

# Building Information Modeling—Agency Wide Actions

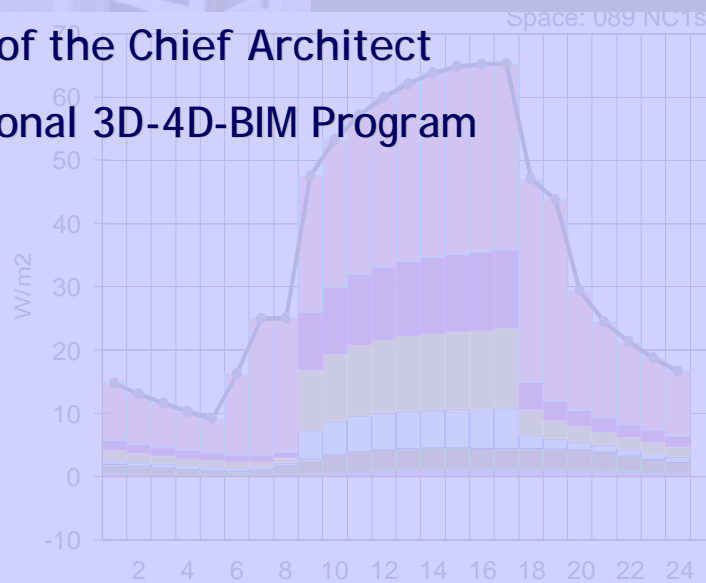
The United States General Services Administration

Public Buildings Service

Office of the Chief Architect

National 3D-4D-BIM Program

Space Identification	
Space Number (ID)	Space Name
1001	LOBBY
1002	STORAGE
1003	ENTRY VEST.
1004	TELE.
1005	ELEC.
1006	CLOSET
1007	OFFICE
1008	CORR.
1009	CLOSET
1010	CLOSET
1011	ENTRY VEST.
1012	ENTRY LOBBY
1013	CLOSET
1014	CLOSET
1015	OFFICE
1016	CORR.
1017	TELE.





# Sample GSA Projects



## PBS Inventory

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Buildings ~8,700

Owned ~1,600

180 million sq.ft.

Leased ~7,100

159 million sq.ft.

GSA presence in 2,100 communities

Federal workers housed in GSA space  
exceed 1.1 million



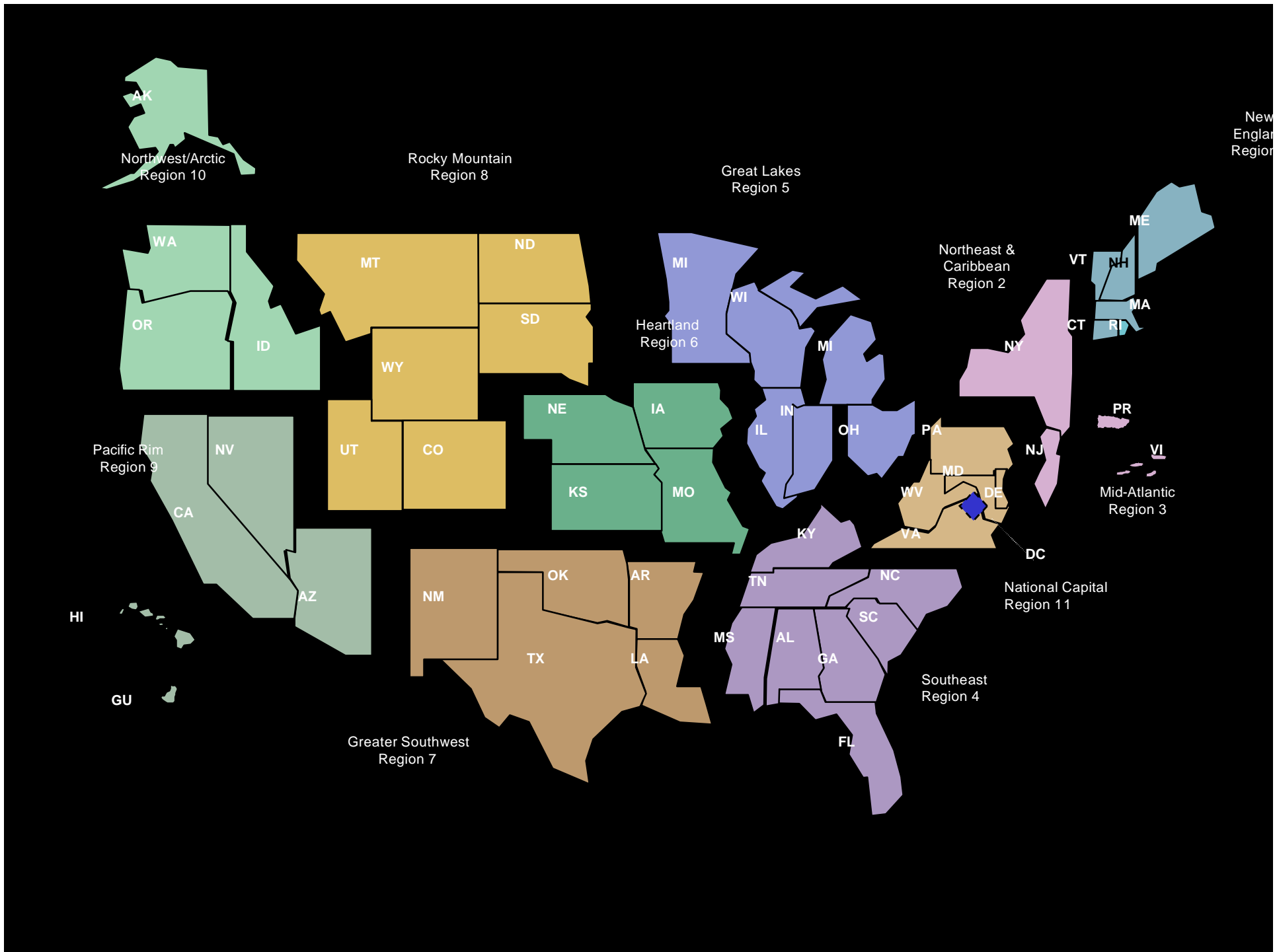
## PBS 3D-4D-BIM Program

### GSA's Project Portfolio

– 193 Active Major Projects, \$12.4 Billion

The screenshot shows the GSA PBS Project Information web application. The page title is "GSA PBS Project Information". The navigation menu includes "Basics", "Scope", "Schedule", "Financial", "Condition", "Team/Partners", "Gallery", "Documents", and "Customer". Below the navigation menu, there are filters for "-Active" and "All Program Areas", and a "GO!" button. The page content includes a "Program Summary" section with a "basics" banner and a table of project data. The table has four columns: "Program Type", "Number of Projects", "RSF", and "ETPC (\$000)". The data is categorized into "Prospectus", "Non Prospectus", and "Reimbursable". The "Totals" row shows 193 projects, 52,793,909 RSF, and \$12,370,096 ETPC.

Program Type	Number of Projects	RSF	ETPC (\$000)
<b>Prospectus</b>			
Lease	23	4,466,028	\$1,094,088
New	70	14,643,969	\$6,355,564
R&A	100	33,683,912	\$4,920,444
<b>Non Prospectus</b>			
Minor New			
Minor R&A			
Hist Preserv			
<b>Reimbursable</b>			
<b>Totals</b>	<b>193</b>	<b>52,793,909</b>	<b>\$12,370,096</b>





## GSA Public Buildings Service



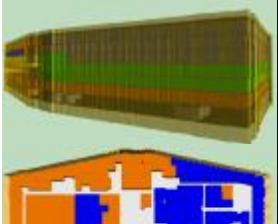
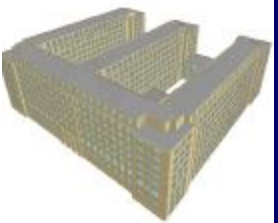
### GSA Office of the Chief Architect (OCA)

provides national leadership, coordination, and guidance to all GSA regions on design, construction, art, urban development, security, accessibility, sustainability, and Building Information Modeling (BIM).

## GSA's National 3D-4D-BIM Program

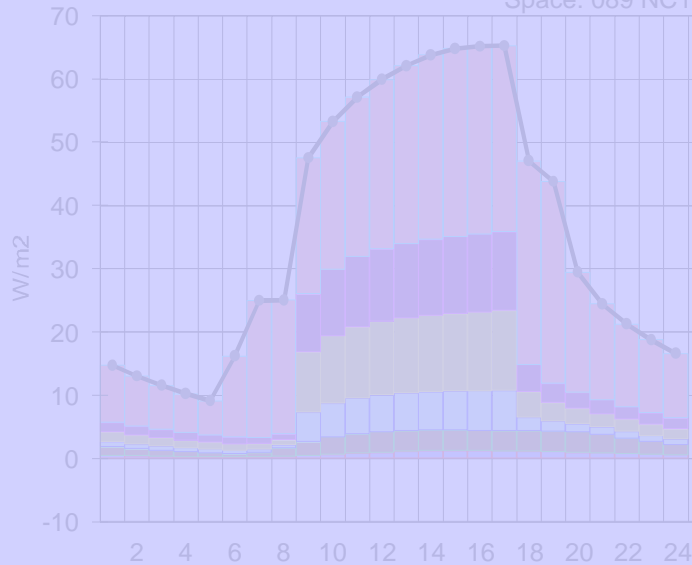
From introduction,  
to pilots and technology/standard development,  
to policy and budget and guidance,  
to program and project deployment and supports

- 10 OCA-led pilots completed
- 10+ OCA-led pilots underway
- 25+ OCA supports on ongoing GSA projects

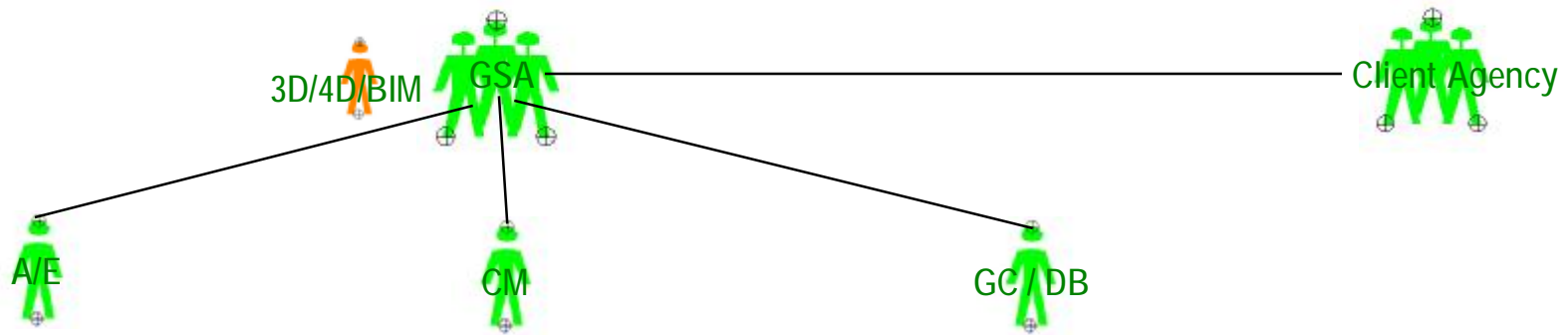


# Why BIM matters to GSA?

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Legend:



authors or integrators of virtual models



benefactors of virtual models

## 10 Pilot Projects led by the OCA:

Across different regions, project types, phases:

Region 2 26 Federal Plaza, NY

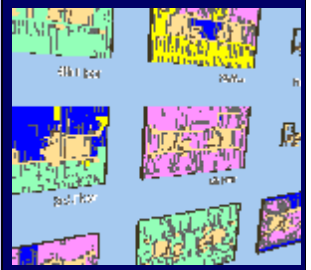
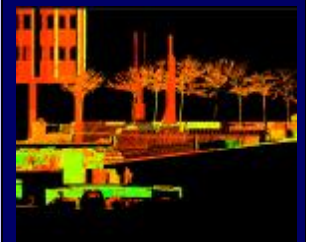
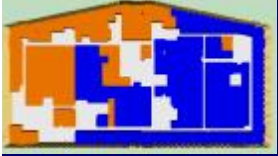
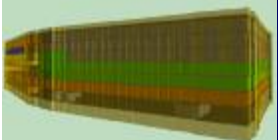
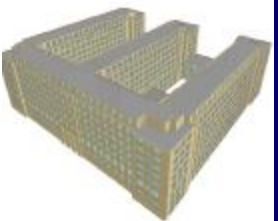
Region 7 FBI Field Office Building, Houston, TX  
 El Paso Courthouse, TX  
 Las Cruces Courthouse, TX

Region 9 300 North Los Angeles Street, CA

Region 10 Pioneer Courthouse, OR

Region 11 Eisenhower Executive Office Bldg, DC  
 GSA Regional Office Building, DC

OCA Proof-of-Concept  
 Northern Border Station Prototype





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## Initiated by GSA Offices and Regions

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### Portfolio [NCR]:

St. Elizabeth (laser scanning)      Optira

### Property Development [NCR]:

St. Elizabeth (site model)      AEC InfoSystems

### Office of Applied Science + CIO Venture Capital Pilot:

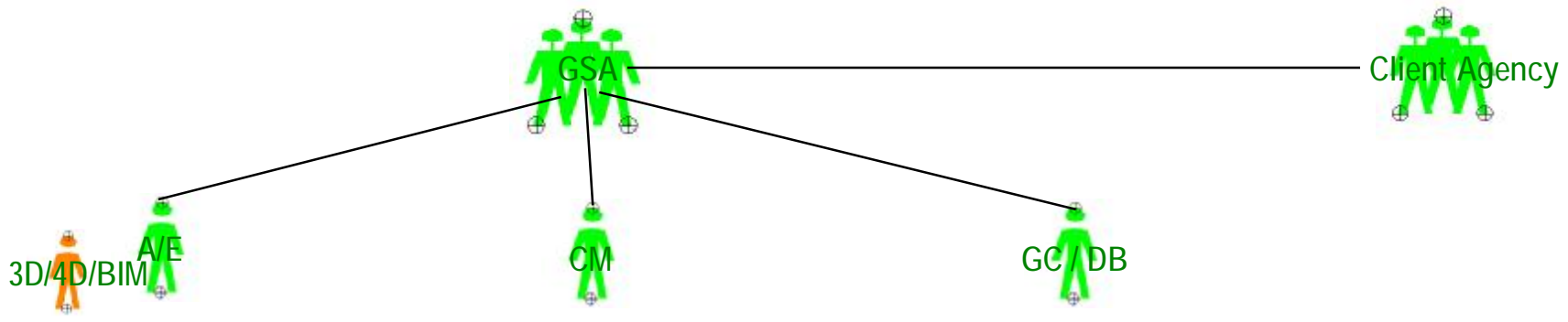
Jackson Courthouse      H3

### Property Management [Region 9] + DOE funding:

Santa Rosa Federal Building      LBNL  
San Diego Courthouse      LBNL, UCSD

### Property Management [Region 6]:

As-Built Documentation of 4 Facilities



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Legend:



authors or integrators of virtual models



benefactors of virtual models

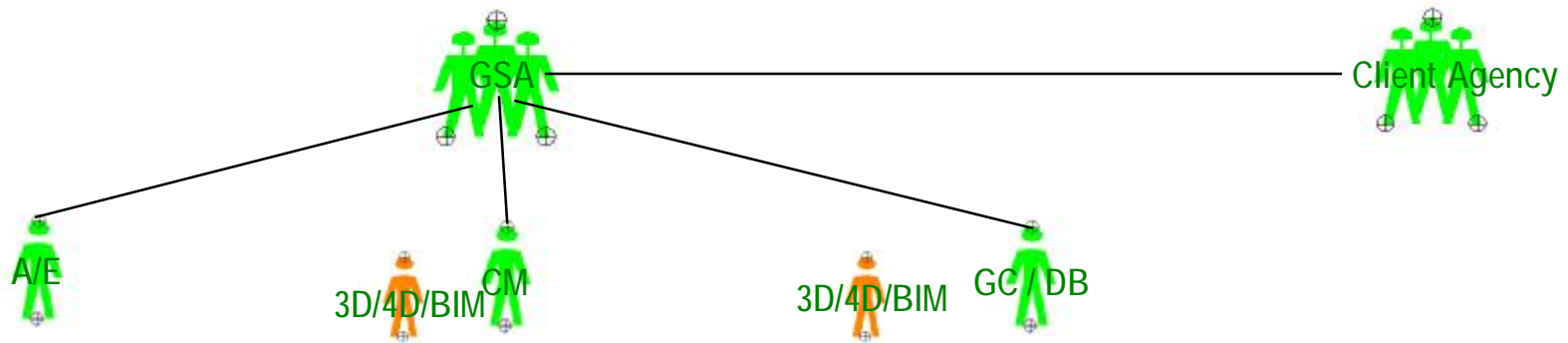


## Initiated by A/E:

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### A/E-Consultants:

Department of Commerce	GGA/EEK
Seattle Courthouse	NBBJ
Eugene Courthouse	Morphosis
San Francisco Federal Building	Morphosis
El Paso Courthouse	BPLW
Las Cruces Courthouse	ASCG
Cape Girardeau Courthouse	F. Bradburn
Ft. Pierce Courthouse	PGAL
FOB 8 (MEP)	GHT
Kansas City IRS	tbd
La Fayette (Proposed)	DMJM
FDA	RTKL
and more...	



Legend:



authors or integrators of virtual models



benefactors of virtual models



## Initiated by CM and GC:

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### Ongoing:

Richmond Courthouse	Jacobs
Fallon Federal Building	Jacobs

### Proposed:

Census Headquarters	Hensel Phelps (bidder)
1800 F Street	Heery
Court of International Trade	Parsons Brinckerhoff
U.S. Mission to UN	Jacobs

And by Holder , Turner , Clark, Mortenson, etc.

*Programing*

*Concept Design*

*Design Development*

*Construction*

*Operation*





Programing

Concept Design

Design Development

Construction

Operation

### Pre-Design

- As-Built Documentation
- Program development/  
Feasibility

### Concept Design

- Validate:  
program, circulation,  
egress, energy, urban,  
preservation, cost

### Design Development / Const. Doc

- Production, coordination
- Mockup
- Phasing

### Construction

- collision detection
- construction sequencing
- shop drawing, fabrication
- construction tolerance

### Commissioning / Operation

- as-built documentation
- system conditioning and reporting
- spatial data management

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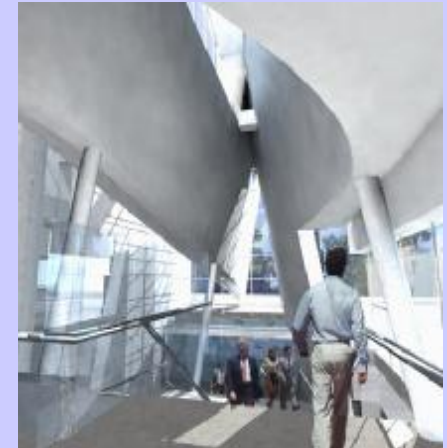
- as-built documentation
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Historic  
(Pre-1940)



Mid-Century  
(1941-1993)



Design Excellence  
(1994-Present)

Historic: 26%

Mid-Century: 56%

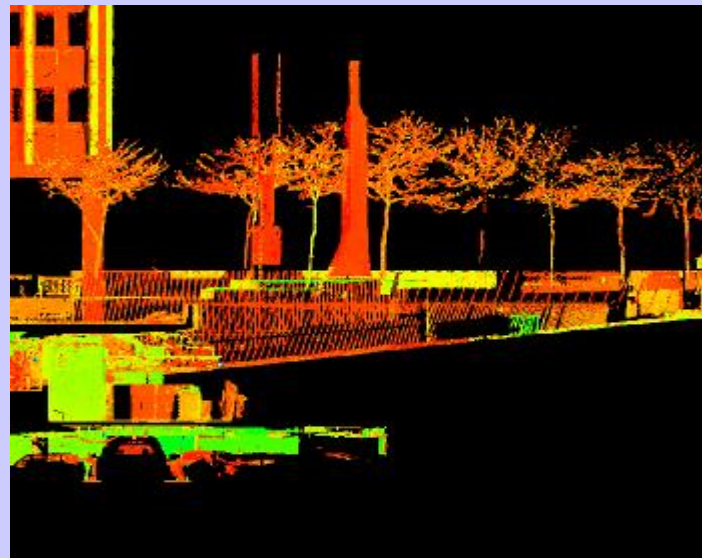
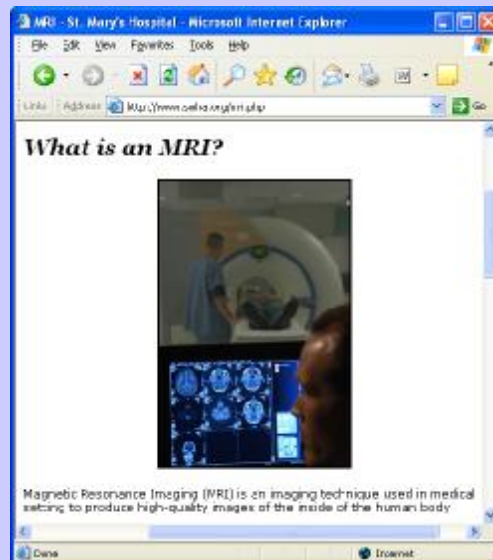
Design Excellence: 7-8%

