

## VDC and BIM

The use of  
Building Information Modeling  
in  
Virtual Design and Construction

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*Presented by Rex Tate*

## Improving project delivery through VDC

### Part 1

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*Presented by Rex Tate*

- 🌀 Defining VDC and BIM
- 🌀 Waste in the AEC industries and its reasons
- 🌀 Models, their content and their value
- 🌀 Using 3d model objects to visualize completed construction activities
- 🌀 The levels of development of model objects

## **B**uilding **I**nformation **M**odeling and **BIM** models

It's a digital representation of the physical and functional characteristics of a building that can be extracted for use during the design, construction and operation phases

A BIM model is a shared knowledge resource that forms a reliable basis for decisions

BIM is a process of managing construction projects with 3d models through collaboration with project team members (architects, subcontractors, engineers, designers, owners)

**The fundamental idea:** BIM is a method of monitoring and tracking change

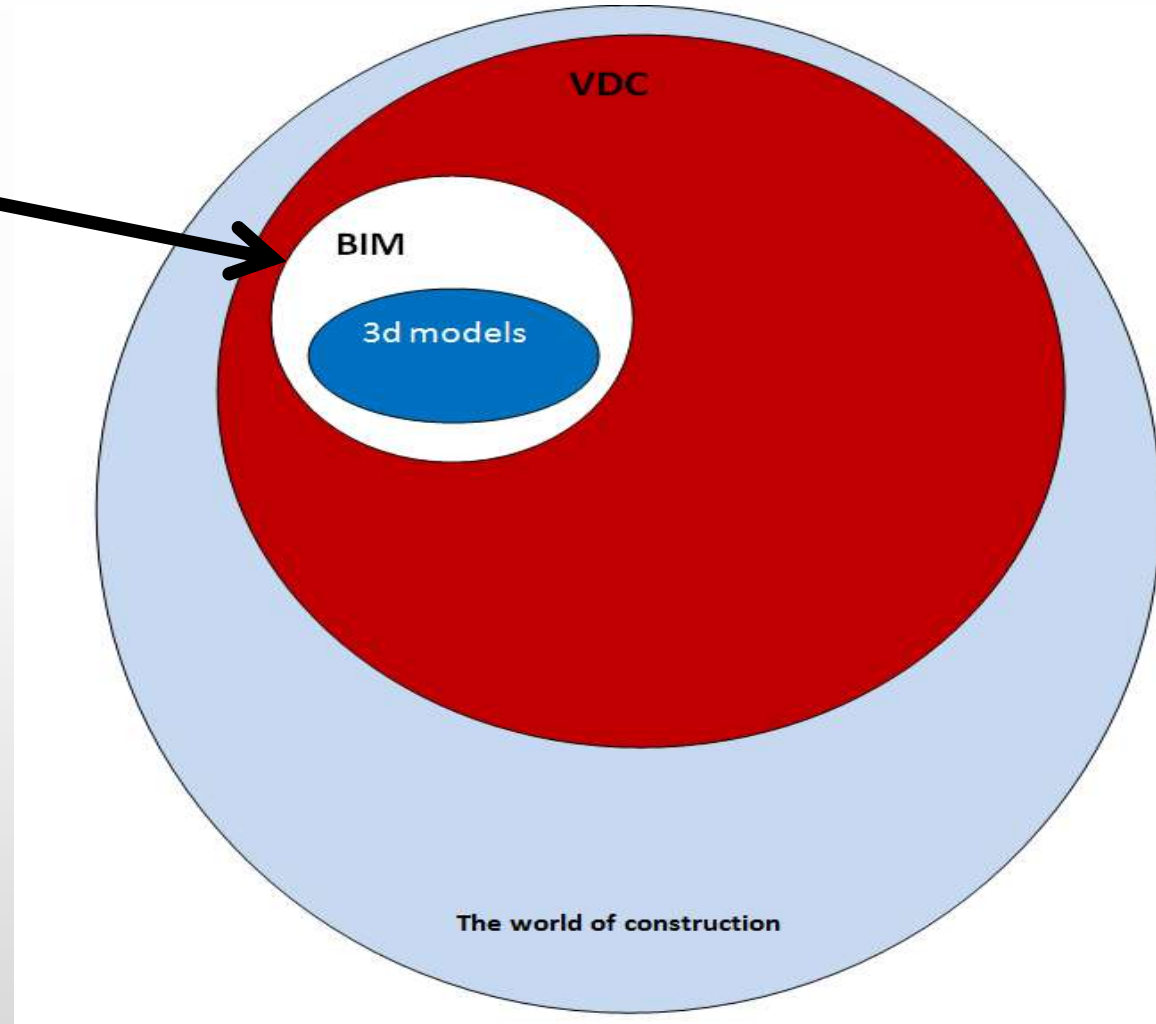
## **V**irtual **D**esign and **C**onstruction

It is the management of integrated performance models for construction projects through model analysis, evidence based metrics, co-located collaborative processes and methods to achieve exceptional value in delivering the building project

VDC is a way of doing things in the design and construction of projects

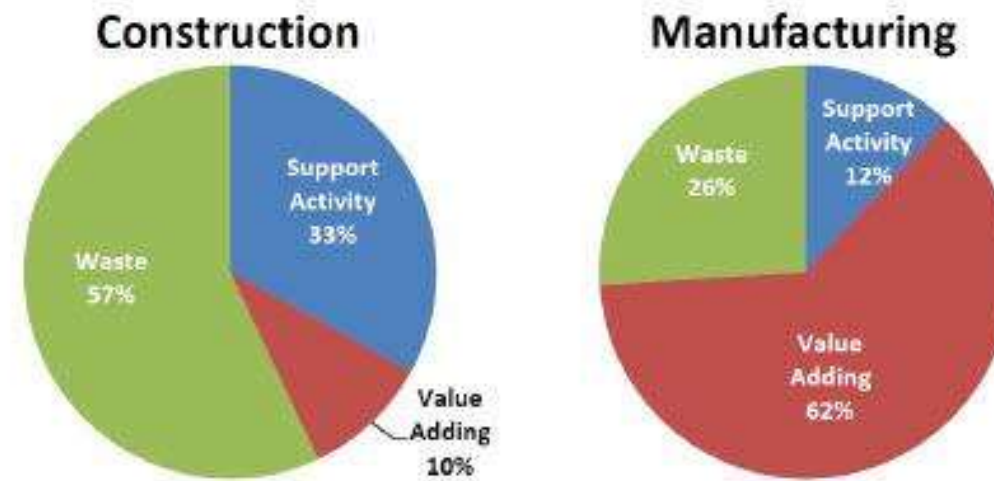
# VDC contains BIM and 3d models are within the BIM processes

