

# SBS5322 Basics of Building Information Modelling

<http://ibse.hk/SBS5322/>



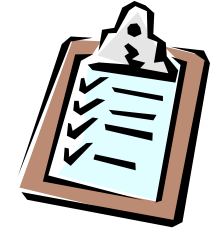
## What is BIM?



*Ir. Dr. Sam C. M. Hui*  
Faculty of Science and Technology  
E-mail: [cmhui@vtc.edu.hk](mailto:cmhui@vtc.edu.hk)

Jan 2018

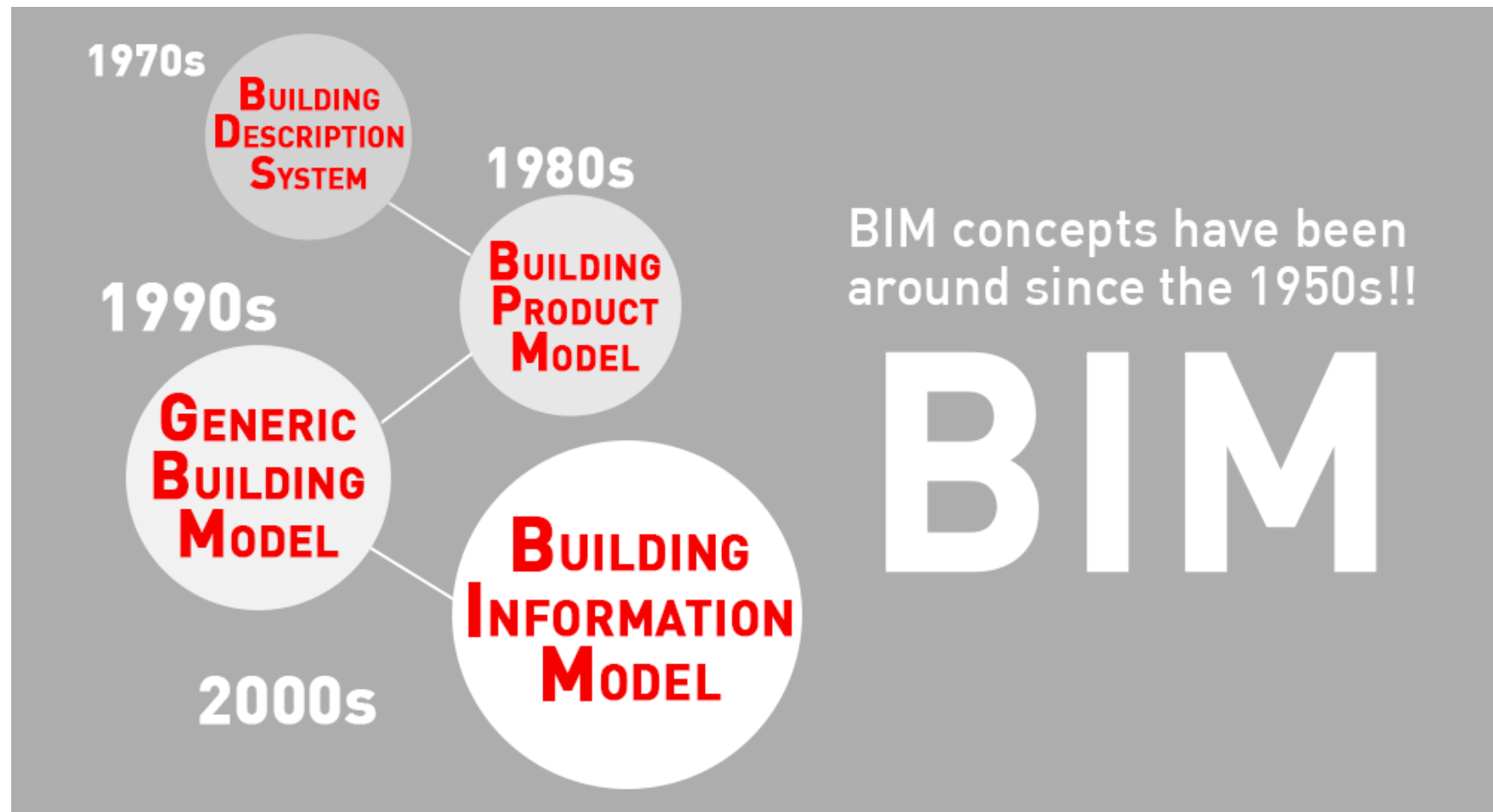
# Contents



- History: From 2D to BIM
- BIM elements and standards
- BIM dimensions
- BIM maturity levels
- Level of development (LOD)

# History: From 2D to BIM

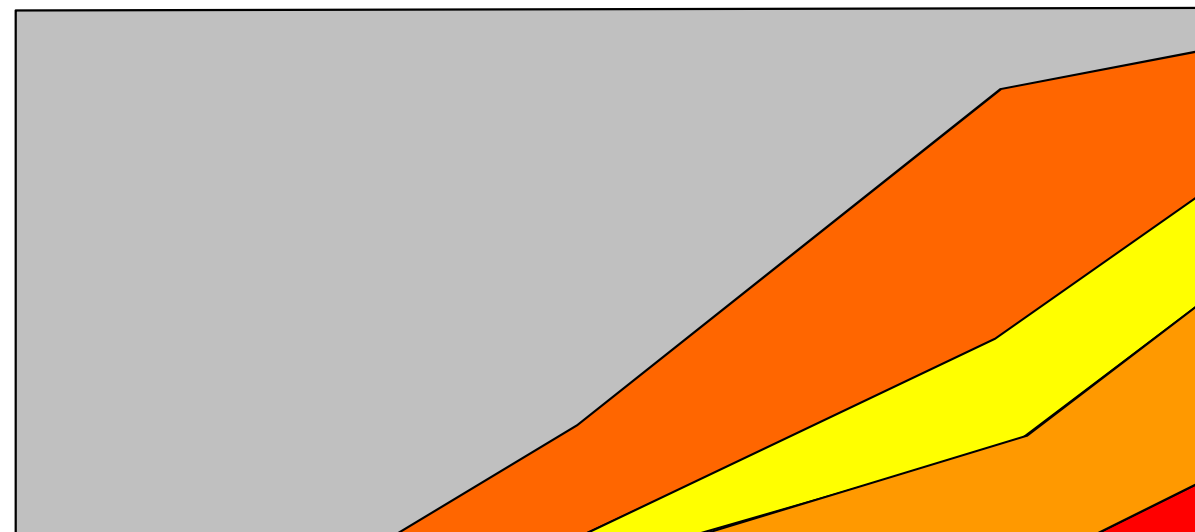
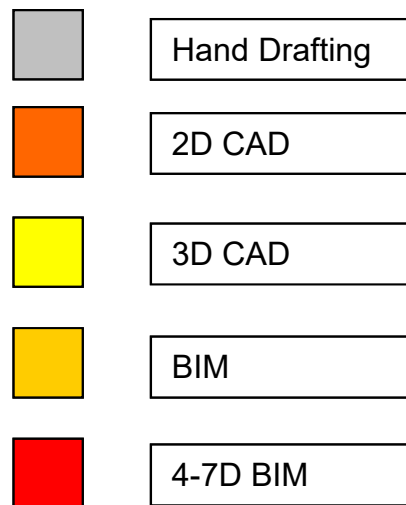
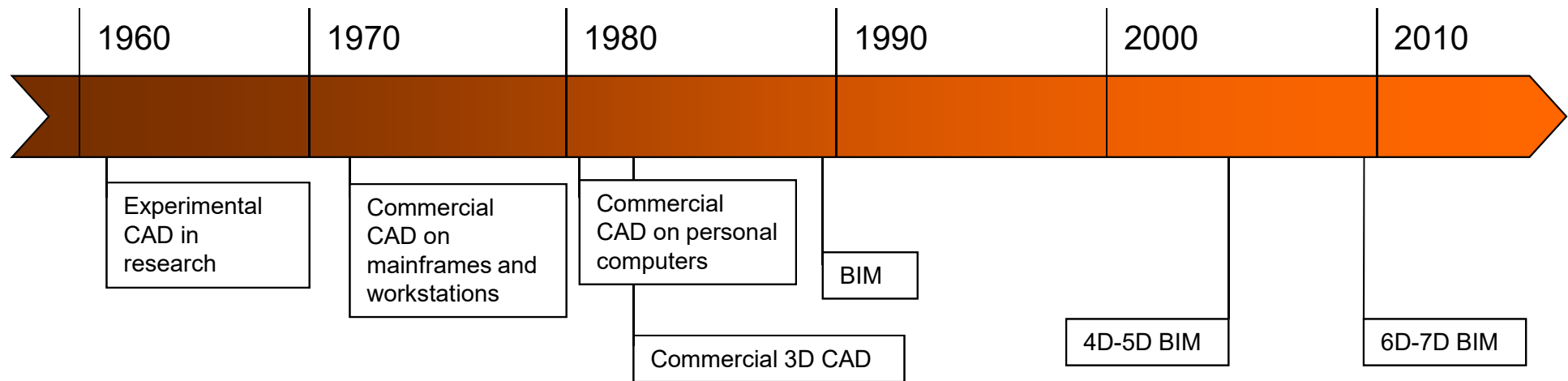
- BIM concept has existed since the late-50s



# Evolution of AEC CAD

- 2D solutions
  - Electronic drafting board
- 3D solutions
  - Modeling for pure visualization purposes
- BIM solutions
  - Models with integrated architectural information
- 4D-5D BIM - Construction Coordination
  - Timing/scheduling and Cost estimation
- 6D-7D BIM
  - Facility Management and Life Cycle Management

# AEC CAD Timeline



# 2D CAD - Workflow

- Design and document all in 2D
- No 3D model
- Drawings in separate files
- Manual coordination of drawings
- No visualization and calculation tools



# 2D CAD - Evaluation

## Benefits

Compared to hand drafting

- Fast modifications
- Accuracy
- Intelligent drafting tools (fills, dimensions)
- Repetitive element handling (blocks, xrefs)

Compared to 3D CAD and BIM

- Simple working concept (electronic drafting)
- Relatively small file size (only 2D data)
- Workflow is applicable for all building types

## Drawbacks

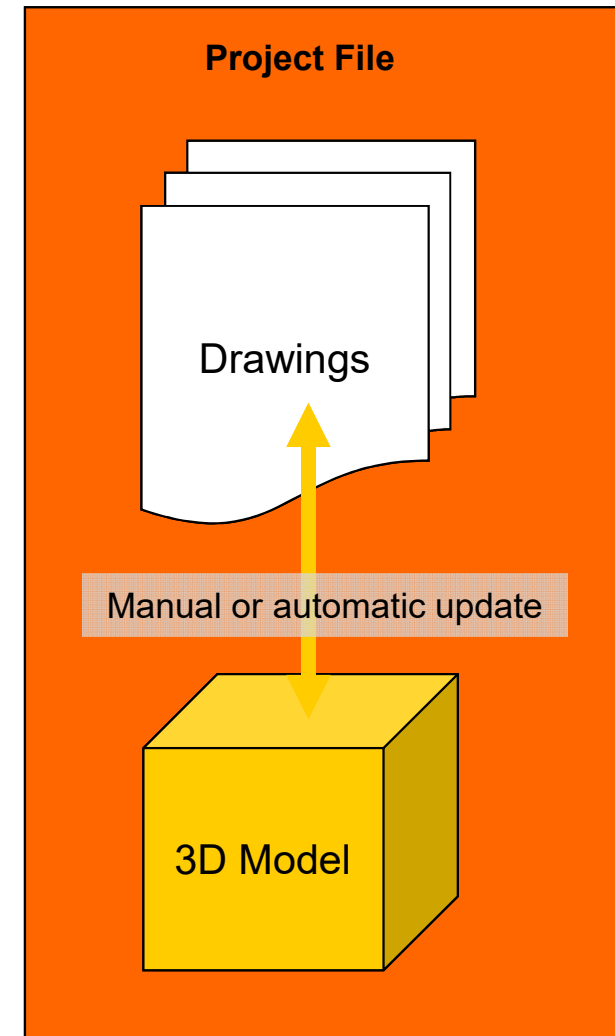
Compared to 3D CAD and BIM

- Drawings are not coordinated automatically
- No 3D visualization
- No automatic calculations, quantity take-offs or schedules
- No collision detection



# 3D CAD - Workflow

- CAD application has 2D & 3D capabilities
- Buildings can be modeled in 3D
- 3D and 2D information can be included in one file
- Drawings are (partially) derived from the model
- No automatic documentation
- Applications mostly works with 2D and 3D tools instead of real architectural elements
- Basic visualization and calculation tools





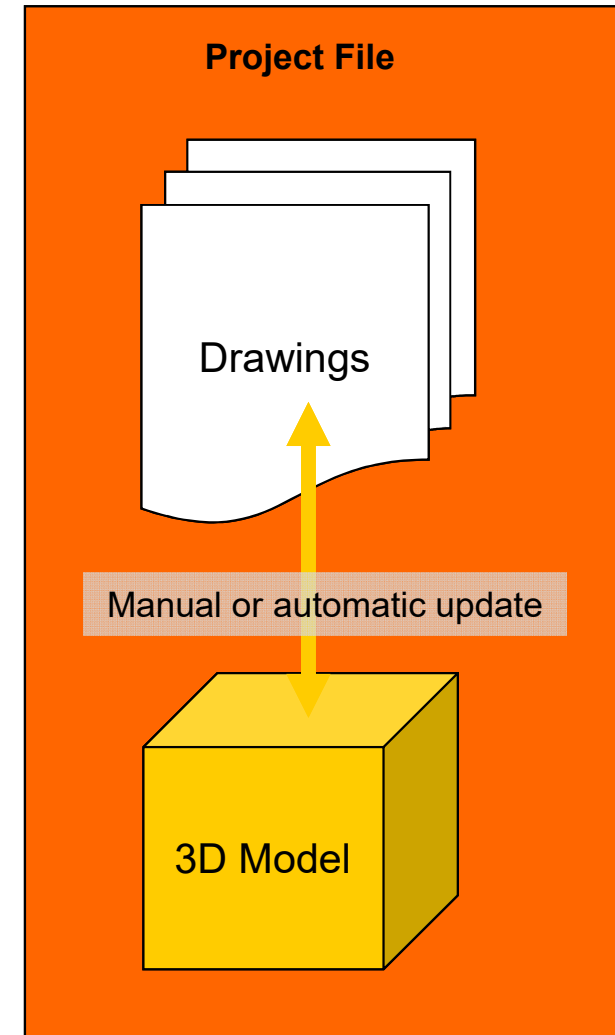
# 3D CAD - Evaluation

## • Benefits

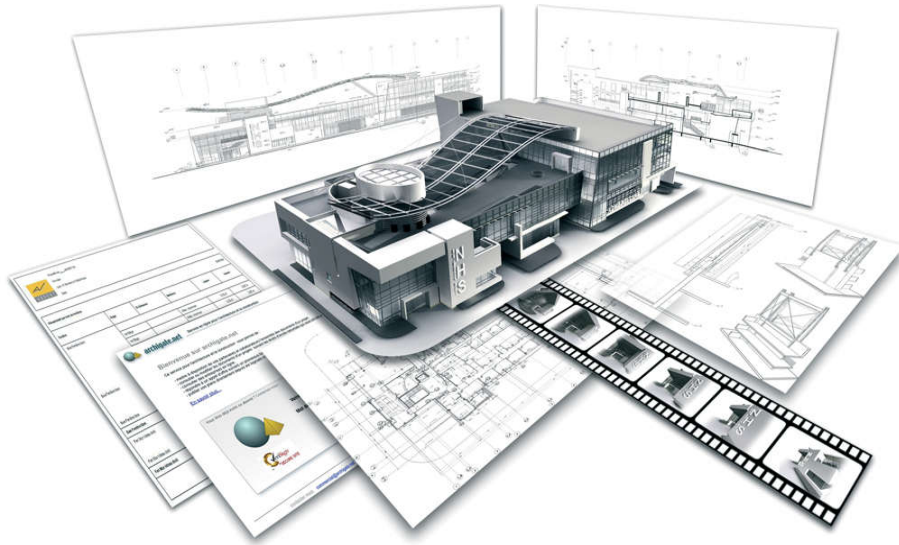
- Compared to 2D CAD
- Easier identification of design problems
- Faster change management
- Visualization and calculation capabilities
- Compared to BIM
- 3D modeling is optional
- Smaller file size

