New Technologies to assist our users in todays 3D world – Applied Research Group

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Bentley
Sustaining Infrastructure

Mission of Applied Research Group

To look beyond the next version of software by identifying, investigating and validating new technologies, functionality, and application areas in support of Bentley's mission to help our users improve the world's infrastructure

How do we conduct research at Bentley?

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- Research projects

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  - Internal prototype development

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    - Users

How do we conduct research at Bentley?

- Research projects
  - Internal prototype development
  - Joint projects
    - Universities
    - Technology Providers
    - Users
- Facilitate thought leadership to address broader infrastructure issues
  - Sustainability
  - Industrialization

2008 Applied Research Themes

- Computational Design
- Work Packaging
- Construction
- Real-time Assets
- Distributed Review & Augmented Reality
- Engineering Optimization

Summary

- Objectives for the Applied Research Group
  - Identify and validate new technologies to benefit Bentley products, solutions, and users
  - Formulate and demonstrate thought leadership in strategic areas for the infrastructure industries
- Communicate progress and results to
  - Bentley colleagues
  - Bentley users
  - Infrastructure industries at large

Real-time Assets

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Real-time Assets

- Integration of:
  - Physical infrastructure asset
  - Wealth of real-time sensor information now possible
    - Remote video
    - Sensors
      - Temperature
      - Motion
      - Operating conditions
      - Acceleration
    - RFID's (Radio Frequency Identification)
  - Virtual infrastructure asset
    - Drawings, 3D models
    - Engineering analyses, calculations
    - Specifications, requirements, databases, vendor information

Real-time Assets

- Potential Benefits
  - Improved asset performance through
    - Measuring actual vs. predicted performance
    - Facilitate performance optimization
    - Remote monitoring of systems and users of the facility
    - Predictive analysis based on measured trends
    - More effective outage planning and management
  - Improved asset safety & security through
    - Asset protection – security planning, threat mitigation
    - Threat assessment, location, and warning
    - Escape, rescue & recovery planning which adapts to changing real-time conditions
    - Assess/predict impact of catastrophic events

Real-time Asset Project

- Purpose
  - Explore and validate potential benefits from:
    - Integrating and visualizing the information provided by a diverse collection of real-time systems within the context of the virtual representation of the asset;
    - Providing the information provided by a diverse collection of real-time systems within the context of each other;
    - Expanding the availability of the real-time asset information to a broader set of stakeholders;
    - Creating a "network effect" whereby the potential benefits from a real-time asset increase geometrically as the number of connected devices and connected users increases; and
    - Providing a single point of integration of the real-time information where it can be managed, secured, and distributed among the asset stakeholders.

Real-time Asset Project

- Approach
  - Maximize the use of existing products and technology;
    - Customize existing products through API's;
  - Don't duplicate the functionality provided by existing real-time systems
    - Interface with real-time sensors/systems via standard API's;
  - Integrate
    - Information from existing real-time systems and independent real-time devices
    - Multiple type of engineering content (i.e., the virtual asset) associated with a physical asset, such as drawings, models, analyses, specifications, images, and other types of documents.
  - De-couple application integration with real-time devices
    - Don't require every application to integrate with every device type
    - Single point of application integration through ProjectWise