## 3D Laser-Scan Documentation of Building Assets

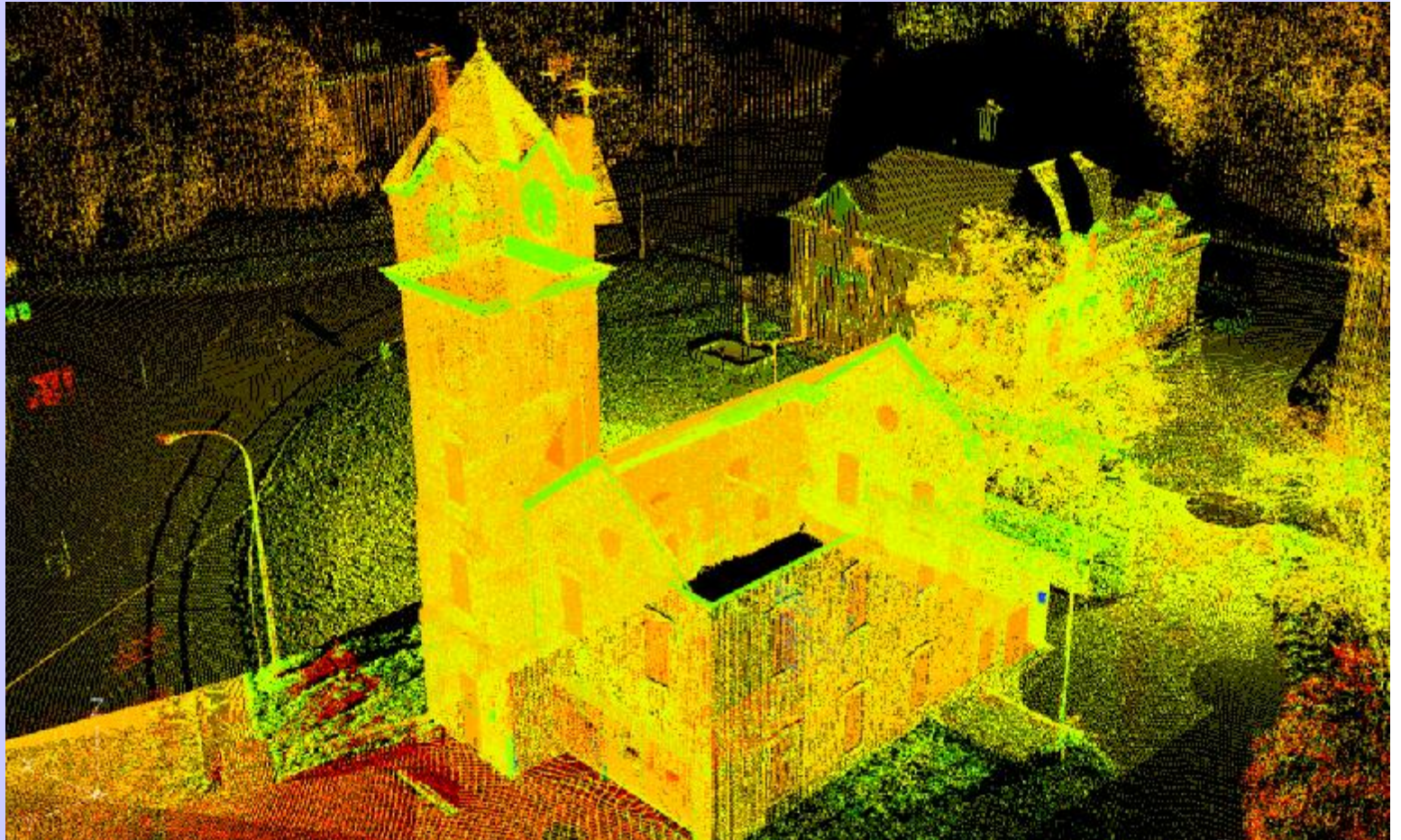
### Technology Solution: 3D Laser Scanning and Penetrating Radar Technologies

Analogy of X-Ray and MRI in medicine

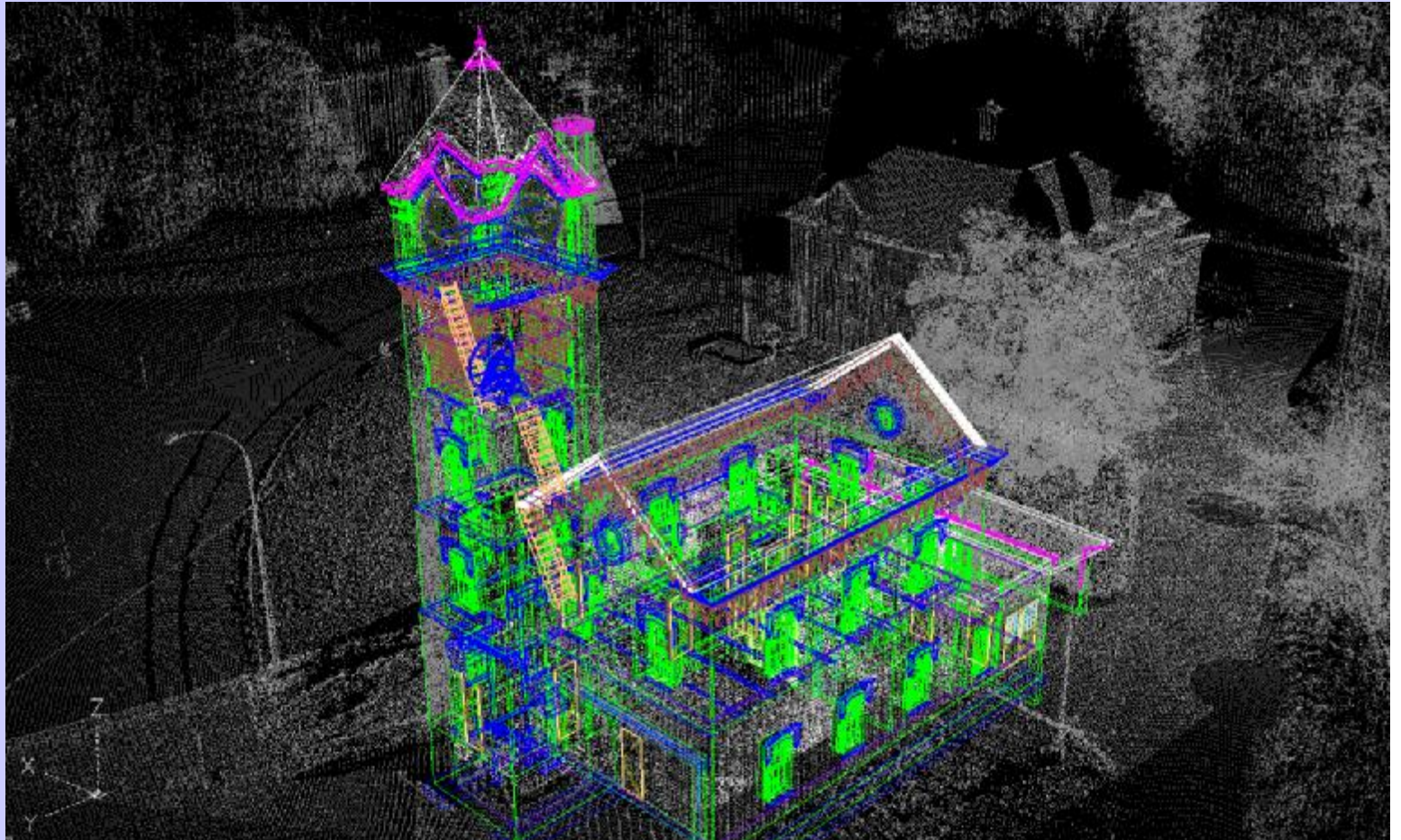
- physicians don't perform operations based on medical history alone
- most up-to-date condition
- local or comprehensive