## • Drawbacks

- Concept doesn't follow the architectural design process
- No automatic documentation
- No real architectural elements



# The BIM Concept



NHS Office, [www.paastudio.com](http://www.paastudio.com)

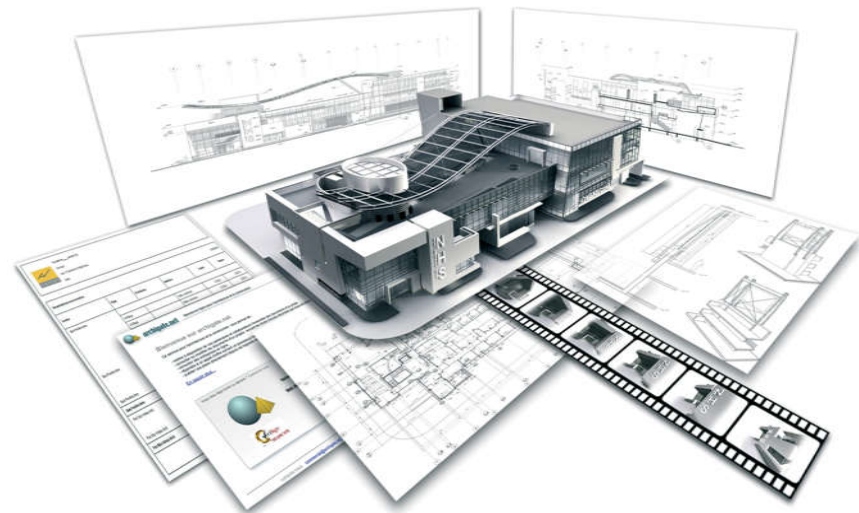
**BIM = Building Information Modeling**

*Also known as „Virtual Building” or „Building Simulation”*

Drawings, model views, visualizations, calculations and quantity take-offs are automatically derived from the 3D model.

# BIM - Workflow

- Single file concept:
  - The complete building model and all of its representations are included in the virtual building file
- Real architectural elements used for modeling
- Changes of the model affects all drawings, and vice versa
- Automatic documentation workflow
- Rich architectural content (libraries)
- Building information data attached to the elements
- Internal visualization tools
- Calculations, schedules



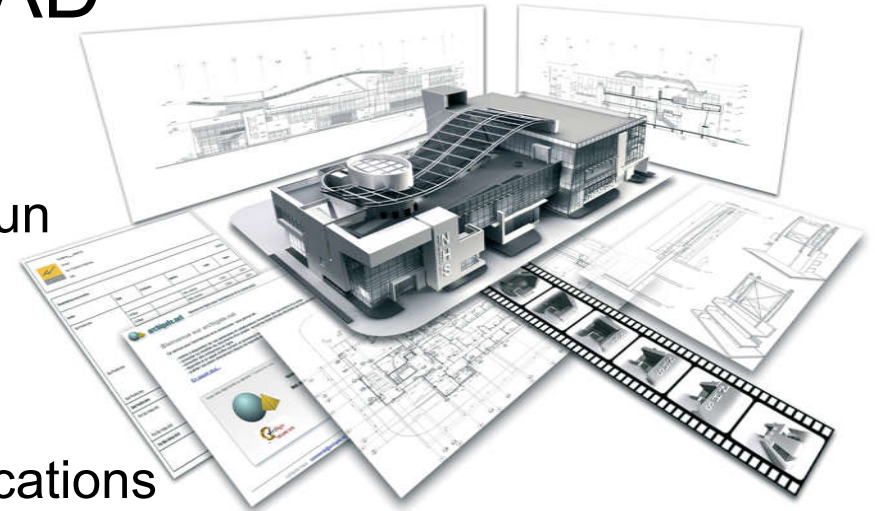
NHS Office, [www.paastudio.com](http://www.paastudio.com)

# BIM - Evaluation

## Benefits

### Compared to 2D and 3D CAD

- Real architectural elements
- Automatic drawing coordination
- Rich visualization content (animation, sun studies, renderings etc.)
- Automatic quantity take-offs, schedules
- Connection to structural, MEP, energy calculation and collision detection applications



NHS Office, [www.paastudio.com](http://www.paastudio.com)

## Drawbacks

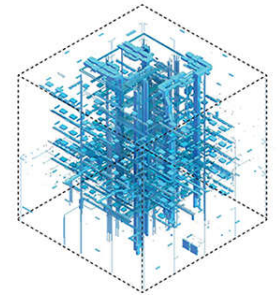
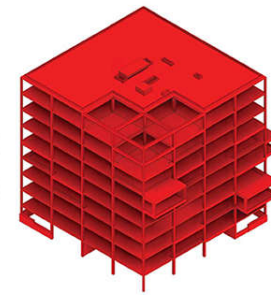
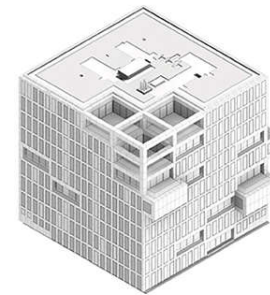
### Compared to 2D and 3D CAD

- Might be difficult to learn the BIM approach for 2D cross-graders
- Training requirements

# BIM elements and standards



- Typical elements:
  - Architecture, MEP (Building Services), Structure
- Information:
  - Model based documentation
  - Calculations and analyses
- Collaboration
  - External, internal, teamwork
- BIM Standards, e.g. in UK and USA



# BIM - Real Architectural Elements

## Drawing representation

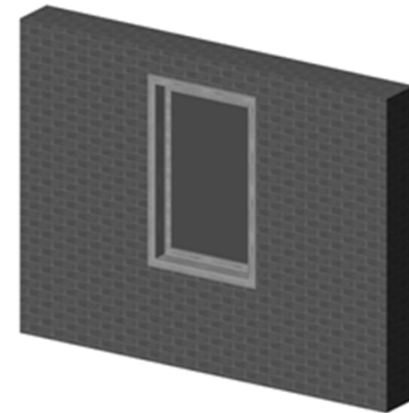
- Floor plan, section and elevation views
- Adjustable contours, fills, backgrounds
- Scale sensitivity

## Model representation

- 3D shapes connected to drawing element
- Surface color and texture

## Non-graphical information

- Material descriptions
- Quantities, volumes
- Cost



TEXTFIELD 1
TEXTFIELD 2
TEXTFIELD 3
TEXTFIELD 4

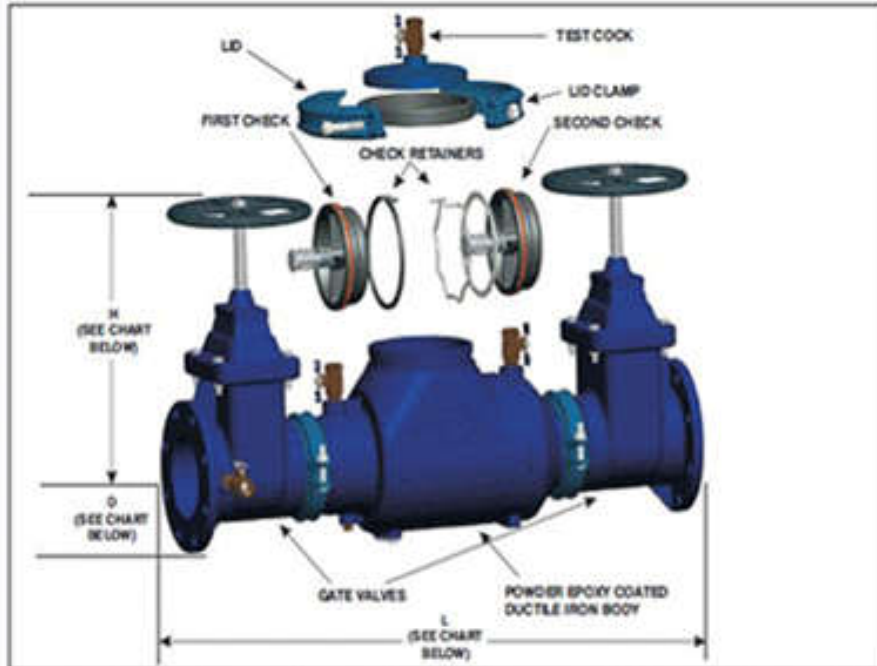
Window Schedule	2006. 03. 06.
-----------------	---------------

W1 Casement 	Width:	0,90 m	1 piece(s)
	Height:	1,50 m	
	User ID	W01	
	Opening orientation	0	
	Material	Wood-Pine	



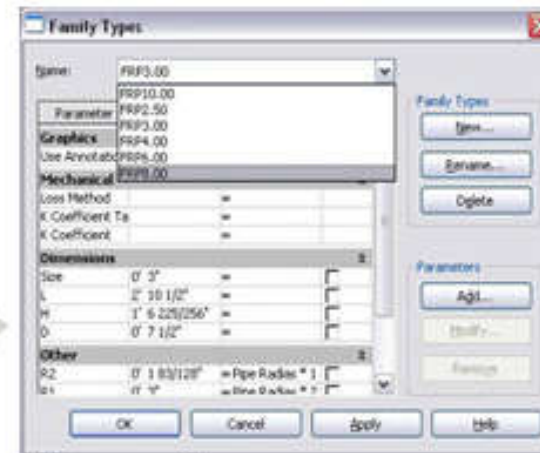
# Example of MEP (Building Services) elements: A valve

## INPUT

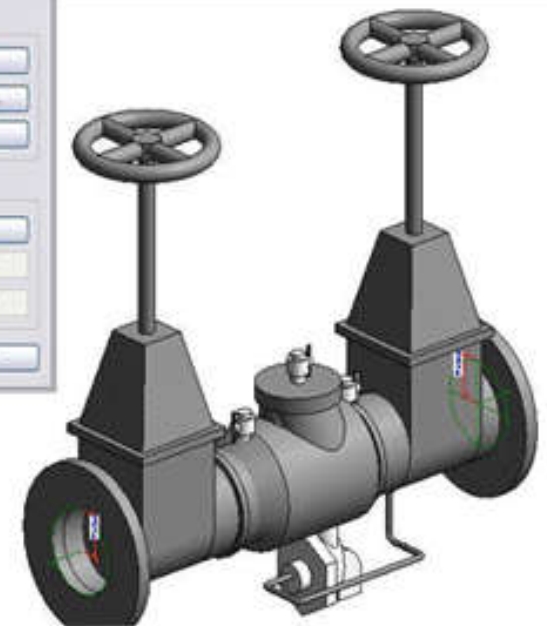


Model No.	Size	L	H OSY OPEN	H NRS	O	OPTIONAL VARIATIONS:	SUFFIX
FDC2.50	2 1/2"	33.5	18.88	16.38	7	<input type="checkbox"/> Non Rising Stem Gate Valve	-NRS
FDC3.00	3"	34.5	21.88	18.88	7.5	<input type="checkbox"/> Outside Stem and Yoke Gate Valve	-OSY
FDC4.00	4"	40.8	25.63	21.60	9	<input type="checkbox"/> Meets Buy America and Pennsylvania Steel Act	-BA
FDC6.00	6"	43.8	35.13	29.13	11	<input type="checkbox"/> Strainer attached	-S
FDC8.00	8"	56.5	44.63	36.60	13.5	<input type="checkbox"/> Double Check Detector Assembly	-DCDA
FDC10.00	10"	59.5	54.5	44.5	16	<input type="checkbox"/> Grooved Flange Connection	-G
						<input type="checkbox"/> No Gate Valves	-LF

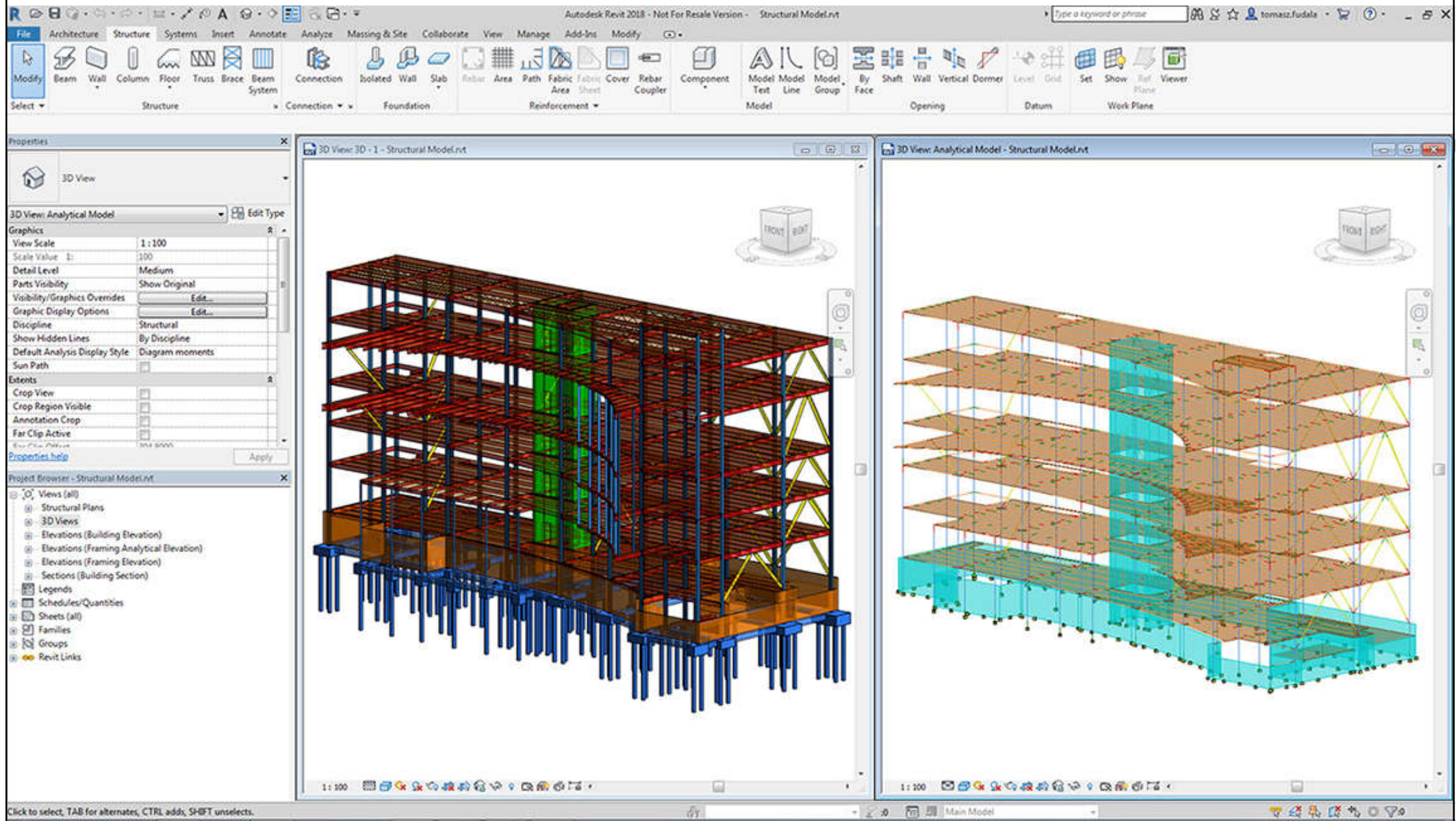
## OUTPUT



ws (6)  
 - Top Plans  
 - Ref. Level  
 - Ring Plans  
 - Ref. Level  
 - Views  
 - View 1  
 - (3D)  
 - Sections (Elevation 1)  
 - Back  
 - Front  
 - Left