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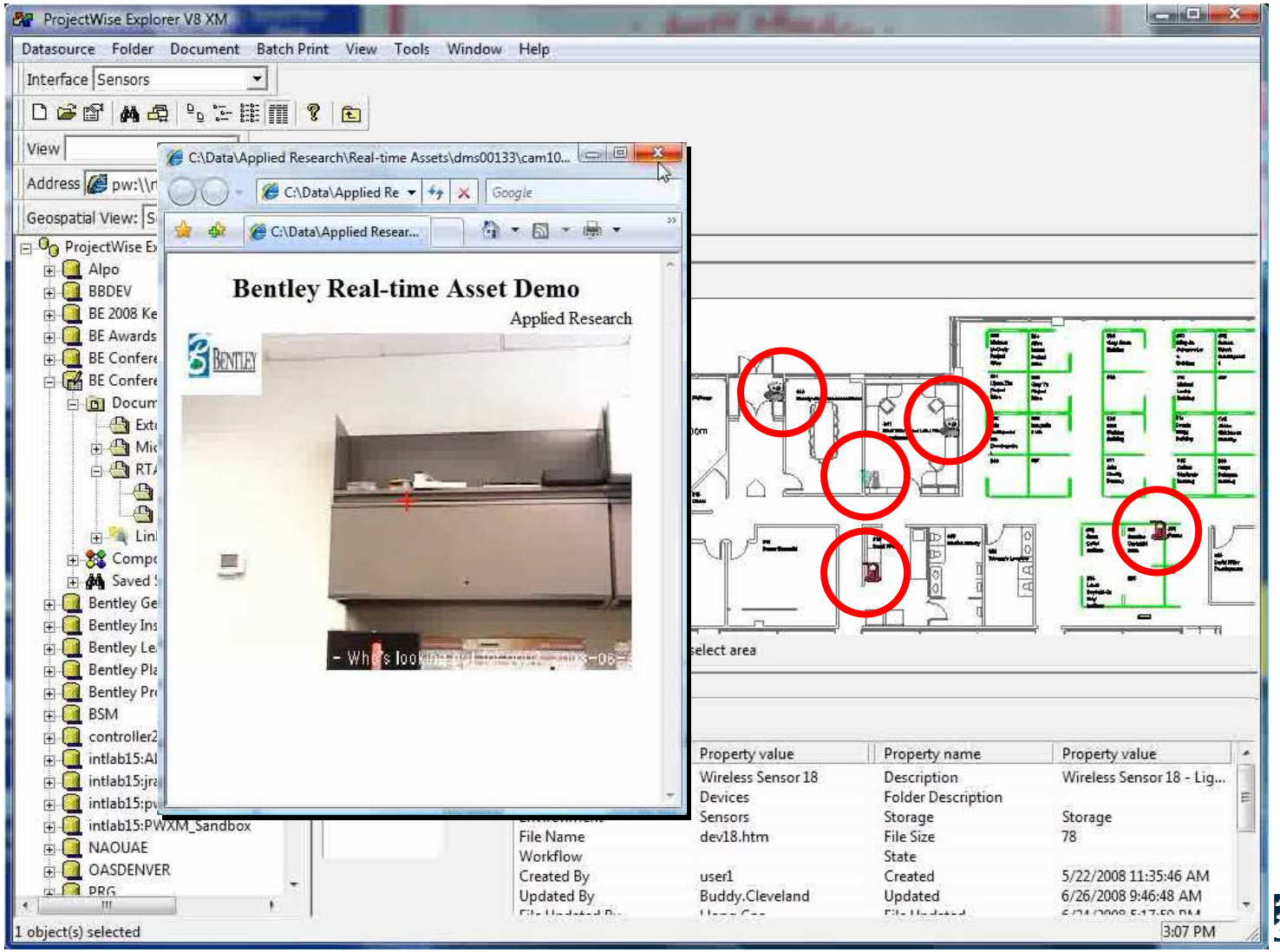
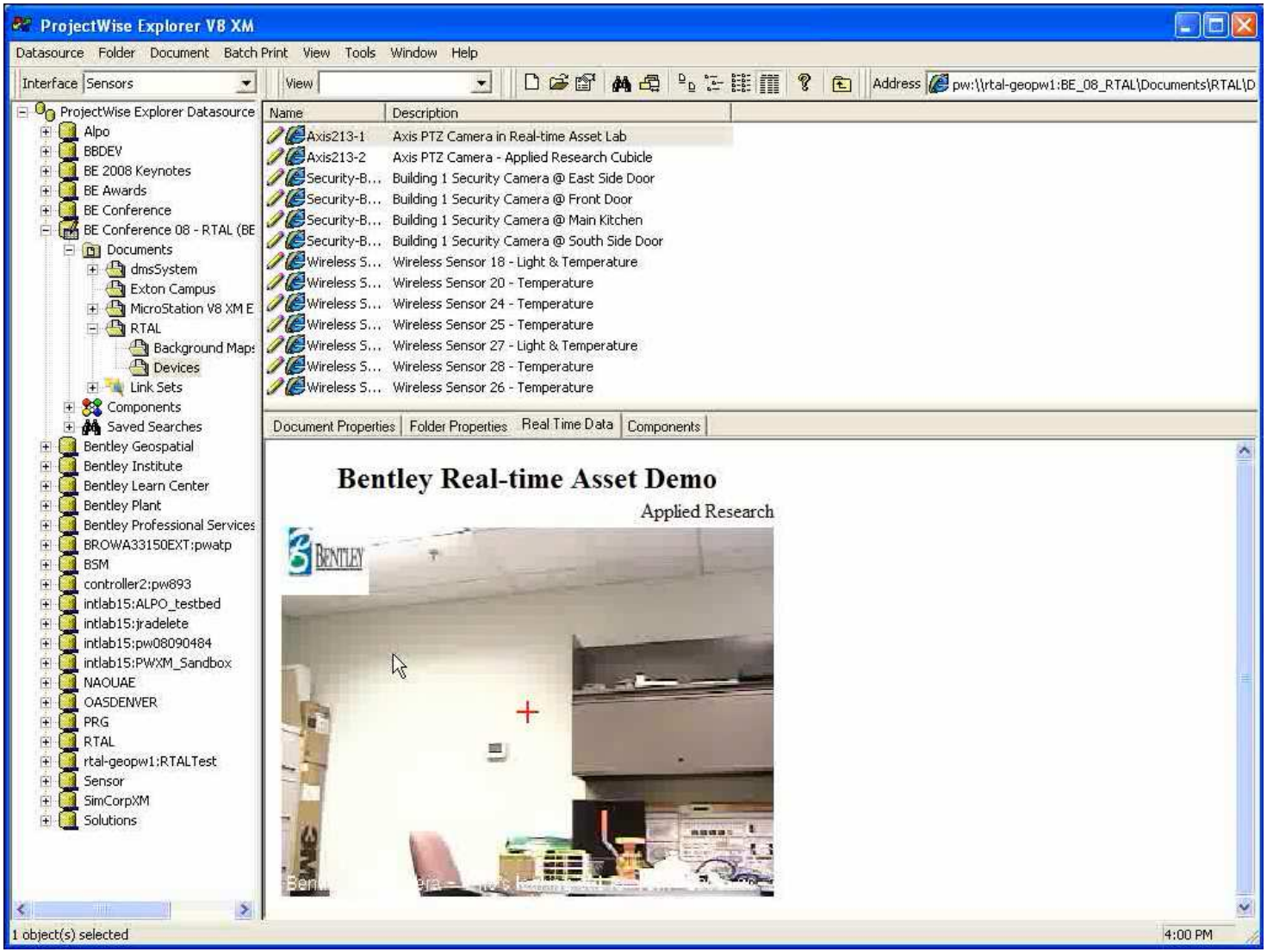
Real-time Asset Project

- Implementation
  - Interfaces to real-time devices managed within ProjectWise
    - Geospatially located
    - Preview within ProjectWise Explorer client
  - Application integration (e.g., MicroStation, ProjectWise Navigator) through:
    - Link Set through Project Explorer
    - Engineering Link based on URL to ProjectWise Web Server
  - Configurable interface to react to device state (e.g., alarm conditions)
    - Trigger alarms
    - Message stakeholders
    - Change interactive display (e.g., green to red)

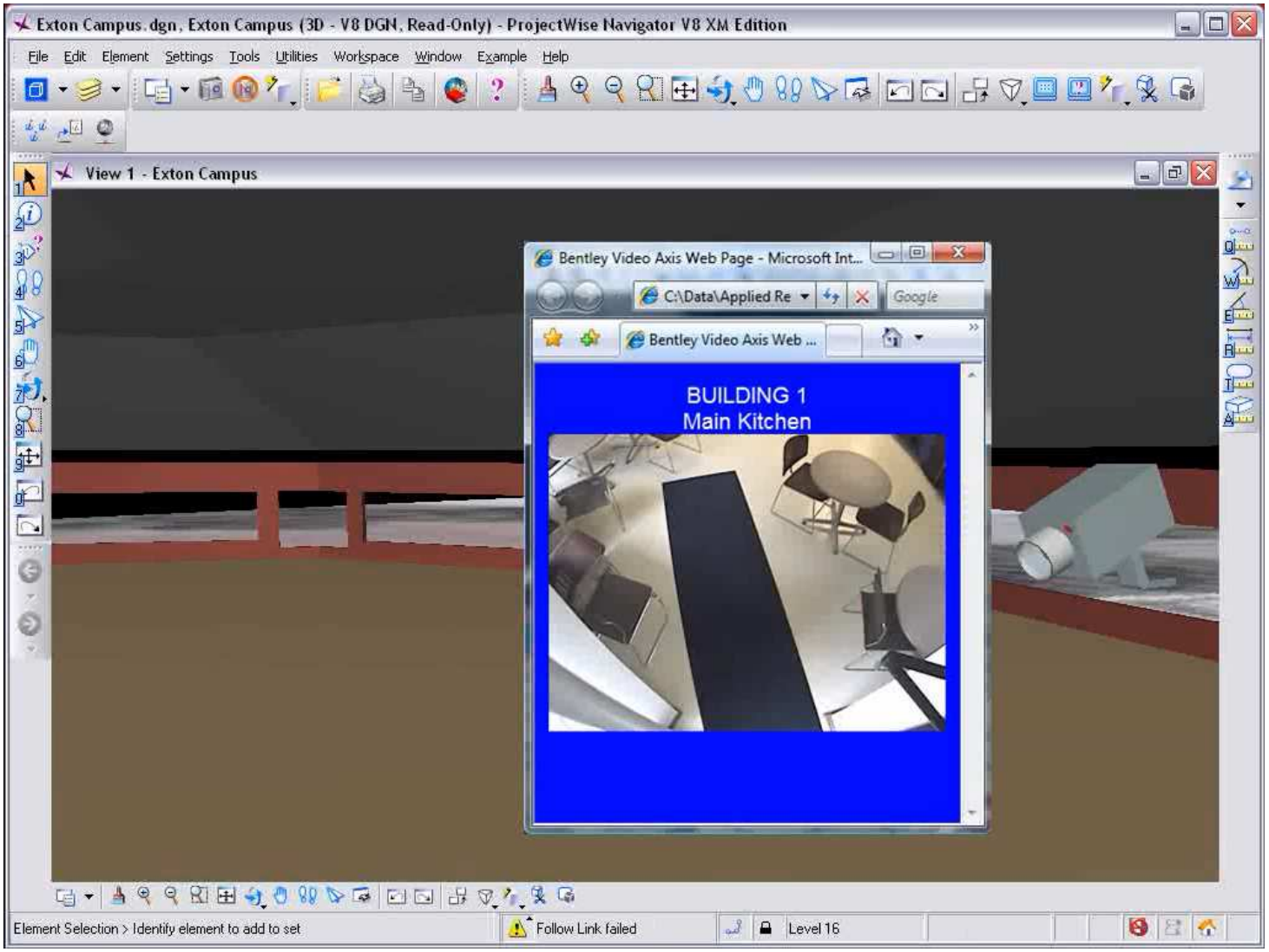
Real-time Asset Project - 01 ProjectWise RTAL Geospatial.wmv



