Building Information Modeling to Facilities Information Management and Beyond

Meghan Ruffo, Thomas Koltoniak, & Geoffrey Coon

Carolinas HealthCare System

Class summary

Carolinas HealthCare System will review the strategic implementation of Building Information Modeling from project inception to facilities management. The owner team will then explore the benefits of project processes, such as multi-team member collaboration, virtual coordination, and owner BIM standards that help minimize project risk. The owner team will also describe their use of BIM during facilities management, which includes space management, asset management, and virtual documentation. Carolinas HealthCare System will conclude with the BIM program lessons learned and return on investment of their BIM to FIM (Facilities Information Management) implementation.

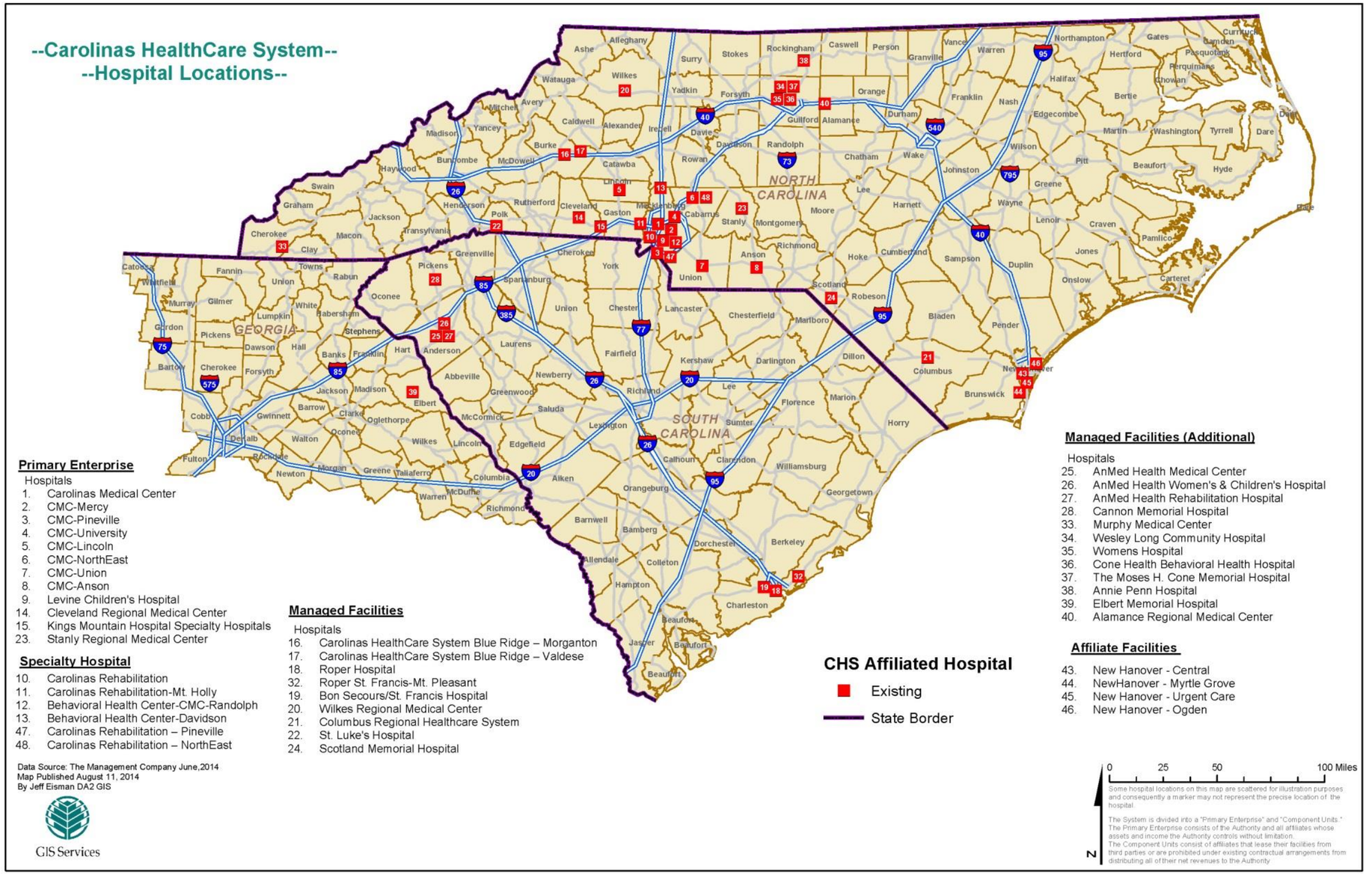
Key learning objectives

At the end of this class, you will be able to:

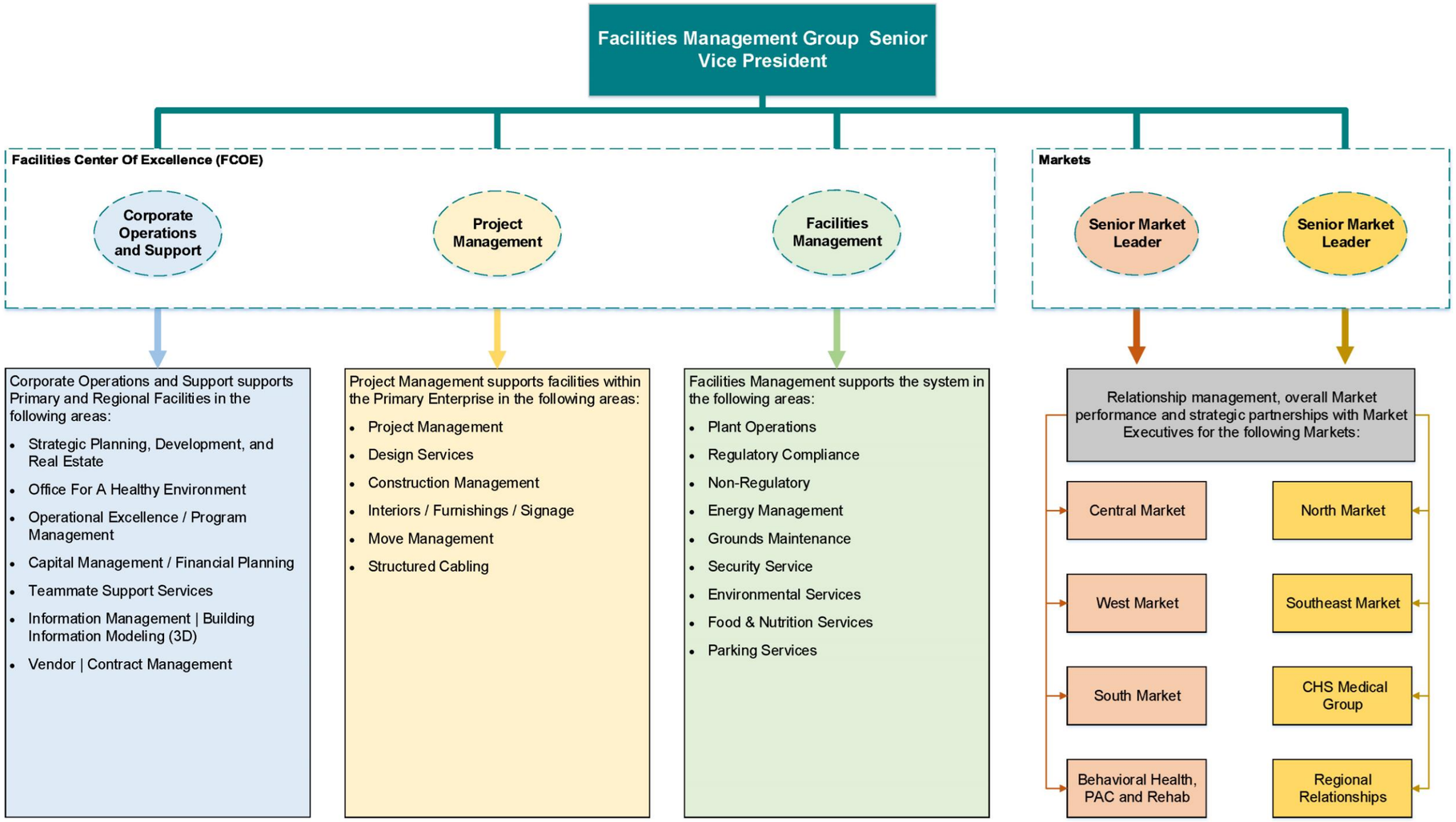
- Understand the need for owner BIM contract requirements and the resources needed to assist with compliance
- Understand the use of virtual coordination to minimize rework and shorten planned downtime
- Understand use of virtual documentation for regulatory compliance
- Understand the program ROI and cost avoidance in utilizing BIM for FIM

Carolinas HealthCare System Overview

Carolinas HealthCare System



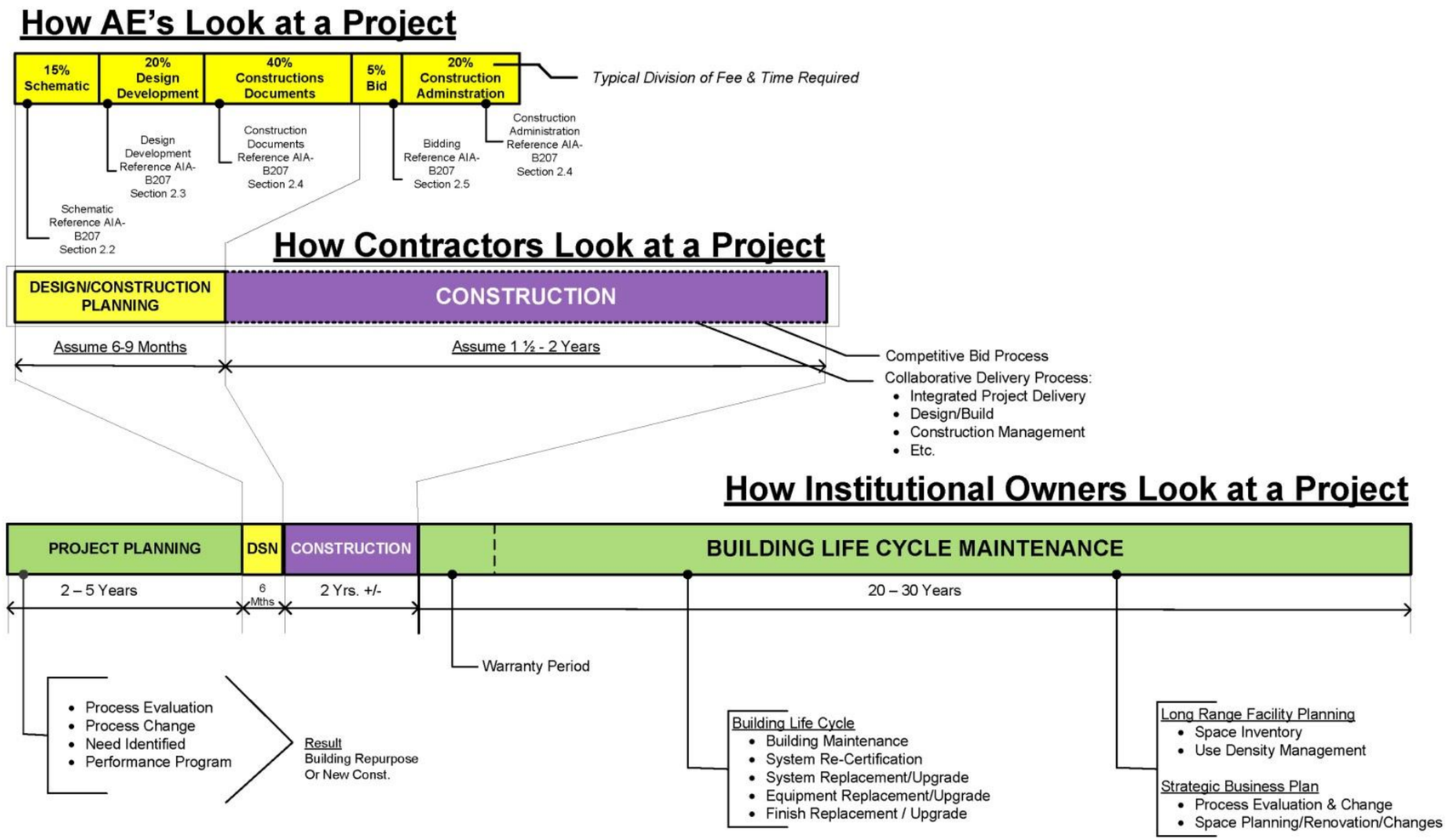
Carolinas HealthCare System



The Value of BIM for Owners

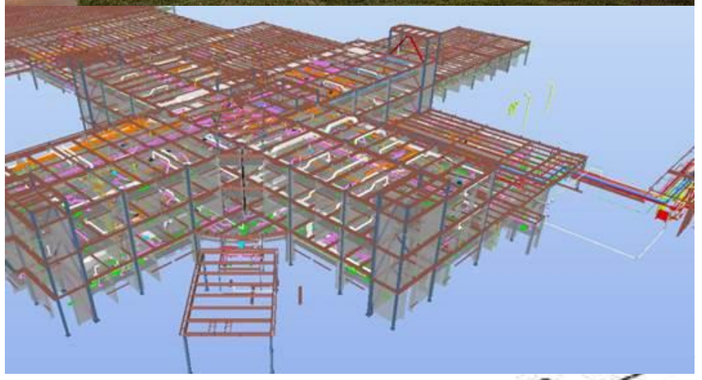
MECKLENBURG COUNTY CodeEnforcement

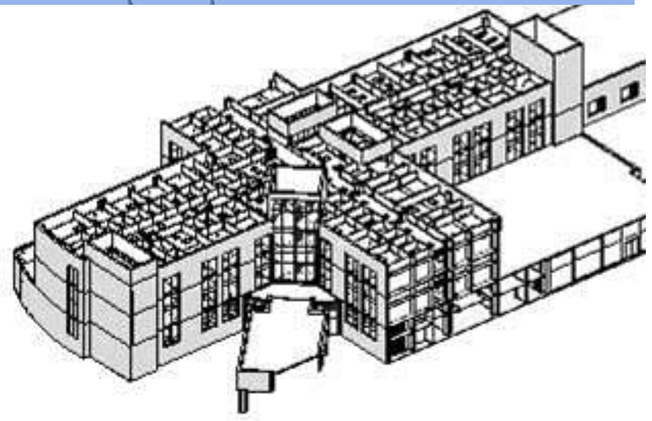
Different Perspectives on
BUILDING DESIGN / CONSTRUCTION
June 25, 2013



Pilot Project

- 2009 CMC-Lincoln Hospital
  - Contractor Initiated
  - Used only for 3D Clash Detection & Coordination
- Savings Realized
  - Over $2 Million in Savings – through errors and omissions reductions
  - Opened 4 Months early





Contract Development and Compliance Verification

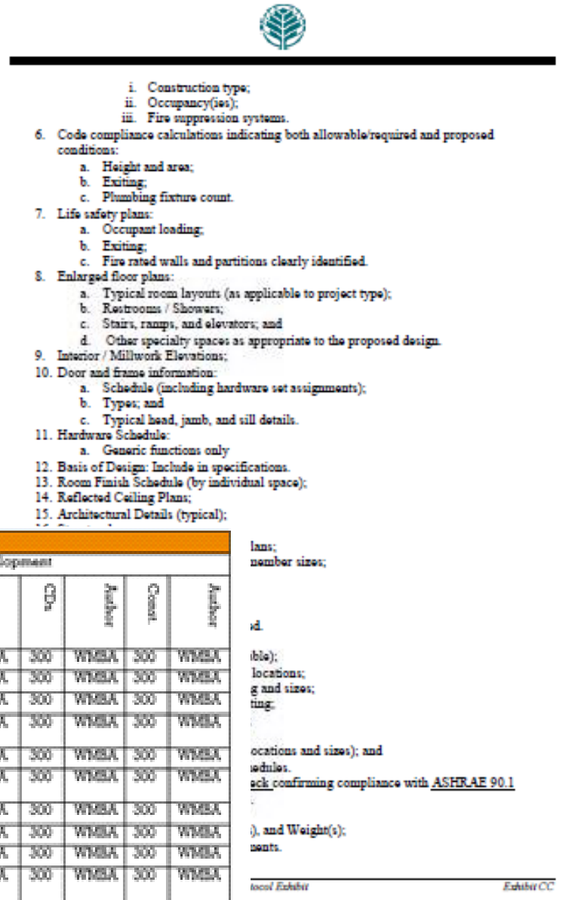
Contract Development

CHS BIM Requirements Development

- 2010 - Created guidelines & selected projects to pilot requirements
- 2011 - Continued guideline development and pilots
- 2012 - Contracts issued using modified AIA E202 with 3 sub-exhibits

Contract Sub Exhibits

- BIM Execution Plan
- Formatting Requirements
- Content Requirements



i. Construction type;
ii. Occupancy(ies);
iii. Fire suppression systems.

6. Code compliance calculations indicating both allowable/required and proposed conditions:
   a. Height and area;
   b. Exiting;
   c. Plumbing fixture count.
7. Life safety plans:
   a. Occupant loading;
   b. Exiting;
   c. Fire rated walls and partitions clearly identified.
8. Enlarged floor plans:
   a. Typical room layouts (as applicable to project type);
   b. Restrooms / Showers;
   c. Stairs, ramps, and elevators; and
   d. Other specialty spaces as appropriate to the proposed design.
9. Interior / Millwork Elevations;
10. Door and frame information:
    a. Schedule (including hardware set assignments);
    b. Types; and
    c. Typical head, jamb, and sill details.
11. Hardware Schedule:
    a. Generic functions only
12. Basis of Design: Include in specifications.
13. Room Finish Schedule (by individual space);
14. Reflected Ceiling Plans;
15. Architectural Details (typical);

lans;
number sizes;

d.