BIM is a component  
within VDC



- VDC and BIM are ways of management that are used to reduce this alarming percent of waste \$'s in construction

## A comparison of construction to manufacturing



*A large portion of the money spent in the construction industry is wasted, when compared to the manufacturing industry*

- Waste is defined as money spent on a project that is **non-value adding**

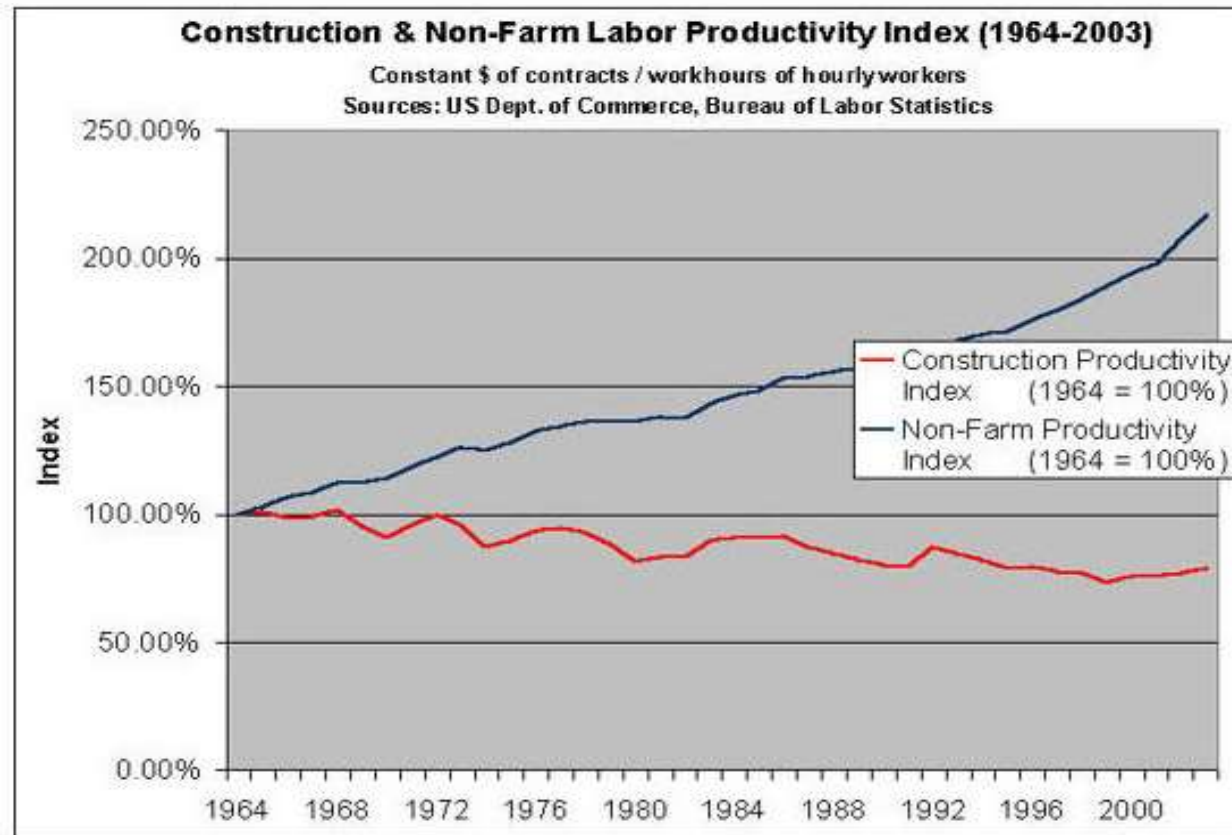
Source: Construction Industry Institute, 2011

- BIM is not software you purchase from a store
- BIM is not just a 3d model
- The act of 'BIMming' is not just using Revit or Tekla to build a 3d model
- Clash detection is not all there is to BIM

- Lonely BIM is building 3d models by yourself
- No early input from others
- No collaboration with others involved in the project
- Don't confuse **design collaboration** (*this results in better designs*) with **design by committee** (*unintelligent group input, poor outcomes and strange results*)
- **'Design by committee'** provides worse designs than lonely BIM in a silo



- The trends of productivity in manufacturing compared to construction
- Manufacturing = **improving**      Construction = **declining**

