Millennium Science Complex

Mechanical Technical Report I

Building/Plant Energy Analysis & Systems Existing Conditions

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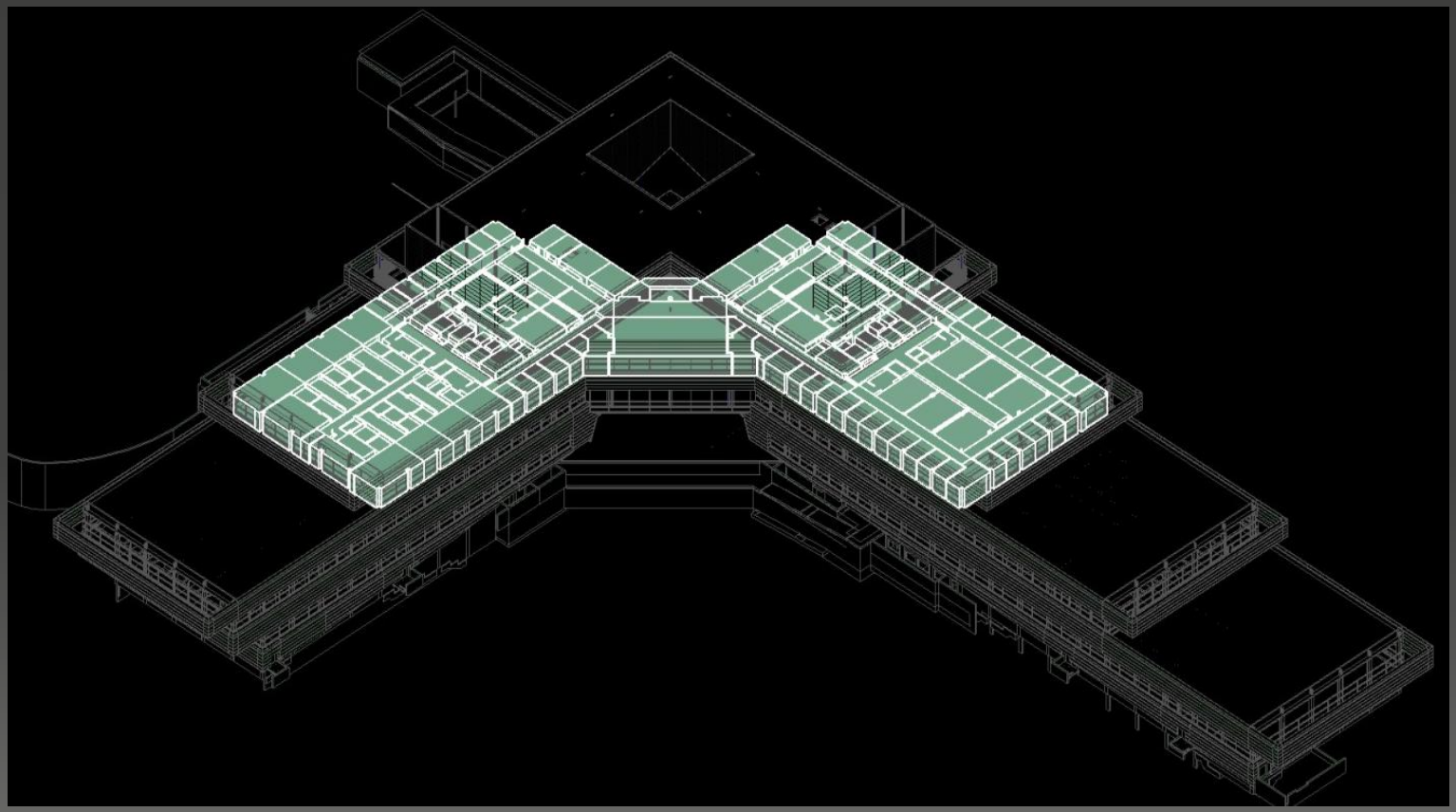
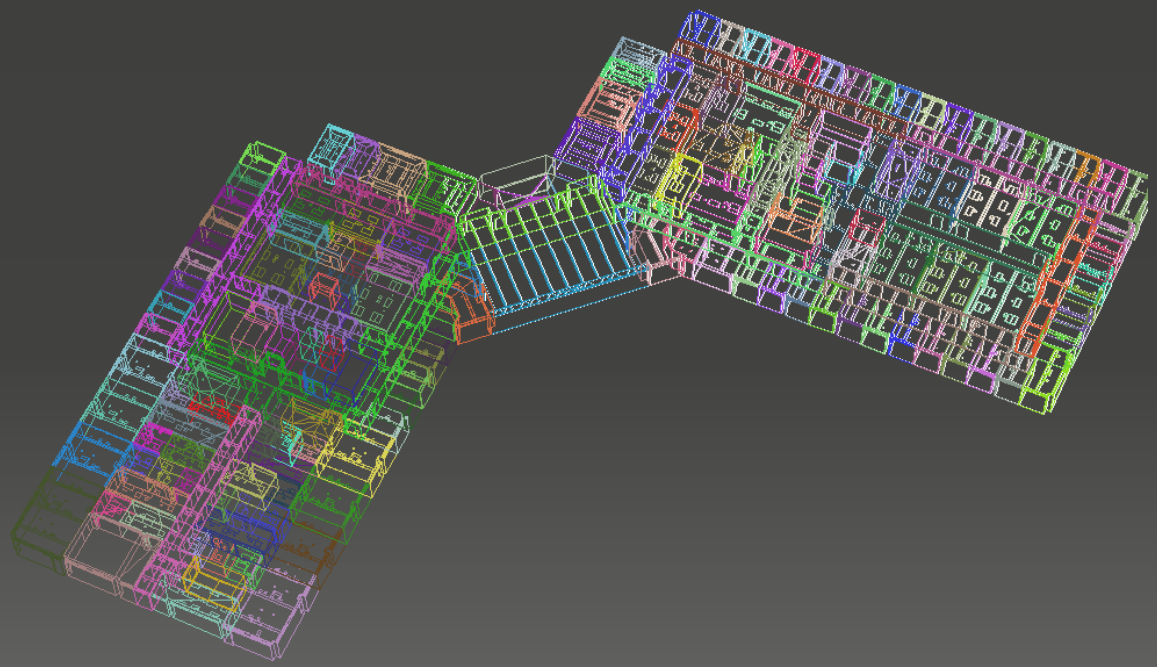
Integrated Project Delivery / Building Information Modeling Thesis 2010-11