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locations;
g and sizes;
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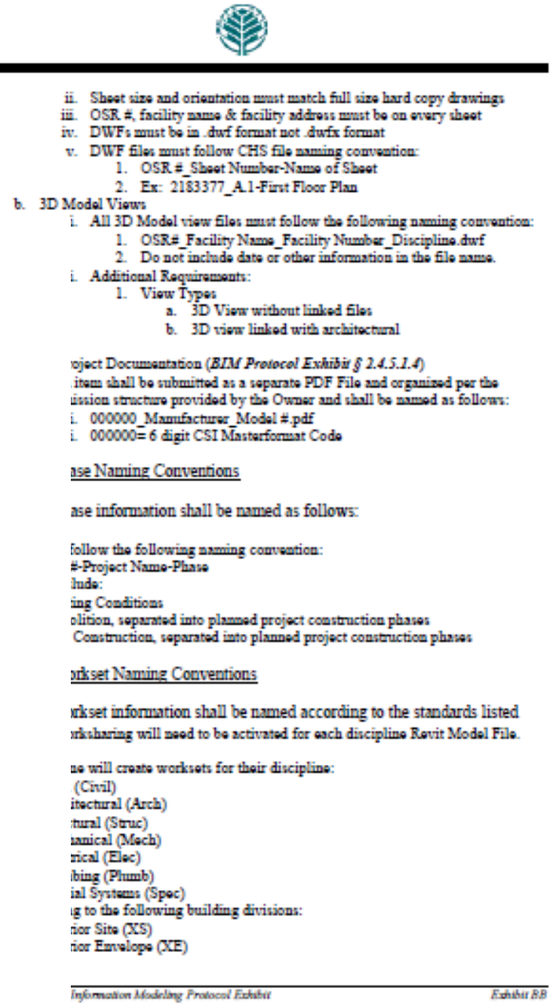
ocations and sizes); and
edules.
ack confirming compliance with ASHRAE 90.1

), and Weight(s);
ents.

tocol Exhibit *Exhibit CC*

ARCHITECTURAL			Level of Development					
Item	Details	CSI Uniformat #	DDs	Author	CDs	Author	Const.	Author
Exterior Wall Systems		B2010	300	WMBA	300	WMBA	300	WMBA
Interior Walls/ Partition Types		C1010	300	WMBA	300	WMBA	300	WMBA
Fire Rated Walls		C1010	300	WMBA	300	WMBA	300	WMBA
Equipment (Kitchen, Medical, Other)		E1040	300	WMBA	300	WMBA	300	WMBA
Ceilings		C1070	300	WMBA	300	WMBA	300	WMBA
Stairs/ Elevators/ Escalators	Vendor Drawings for Elevators will be provided.	B1080	300	WMBA	300	WMBA	300	WMBA
Doors and Door Frames		C1030	300	WMBA	300	WMBA	300	WMBA
Windows, Glazing, and Curtain Wall		B2020	300	WMBA	300	WMBA	300	WMBA
Millwork and Casework		E2010	300	WMBA	300	WMBA	300	WMBA
Roofing	Insulation, sloping, access, and details will be provided by WMBA.	B1020	300	WMBA	300	WMBA	300	WMBA
Furniture	WMBA Interiors	E2010	300	WMBA	300	WMBA	300	WMBA
Soft Goods	WMBA Interiors	E2020	300	WMBA	300	WMBA	300	WMBA
Artwork	WMBA Interiors	E2020	300	WMBA	300	WMBA	300	WMBA
Finishes	WMBA Interiors	C2010	300	WMBA	300	WMBA	300	WMBA
Ceiling Finishes		C2010	300	WMBA	300	WMBA	300	WMBA



ii. Sheet size and orientation must match full size hard copy drawings
iii. OSR #, facility name & facility address must be on every sheet
iv. DWFs must be in .dwf format not .dwfx format
v. DWF files must follow CHS file naming convention:
   1. OSR #_Sheet Number-Name of Sheet
   2. Ex: 2183377_A.1-First Floor Plan

b. 3D Model Views
   i. All 3D Model view files must follow the following naming convention:
      1. OSR#_Facility Name_Facility Number_Discipline.dwf
      2. Do not include date or other information in the file name.
   i. Additional Requirements:
      1. View Types
         a. 3D View without linked files
         b. 3D view linked with architectural

oject Documentation (*BIM Protocol Exhibit § 2.4.5.1.4*)
item shall be submitted as a separate PDF File and organized per the
ission structure provided by the Owner and shall be named as follows:
i. 000000_Manufacturer_Model #.pdf
i. 000000= 6 digit CSI Masterformat Code

ase Naming Conventions

ase information shall be named as follows:

follow the following naming convention:
#-Project Name-Phase
lude:
ing Conditions
olition, separated into planned project construction phases
Construction, separated into planned project construction phases

orkset Naming Conventions

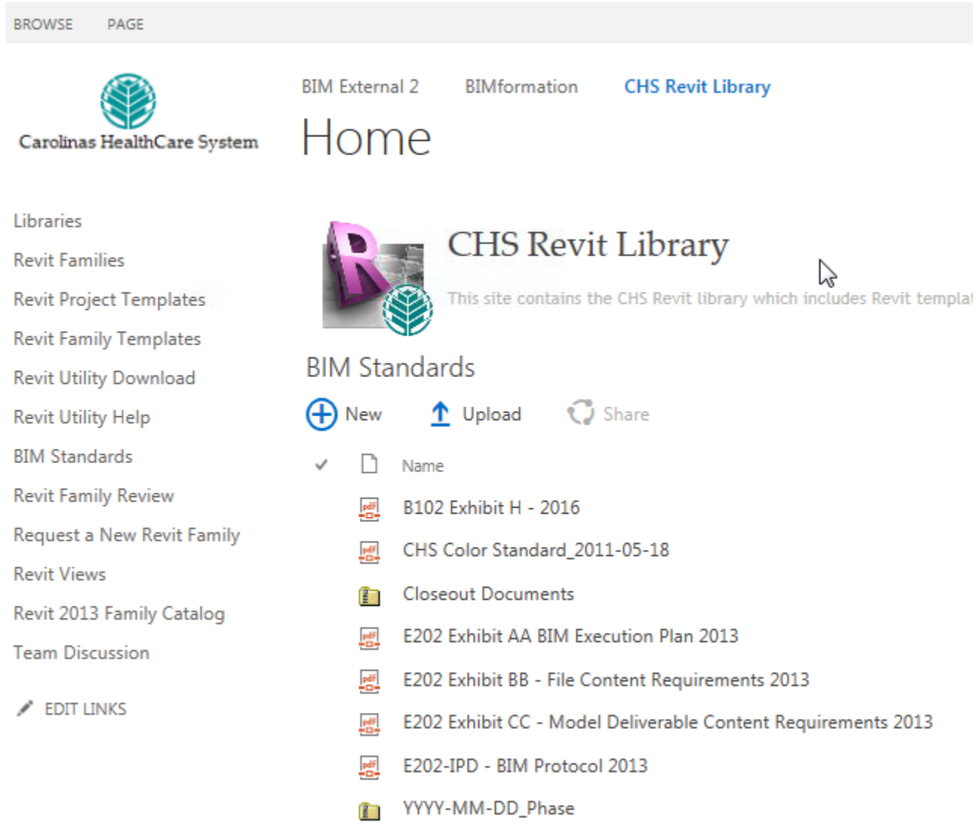
rkset information shall be named according to the standards listed
rksharing will need to be activated for each discipline Revit Model File.

ne will create worksets for their discipline:
(Civil)
itectural (Arch)
tural (Struc)
anical (Mech)
rical (Elec)
bing (Plumb)
ial Systems (Spec)
g to the following building divisions:
ior Site (XS)
ior Envelope (XE)

Information Modeling Protocol Exhibit *Exhibit BB*

Resources to Assist with Compliance

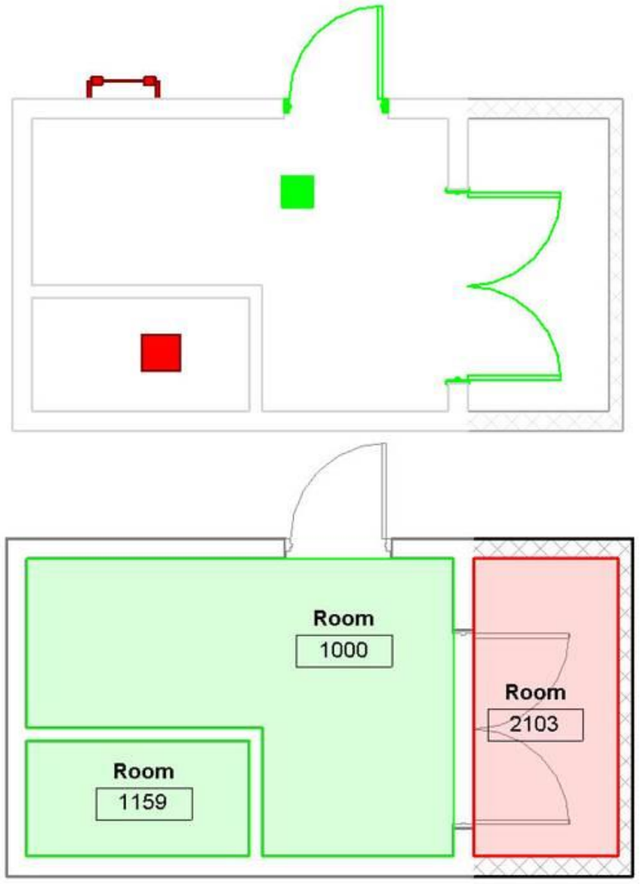
- Revit Templates
- Family Library
- Add-ins (CHS BIM Utilities)



Revit Templates

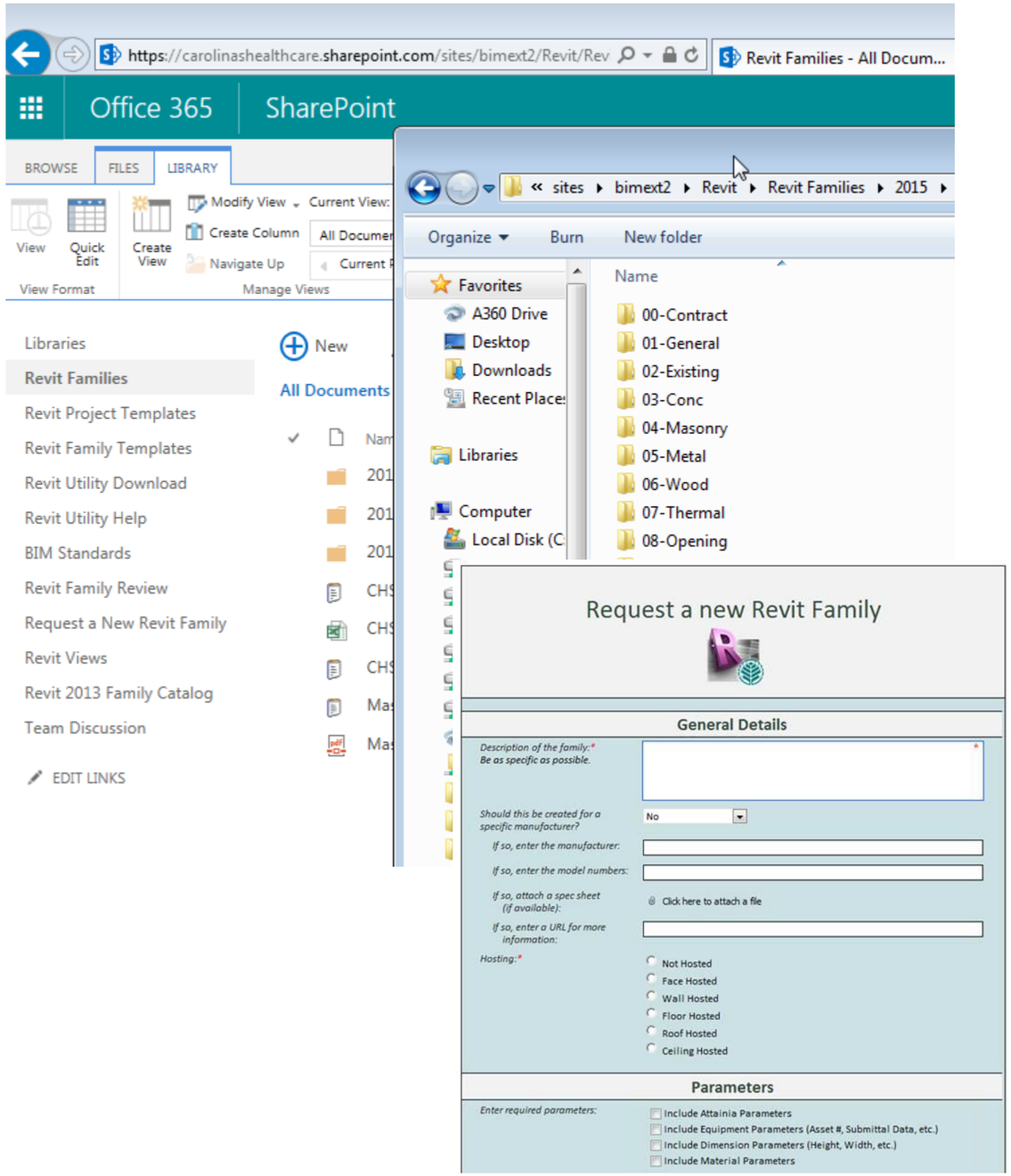
- Project Templates
  - Architectural, MEP, Structural
  - CHS Shared Parameter File
  - Review Template
    - Consultants use to visually review model prior to submission

- ***Consistent Formatting of Models***



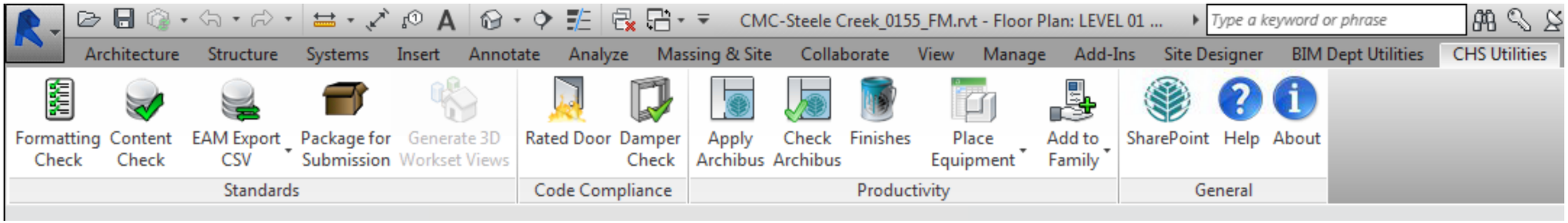
Revit Library

- 1000 Families and growing
- Named and formatted per CHS standards
- Updated regularly on CHS SharePoint Site
- Process to request new family creation

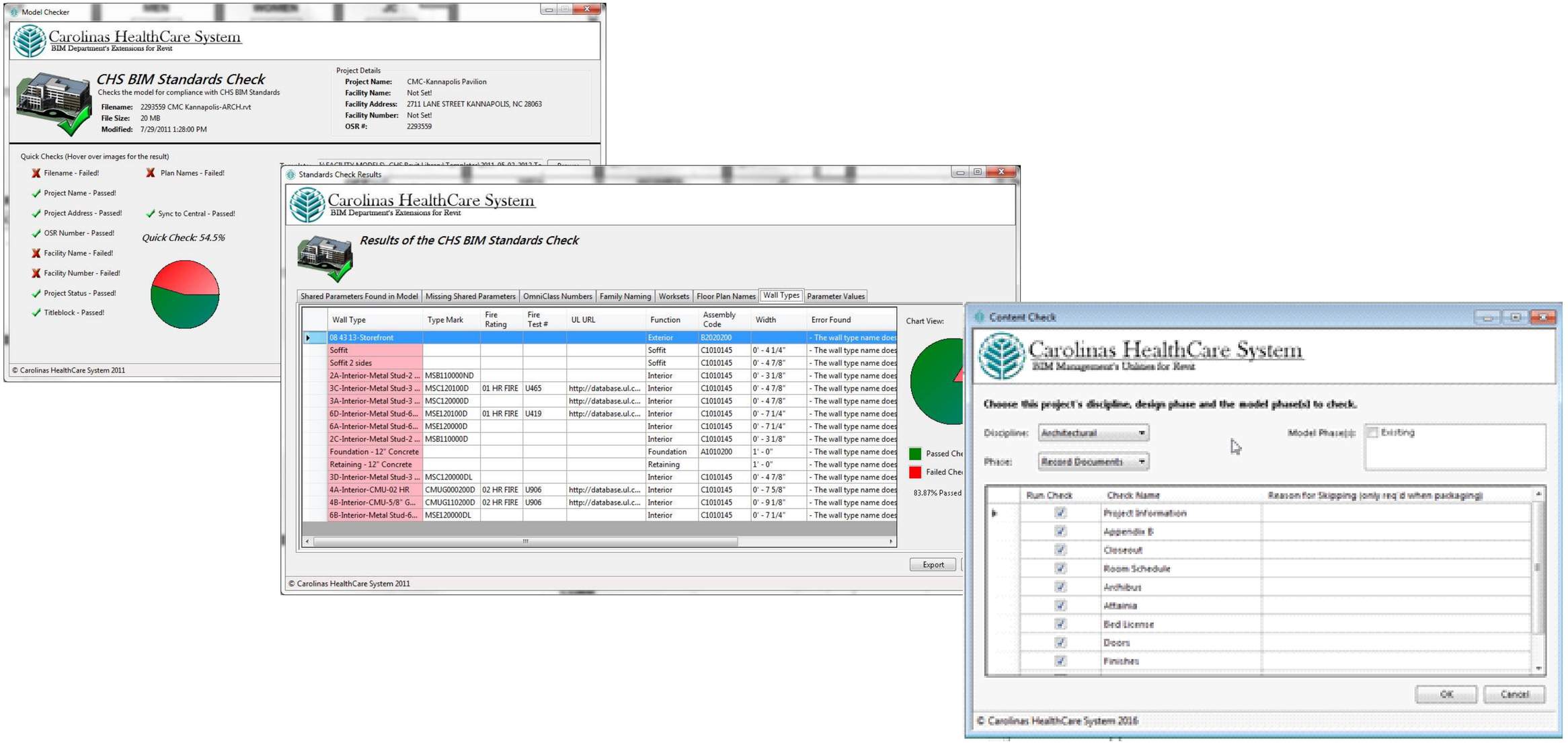


CHS BIM Utilities

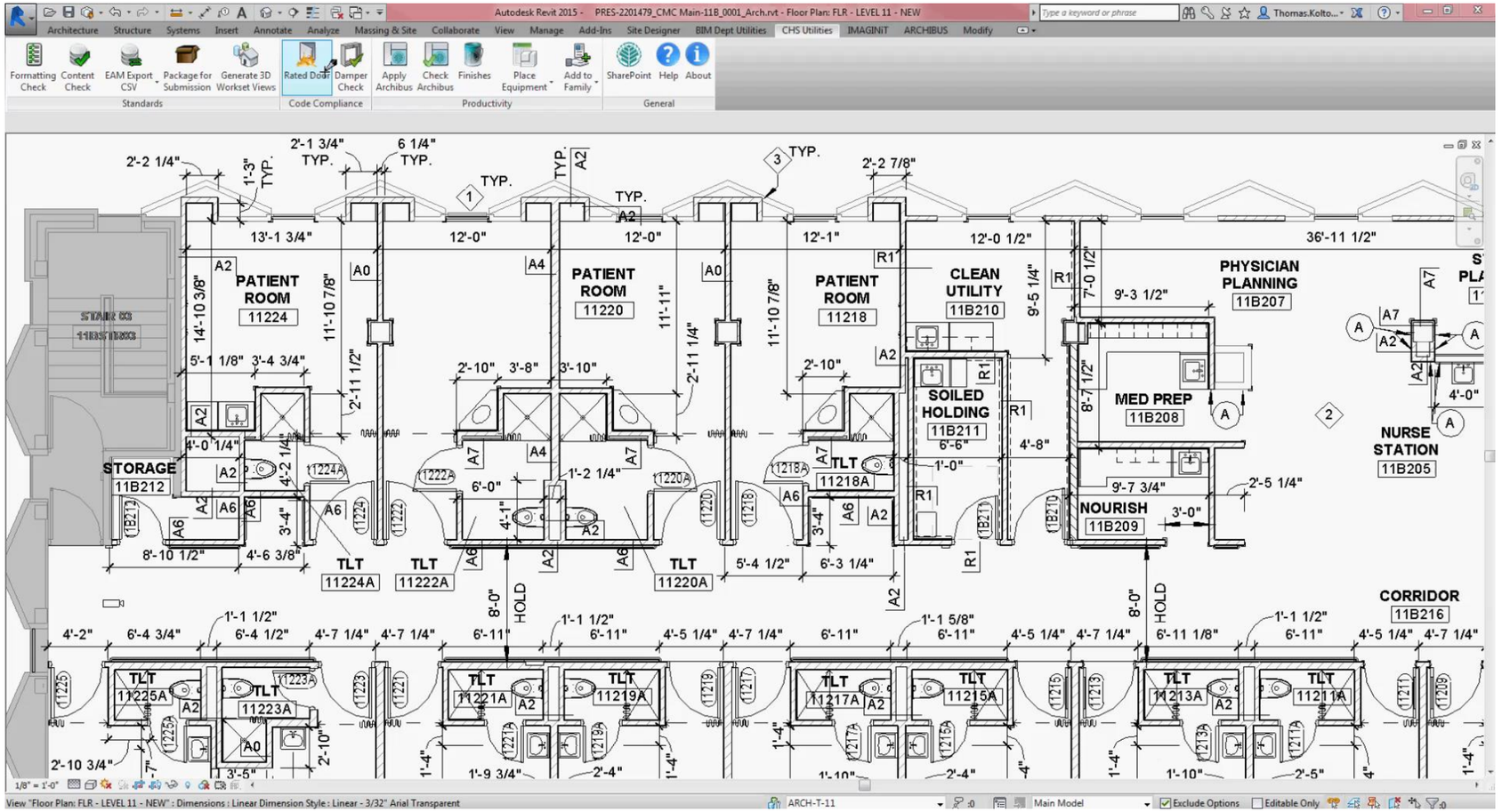
- Standards
  - Formatting Check, Content Check, EAM Export, & Package for Submission
- Code Compliance
  - Rated Door & Damper Check
- Productivity
  - Apply & Check Archibus, Finishes, Place Equipment, & CHS Parameter Add