## St. Elizabeth's Campus [NCR Portfolio]

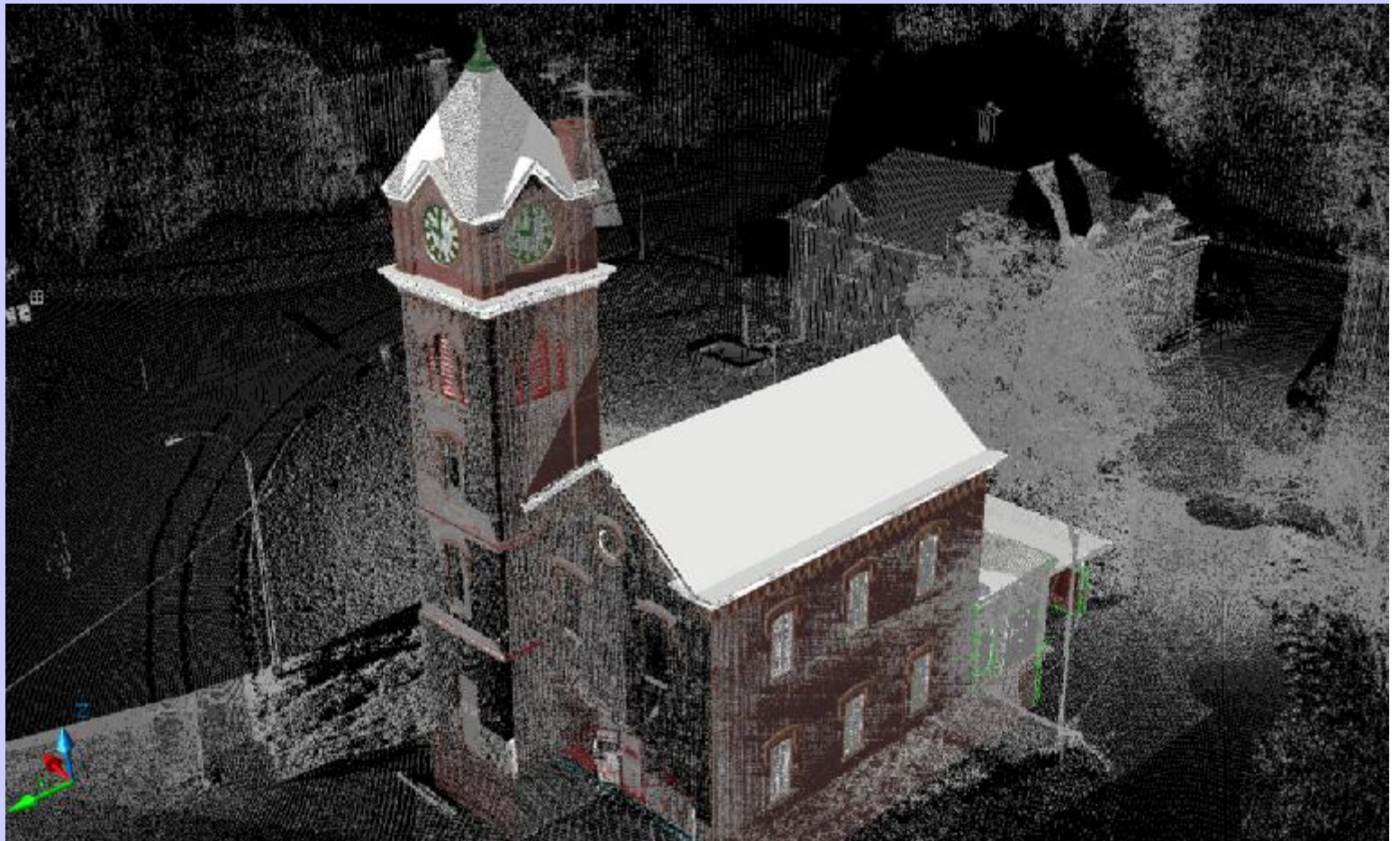


## St. Elizabeth's Campus [NCR Portfolio]





## St. Elizabeth's Campus [NCR Portfolio]



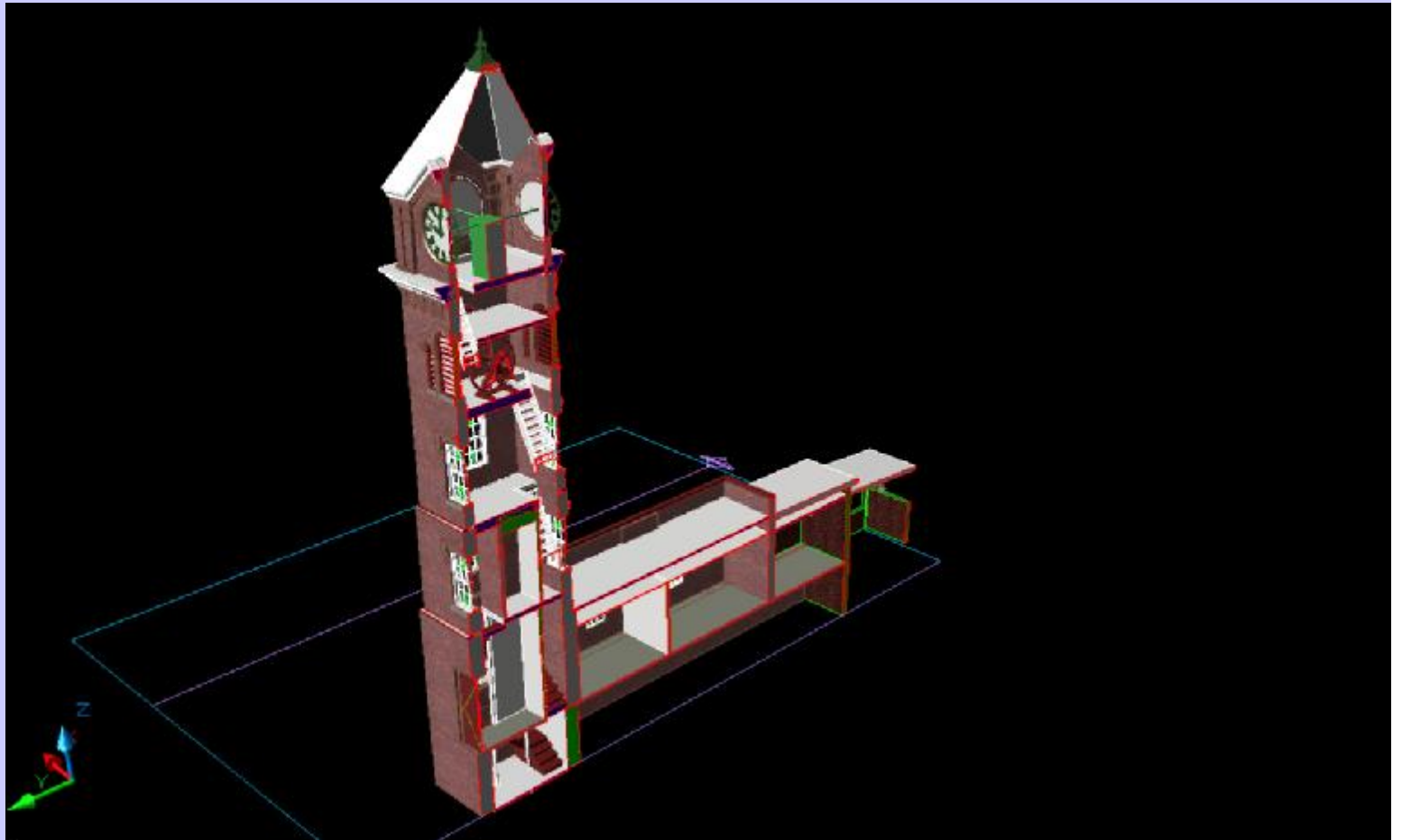
## St. Elizabeth's Campus [NCR Portfolio]



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Programing

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### Commissioning / Operation

- as-built documentation
- system conditioning and reporting
- spatial data management

Business Question:

How does PBS validate whether the design meets our program during concept phase?

Space Measurement

Gross Building Area

Gross Design Area

Usable Area

Rentable Area

Efficiency

Volume

Public/Private  
Ratio

Fenestration  
Ratio

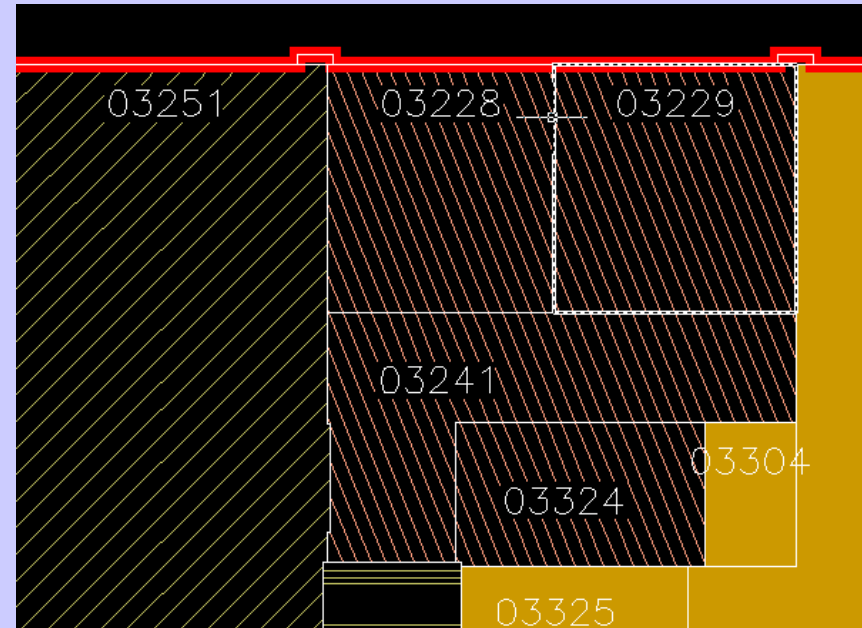
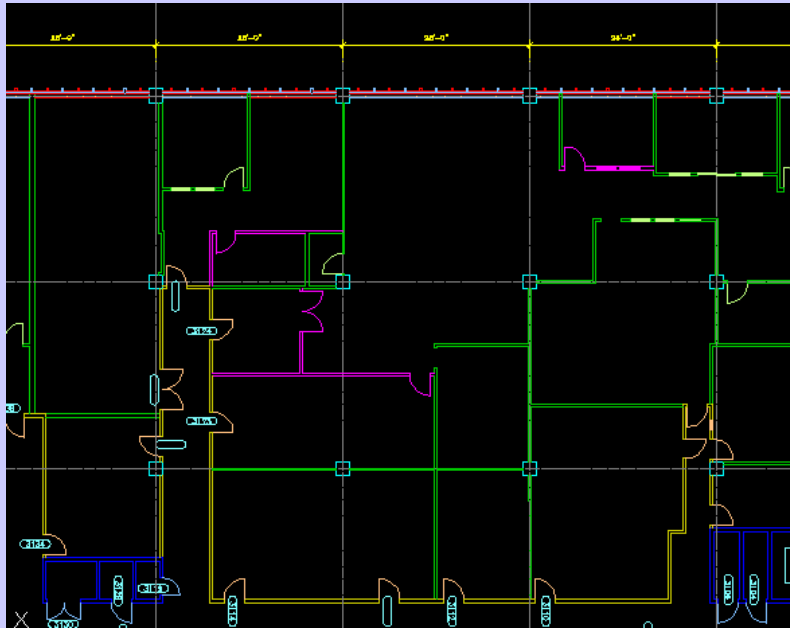
Skin to Floor  
Ratio