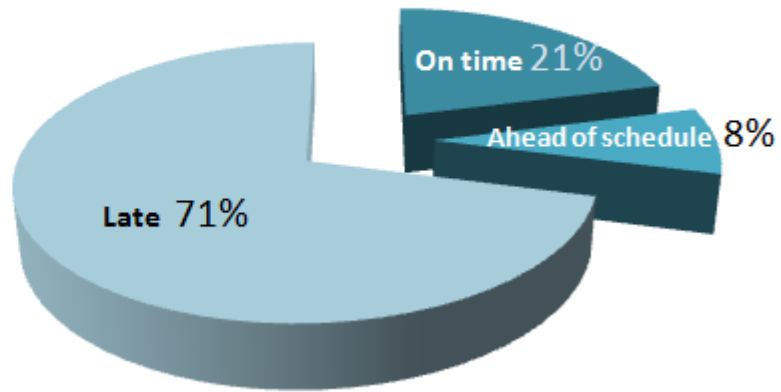


Source: US Department of Commerce  
Bureau of Economic Analysis, 2005

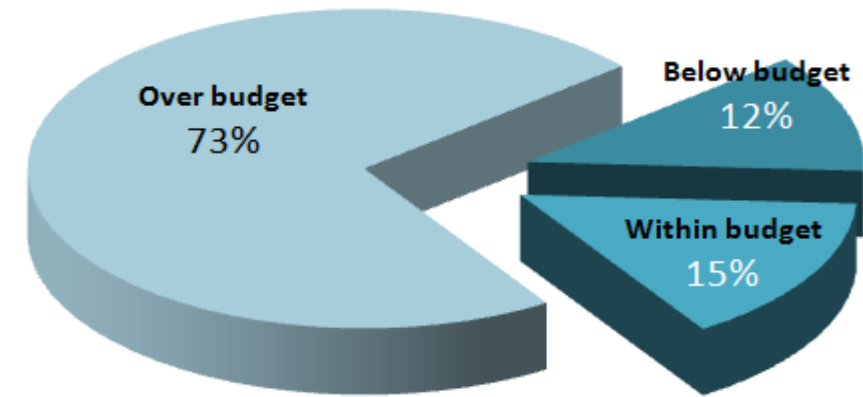
# Construction projects

## Waste of time and waste of money

### Construction projects: on time completion



### Budget outcomes



Source: Harvard Business Review

# Why ?

**Construction and design are fragmented processes**

**Manufacturing is not**

**The fragmentation is one factor in waste**



VDC can move it from a fragmented to an integrated process



**Building  
Owner**



**Architect/Engineer**

**General contractor**



**Contractor**

**Subcontractors**



**Contractor**



**Building Product Manufacturer /  
Supplier / Distributor**

**Consultants and  
Design engineers**



**Architect/Engineer**

## A culture of measurement

- 🌀 Manufacturing has it
- 🌀 AEC does not



## Priced based versus qualifications based and best value criteria:

- Price based = low bid requirement and/or negotiated price after bid
- Best qualifications = owner determines contractor fitness and negotiates price
- Best value = Best qualifications + price basis

**Low bid winners** versus **Contractor fitness**

# The adversarial nature of DBB and its low bid procurement method requirement



- Traditional contracting methods are inherently adversarial
- The conditions at the project's beginning define the outcome
- VDC **requires** early involvement of designers and builder
- The nature of DBB does **not allow** early collaborative involvement
- The impact of early involvement of parties is lost
- Dysfunctional competition and the false premise that the owner's costs are best controlled by low bid requirements
- IPD with VDC operates within a collaborative framework
- It can eliminate the artificial adversarial environment if carried out correctly

## Bidding skills versus Construction skills

- Construction companies compete to win jobs through the low bid process, **NOT** to deliver projects
- They compete with one another on their claims capabilities, change order talents and their estimating prowess, **NOT** on their construction abilities

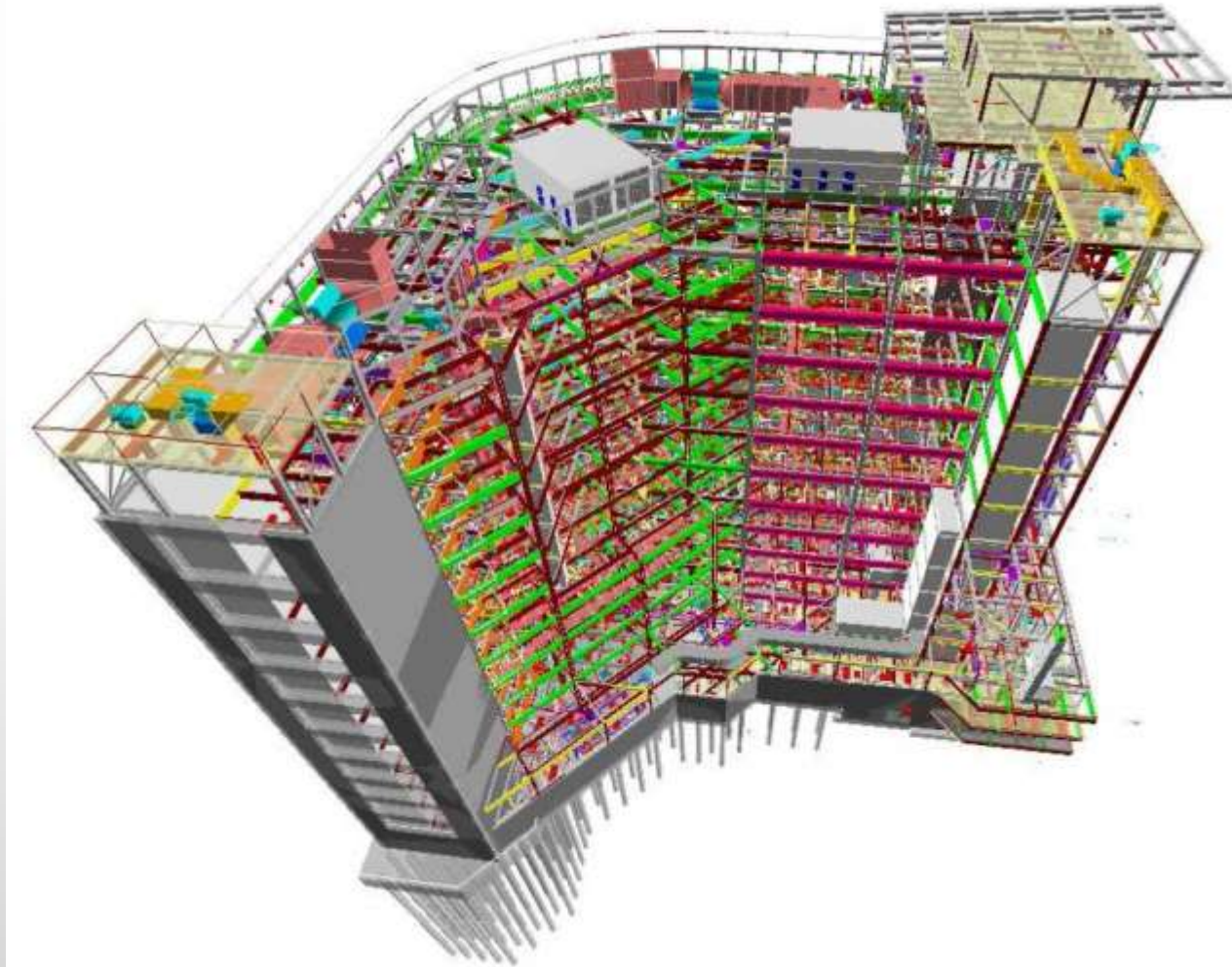


- Design is not produced independently in the VDC environment
- Must avoid bad design by committee but use collaboration in a good way
- Involvement of contractor, subcontractor, engineers and consultants at the design stage is **mandatory** with VDC if benefits are to be realized
- IPD with VDC is a complex but beneficial (in time and \$'s) team agreement
- VDC methods can be used partially on a project's post-design stages, but much of the advantageous impact is lost
- In IPD, the risks are shared among the team's organizations but so are the monetary benefits and gains