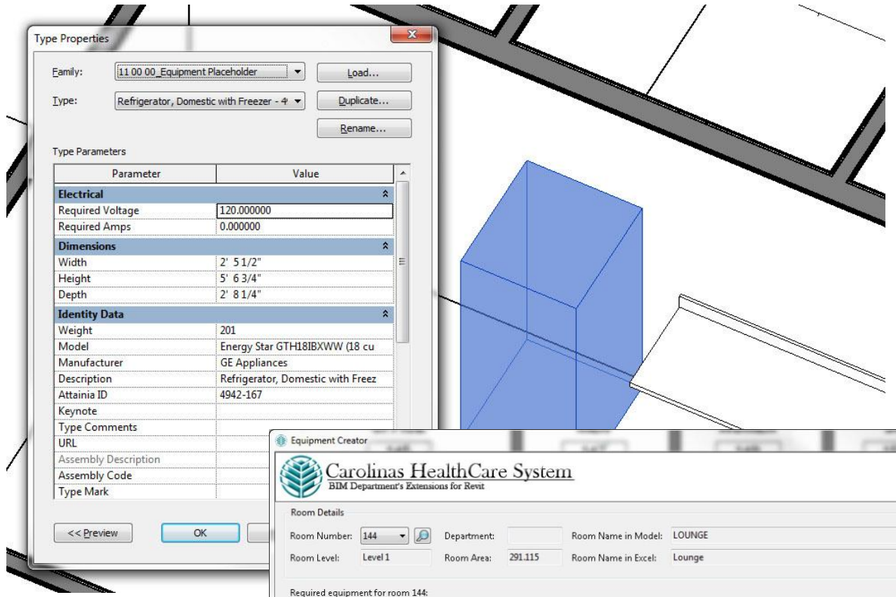
CHS BIM Utilities - Standards

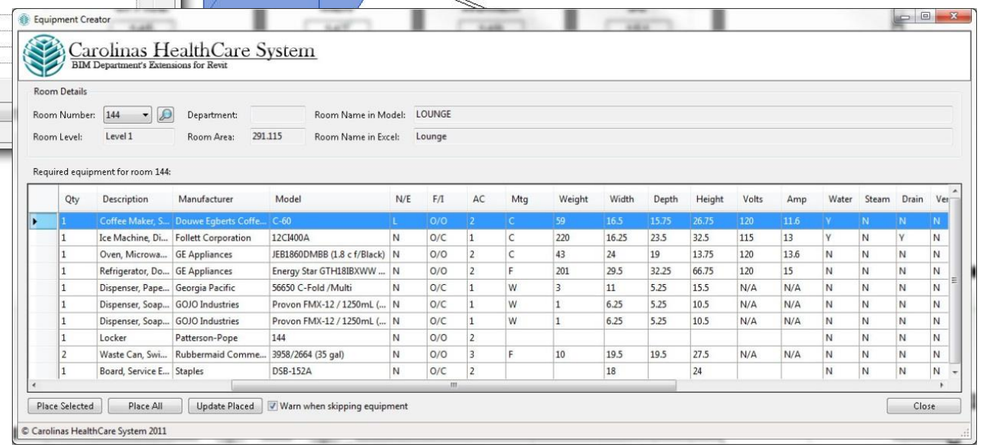


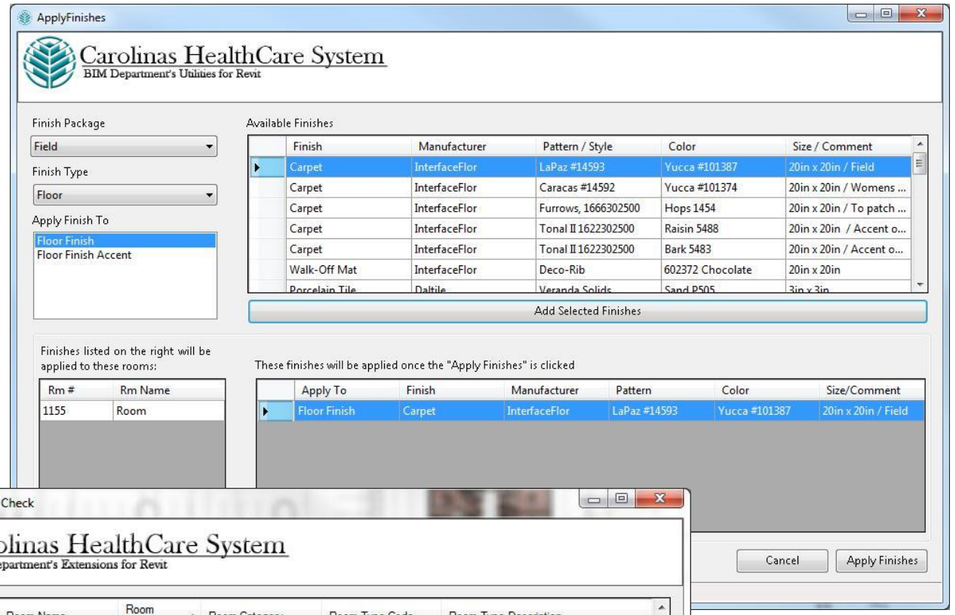
CHS BIM Utilities – Code Checks

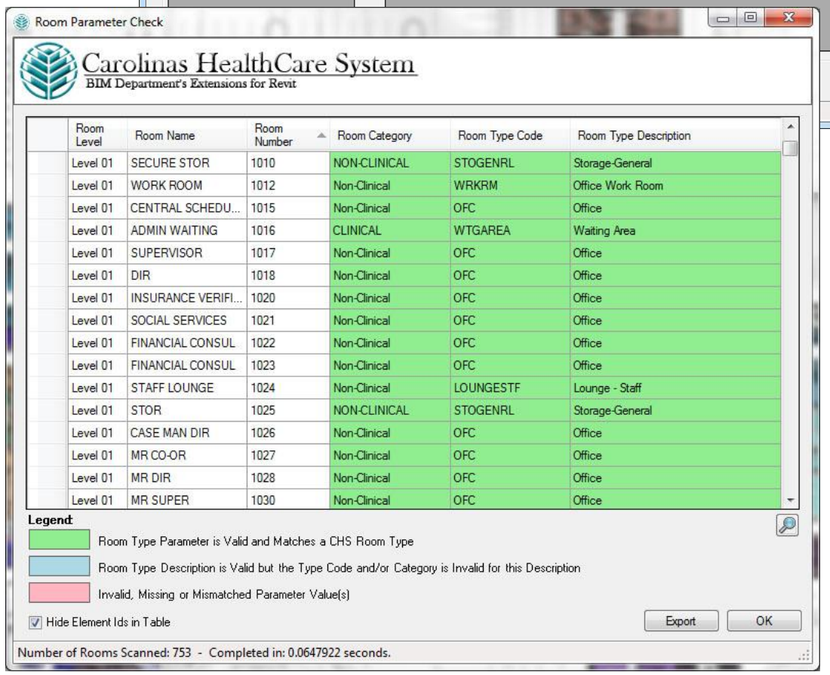


CHS BIM Utilities – Productivity

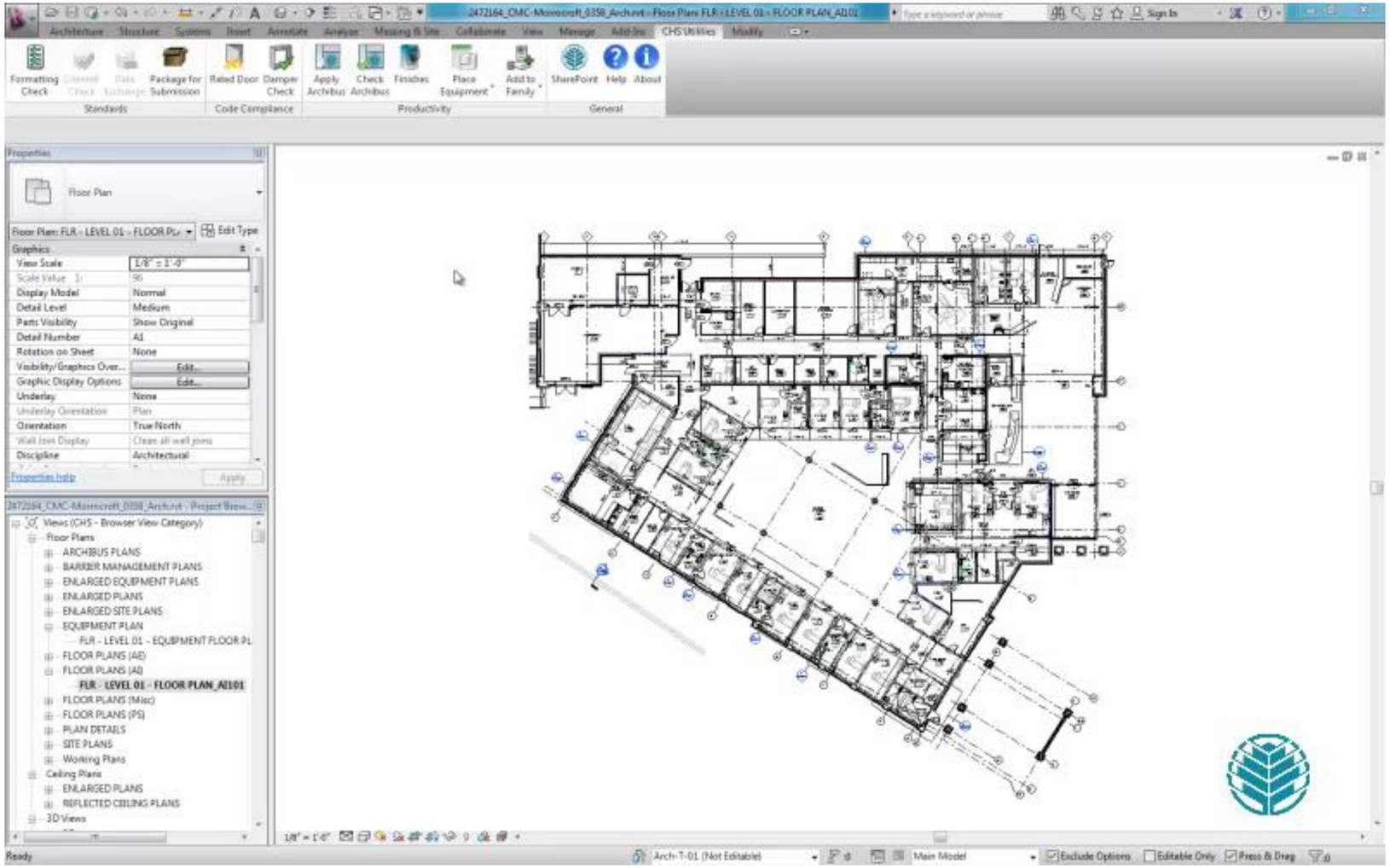






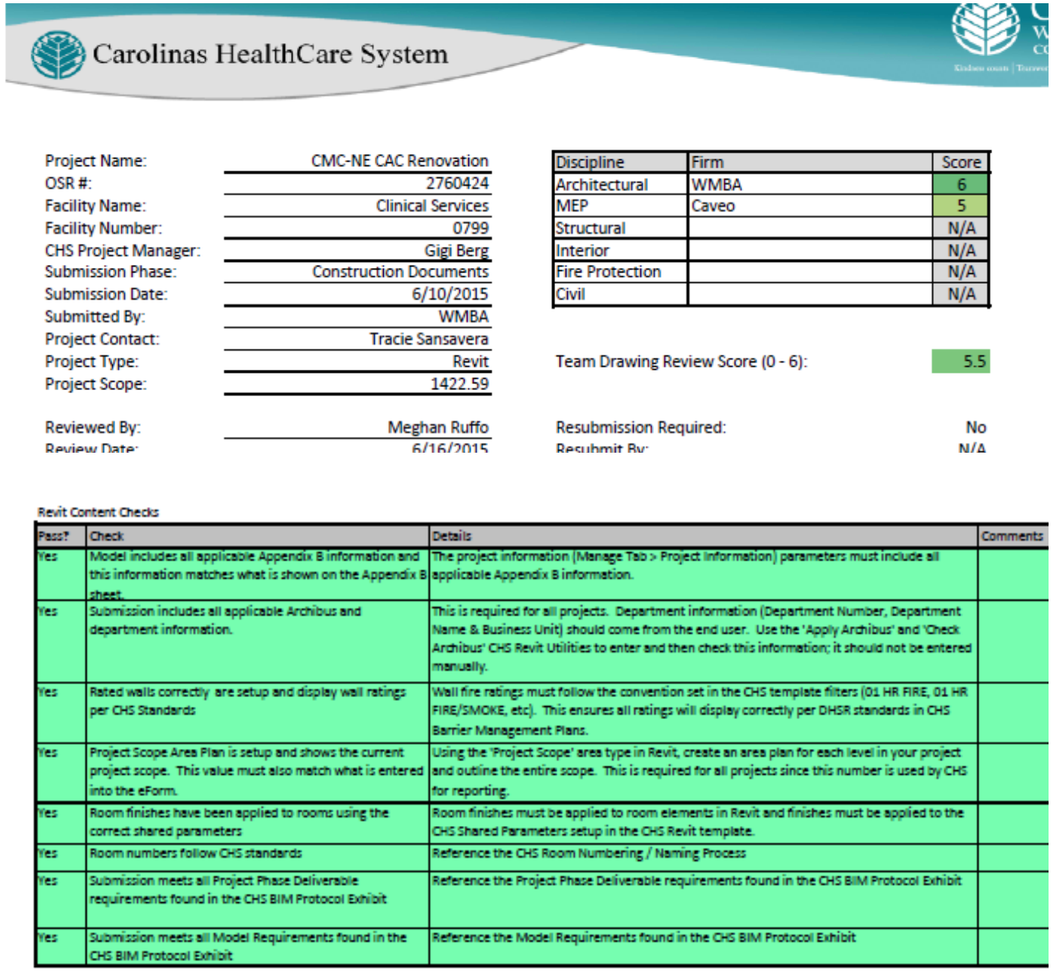


CHS BIM Utilities – Productivity



Submission Review and Scoring

- Review Each Submission at Milestone Phase
  - Run Automated Checks
  - Review Template
  - Standardized Review Checklist
- Reviewed throughout the project in order to:
  - Avoid Rework
  - Avoid Delay in Deliverable
  - Ensure Quality of Model through-out the project



Carolinas HealthCare System

Project Name:	CMC-NE CAC Renovation
OSR #:	2760424
Facility Name:	Clinical Services
Facility Number:	0799
CHS Project Manager:	Gigi Berg
Submission Phase:	Construction Documents
Submission Date:	6/10/2015
Submitted By:	WMBA
Project Contact:	Tracie Sansavera
Project Type:	Revit
Project Scope:	1422.59
Reviewed By:	Meghan Ruffo
Review Date:	6/16/2015

Discipline	Firm	Score
Architectural	WMBA	6
MEP	Caveo	5
Structural		N/A
Interior		N/A
Fire Protection		N/A
Civil		N/A

Team Drawing Review Score (0 - 6): 5.5

Resubmission Required: No

Resubmit By: N/A

Revit Content Checks

Pass?	Check	Details	Comments
Yes	Model includes all applicable Appendix B information and this information matches what is shown on the Appendix B sheet.	The project information (Manage Tab > Project Information) parameters must include all applicable Appendix B information.	
Yes	Submission includes all applicable Archibus and department information.	This is required for all projects. Department information (Department Number, Department Name & Business Unit) should come from the end user. Use the 'Apply Archibus' and 'Check Archibus' CHS Revit Utilities to enter and then check this information; it should not be entered manually.	
Yes	Rated walls correctly are setup and display wall ratings per CHS Standards	Wall fire ratings must follow the convention set in the CHS template filters (01 HR FIRE, 01 HR FIRE/SMOKE, etc). This ensures all ratings will display correctly per DHSR standards in CHS Barrier Management Plans.	
Yes	Project Scope Area Plan is setup and shows the current project scope. This value must also match what is entered into the eForm.	Using the 'Project Scope' area type in Revit, create an area plan for each level in your project and outline the entire scope. This is required for all projects since this number is used by CHS for reporting.	
Yes	Room finishes have been applied to rooms using the correct shared parameters	Room finishes must be applied to room elements in Revit and finishes must be applied to the CHS Shared Parameters setup in the CHS Revit template.	
Yes	Room numbers follow CHS standards	Reference the CHS Room Numbering / Naming Process	
Yes	Submission meets all Project Phase Deliverable requirements found in the CHS BIM Protocol Exhibit	Reference the Project Phase Deliverable requirements found in the CHS BIM Protocol Exhibit	
Yes	Submission meets all Model Requirements found in the CHS BIM Protocol Exhibit	Reference the Model Requirements found in the CHS BIM Protocol Exhibit	