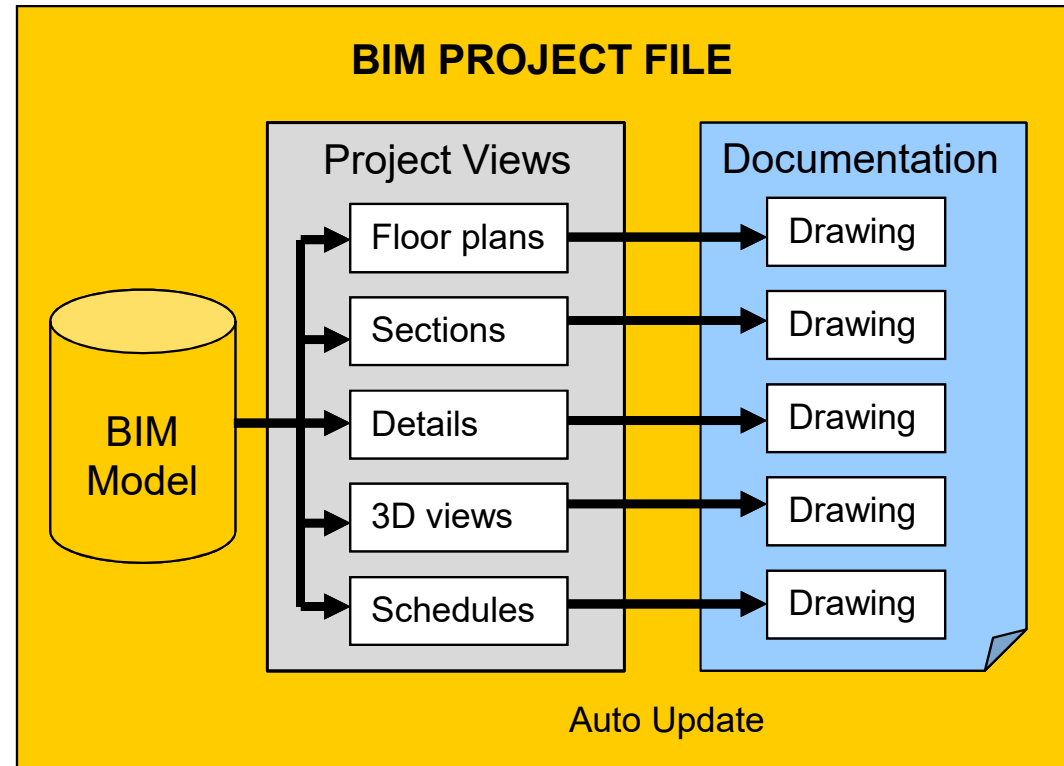
# BIM structure elements and structural analysis





# BIM - Model Based Documentation

- Coherence between model and drawing
- All drawings derived from the model
- Model coordinates drawings
- Scale sensitive elements
- The complete project lifecycle can be controlled from a single file
- Rich 3D visualization content



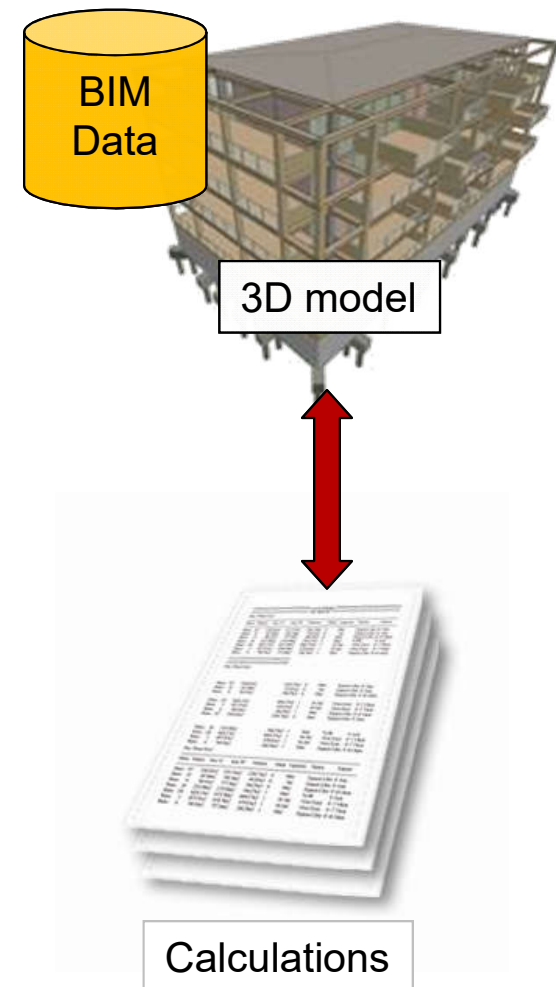
# BIM - Calculation

## Additional information attached to a model

- Quantity
- Materials
- Descriptions
  - Product details
  - Construction details
  - Safety details
- Cost

## Instant Calculation

- Quantity takeoffs
- Room Inventories
- Door & Window schedules



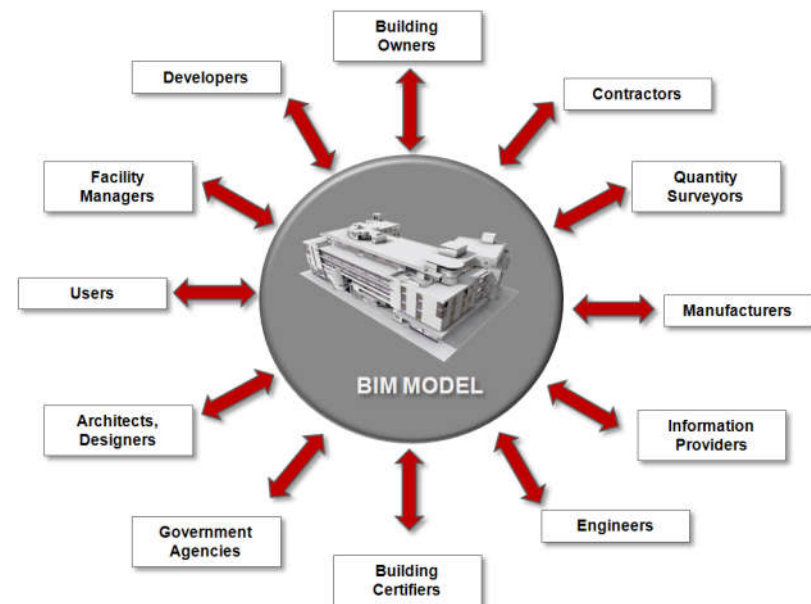
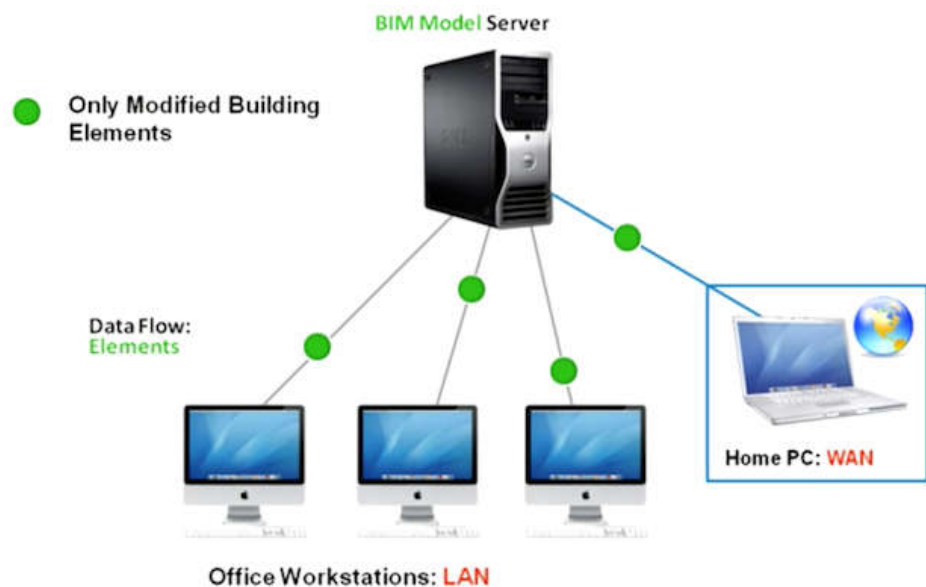
# BIM - Collaboration

The AEC industry is moving toward integration of disciplines.

The collaborative mode will become a standard approach.

Collaboration solutions in BIM:

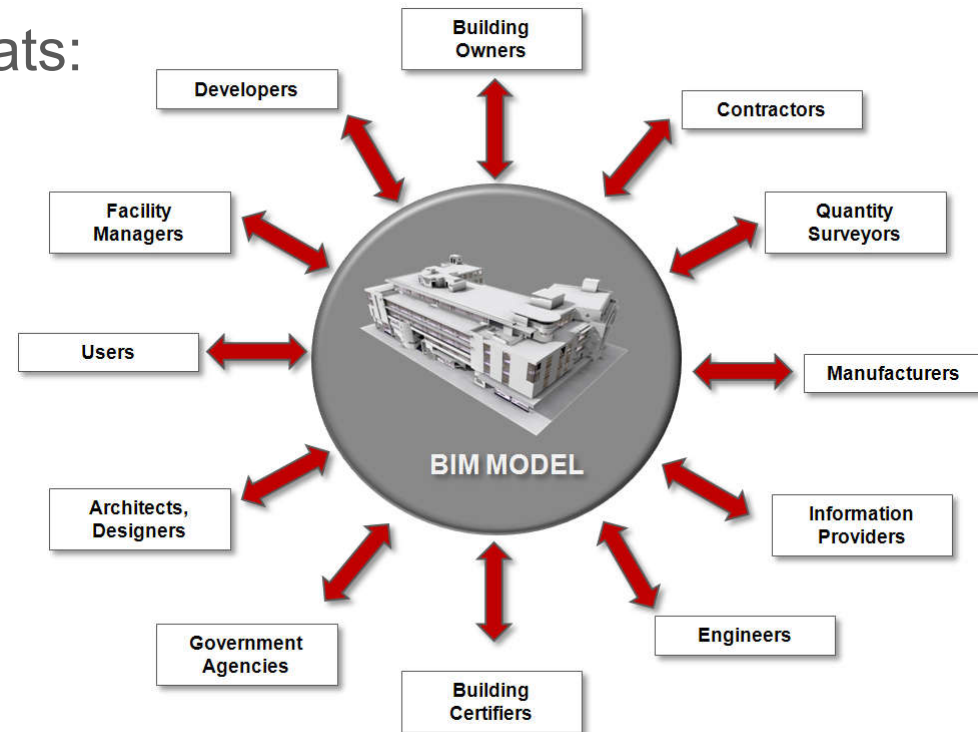
- Internal Collaboration
- External Collaboration



# BIM - External Collaboration

BIM applications allow the sharing of building data with the project stakeholders via many file formats:

- IFC
- DXF-DWG
- PDF
- XML
- Native file formats
- .....

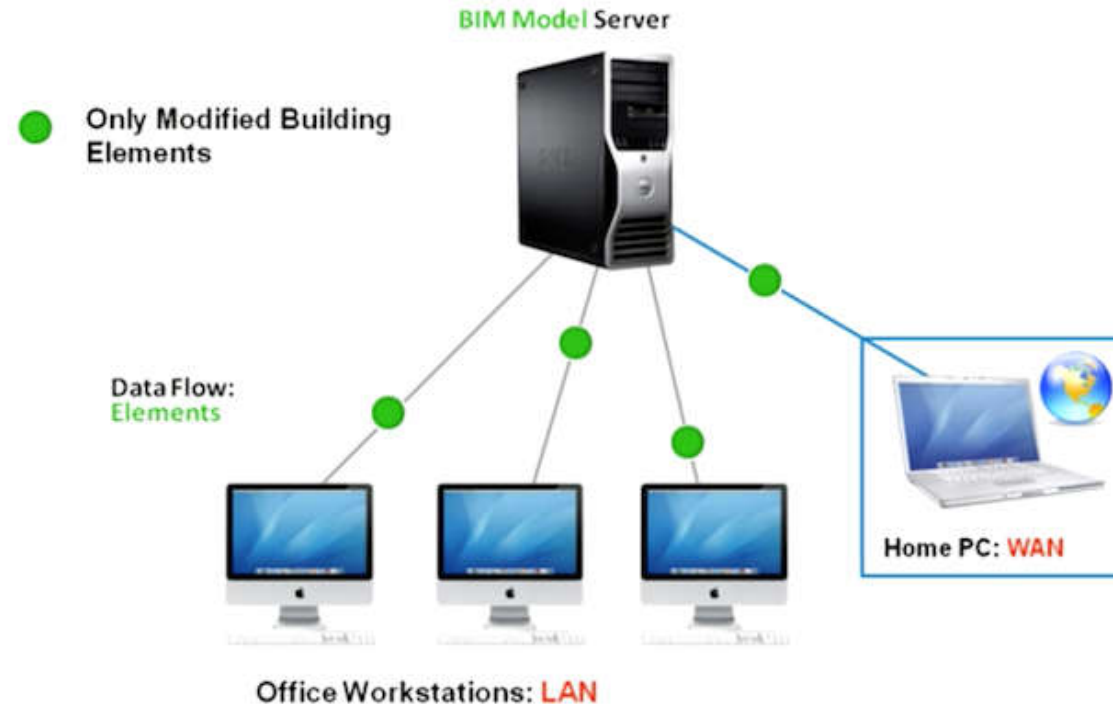


# BIM - Internal Collaboration

Advanced BIM applications allow the seamless sharing of the virtual building data between the project team members

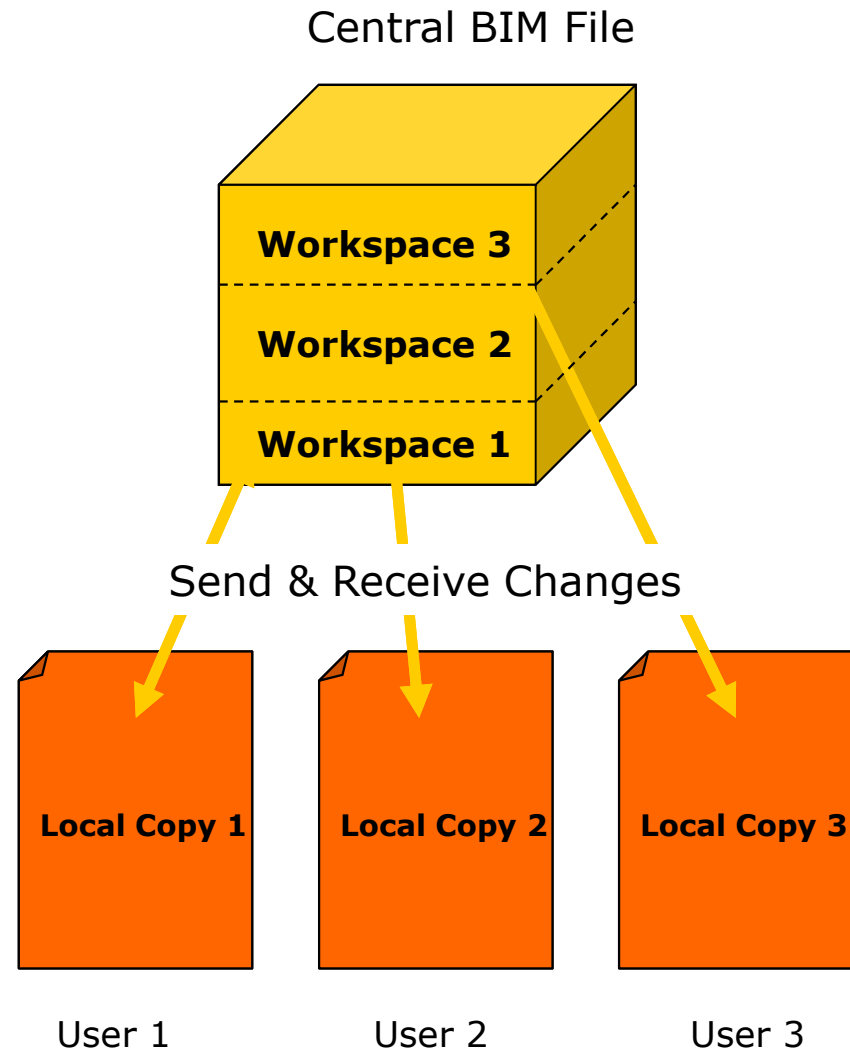
The most common project sharing methods are:

- Hotlinked file methods
- File-server based teamwork solutions
- Client-server based teamwork solutions



# BIM - Teamwork

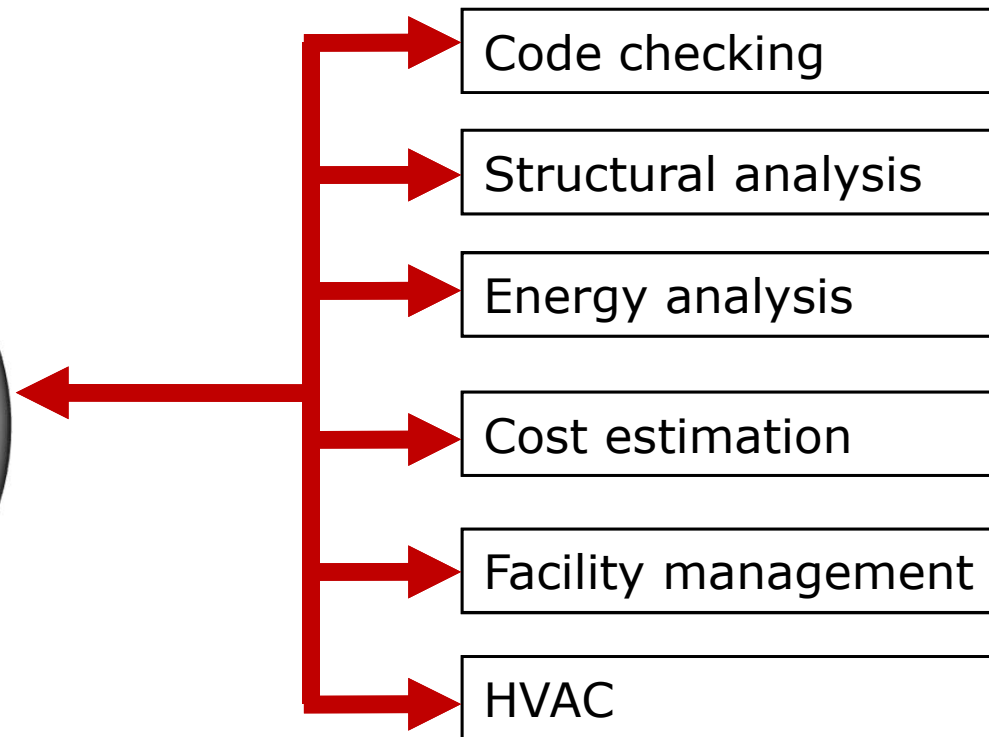
- Teamwork solutions in BIM applications are usually based on the following concept:
  - Central file contains the complete virtual building database
  - Team members work on local copies of the project
  - Team members have dedicated workspaces
  - Team members send and receive changes between the server and their local project copies



# BIM - Analysis, Coordination

Further processing the BIM data in third party applications allows a wide range of analytical activities:

- Code checking (collision detection)
- Energy efficiency analysis
- Structural analysis



# BIM - AEC CAD standards

- BS 1192 (British Standards) widely used in the UK
- AIA CAD Layer Guidelines is widespread in the U.S.
- Uniformat is a U.S. standard for the organization of building elements
- ISO 13567 International standard, common in Northern Europe

		1	A-FURN
		1	A-GLAZ-FULL
		1	A-LITE
		1	A-MARK-DETL
		1	A-MARK-ELEV
		1	A-MARK-SECT
		1	A-NPLT
		1	A-NPLT-HTSP
		1	A-NPLT-SEO
		1	A-PICT
		1	A-ROOF
		1	A-WALL-EXTR
		1	A-WALL-INTR
		1	C-TOPO
		1	C-TOPO-02FT
		1	C-TOPO-10FT
		1	C-TOPO-TEXT
		1	E-POWR

## U.S. National CAD Standard (NCS) - layer name format

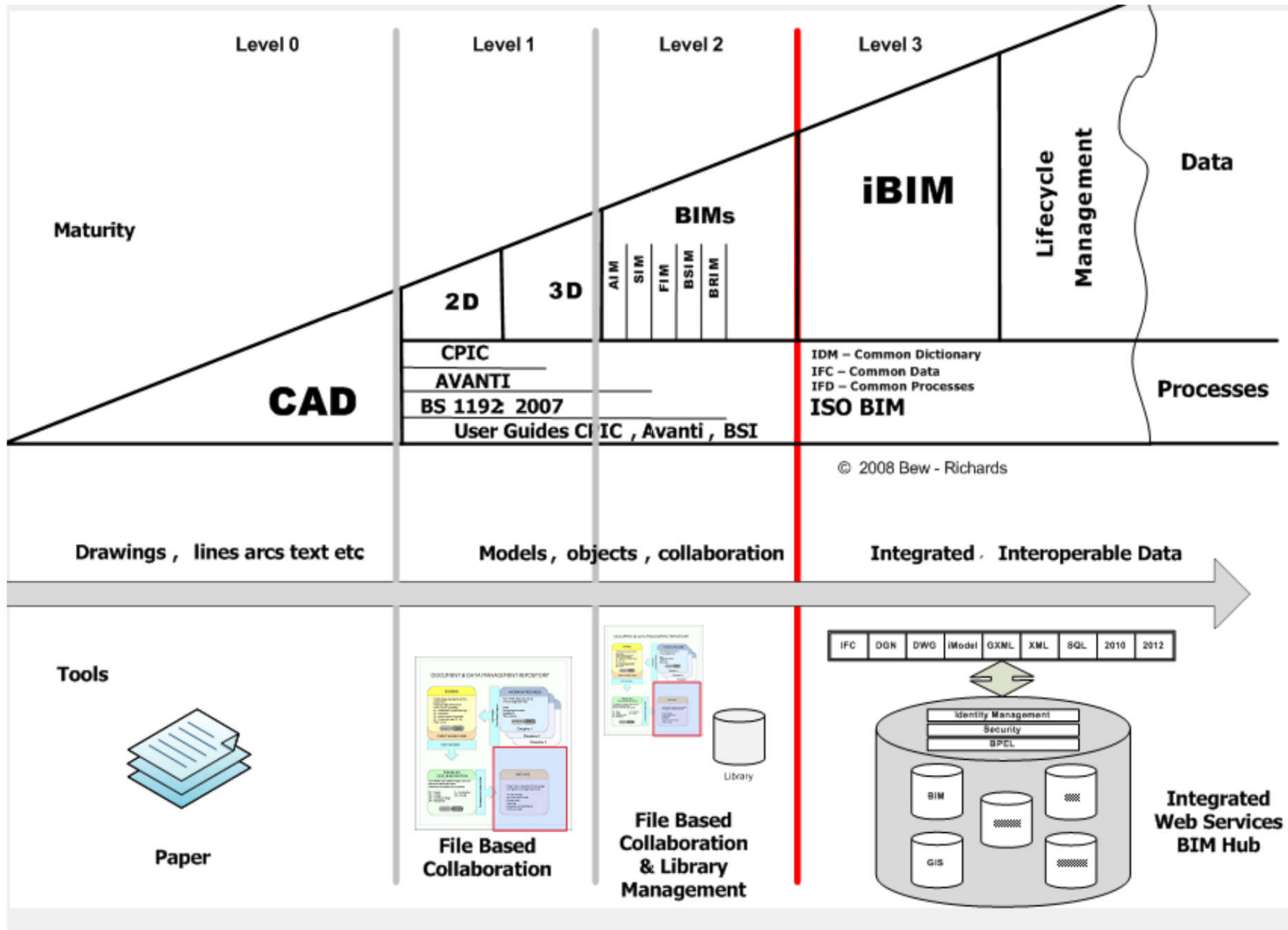
Discipline		Major Group			Minor Group			Minor Group			Status							
A	I	-	W	A	L	L	-	F	U	L	L	-	D	I	M	S	-	N

## AEC (UK) CAD Standard - layer name format

Role	Classification			Presentation	Description				View					
A	-	G	2	2	-	M	-	F	I	O	O	R	-	Fwd



# BIM - AEC (UK) BIM standards



[Source – M.Bew and M.Richards 2008]

(Source: Graphisoft BIM Curriculum <http://www.graphisoft.com/learning/bim-curriculum/>)

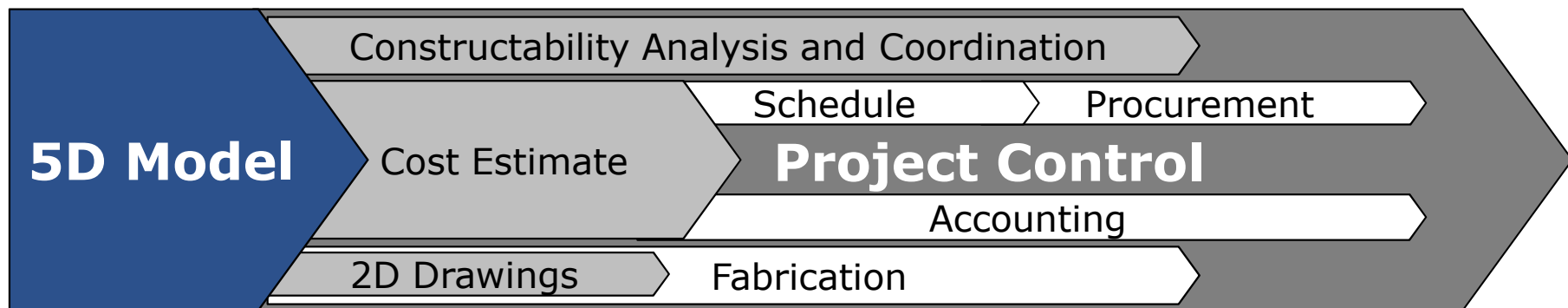
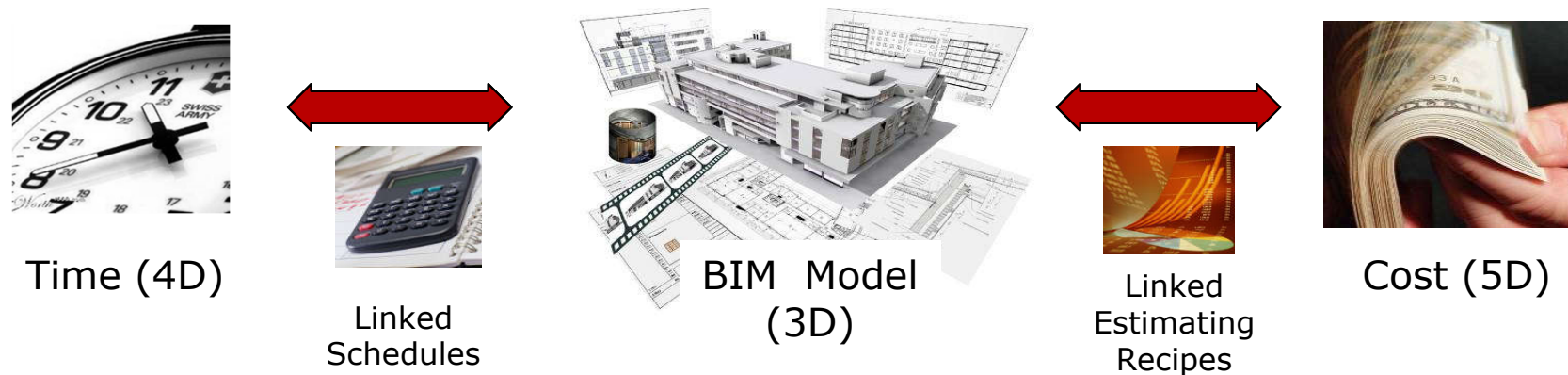
# BIM elements and standards



- Common protocols and standards:
  - PAS 1192-2 Specification for information management for the capital/delivery phase of construction projects using Building Information Modelling
  - PAS 1192-3 Specification for information management for the operational phase of construction projects using building information modelling
  - Industry Foundation Classes (IFC)
  - COBie (Construction Operations Building Information Exchange)

# Virtual Construction

- Construction industry is moving towards automated solutions. Adding time and cost information to the 3D model results the virtual construction model.



# BIM dimensions

## 3D

- Existing Conditions Models
  - Laser scanning
  - Ground Penetration Radar (GPR) conversions
- Safety & Logistics Models
- Animations, renderings, walkthroughs
- BIM driven prefabrication
- Laser accurate BIM driven field layout

## 4D

### SCHEDULING

- Project Phasing Simulations
- Lean Scheduling
  - Last Planner
  - Just In Time (JIT) Equipment Deliveries
  - Detailed Simulation Installation
- Visual Validation for Payment Approval

## 5D

### ESTIMATING

- Real time conceptual modeling and cost planning (DProfiler)
- Quantity extraction to support detailed cost estimates
- Trade Verifications from Fabrication Models
  - Structural Steel
  - Rebar
  - Mechanical/Plumbing
  - Electrical
- Value Engineering
  - What-if scenarios
  - Visualizations
  - Quantity Extractions
- Prefabrication Solutions
  - Equipment rooms
  - MEP systems
  - Multi-Trade Prefabrication
  - Unique architectural and structural elements

## 6D

### SUSTAINABILITY

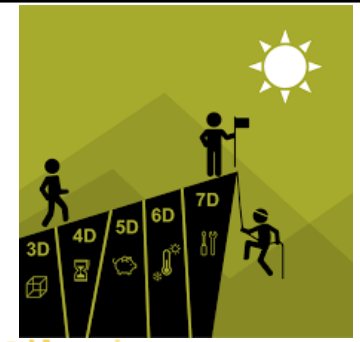
- Conceptual energy analysis via DProfiler
- Detailed energy analysis via EcoTech
- Sustainable element tracking
- LEED tracking

## 7D

### FACILITY MANAGEMENT APPLICATIONS

- Life Cycle BIM Strategies
- BIM As-Built
- BIM embedded O&M manuals
- COBie data population and extraction
- BIM Maintenance Plans and Technical Support
- BIM file hosting on Lend Lease's Digital Exchange System

