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The Next Steps in BIM: Civil and Construction Coordination with BIM Models

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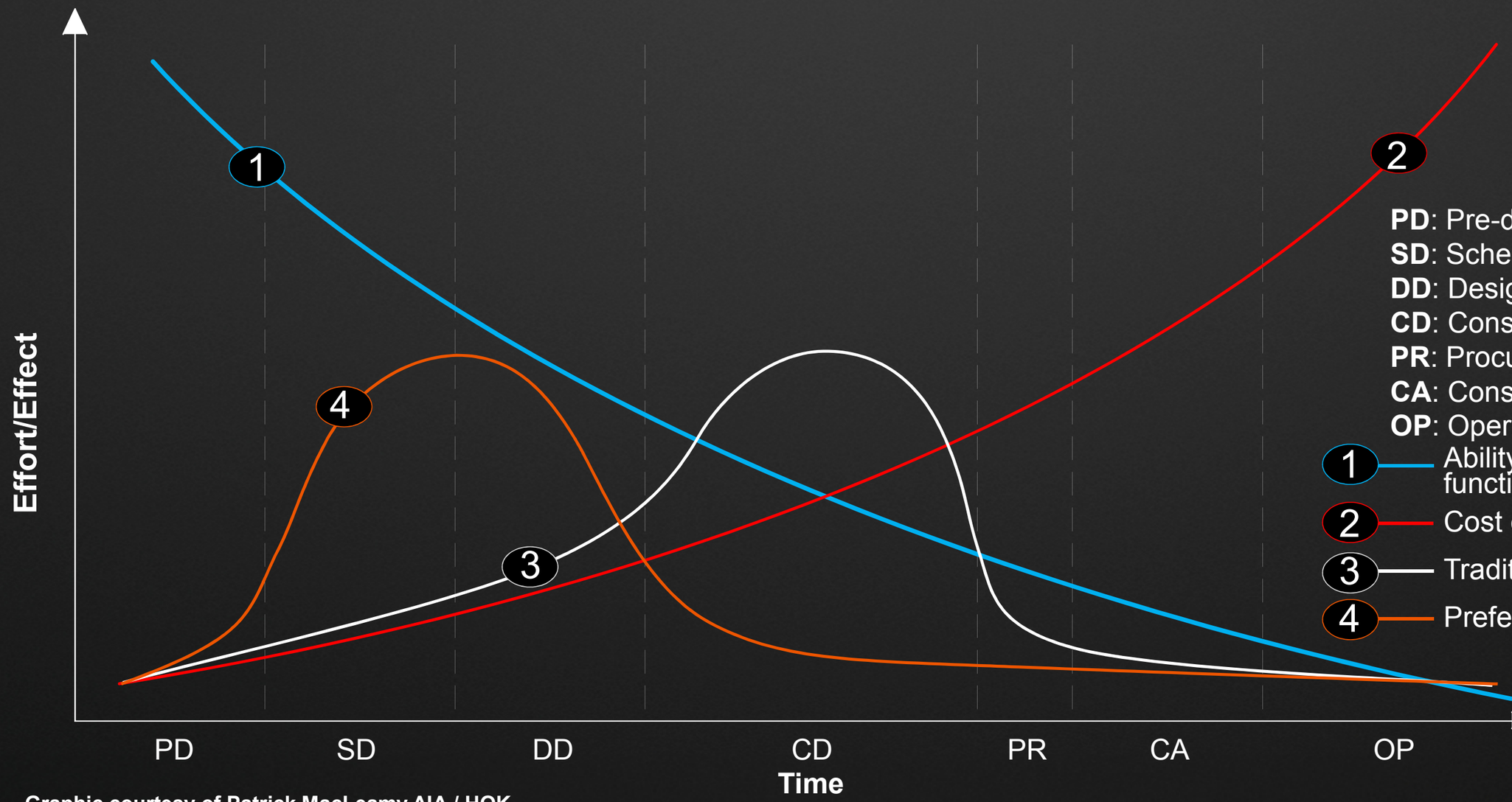
Class Summary

BIM as both a process and a type of software has been utilized for architectural and engineering design and documentation for some time now, and its use continues to spread to more facets of the AEC industry. This class will focus on the BIM process as it applies now more than ever to both the civil and construction trades. Using real world examples and core design concepts, we will explore strategies for how the civil and construction trades can best coordinate with the other trades' BIM models and data. We will also discuss the benefits of improving civil engineering collaboration with the other BIM models during the design and documentation stage, and later incorporating the construction and subcontractor models. With increased collaboration at every stage comes improved design efficiency, reduced costs, and the potential for a more interactive model deliverable that can be leveraged by owners for operations and maintenance.

Learning Objectives

- Identify the process for keeping a coordinated BIM model within the construction process
- Describe what information is typically needed from a BIM model for construction and civil use
- Create a BIM model for construction management from a documentation model
- Describe useful techniques for sharing relevant data between the architectural, MEP, structural, and civil trades

Evolution toward a new design process

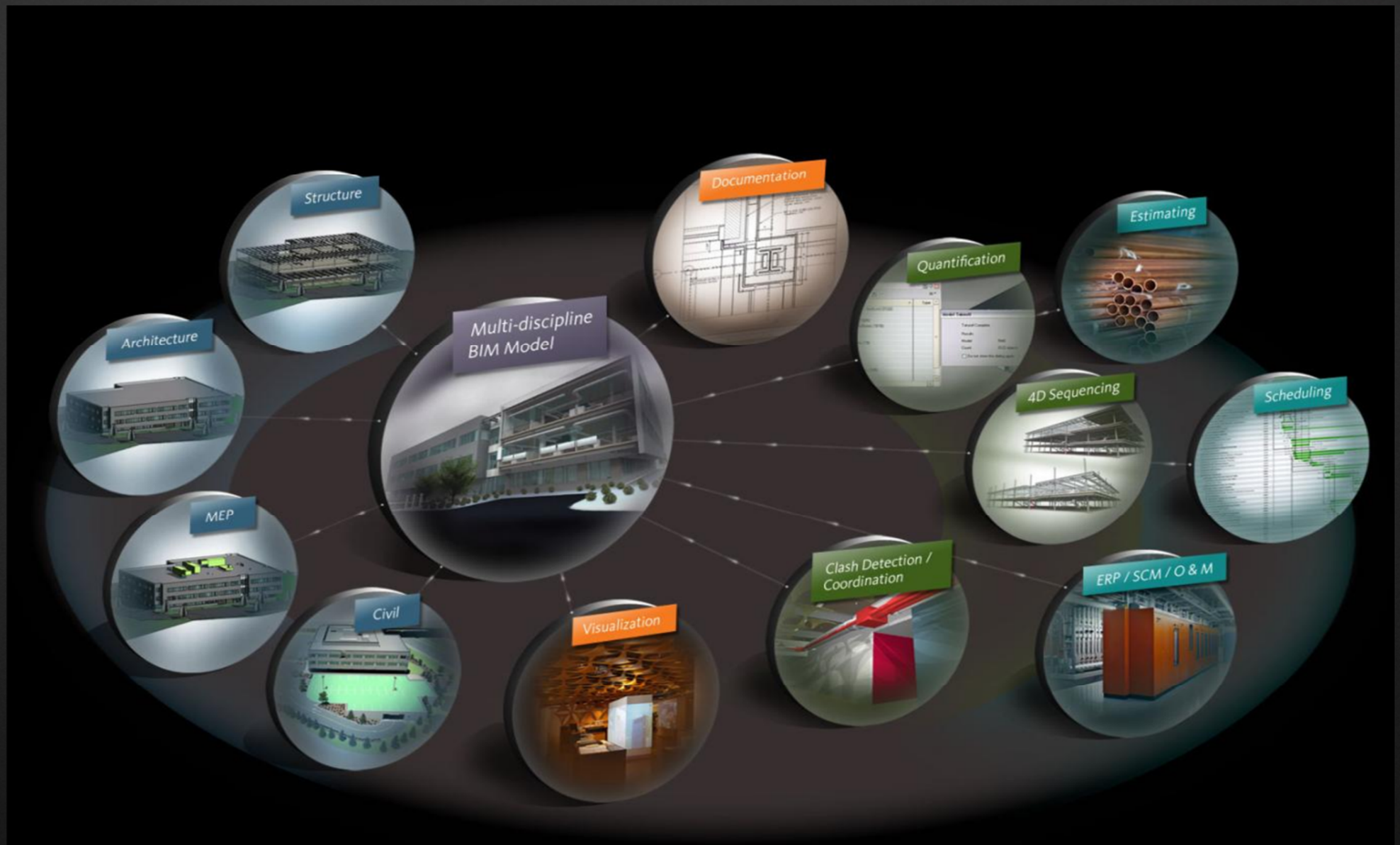


PD: Pre-design
SD: Schematic design
DD: Design development
CD: Construction documentation
PR: Procurement
CA: Construction Administration
OP: Operation