Project procurement of construction, professional services and subcontractor services:

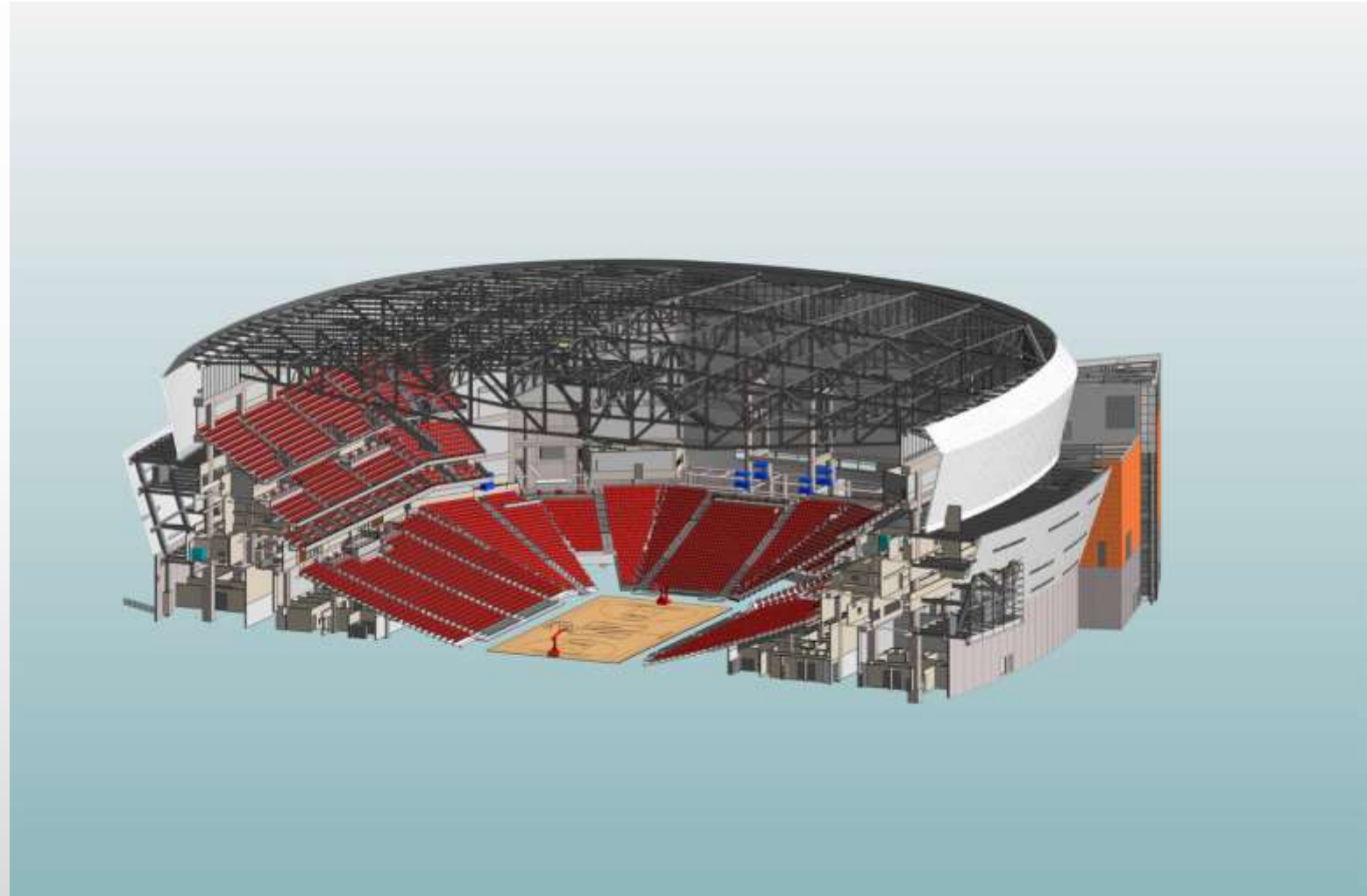
| Project delivery type | Procurement method  |
|-----------------------|---------------------|
| IPD with VDC          | Best qualifications |
| Design / Bid / Build  | Low bid             |
| Design / Build        | Best value          |
| CM                    | Best value          |

# A 3d model and its objects



Each individual object within a model can be loaded with information

- Sizes and weights
- Costs
- Crews and labor costs
- Material information
- Characteristics
- Installation equipment
- Attributes
- Transportation requirements
- Construction time information and scheduling data
- Product information



## Visualization

- 🌐 You can view the building from all angles, inside and out  
This can't be done with 2d plans and drawings
- 🌐 This viewing ability from everywhere reveals problems and allows for corrections that may not be discovered with 2d drawings until actual physical on site construction is underway
- 🌐 This saves labor time and material costs that would be spent on tearing down in place wrongly erected items and rebuilding them correctly
- 🌐 Using both 3d models and 2d plans allows for the best comprehension

- 🌀 **Output** and **Input**

- 🌀 **Level of Development** is the rank of reliability of the model's output

This is based on the degree to which an object's geometry and attached information has been considered and accurately determined

- 🌀 **Level of Detail**

How much detail is included in each model object? This is the physical data input into the model by the element authors and contributors

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🌀 *Development* provides **output**