Real-time Asset Project - 02 ProjectWise RTAL Preview Pane.wmv



Real-time Asset Project - 03 Navigator RTAL.wmv



...or even PDF

Real-time Asset Project

- This project is not intended to:
  - Duplicate or replace the functionality of specific real-time systems, e.g., security systems, process control systems, HVAC control systems, etc.
  - Be a platform for single purpose, specific device systems.
  - Provide "middleware" for communicating with real-time devices.
- This project is intended to:
  - Integrate multiple, disparate real-time systems into a holistic environment
    - To provide an integrated view into the infrastructure asset;
    - Integrate with engineering content; and
    - Enable other applications to easily display real-time information in the context of their functionality.

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Real-time Asset Project

- Summary
  - Storing and managing devices in ProjectWise is complete
    - GeoSpatial location
    - Real-time preview
  - Linking other applications to the devices managed by ProjectWise is demonstrated
  - Next steps:
    - The number and type of devices the current prototype supports is being dramatically expanded
    - Implementation of prototype for reacting to state changes and alarm conditions is under development

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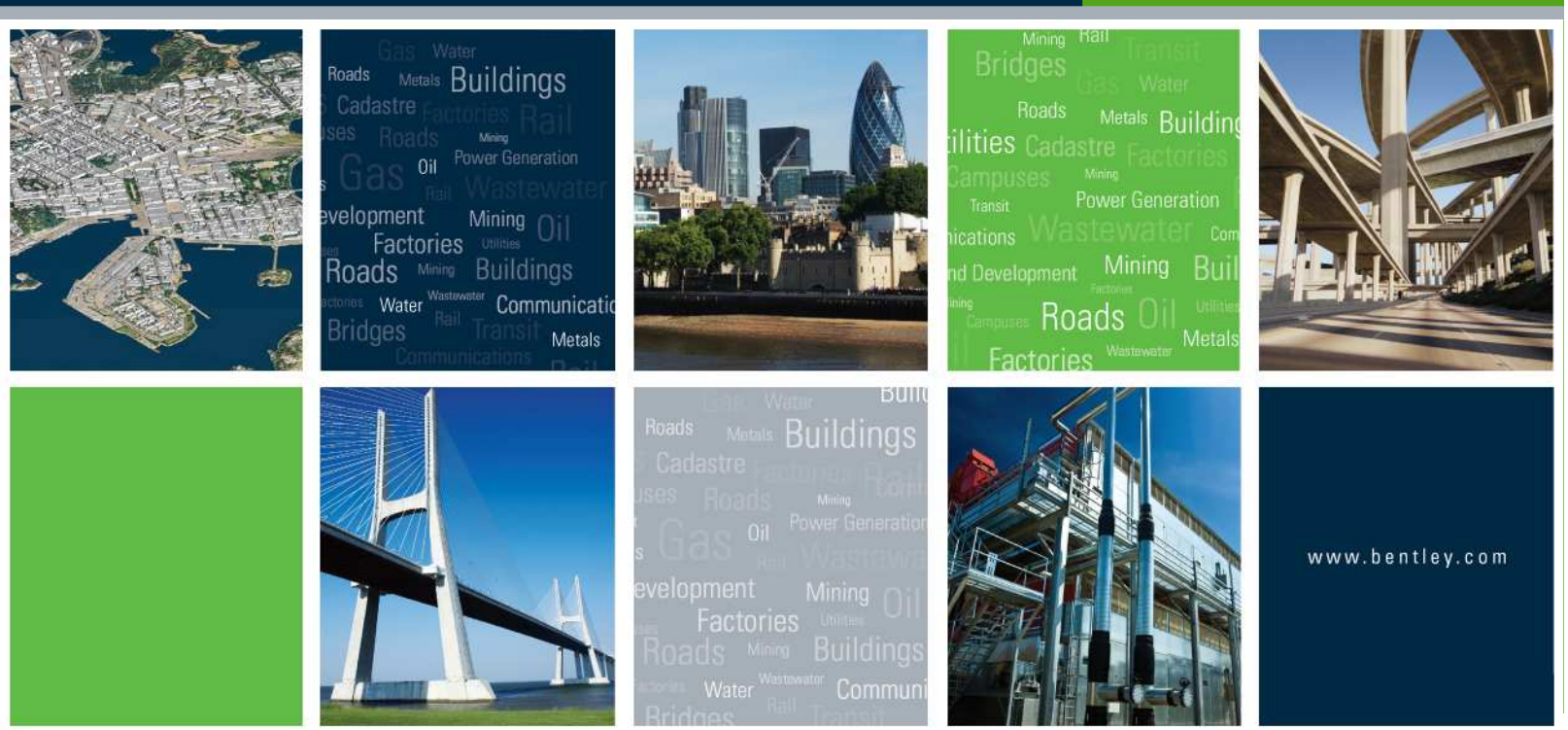

