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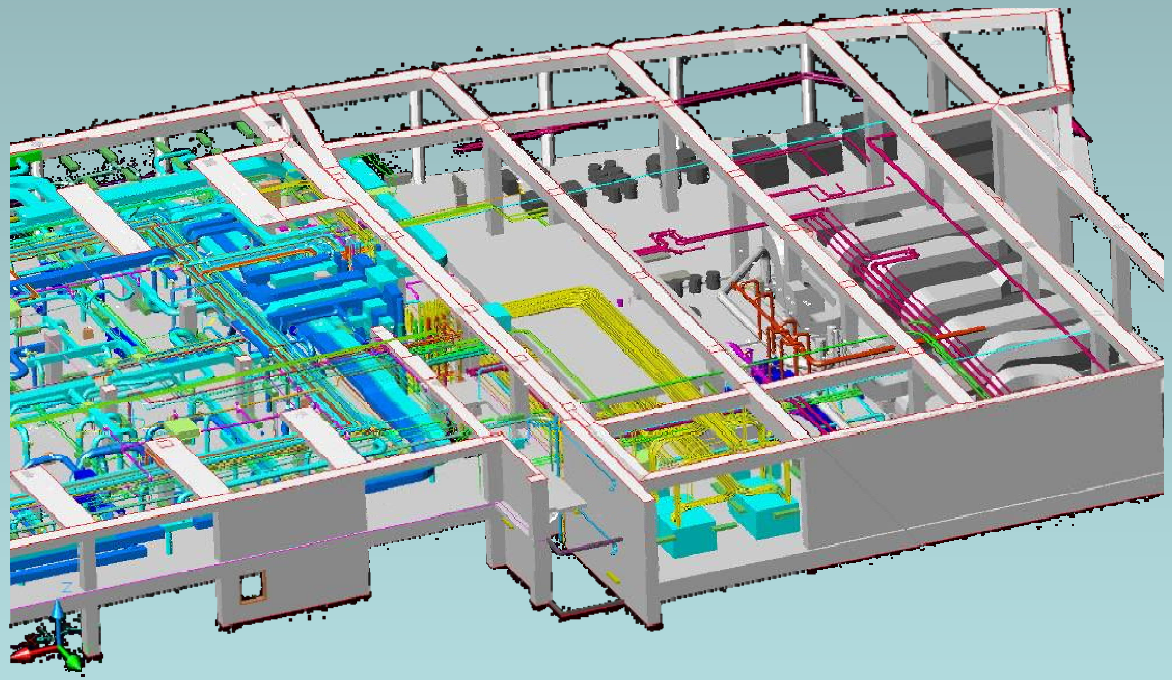
3D/4D Coordination and Collaboration for Construction Projects



Zaki Mallasi,
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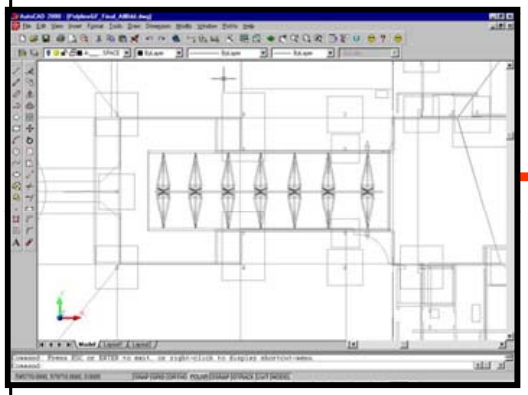
- Content

- *1) Limitations of traditional collaboration tools.*
- *2) Impact of un-coordinated design/construction info.*
- *3) What is the BIM Concept?*
- *4) Coordination protocol using Navisworks*
- *5) Navisworks tool demonstration*
- *6) Visualizing construction work progress in 4D*
- *7) iConViz © - 4D tool demonstration*
- *8) Conclusion: lessons learned and benefits*

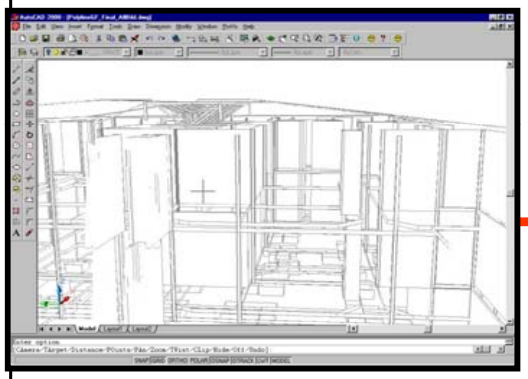
1- Limitations in Traditional Collaboration Methods

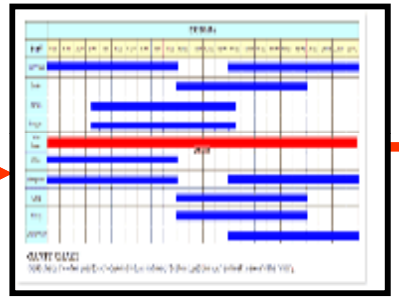
- *In the 2D environment design errors aren't readily revealed so coordination is manual*
- *Design and construction information are intense and therefore difficult to evaluate or communicate.*
- *No re-presentation of constructability execution scenarios.*
- *Plain 2D drawings look cool but provides limited collaboration, leading to staff spending hours on coordination.*

2- Impact of Un-coordinated Design/Construction Info.

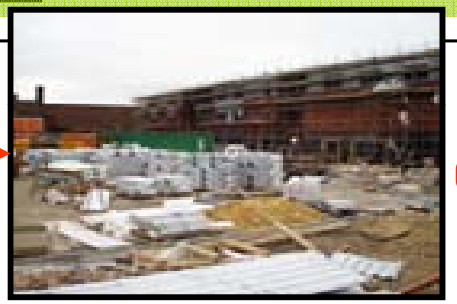


CAD Drawings





Project Schedule



Site congestions

Crowded areas

Access blockage

Design → Bid/Planning → Build

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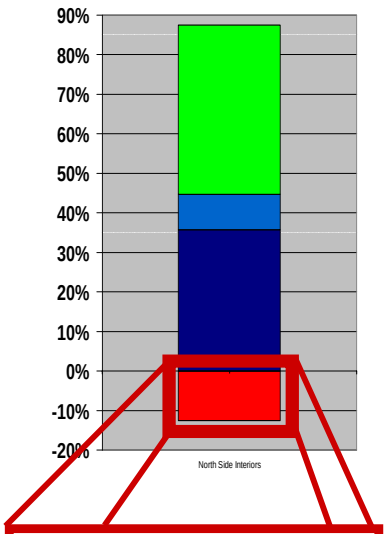
2- Impact of Un-coordinated Design/Construction info.



12 % non-productive

Impact on workers productivity

A/C Duct workspace obstructing Drywall 2nd fix job

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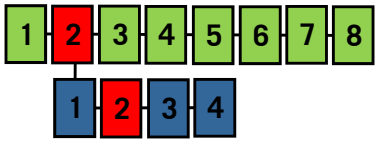
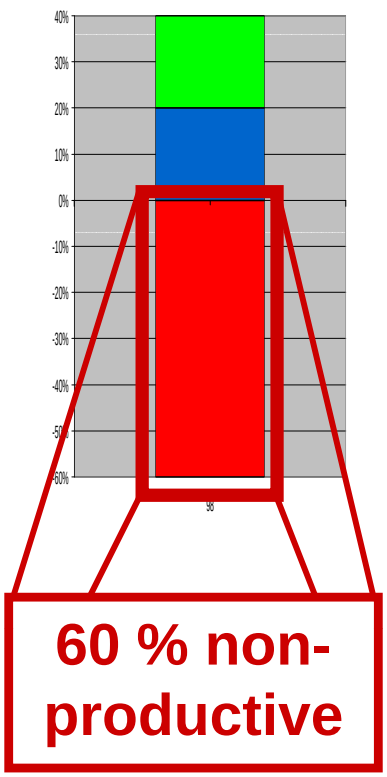


2- Impact of Un-coordinating Design/Construction Info.