Building Overview

Revit Information Sharing



GBXL Information Sharing



Load Calculation Summaries

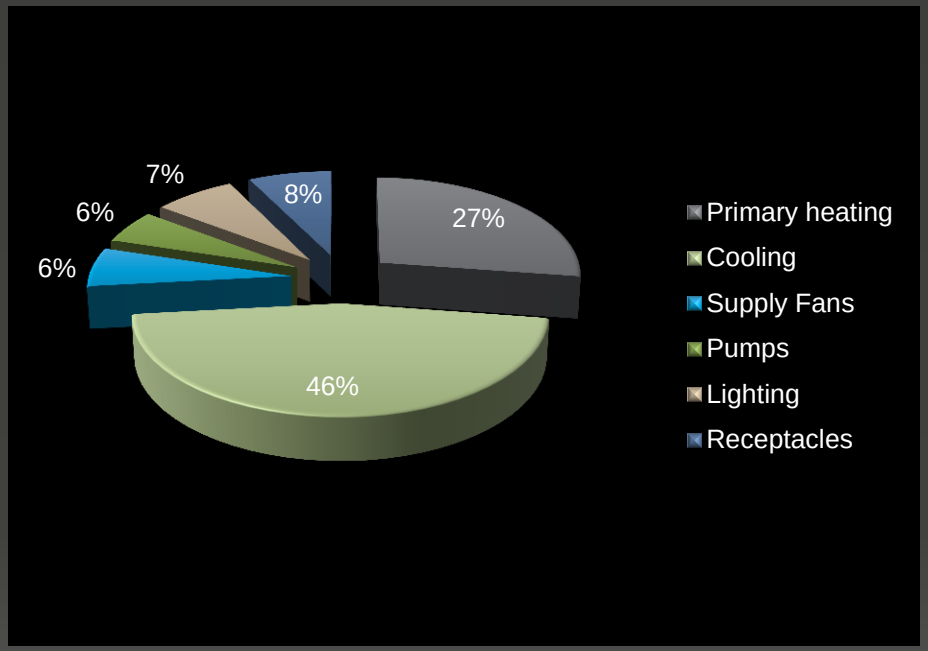
- ***Table 8: Office Zone Load Summary***