Portfolio/Property  
Management

STAR space type

STAR space category

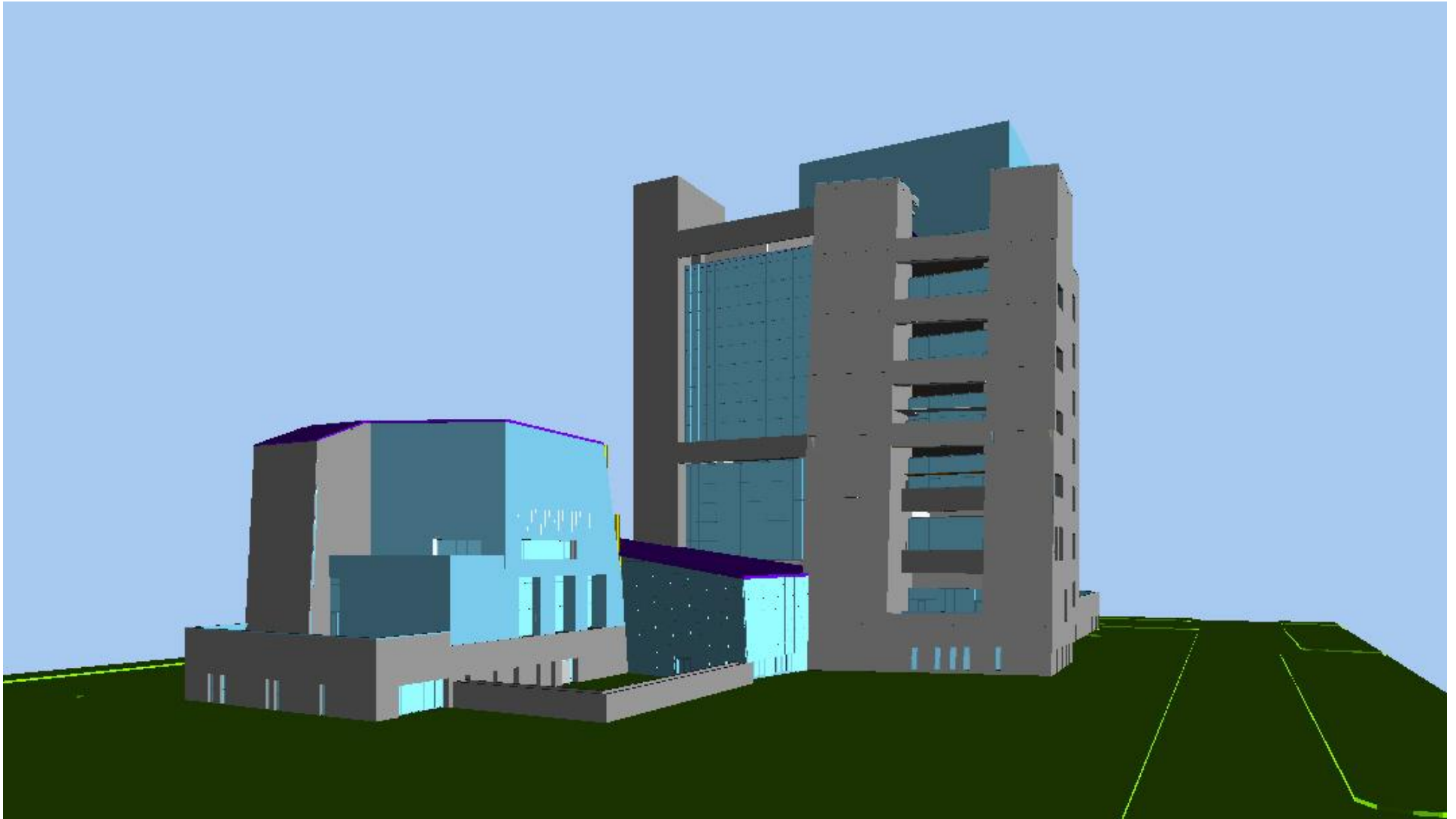
Agency Bureau Code



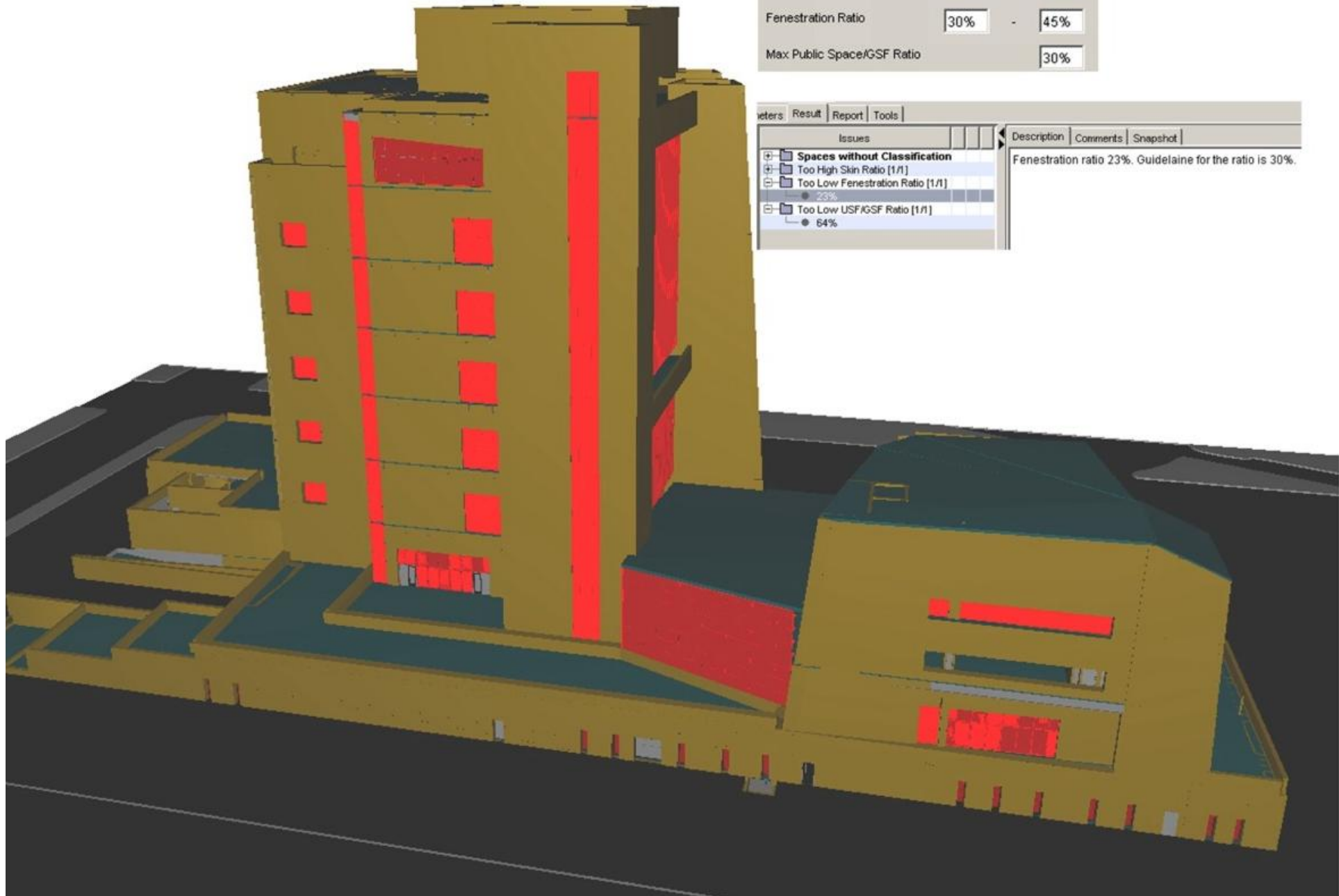
- A/E tabular reports and verbal responses
- 2D tracing of spaces to perform “polyline” area summation
- management of alterations over a building’s life-cycle

Turnaround, Interpretation of PBS Business Rules, ANSI/BOMA, Volumetric Characteristics, Manual vs. Machine Errors





In the new El Paso Courthouse project, BPLW has chosen (by their discretion) to build a 3D BIM to support its construction documentation. We thank BPLW for sharing its BIM. We have conducted a review of the model and offered the following observations.

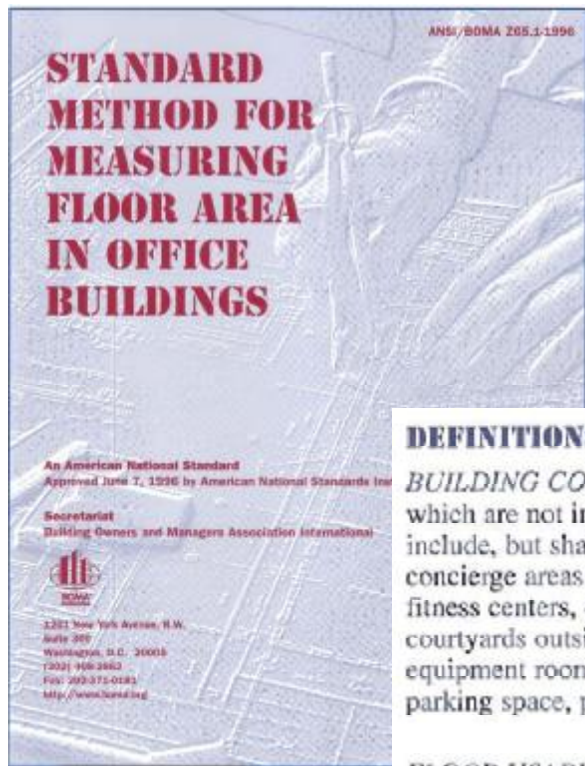


Min USF/GSF Ratio	<input type="text" value="67%"/>
Skin Ratio	<input type="text" value="45%"/> - <input type="text" value="55%"/>
Fenestration Ratio	<input type="text" value="30%"/> - <input type="text" value="45%"/>
Max Public Space/GSF Ratio	<input type="text" value="30%"/>

Issues		Description	Comments	Snapshot
+ Spaces without Classification				
+ Too High Skin Ratio [1/1]				
- Too Low Fenestration Ratio [1/1]				
● 23%				
- Too Low USF/GSF Ratio [1/1]				
● 64%				

Fenestration ratio 23%. Guidelaine for the ratio is 30%.

# Basis for Spatial Program Validation *During Early Project Phases*



- ü GSA Business Assignment Guide (2005)
- ü ANSI-BOMA Standard (1996)
- ü Region's SDM Formatting Standard

## **DEFINITIONS**

*BUILDING COMMON AREA* shall mean the areas of the building that provide services to building tenants but which are not included in the *OFFICE AREA* or *STORE AREA* of any specific tenant. These areas may include, but shall not be limited to, main and auxiliary lobbies, atrium spaces at the level of the finished floor, concierge areas or security desks, conference rooms, lounges or vending areas, food service facilities, health or fitness centers, daycare facilities, locker or shower facilities, mail rooms, fire control rooms, fully enclosed courtyards outside the exterior walls, and building core and service areas such as fully enclosed mechanical or equipment rooms. Specifically excluded from *BUILDING COMMON AREA* are *FLOOR COMMON AREAS*, parking space, portions of loading docks outside the building line, and *MAJOR VERTICAL PENETRATIONS*.

*FLOOR USABLE AREA* shall mean the sum of *USABLE AREAS* of *OFFICE AREAS*, *STORE AREAS* and *BUILDING COMMON AREAS* of a floor. The amount of *FLOOR USABLE AREA* can vary over the life of a building as corridors expand and contract and as floors are remodeled.

## The Drive for Open Standard

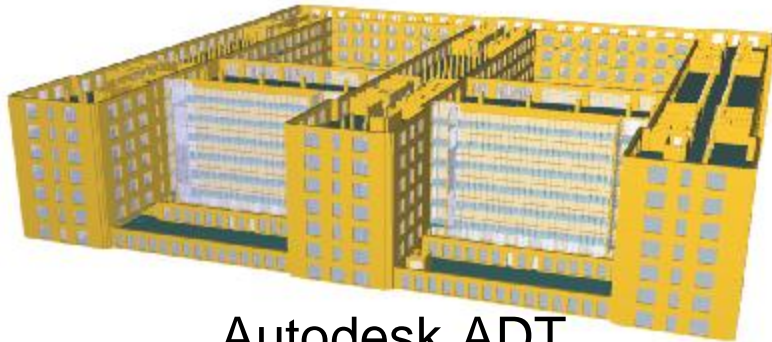


### BIM-Authoring Vendors

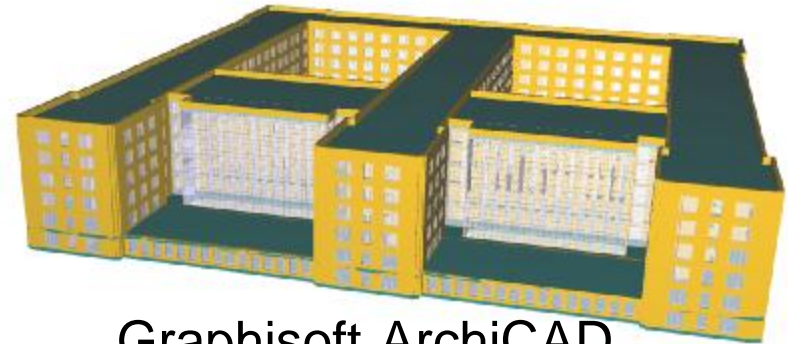
Autodesk & Inopso  
Architectural Desktop  
Autodesk Revit  
Bentley Architecture  
Graphisoft ArchiCAD  
Onuma Planning Stm.