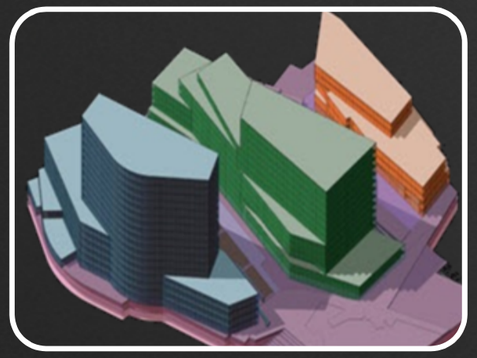
1 — Ability to impact cost and functional capabilities
2 — Cost of design changes
3 — Traditional design process
4 — Preferred design process

Graphic courtesy of Patrick MacLeamy AIA / HOK

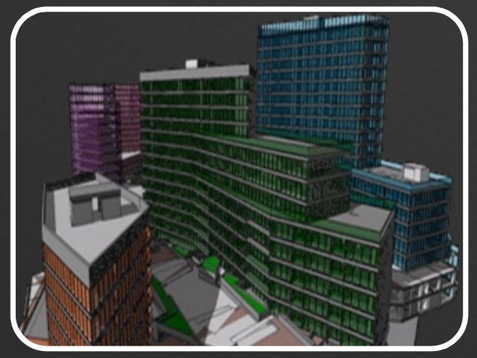
BIM for construction



Enhanced Delivery Methods - AIA E202 – BIM Protocol

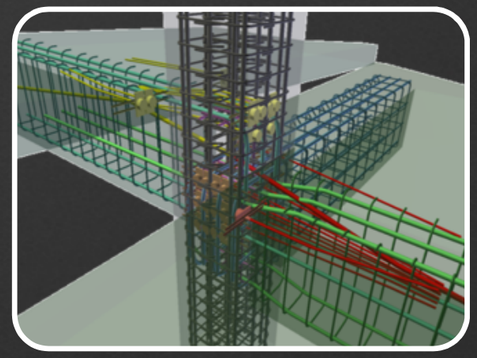


LOD 100
Essentially the equivalent of conceptual design, the model would consist of overall building massing and the downstream users are authorized to perform whole building types of analysis (volume, building orientation, cost per square foot, etc.)



LOD 200
Similar to schematic design or design development, the model would consist of "generalized systems or assemblies with approximate quantities, size, shape, location and orientation." Authorized uses would include "analysis of selected systems by application of generalized performance criteria."

LOD 300
Model elements are suitable for the generation of traditional construction documents and shop drawings. As such, analysis and simulation is authorized for detailed elements and systems.



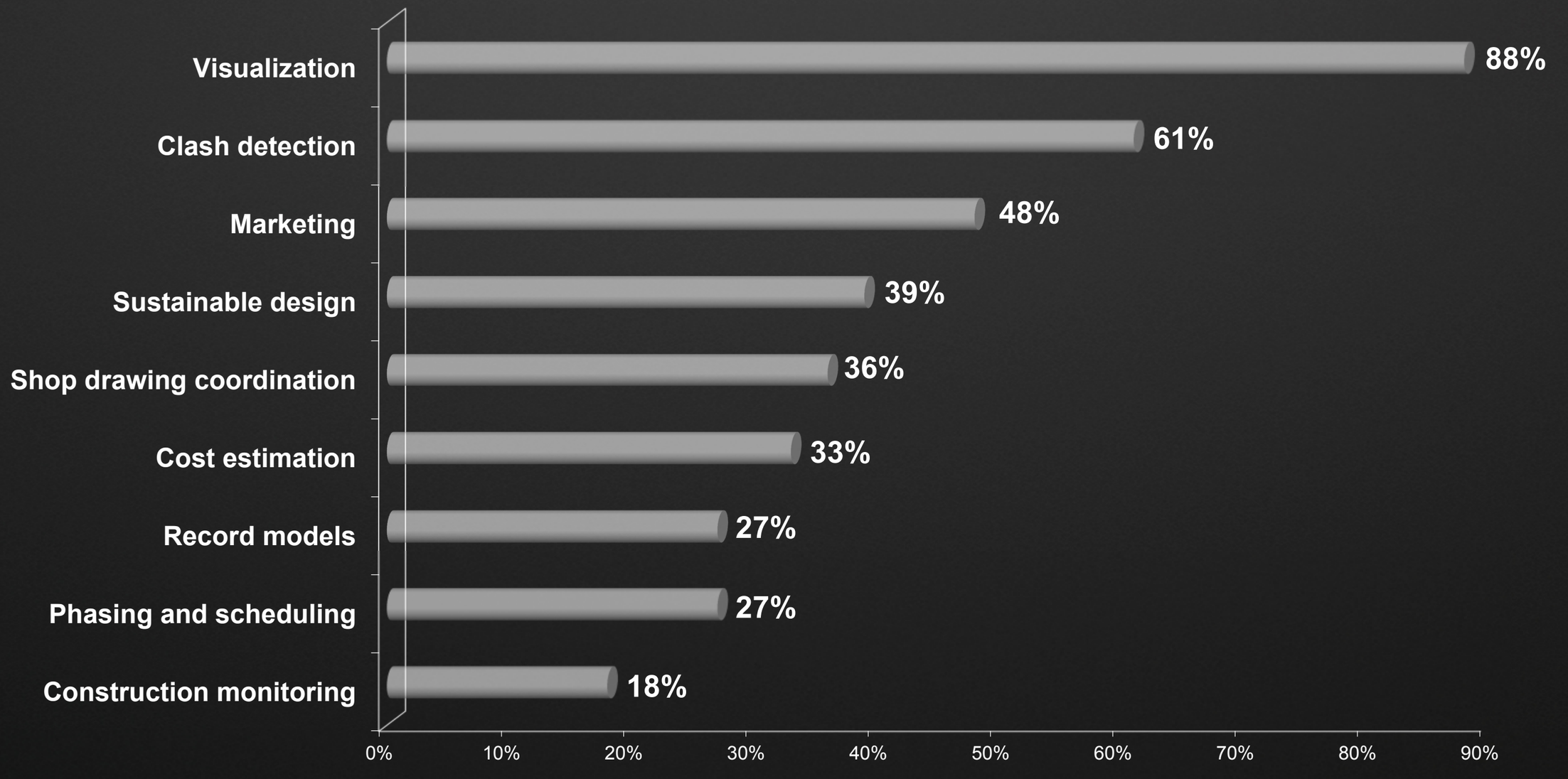
LOD 400
This level of development is considered to be suitable for fabrication and assembly. The Model Element Author for this LOD is most likely to be the trade contractor or fabricator as it is usually outside the scope of the architect's or engineer's services or would constitute severe risk exposure if such parties are not adequately insured.

LOD 500
The final level of development represents the project as it has been constructed - the as-built conditions. The model is suitable for maintenance and operations of the facility.

The requirements for a LOD500 model should be driven by Lifecycle Applications, and could actually have less detail than a LOD 400 model.

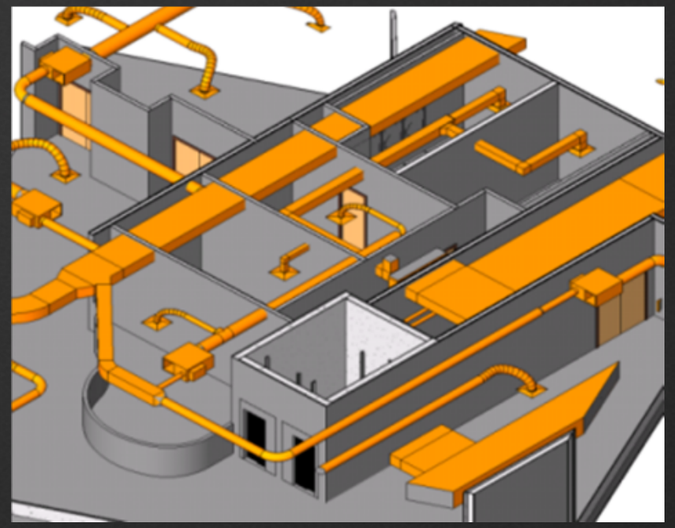
The benefits of BIM for the AEC industry

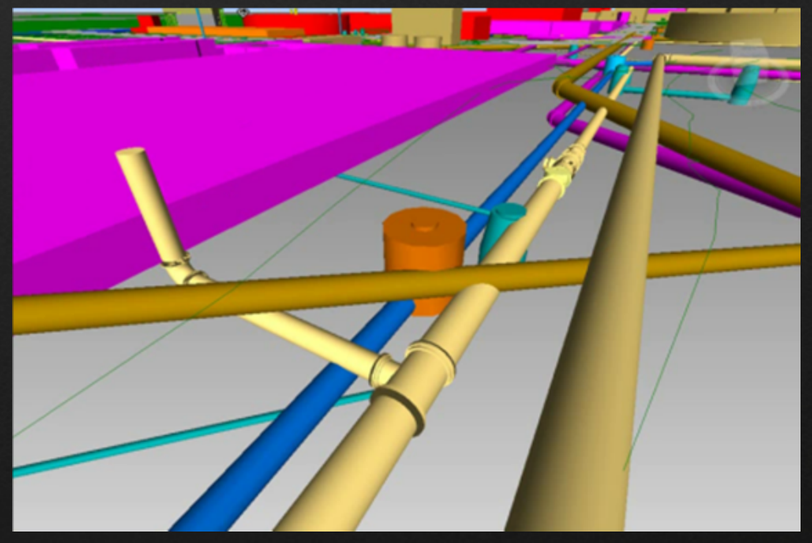
What aspects of BIM integration is your organization using?



