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Integrated MEP Design and Construction: The BIM Revolution

Presenter Names

Chip Branscum, PE | cbranscum@pinnaclecad.com

Barry Brunet | bbrunet@bernhardmcc.com

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Speakers Info

Chip Branscum, PE
Director of Engineering
Pinnacle INFOTECH

Director of Engineering at Pinnacle Infotech with 34 years of experience in the HVAC industry, licensed to practice engineering in 25 states. 14 years of design-build experience including Engineer of Record for Ohio's first LEED Platinum Certified project. Active member of local building appeals board, past president of local ASHRAE chapter and Assistant Scout Master/Eagle Coordinator for local Boy Scouts of America Troop 850.

Barry Brunet
BIM/VDC Director
Bernhard MCC

Corporate BIM/VDC Manager for 15 years with Bernard Energy Solutions. Manages BIM teams across offices in 7 different states. Responsible for strategic implementation and solutions within $400M company of over 1,100 employees. Works with teams from pre-design and pre-construction planning throughout successful modelling and coordination of complex projects.

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Key Learning Objectives

- **Integrated Design – What does this really mean?**
  - Building Information Modelling software can to improve design efficiencies, save time, reduce errors, and construction costs.
- **Central Model Collaboration**
  - Using an integrated central model to optimize design and coordination between disciplines.
- **Integrating Software**
  - Using software solutions for design, analysis, and collaboration.
- **Lesson Learned Case Studies**

Global Offices

Durgapur Campus (India)

Kolkata Campus (India)

Jaipur Campus (India)

Houston Office, U.S.A.

London (U.K.)

Calolziocorte (Italy)

Dubai (U.A.E.)

Zurich (Switzerland)

Sample Projects

UC Berkeley Memorial Stadium, USA

Well Pharma Medical Plant, UAE

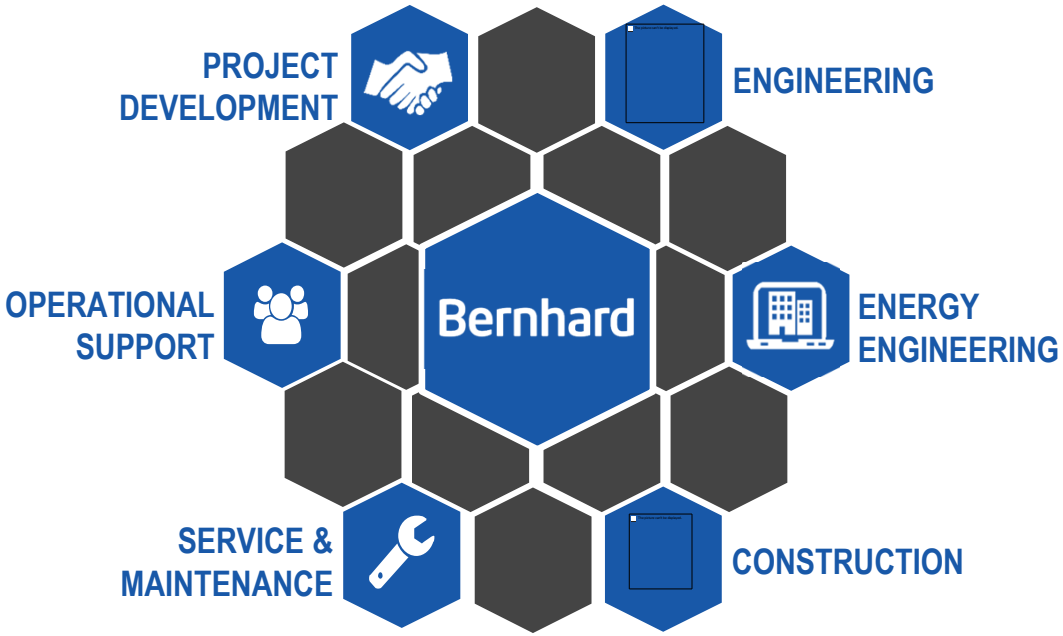
Marlins Park Stadium, USA

New Orleans International Airport

Central Baptist Hospital, USA

Dubai International Airport, UAE

The **Bernhard** Companies came together to offer a holistic **"Energy-as-a Service"** solution.



MISSION: ***Bernhard*** *delivers innovative engineering, construction, and energy solutions that empower our clients and promote a sustainable future.*

Bernhard MCC

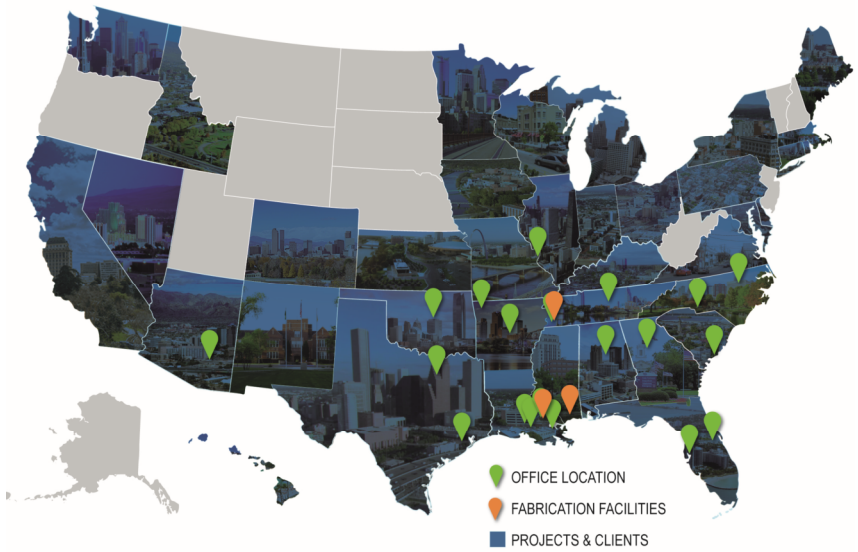
100+ YEARS
FOUNDED IN 1919

$800+ MILLION
ANNUAL REVENUE

3,000
EMPLOYEES

900
ACTIVE PROJECTS

$38.5 Million
ANNUAL ENERGY SAVINGS



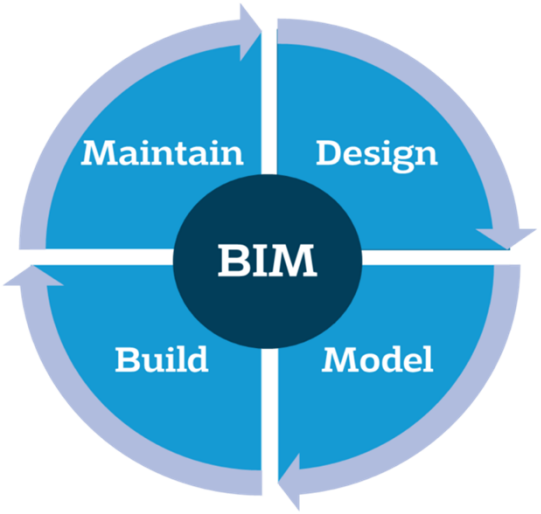
ENERGY-AS-A-SERVICE

We have the in-house expertise to deliver the right solution for your needs. As an integrated team, we have the unique ability to self-perform every facet of a project as a turnkey solution. Together, we deliver better ideas.

ENGINEERING | MECHANICAL CONSTRUCTION | ELECTRICAL CONSTRUCTION | OPERATIONS & MAINTENANCE

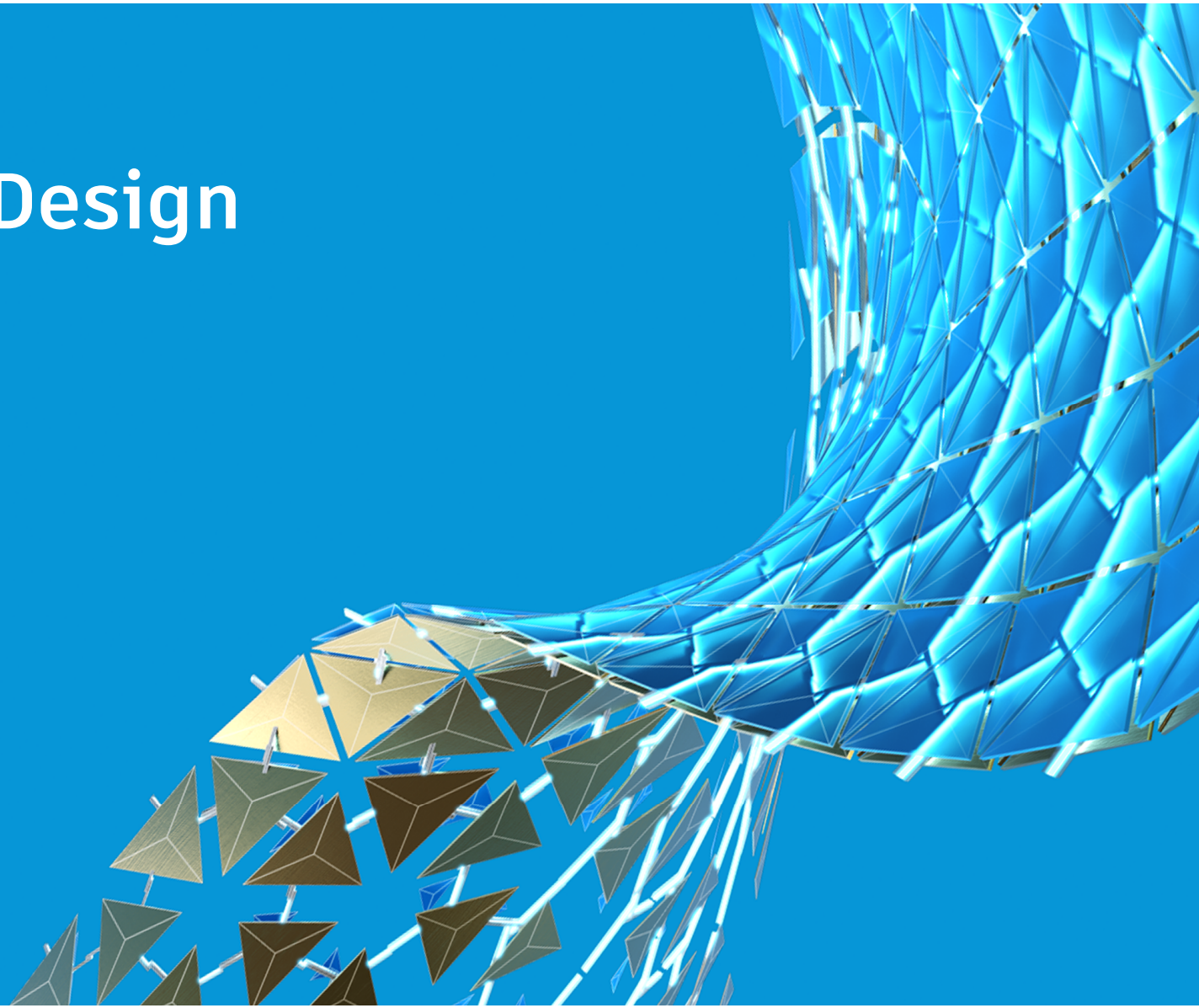
Bernhard

Bernhard MCC – BIM/VDC

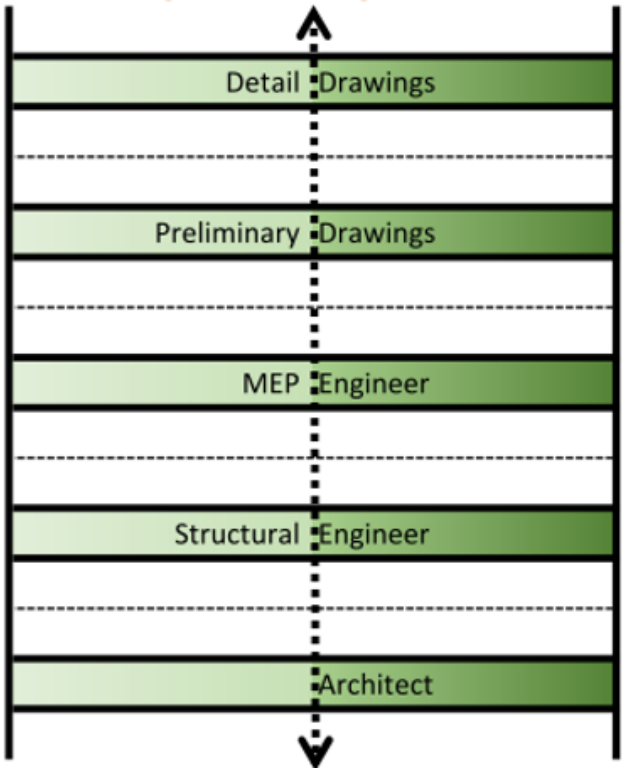


- **50+** In-house BIM/VDC Staff Members
- **12** Experienced in Leading BIM Coordination efforts:
  - Clash detection with viewpoint organization
  - Recommending coordination changes
  - Working with GC and trade partners to develop RFIs
- All BIM/VDC Staff have Navisworks Manage with the Glue Plug-in
- All BIM/VDC Staff have Autodesk Fabrication, Bluebeam & Revit with Fabrication Parts
- **7** Full Time In-house Fabrication Detailers
- **10** Trimble Robotic Stations with 10+ operators in the Carolina Region