*Detail* is the **input**

# The six levels of development

## An expansion on the AIA protocol

 Level 100

 Level 150

 Level 200

 Level 300

 Level 350

 Level 400

 Level 450

 Level 500

 Level 600

### Purpose:

Conceptual design

Space planning

Schematic design

Design development

Pre-construction

Construction documents

Construction administration

As-built model

Operations and management

### Representation:

Conceptual geometry

Approximate geometry

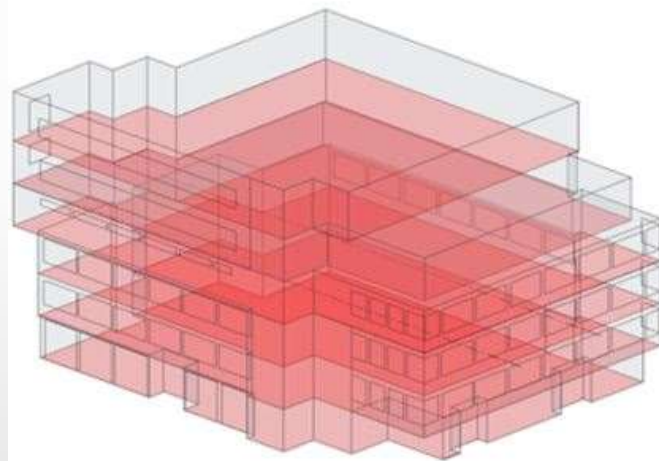