BIM's Return On Investment

- Up to 40% elimination of unbudgeted change
- Up to 80% reduction in time taken to generate a cost estimate
- Cost estimation accuracy within 3%
- A savings of up to 10% of the contract value through clash detections
- Up to 7% reduction in project time

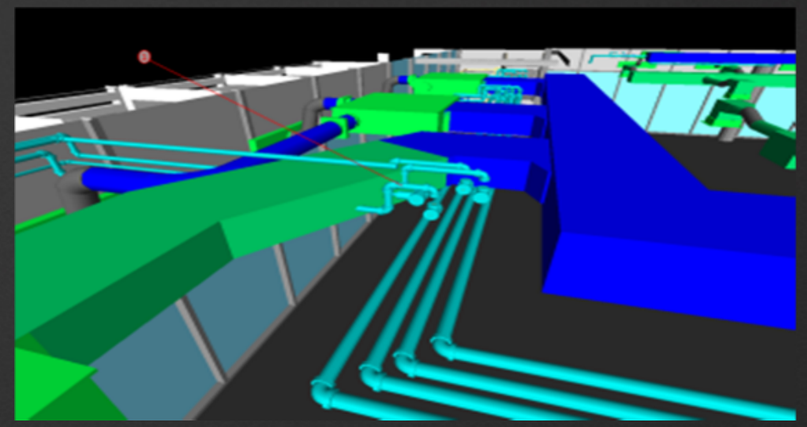


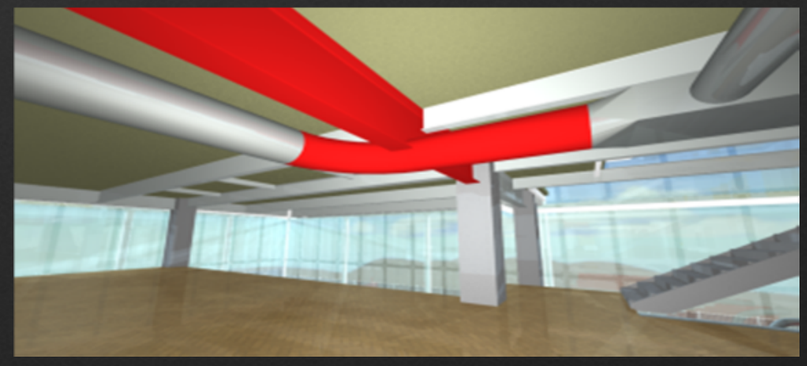


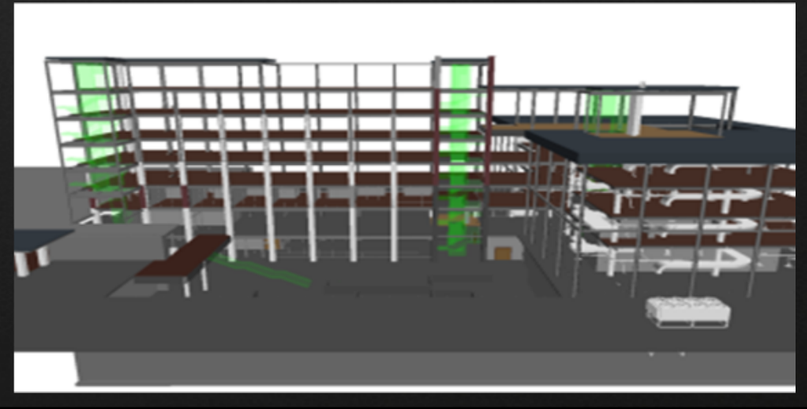
Stanford University Center for Integrated Facilities Engineering (CIFE) figures based on 32 major projects using BIM

BIM Enabled Sustainable Design Construction

- Visualize design options to inform better decisions
- Evaluate project cost and environmental impact
- Minimize waste with quantity take off and clash detection
- Optimize construction and demolition sequencing with 4D simulation
- Accelerate project delivery and return higher Owner value with enhanced collaboration