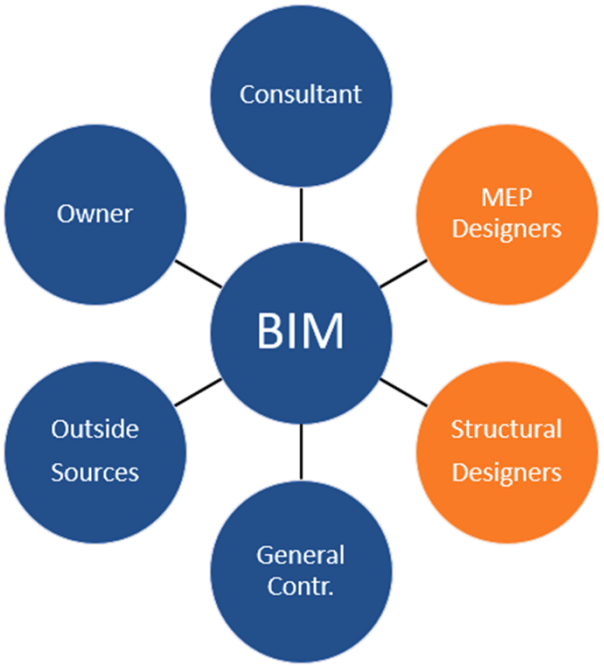
Integrated Design



Integrated BIM Design



Concurrent Process

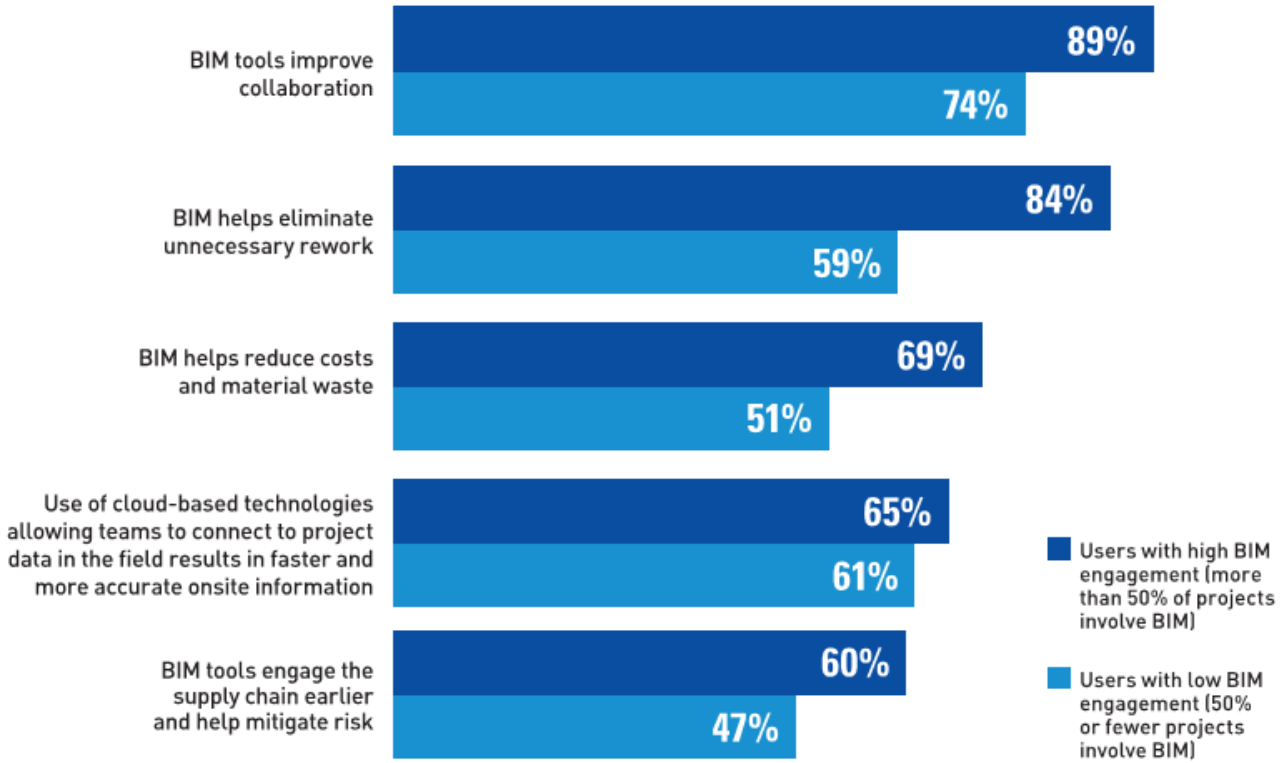


System Integration

Dodge Analytics Survey

Top Values of BIM (by Level of BIM Engagement)

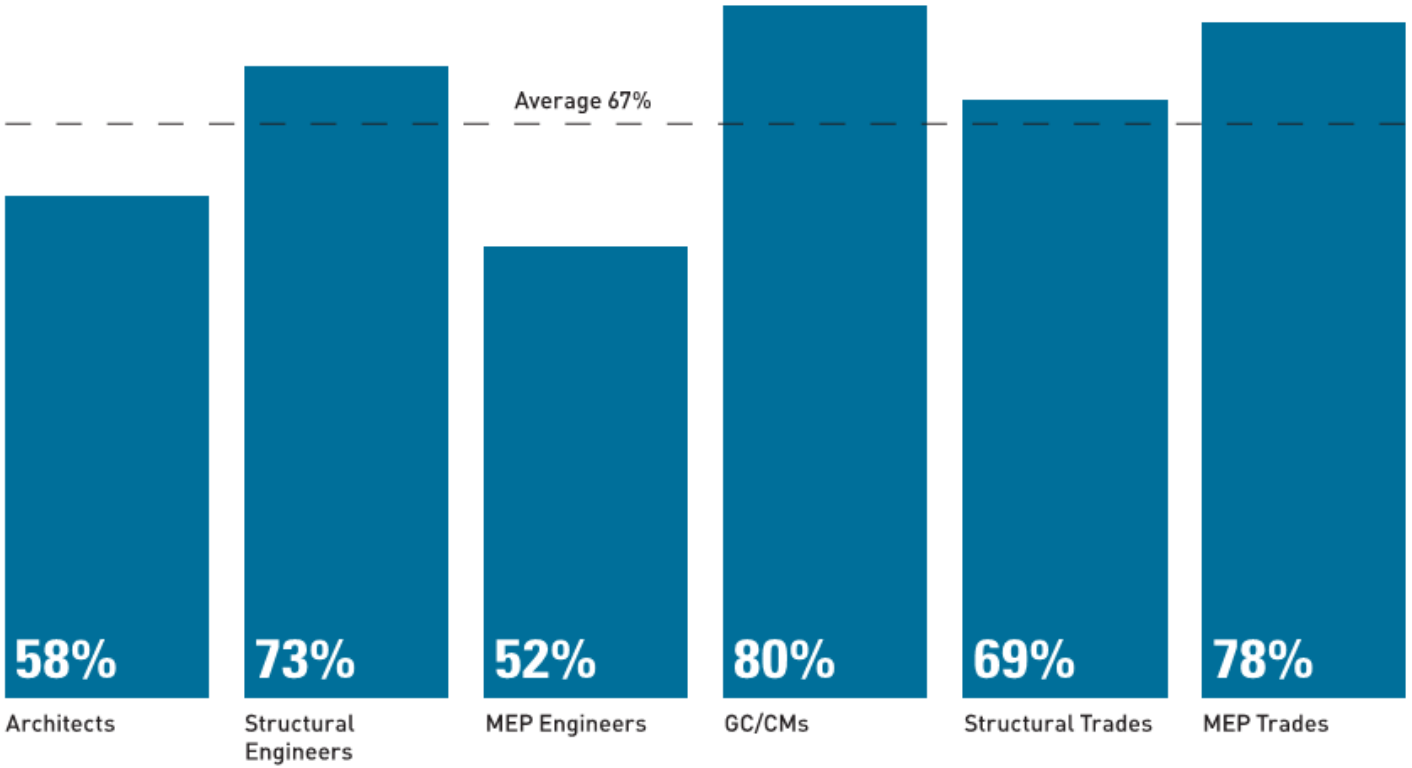
Percentage of high and low engagement BIM users who agree or strongly agree with each value statement