Poor site space utilization causes work interruptions

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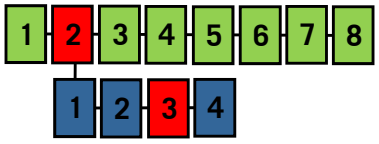
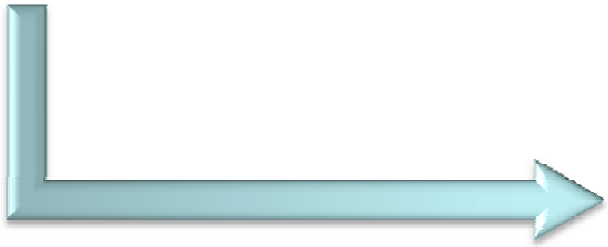
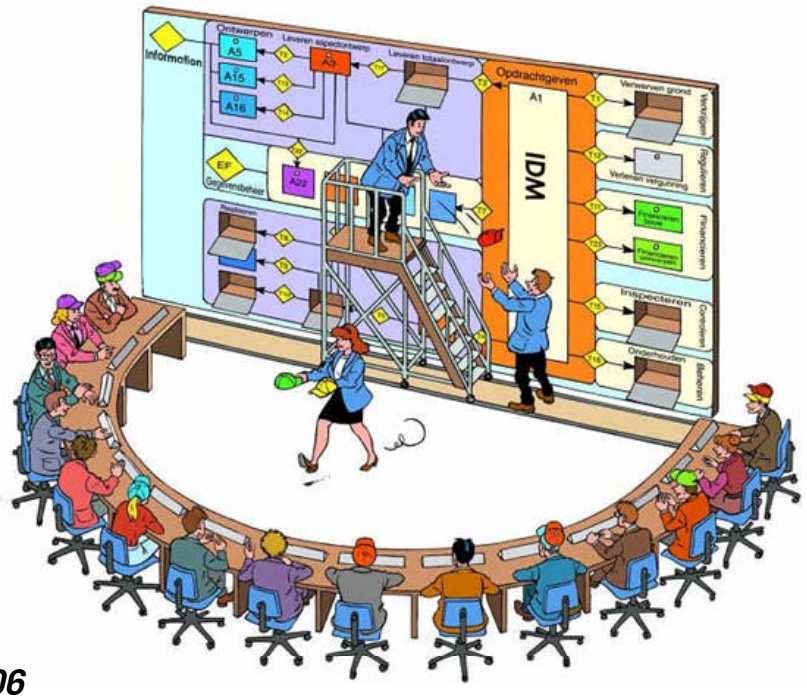


2- Impact of Un-coordinated Design/Construction info.

- ***Paradigm shift from fragmented information approach to integrated and focused one.***

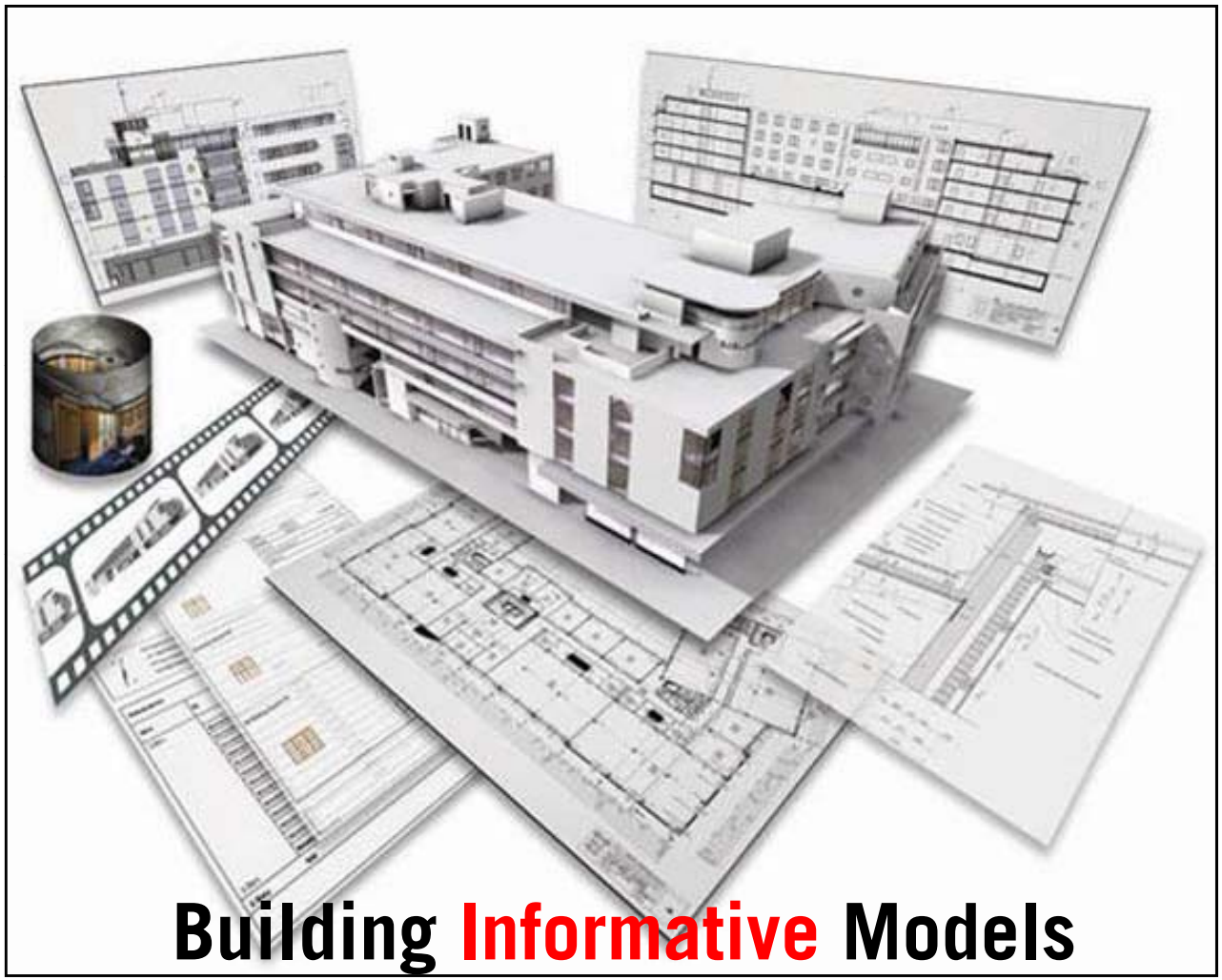




Source: National Institute of Building Science, BIM Standards, 2006

3- What is the BIM Concept: *architecturally*

- **Building Information Modeling (BIM) Working Environment**

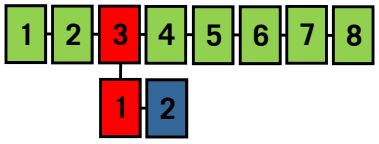


Approved Definition:

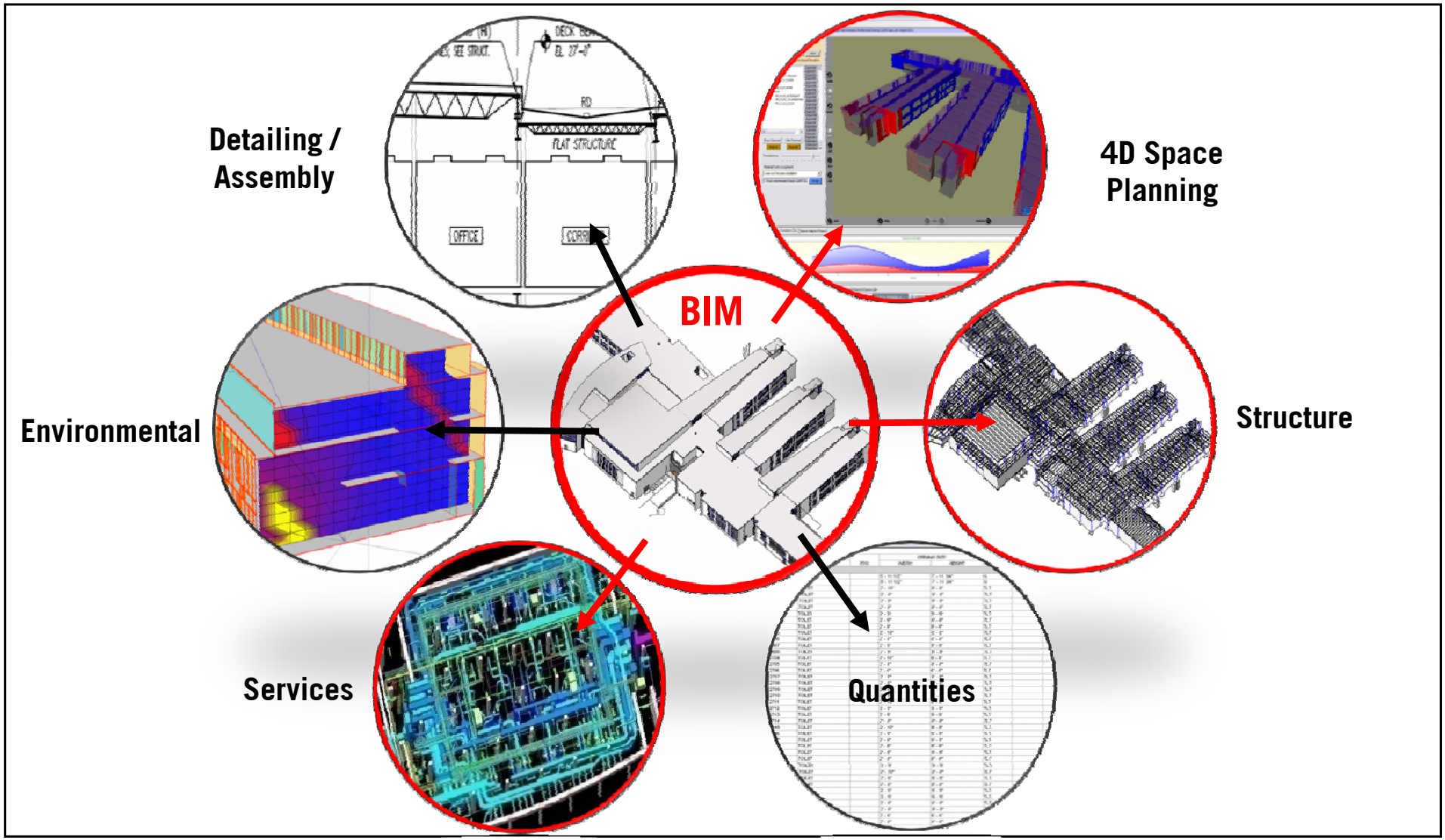
- Digital representation of physical and functional characteristics of a building.

- Serves as a shared knowledge resource for information about that building

Source: National Institute of Building Science, BIM Standards, 2006



3- What is the BIM Concept: *integrated design/construction*



4- Coordination Protocol Using Navisworks: *case study*

Project Scope

- *240,000 sq. ft. Biocontainment Research/Laboratory for Federal Government client, in Frederick Maryland*
- *7-storey research labs, staff offices, parking lot, public space, and conference rooms.*
- *$120M negotiated contract*
- *Project start September 2006*
- *Project scheduled completion is on June 2009*

3D Model

Project During Construction

4- Coordination Protocol Using Navisworks: *teams role*

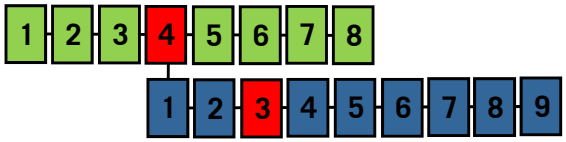
Role	Modeling Scope	3D software	Phase Model Created
Architect	Architectural modeling in 3D, **BIM coordination**	ADT, Revit , **Navisworks**	Schematic Design
Mechanical, Electrical, and Process Engineering	Basis of design for MEP systems	AutoCAD	Design Development /Construction Documents
Structural Engineer	Steel structure, concrete foundation, and shear walls	ADT, **Navisworks**	Design Development /Construction Documents
General Contractor	Overall coordination of MEP in 3D	**Navisworks**, ADT	Design Development /Construction Documents
Mechanical Subcontractors	Ductwork and piping in 3D	Autodesk building Systems	Design Development /Construction Documents
Electrical Subcontractors	Conduit and cable trays	Autodesk building Systems	Design Development /Construction Documents
Plumbing Subcontractors	Plumbing system in 3D	Autodesk building Systems	Design Development /Construction Documents
Fire Protection Subcontractors	Fire protection systems	AutoCAD	Design Development /Construction Documents

4- Coordination Protocol Using Navisworks*: *steps*

Step 1: Identify the Usage of the 3D Model

- *Project team discuss the specific uses of the 3D model.*
- *The use of the model dictates the 3D modeling requirements.*
- *Responsibilities for the various parties in the project.*
- *Establish the 3D modeling effort and LOD to be modeled (cost factor).*
- *Define the Work Breakdown Structure showing how different models are going to be integrated.*