Contract Development and Compliance Verification

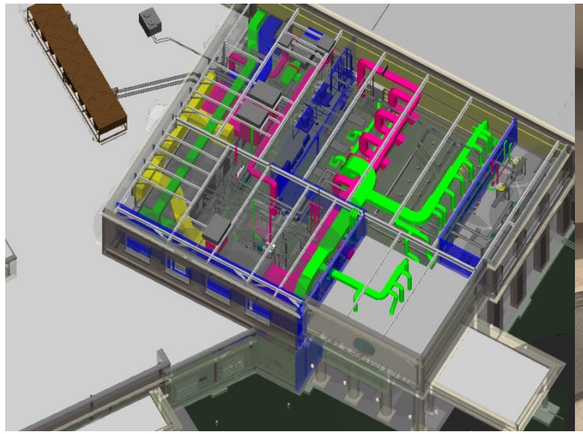
- Define what “BIM” is to CHS
  - *“All drawings and schedules required for design, assessment, review, bidding, and construction shall be extractions from the Project Model”*
  - CHS is requirement a Building **Information** Model – not asking for just 3D drafting
- Clearly State Deliverable Requirements
  - Revit Deliverable
  - Navisworks Deliverable
  - Required content in each model per Milestone Phase
- **Eliminate subjectivity in BIM Process**

Design and Construction

Project Type Specifics

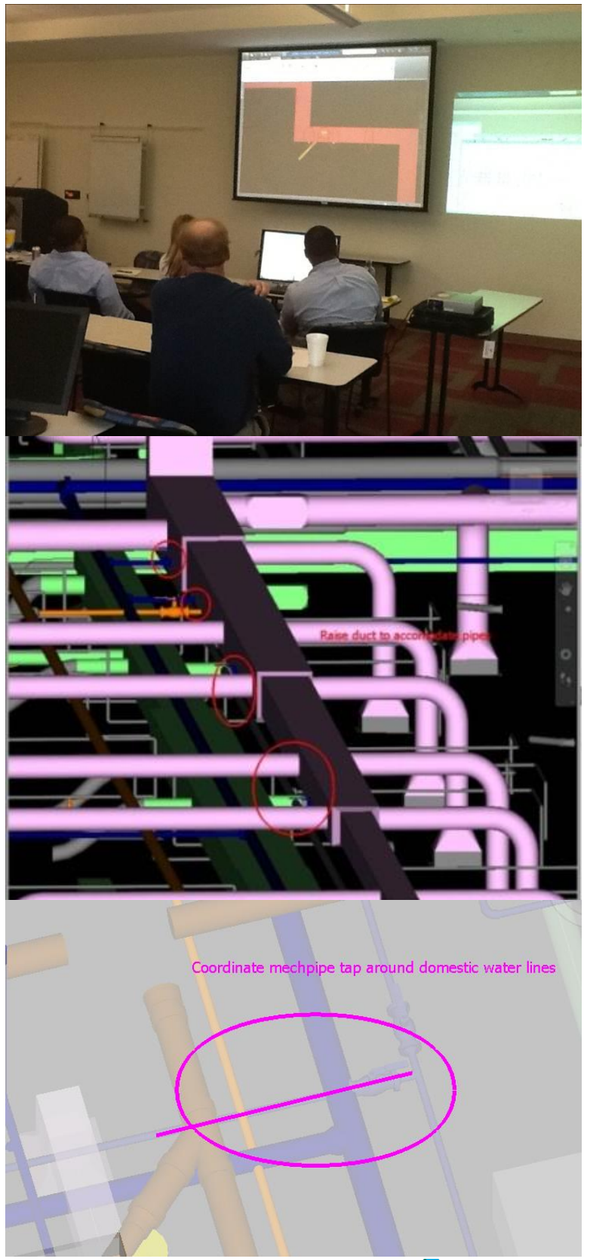
- Not a one-size fits all approach
- Varies by project type and size
  - New Construction vs. Renovation
  - Acute Care, Medical Office, and General Office

Aesthetics Only (Furniture and Finishes)	Provide finish information in Revit Room object. Room objects can be created from lines on top of CAD files or from an existing 3D model	CHS created tool that allows designed to auto-populate fields (manufacturer and model #) which reduces input time by designer Information is embedded into model and is linked to report on SharePoint for all CHS team members to access	Finish information not located in consistent place – sometimes on drawings and sometimes in the specifications. Finding manufacture and model in this way is time consuming and does not allow us to easily import into an FM system.
MEP Equipment Replacement	Draw new work in 3D Revit	Existing conditions can be 2D CAD reference files, but new work – new ductwork or AHU should be modeled in Revit 3D per CHS standards. This allows us to start to build MEP models for future projects and renovation without adding more work to the project. The teams have to draw this anyway – Revit helps with future projects and maintenance.	Teams could draw everything in 2D, but we would never be able to start to build MEP models for future projects or maintenance.
	Populate required parameters for new equipment (Manufacturer, model number, serial number, and link O&M, submittal, & warranty)	New equipment should meet all of the data parameter requirements as this can be exported into our EAM system and used for maintenance. On equipment replacement projects this is typically a handful of elements.	Team could not populate the information and the models would be 3D representations only which is not Building Information Modeling.
CERP	Draw new work in 3D Revit	Existing conditions can be 2D CAD reference files, but new work – new ductwork or AHU should	Teams could draw everything in 2D, but we would never be able

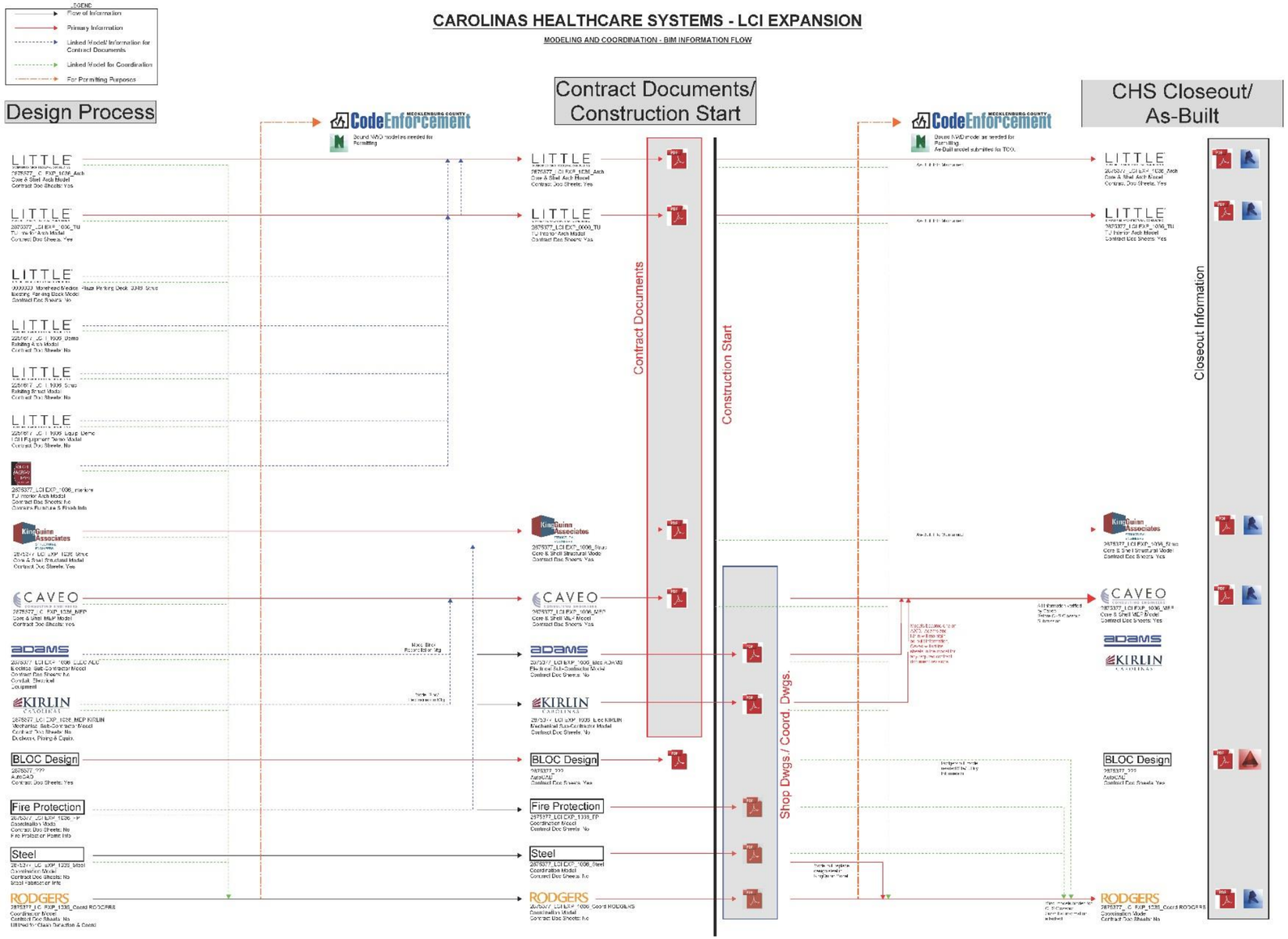


Collaborative Delivery

- Aiming for a more dynamic process – teams tend to fall back on traditional delivery methods
- Currently using Collaborate for Revit on 5 large projects – with over 100 Revit users total (25 per project)
  - Easy set-up
  - Owner monitored collaboration – more insight into the process
  - Seeing more positive collaboration between design and constructing team
- Goal is to have construction documents and shop drawings at the end of the design phase.



Collaborative Delivery



Partnership with Local Code Enforcement

COLLABORATION WITH CODE ENFORCEMENT AND NC BOARD OF ARCHITECTURE

The team worked with local code enforcement (AHJ) to pilot BIM technology for code review. The local code enforcement team were involved from conceptual design through project completion, creating a collaborative environment for reviewing code issues. The code review team had access to the cloud hosted models and drawings and could review issues in real-time. The code reviewers created a time of reviewers and inspectors to review the coordination model as a virtual inspection to document construction issues prior to physical construction. The BIM Execution Plan included the code reviewers time as well as time for virtual inspections in the model development work-flow.

The local code review also piloted the use of tablets for field inspections. Inspections all carried Ipads and were able to pull up the latest drawings from the team cloud to provide mark-ups and check review status.

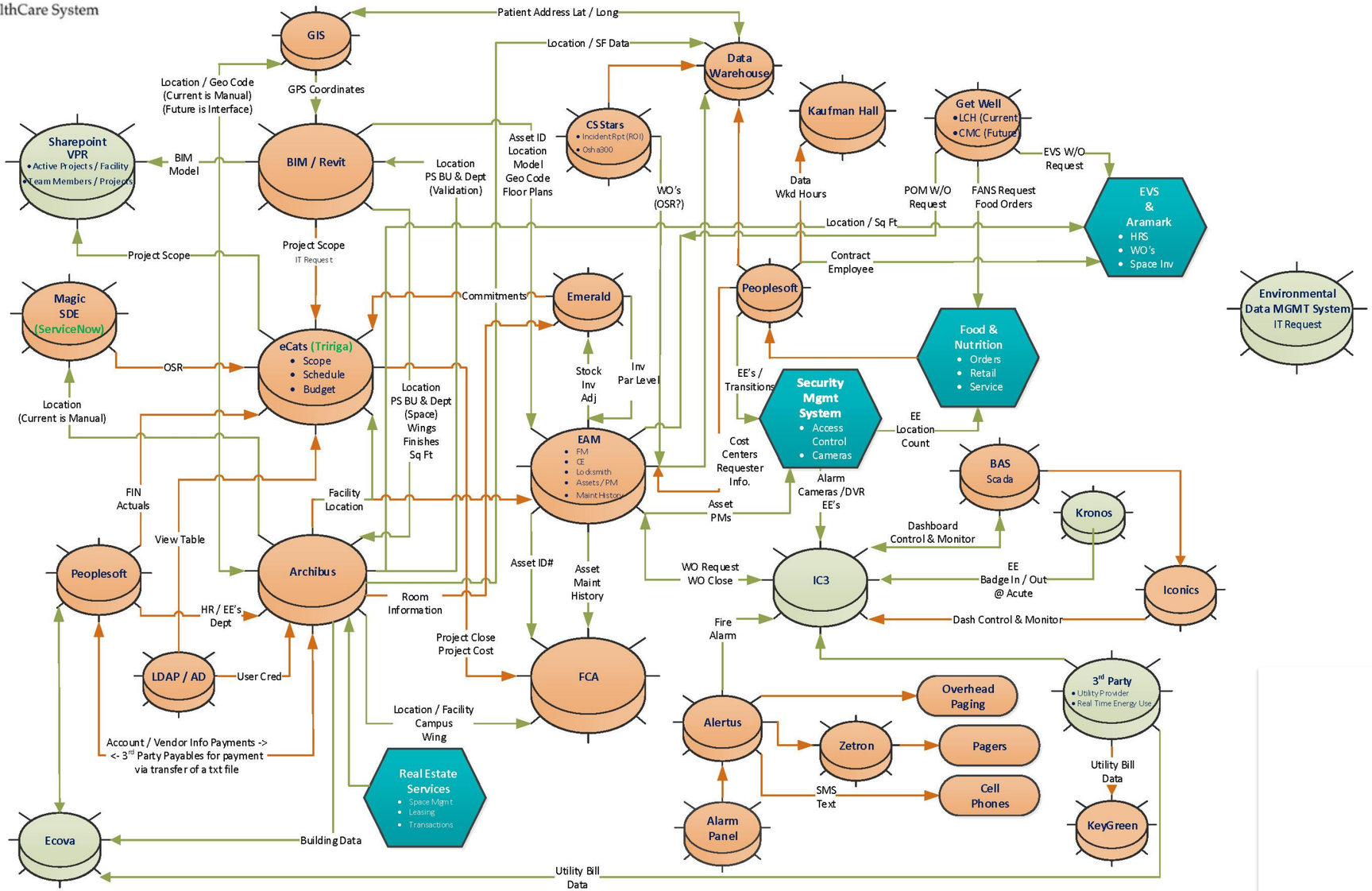
Core Lab utilized the pilot program for digital review using Building Information modeling. The collaborative effort of this review on all trades, in conjunction with having the 3d model helped bring to light critical issues such as exiting issues and the ratings required to hold up the second floor Electrical switch gear room. By all trades of reviewers and design team collaborating on the various issues this decreased review time and expedited this project through to permitting. The use of the 3d model was crucial in identifying these items upfront in plan review and not after construction in the field during inspection.

James Bartel,
Mecklenburg County Code enforcement

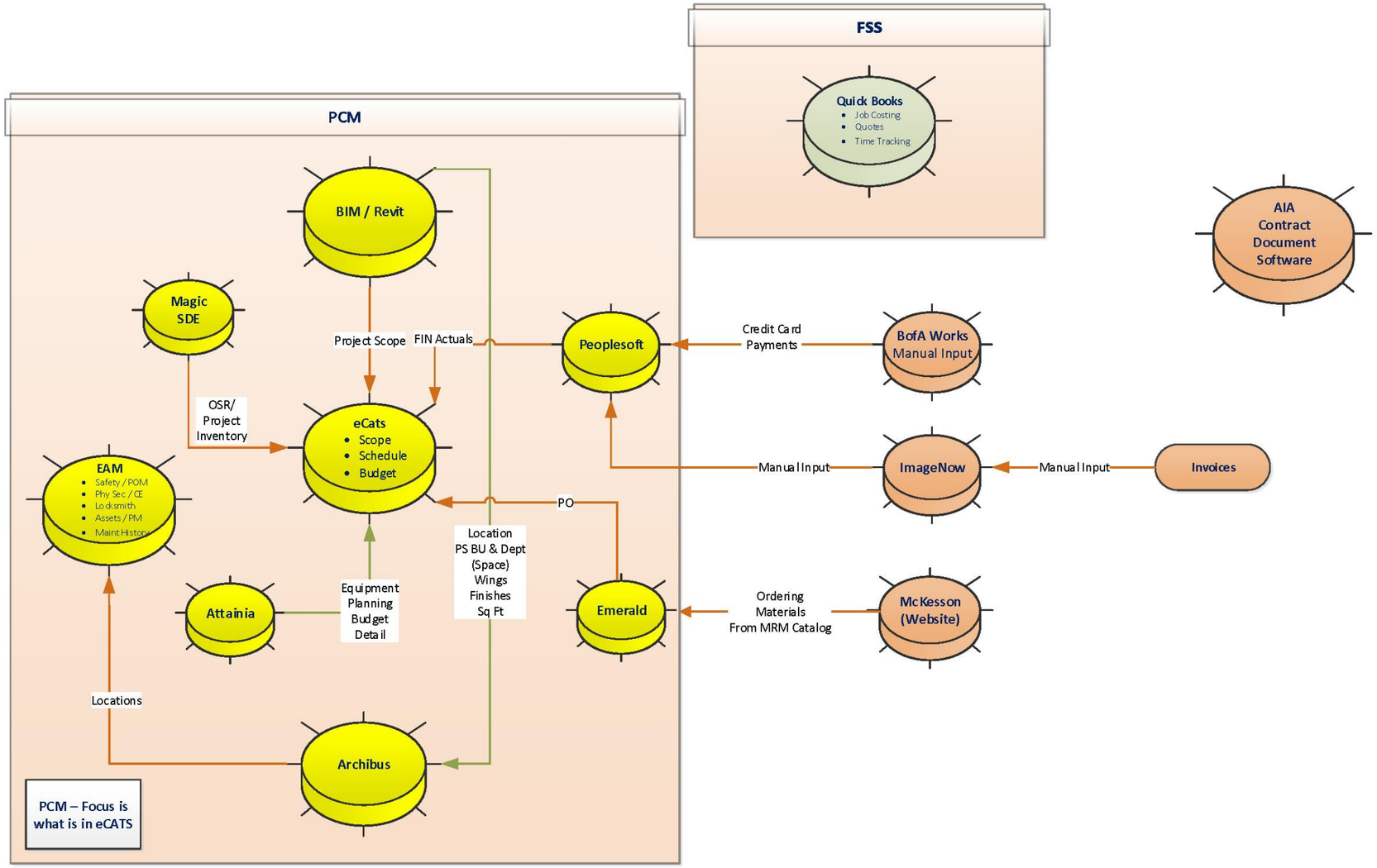
Facilities Information Management

Facilities Information Management Strategy

Carolinas HealthCare System



Facilities Information Management Strategy



Virtual Documentation

Virtual Plan Room: Cost effective method to distribute Information from BIM across enterprise in user friendly format

- CHS uses SharePoint 365 (Hosted on Microsoft Cloud)
  - Houses non-Revit documentation
    - O&M Manuals, Submittals, and Warranties
  - Houses Archive Drawings (dating back to 1930)

Virtual Plan Room – Internal Users:

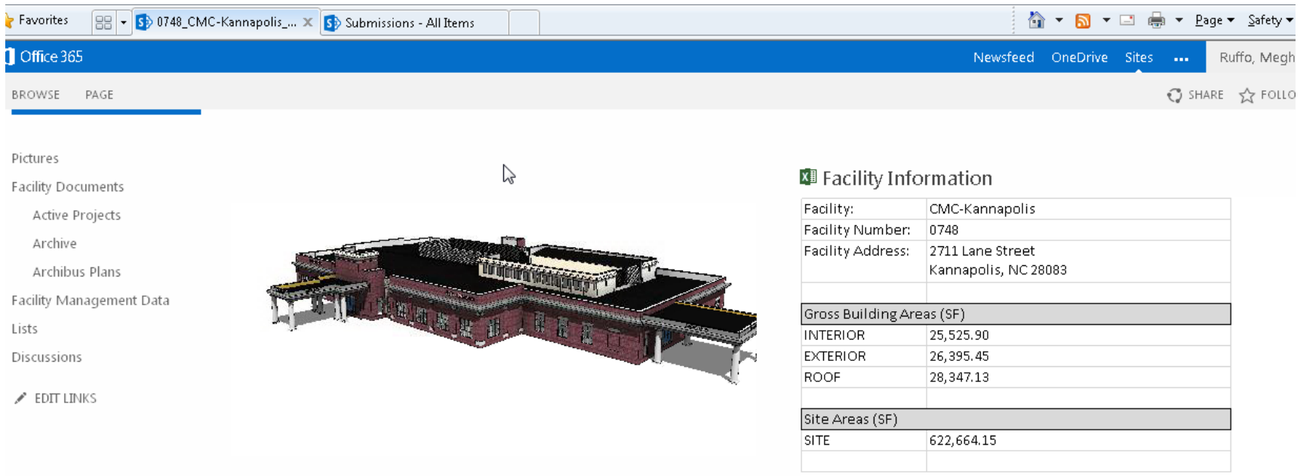
- Each Facility has own sub-site
- Publish Revit Data to facility homepage – Area, Building Code Information, Finish Schedule
- Contains Floor Plans, life safety drawings, Bed License submissions and regulatory compliance documents published from Revit.
- Some drawings contain hyperlinks to O&M, Submittals, Warranties, and Photos

Virtual Plan Room – Outside Consultants:

- Publish Standards and Requirements for External A/E/C Access
- Digital Closeout Process
- Revit Templates and Family Library

Virtual Documentation

- Homepage Example



Facility Information

Facility:	CMC-Kannapolis
Facility Number:	0748
Facility Address:	2711 Lane Street Kannapolis, NC 28083
Gross Building Areas (SF)	
INTERIOR	25,525.90
EXTERIOR	26,395.45
ROOF	28,347.13
Site Areas (SF)	
SITE	622,664.15

Appendix B Information

Code Enforcement Jurisdiction	City of Kannapolis / Cabarrus County
Building Data	
Construction Type	II-B
Sprinklers	Yes
Sprinkler Code	NFPA 13
Standpipes	Yes
Standpipe Class	Wet
Fire District	No
Building Height	26' - 0"
High Rise	No
Mezzanine	No
Occupancy	
Primary Occupancy	Business
Secondary Occupancy	
Special Occupancy	
Mixed Occupancy	No
Life Safety System Requirements	
Emergency Lighting	Yes
Exit Signs	Yes
Fire Alarm	Yes
Smoke Detection Systems	Yes
Panic Hardware	Yes

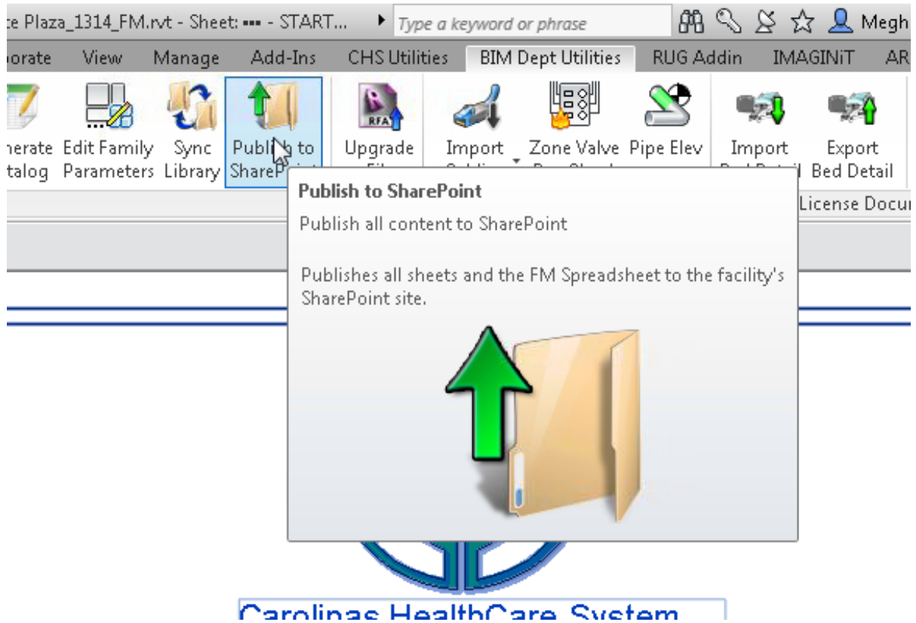
Excel Online - FM Spreadsheet

Edit in Excel | Comments | Download a Copy | Print

	A	B	C	D	E	F	G	H
1	FINISH SCHEDULE							
2	Level	Number	Name	Base Finish	Base Finish Manu	Base Finish Color	Base Finish Size/Comme	Floor Finish
3								
4	Level 01	101	WC STOR	WB1		PLAIN SLICED, WHITE BIR	STAINED TO MATCH PL-1	1/4" EASED TO
5	Level 01	102	VESTIBULE	WB1		PLAIN SLICED, WHITE BIR	STAINED TO MATCH PL-1	1/4" EASED TO
6	Level 01	103	FP RISER	RB1	BURKE MERCER	RUBBERMYTE	CHS1-303	4" COVE BASE
7	Level 01	104	CORR	WB1		PLAIN SLICED, WHITE BIR	STAINED TO MATCH PL-1	1/4" EASED TO
8	Level 01	105	RECEPTION A	WB1		PLAIN SLICED, WHITE BIR	STAINED TO MATCH PL-1	1/4" EASED TO
9	Level 01	106	RECEPTION B	WB1		PLAIN SLICED, WHITE BIR	STAINED TO MATCH PL-1	1/4" EASED TO
10	Level 01	107	LOBBY					
11	Level 01	108	WORK RM II	WB1		PLAIN SLICED, WHITE BIR	STAINED TO MATCH PL-1	1/4" EASED TO
12	Level 01	108A	PHARMACY	WB1		PLAIN SLICED, WHITE BIR	STAINED TO MATCH PL-1	1/4" EASED TO
13	Level 01	109	RECEPTION C	WB1		PLAIN SLICED, WHITE BIR	STAINED TO MATCH PL-1	1/4" EASED TO

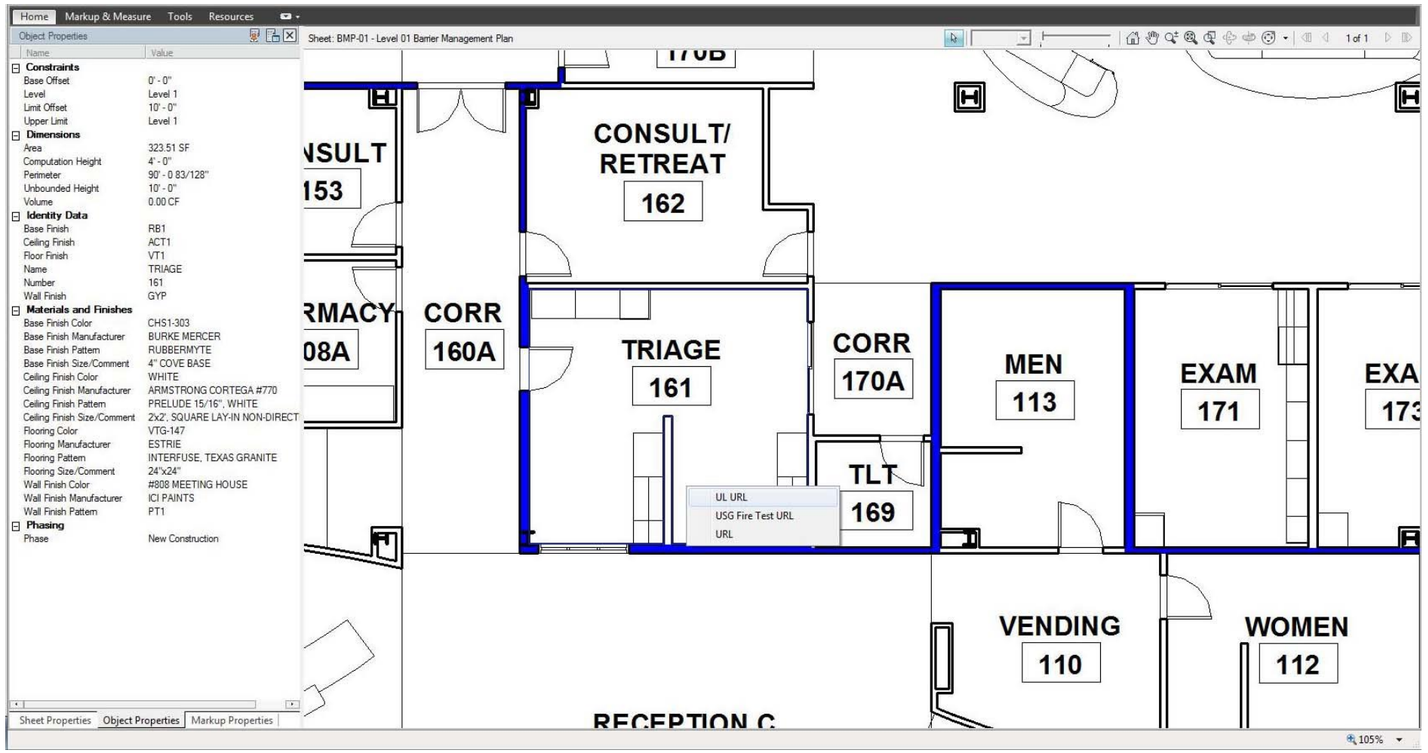
Change Log | Appendix B | Room Schedule | Finish Schedule | Sheet List

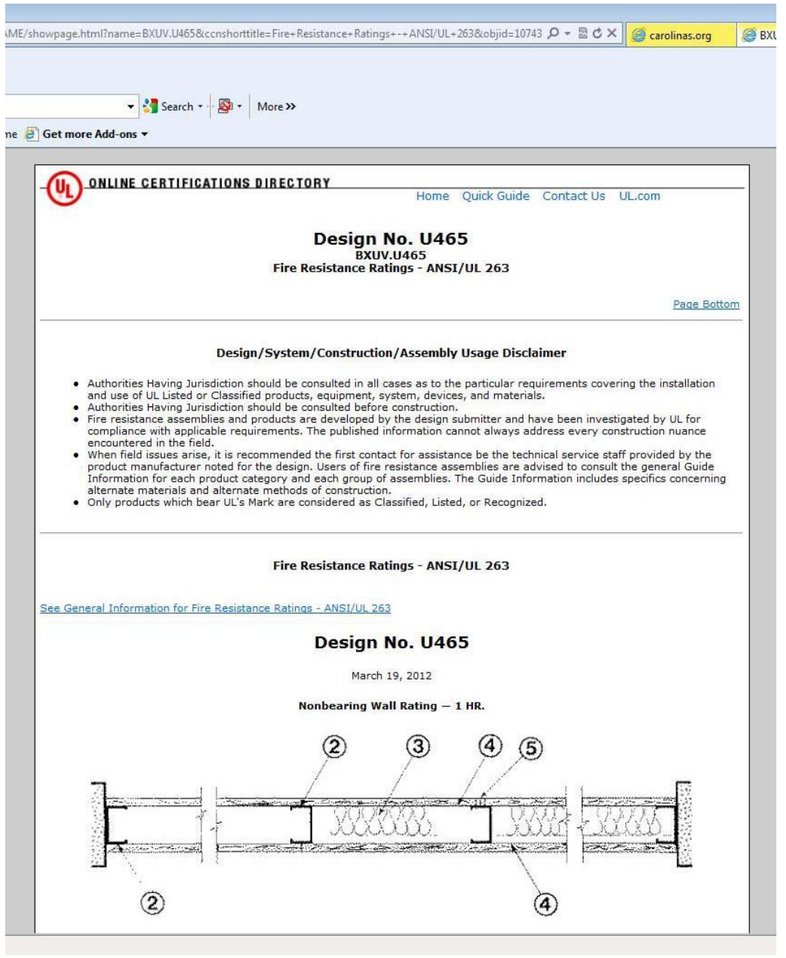
COUNT: 100 HELP IMPROVE OFFICE



Virtual Documentation

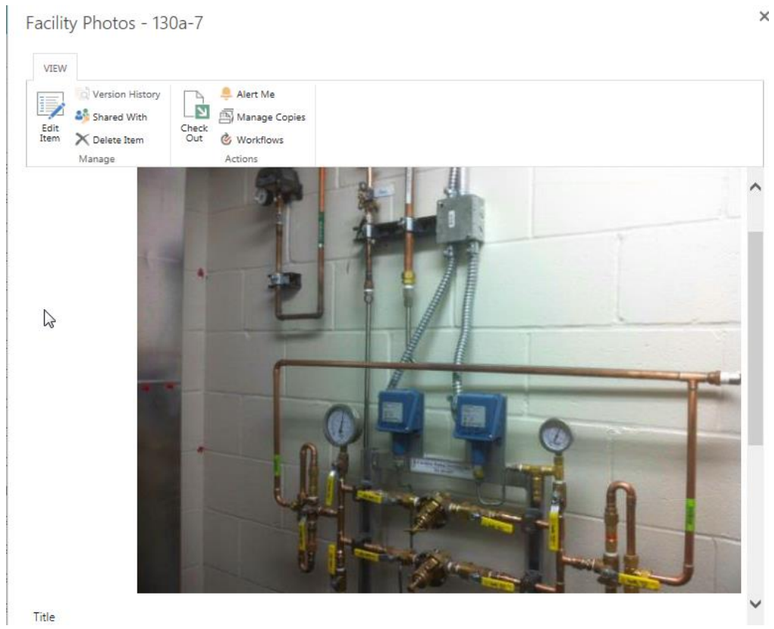
- Barrier Management Plans

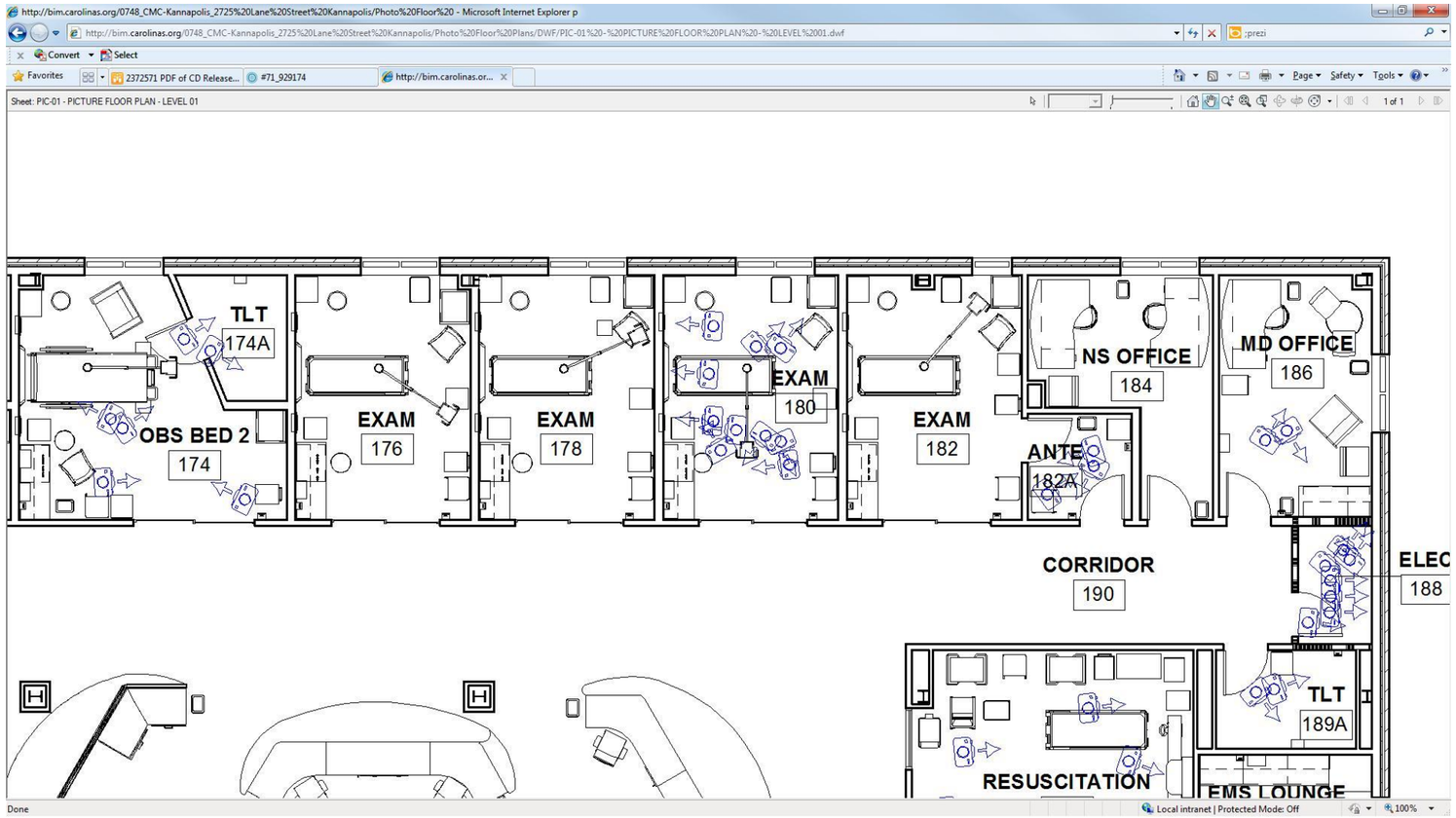




Virtual Documentation

- Linked Photos





Virtual Documentation

- Security Device Plans

Security Device Schedule Level 02						
Mark	Security ID #	Type	Room: Number	Room: Name	Room: Department	Room: Department #
262	290-1-01	CR	02STR10	STAIR 10	VERTICAL	VERTICAL
263	289-1-01	CR	2344NS	NURSE STATION	NSG - ICU	524500
264	289-2-01	CR	C2346	CORRIDOR	BASE BUILDING AREAS	BASEBLDG
265	298-2-00	CR	C2390	CORRIDOR	BASE BUILDING AREAS	BASEBLDG
266	298-6-00	CR	C2390	CORRIDOR	BASE BUILDING AREAS	BASEBLDG
267	299-2-00	CR	C2390	CORRIDOR	BASE BUILDING AREAS	BASEBLDG
268	289-3-01	CR	C2390	CORRIDOR	BASE BUILDING AREAS	BASEBLDG
269	289-4-00	CR	C2388	CORRIDOR	BASE BUILDING AREAS	BASEBLDG
270	289-2-00	CR	C2388	CORRIDOR	BASE BUILDING AREAS	BASEBLDG
271	289-5-01	CR	C2387	CORRIDOR	BASE BUILDING AREAS	BASEBLDG