Augmented Reality and other field visualization techniques in construction

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Field Visualization

- 3D models on job site
  - Applications
    - Construction Planning
    - Field Training
    - Validating field operations

Field Visualization

- Visualization environment
  - Indoor location like a temporary construction office
  - Traditional computing equipment used
  - Drawings and other project data accessed here
  - Fixed locations encumber data use

Field Visualization

- Mobile visualization
  - Objective
    - Access data from where you are
  - Issues
    - Expense and portability of mobile equipment
    - Poor wireless service at jobsite
  - Innovations
    - More affordable and powerful mobile computing devices
    - Tablet PCs, UltraMobile PCs, Windows Mobile
    - Improved wireless access

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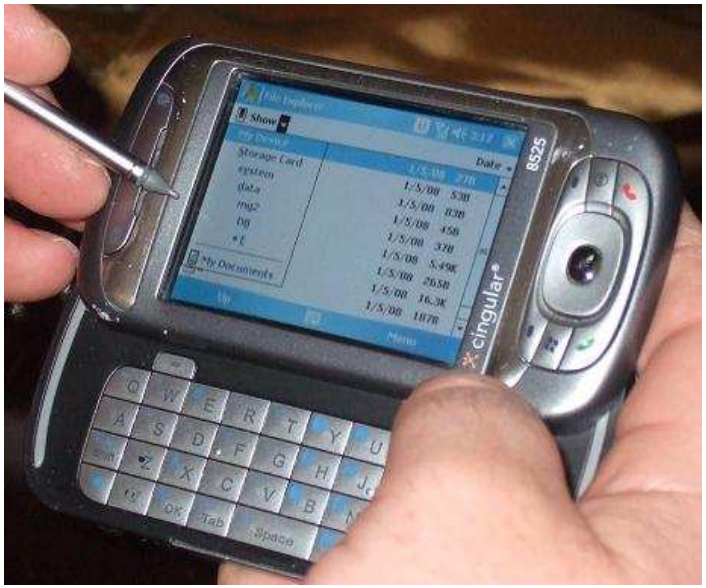
Field Visualization

- New Issues emerge with mobile computing
  - Small display
  - Mouse is replaced by touch screen
  - Miniaturized keyboard

Field Visualization

- Mobile devices use traditional Windows User Interface
- Information navigated via miniature tree views & forms
  - Require both hands
  - Awkward for 3D navigation!



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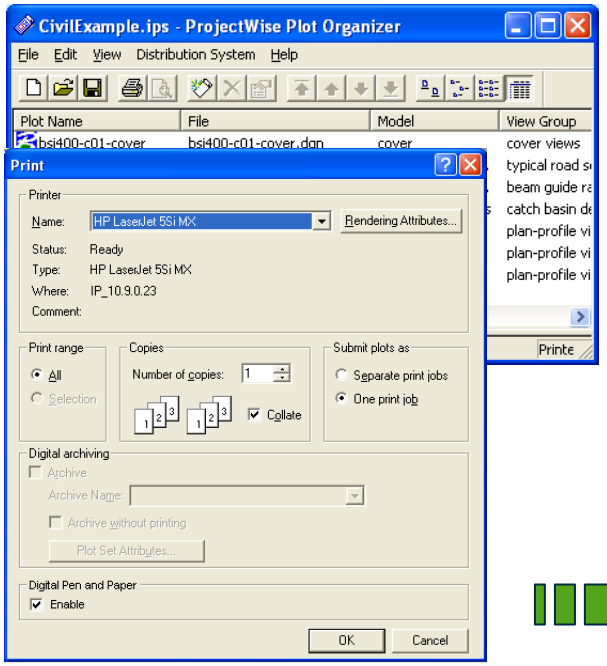
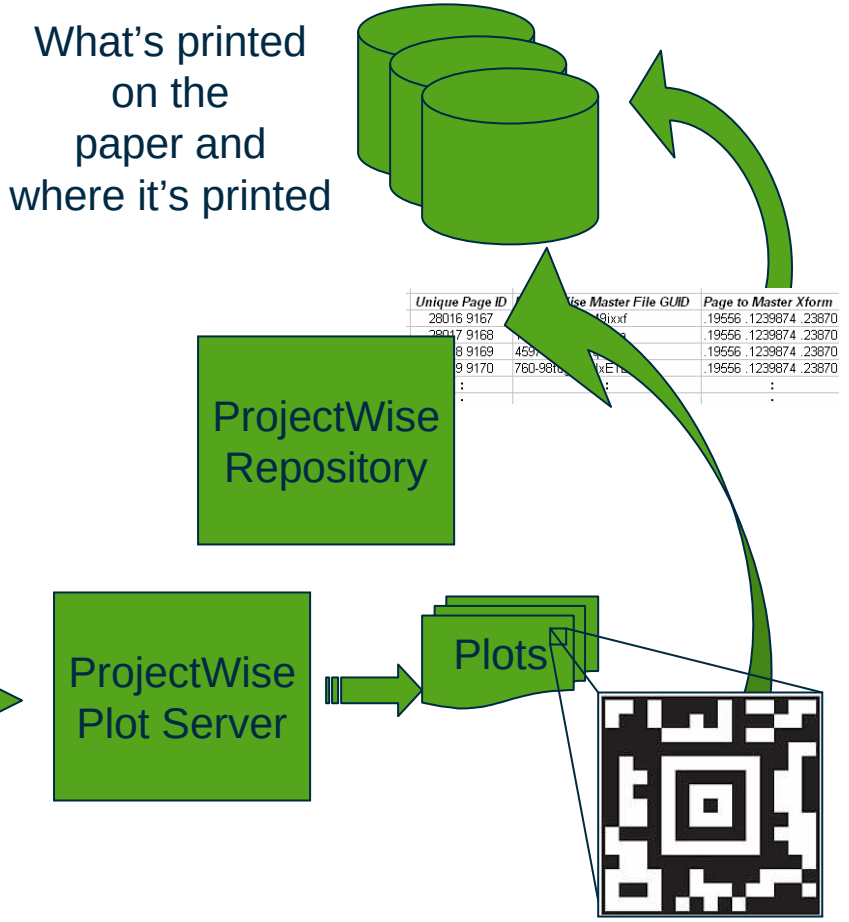
- Adapting a small device user interface for AEC
  - Objectives
    - Maximize screen area use
    - Minimize touch screen use
    - Eliminate keyboard use
  - Approach
    - Model user interface after a phone's camera application
    - Use paper documents already in use on job site to query information system