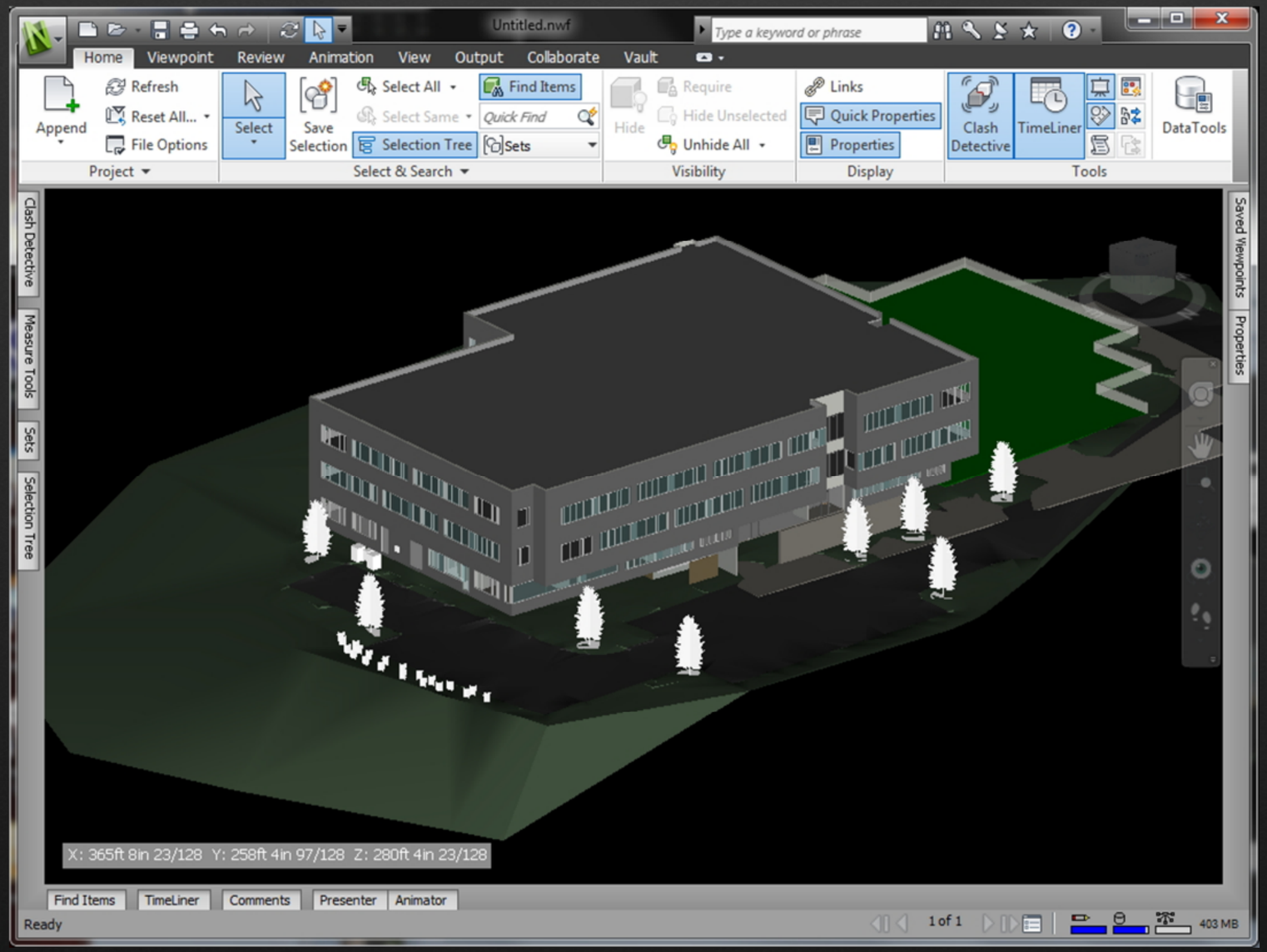
Current BIM shortfalls

Fun

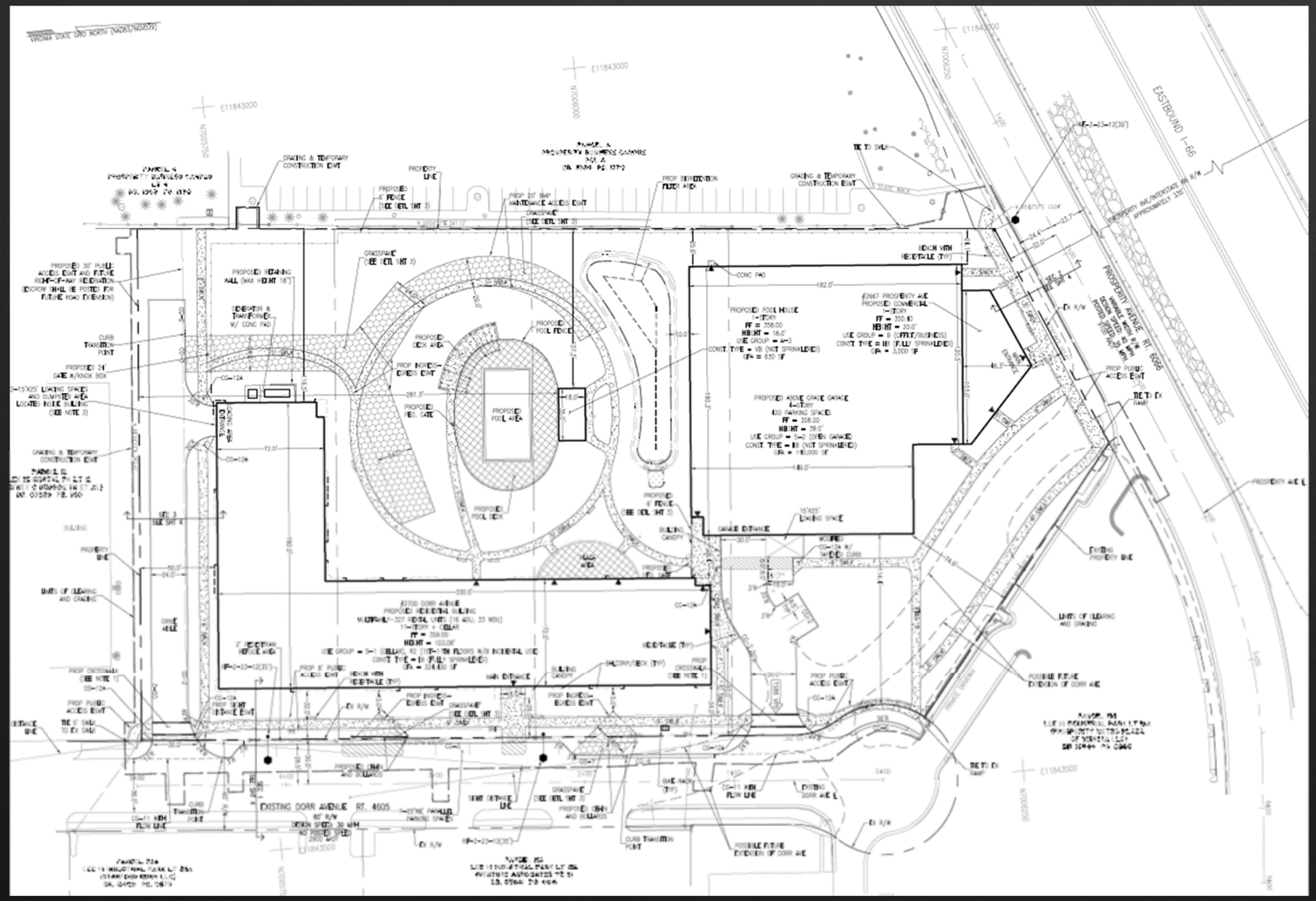
Current BIM shortfalls

Fun

Coordination Issues



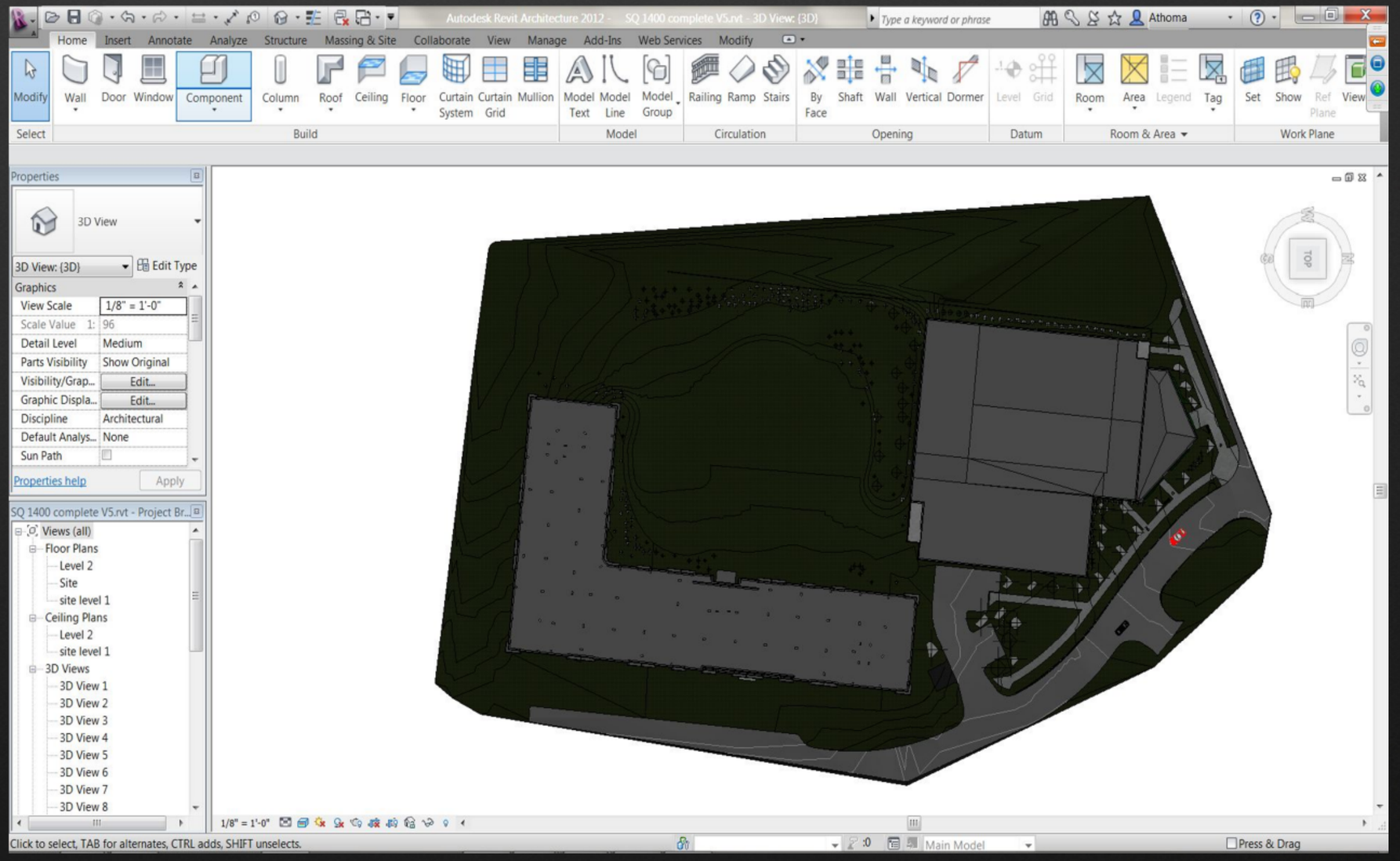
Civil BIM Design



Site for construction visualization

Civil BIM Design

Site for construction visualization



Civil BIM Design

Site for construction visualization

CIVIL BIM sustainability

LEED site points
LEED Platinum building

CIVIL BIM sustainability

Site conditions

- Retain water on site
- Building in flood plain
- No more than 25% increase in water run off allowable

CIVIL BIM sustainability

Site and building interaction

CIVIL BIM sustainability

Reduction of construction waste

Control construction impact.