### BIM-Viewing/Analysis

Solibri Model Checker



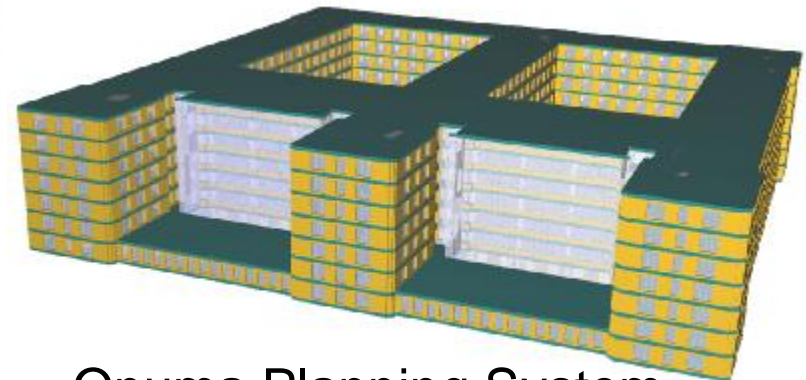
Autodesk ADT



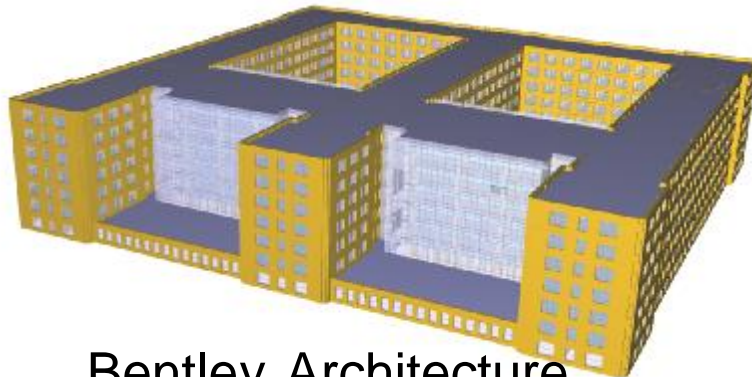
Graphisoft ArchiCAD



Autodesk Revit



Onuma Planning System



Bentley Architecture

**Space Object**

Space Name

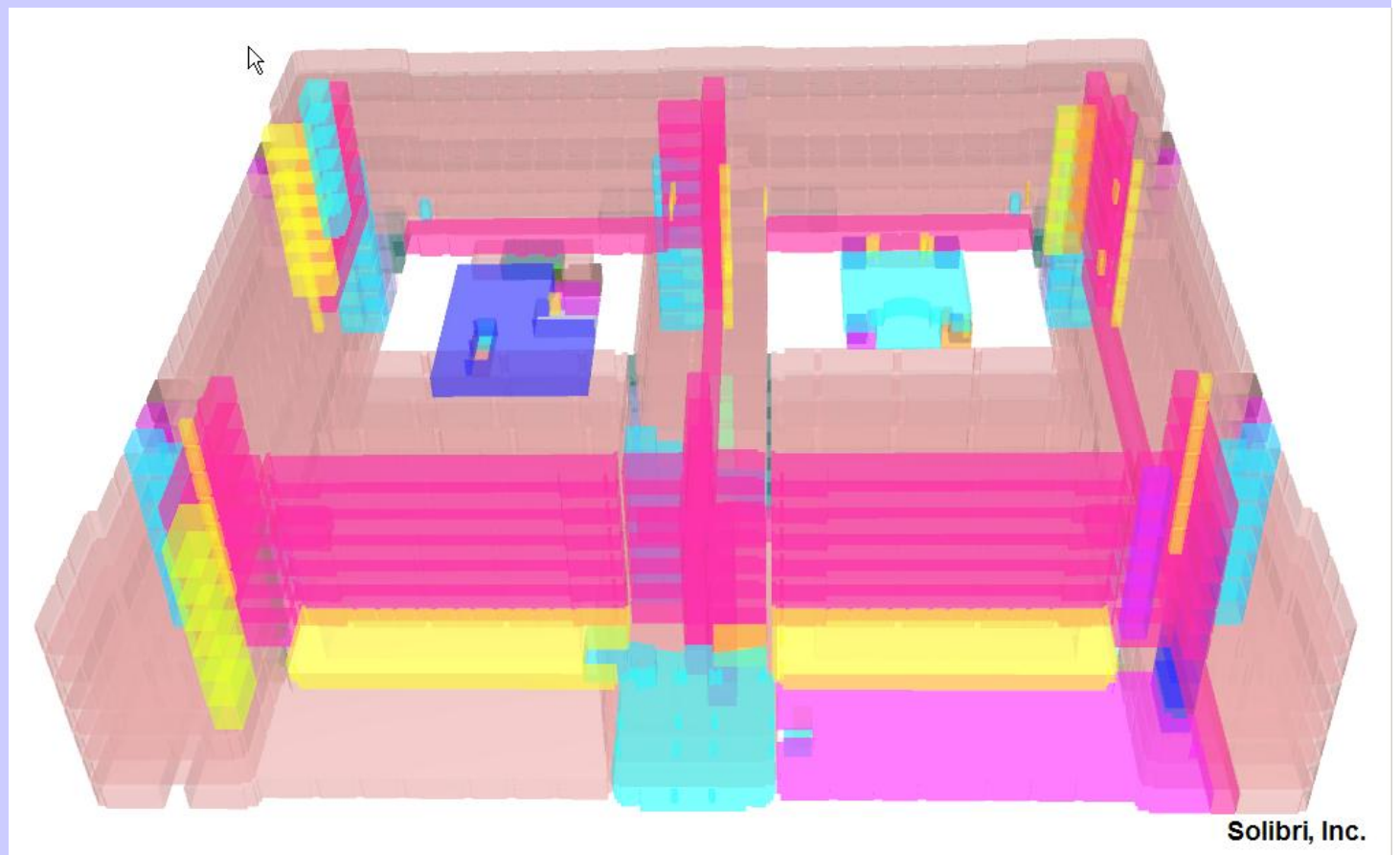
Space Number (ID)

Occupant Org. Name

Client Space Type



Visualize by Over 10 Different Parameters:  
e.g., space, zones, billing, agency, etc.



## Typical floor area and efficiency from 1800-F (GSA CO) Building

Gross Building Area	94,961
Gross Measured Area	87,920
Vertical Penetration Area	2,917
Floor Rentable Area	85,003
Usable Office Area	68,938
Usable Building Common Area	4,706
Floor Usable Area	73,644
Floor Common Area	11,359
Basic Rentable Office Area	79,571
Basic Rentable Building Common Area	5,432
Total Rentable Area	85,003
USF/GSF	0.84
Floor R/U	1.15



Programing

Concept Design

**Design Development**

Construction

Operation

### Programming

- As-Built Documentation
- Program development/  
Feasibility

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- Validate:  
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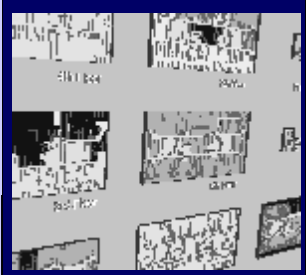
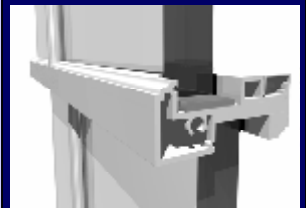
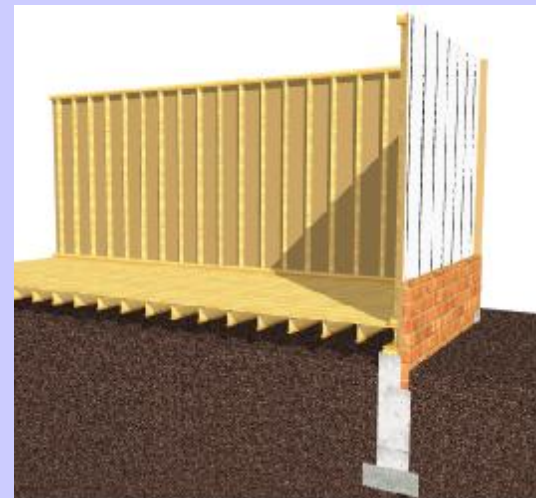
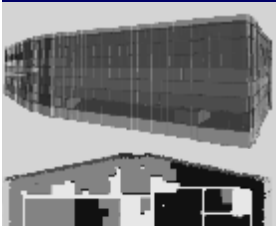
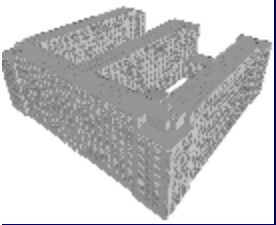
### Commissioning / Operation

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## PBS 3D-4D-BIM Program

Border Station Prototype, US-Canada Border

– BIM-based design in support of project planning and alternative analysis



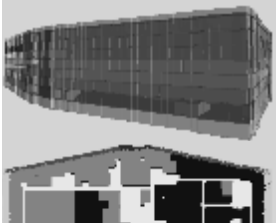
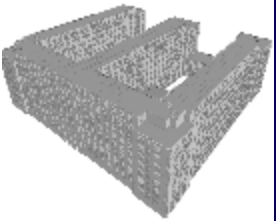
- site orientation, vehicular flow, structural alternatives, material choices, and construction means and methods were studied during the early programming phase

- visual animation, orientation trade-off, and pre-fabrication studies were carried out with the building information model

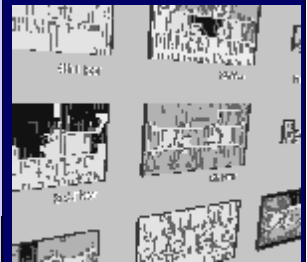
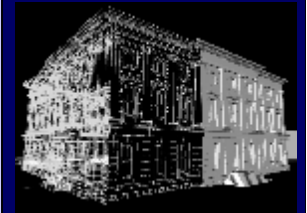
## PBS 3D-4D-BIM Program

Eisenhower Executive Off Bldg, Wash D.C. —

— A balance between security requirements and historical preservations



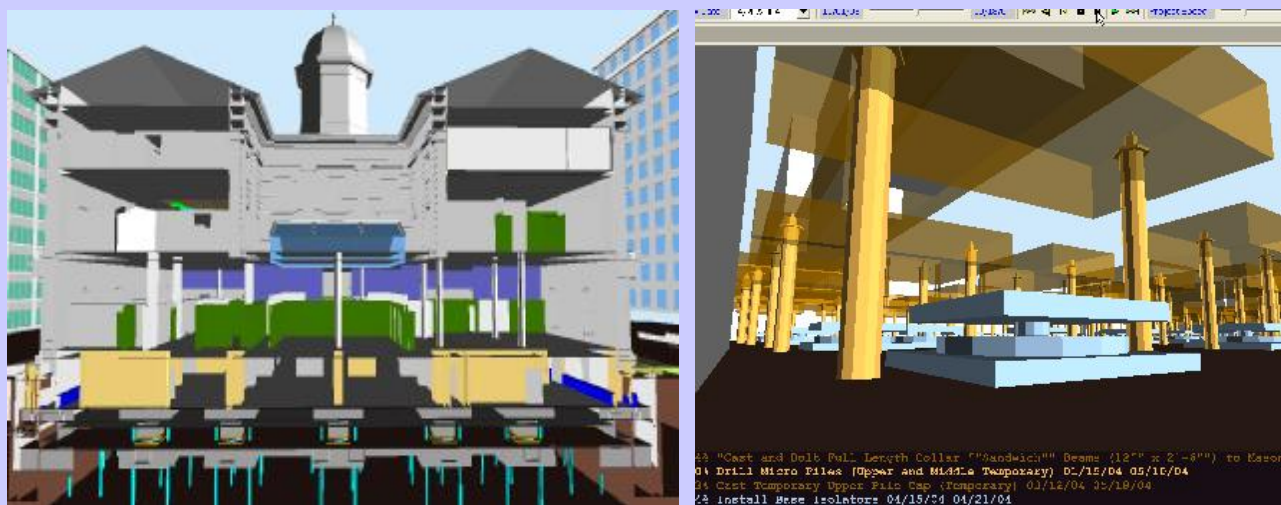
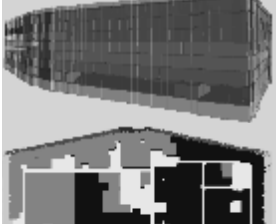
- a BIM and a Quicktime movie were constructed based on fabricator's shop drawings, at 1/48" accuracy
- daylight and shadow were cast based on city's longitude, latitude
- perspective of a pedestrian was simulated based on elevation and site dimensions