Printed Page Enables Information Query





Mobile Visualization Framework

ProjectWise Database

Unique Page ID	ProjectWise Master File GUID	Page to Master Xform
28016 9167	14314794543-49ixxf	.19556 .1239874 .23870
28017 9168	13436[5i6pou45ixxa	.19556 .1239874 .23870
28018 9169	459744uorijfd;qtras;f	.19556 .1239874 .23870
28019 9170	760-98tuggjvz;lxETB	.19556 .1239874 .23870
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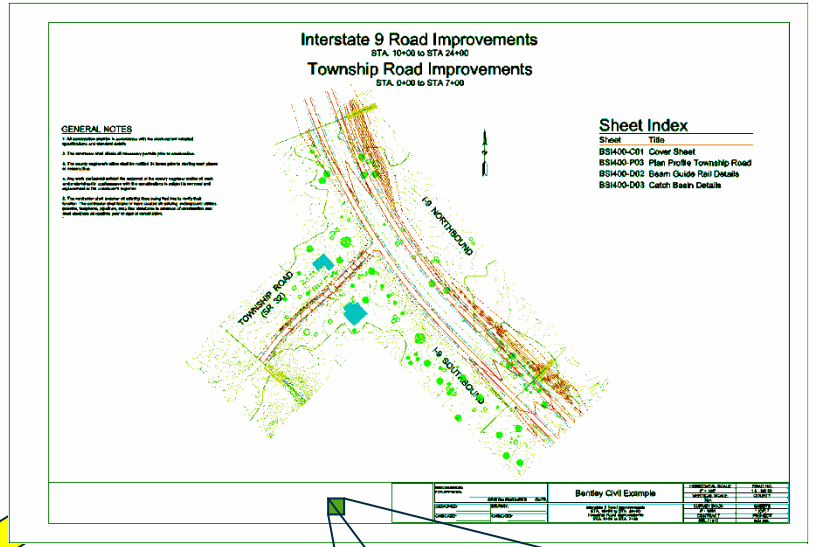
ProjectWise Server



- Digital Plot ID
- Models, Drawings, Properties
- Photos, Audio and other simple annotations

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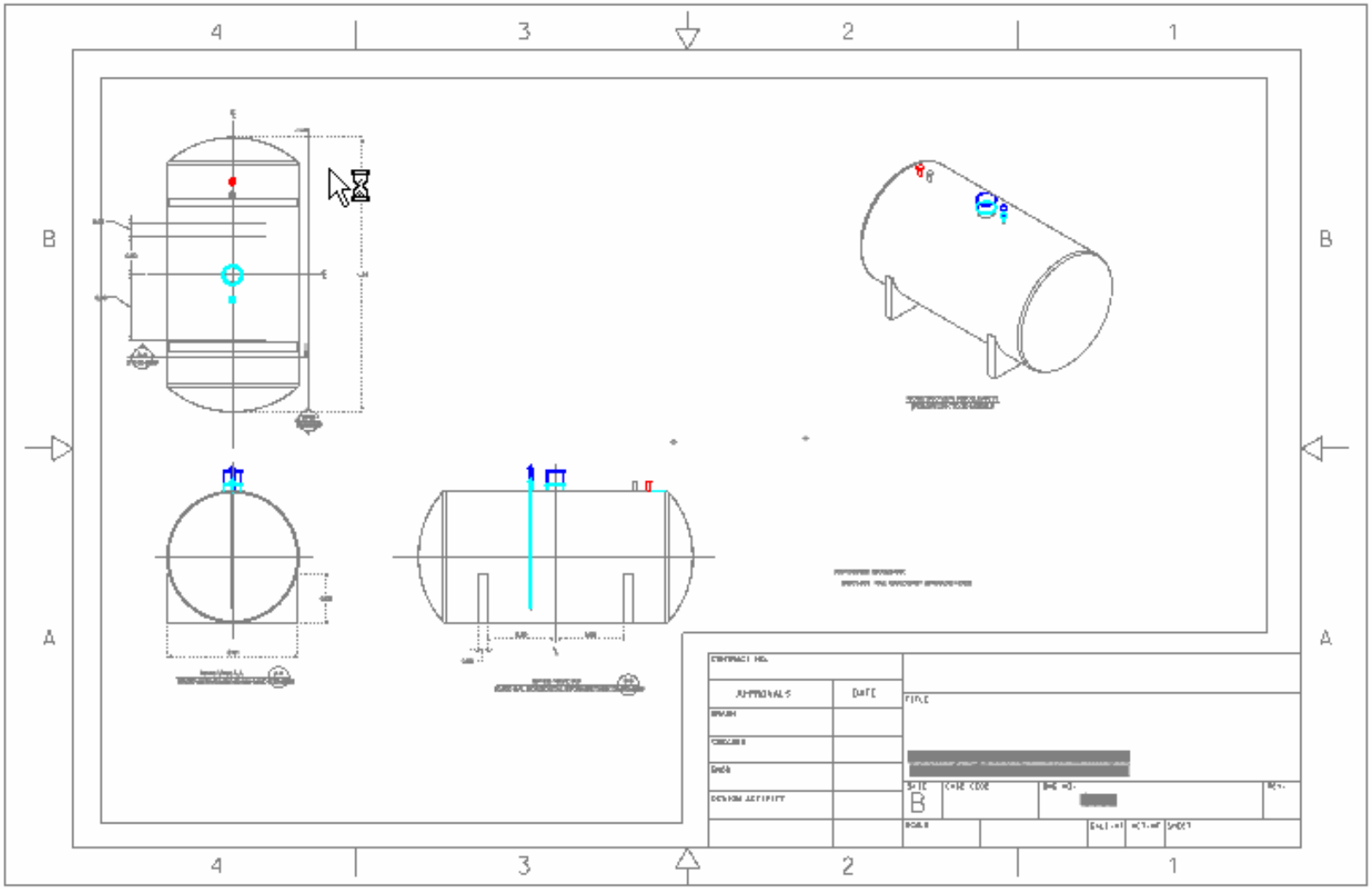
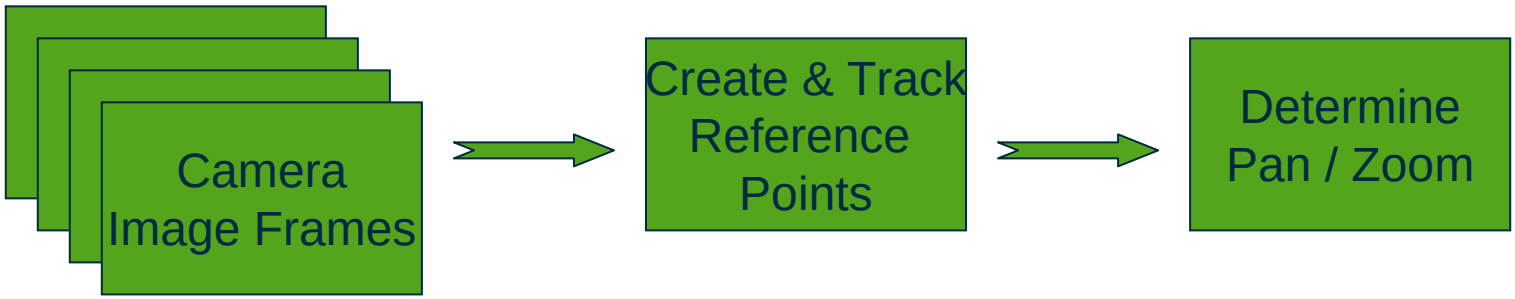
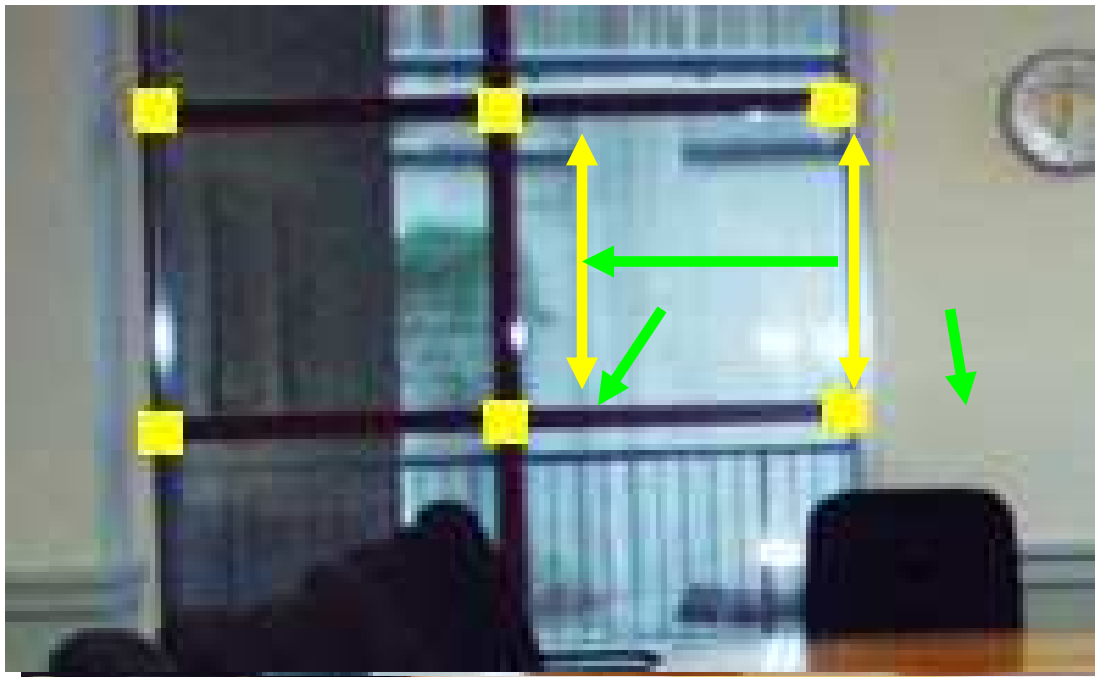
Provenance