	Cooling (tons)	Heating (MBTUh)	Supply Airflow (cfm)	Outside Air Percentage	cfm/ft^2
Baseline 90.1	113.3	779.6	39,814	16.3	1.39
Existing Design	97.2	513.9	28,974	22.5	1.01

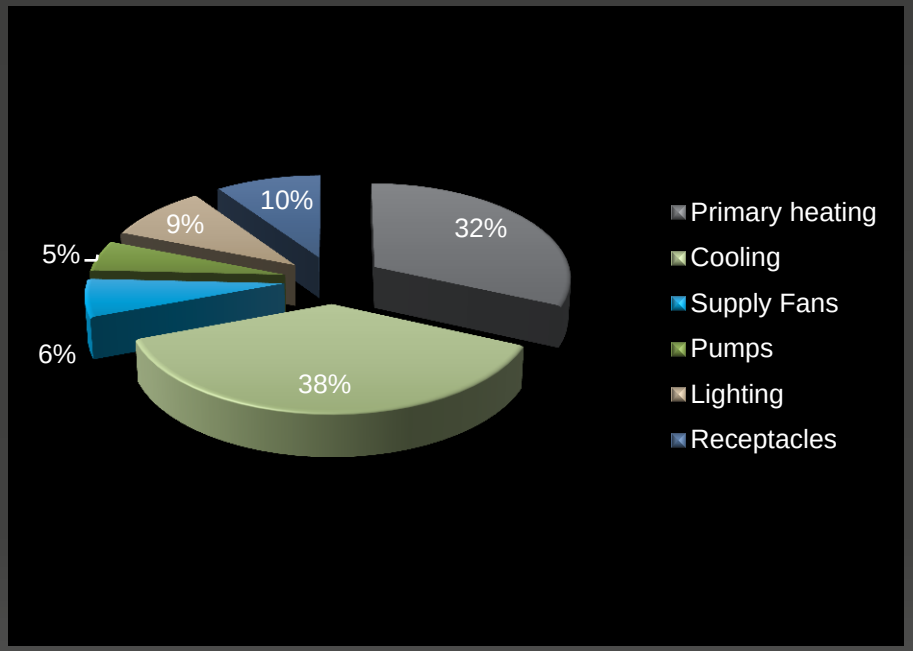
- ***Table 9: Laboratory Zone Load Summary***

	Cooling (tons)	Heating (MBTUh)	Supply Airflow (cfm)	Outside Air Percentage	cfm/ft^2
Baseline 90.1	295.8	3,151.4	34,078	100.0	2.19
Existing Design	217.7	2,409.2	25,588	100.0	1.64