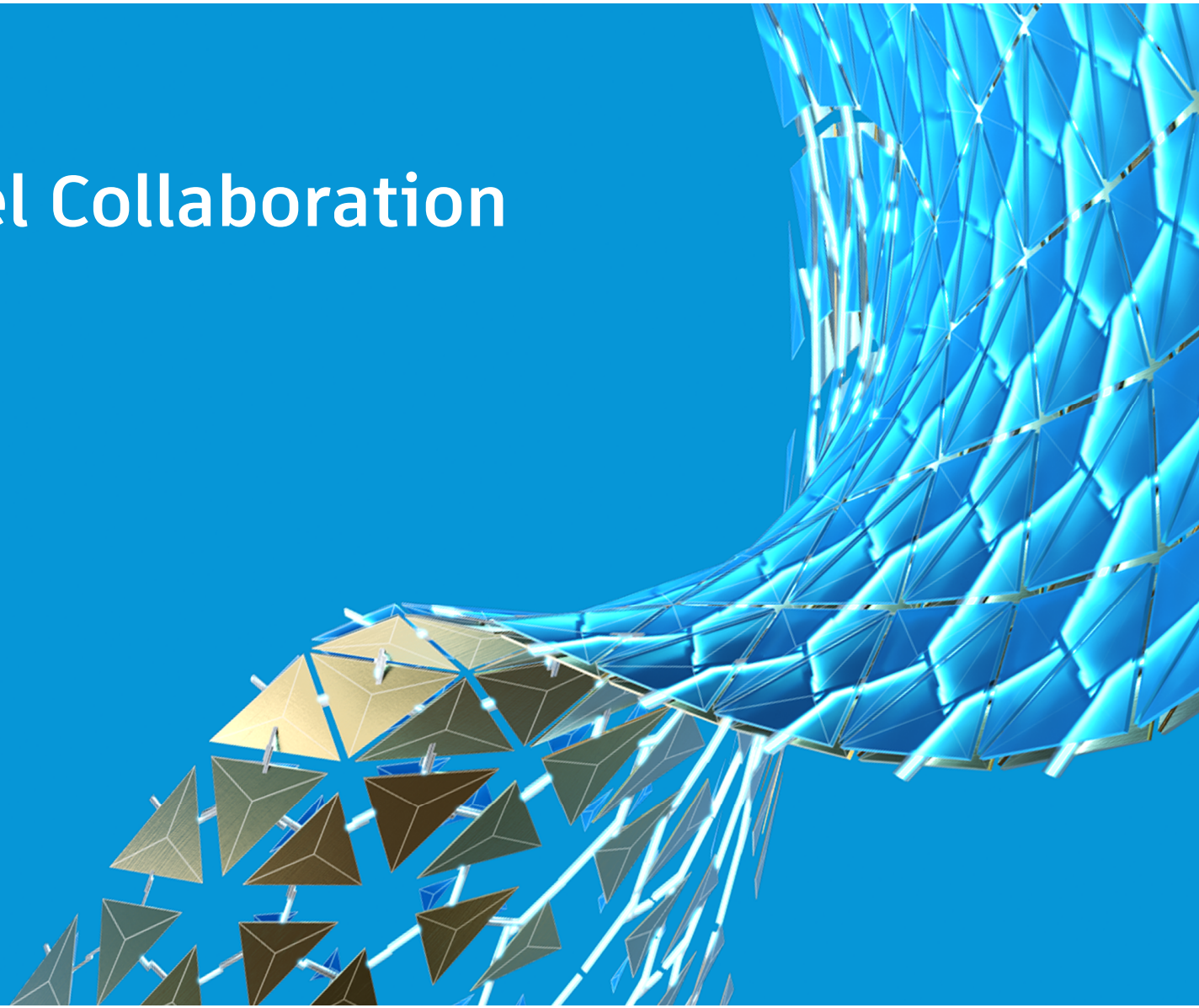
Dodge Analytics Survey

Top Values of BIM (by Discipline)

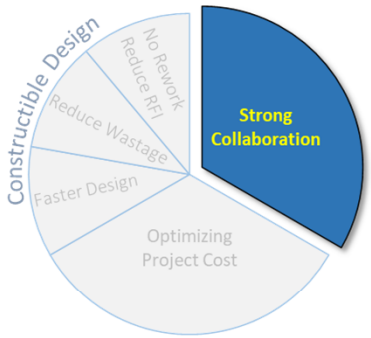
Percentage of each discipline that agrees or strongly agrees with all value statements



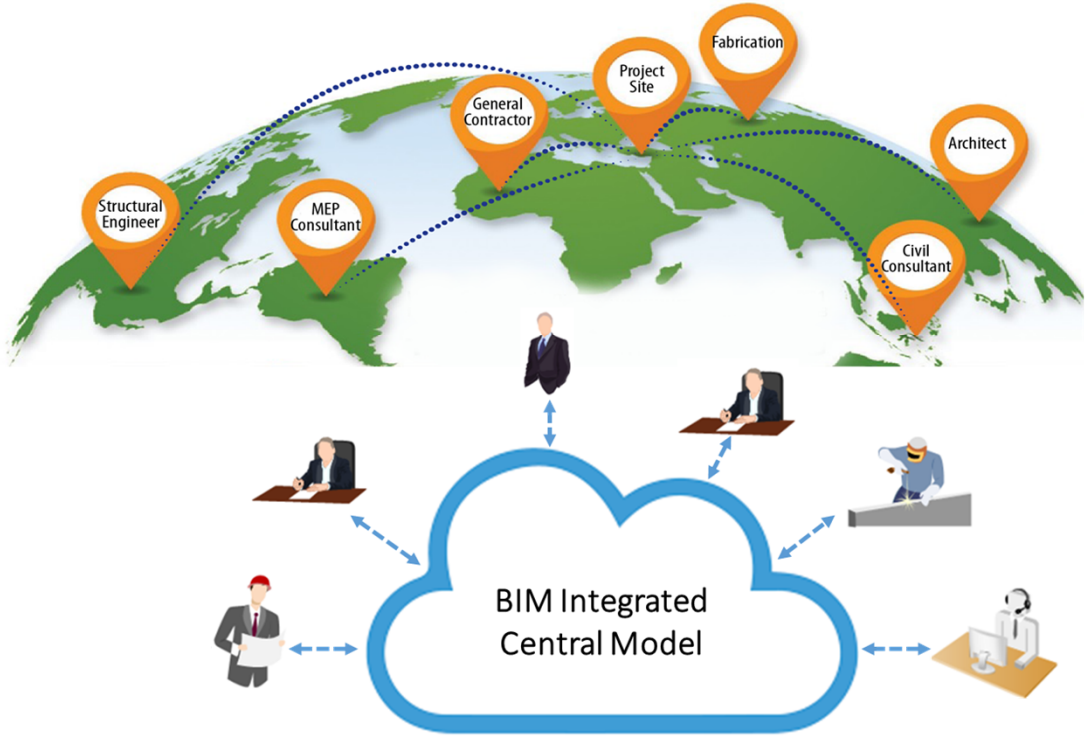
Central Model Collaboration



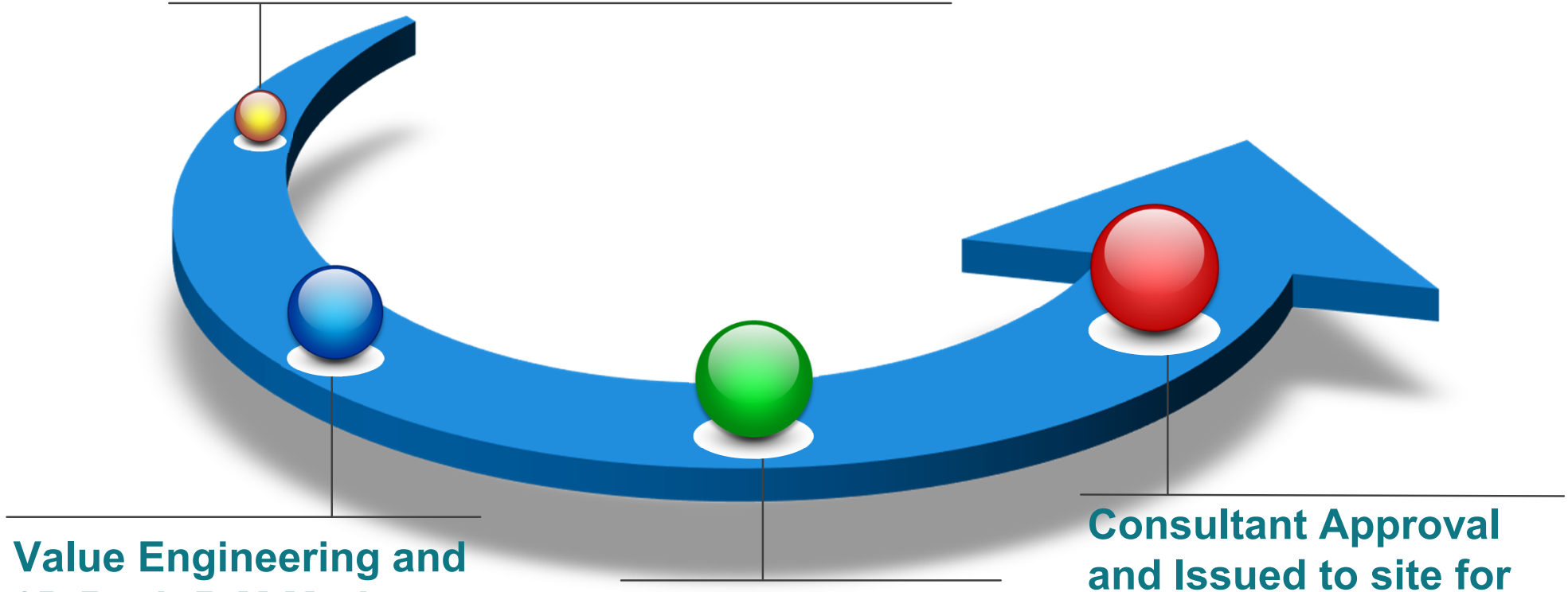
Collaboration



- One central model
- Real-time communication
- Up-to-date information



Connectivity



Team Collaboration

Owner

Virtual Design Manager

Architect

BIM360

- PROJECT E-MAIL
- DOCUMENT CONTROL
- RFI
- FILE TRANSFER
- MARKUPS
- TRANSMITTALS

Engineering Consultants

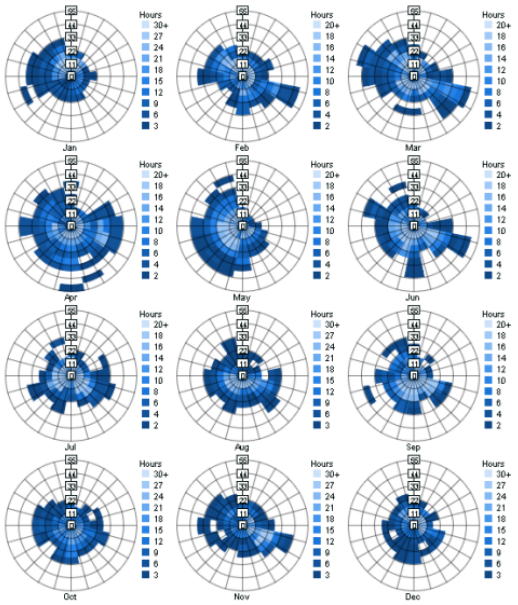
General Contractor

Site Team

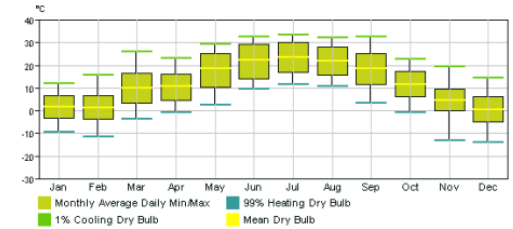
Specialty Consultants

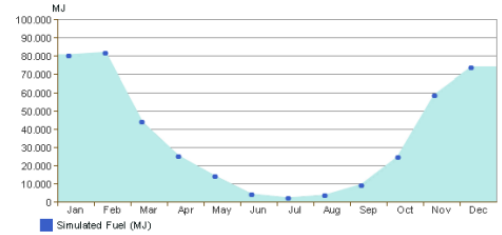
Specialty Contractors
HVAC
Electrical
Plumbing
Fire

Energy Models

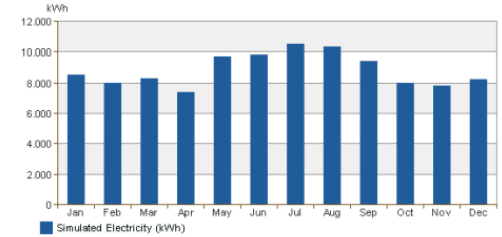


Monthly Design Data

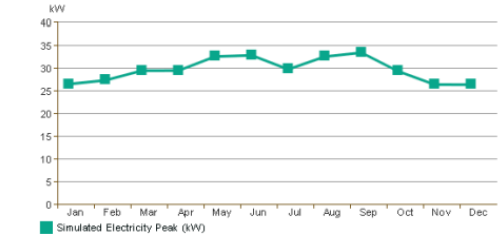




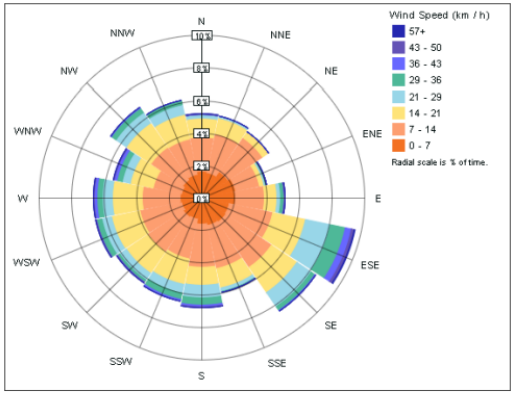
Monthly Electricity Consumption



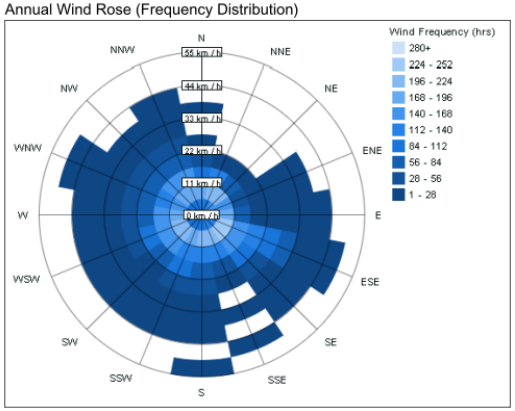
Monthly Peak Demand



Annual Wind Rose (Speed Distribution)