Air Mouse

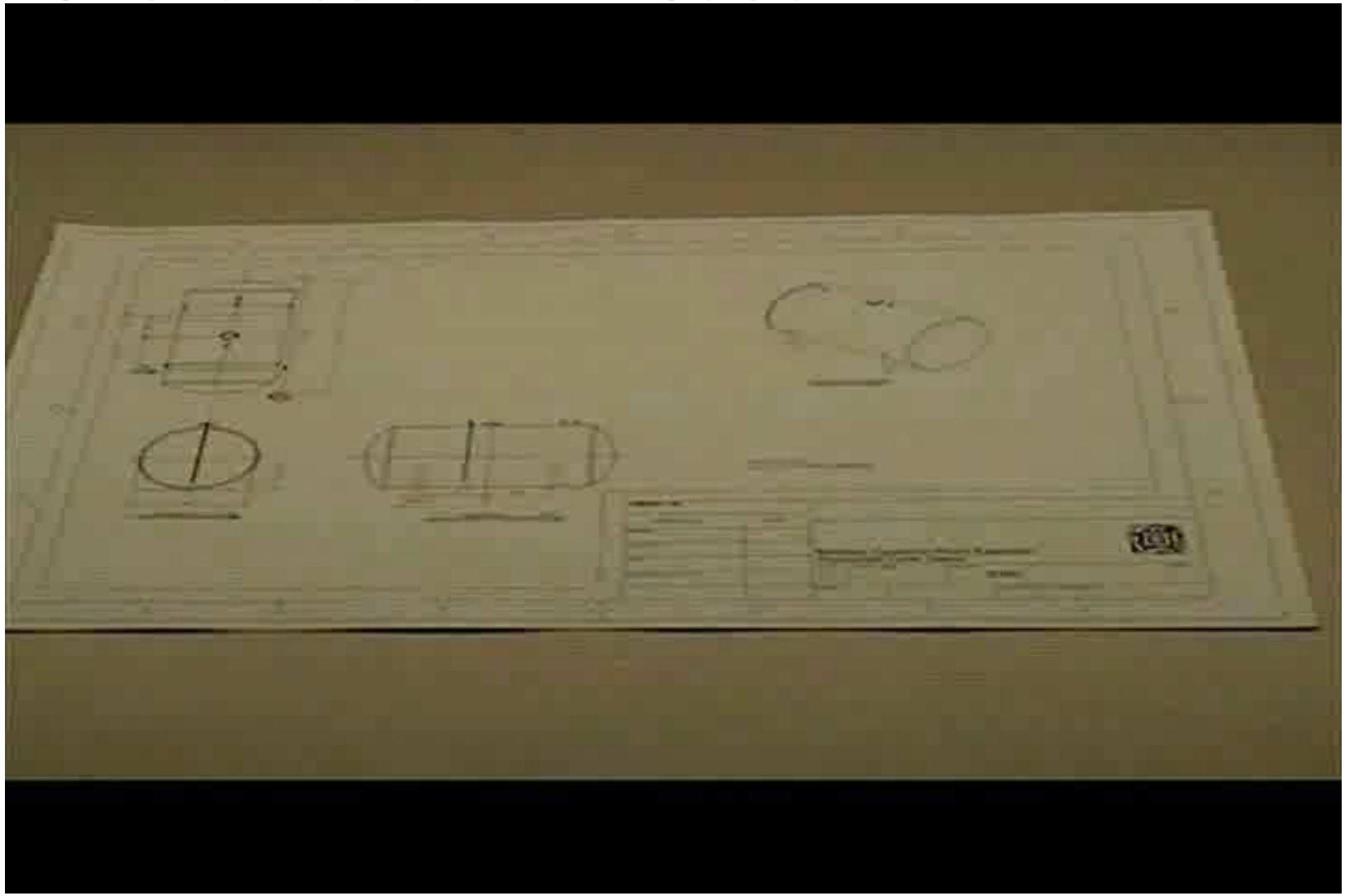




Zoom

Pan

Provenance & Air Mouse



Augmented Reality Model Navigation

- Synchronized superposition of real with synthetic images

Augmented Reality Model Navigation

- Synchronized superposition of real with synthetic images

Augmented Reality Model Navigation

- Synchronized superposition of real with synthetic images

Augmented Reality Model Navigation

- Visualization of sub-surface infrastructure

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Augmented Reality Model Navigation