Equipment Energy Consumption



- ***Figure 3: ASHRAE 90.1***



- ***Figure 4: Existing Design***

Summarized Annual Energy Consumption

- ***Table 11: Summarized Annual Results***

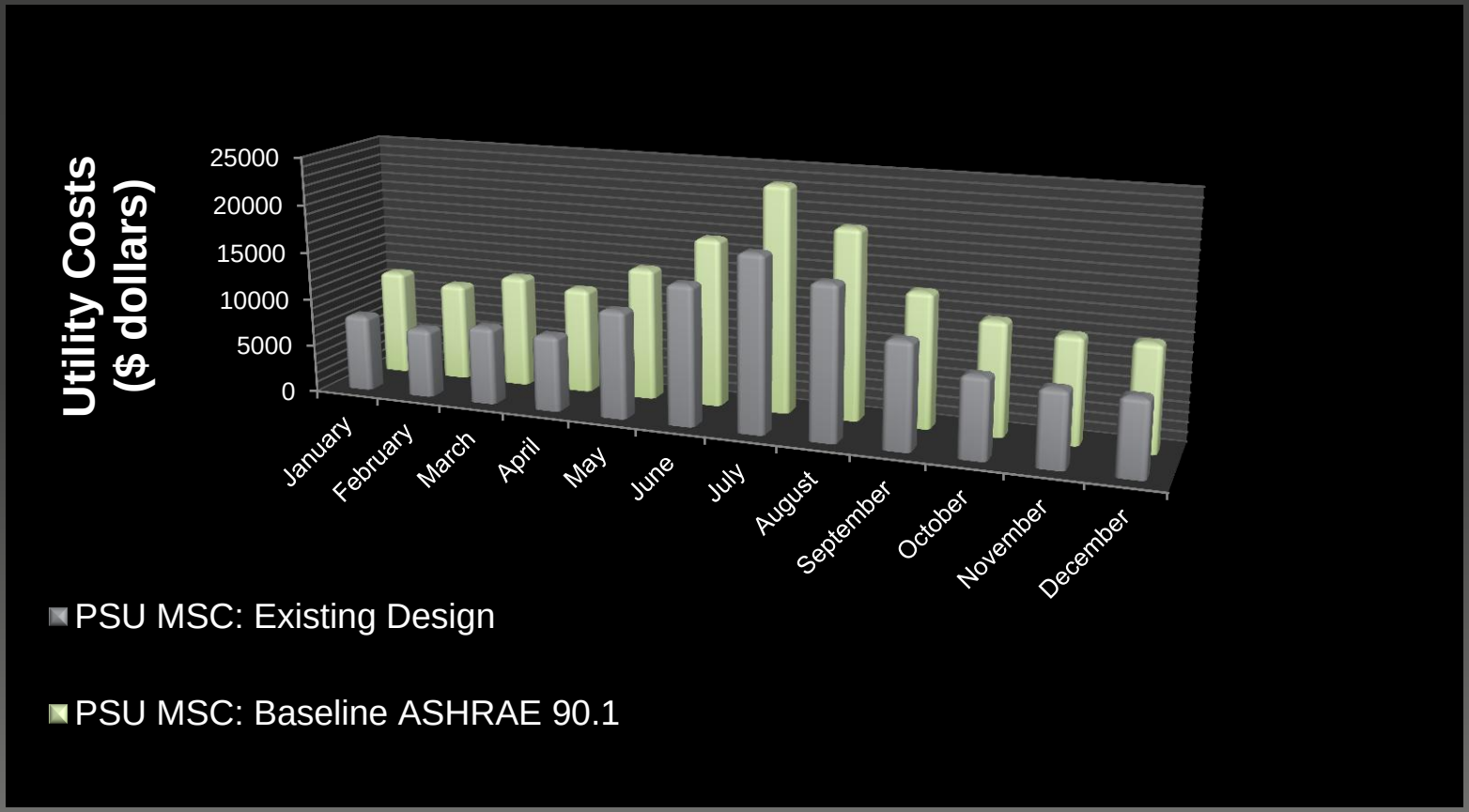
	ASHRAE 90.1	Existing Design	Percent Savings	Cost Savings
Electricity (kWh)	765,979	684,280	11%	$6,141
Purchased Chilled Water (therms)	45,039	28,705	44%	$29,891
Purchased Steam (therms)	26,694	24,119	9%	$2,111
Total Costs and Savings	$161,889	$123,745	23%	$38,144

- ***Table 12: Comparison of Baseline and Existing Design Energy Intensities***

	Baseline ASHRAE 90.1	Existing Design
Energy Intensity (kBTU/ft^{2-} yr)	221.2	172.2
Cost	$3.72/SF	$2.85/SF