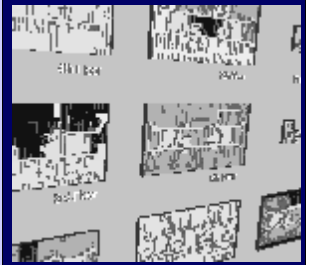
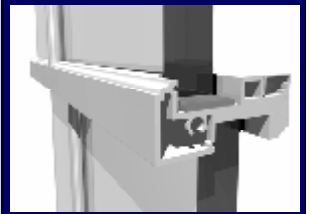
## PBS 3D-4D-BIM Program

U.S. Courthouse, Portland, OR

– Improving the means of communications with the public, tenants, and bidding contractors



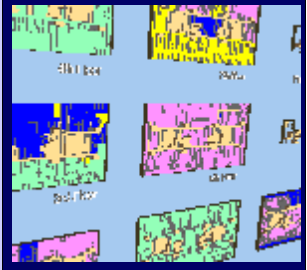
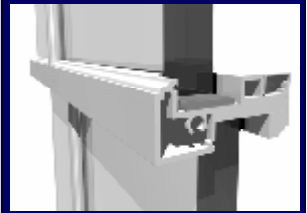
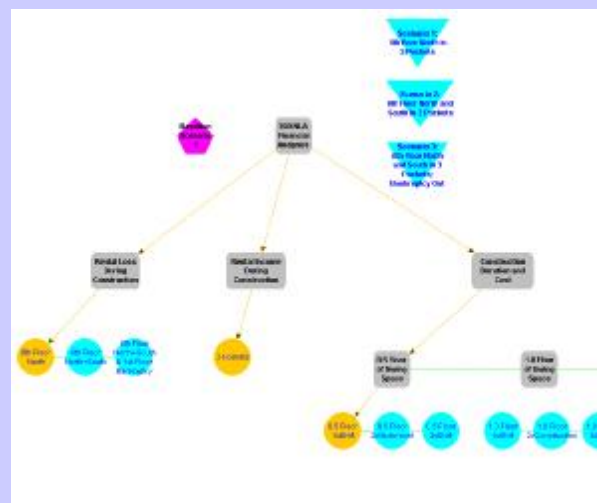
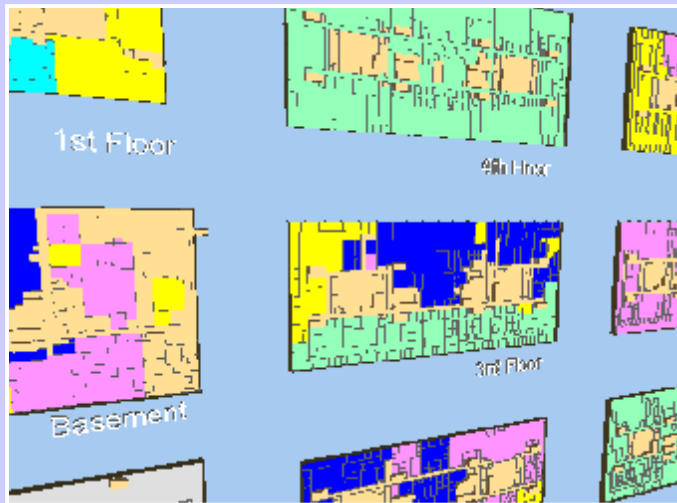
- a historical landmark undergoes a seismic upgrade with the installation of base isolators
- 4D modeling integrates design intent, structural engineers' specifications, and a construction schedule into a single model
- the model and the animation fostered GSA's communications with the public, tenants, and GC bidders



PBS 3D-4D-BIM Program

300 NLA Federal Bldg, Los Angeles, CA

– Model-based tenant phasing enables schedule reduction and improved cost predictability



- a fully occupied federal building will go through a 16-phase seismic upgrade and modernization
- data integration, 4D-modeling, and the Decision Dashboard enable the team to reduce overall schedule by 19% while uncovering major errors in cost assumptions
- 4D-modeling provides an effective means for communication with the tenant agencies

Programing

Concept Design

Design Development

Construction

Operation

### Programming

- As-Built Documentation
- Program development/  
Feasibility

### Concept Design

- Validate:  
program, circulation,  
egress, energy, urban,  
preservation, cost

### Design Development / Const. Doc

- Production, coordination
- Mockup
- Phasing

### Construction

- collision detection
- construction sequencing
- shop drawing, fabrication
- construction tolerance

### Commissioning / Operation

- as-built documentation
- system conditioning and reporting
- spatial data management

PBS 3D-4D-BIM Program  
Office Building, Houston, TX

– Design intent omissions uncovered and coordinated before construction bidding



- a new office building with innovative façade system
- building information modeling enabled early detection of design errors and omissions pertaining to the façade system
- the designer team was able to incorporate the findings, correct the drawings, and avoided costly change orders and RFI's that would impact the project schedule



# New Construction

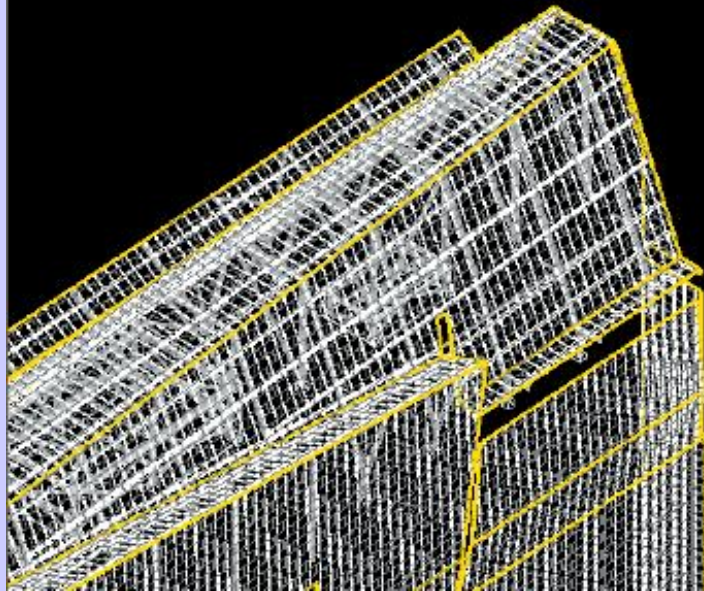


San Francisco Federal Office

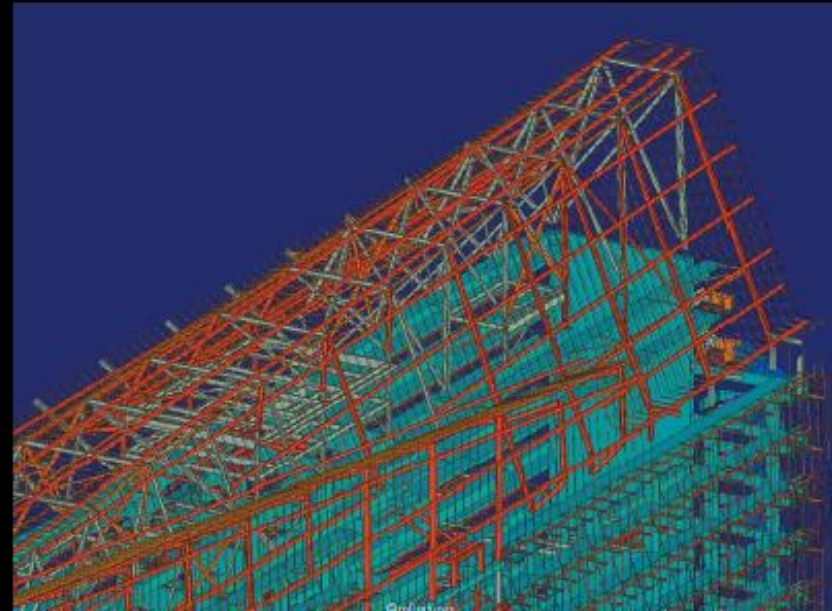


## 2005 AIA TAP BIM Award Winner Morphosis: New San Francisco Federal Building

Design Team Skin and Framing model



B.D.S. detail model



Programing

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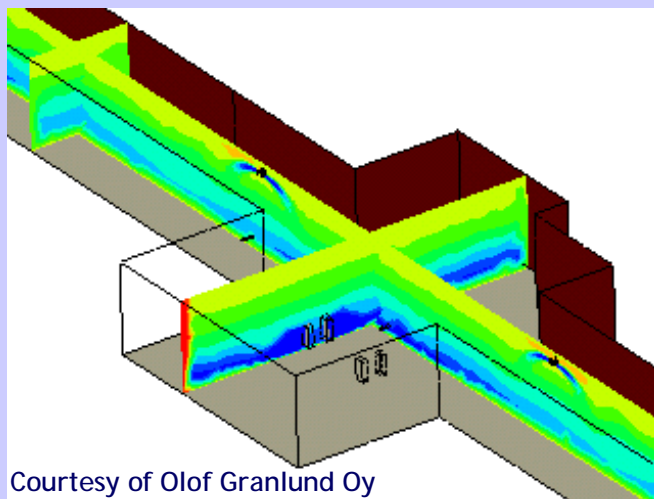
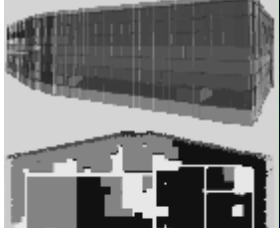
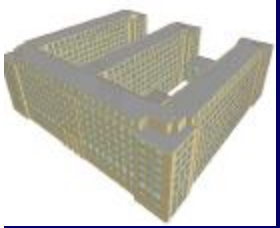
### Commissioning / Operation

- as-built documentation
- system conditioning and reporting
- spatial data management

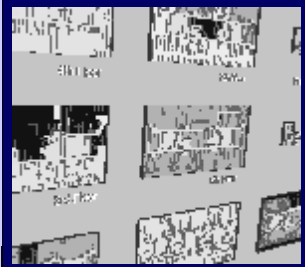
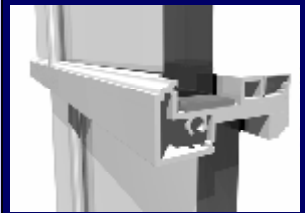
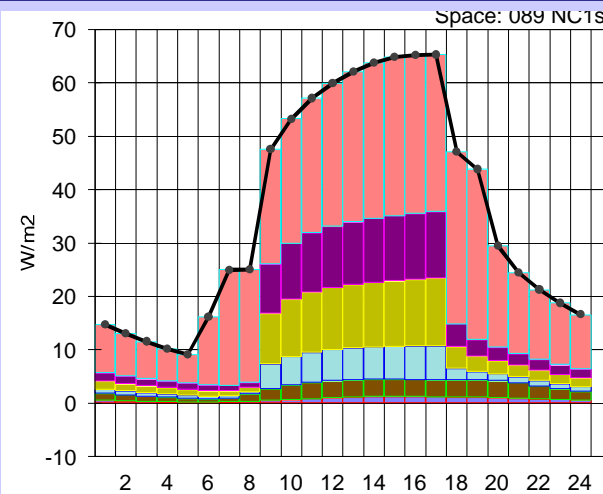
PBS 3D-4D-BIM Program

GSA Central Off Bldg, Wash D.C.