Precise geometry

Construction and fabrication ready

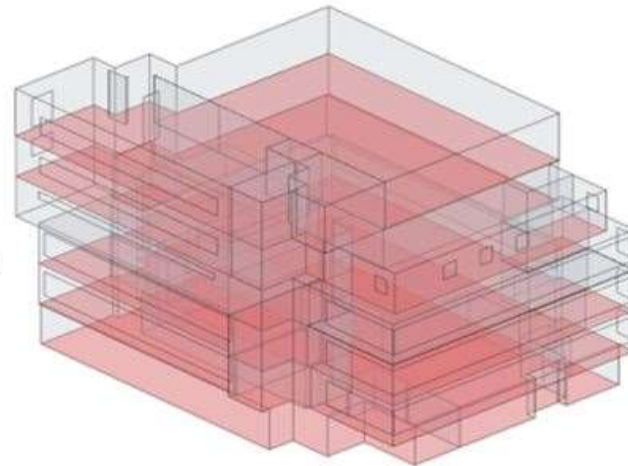
Current conditions

Facility management information

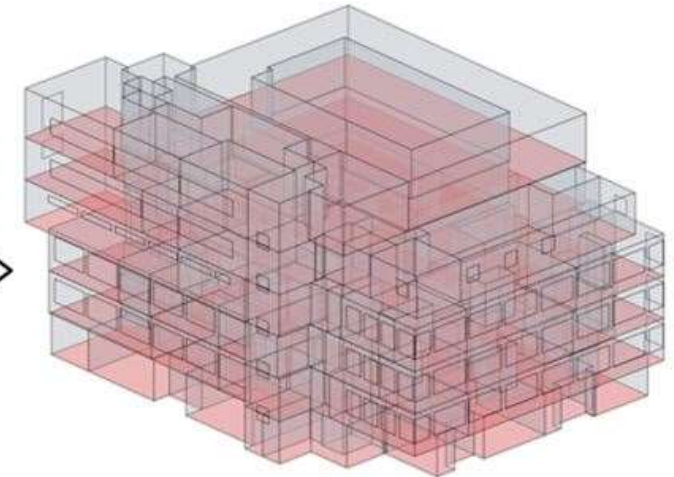
# Massing and defined spaces



**Generic Mass**



**Mass with some spaces defined**



**Mass with all spaces defined**





# The uses of the six levels of development

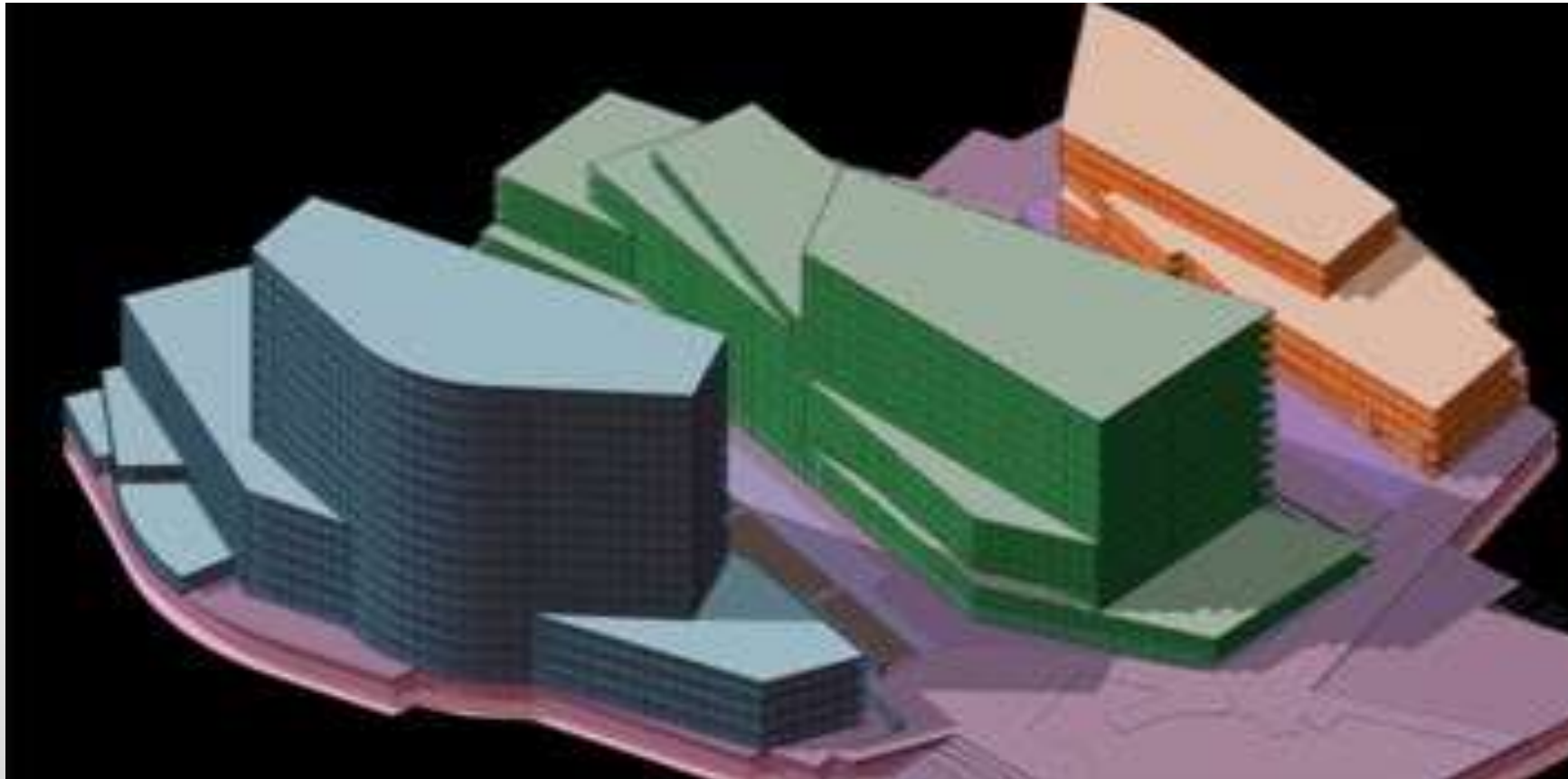


# A model of level 100 objects

## It's just your initial idea

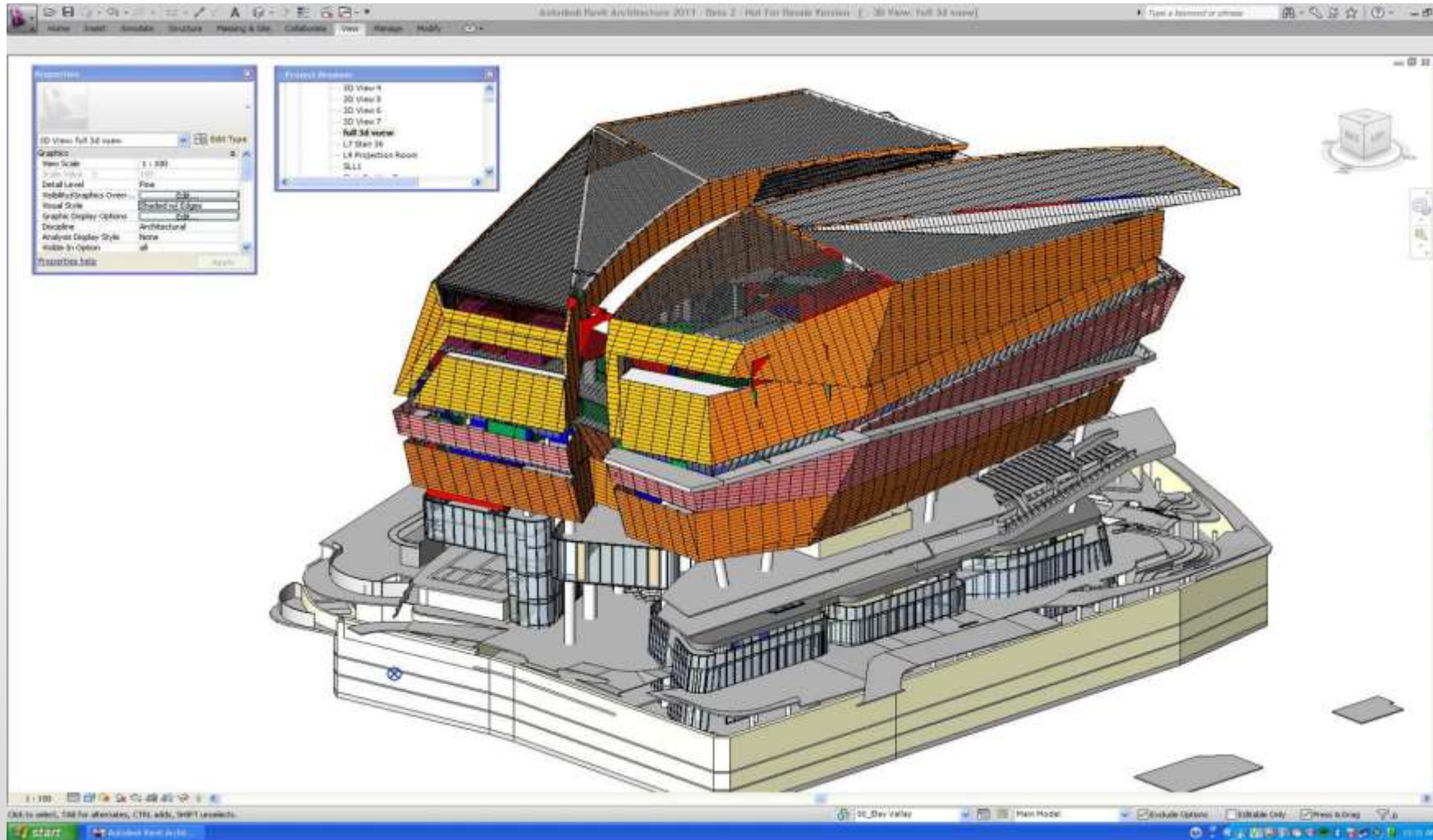
