
- Both semantic modelling
- IFC more semantically rich (=more info)
- It challenges conversion
- Limit IFC complexity prior the conversion



Example of differences between IFC and CityGML model. From: Ding et al (2017)

Data Storage – File System and Database

- BIM and GIS use different systems of data storage
- BIM uses a file system, organised and accessible in Common Data Environment
- GIS data are stored in relational databases
- Can be accessed and queried by SQL

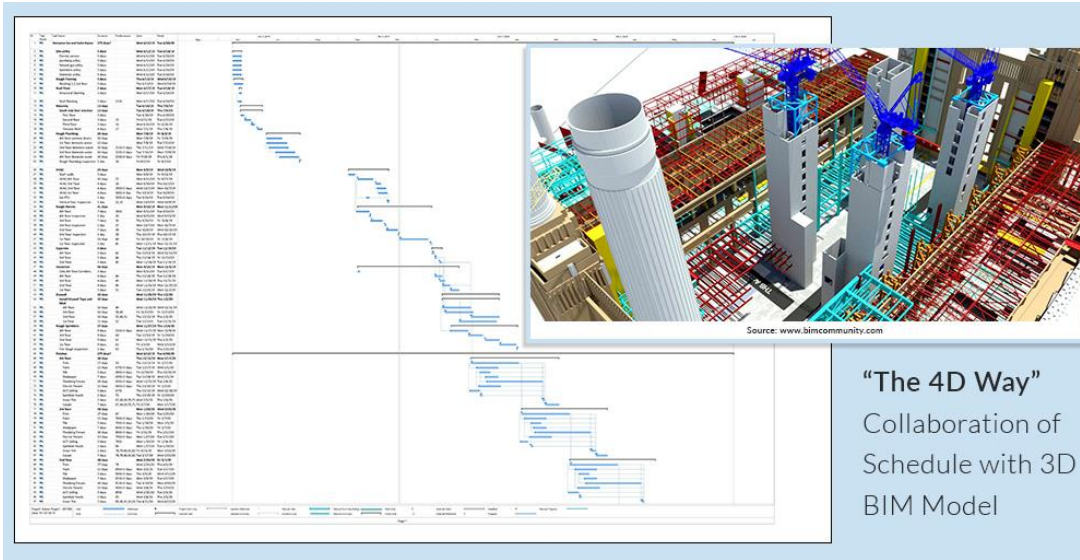


Document Database VS Relational Database

DatabaseTown.com

	Document Database	Relational Database
Data Model	<ul style="list-style-type: none">• A document database stores data in the form of documents, which can include nested data structures. Each document can have a unique structure and can contain different fields.	<ul style="list-style-type: none">• A relational database stores data in tables with rows and columns, with a fixed schema. Data is split across multiple tables to eliminate data redundancy and improve data integrity.
Querying	<ul style="list-style-type: none">• Document databases may have limited querying capabilities compared to relational databases, particularly when it comes to performing complex, multi-table joins.	<ul style="list-style-type: none">• Relational databases have a powerful querying language (SQL) that allows for complex data retrieval and joins across multiple tables.

Frequency of Updates



The-4D-Way-Collaboration-of-Schedule-with-3D-BIM-Model-Blog-by-United-BIM_.jpg

- BIM – frequent updates, especially during construction
- 3D City models – no need of frequent changes
- BIM-GIS integrated models need to be updated as often as the BIM itself
- Seamless compatibility crucial