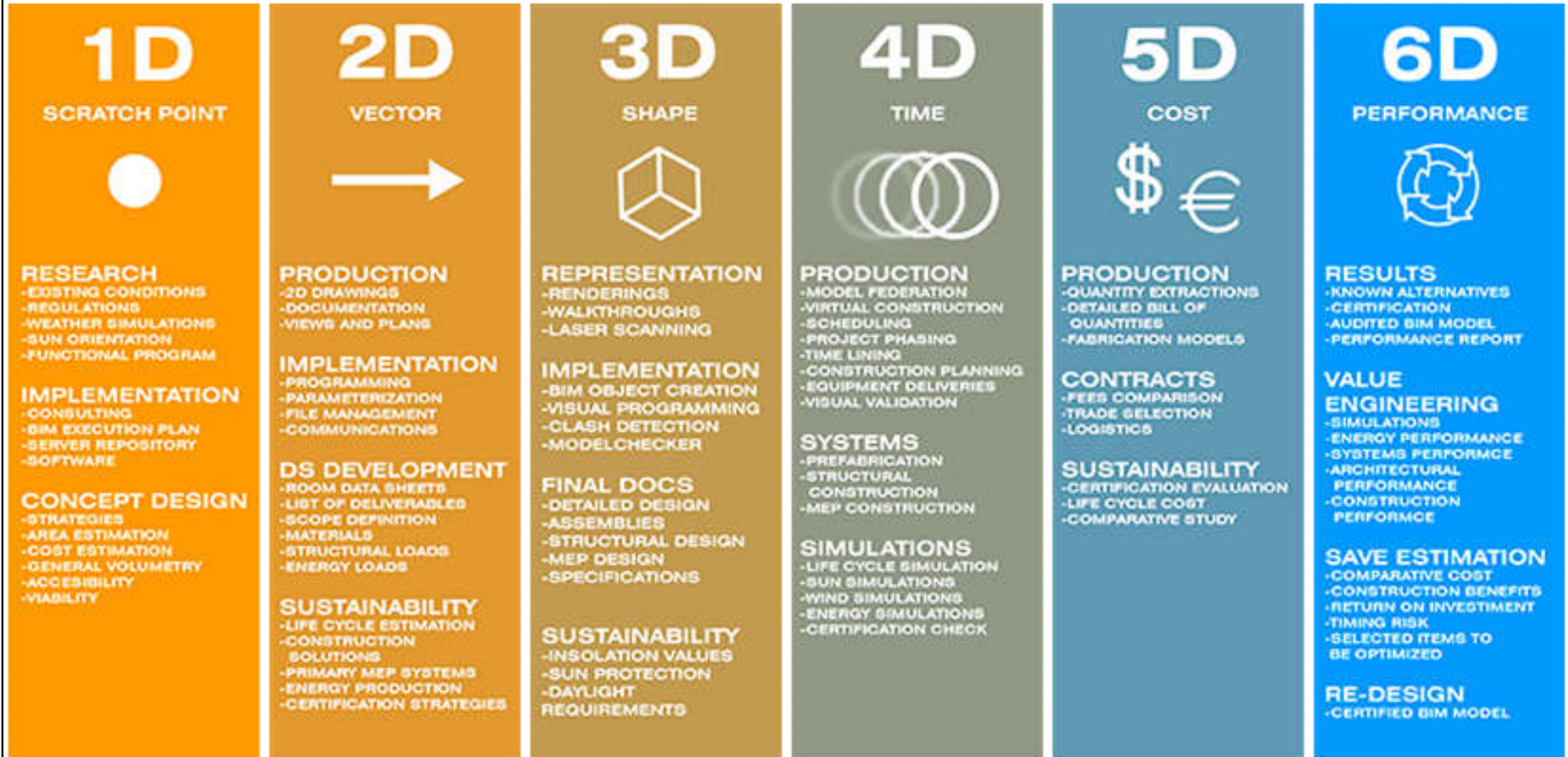
# BIM dimensions



- Very broadly, building information includes:
  - 2D
  - 3D
  - 4D (including time / programme information)
  - 5D (including cost information)
  - 6D (including facilities management information)
- Parametric software modelling is used
- The common data environment (CDE) is the single source of information for the project

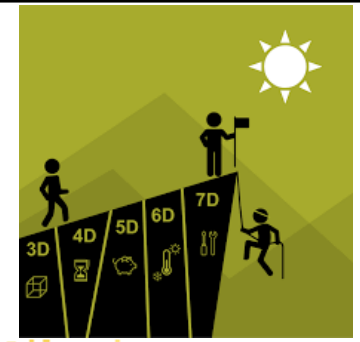


# BIM dimensions: 1D to 6D



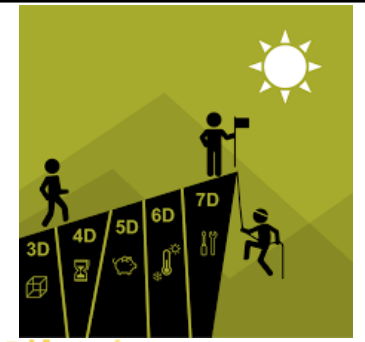
Note: the 6D is sometimes associated with Facility Management activity or Sustainability.

# BIM dimensions



- **3D + Time = 4D Schedule**
  - Better communication for construction sequencing
  - Better site planning & logistics
  - Better analysis for project management
  - Uncovers flawed logic in the schedule from visual
- **4D + Quantity + Cost = 5D**
  - QTO – Quantity Take Off (in minutes), estimation
  - Spot the difference – track changing variables
  - Auto search & dynamic document of record

# BIM dimensions



- **5D + Facility Information = 6D**
  - As-builts are delivered as a Model
  - O&M data – Technical product info – Warranty info – Maintenance schedule/history – All exist in the Model
  - Space utilization tool – Simplify remodels – lease and rental analysis tools
- **7D? or nD? = Sustainability, Safety**



# 6D

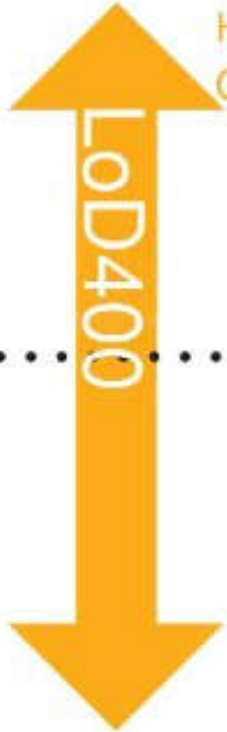
+LIFE CYCLE



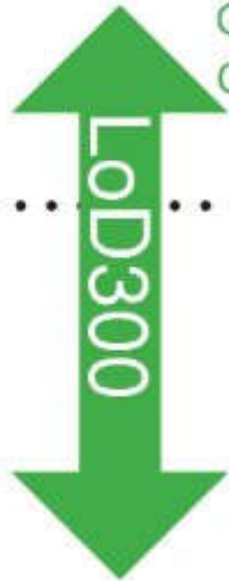
LIFE CYCLE READY  
GREAT MODEL DETAIL  
COMPLETE PARAMETERS

# 5D

+COST



HIGHEST LEVEL OF MODEL DETAIL  
CONSTRUCTION PARAMETERS



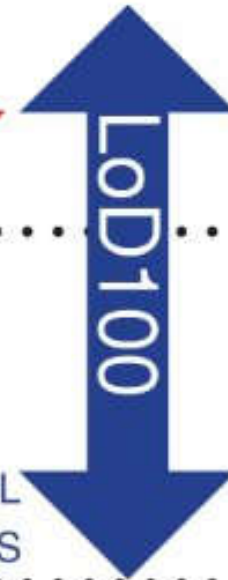
GREAT MODEL DETAIL  
CONSTRUCTION PARAMETERS

# 4D

+TIME



GENERAL MODEL DETAIL  
GENERAL PARAMETERS

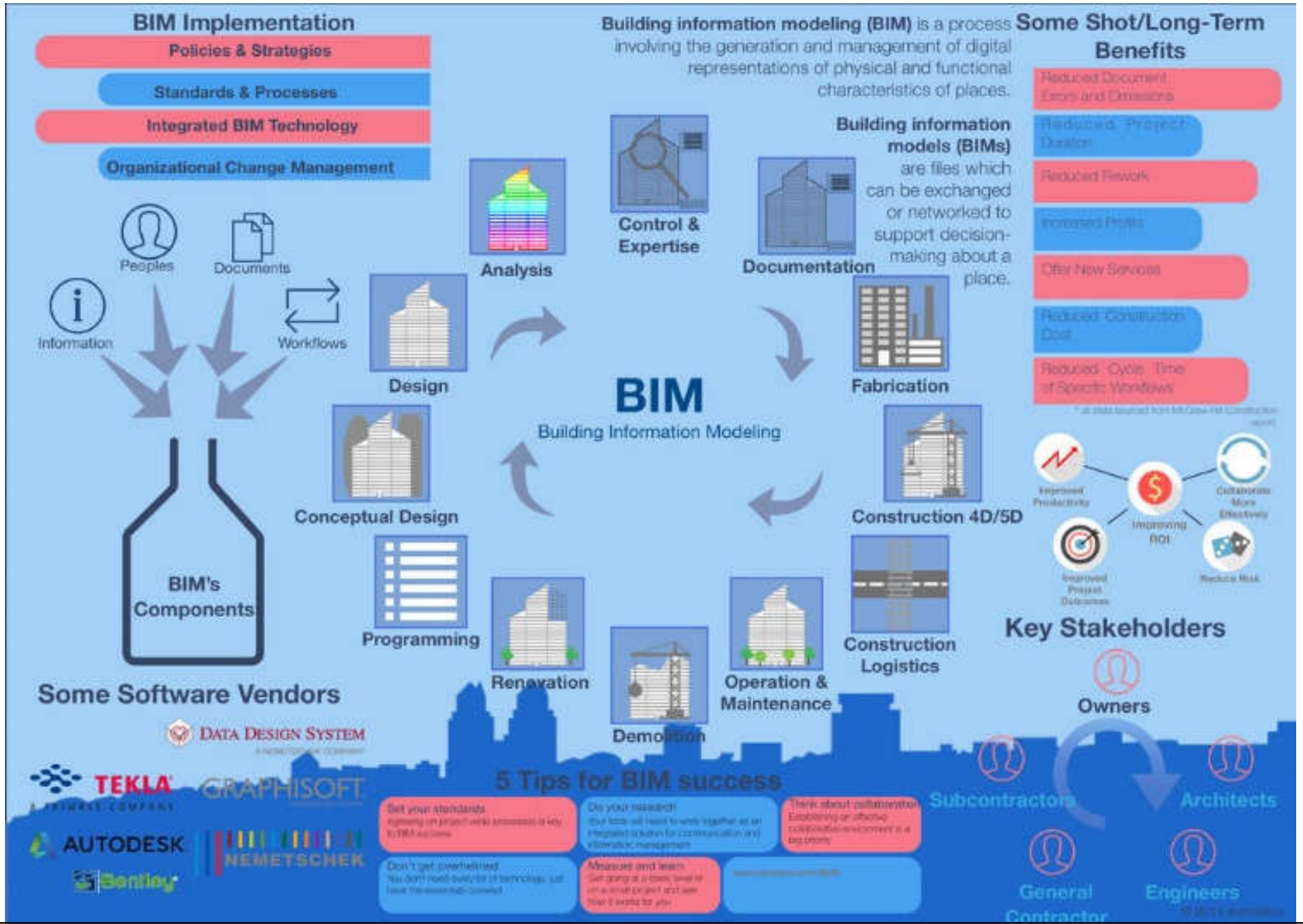


# 3D

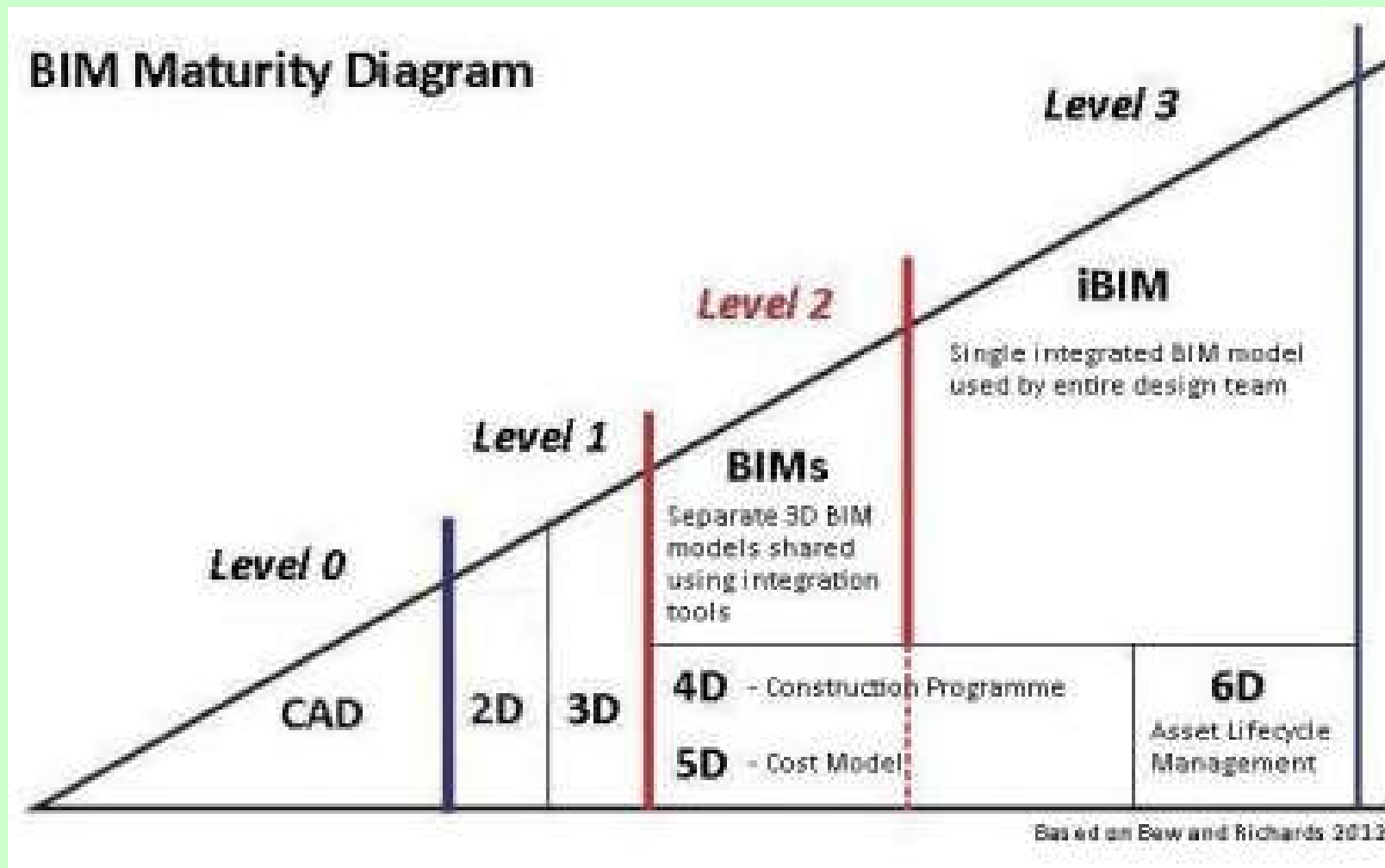
3D MODEL

MASSED MODEL  
ANALYTICAL PARAMETERS

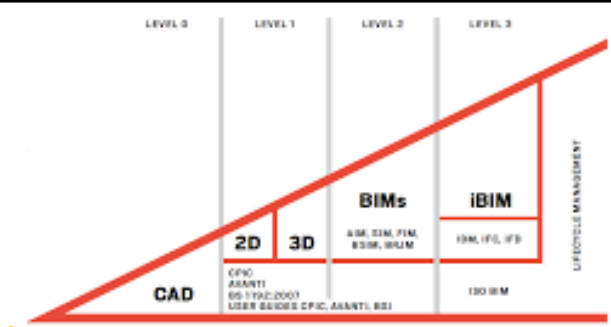
# The big picture of BIM



# BIM maturity levels

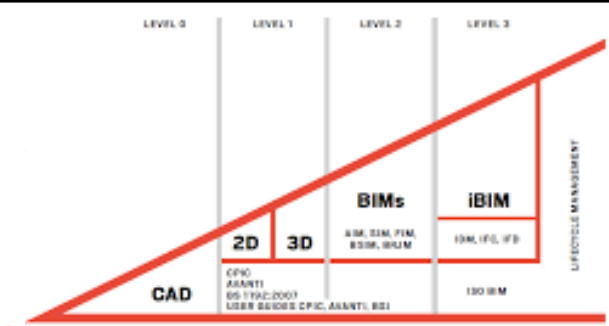


# BIM maturity levels



- The range of BIM maturity levels:
  - Level 0: Unmanaged CAD (Computer Aided Design)
  - Level 1: Managed CAD in 2D or 3D
  - Level 2: Managed 3D environment with data attached, but created in separate discipline models
  - Level 3: Single, online, project model with construction sequencing, cost and life-cycle management information