The geometry is only conceptual

There aren't any true sizes yet but there will be as the model is developed



# Level 200 objects

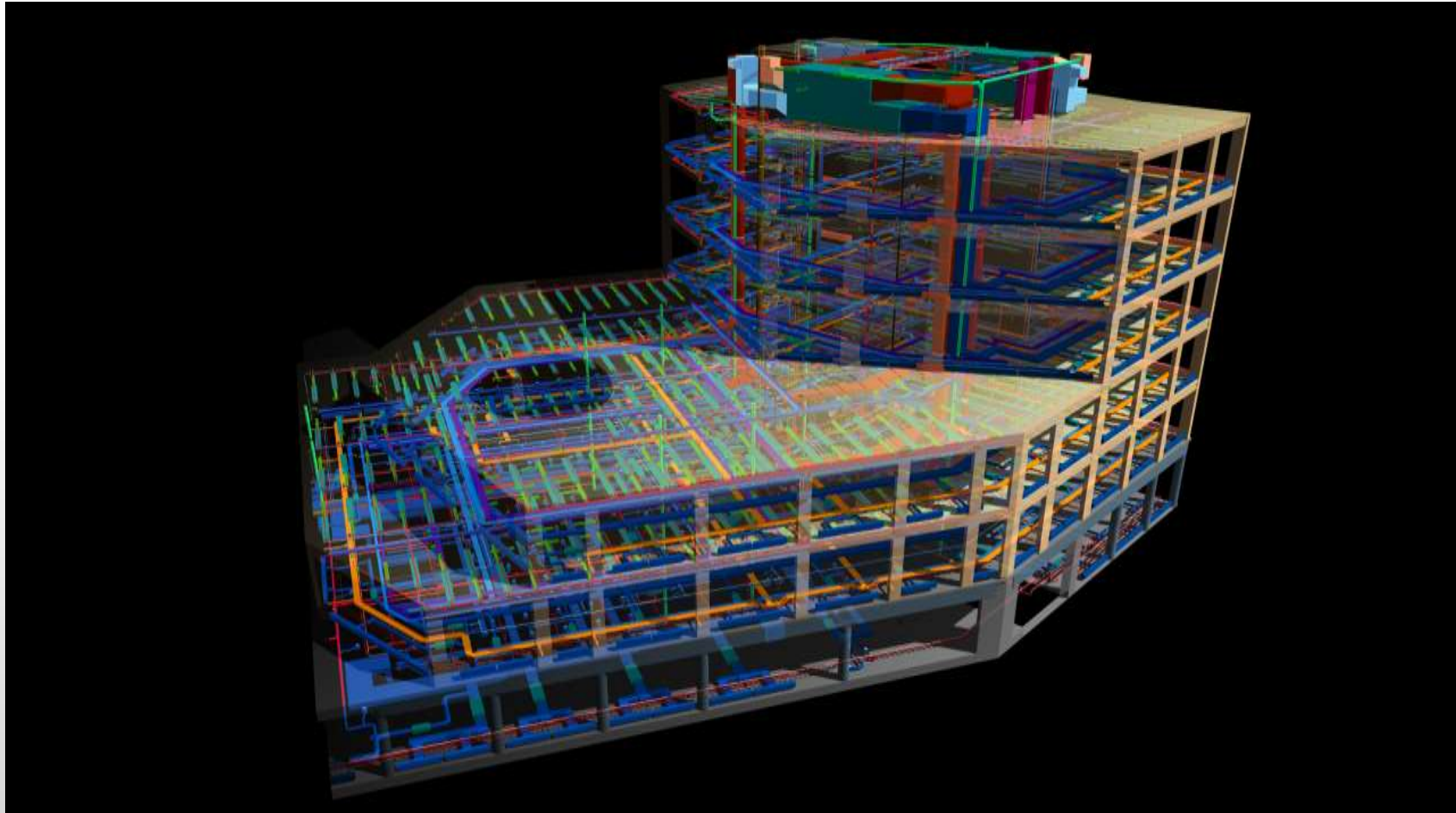
We are beyond a sketched idea but not enough detail yet to build it



# Level 400 objects in a model

## This is buildable

There is enough information in the model to physically build it on site  
We are now at the construction documents level



# Level 500

It's pretty, but are the objects loaded with level 500 information?