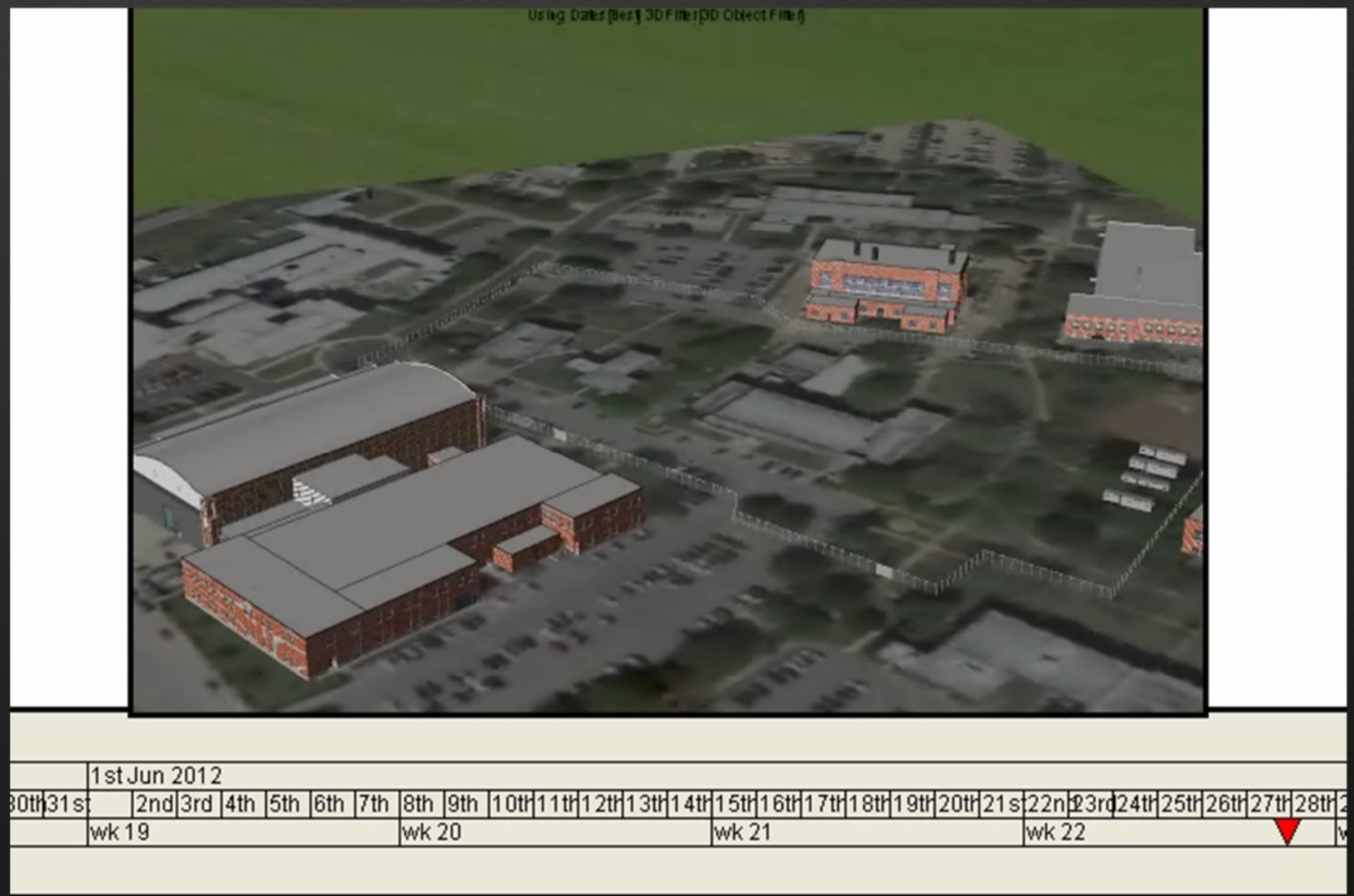
CIVIL BIM sustainability

Erosion and Sediment control

Green features take time to
… well become green

Civil BIM construction

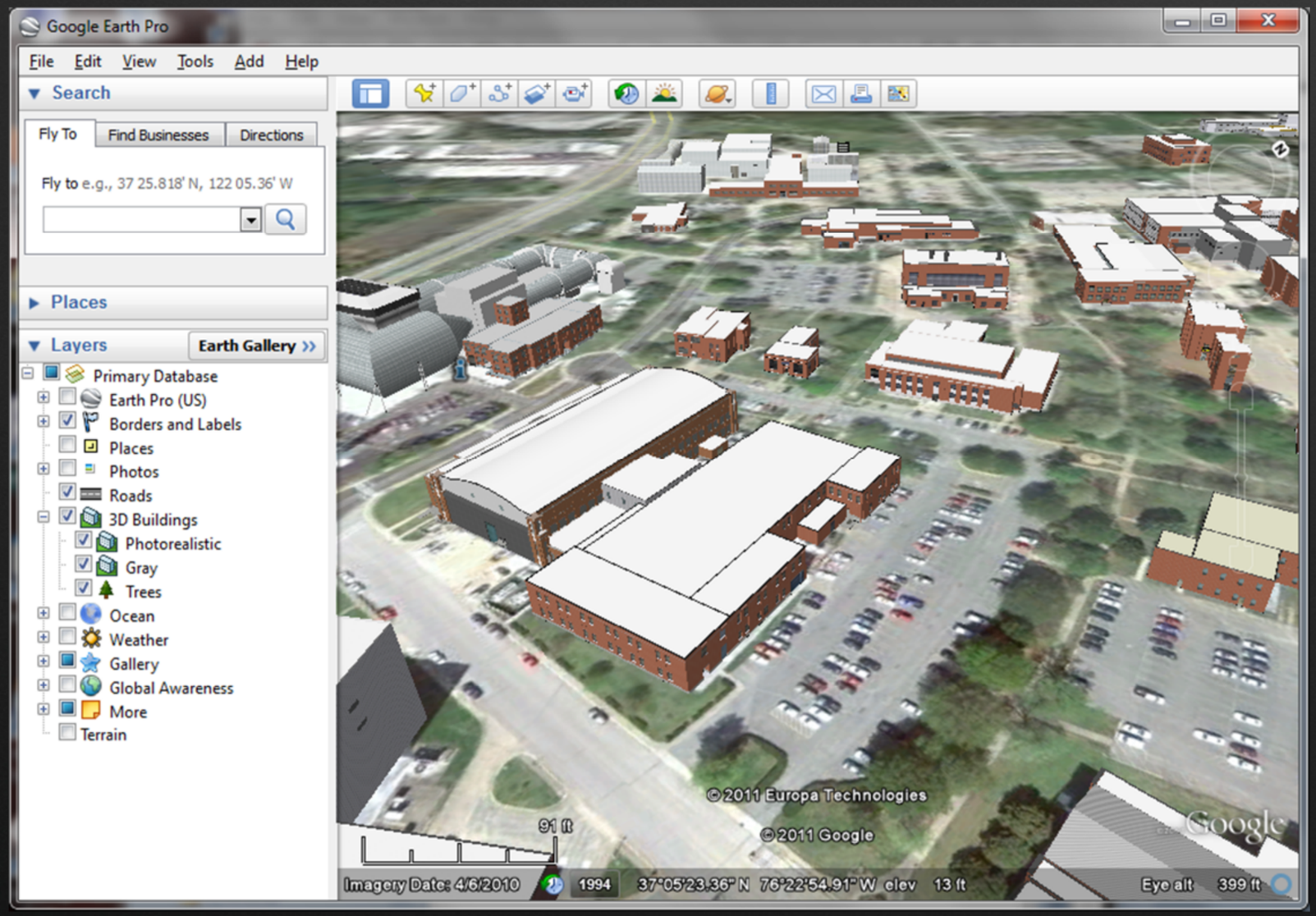
- Macro 4D
- Site completes picture



Civil BIM construction

- Micro 4D
- Site allows for better understanding of current conditions

Civil BIM technology

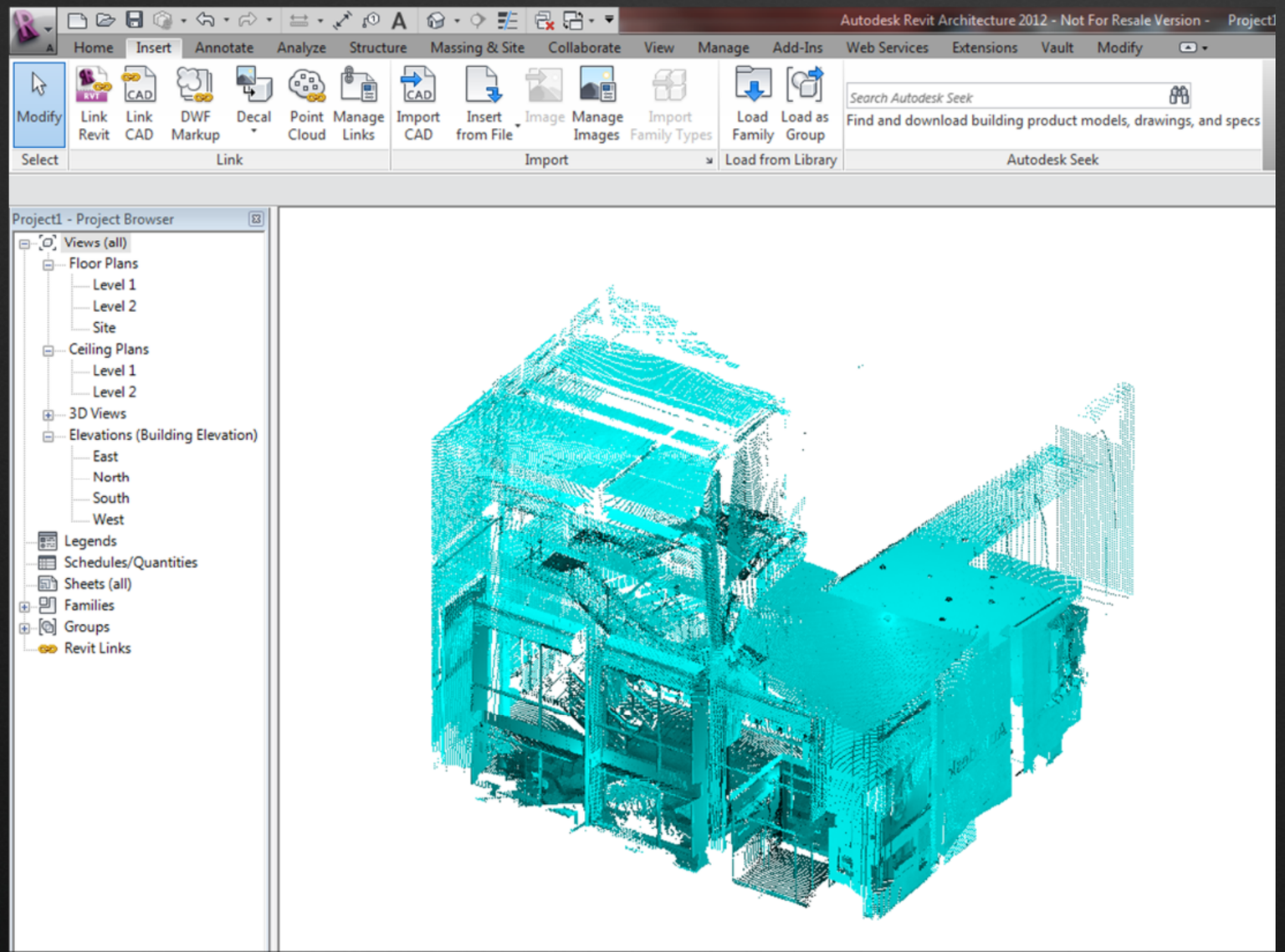


- User Friendly
- Data is accessible
- Free

Civil BIM technology - Autodesk Infrastructure Modeler

- Quickly build models
- Incorporate data from other programs