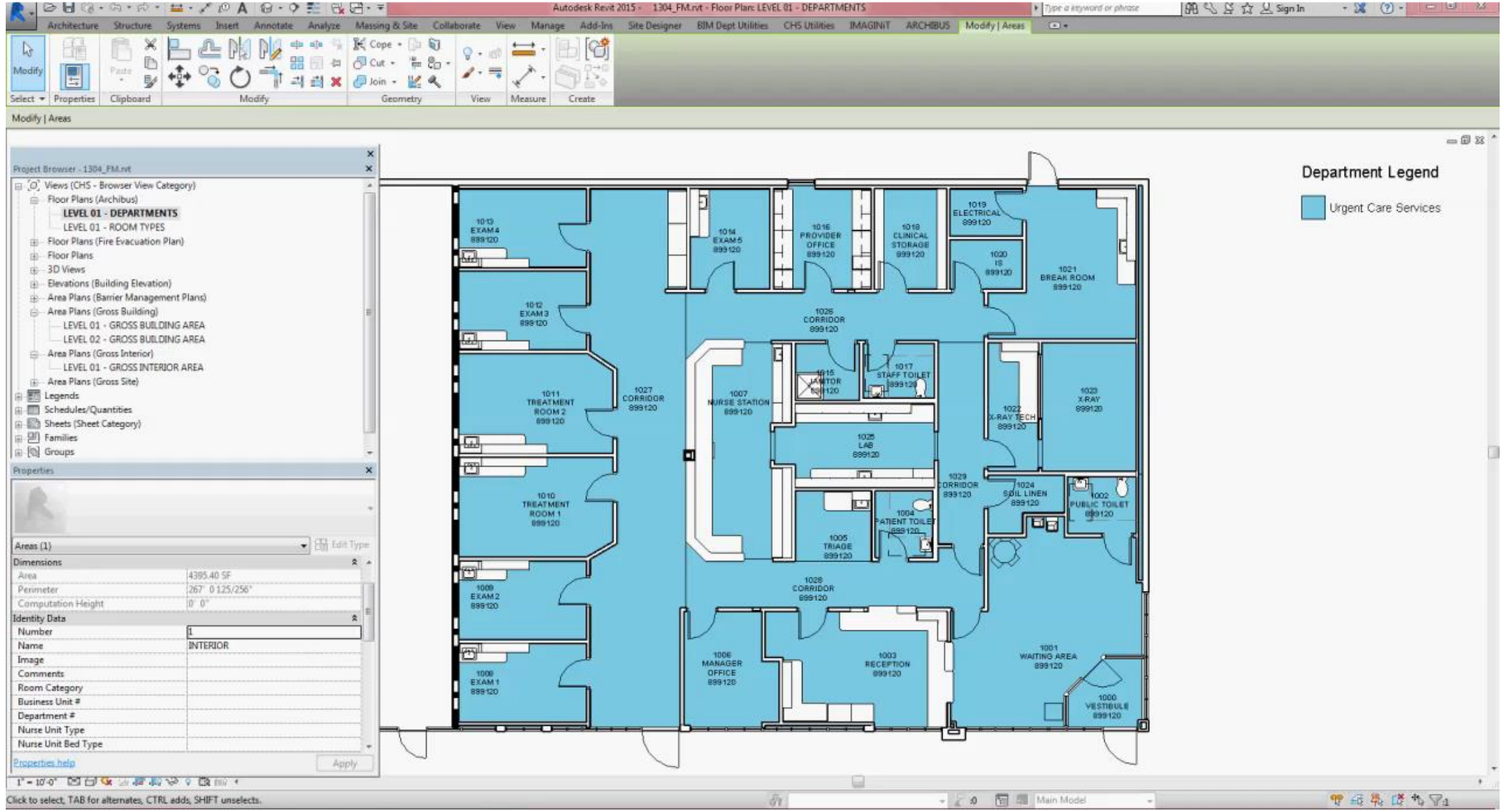
Space Management

- Archibus is the system of record for space and lease management
  - Off the shelf add-in that creates bi-direction integration with Revit
  - Revit pushes room name, room number, and area data into Archibus
  - Department information is looked up in Archibus and linked to models
    - Initial push is from Revit, but data is managed in Archibus and synced back to Revit weekly
  - Physical backgrounds also published to web browser for interactive drawings

Archibus Revit Interface

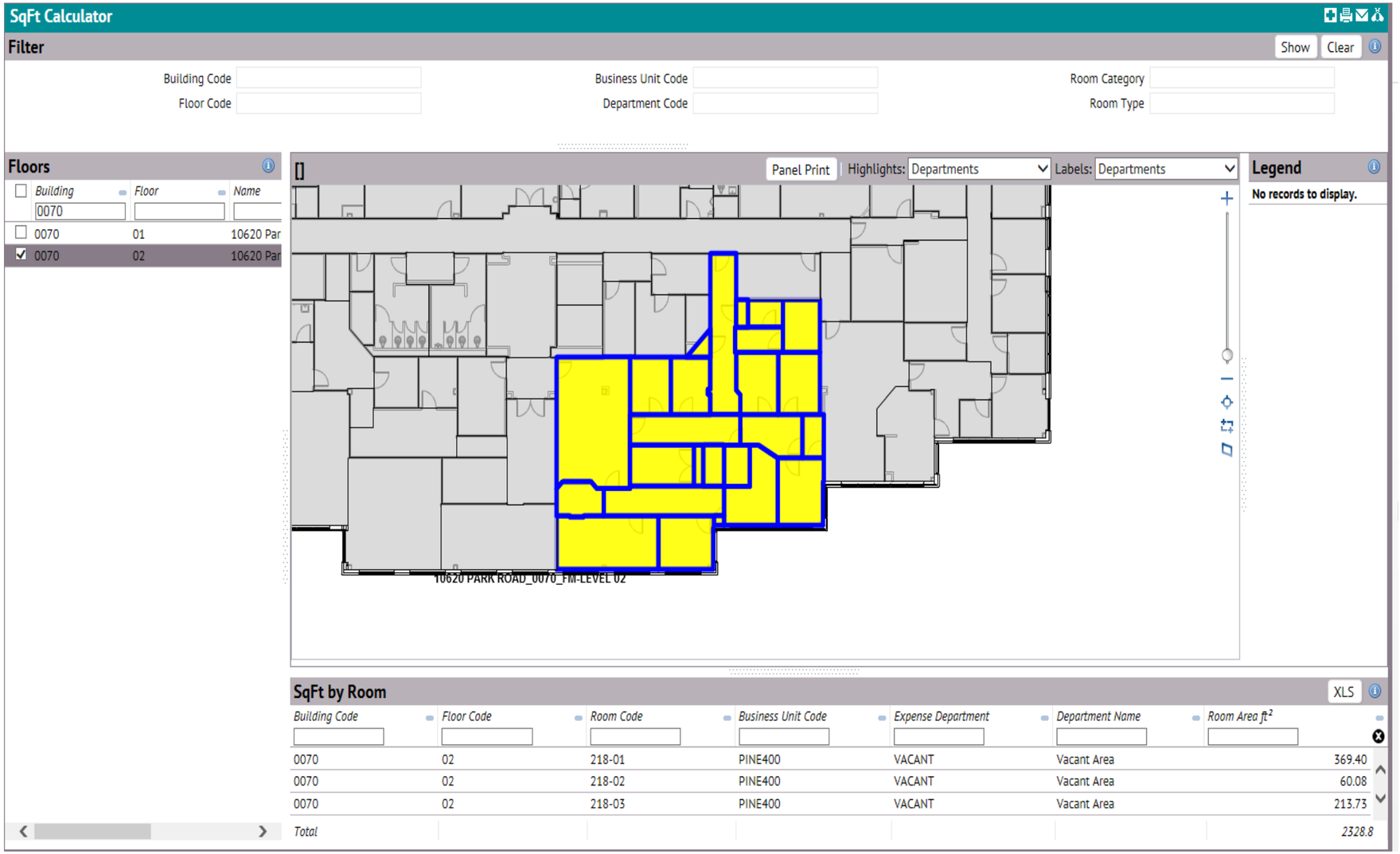
Revit to Space Management Integration

- **Cataloging data from Revit to Archibus**



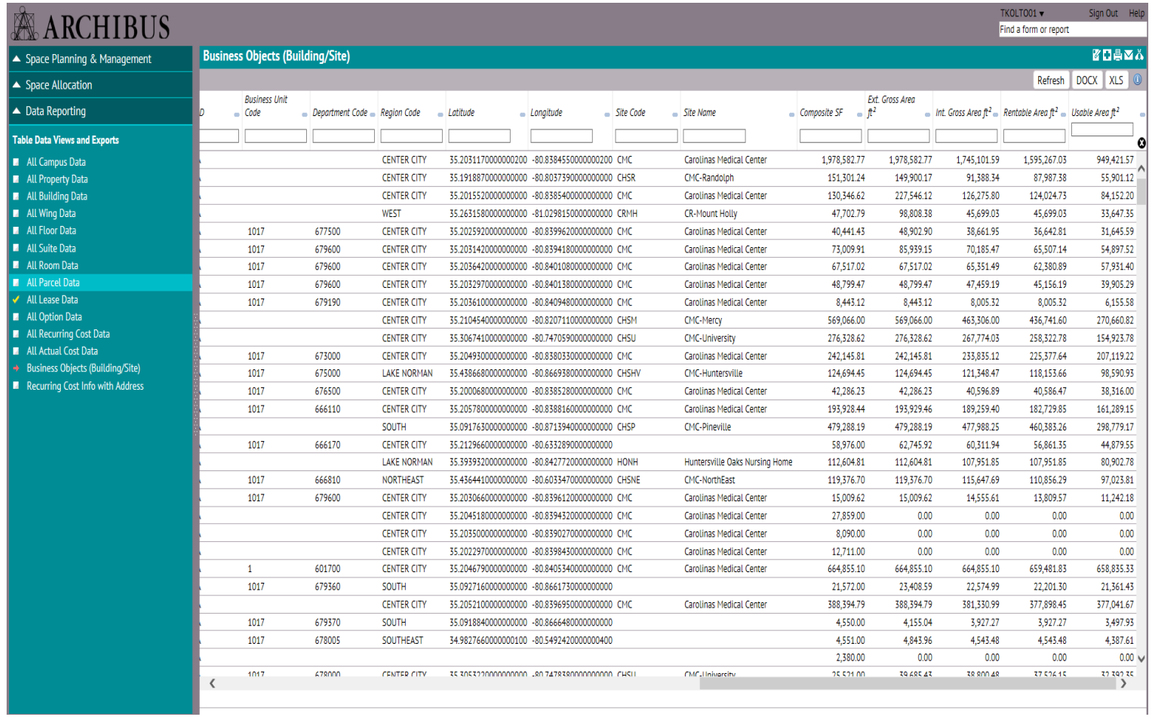
Space Management

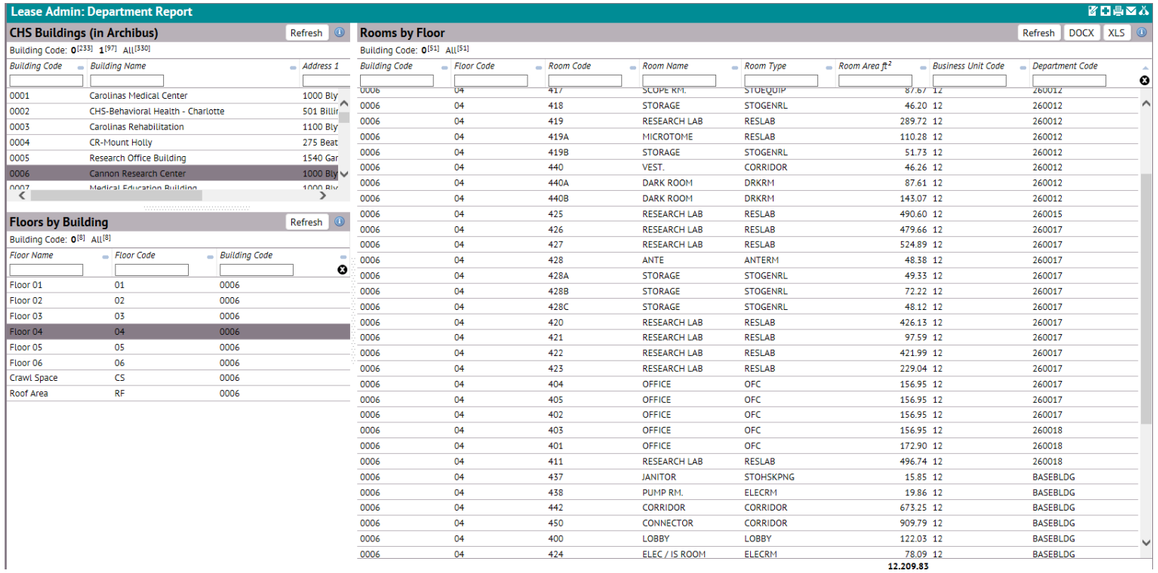
- **Interactive Web Based Drawings / Area Calculator**



Space Management

- **Data Reporting in Archibus**

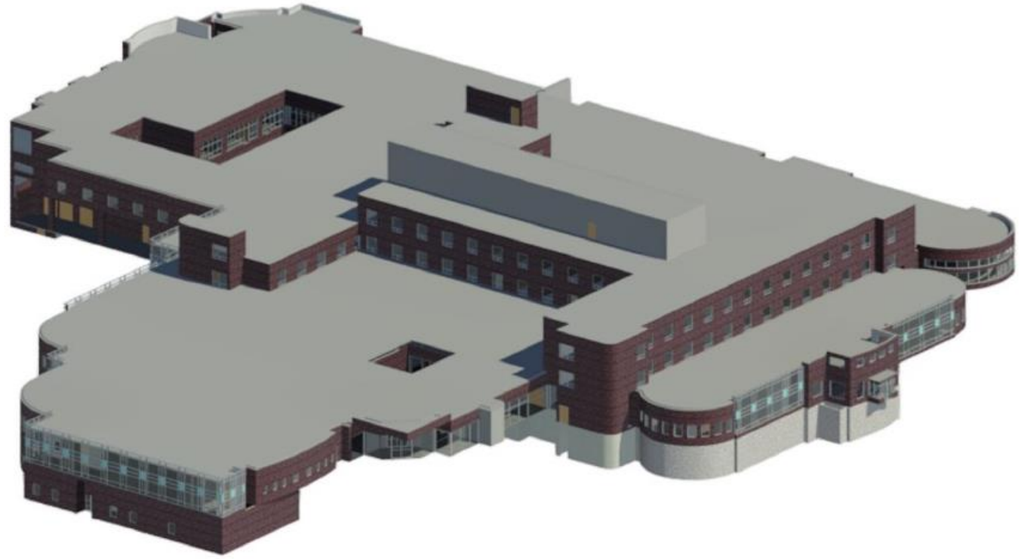




Converting Existing Facilities

- Current State:
  - Over 17 million SF in Primary Enterprise
  - 15.8 million SF linked with Revit connected to Archibus
    - Only 1 remaining facility in conversion process
  - Converting all CAD to Revit -
    - Review information needed for space management – walls, doors, columns, windows.
    - BIM Savvy users – better quality, no training required
    - Look at level of detail required – fabrication level model not needed
- For facilities where CAD existed but not connected to Archibus (no SF reports) – Revit process twice as fast as CAD polyline
- For new facilities that follow CHS BIM requirements – time reduced from 40 hours to 1 hour enter into system

Converting Existing Facilities

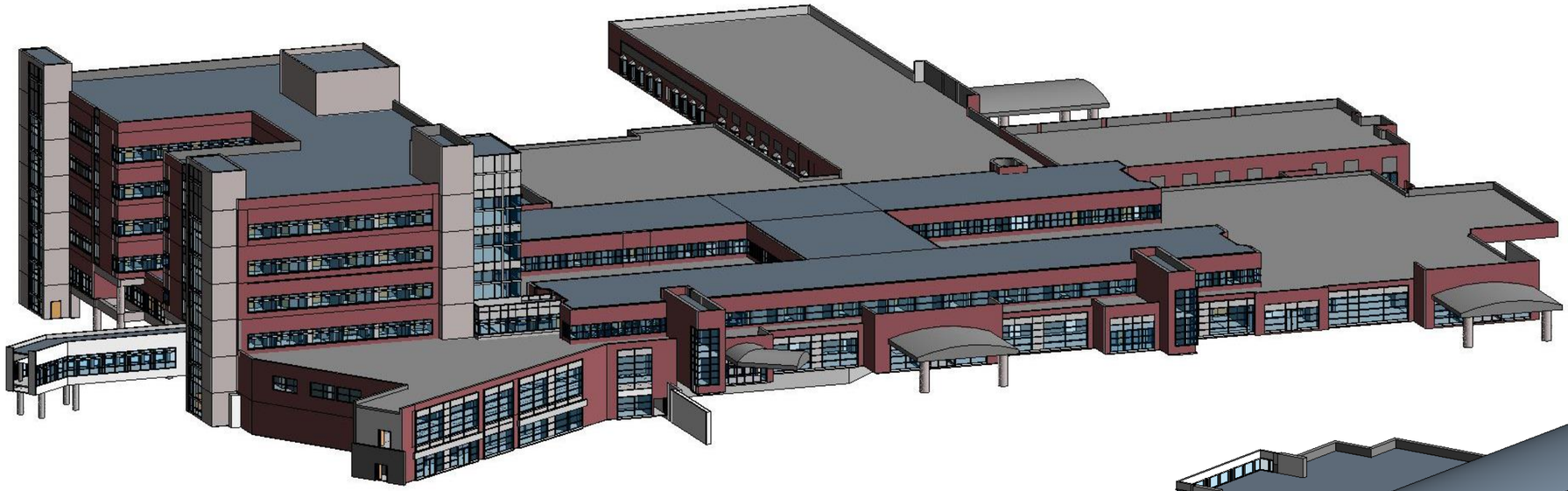


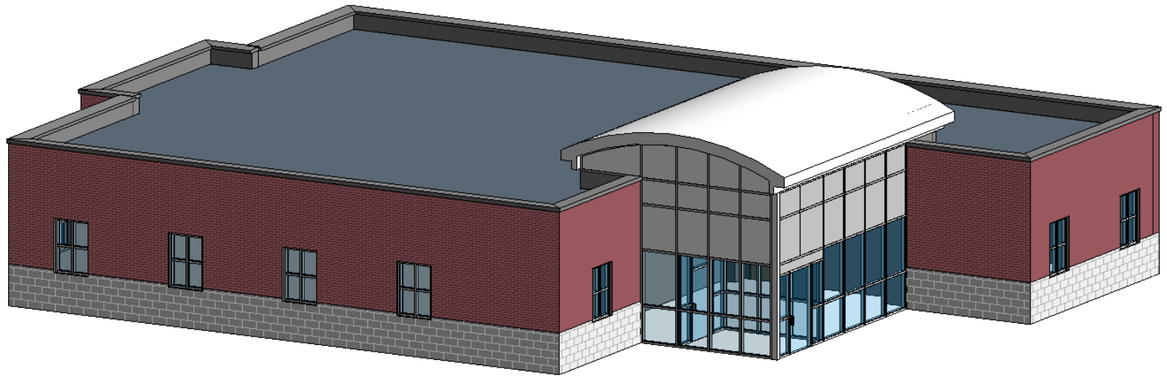
Stanly Regional Medical Center

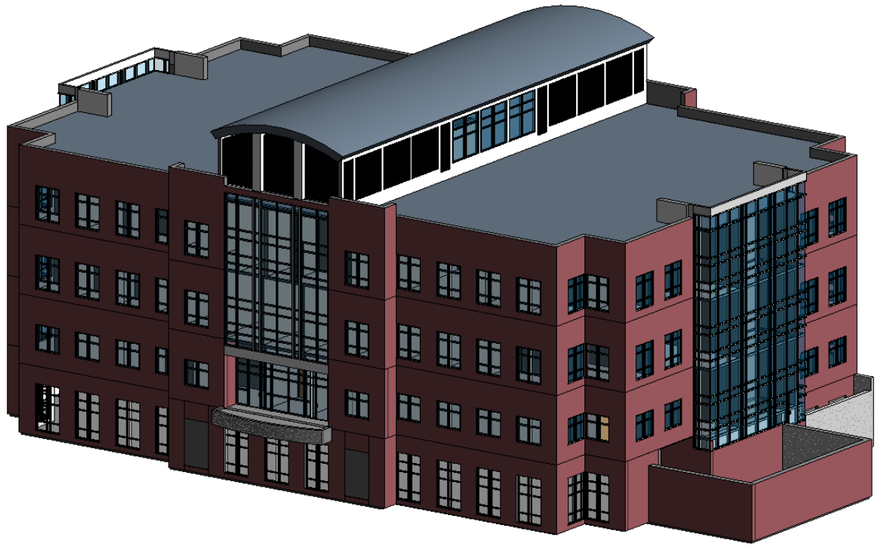
For some facilities – the model was created from paper drawings and field measuring