Annual Wind Rose (Frequency Distribution)



Monthly Wind Roses

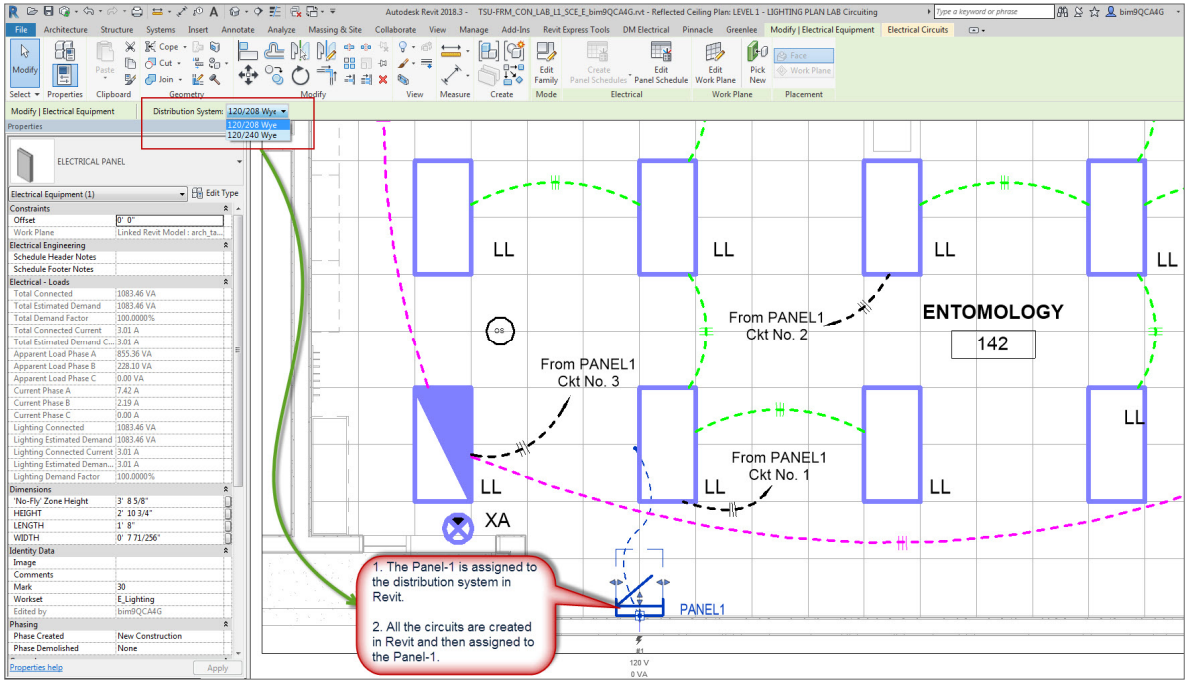
Lighting Simulation

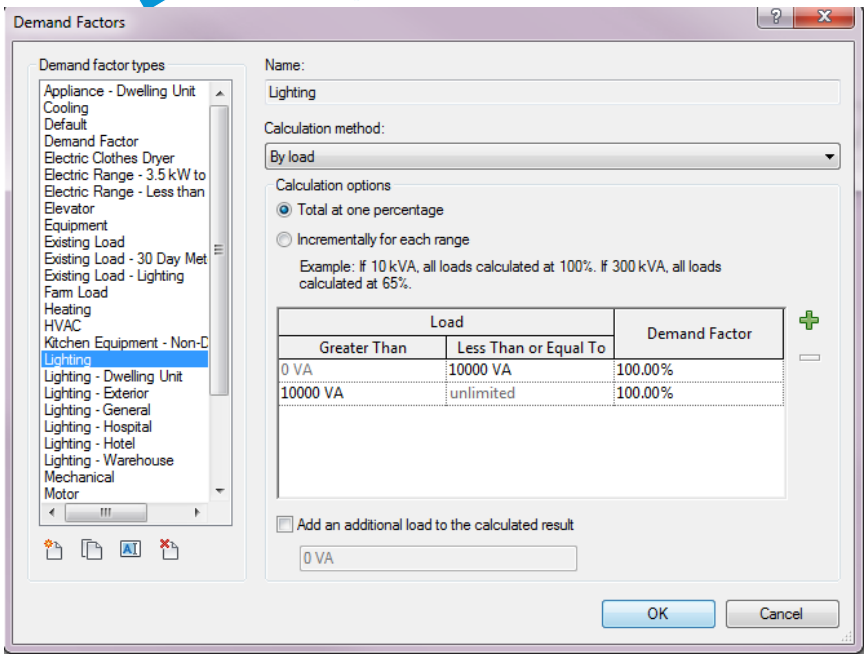
Lighting renderings using **DIALux**

Lighting rendering using **ElumTools** (an add-in in Revit)