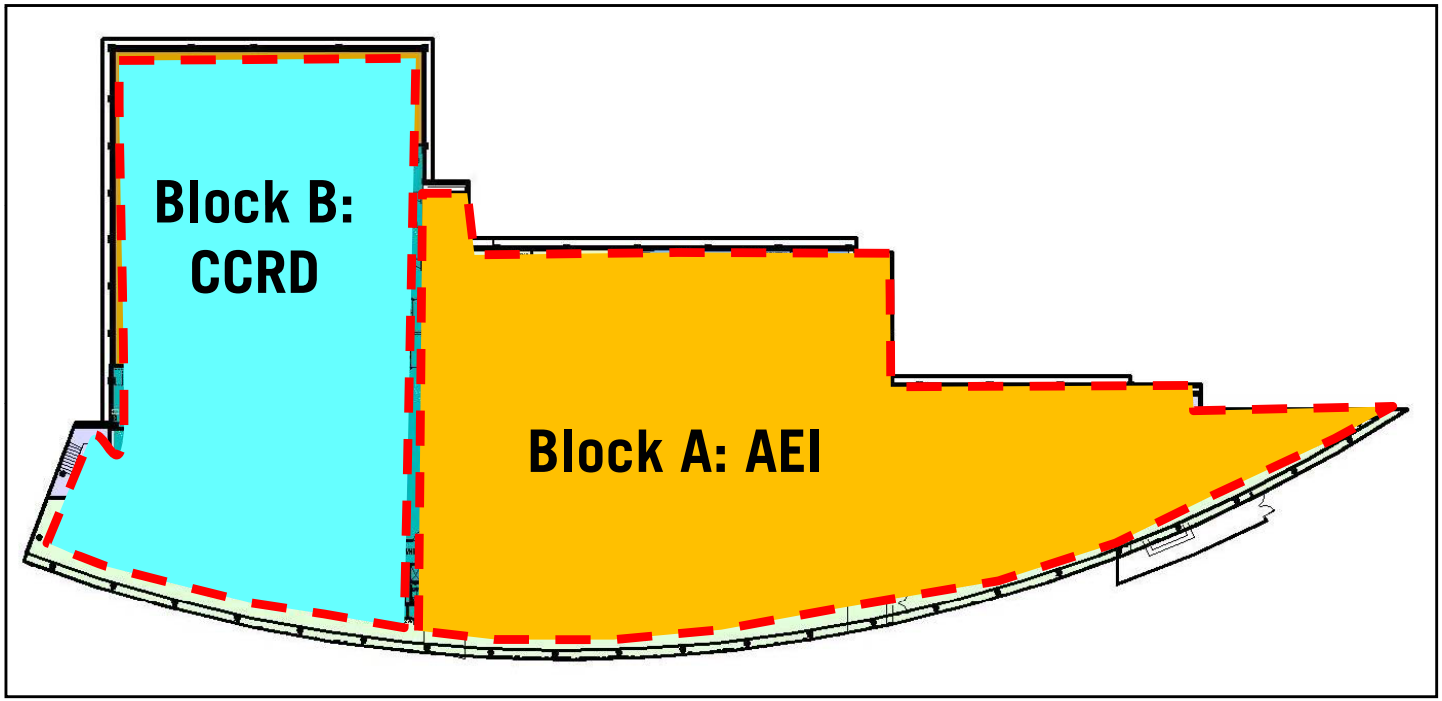
**Source: Staub-French and Khanzode (2006), http://itcon.org/2007/26*



4- Coordination Protocol Using Navisworks: *steps*

Step 1: Identify the Usage of the 3D Model

- ***Construct the model in relation to the Zones in the project***



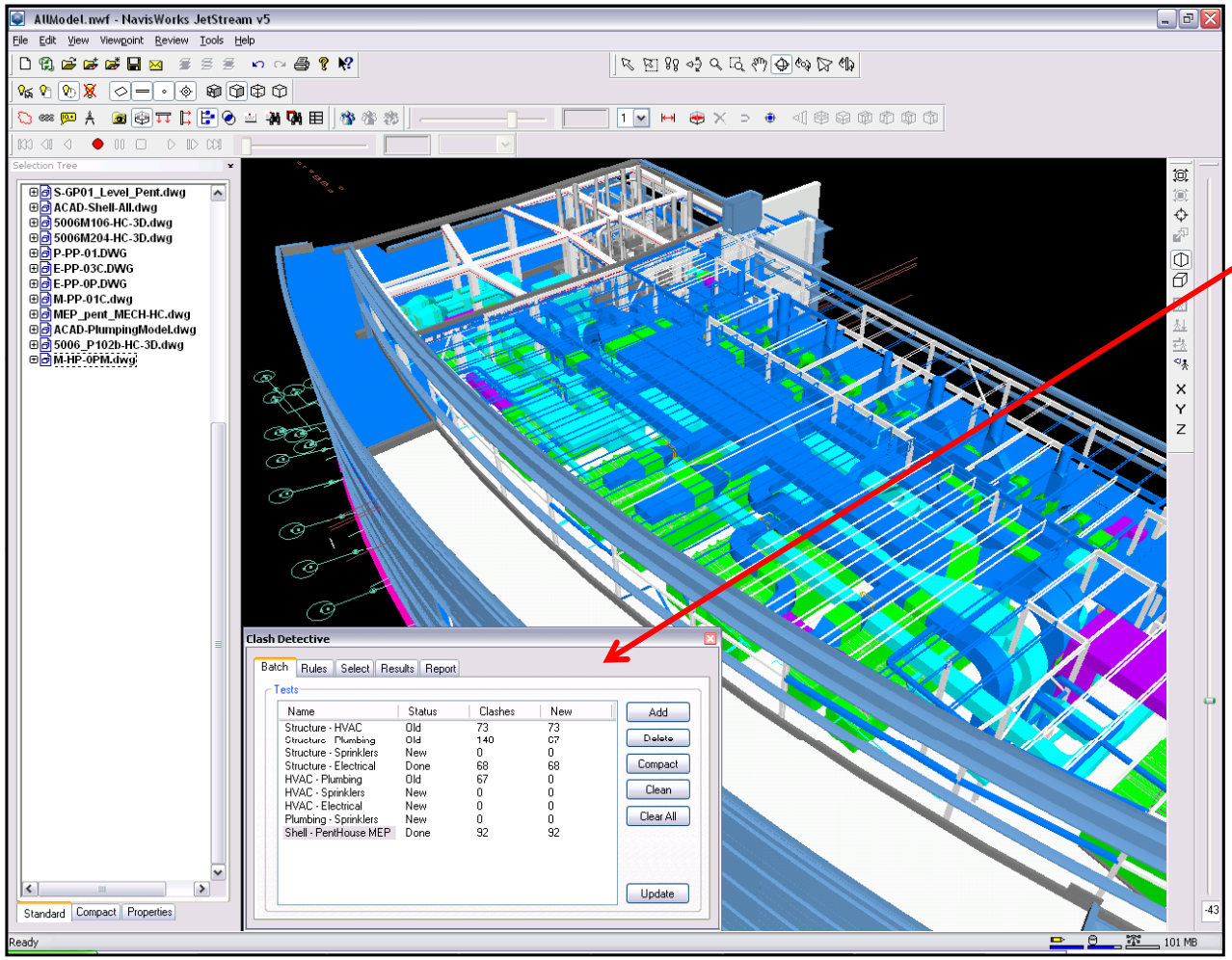
4- Coordination Protocol Using Navisworks: *steps*

Step 2: Establish a Conflict resolution Process

- ***Very important to ensure that the team is making progress towards conflict-free solution of the project.***
- ***Manage the process of detecting and resolving conflicts between trades.***
- ***Track conflicts according to status (i.e. new, active, approved, resolved, new)***
- ***Systemize conflict detection between trades, document them, and resolve the conflicts in the same sequence.***