Monthly Utility Costs

- ***Figure 5: Comparison of Baseline and Existing Design Monthly Utility Costs***

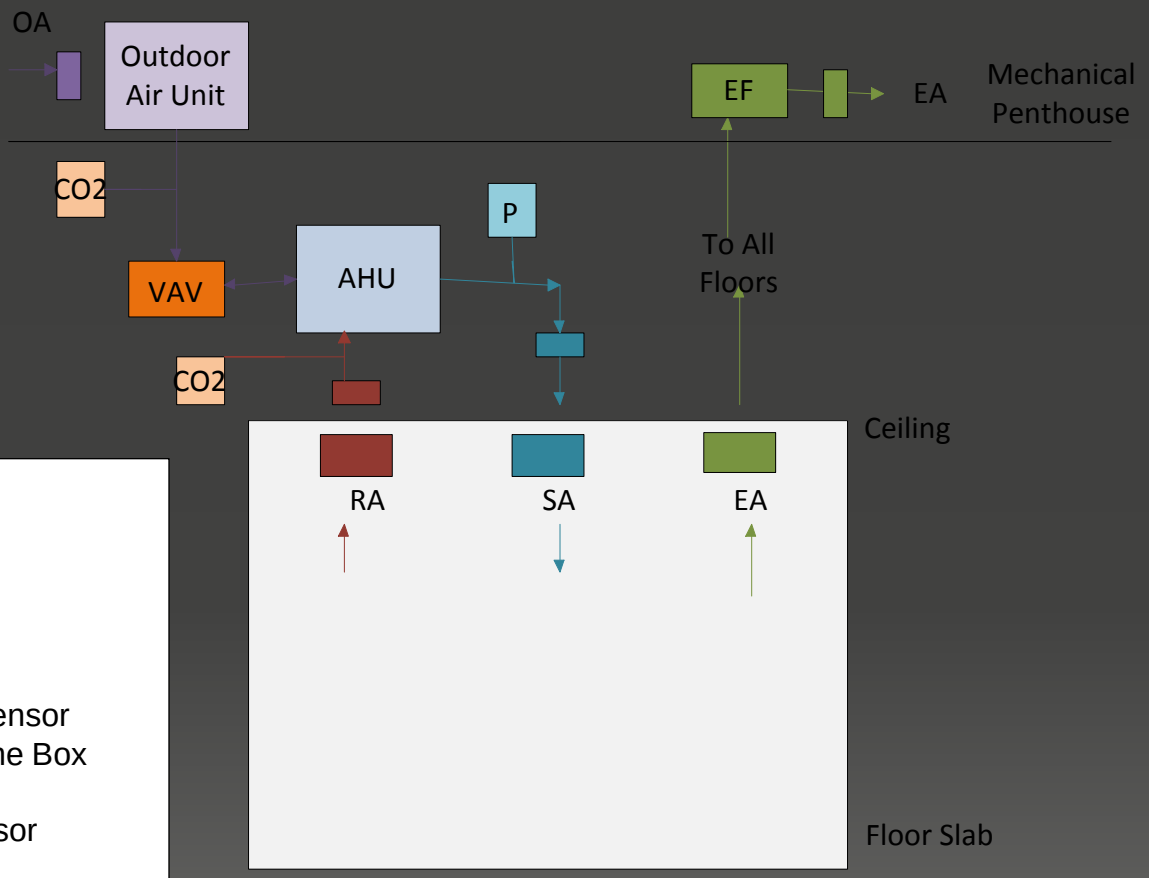


Building Emission Rates

	ASHRAE 90.1 Standard Emissions	Existing Design
Total Building Energy (Btu/ft^2-yr)	221,194	172,158
Total Source Energy (Btu/ft^2-yr)	335,995	280,932
CO_2 (lbm/yr)	3,487,813	2,714,609
SO_2 (gm/yr)	26,966	20,988
NO_X (gm/yr)	5,420	4,219