# BIM maturity levels



- BIM Levels explained
  - Level 0:
    - No collaboration; 2D CAD drafting only
    - Output and distribution is via paper or electronic prints, or a mixture of both
  - Level 1:
    - A mixture of 3D CAD for concept work, and 2D for drafting of statutory approval documentation and production information
    - Models are not shared between project team members

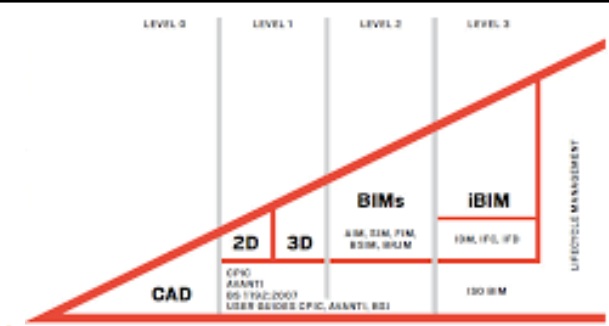


# BIM maturity levels

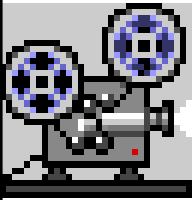


- BIM Levels explained (cont'd)
  - Level 2:
    - Collaborative working – all parties use their own 3D CAD models, but not necessarily working on a single, shared model
    - Design information is shared and exchanged through a common file format
  - Level 3: **OPEN BIM™**
    - Full collaboration between all disciplines by means of using a single, shared project model which is held in a centralized repository (also known as “Open BIM”)

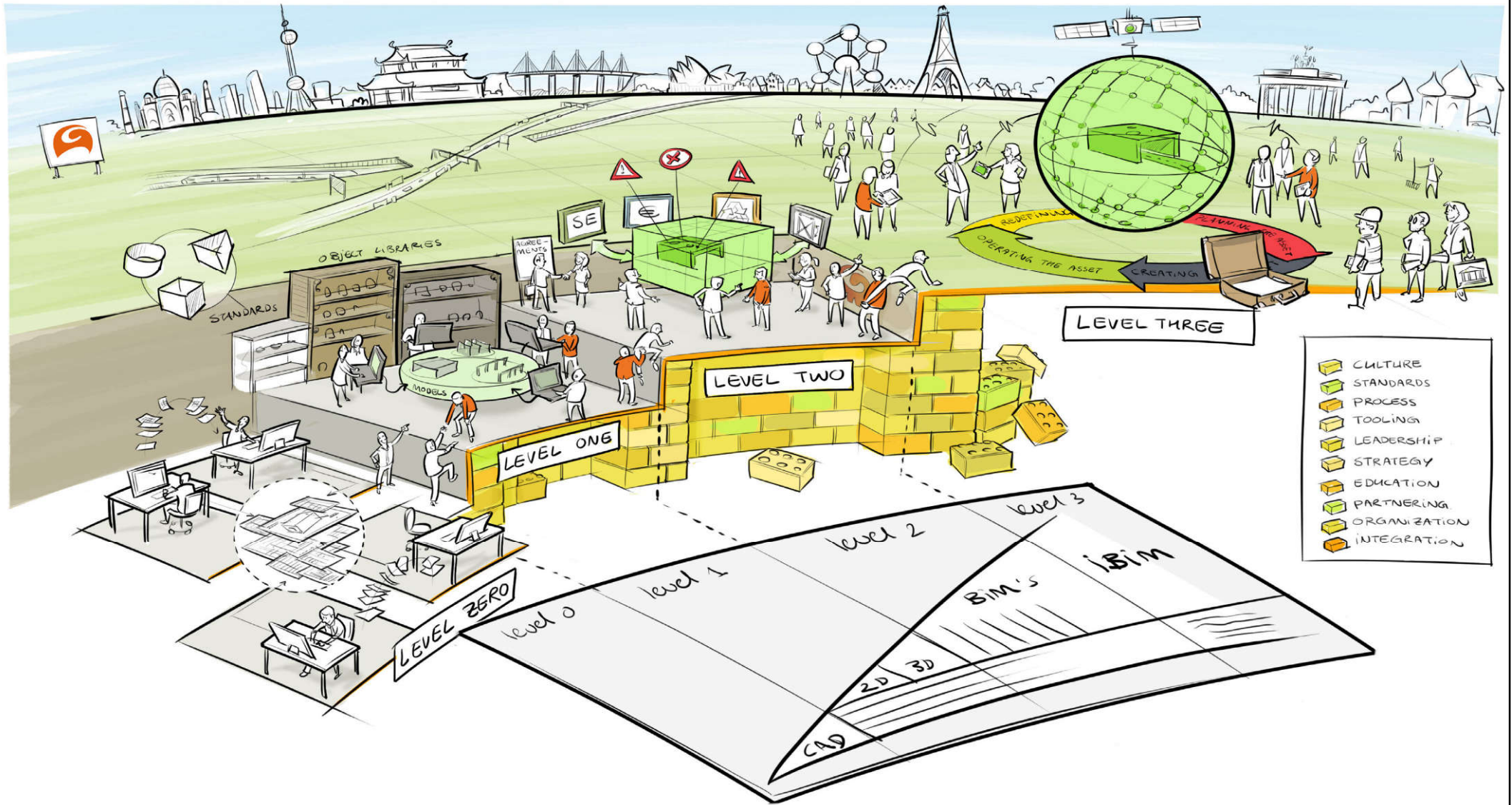
# BIM maturity levels



- Video: Wienerberger - What is BIM? (5:23)
- <https://youtu.be/ZYvQk78W1Tc>
- An brief introduction to BIM and Geo-BIM, through a short animation. The video highlights what BIM Level 2 and Level 3 entail and how these are directly influencing construction in the UK.

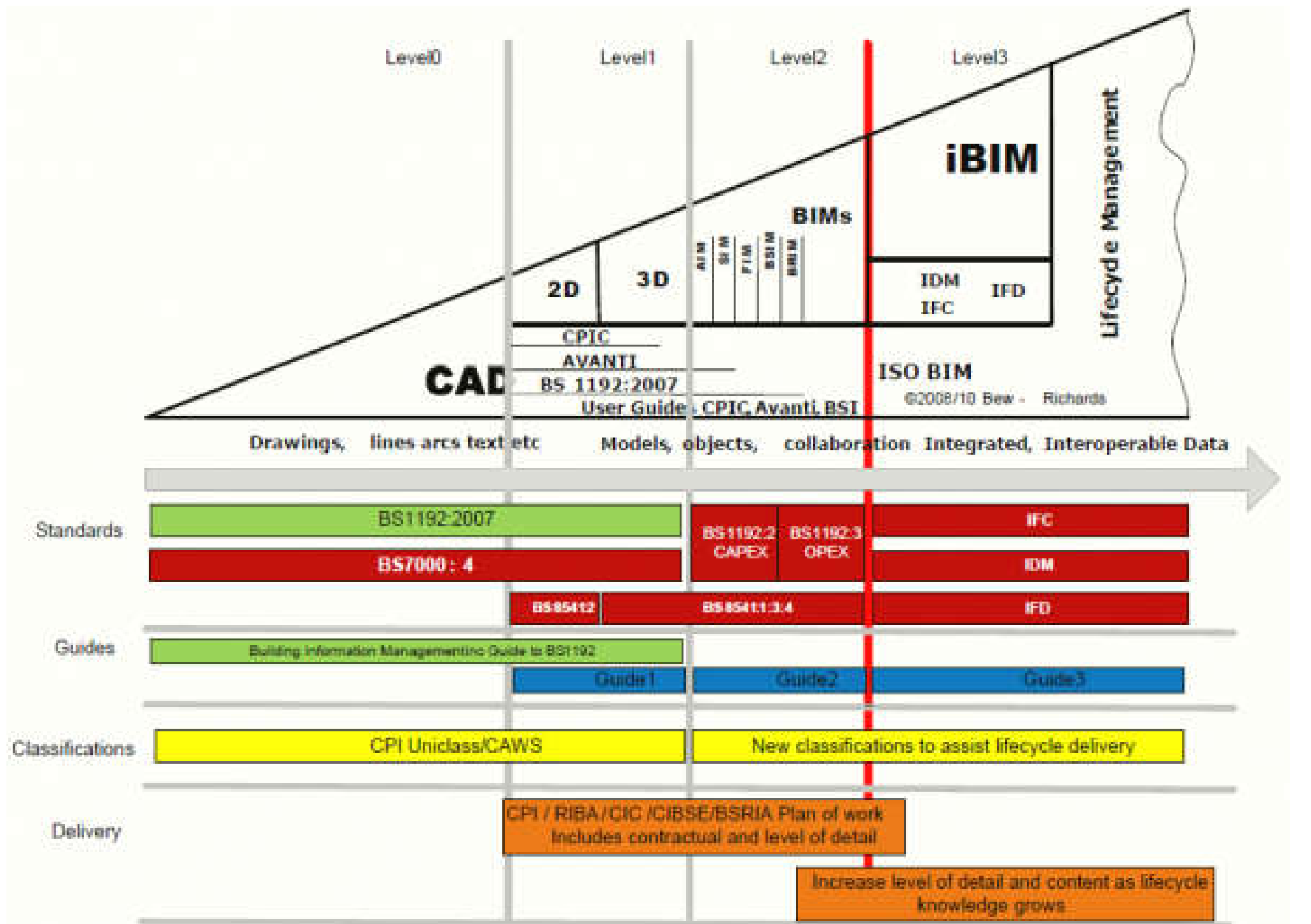


# BIM maturity levels

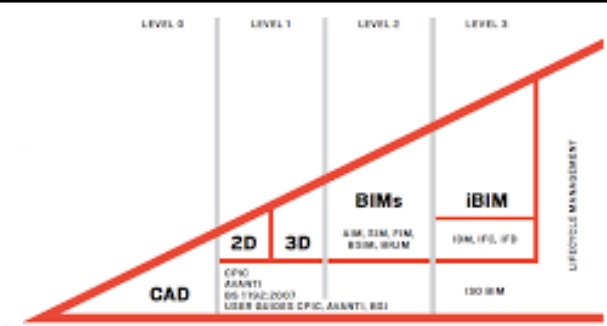




# BIM maturity levels and development path in UK



# BIM maturity levels



- Maturity of organisations regarding BIM:
  - Company level: object-based modelling
  - Project level: information exchange processes based on models (for collaboration)
  - Sectorial level: a global view, linked to public (procurement) policies, e.g. mandatory BIM
- Integrated Project Delivery (IPD): the long-term goal of BIM implementation

# Integrated Project Delivery

*“Integrated Project Delivery (IPD) is a project delivery approach that **integrates people, systems, business structures and practices** into a process that collaboratively harnesses the talents and insights of all participants to **reduce waste and optimize efficiency** through all phases of design, fabrication and construction.”*



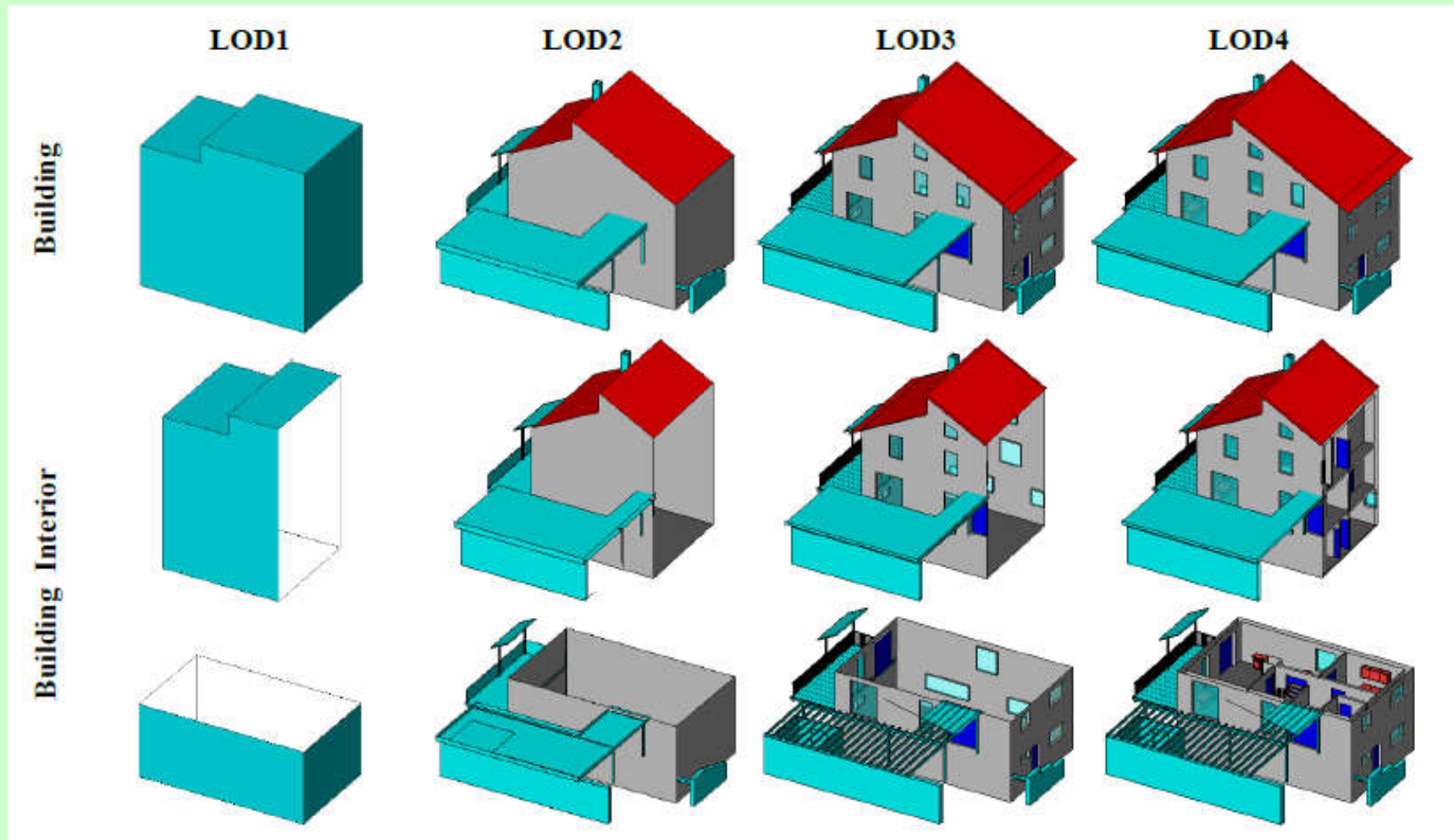
Traditional		IPD
Segmented	<b>Teams</b>	Integrated, collaborative
Linear, distinct, segregated	<b>Process</b>	Concurrent, multi-level, integrated
Individually managed	<b>Risk</b>	Collectively managed
Individual success, minimum effort for maximum return	<b>Reward</b>	Value-based, team success
Paper based, 2D, analog	<b>Technology</b>	Digitally based, BIM, 4D
Minimize or transfer risk, don't share	<b>Agreements</b>	Open sharing, collaboration, full integration
Individually focused	<b>Education</b>	Team-based , integrated, collaborative

# BIM maturity levels

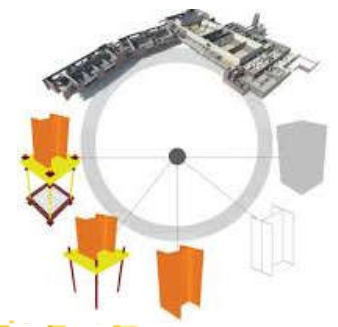


- Integrated Project Delivery (IPD) 集成項目交付
  - Involve all team members in design meetings
  - Identify key objectives up front
  - Open collaboration at all stages of a project
  - BIM is utilized
  - Minimize paper based processes and collaborate digitally
  - Check for & manage interferences with 3D clash detection
  - Set up contract mechanisms that enable and reward achievement of key objectives
  - Create a culture of trust and information sharing (win-win-win)