- Viewing model in real-world setting

Augmented Reality Model Navigation

- How can that be achieved?
  - Portable device equipped with camera, 3D graphics
  - Real time image-model synchronization
    - Real-time observer's position
    - Real-time observer's orientation
    - High precision
  - Not easy

Augmented Reality Model Navigation

ProjectWise Database

Unique Page ID	ProjectWise Master File GUID	Page to Master Xform
28016 9167	14314794543-49ixxf	.19556 .1239874 .23870
28017 9168	13436[5i6pou45ixxa	.19556 .1239874 .23870
28018 9169	459744uorijfd;qtras;f	.19556 .1239874 .23870
28019 9170	760-98tuggjvz;lxETB	.19556 .1239874 .23870
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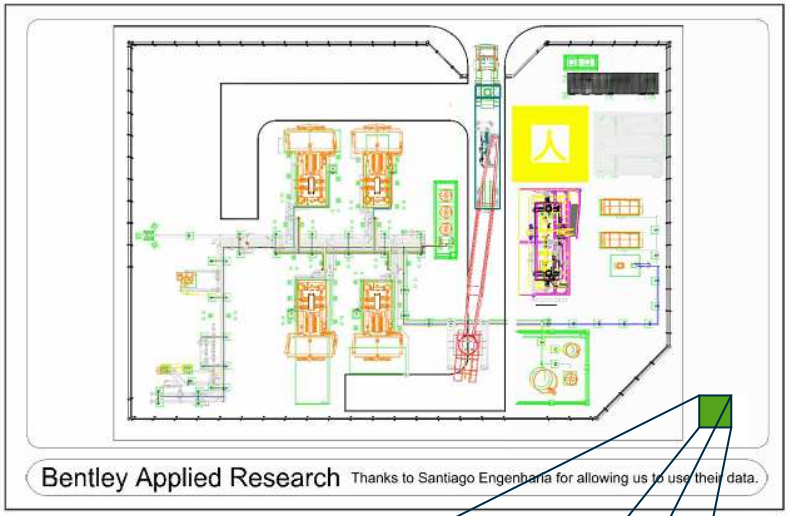
ProjectWise Server

Model, volume, levels…



Digital Plot ID

Model and view information

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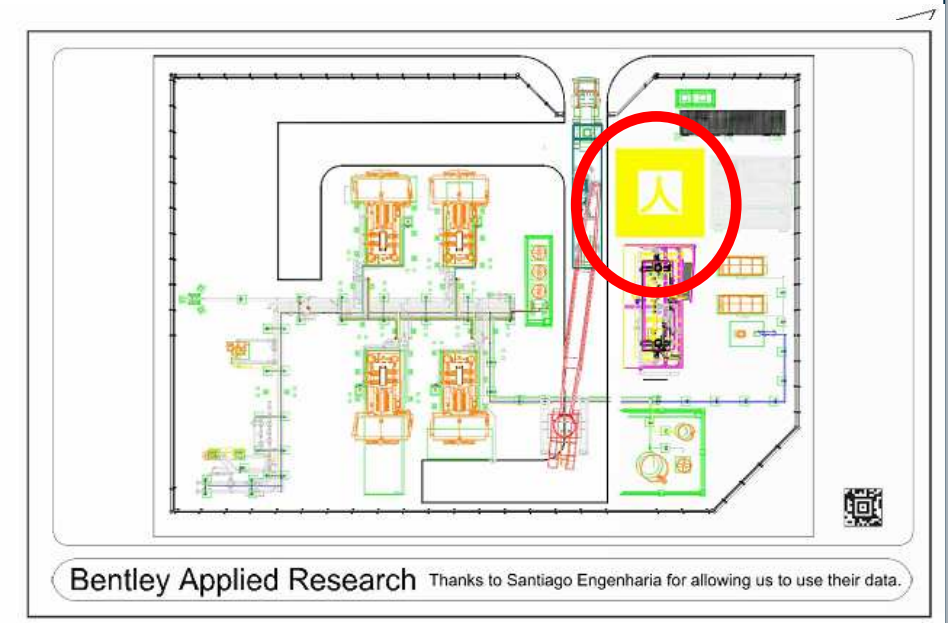
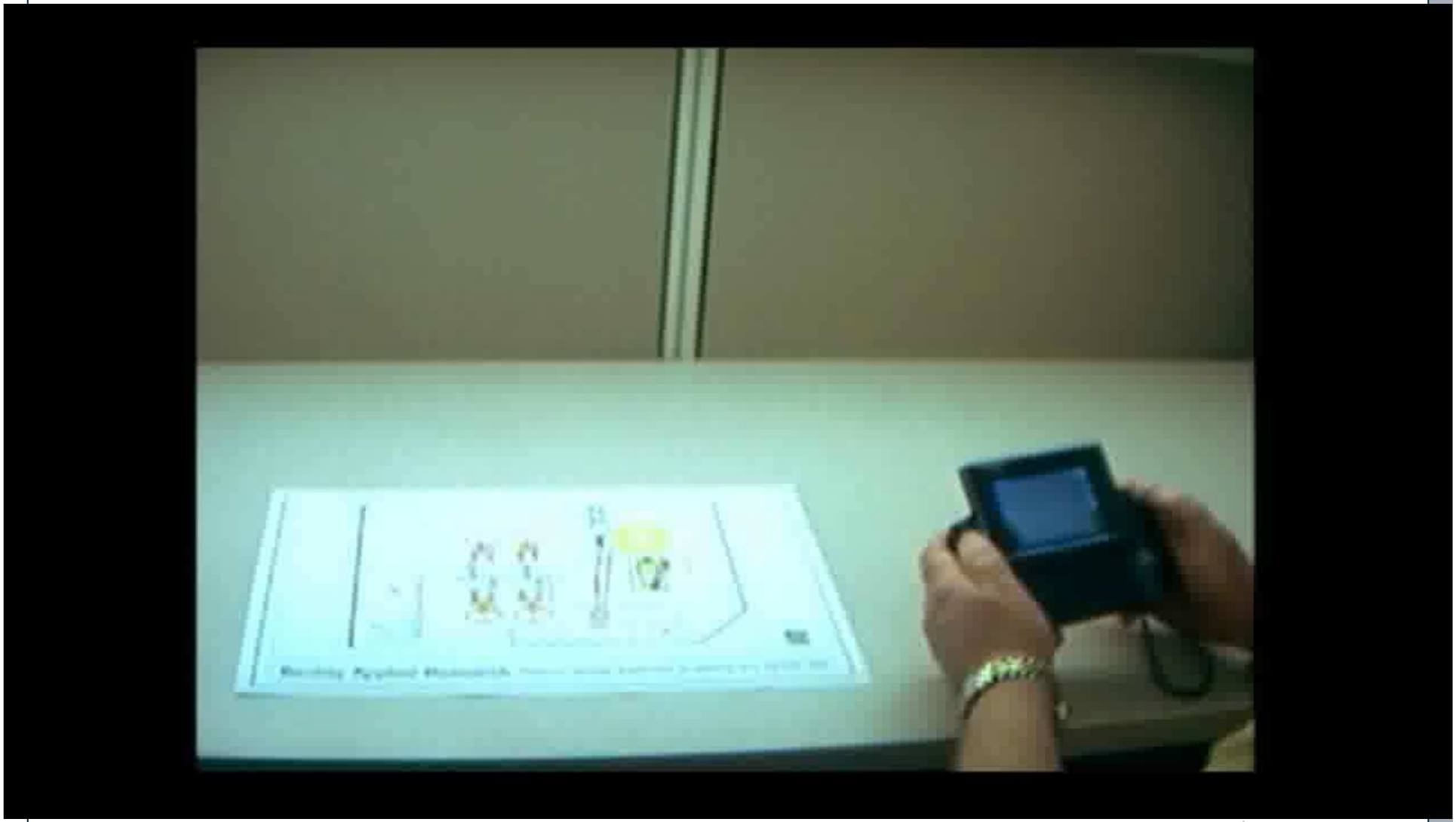
Augmented Reality Model Navigation