Rendering image in **Navisworks Manage**

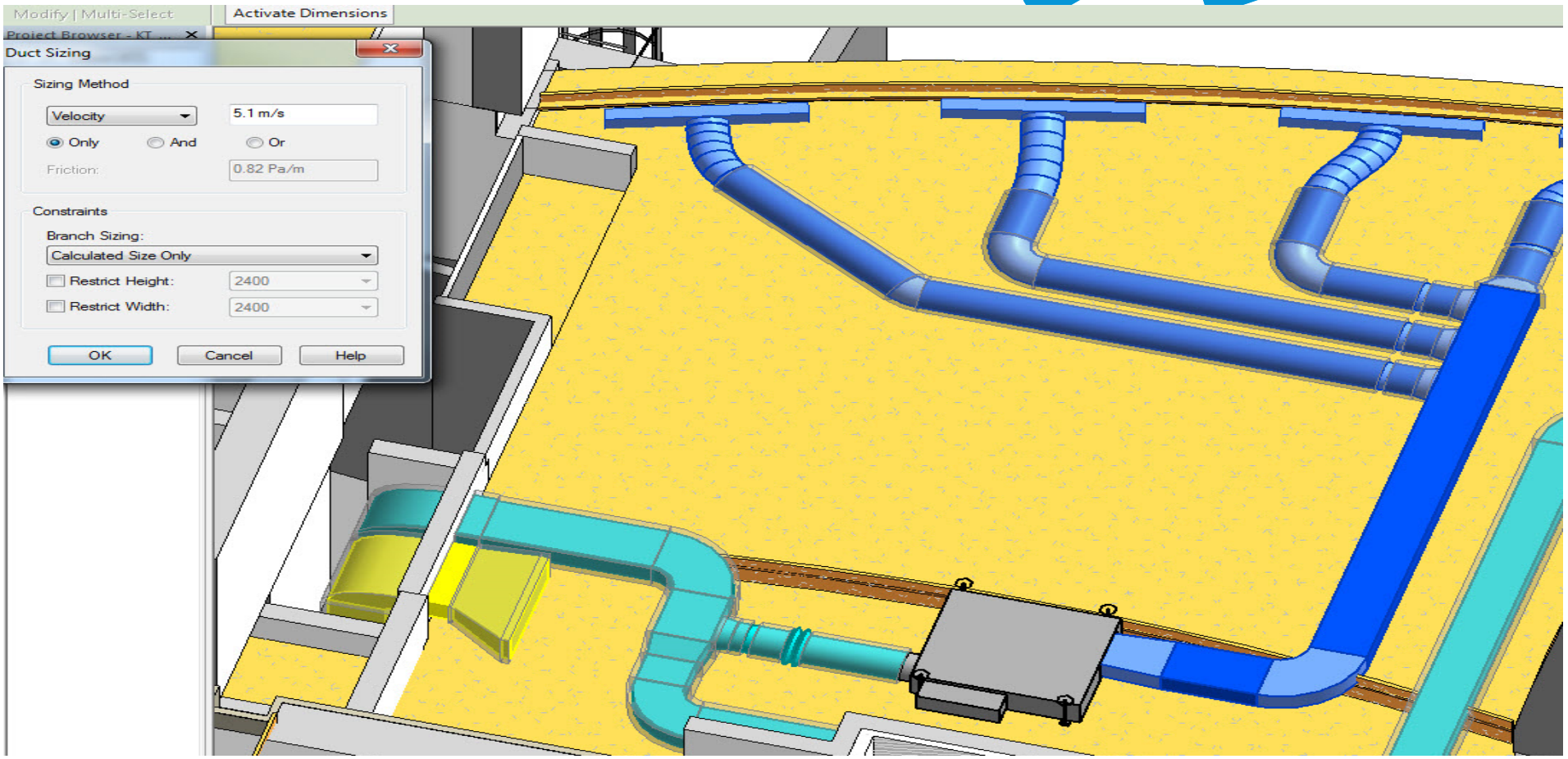
Electrical Design



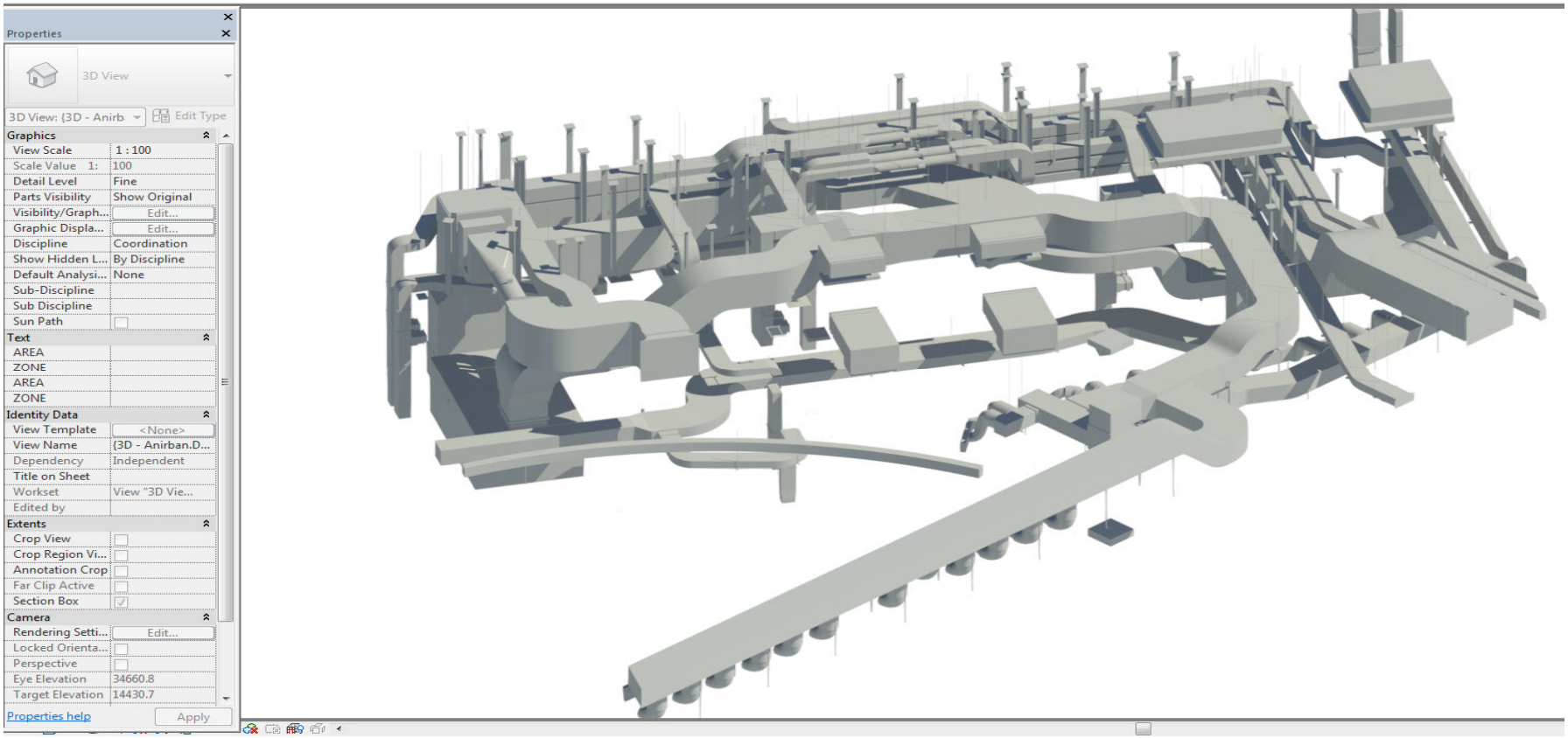


- ❑Classify the load
- ❑Define their demand factor in Revit
- ❑Easily reflect load classification in panel schedule as well as demand load.