Converting Existing Facilities

- Example of facilities converted from CAD to Revit
- Shows the amount of detail needed for square footage calculations







Asset Management

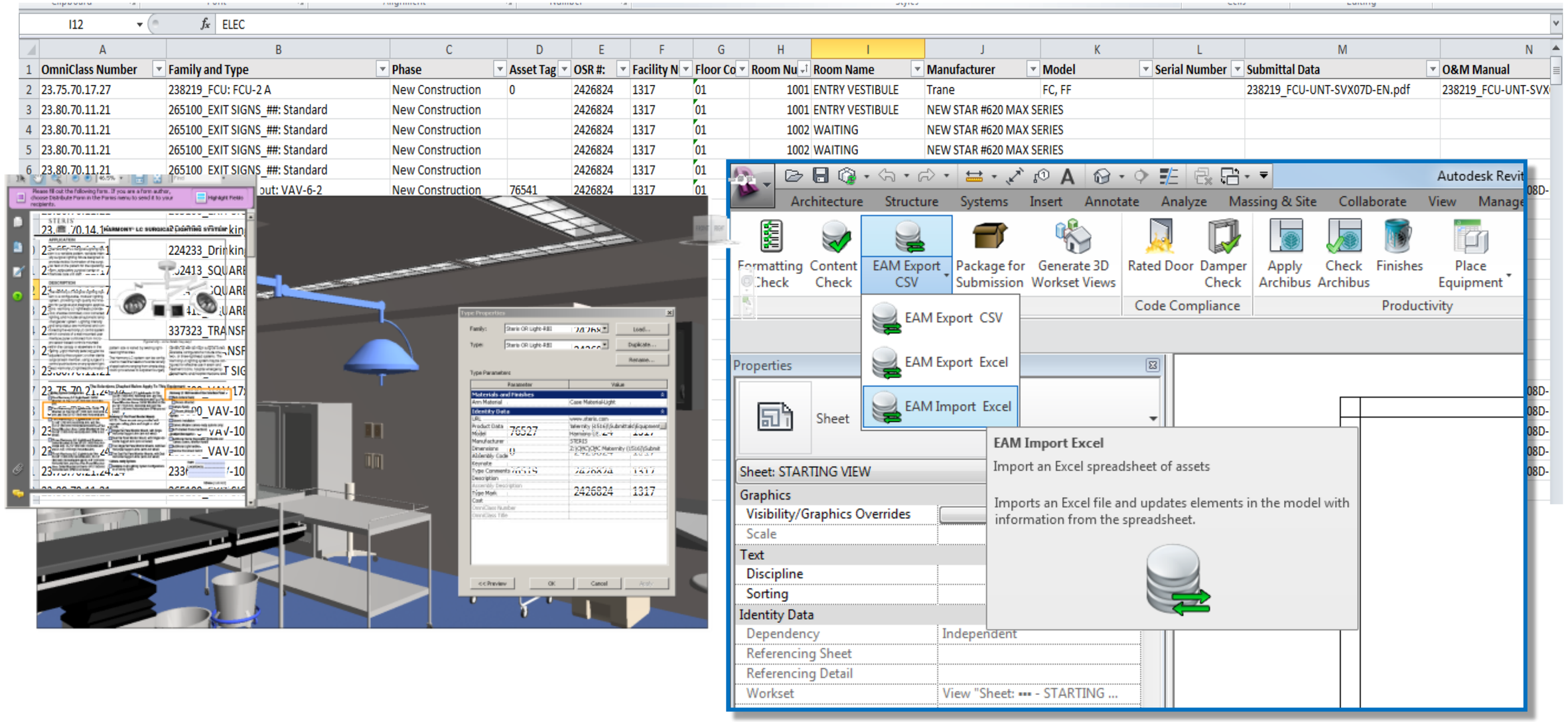
Asset Management / CMMS (Computerized Maintenance Management System)

- Current State:
  - Revit to CMMS integration with custom created Excel export for data transfer:
    - Asset information is automated instead of field surveyed and manually entered.
    - BIM team reviews data quality – using automated checks from Revit Add-ins.
    - Excel Export can be used to collect data and import data back into the model.

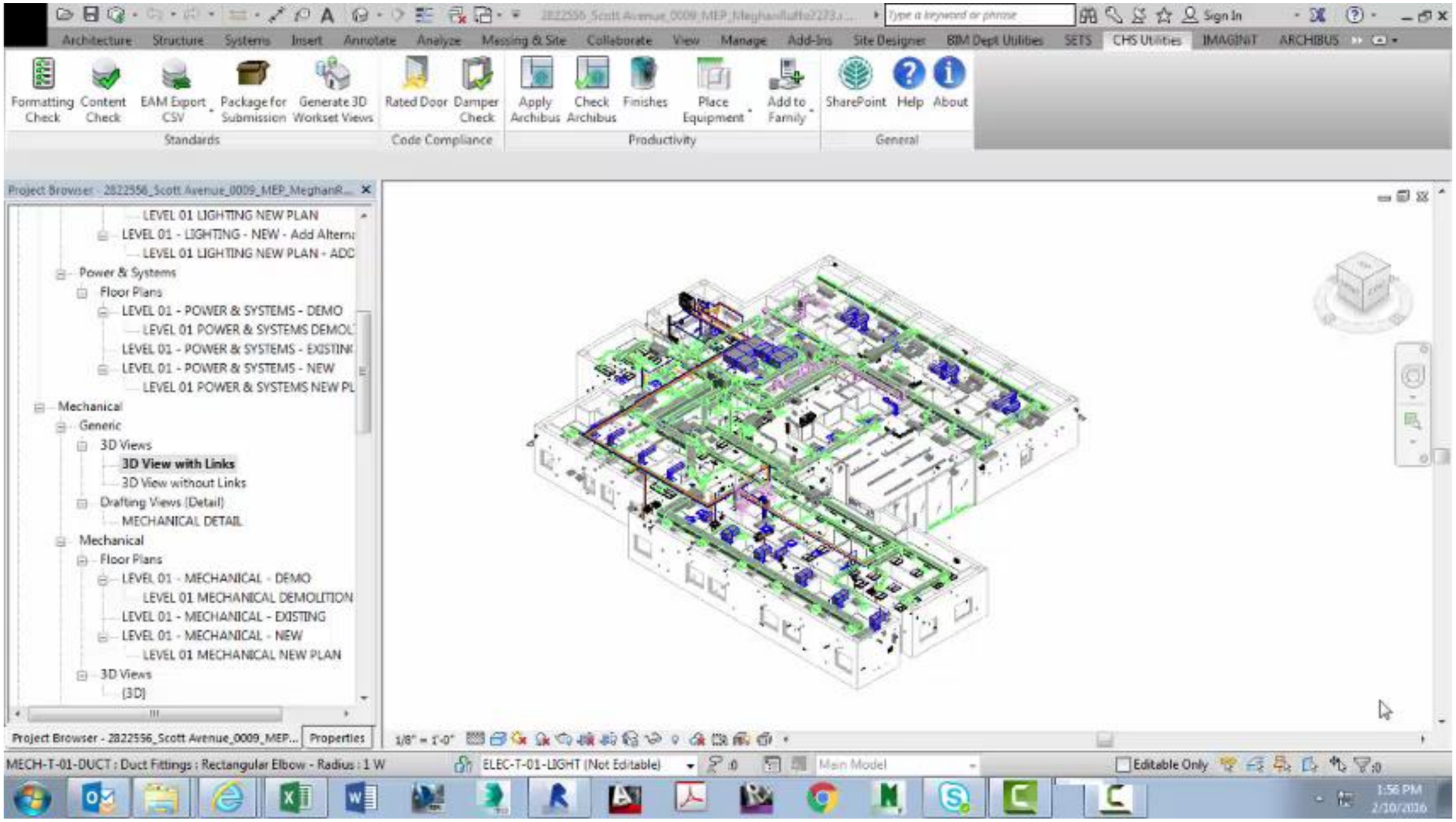
- Goals / Best Practice:
  - Review the information requirements for your healthcare system. Look at type and quantity of data needed. Not all project data may be needed for Facilities Management.
  - Review how information is collected. User friendly interfaces and familiar platforms help ensure data is easy to collect - Excel to Revit can be a time saver.
  - Make the process applicable and consistent to all project types (new, renovated, large, small)
  - Exported data can be used to feed CMMS system to help build capital budgeting and forecasting. (facility systems and equipment replacements)