- Sketch multiple alternatives
- Communicate ideas interactively

Civil BIM technology



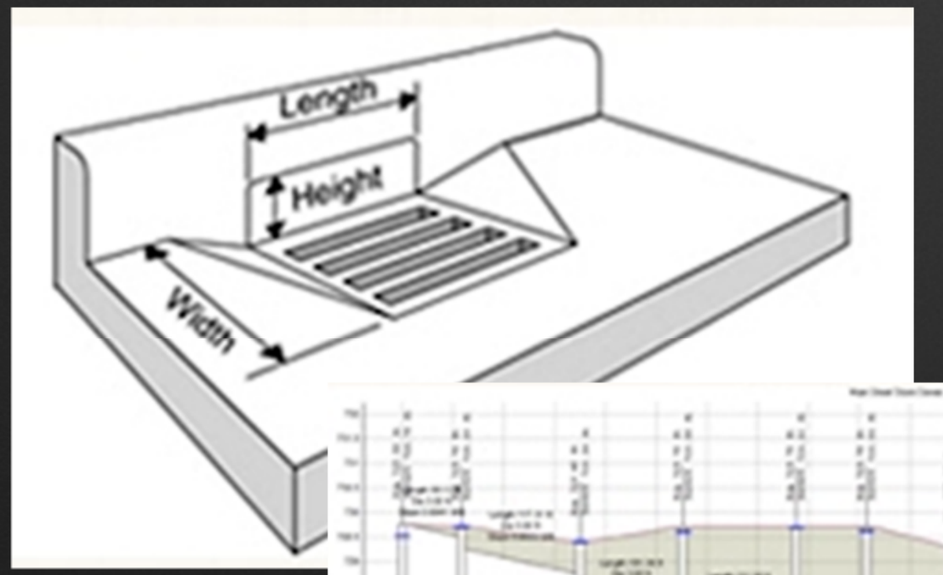
- Pointcloud Data
- Exiting condition data
- As-Built content

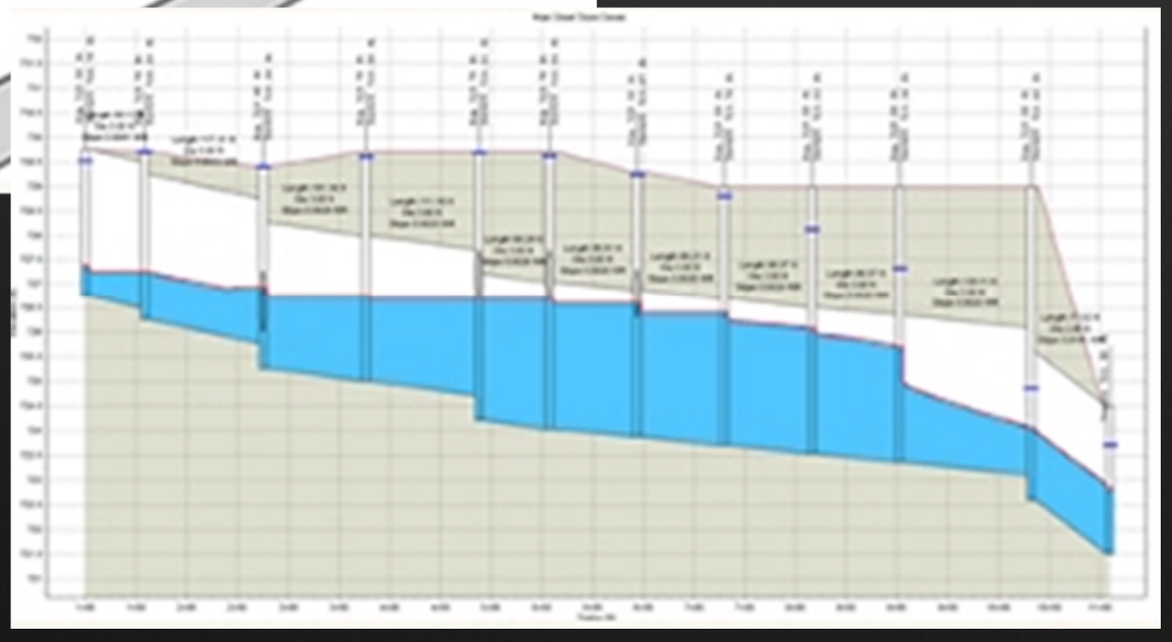
Civil BIM technology

Creation of point clouds will become more commonplace

Civil BIM technology

Autodesk® Storm and Sanitary Analysis

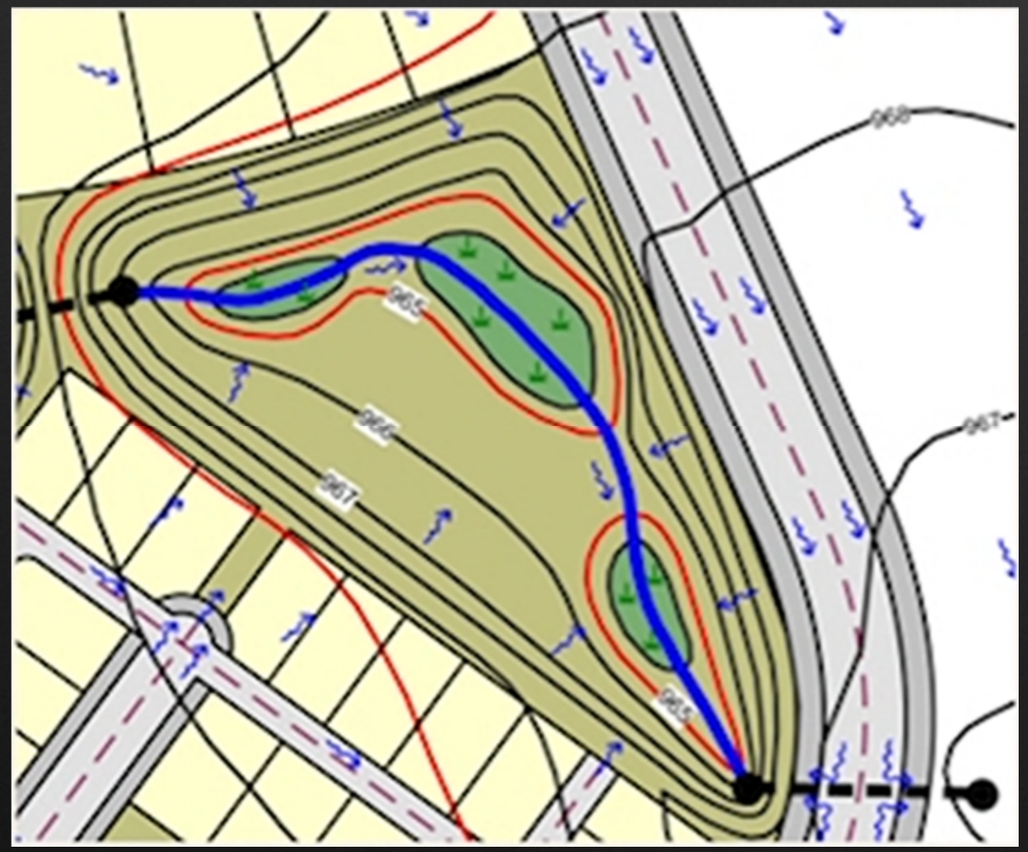




- Rainfall designer
- Storm distributions
- Time of concentration
- Built-in curb openings, storage chambers
- Detention and retention modeling