– Energy analysis and computational fluid dynamic simulation of an existing office building



Courtesy of Olof Granlund Oy



- BIM and IFC enabled direct model exchange with an energy consultant for a simulation of the thermal condition and energy usage of an existing facility

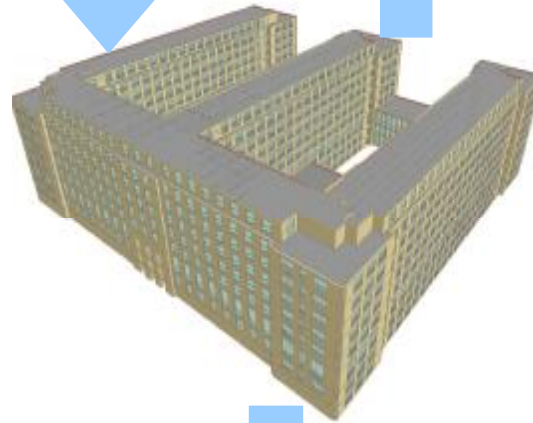
- thermal zones, construction materials, insulation types, and window properties are analyzed by a DOE-2 based program, which simulated energy consumption based on the occupancy activities across a typical work day.

**PBS Investment**

- Objectives Ø Business Process excellence
- Ø OCA programs
- sustainable Ø LEED
- innovation Ø workplace 20.20

**PBS Expenditure**

- Objectives Ø Business Process conservation
- Ø energy management
- satisfaction Ø customer relations
- operation Ø performance measures



investment effectiveness?

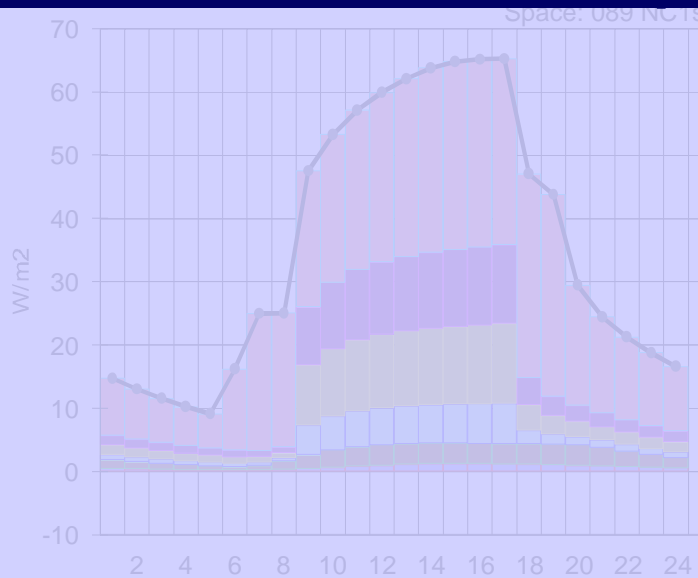
operation efficiency?

**Information Basis**

- energy bills,
- survey/complaints,
- walkthrough inspection,
- field measurements,
- reactive measures

Space Identification	
Space Number (ID)	Space Name
1001	LOBBY
1002	STORAGE
1003	ENTRY VEST.
1004	TELE.
1005	ELEC.
1006	CLOSET
1007	OFFICE
1008	CORR.
1009	CLOSET
1010	CLOSET
1011	ENTRY VEST.
1012	ENTRY LOBBY
1013	CLOSET
1014	CLOSET
1015	OFFICE
1016	CORR.
1017	TELE.

# Where we are? The steps forward...





## Sensible to Technology and Consultants Maturity

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Establish Minimum Requirements:

Spatial Program Validation

High Business Value

Achievable

Series 02—GSA BIM Guide for Spatial Program Validation

Support “Above and Beyond” 3D, 4D, and BIM applications:

3D Laser Scanning, 4D Phasing, Energy Simulation, Coordination

Project-by-Project Basis (don't boil the ocean)

Series 01—GSA BIM Guide Overview



# CAPITAL INVESTMENT & LEASING PROGRAM CALL



**FY 2008**

U.S. General Services Administration  
GSA Public Buildings Service  
Office of Real Property Asset Management

<http://rw-qpnet-oca.gsa.gov>



Public Buildings Service  
Office of Real Property Asset Management

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## FedBizOpps:

*For all prospectus projects receiving design funding in **FY2007 and beyond**, a **spatial program** Building Information Model will be the **minimum requirement** for all new and modernization projects that will be submitted to Commissioner of the Public Buildings Service for **Final Concept approvals**.*

## Scope of Work:

*... check with OCA for latest template and advice on customization*



## Ongoing 3D-4D-BIM Projects led by OCA:

### Spatial Program Validation

Region 4 Tuttle Annex, GA

Region 5 Dirksen Federal Building, IL (and laser as well)  
Rockford Courthouse, IL

Region 10 Edith Green Federal Office, OR

R11/NCR 1800 F Street GSA CO, DC  
HCHB Dept of Commerce, DC  
St. Elizabeth's Campus, DC (candidate; led by NCR)



## Ongoing 3D-4D-BIM Projects led by OCA:

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### Energy Simulation

Region 8 Salt Lake City Courthouse, UT

### 3D Laser Scanning

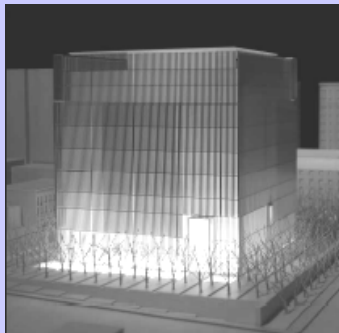
Region 2 Brooklyn Post Office and Courthouse, NY

Region 4 Peachtree Summit Building, GA  
Miami Judicial Campus, FL

### Phasing

Region 9 PJKK Federal Building, HI

Region 10 Edith Green Federal Building, OR



# Center of Expertise: OCA's 3D-4D-BIM Program

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## **Program: ongoing projects**

Advise Regions on Solicitation, Scope, Implementation, and Evaluation

Final Concept Review of Spatial BIM models

Manage Program Budget and Monitor Project Funding on BIM

Process Mapping, Metrics, Value

Compiling Best Practices (laser scanning, energy modeling, space)

## **Program: ongoing development (strategic next steps)**

Developing BIM functionality on shipping BIM products

- adopt and extend the IFC open international standard

- in-kind contributions from 5 software products and counting

Automating BIM Review of Courts Design Guide

Energy and Operations, Post Occupancy Evaluation, Equipment, Operation



# Center of Expertise: OCA's 3D-4D-BIM Program

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## Within PBS

Collaborate with GSA Offices and Regions (Portfolio, SDM, Property Management, CIO, etc.)

Sponsor regional advocates to BIM training program

Solicit BIM project nominations from regions

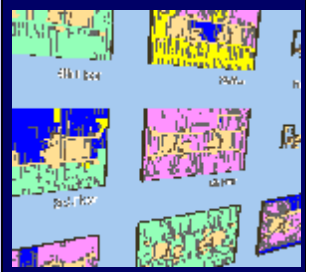
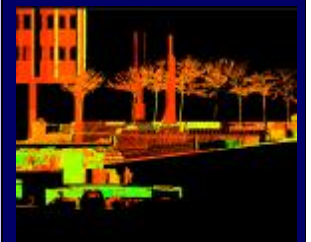
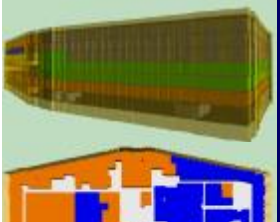
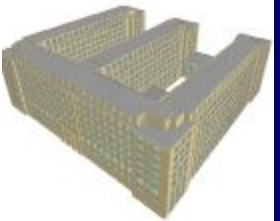
## Industry Exchange

International, National, and Local standards and professional organizations

## GSA's National 3D-4D-BIM Program

From introduction, pilots, to policy and program implementation

- 10 OCA-led pilots completed
- 11 OCA-led pilots underway
- 25+ OCA supports on ongoing GSA projects
- Strategy and Tactics (funding, contracts, req's)
- The GSA BIM Guide Series:
  - 01—Overview
  - 02—Spatial Program Validation
  - Drafting... 3D Laser Scanning,  
4D Phasing,  
Energy Performance  
and Operation,  
Circulation Validation



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BIM VDC IFC 3D 4D 5D  
VIRTUAL DESIGN AND CONSTRUCTION  
INTELLIGENCE  
OPERABILITY

GSA Building Information Modeling Guide Series

## 01 - GSA BIM Guide Overview

Version 0.50 – November 1, 2006

United States General Services  
Public Buildings Service (PBS)  
Office of the Chief Architect (OCA)

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BIM VDC IFC 3D 4D 5D  
VIRTUAL DESIGN AND CONSTRUCTION  
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GSA Building Information Modeling Guide Series

## 02 - GSA BIM Guide For Spatial Program Validation

Version 0.90 – November 1, 2006

United States General Services Administration (GSA)  
Public Buildings Service (PBS)  
Office of the Chief Architect (OCA)





## Handouts

## Acknowledgements (in-kind contributions)

Autodesk Architectural Desktop + Inopso

Autodesk Revit

Bentley Architecture

Graphisoft ArchiCAD

Onuma Planning System





## PBS OCA 3D-4D-BIM Program

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Stanford University/CIFE Visiting Fellows

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Region 4—	Brian Kimsey, Cliff Antrobus
Region 5—	Chuck Hardy, Richard Gee
Region 6—	John Brumley
Region 9—	Jill Manzi, Mark Levi
Region 11/NCR— and more.....	Steve Hagan, Mark Velsey, Mark Ilich

**<http://www.gsa.gov/bim>**