Asset Management

View of data export & custom add-in within Revit

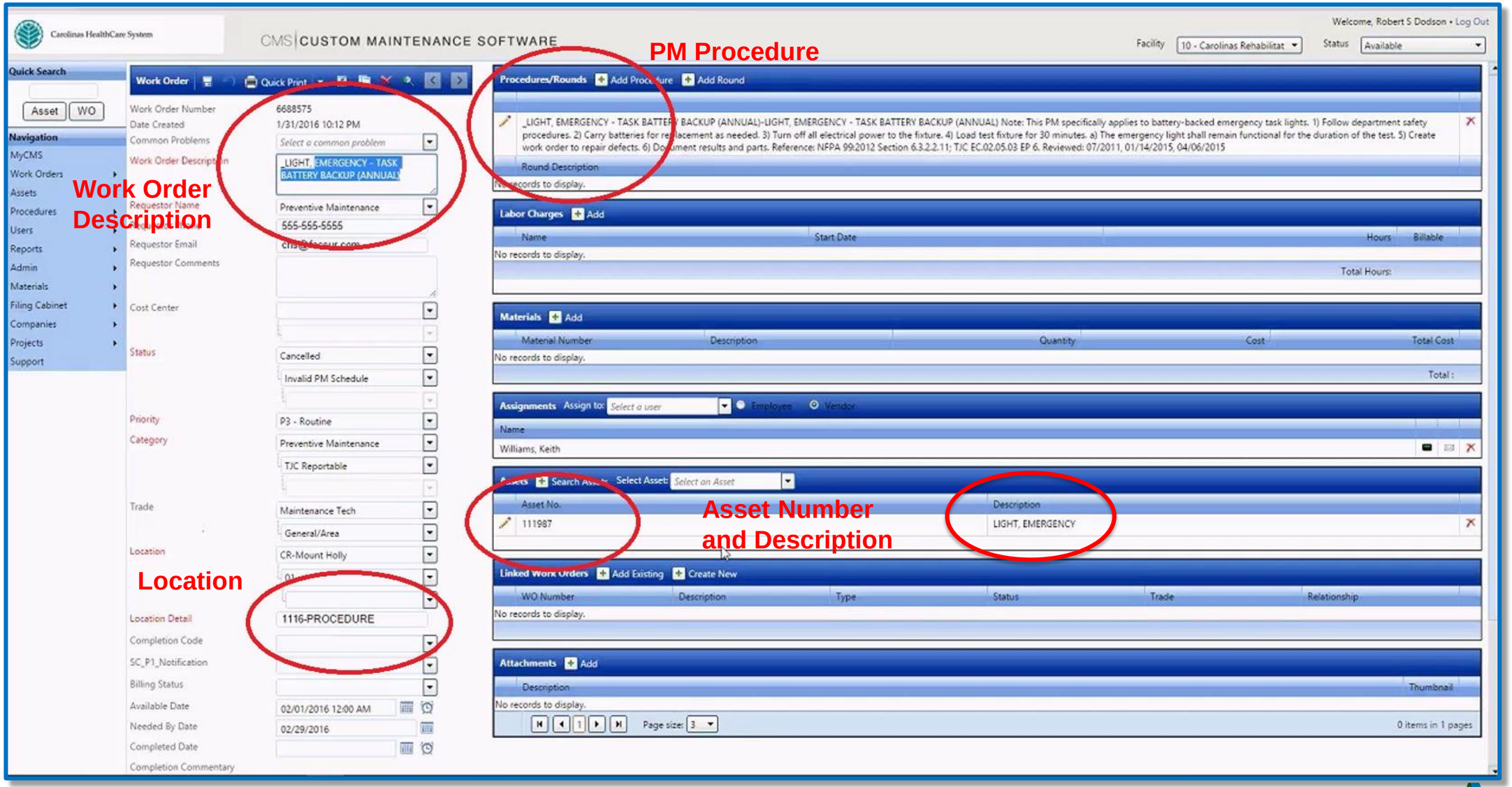


Asset Management



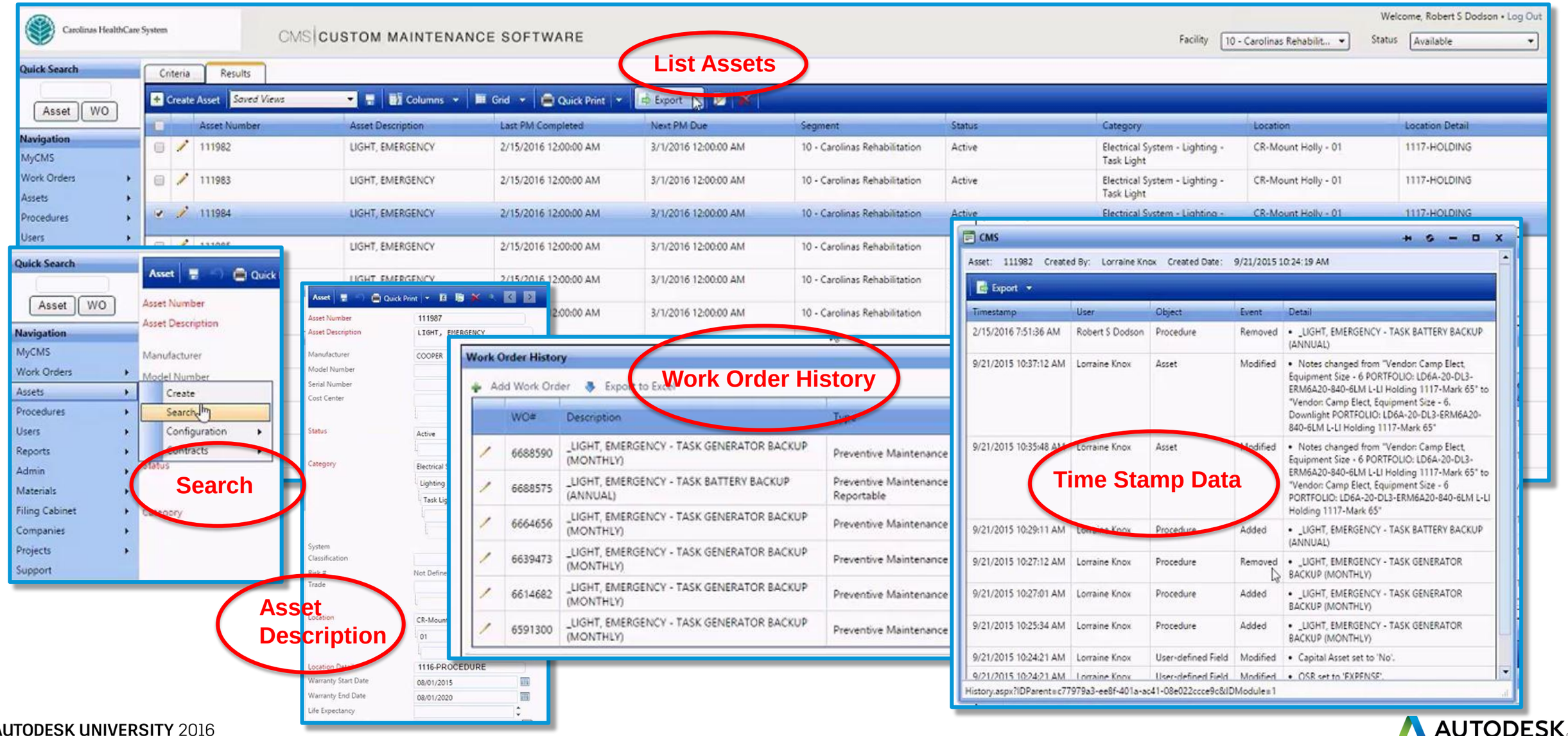
Asset Management

CMMS – FM/POM Maintenance Management – CMS Dashboard



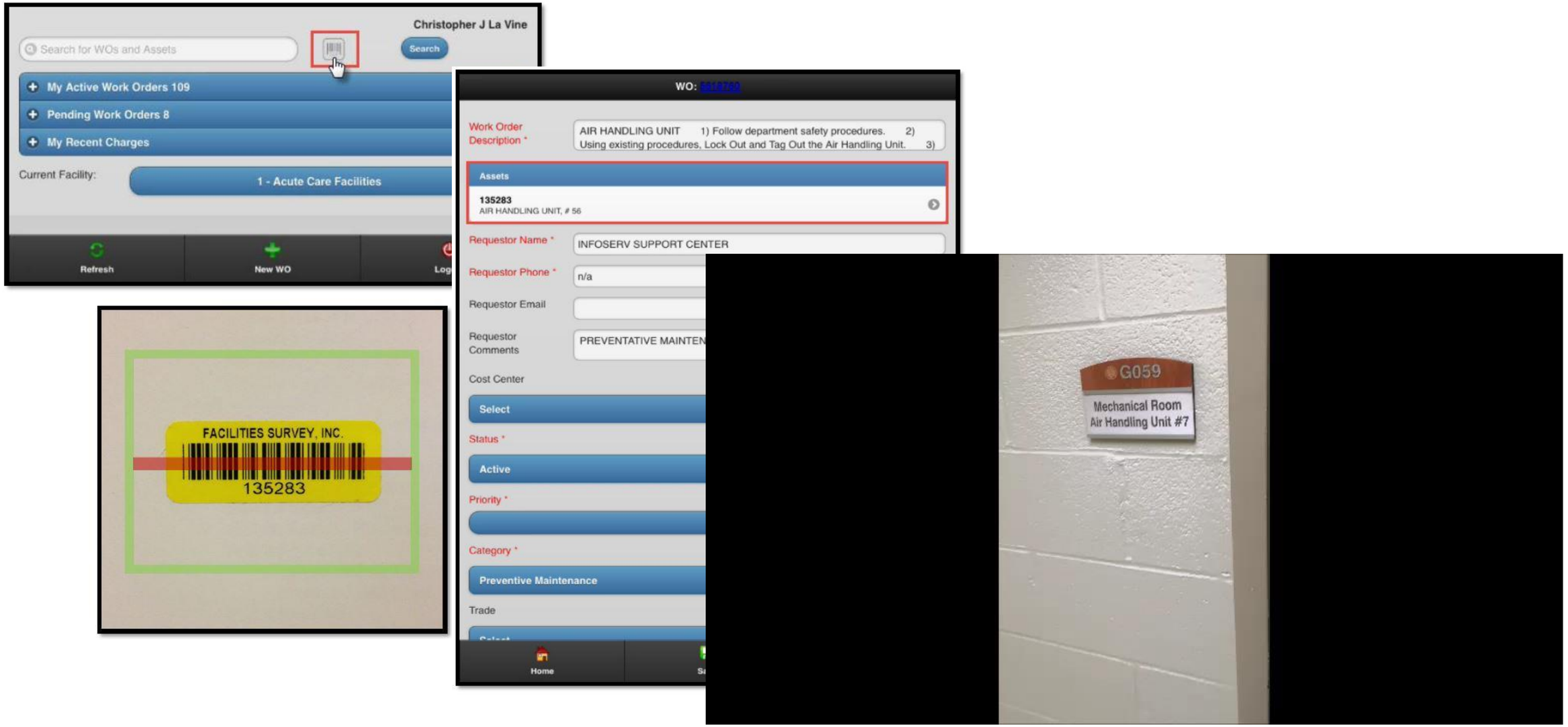
Asset Management

CMMS – FM/POM Asset Management – CMS Dashboard



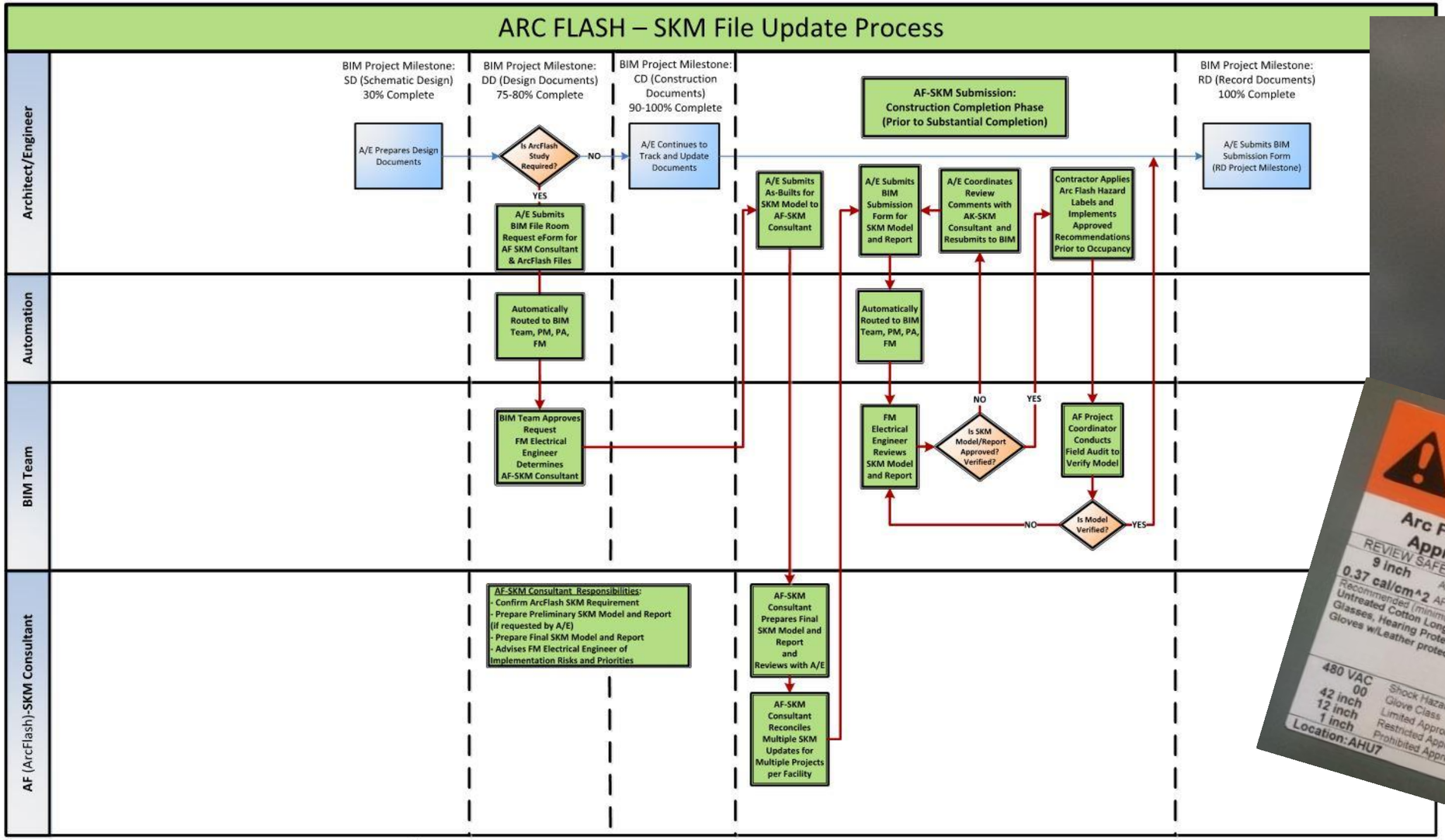
Asset Management

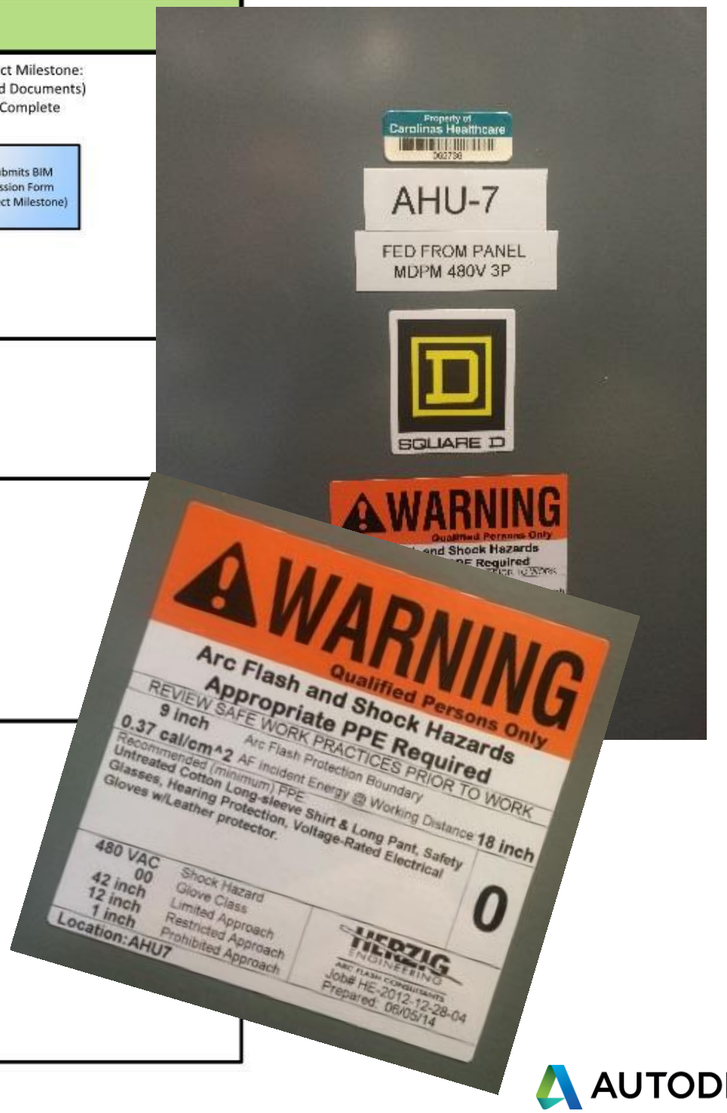
CMMS – FM/POM Asset Management – Mobile Device Application



Supplemental Documentation

ArcFlash - SKM File Management thru BIM Process

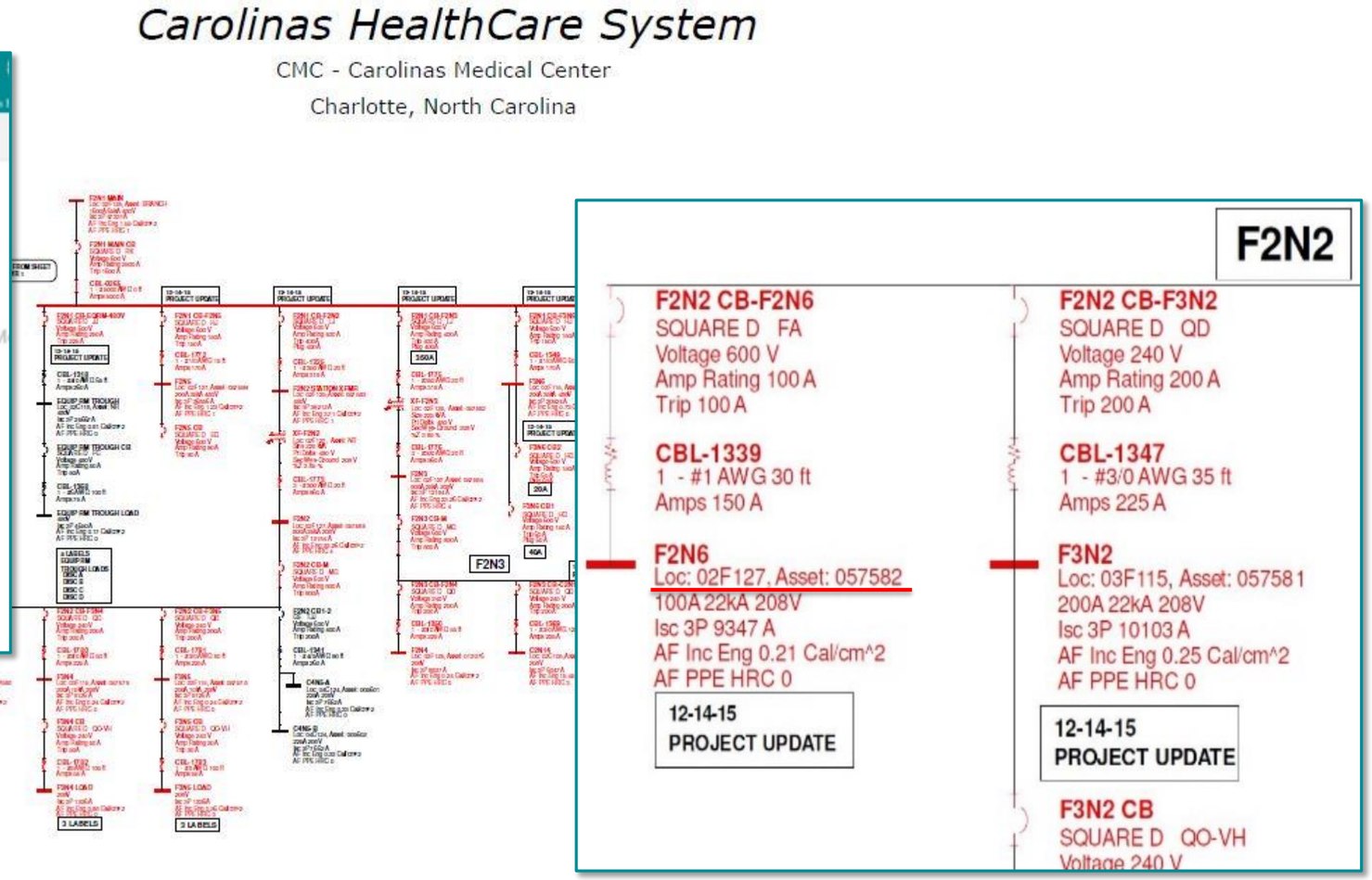




Supplemental Documentation

ArcFlash – Reports and One-line Diagrams

- BIM External 2 – SharePoint Site Access



Supplemental Documentation

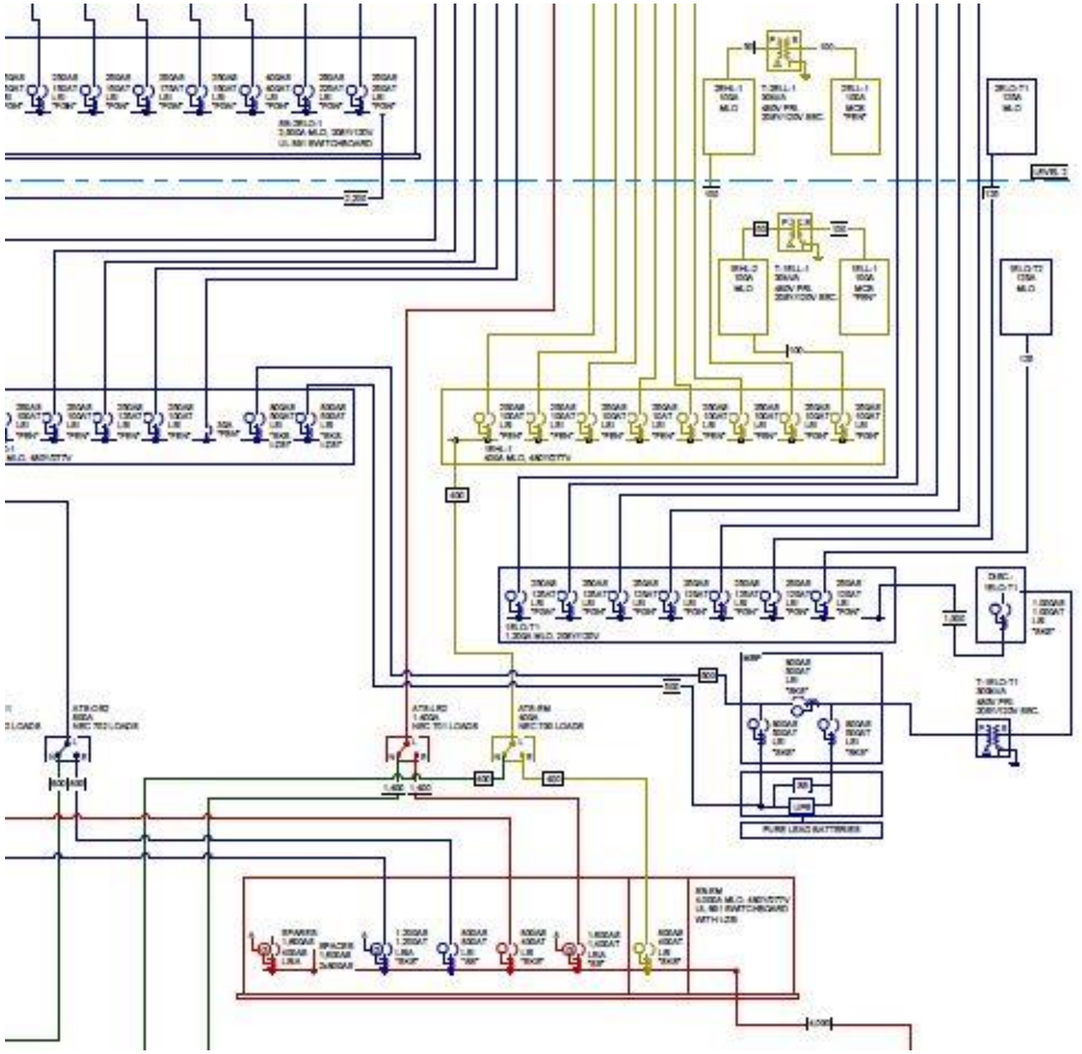
Master Facility Electrical Riser Diagrams – BIM Process 2017

- A/E uses CHS Single-Line Diagram Revit Template available on the BIM SharePoint Site.

- Diagrams are color coded per CHS/DHSR compliance standards.

- A/E submits Final Master Facility Single-Line Diagram at Record Documentation Closeout Phase.

- CHS BIM and FM-POM Team review submission.



Conclusion

BIM Program Return on Investment

- The CHS BIM Program has demonstrated the following values:
- Project and Construction Management
  - 25% Error and Omission reduction on BIM projects (from 2.2% to 1.66%) Approximate value is $500K on 2013 capital project value of $100M
- Virtual Plan Room
  - 500K Reduction in reimbursable costs over 5 years
- Space Management
  - Annual labor savings of $30K due to reduction in FTE hours entering SF data
- Asset Management
  - Annual savings of $45K due reduction in FTE hours in EAM data entering
- Total annual CHS benefit from the overall BIM Program has exceeded $1.7M over the last five years.

- Award Recognition: The CR-NE project was awarded a 2014 Honorable Mention for BIM in Facilities Management from the National AIA Technology in Architectural Practice Committee

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  - Geoffrey.Coon@carolinashealthcare.org

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- AU speakers will get feedback in real-time.
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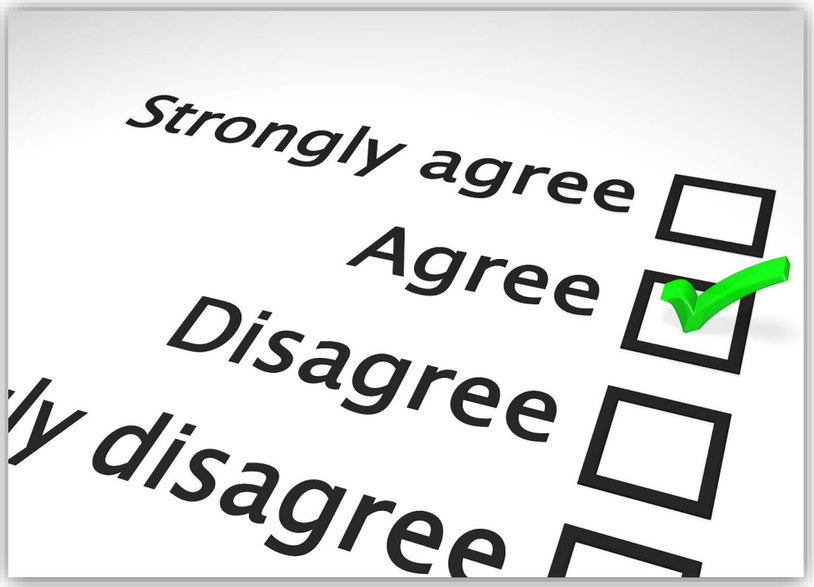

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