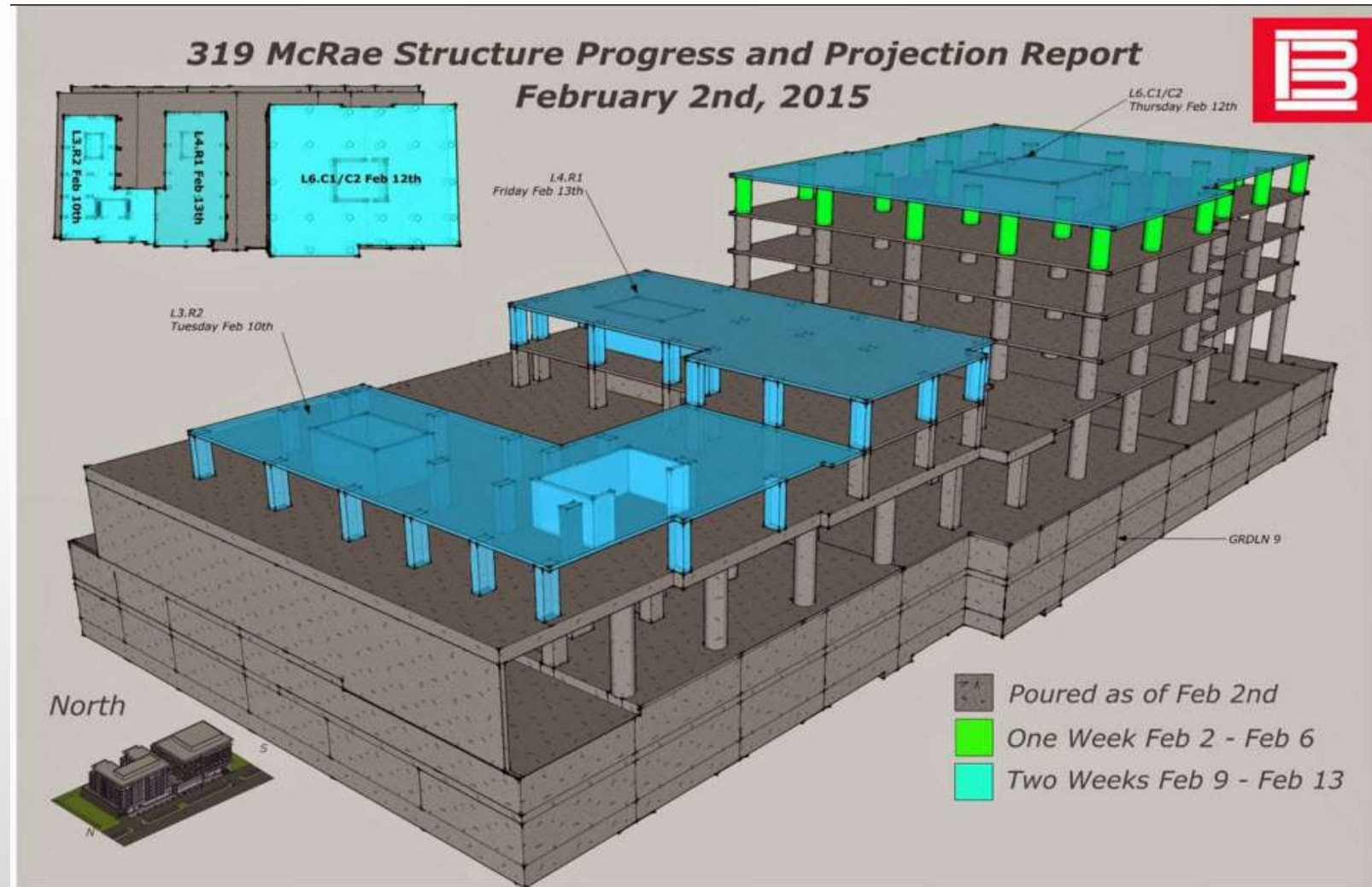
# As-built



# Use of a 3d model to visualize accomplished activities and future ones

## View completed activities and upcoming activities

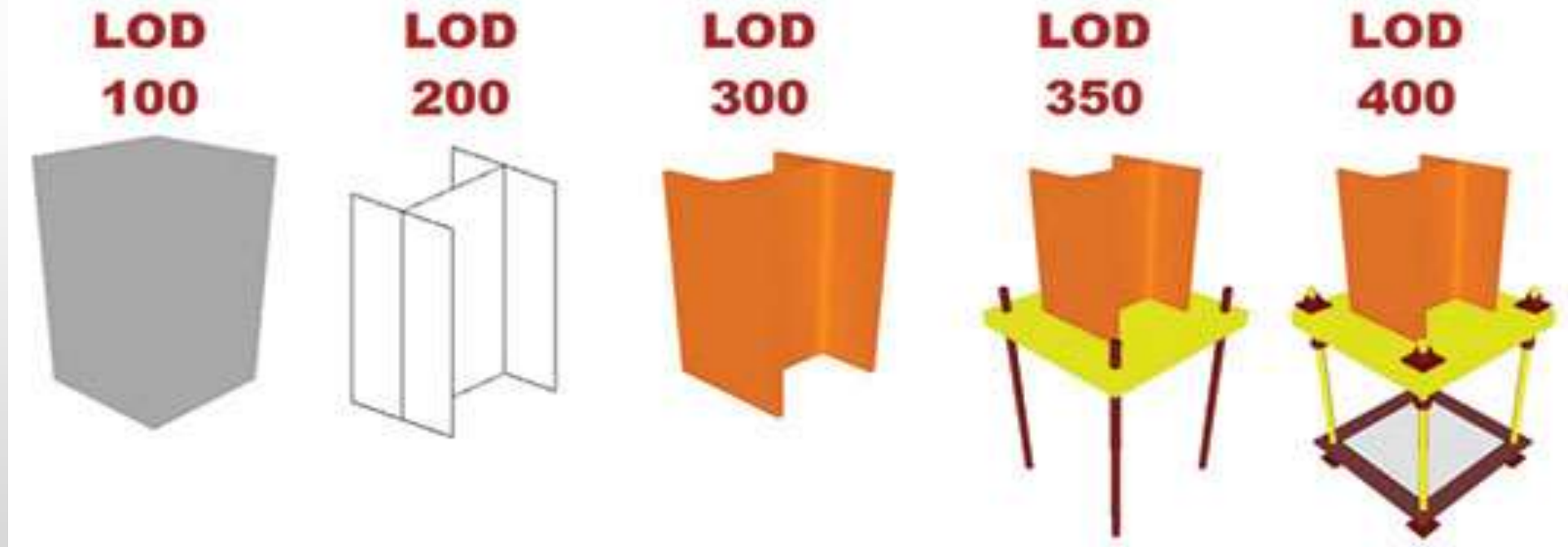
- Display only the objects of interest (here, structural concrete in current phase)
- Color coded groups of objects (to distinguish among completed, near future and farther out activities)
- View accomplished objects that represent completed activities in one color
- View upcoming objects in other colors, based on scheduled sequence



# The increase in details for a column as the levels are developed

## From LoD 100 to 400

We have a vertical element, we have a column that's kind of in this area, there's a steel column of a specific size and strength and coating in a known place, it's on a base plate, it's secured with anchor bolts of a certain size





# Levels of model object development

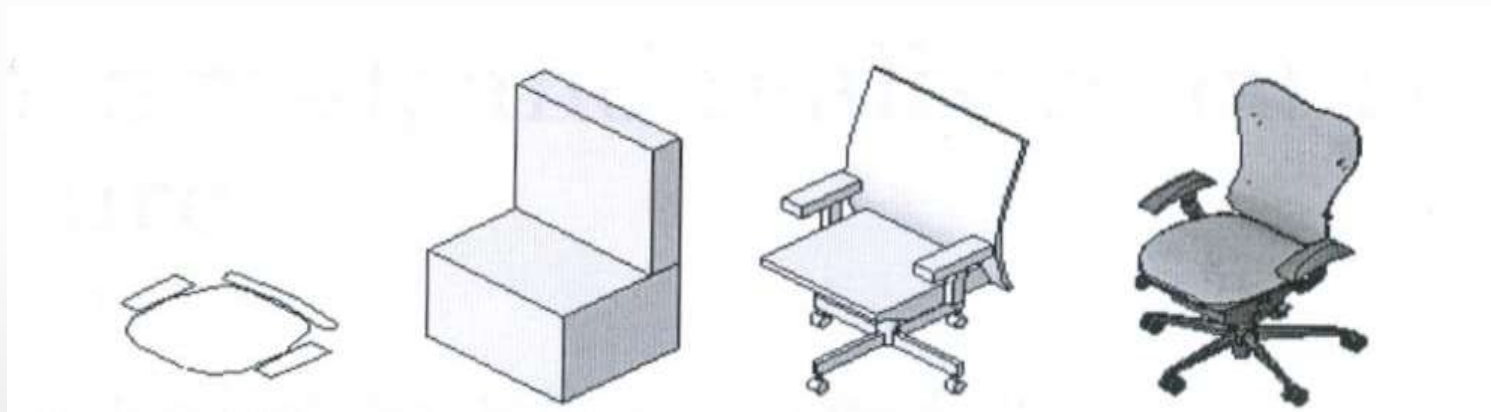
Level 100   Level 200   Level 300   Levels 400 and 500

*Conceptual*

*Schematic*

*Defined*

*Rendered*





*Thank you*