4- Coordination Protocol Using Navisworks: *steps*

Step 2: Establish a Conflict Resolution Process



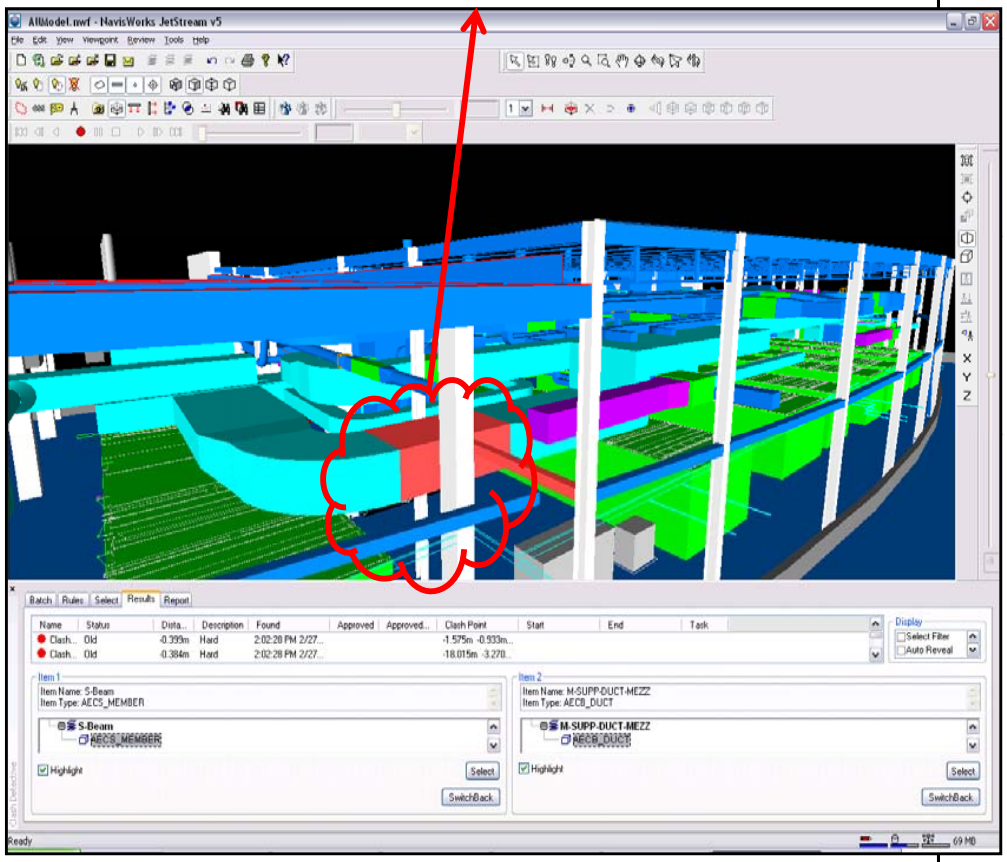
Screenshot showing clash test types performed between trades

4- Coordination Protocol Using Navisworks: *steps*

Step 3: Develop Review Cycle Between Disciplines:

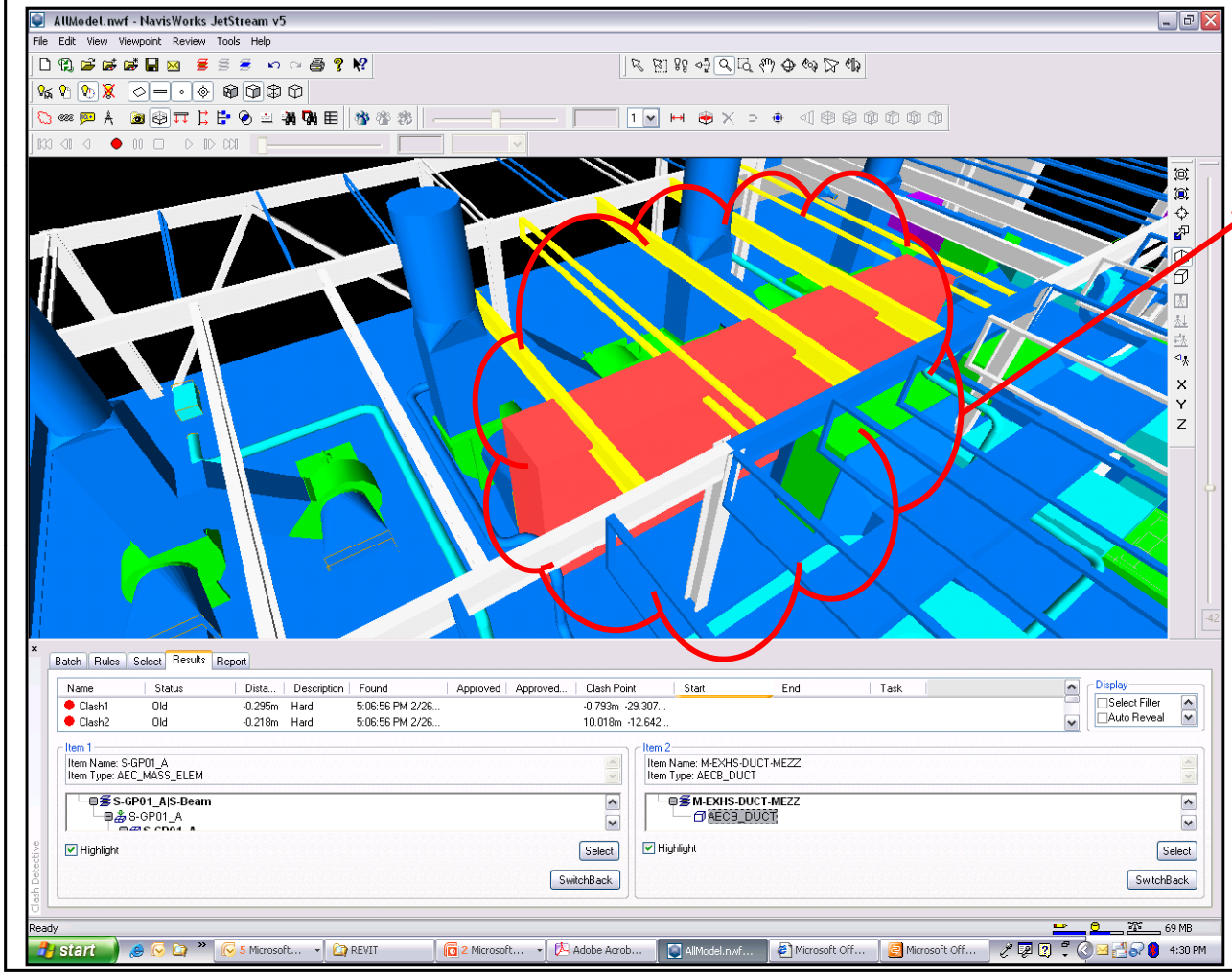
- ***Start with toughest trade to coordinate like HVAC & Structure, then Plumbing, and lastly fire.***
- ***Establish timing and general meetings process for coordinating 3D models***
- ***Classify clash types (soft, medium, hard, etc.)***

Hard conflict between structural beam and HVAC duct



4- Coordination Protocol Using Navisworks: *steps*

Step 3: Develop Review Cycle Between Disciplines:



Design conflict between structural beams and air handling unit

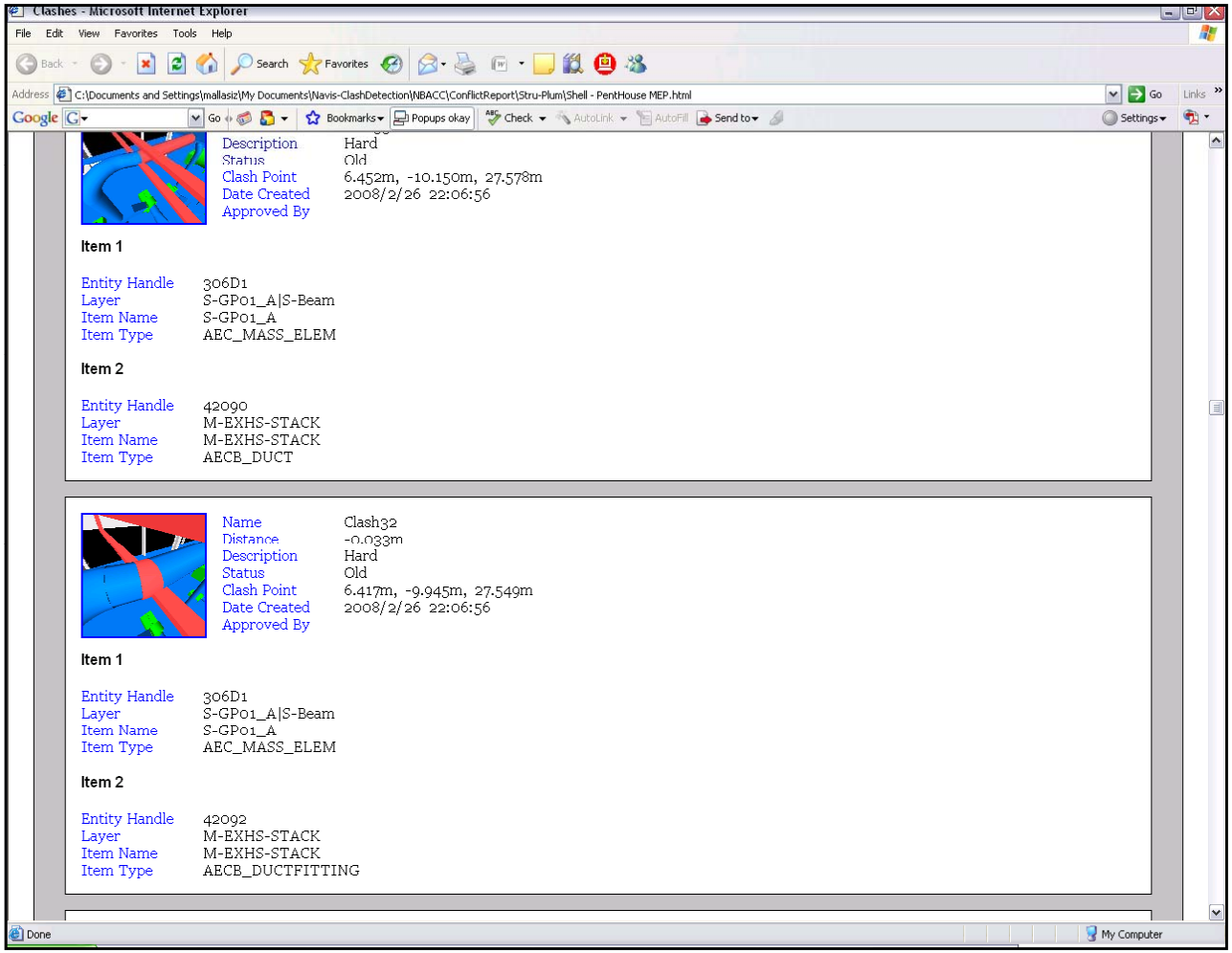
4- Coordination Protocol Using Navisworks: *steps*

Step 4: Document Collisions Log and Solutions:

Conflict No.	Zone	Grid Lines	Description	Trade	Correction Date	Uploaded to FTP	Comments	Corrected By
1	Block A	G-H and 6-7	Duct Flange and E-rack	ABC Mechanical	04-20/2007	04-20/2007	Resolved	ABC
2	Block A	A-B and 1-2	Structure Beam and Pipe	ABC Mechanical	04-20/2007	04-20/2007	Resolved	ABC
3	Block B	H and I	Pipe and Air Duct	EFG Sub-Plumbing	07-20/2007	07-20/2007	Pending	ABC
4	Block A	H-I and 3-4	Cable Tray and Duct Flange	XYZ Electrical	07-20/2007	07-20/2007	Pending	XYZ
5	Block B	H-I and 1-2	Duct Flange and E-rack	ABC Mechanical	07-20/2007	07-20/2007	Resolved	XYZ
6	Block B	D and E	Structural Column and Piping	EFG Sub-Plumbing	08-18/2007	08-18/2007	Move piping 3” East	XYZ
7	Block A	F and 11-12	Cable Tray and Duct Flange	XYZ Electrical	08-18/2007	08-18/2007	Resolved	ABC
8	Block B	I and 8-9	Structural Beam and Piping	EFG Sub-Plumbing	08-18/2007	08-18/2007	Move pipe 4” down	ABC

5- Navisworks Tool Demonstration:

Step 4: Document Collisions Log and Solutions:



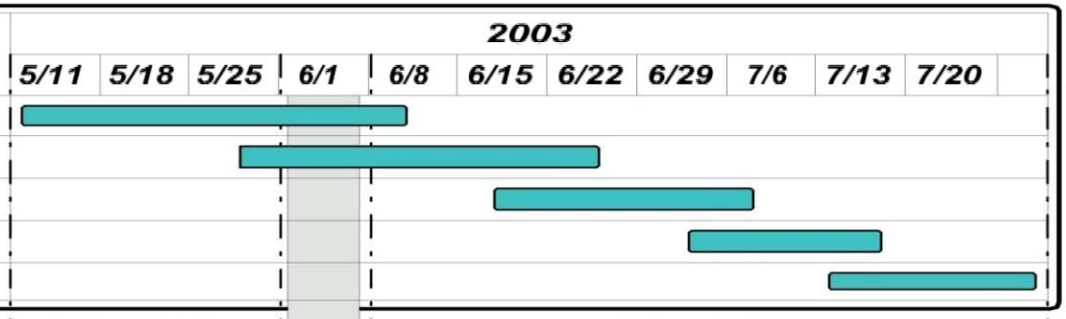
Screenshot showing conflicts report in HTML format

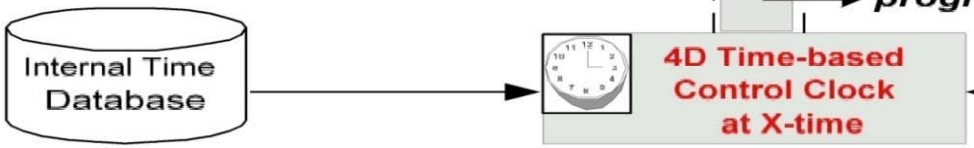
… Navisworks for Demonstration

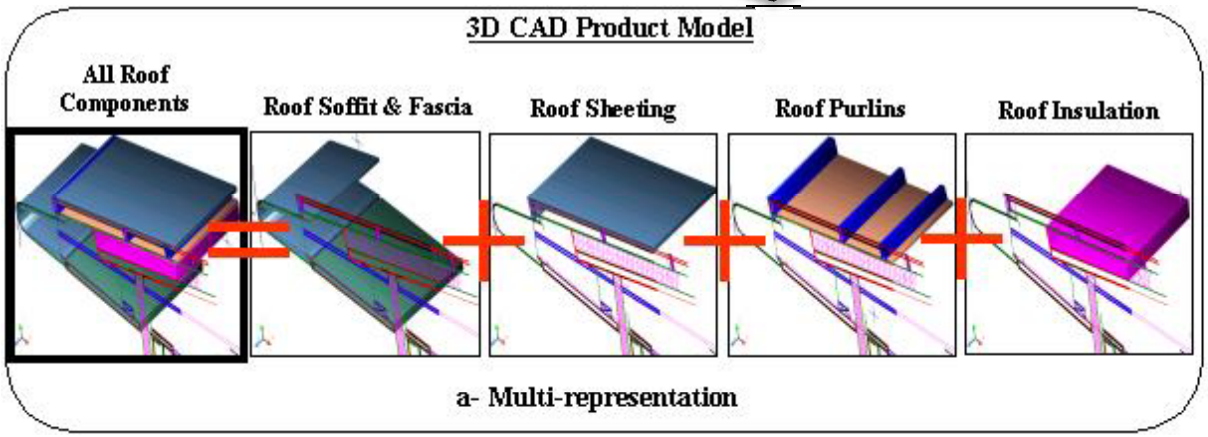
Launch

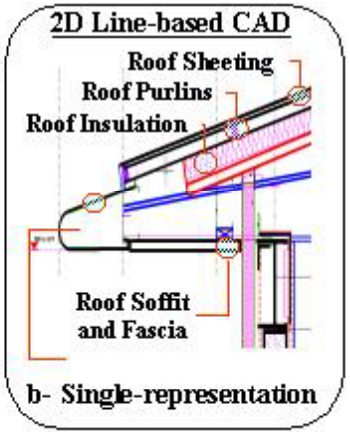
6- Visualizing Construction Work Progress in 4D: *concept*