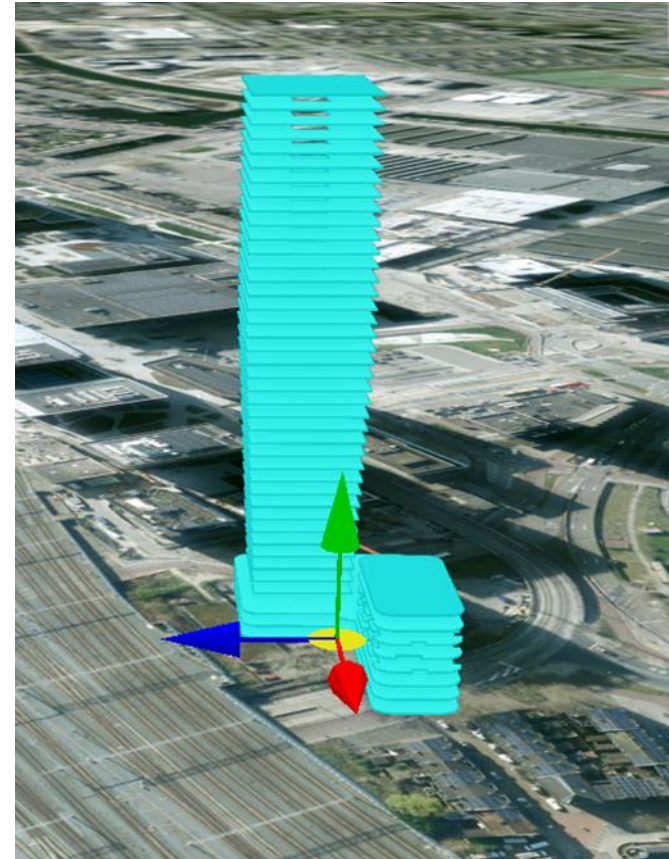
Georeferencing – total and local

BIM

- own local referencing system as default
- connected to the construction site

GIS

- always absolutely georeferenced = real-world coordinate system
- necessary to control if IFC is georeferenced otherwise georeference it or include georeferencing in the integration



Adding BIM model into GIS, Esri's training data, screenshot

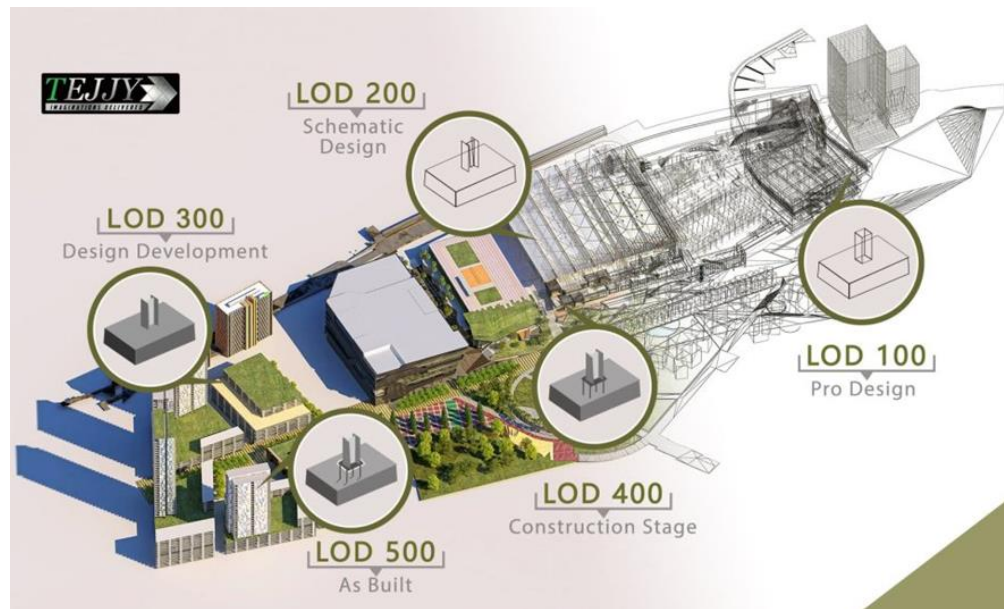
LoD, Level of Detail

BIM

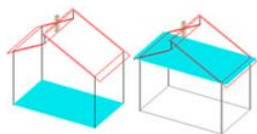
- also called “level of development”
- Information levels at various phases of the life-cycle

GIS

- Generalisation of the model
- Diverse LoD in the same model



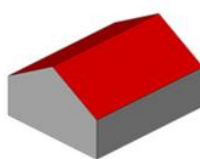
LOD0



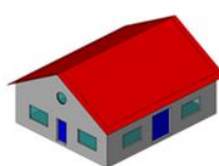
LOD1



LOD2



LOD3



Up: LoD in BIM. From: <https://www.tejy.com/wp-content/uploads/2021/11/Level-of-Development-LOD-Tejy-Inc-1-1024x627.jpg>

Left: LoD in GIS. From: <https://www.gim-international.com/content/news/citygml-3-0-conceptual-model-approved-as-official-ogc-standard>

Thank you for your attention



<https://birgitproject.eu/>

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