- ***Table 14: Comparison of emission rates from Trane TRACE***

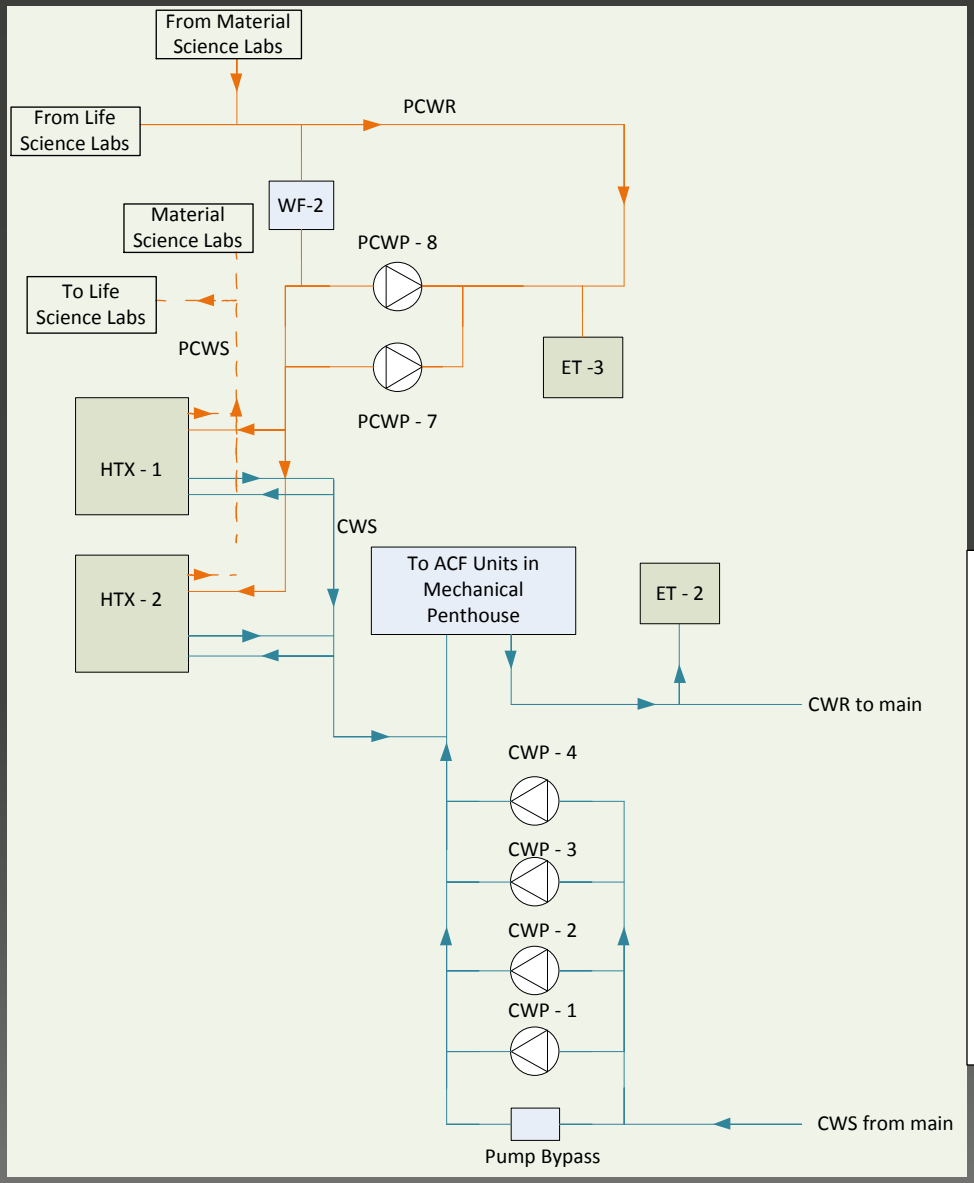
Typical Airside Diagram for Spaces



Legend

RA: Return Air
SA: Supply Air
EA: Exhaust Air
OA: Outside Air
CO_2: Carbon Dioxide Sensor
VAV: Variable Air Volume Box
EF: Exhaust Fan
P: Static Pressure Sensor