Civil BIM technology

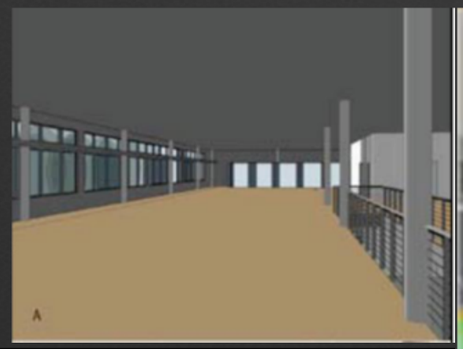
Autodesk® Storm and Sanitary Analysis
Water quality modeling

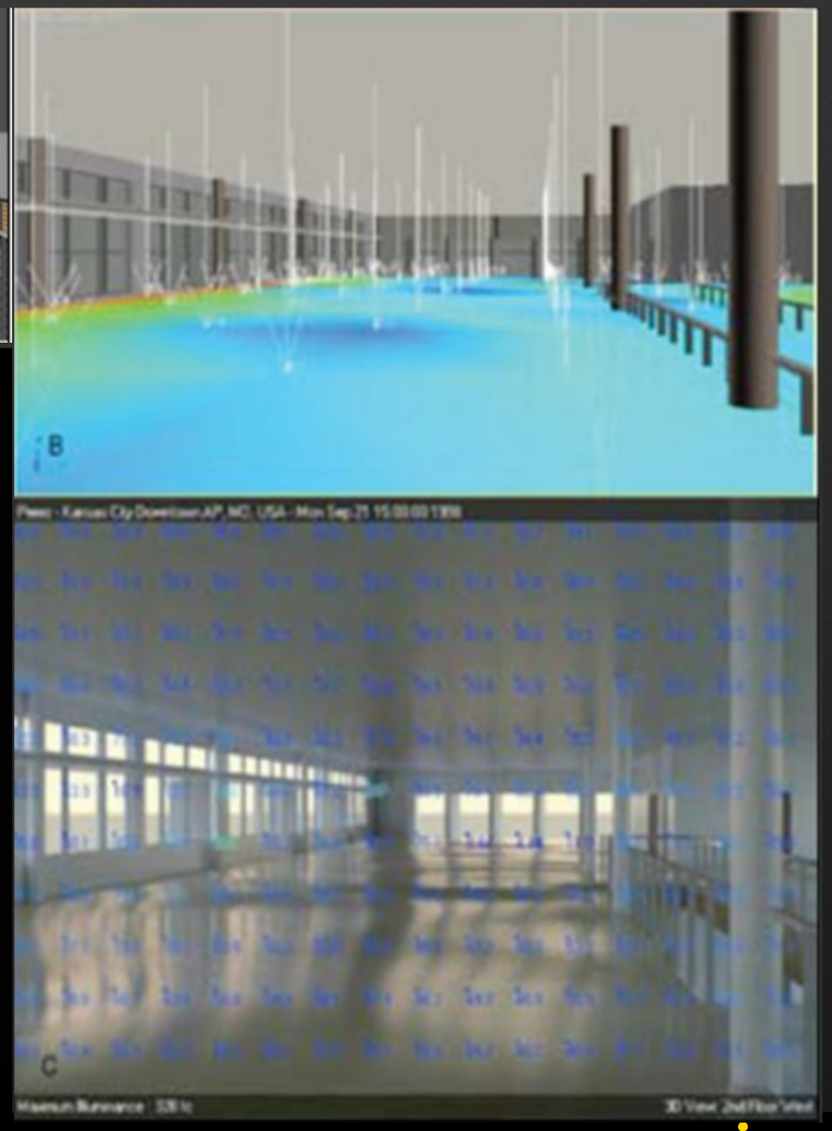


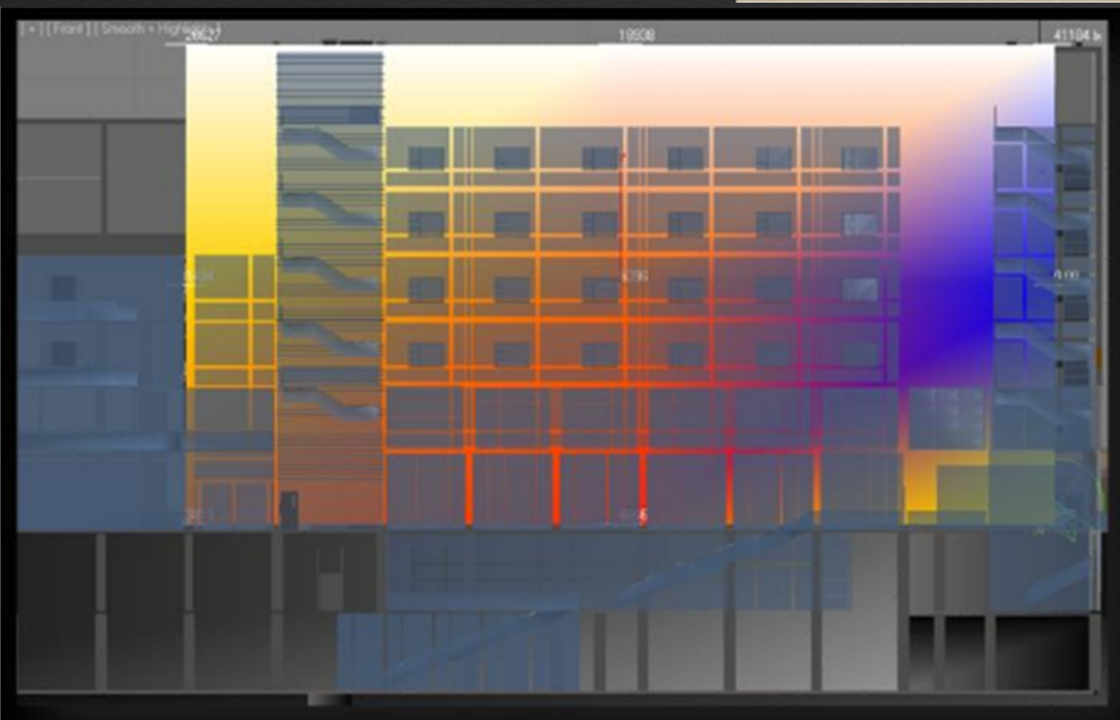
- Water quality simulations
- Account for sustainable design and Best Management Practices (BMP)
- Total Maximum Daily Load
- Exfiltration Method Options