# Level of development (LOD)

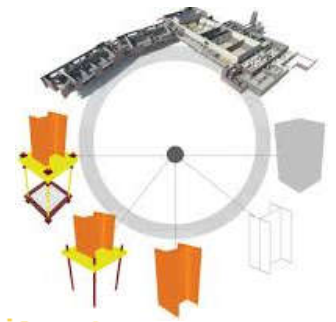


# Level of development (LOD)



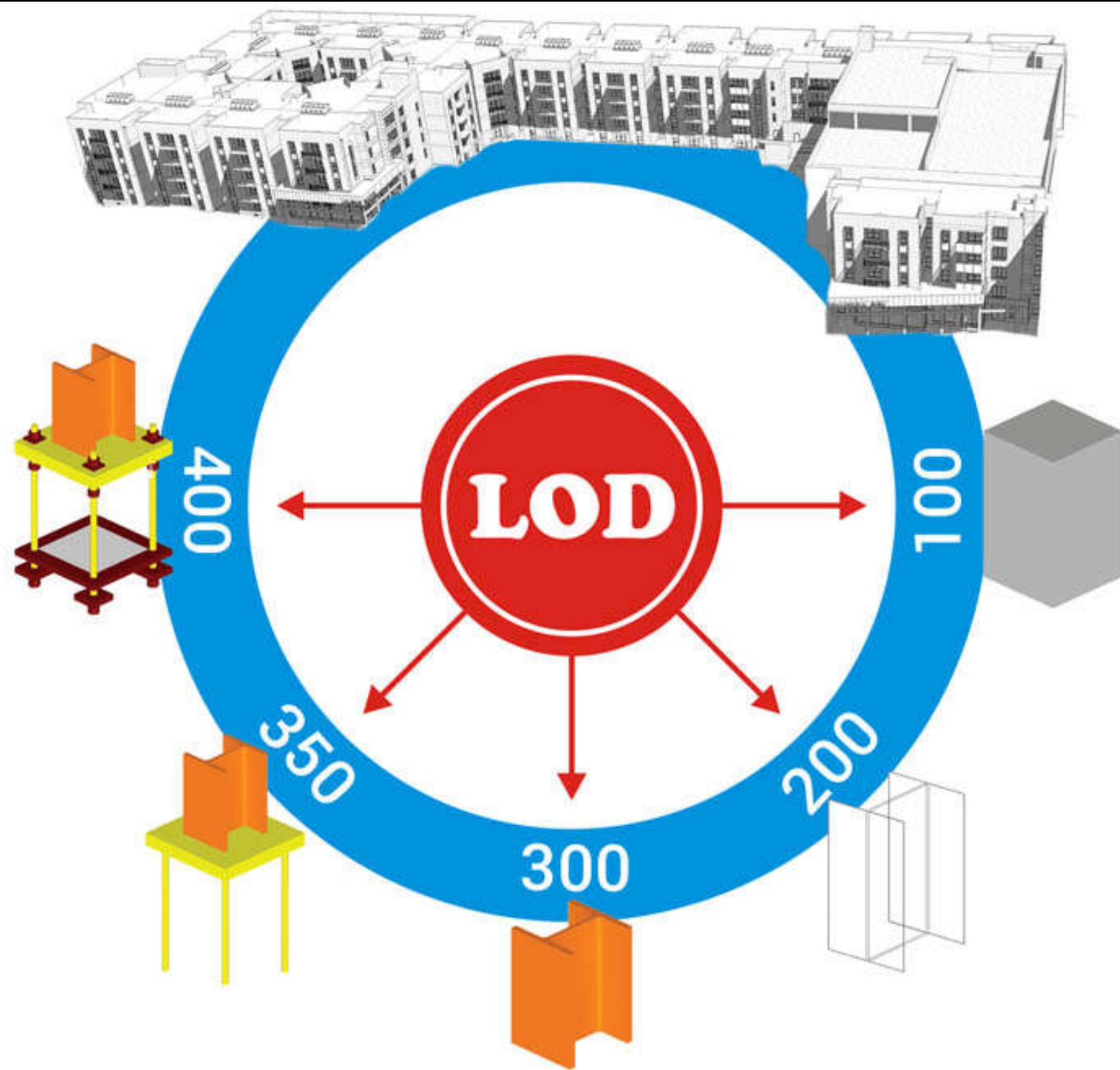
- LOD is commonly used to represent the level of precision of model content
  - This is the degree to which an element's geometry and its attached information have been thought through – the degree to which project team members may rely on the information when using the model
  - The expected LOD by element/category/building system at each stage of the project has to be determined and documented

# Level of development (LOD)

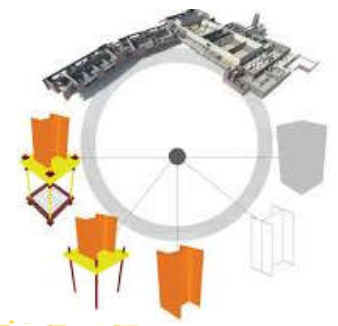


- Level of Development (LOD) specifications:
  - LOD 100: Conceptual design
  - LOD 200: Design Development
  - LOD 300: General Construction documents
  - LOD 350: The compromise
  - LOD 400: Fabrication information
  - LOD 500: As-built model





# Level of development (LOD)



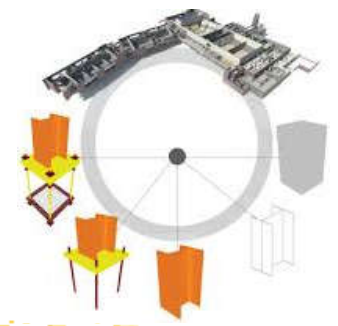
- LOD 100 elements:

- Are not geometric presentations (may be symbols or other generic representations)
- Any information derived from them must be considered approximate

- LOD 200 elements:

- Are represented graphically but are generic placeholders, e.g., volume, quantity, location, or orientation (they must be considered approximate)

# Level of development (LOD)



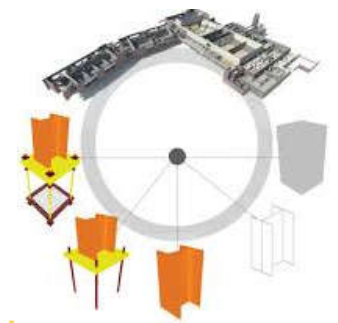
- LOD 300 elements:

- Are graphically represented as specific systems, objects, or assemblies from which quantity, shape, size, location, and orientation can be measured directly, without having to refer to non-modeled information such as notes or dimension call-outs

- LOD 350 elements:

- Are enhanced beyond LOD 300 by the addition of information regarding interfaces with other building systems

# Level of development (LOD)



- LOD 400 elements:

- Are modeled at sufficient detail and accuracy for fabrication of the represented component

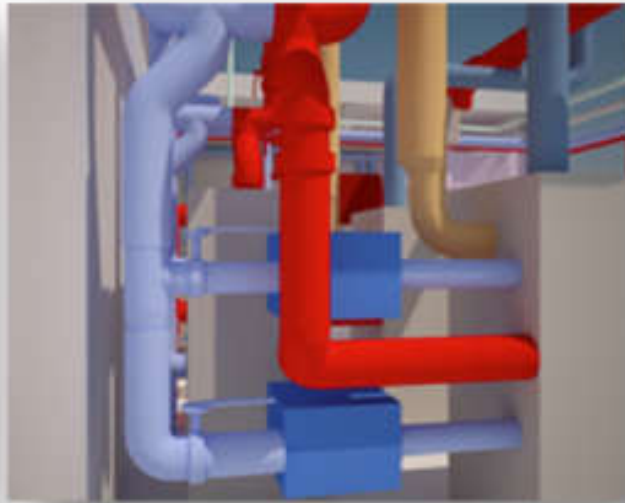
- LOD 500 element:\*

- It is a field verified representation in terms of size, shape, location, quantity, and orientation
- Non-graphic information may also be attached
- \* The Specification does not define or illustrate it

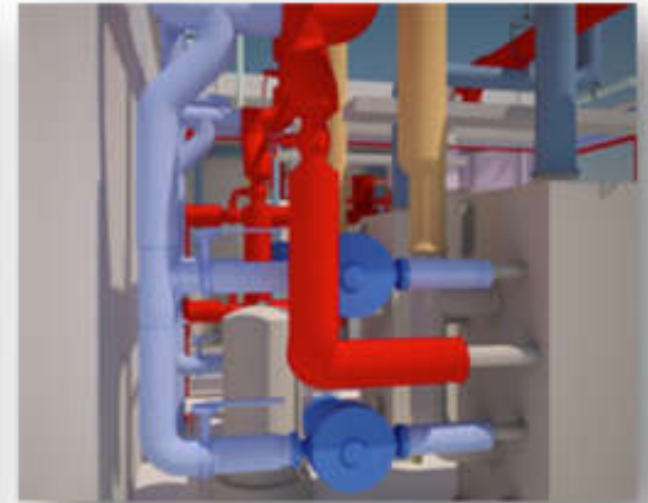
# A piping project at various LOD levels



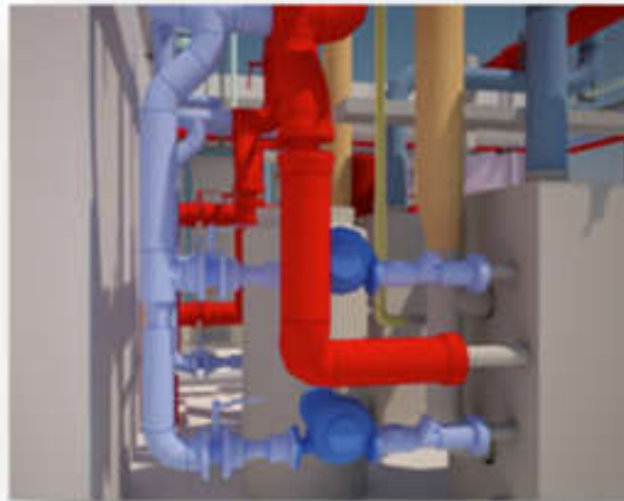
**LOD 200**



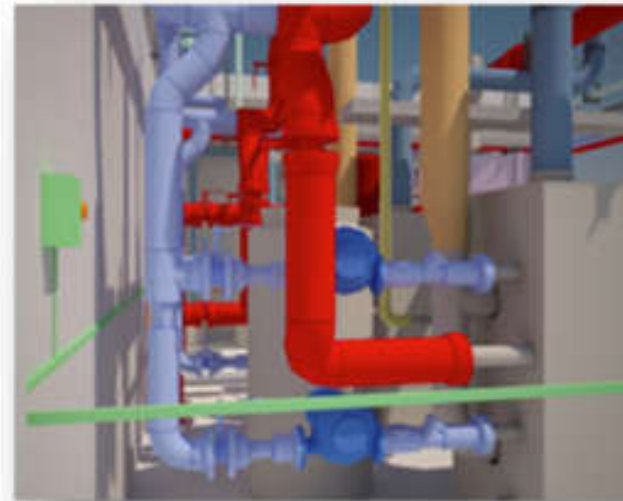
**LOD 300**



**LOD 350**



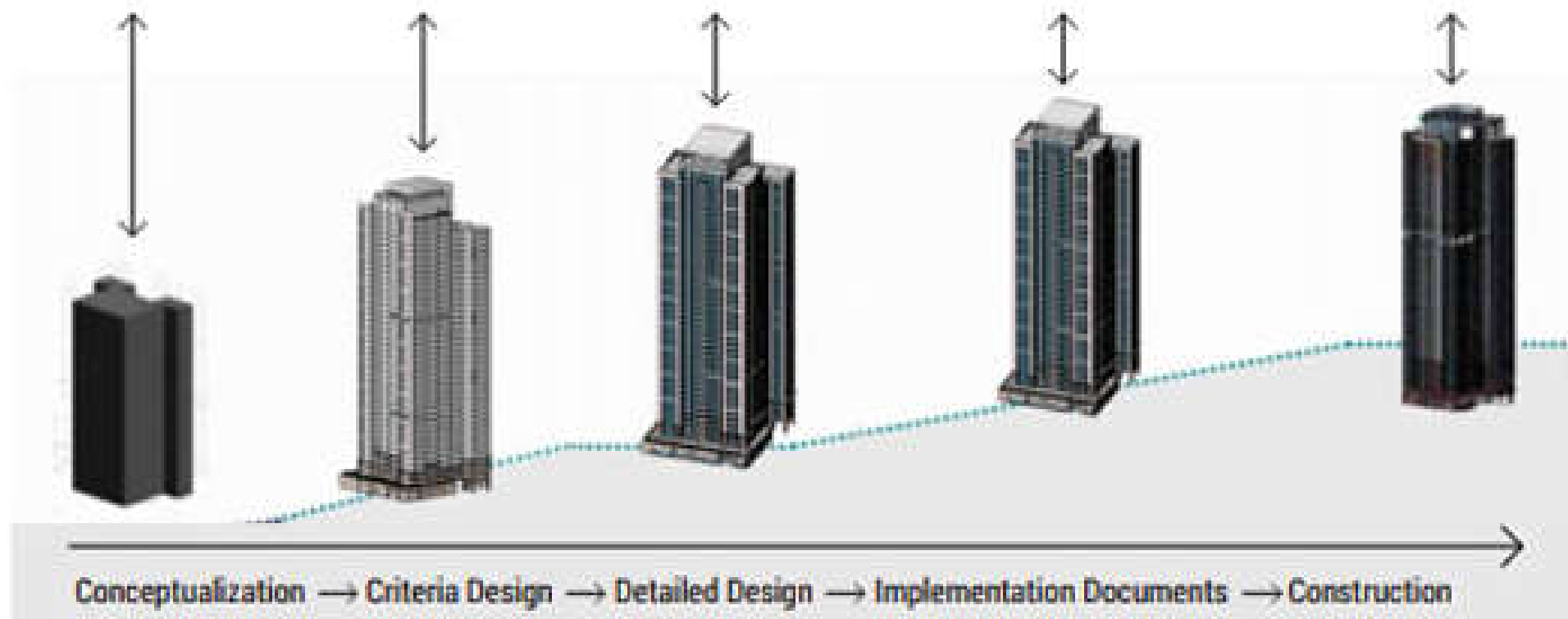
**LOD 400**



**LOD 500**

# Level of Development (LOD): examples

LOD 100	LOD 200	LOD 300	LOD 400	LOD 500
	Remicon Glass	Ready-Mixed on Steel Glass Paint Insulation Concrete Product	Ready-Mixed on Rebar Glass Paint Insulation Concrete Product Steel	Ready-Mixed on Rebar Glass Paint Insulation Concrete Product Steel
0%	52%	95%	100%	100%
N/A	Simplicity Assesment	Detailed Assesment	Detailed Assesment	Detailed Assesment





# LEVEL of DEVELOPMENT

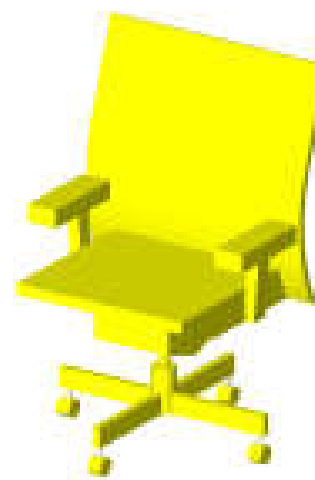
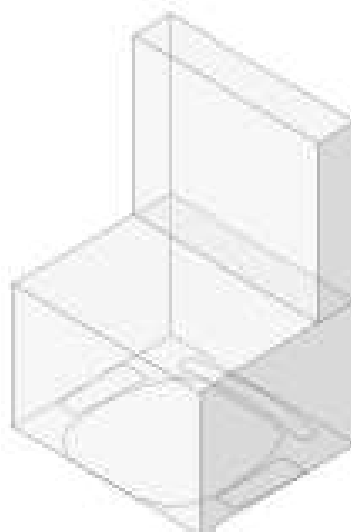
**LOD 100**

**LOD 200**

**LOD 300**

**LOD 400**

**LOD 500**



Concept (Presentation)

Design Development

Documentation

Construction

Facilities Management

**DESCRIPTION:**

**Office Chair**  
Arms, Wheels

**WIDTH:**

**DEPTH:**

**HEIGHT:**

**MANUFACTURER:**

Herman Miller, Inc.