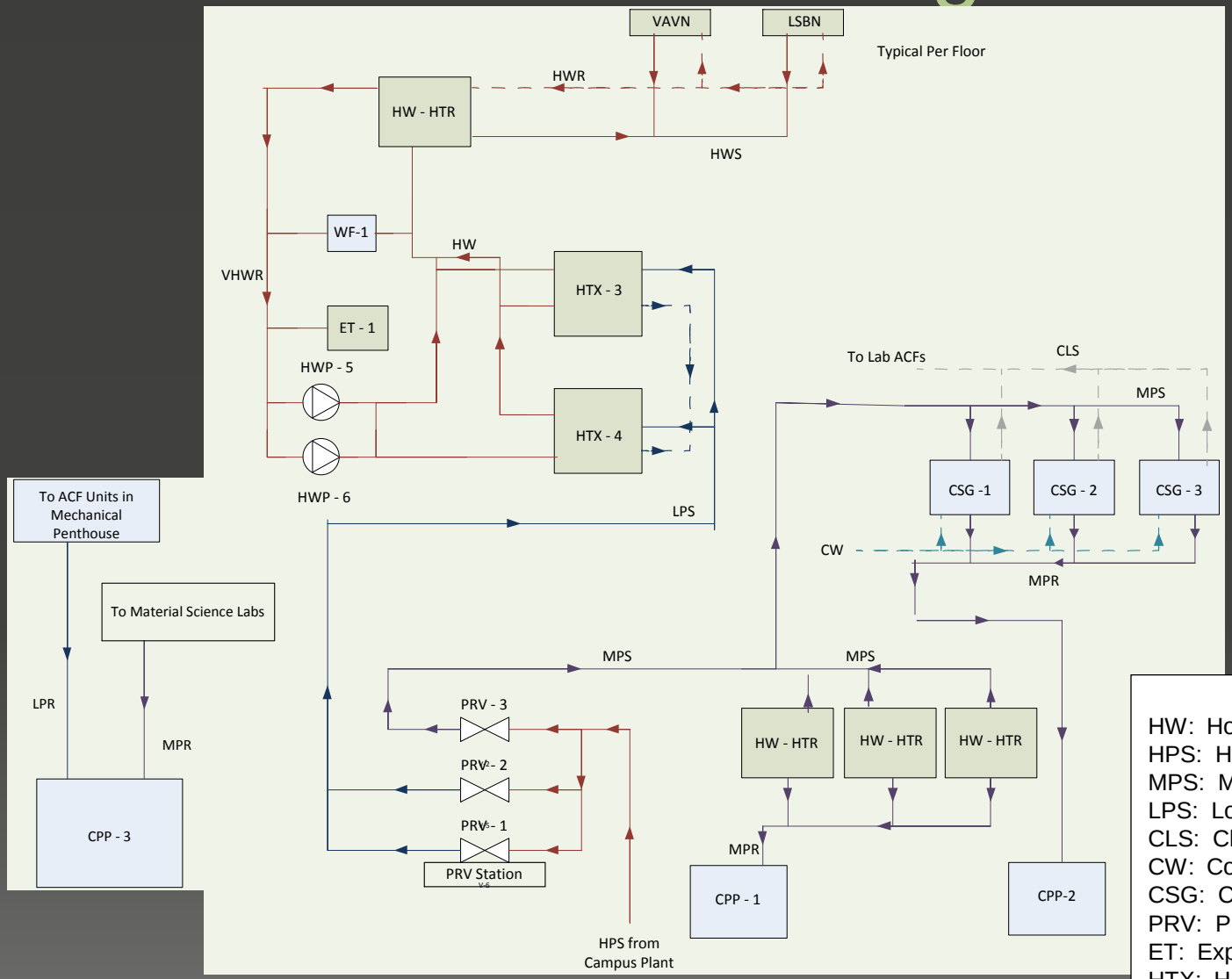
Chilled Water Flow Diagram



Legend

HTX: Heat Exchanger
ET: Expansion Tank
CWP: Chilled Water Pump
PCWP: Process Chilled Water Pump
WF: Water Filter
PCWS/R: Process Chilled Water Supply/Return
CWS/R: Chilled Water Supply/Return