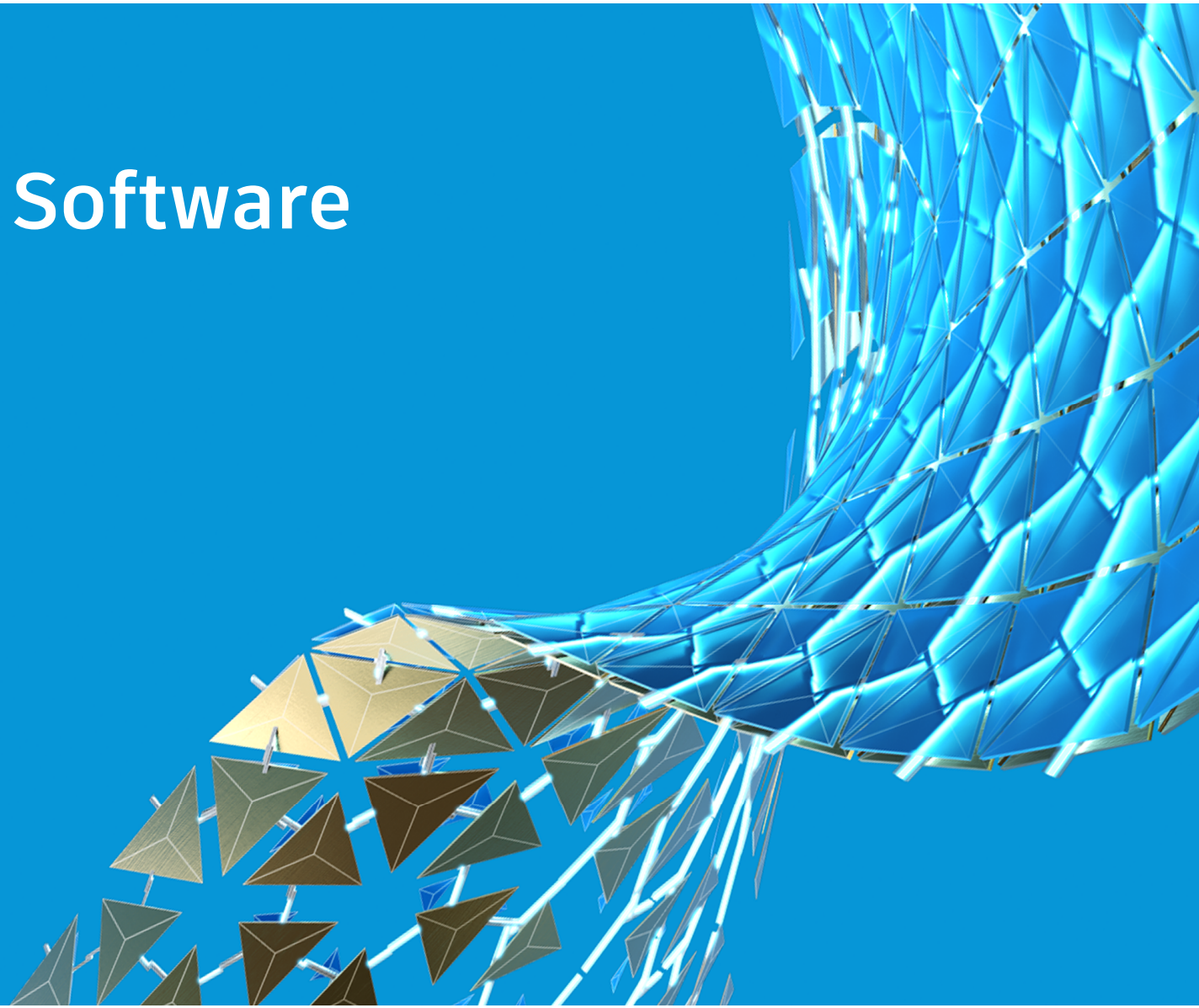
Duct Design - Revit



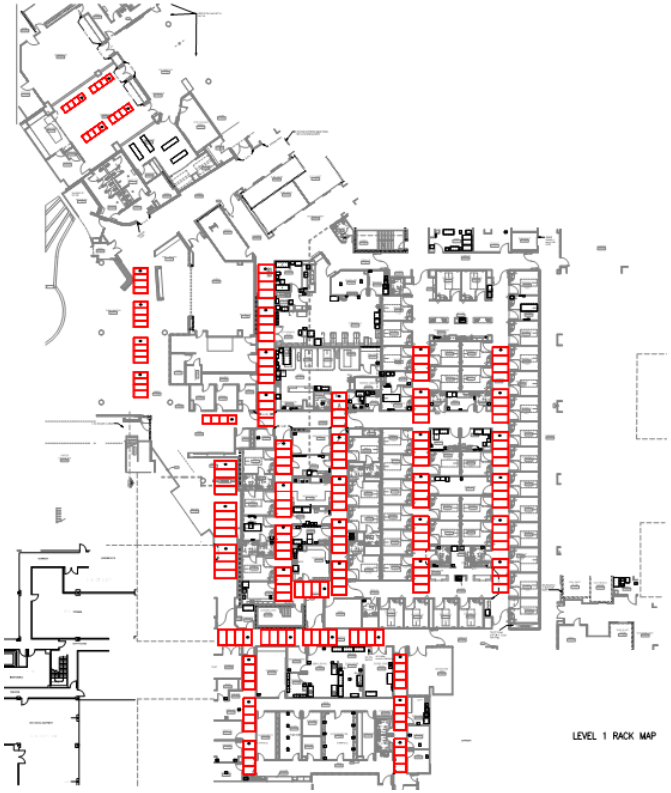
Static Pressure Analysis



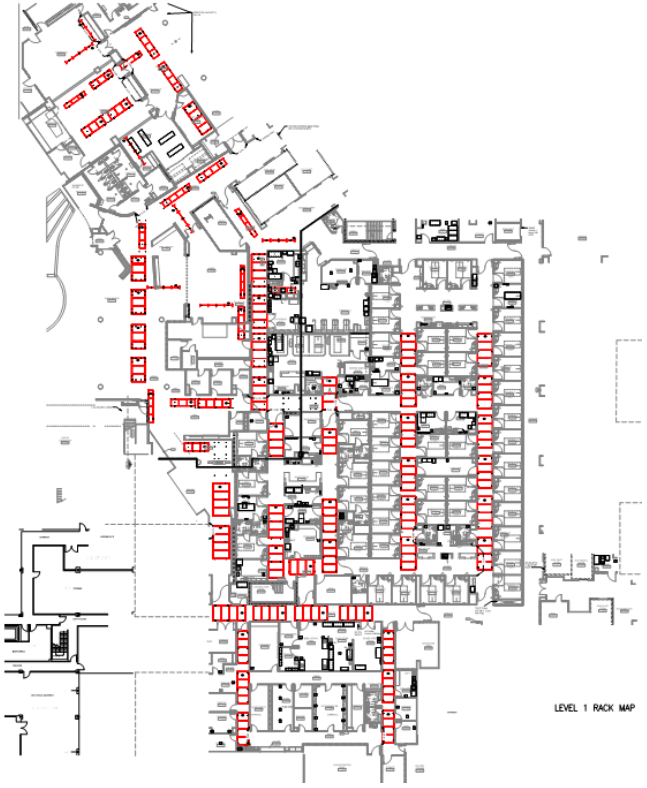
Integrating Software



MEP Rack Design

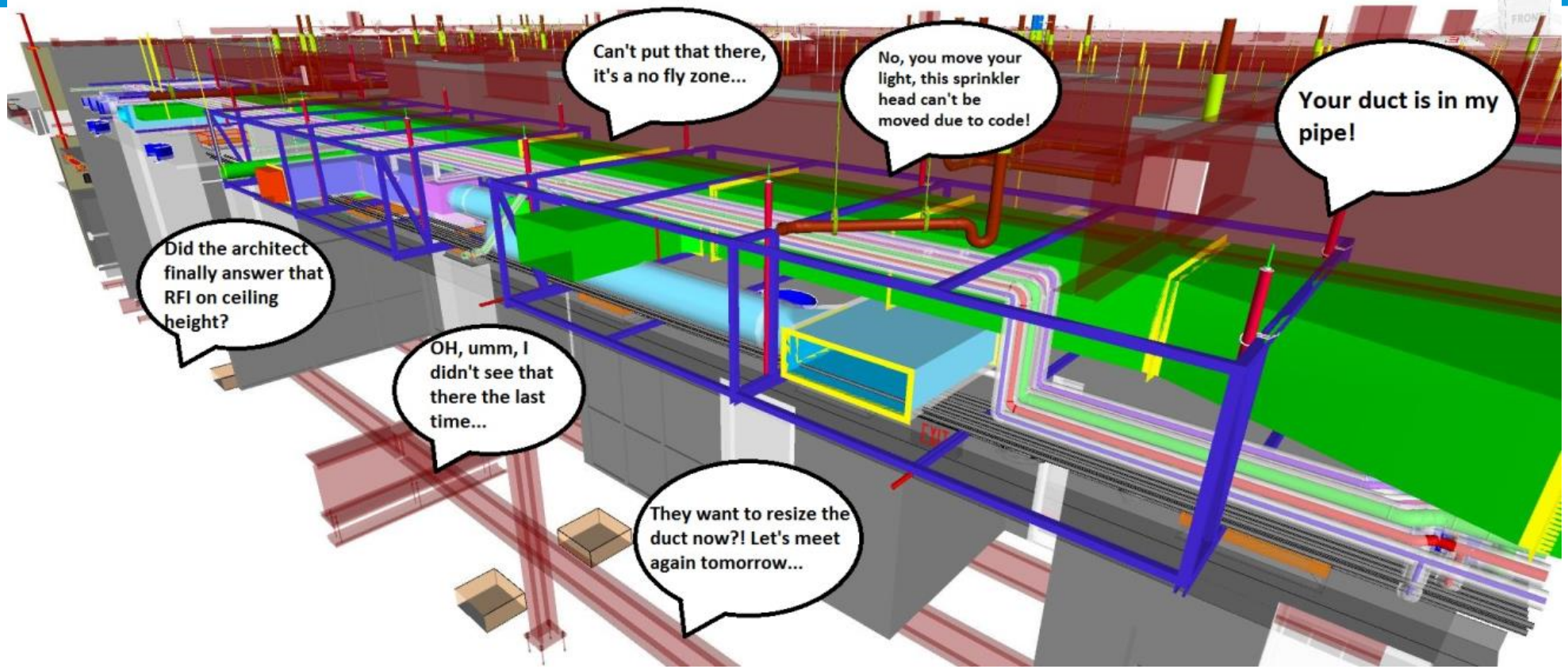


Pre Design

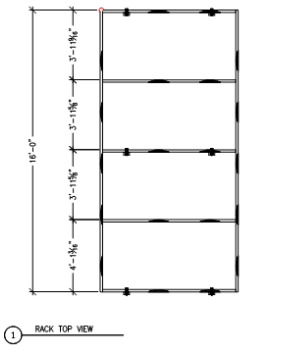


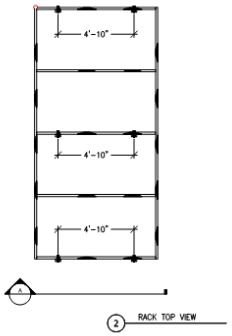
Actual Rack System

Coordination Challenges



MEP Rack Design



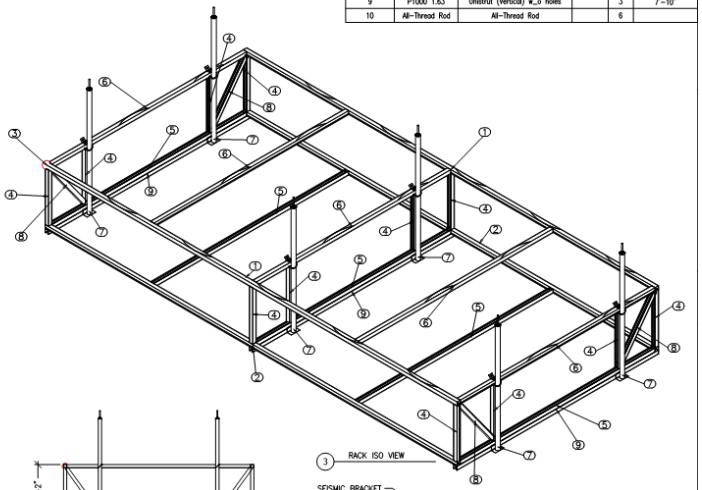


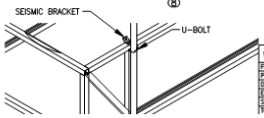
FITTINGS

Tag No.	Size	Qty	Cnctr 1	Cnctr 2	Cnctr 3	Cnctr 4	Source	Fittings	Order
3	ROP	1	None	None	None	None	ROP	ROP	

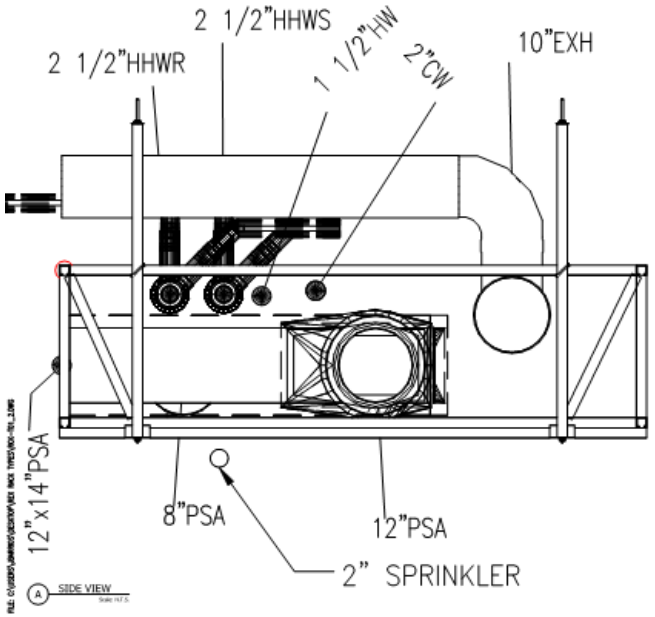
Rack–Assembly Materials

Tag No.	Size	Description	Order	Qty	Length (ft)
1	P1000 1.63	Unistrut (Vertical)		2	16'–0"
2	P1000 1.63	Unistrut (Vertical) w_o holes		2	16'–0"
4	P1000 1.63	Unistrut (Vertical) w_o holes		12	1'–10 3/4"
5	P1000 1.63	Unistrut (Vertical) w_o holes		5	7'–6 3/4"
6	P1000 1.63	Unistrut (Vertical)		5	7'–6 3/4"
7	L2x2x1/8	Equal Angle (Horizontal)		6	4"
8	P1000 1.63	Unistrut (Vertical) w_o holes		4	2'–2 3/4"
9	P1000 1.63	Unistrut (Vertical) w_o holes		3	7'–10"
10	All–Thread Rod	All–Thread Rod		6	

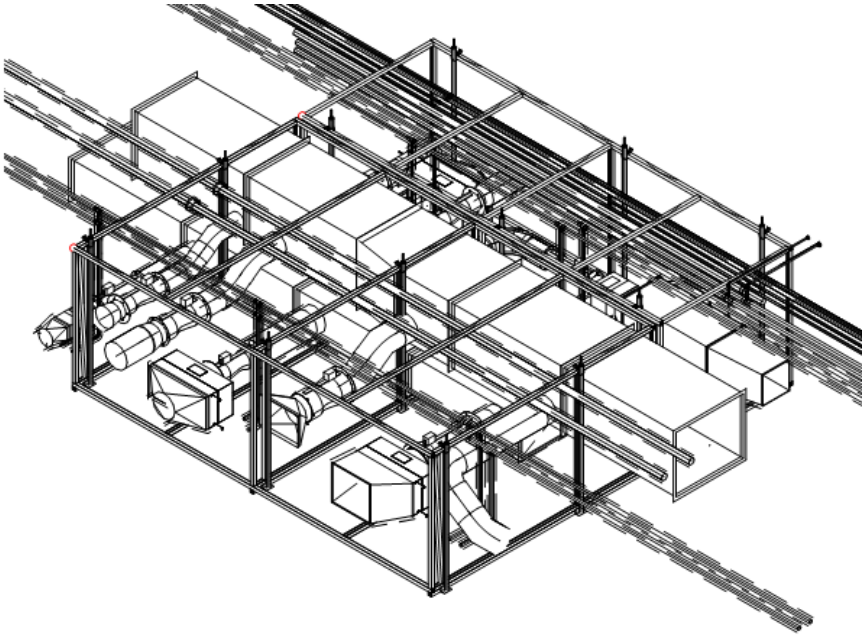




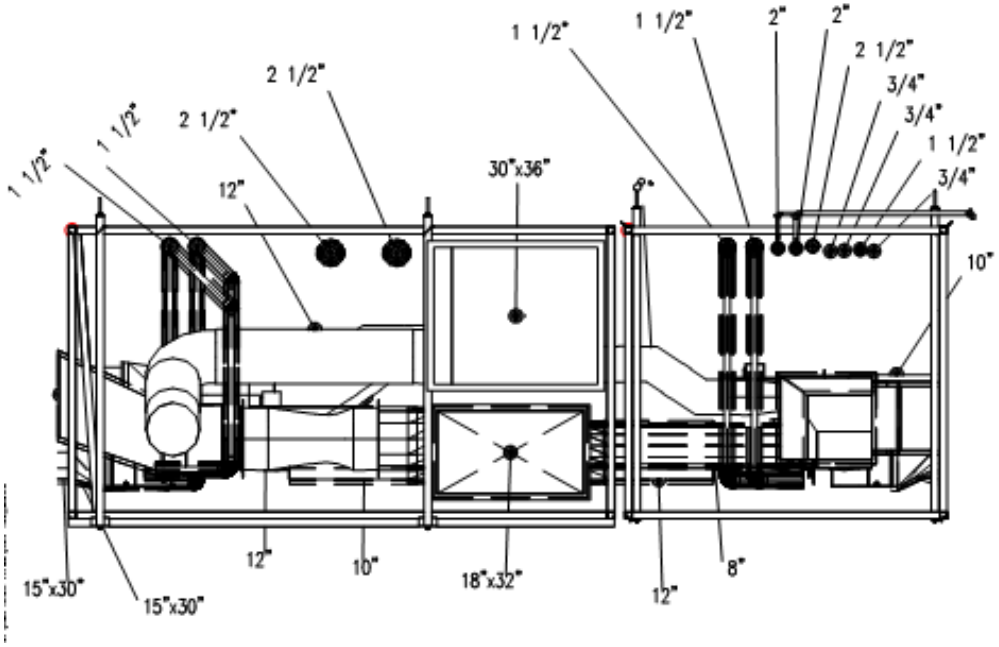
WEIGHT CALCULATIONS:
FRAME WEIGHT = 344 LBS.
PIPE WEIGHT= 330 LBS.
DUCT WEIGHT = 440 LBS.
ELEC WEIGHT = 0 LBS.
SPRK WEIGHT = 154 LBS.
TOTAL WEIGHT = 1268 LBS.



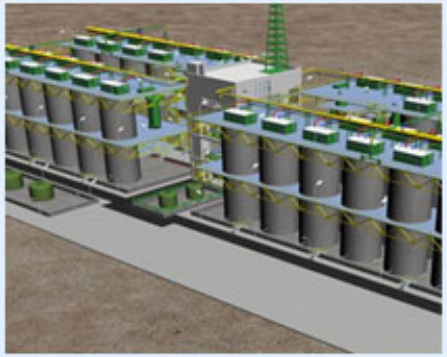
MEP Rack Design

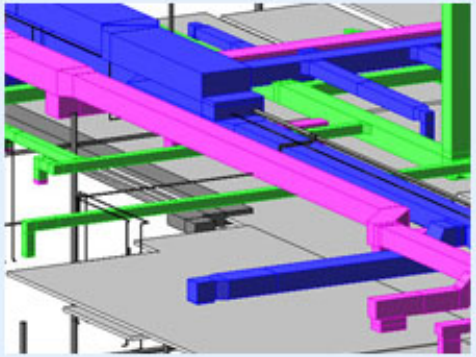


3 RACK ISO VIEW



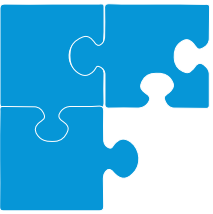
Navisworks

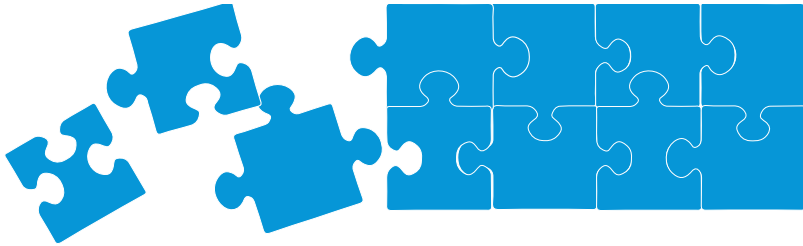





- ❑Reduce/Eliminate RFI and change orders as constraints of construction
- ❑Deliver clash-free Constructible Model
- ❑Simulation/Optimization & Evaluation of Design stages – integrated design/analysis
- ❑Flexibility to edit & change quickly
- ❑Collaboration with Owners, Architects, Contractors and others using BIM 360
- ❑Quality Output