**MODEL:**

Mirra

**LOD:**

**100**

**DESCRIPTION:**

**Office Chair**  
Arms, Wheels

**WIDTH:**

**700**

**DEPTH:**

**450**

**HEIGHT:**

**1100**

**MANUFACTURER:**

Herman Miller, Inc.

**MODEL:**

Mirra

**LOD:**

**200**

**DESCRIPTION:**

**Office Chair**  
Arms, Wheels

**WIDTH:**

**700**

**DEPTH:**

**450**

**HEIGHT:**

**1100**

**MANUFACTURER:**

Herman Miller, Inc.

**MODEL:**

Mirra

**LOD:**

**300**

**DESCRIPTION:**

**Office Chair**  
Arms, Wheels

**WIDTH:**

**685**

**DEPTH:**

**430**

**HEIGHT:**

**1085**

**MANUFACTURER:**

Herman Miller, Inc

**MODEL:**

Mirra

**LOD:**

**400**

**DESCRIPTION:**

**Office Chair**  
Arms, Wheels

**WIDTH:**

**685**

**DEPTH:**

**430**

**HEIGHT:**

**1085**

**MANUFACTURER:**

Herman Miller, Inc

**MODEL:**

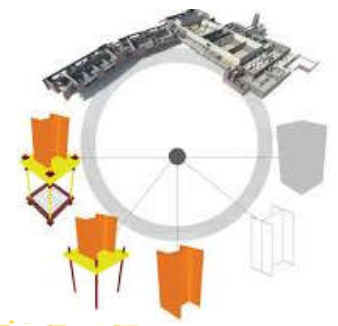
Mirra

**PURCHASE DATE:**

**01/02/2013**

(Only data in red is useable)

# Level of development (LOD)



- Level of Development vs. Level of Detail
  - Level of Detail (LoD) is essentially how much detail is included in the model element
  - Level of Development (LOD) is the degree to which the element's geometry and attached information has been thought through
    - Level of Detail can be thought of as input to the element, while Level of Development is reliable output
  - Levels of (model) information (LOI), which relates to the non-graphical content of models

# Level of Development (LOD) vs. Level of Detail (LoD)

# LOD

Level of Development

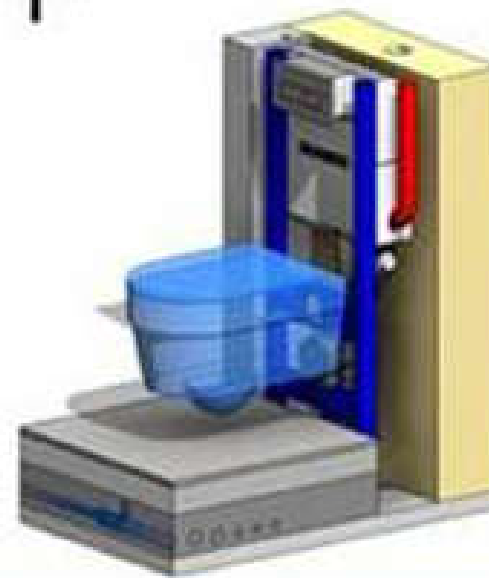
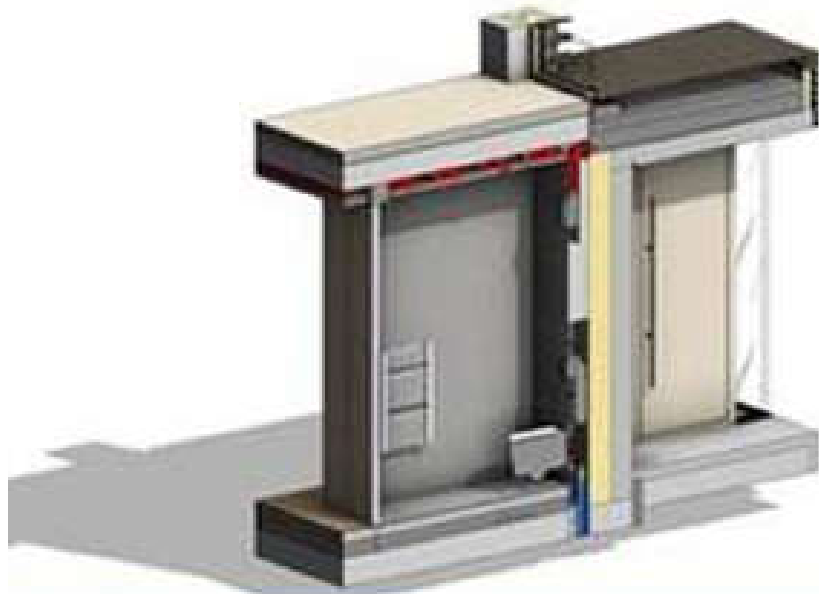
# LoD

Level of Detail

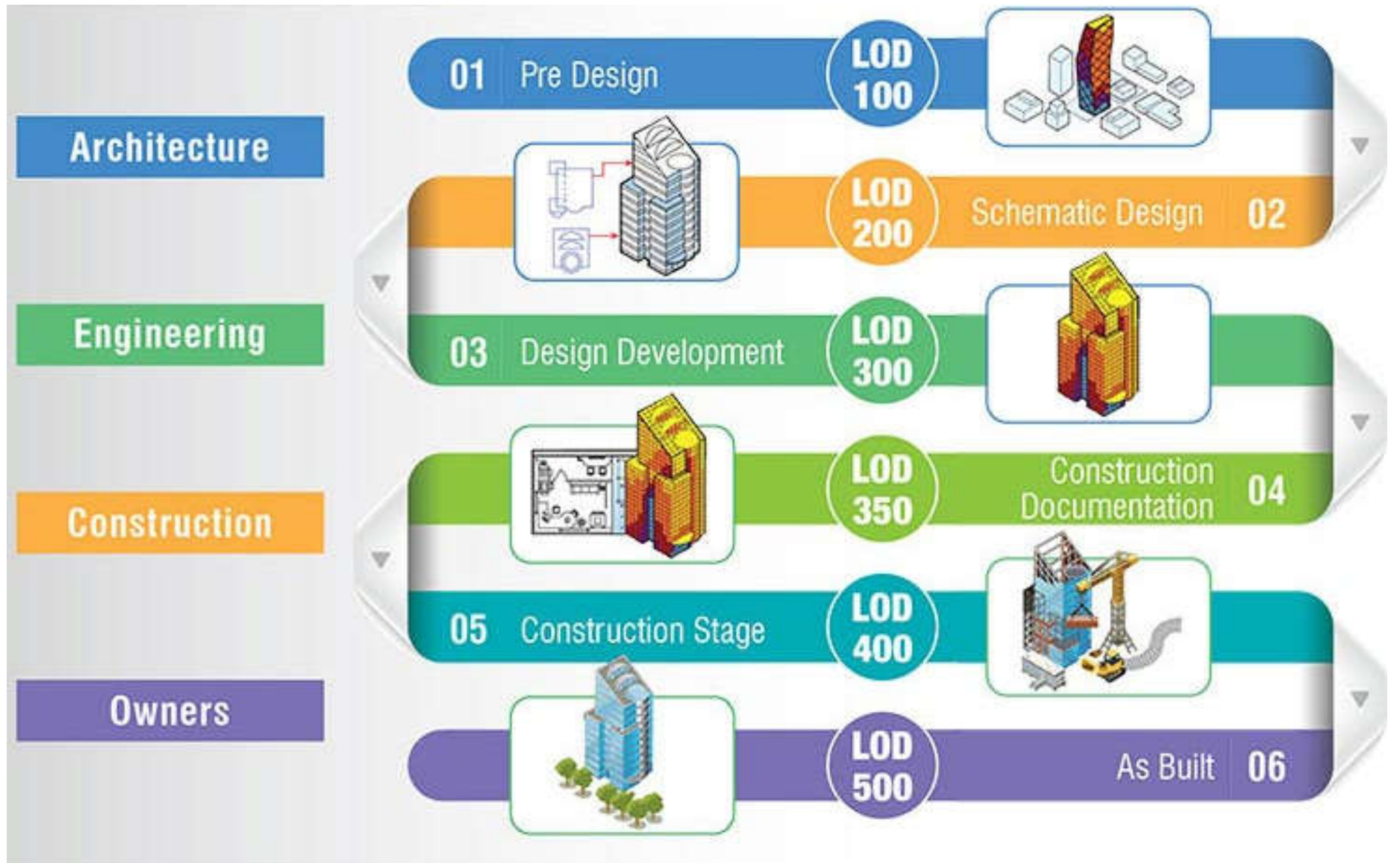
# LOI

Level of Information

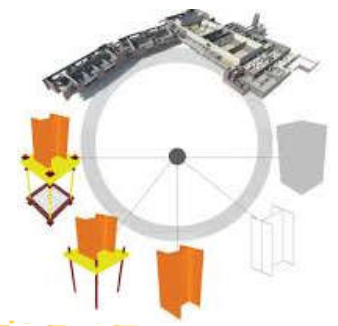
+



# Level of Development (LOD) and building development process





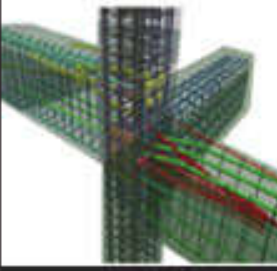



# Level of development (LOD)



- LOD in the design and construction process:
  - 1. Element-oriented modelling
    - As-Built (LOD 500)
    - Fabrication and assembly (LOD 400)
  - 2. System/Component oriented modelling
    - Detailed design (LOD 300)
    - Basic design (LOD 200)
  - 3. Conceptual information model
    - Conceptual design (LOD 100)
    - Client requirements (Pre-modelling)



Element-Oriented Modeling	As-Built	LOD 500		<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; margin: 5px;">Operation</div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; margin: 5px;">Budget</div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; margin: 5px;">Occupancy</div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; margin: 5px;">Capacity</div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; margin: 5px;">Location</div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; margin: 5px;">LEED Class</div> </div>																			
	Fabrication and Assembly	LOD 400		<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; margin: 5px;">Shape Areas Volumes</div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; margin: 5px;">Number of Levels Structural System</div> <div style="border: 1px solid black; border-radius: 10px; padding: 5px; margin: 5px;">Mechanical Systems Electrical Systems</div> </div>																			
System \ Component Oriented Modeling	Detailed Design	LOD 300		<table border="1" style="border-collapse: collapse;"> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">Component 1 Basement Space</td> <td>Geometry</td> <td>G1</td> <td>G2</td> <td>-</td> <td rowspan="3" style="font-size: 2em;">}</td> <td rowspan="3" style="vertical-align: middle;">Component Attributes</td> </tr> <tr> <td>Position</td> <td>P1</td> <td>P2</td> <td>-</td> </tr> <tr> <td>Specification</td> <td>S1</td> <td>S2</td> <td>-</td> </tr> </table>	Component 1 Basement Space	Geometry	G1	G2	-	}	Component Attributes	Position	P1	P2	-	Specification	S1	S2	-				
	Component 1 Basement Space	Geometry	G1	G2		-	}	Component Attributes															
Position		P1	P2	-																			
Specification		S1	S2	-																			
Basic Design	LOD 200		<div style="display: flex; justify-content: space-around;"> <table border="1" style="border-collapse: collapse;"> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">Comp. 1.1 Basement Wall</td> <td>Geo.</td> <td>G1</td> <td>-</td> </tr> <tr> <td>Pos.</td> <td>P1</td> <td>-</td> </tr> <tr> <td>Spc.</td> <td>S1</td> <td>-</td> </tr> </table> <table border="1" style="border-collapse: collapse;"> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">Comp. 1.2 Basement Floor Slab</td> <td>Geo.</td> <td>G1</td> <td>-</td> </tr> <tr> <td>Pos.</td> <td>P1</td> <td>-</td> </tr> <tr> <td>Spc.</td> <td>S1</td> <td>-</td> </tr> </table> </div> <p style="text-align: center; color: red;">Inter-model Dependency</p>	Comp. 1.1 Basement Wall	Geo.	G1	-	Pos.	P1	-	Spc.	S1	-	Comp. 1.2 Basement Floor Slab	Geo.	G1	-	Pos.	P1	-	Spc.	S1	-
Comp. 1.1 Basement Wall	Geo.	G1	-																				
	Pos.	P1	-																				
	Spc.	S1	-																				
Comp. 1.2 Basement Floor Slab	Geo.	G1	-																				
	Pos.	P1	-																				
	Spc.	S1	-																				
Conceptual Information Model	Conceptual Design	LOD 100		<div style="display: flex; justify-content: space-around;"> <table border="1" style="border-collapse: collapse;"> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">C. 1.1.1 Wall Formwork</td> <td>G</td> <td>-</td> </tr> <tr> <td>P</td> <td>-</td> </tr> <tr> <td>S</td> <td>-</td> </tr> </table> <table border="1" style="border-collapse: collapse;"> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">C. 1.1.2 Wall Rein. Bar</td> <td>G</td> <td>-</td> </tr> <tr> <td>P</td> <td>-</td> </tr> <tr> <td>S</td> <td>-</td> </tr> </table> </div> <p style="text-align: center; color: green;">Inter-model Dependency</p>	C. 1.1.1 Wall Formwork	G	-	P	-	S	-	C. 1.1.2 Wall Rein. Bar	G	-	P	-	S	-					
	C. 1.1.1 Wall Formwork	G	-																				
P		-																					
S		-																					
C. 1.1.2 Wall Rein. Bar	G	-																					
	P	-																					
	S	-																					
Client Requirements	Pre-Modeling		<div style="display: flex; justify-content: space-around;"> <table border="1" style="border-collapse: collapse;"> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">C. 1.2.2 Floor Slab Rein. Bar</td> <td>G</td> <td>-</td> </tr> <tr> <td>P</td> <td>-</td> </tr> <tr> <td>S</td> <td>-</td> </tr> </table> <table border="1" style="border-collapse: collapse;"> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">C. 1.2.1 Floor Slab Formwork</td> <td>G</td> <td>-</td> </tr> <tr> <td>P</td> <td>-</td> </tr> <tr> <td>S</td> <td>-</td> </tr> </table> </div>	C. 1.2.2 Floor Slab Rein. Bar	G	-	P	-	S	-	C. 1.2.1 Floor Slab Formwork	G	-	P	-	S	-						
C. 1.2.2 Floor Slab Rein. Bar	G	-																					
	P	-																					
	S	-																					
C. 1.2.1 Floor Slab Formwork	G	-																					
	P	-																					
	S	-																					





# Further reading

- BIM For Beginners by The B1M
  - <https://www.theb1m.com/BIM-For-Beginners>
- BIM Levels explained
  - <https://www.thenbs.com/knowledge/bim-levels-explained>
- Building information modelling BIM
  - [https://www.designingbuildings.co.uk/wiki/Building\\_information\\_modeling\\_BIM](https://www.designingbuildings.co.uk/wiki/Building_information_modeling_BIM)
- Level of Development - LOD - as a Lifecycle BIM tool
  - <http://blog.areo.io/level-of-development/>
- Project Phases & Level of Development
  - <https://sustainabilityworkshop.autodesk.com/buildings/project-phases-level-development>