- Application finds mark
- Calculates position of camera with respect to mark
- Using information saved by ProjectWise Plotting, camera's position with respect to model is calculated
- Moving camera navigates model



Augmented Reality Model



Location-aware 3D visualization

- Objective
  - Enable 3D model visualization on the field
  - Based on location
  - Run on small devices
  - Avoid complex 3D user interface

Location-aware 3D visualization

- Approach
  - Position
    - GPS
    - Fixed (clicking on model)
  - Orientation/Bearing
    - Compass
    - Orientation sensor

Location-aware 3D visualization

- Applications
  - Construction site monitoring
    - Differences As Built vs. As Designed
    - Delays in construction process

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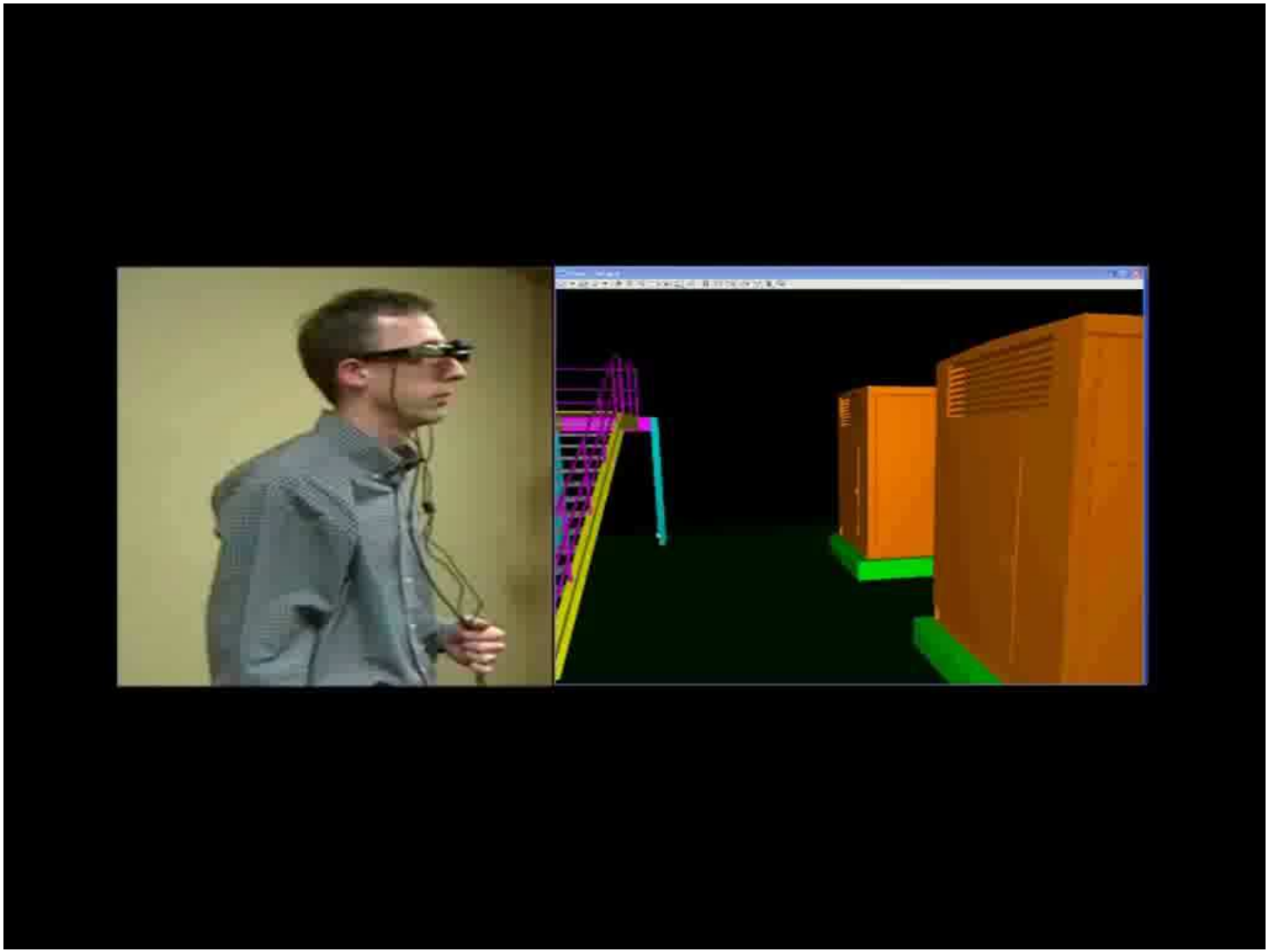
Location-aware 3D visualization

Location-aware 3D visualization

- Applications
  - Inside out visualization

Location-aware 3D visualization

Location-aware 3D visualization



Questions?

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