Sample software





AUTODESK REVIT MEP

AUTODESK AUTOCAD

HAP HOURLY ANALYSIS PROGRAM

COMcheck™ REScheck™

VisualARQ Flexible BIM for Rhino

DIALux

eQUEST

AUTODESK® BIM 360™

AutoSPRINK FIRE SPRINKLER COMPUTER AIDED DESIGN

etap Thinking Power

TRANE TRACE™ 700

energyPRO

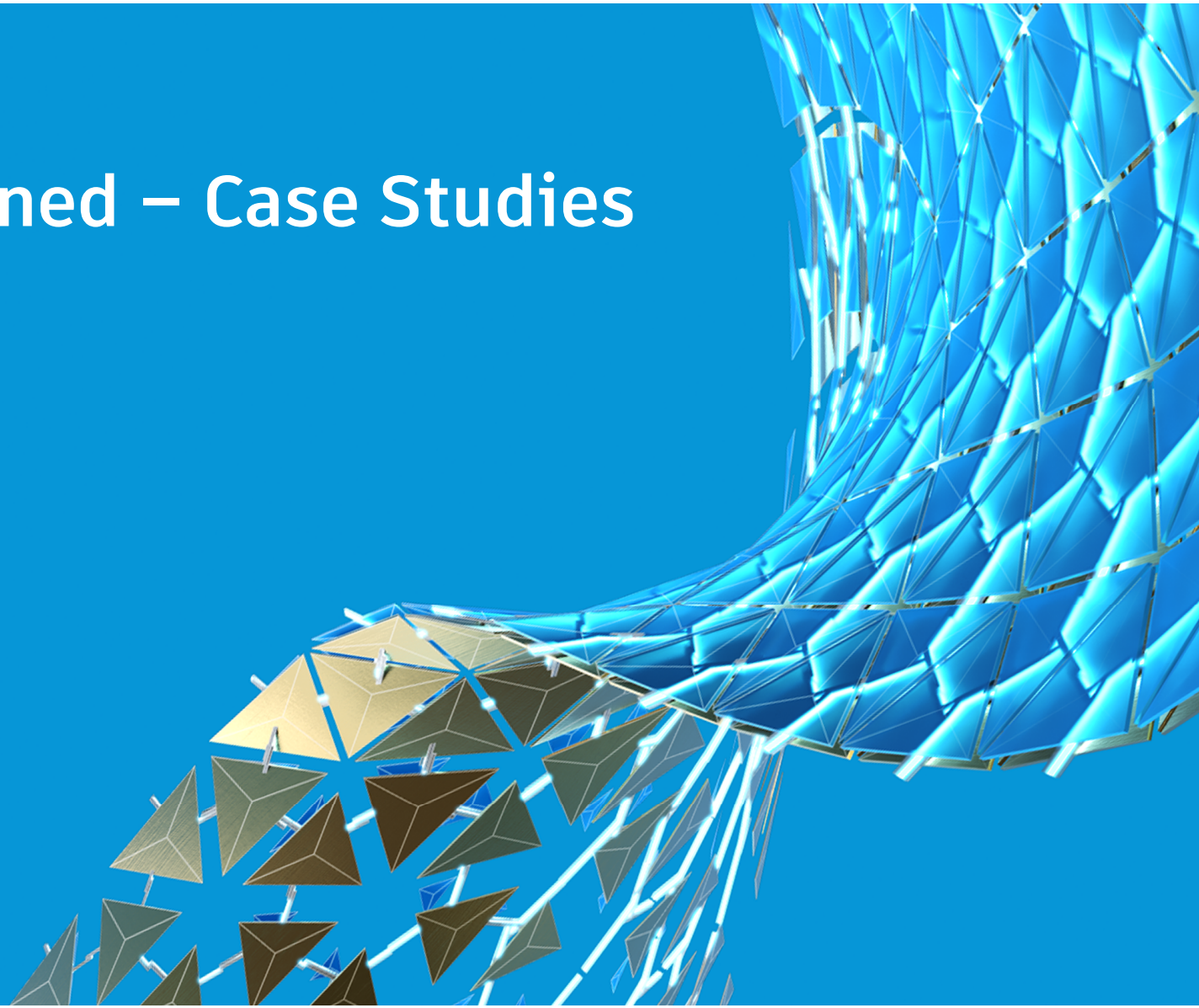
AUTODESK NAVISWORKS

eVolve MEP

McQuay Air Conditioning

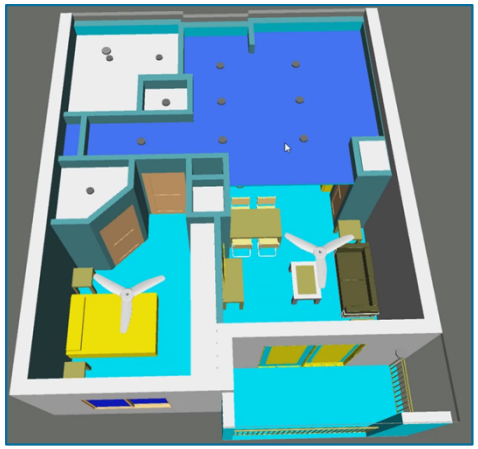
AUTODESK® REVIT® Structures

Lessons Learned – Case Studies



Heat Load Calculations

Tonnage of the Dwelling Unit Saved almost **1/4th** Time of Conventional Method



No.	Name	System	Zone	Width	Length	Height	Check Errors
1	Unit A1	1	1	520	1	10	No

Floor Material

		U-Value	Width	Length	Perimeter	STD	WTD
S D C	1	0	0	0	0	0	0
S D C	2	0	0	0	0	0	0

Roof/Ceiling Material

		U-Value	Width	Length	Direction	STD	WTD
S D C	1 18A-38	0.026	520	1	UP	0	0
S D C	2	0	0	0	UP	0	0

Wall Material

		U-Value	Length	Height	Direction	STD	WTD
S D C	1 12C-3sw	0.064	22.3	9.1	N	0	0
S D C	2 12C-3sw	0.064	22.0	9.1	S	0	0
S D C	3 12C-3sw	0.064	27.5	9.1	S	0	0
S D C	4	0	0	0	N	0	0

Glass Material

		U-Value	SHGC	Width	Height	Ref	Occ.	O.Proj	O.Off
S D C	1 IECCWIND2015	0.4	0.25	6.25	3	1	2	0	0
S D C	2 IECCWIND	0.4	0.25	6.25	3	2	2	0	0
S D C	3	0	0	0	0	0	0	0	0
S D C	4	0	0	0	0	0	1	0	0
S D C	5	0	0	0	0	0	1	0	0

Door Material

		U-Value	Width	Height	Ref
S D C	1	0	0	0	0
S D C	2	0	0	0	0

People & Equip.

Ppl:	2
S.Eq:	5034
L.Eq:	683

Other

Regs:	0
Infil:	0
Vent:	0
Light:	260
Rm.Qty	1
Mode:	Both
Rad.F:	0
Notes:	[Data]

Rhvac - Residential & Light Commercial HVAC Loads — Elite Software Development, Inc.
Pinnacle Infotech Inc [Houston — Bishop_highline_lot_1
Houston, TX 77036 — Page 8

System 1 Room Load Summary

Room No	Name	Area SF	Htg Sens Btuh	Min Htg CFM	Run Duct Size	Run Duct Vel	Clg Sens Btuh	Clg Lat Btuh	Min Clg CFM	Act Sys CFM
---Zone 1---										
1	Unit A1	520	4,440	59	5-6	460	9,746	1,083	452	452
	Ventilation		1,782				1,049	591		
	System 1 total	520	6,222	59			10,794	1,674	452	452

System 1 Main Trunk Size: 8x12 in.
Velocity: 678 ft./min
Loss per 100 ft.: 0.108 in.wg

Cooling System Summary

	Cooling Tons	Sensible/Latent Split	Sensible Btuh	Latent Btuh	Total Btuh
Net Required:	1.04	87% / 13%	10,794	1,674	12,468

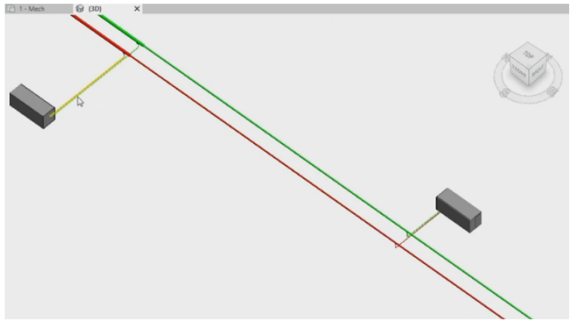
Equipment Data

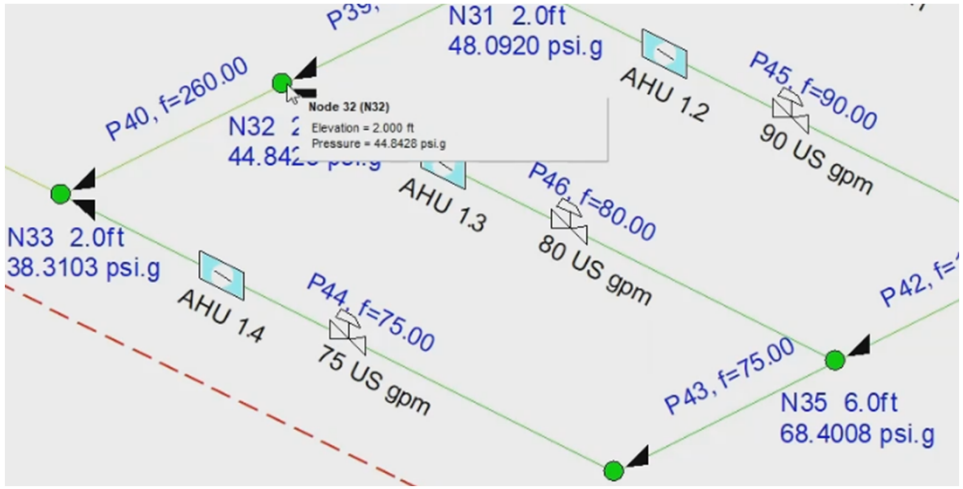
	Heating System	Cooling System
Type:	Natural Gas Boiler	Standard Air Conditioner
Model:		
Indoor Model:		
Brand:		
Efficiency:	0 AFUE	0 SEER
Sound:	0	0
Capacity:	0 Btuh	0 Btuh
Sensible Capacity:	n/a	0 Btuh
Latent Capacity:	n/a	0 Btuh

This system's equipment was selected in accordance with ACCA Manual S.
Manual S equipment sizing data: SODB: 99.3F, SOWB: 74F, WODB: 28.7F, SIDB: 75F, SIRH: 50%, WIDB: 70F, Sen. gain: 10,794 Btuh, Lat. gain: 1,674 Btuh, Sen. loss: 6,222 Btuh, Entering clg. coil DB: 77.2F, Entering clg. coil WB: 63.6F, Entering htg. coil DB: 41.9F, Clg. coil TD: 20F, Htg. coil TD: 70F, Req. clg. airflow: 452 CFM, Req. htg. airflow: 59 CFM

Pump Head Calculations

Pump Head Calculation through Pipe Flow Expert Saved almost **50% time** of Conventional