ID	Activity Name	Start	End
1	Foundations	5/12/03	6/10/03
2	Superstructure Frame	5/29/03	6/25/03
3	Floors	6/18/03	7/7/03
4	Stairs	7/3/03	7/17/03
5	Roofs	7/14/03	7/29/03

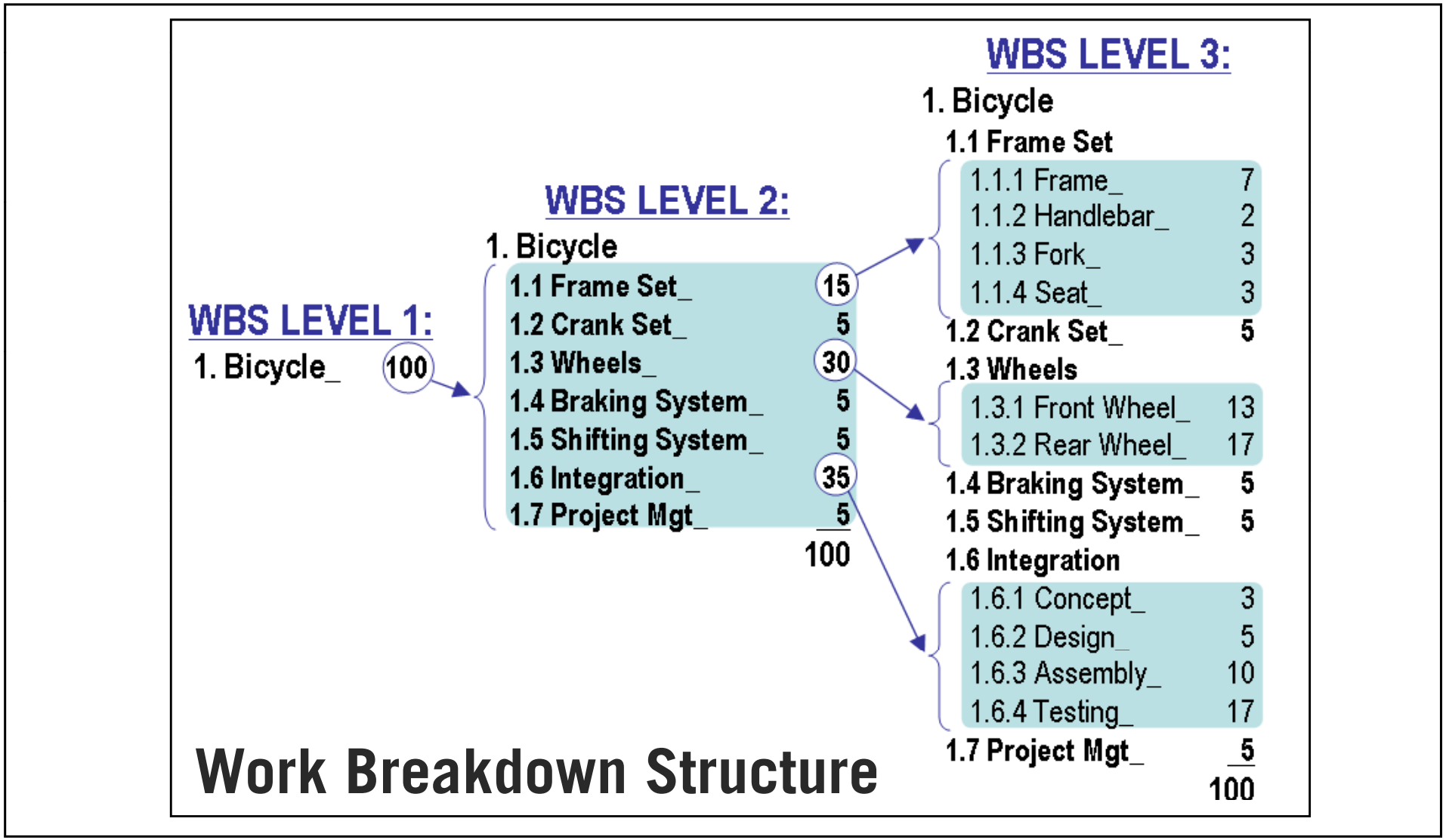




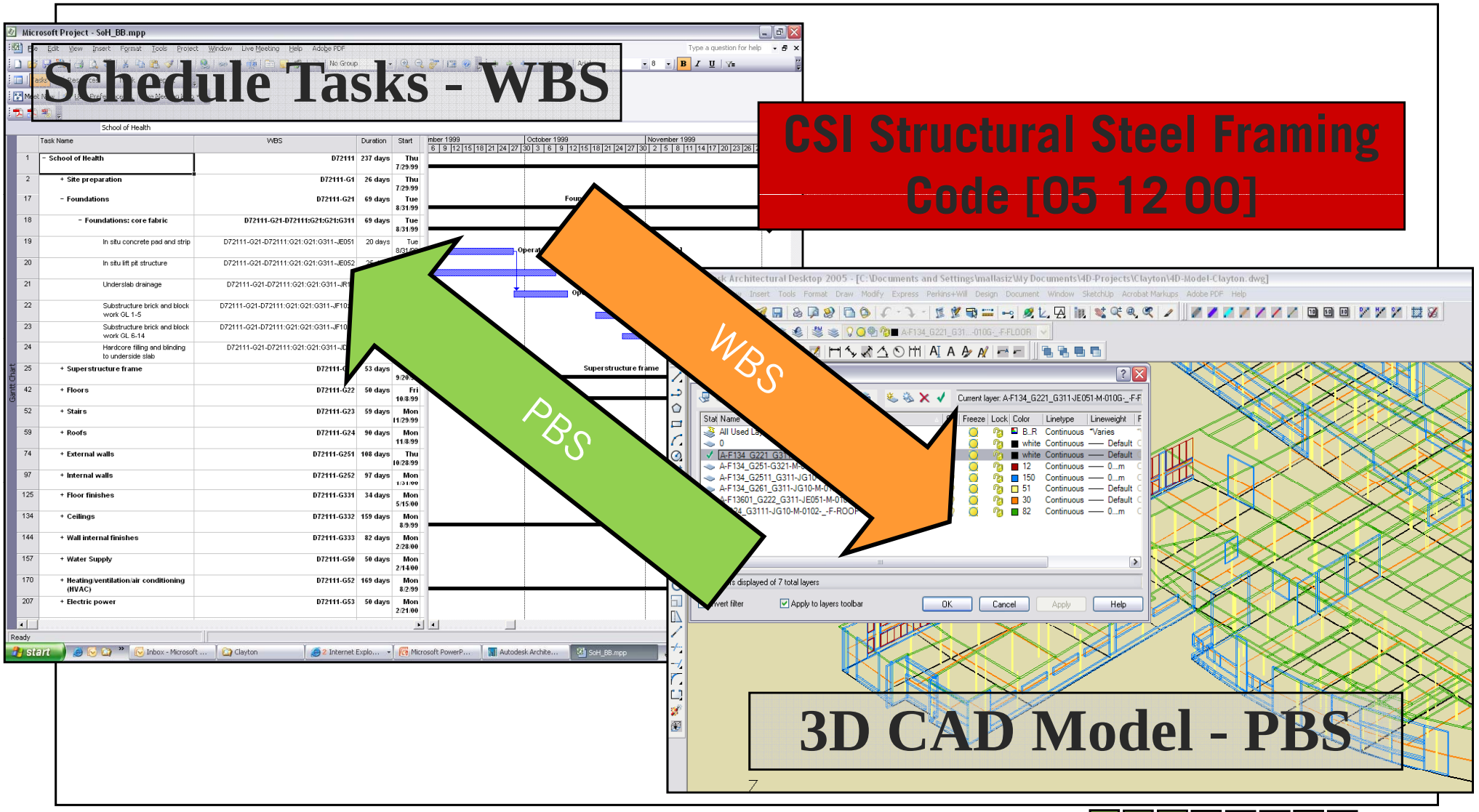




6- Visualizing Construction Work Progress in 4D: *concept*



6- Visualizing Construction Work Progress in 4D: *concept*



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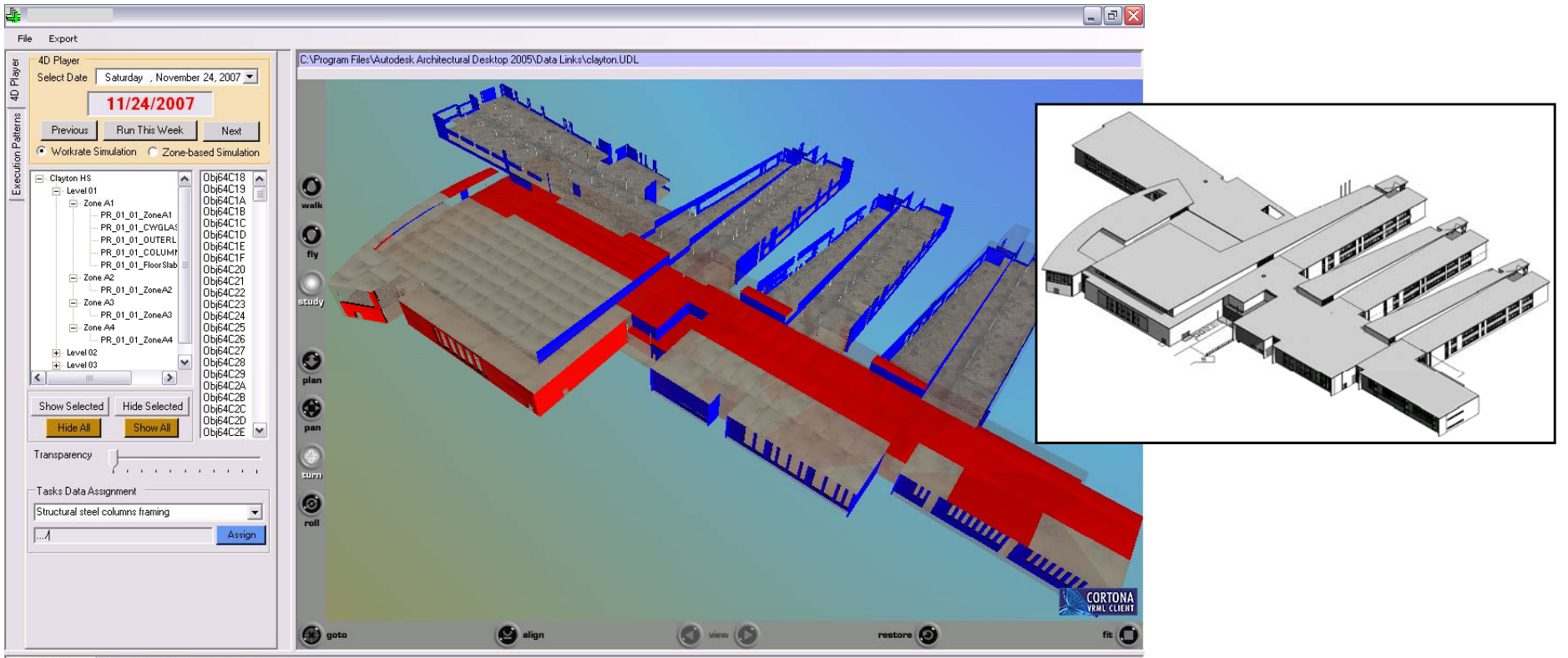
7- iConViz© - 4D Tool Demonstration: *High School Project*



... 4D Demonstration

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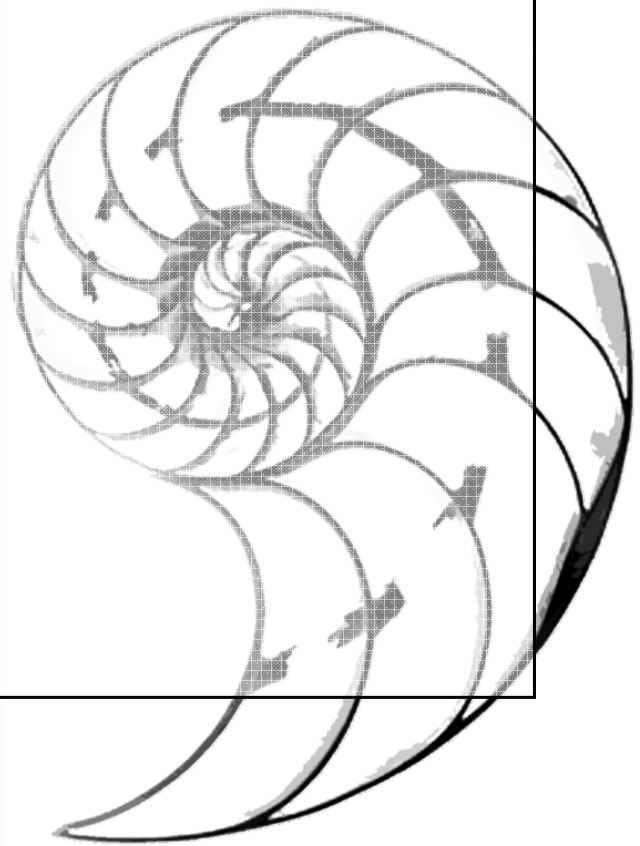
8- Conclusion: *benefits*

- *Major design conflicts are identified prior to construction*
- *Improved productivity due to a more efficient installation process and less workspace interferences.*
- *Less rework due to increased accuracy level of field installation.*
- *More opportunity for pre-fabrication which leads to cost and time saving during construction.*
- *Fewer requests for information (RFI) and change orders.*
- *Expect to deliver the project in less time due to 4D space planning and tuned construction sequence analysis.*

8- Conclusion: *lessons learned*

- ***Balance the scope of 3D modeling, timing and sequence between trades in accordance with design development process***
- ***Carefully assemble the project team to leverage the benefits of BIM***
- ***Assign one person with role of coordinating, integrating and maintaining the 3D/4D model (BIM Manager).***
- ***Increased in design time by 25% due to 3D modeling time spent in every discipline.***
- ***Identify with team at early stage different level of detail when creating 4D production model.***

Question and Answers

Thank You