Civil BIM technology

Autodesk 3Ds Max Design

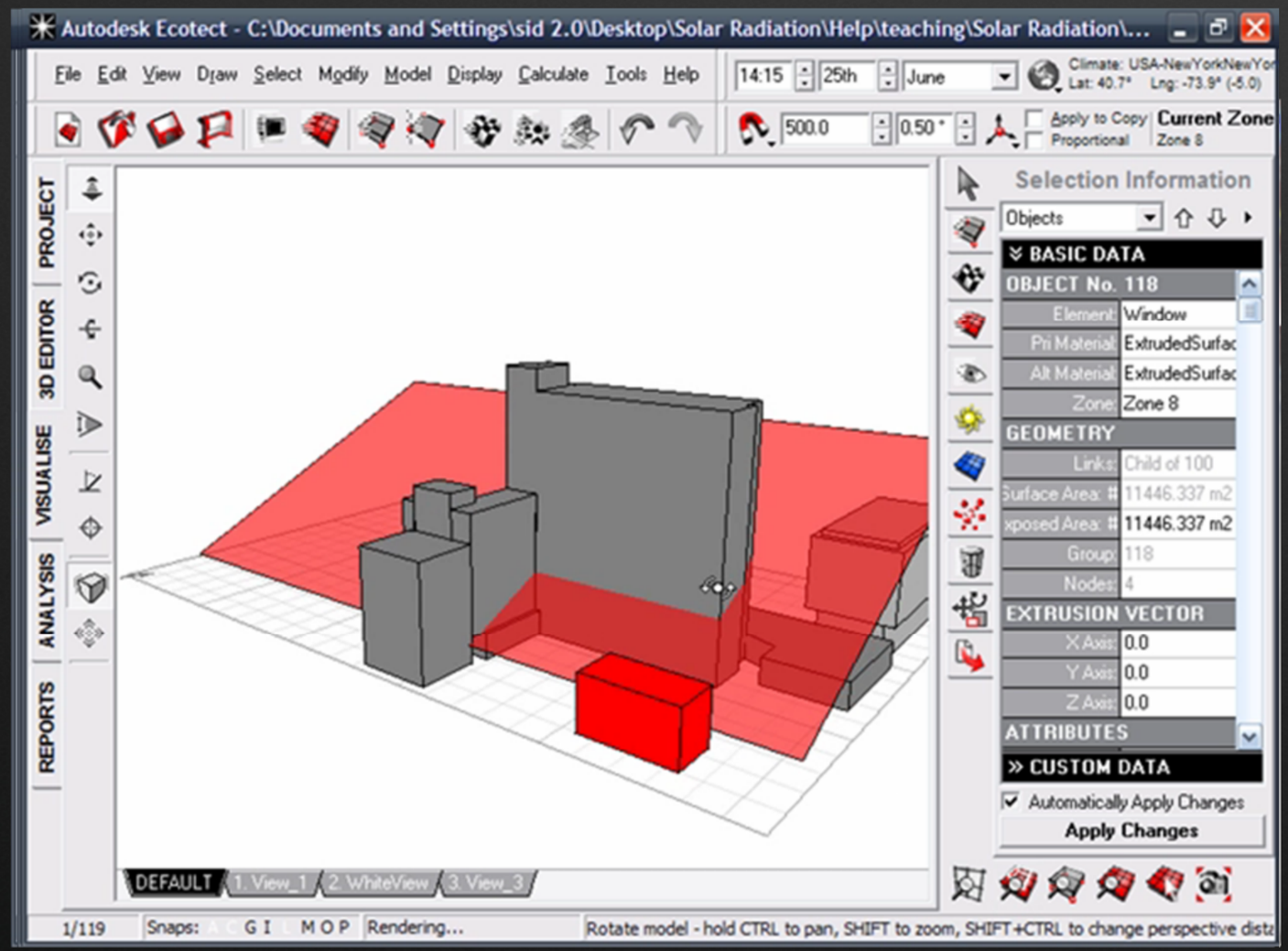






Civil BIM technology

Autodesk Ecotect



- Visibility Analysis
- Before and After Calculations
- Envelope Calculations

Civil BIM future

- 150,000 Photos
- 21 Hours to compile

Civil BIM future

Autodesk®

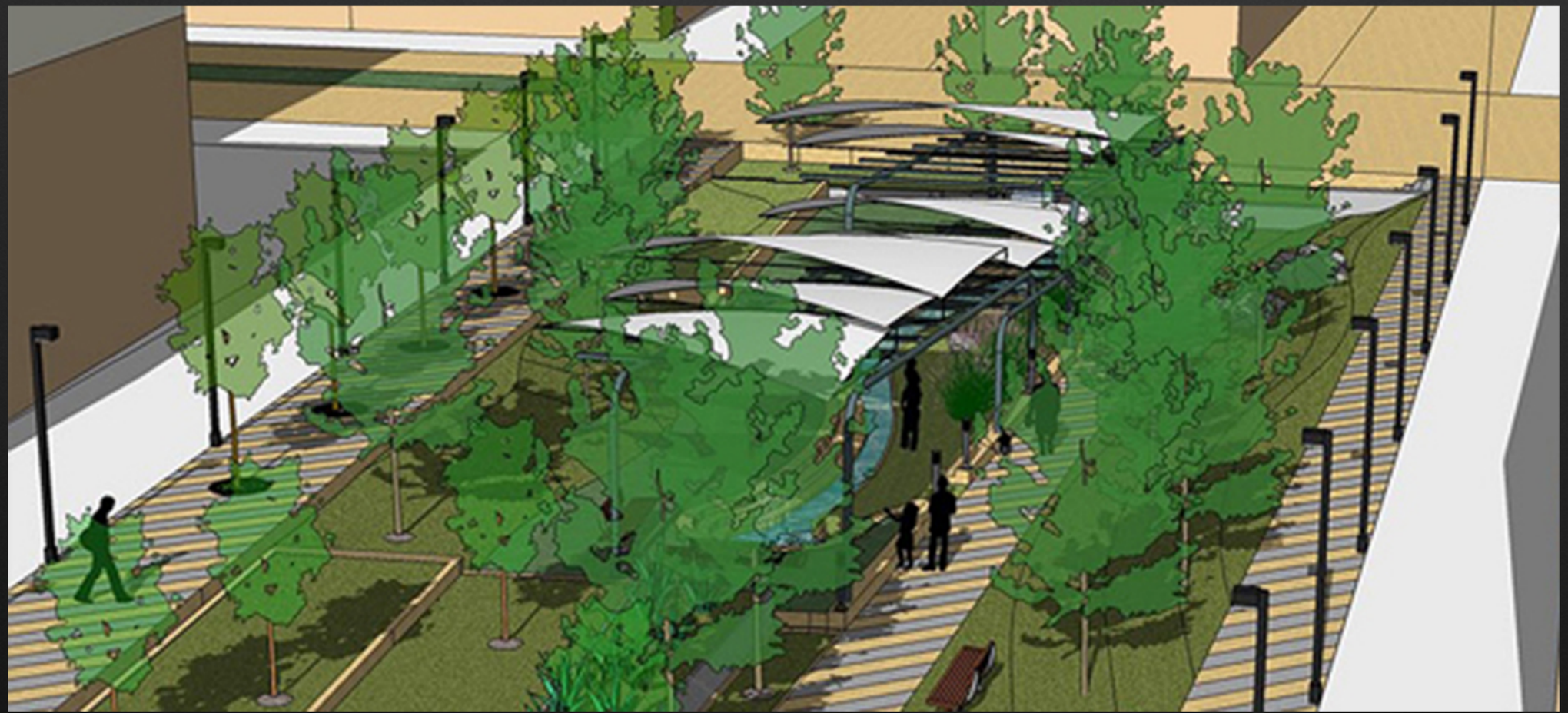
introduces

Civil BIM future

- 412 Images
- 1 Hour to compile

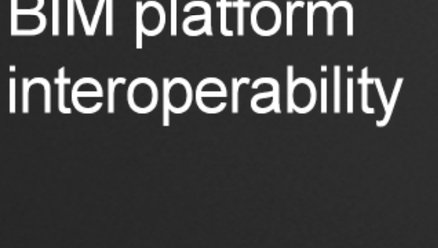
Civil BIM future

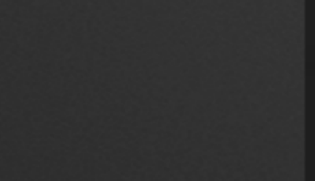
Leed site



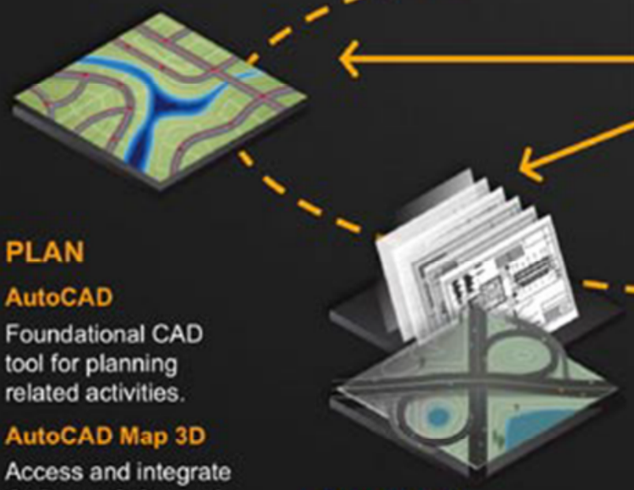
Civil BIM future

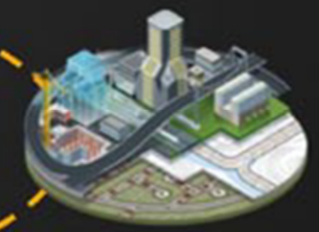
BIM platform interoperability





Infrastructure Design Suite | Task Coverage





PLAN

AutoCAD

Foundational CAD tool for planning related activities.

AutoCAD Map 3D

Access and integrate CAD and GIS data for analysis and reporting and more informed decision making.

DESIGN & DOCUMENT

AutoCAD

Foundational design and documentation tools.

AutoCAD Civil 3D

Brings power of BIM to infrastructure to explore more design options, analyze project performance, and deliver coordinated documentation.

VALIDATE & VISUALIZE

3ds Max Design

Photorealistic rendering and animation to validate and tell the story behind infrastructure designs.

COORDINATE

Navisworks Simulate

Integrate models from multiple sources for project review, navigation and construction sequencing.

MANAGE

AutoCAD Map 3D

Maintain as-built records accurately and manage infrastructure assets effectively.

Civil BIM call to action

Civil adds value to BIM

- Site completes picture
- Site adds better understanding of existing conditions

Who benefits from including civil models into the BIM process?

- Architects
- Sustainable Design
- Civil Engineers
- Constructors
- Owners
- Designers

Civil BIM call to action

So it’s all smooth sailing right?

- Not if we don’t learn from each other

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