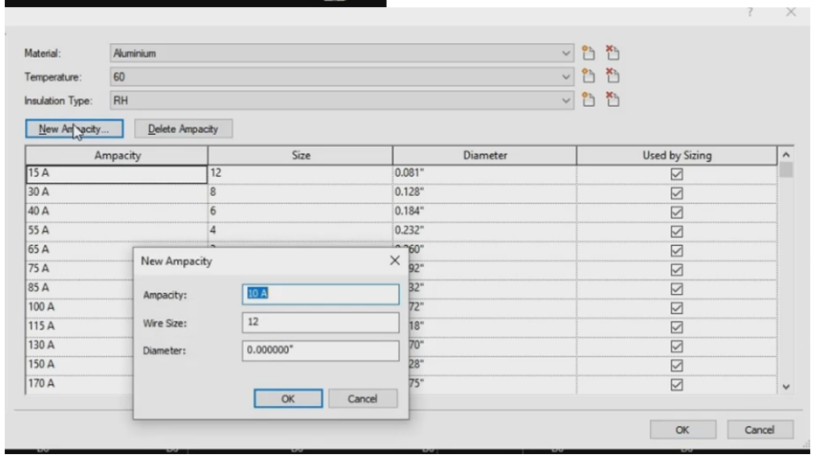


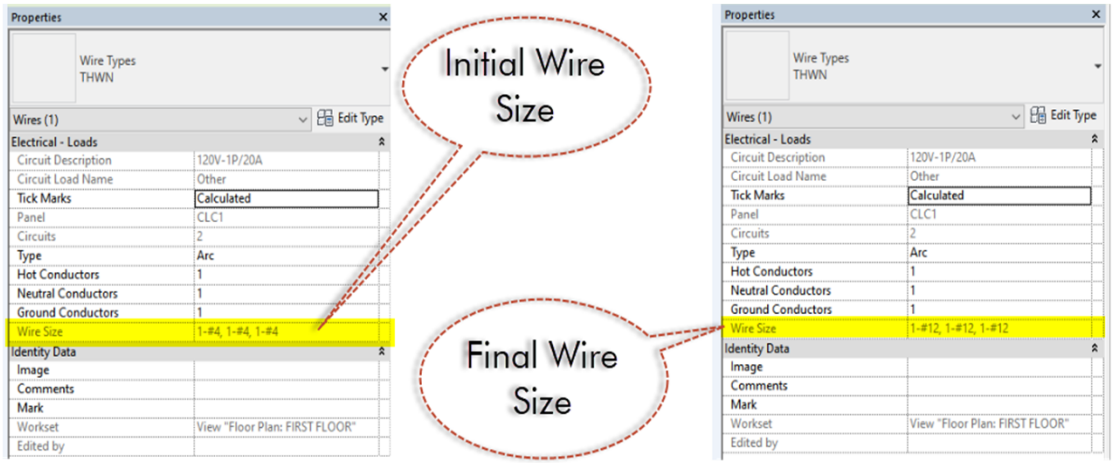


Pipe Id	Pipe Name	Pump Name	Speed rpm	Pref. Op From US gpm	Pref. Op To US gpm	Flow In/Out US gpm	Velocity ft/sec	Suction Pressure psi.g	Discharge Pressure psi.g	Pump Head (+) ft.hd Fluid	Pump NPSHr ft.hd (absolute)	Pump NPSHa ft.hd (absolute)	Pump Efficiency Percentage	Pump Power Horsepower
2	P2	Pump	1400	1029.95	2403.21	1165.00	7.471	0.5551	61.0920	139.638	6.687	34.89	73.37	56.0727

Wire Size Optimization

Automatic Wire Sizing Through BIM Integrated Tool Revit. Saved almost **50% time** of Conventional Method





Amazing Facts

Architect: Adrian D. Smith, Adrian Smith + Gordon Gill Architecture
Developer: Jeddah Economic Company (JEC)

2 Freedom Towers (834 m) + **1** Empire State Building (381 m) **~ J**eddah Tower (1,100 m)

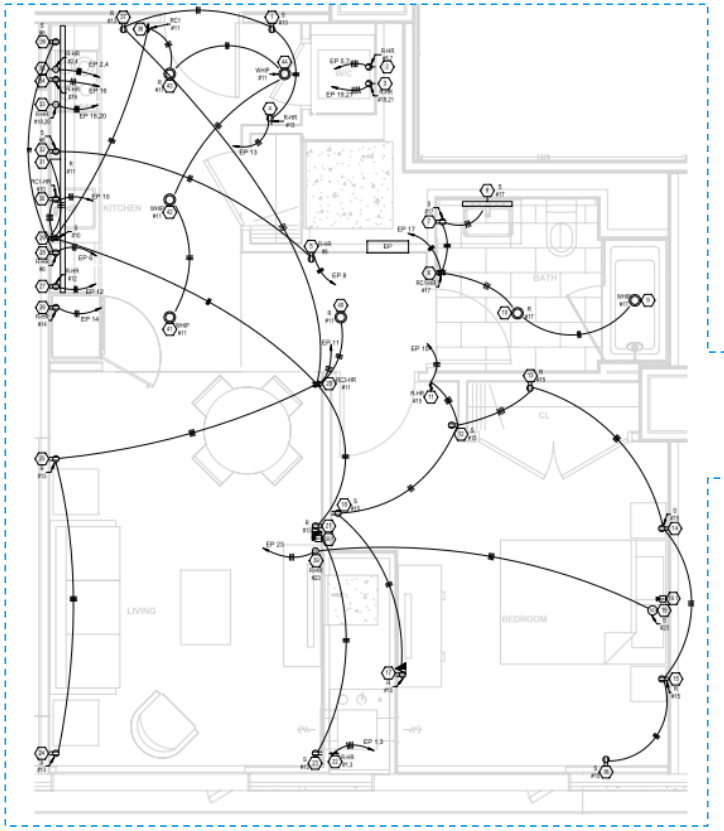
The R&D cost is **33%** of the total construction cost (> $1.2 Bn)

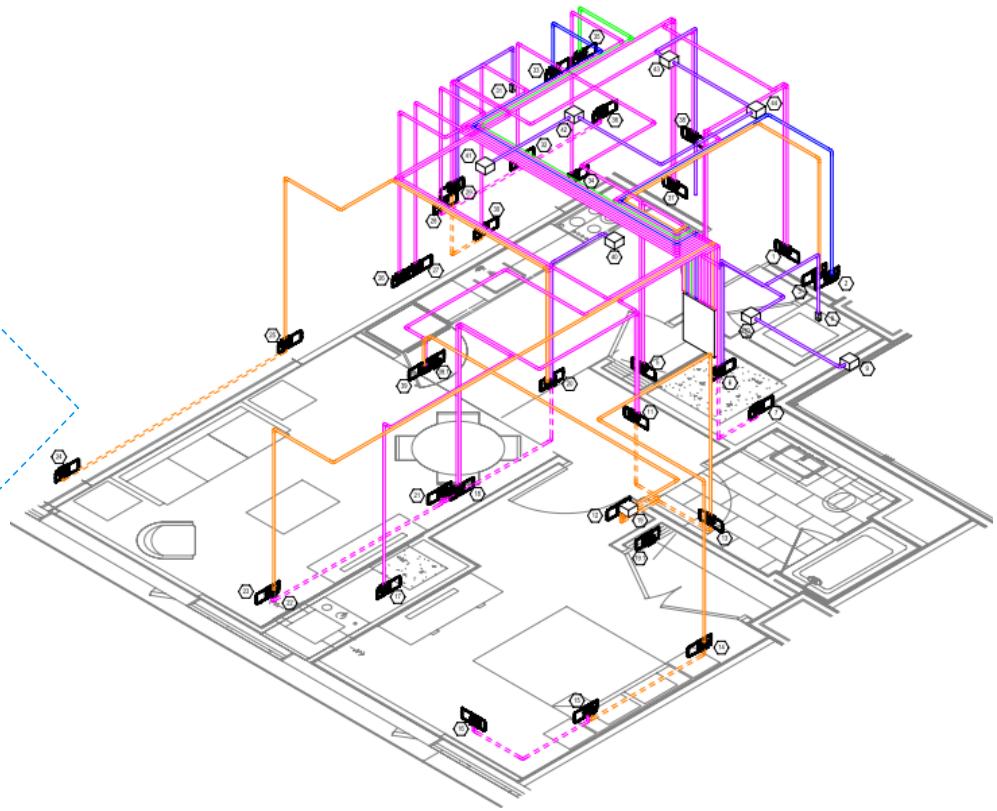
Featuring **59 elevators** with **4 double** decker & **3 triple** decker

270 piles underneath **~** Approx. **30 floors (105 m)** under the ground

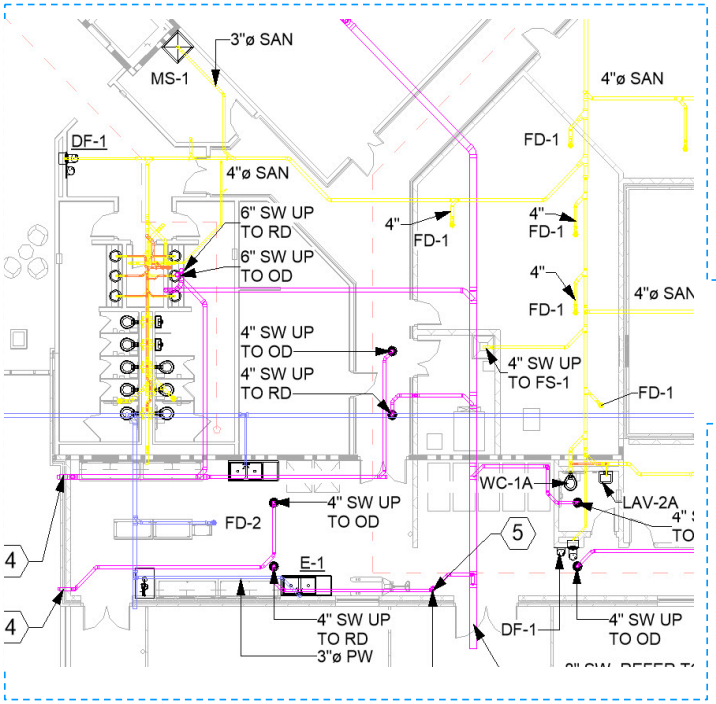
All Steel bars used underneath are electrified to keep rust free for more than 100 years

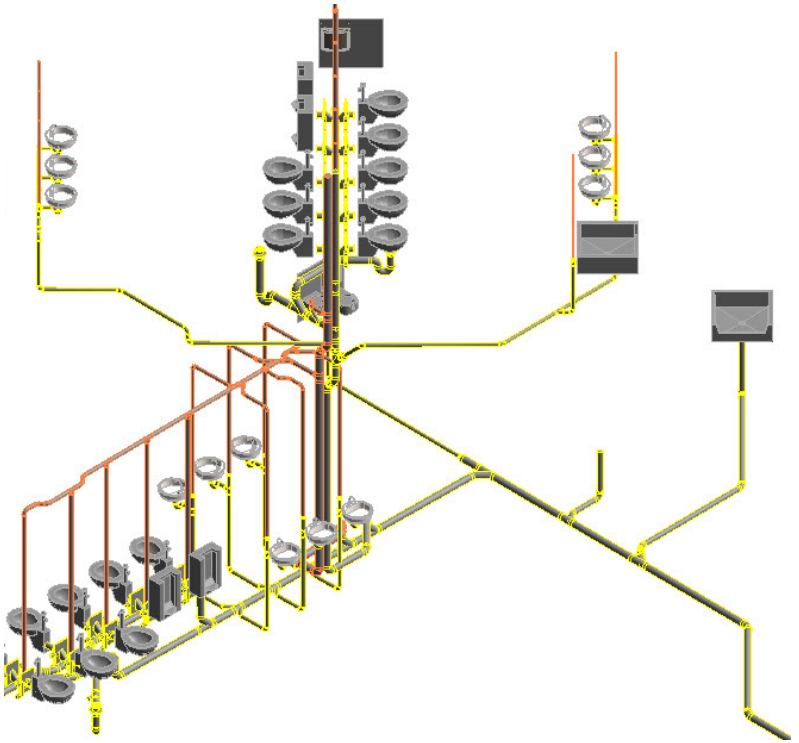
Integrated Electrical





Integrated Plumbing





Integrated Fire Protection