Hot Water Flow Diagram



Legend

HW: Hot Water
HPS: High Pressure Steam
MPS: Medium Pressure Steam
LPS: Low Pressure Steam
CLS: Clean Steam
CW: Cold Water
CSG: Clean Steam Generator
PRV: Pressure Reducing Valve
ET: Expansion Tank
HTX: Heat Exchanger
CPP: Condensate Power Pump

Lost Usable Space

Table 22: Lost Usable Area Breakdown

Floor	Lost Usable Area
Basement	9,050 SF
1st Floor	4,150 SF
2nd Floor	1,175 SF
3rd Floor	1,014 SF
4th Floor: Mechanical Penthouse	27,287 SF
Total Area Lost	42,676 SF

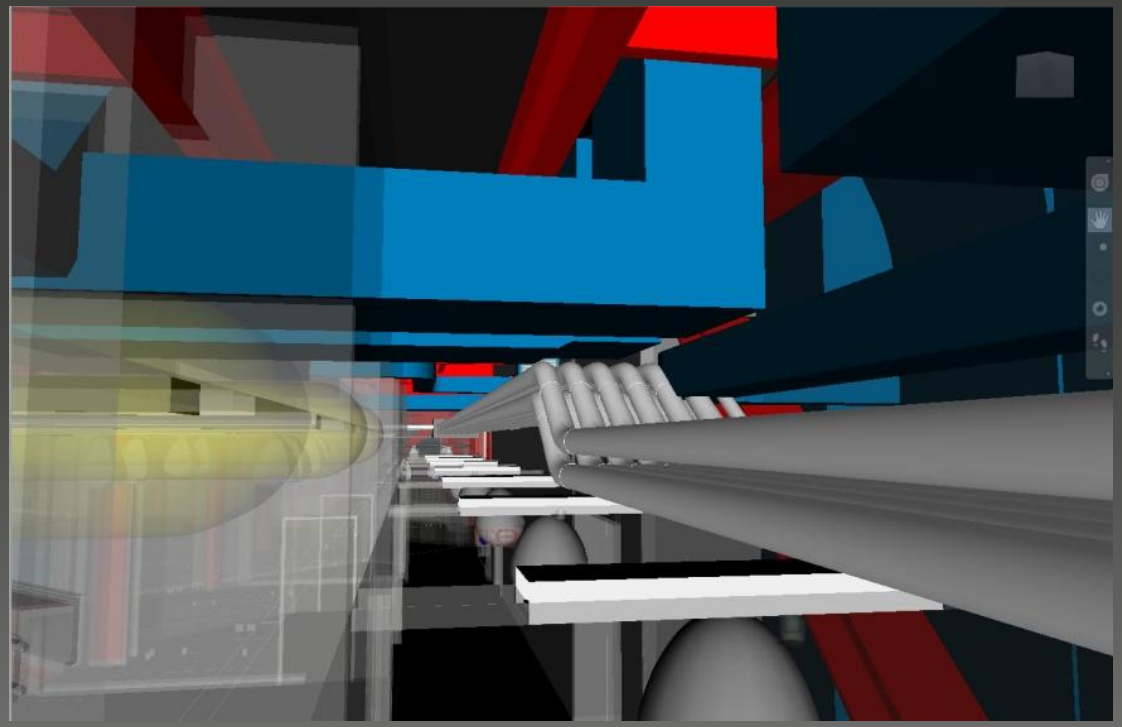
LEED Energy Credits

Table 24: LEED Credit Breakdown

Category	Possible Points
Sustainable Sites	11/14
Water Efficiency	3/5
Energy & Atmosphere	5/17
Materials & Resources	5/13
Indoor Environmental Quality	12/15
Innovation % Design Process	5/5
TOTAL	41/69

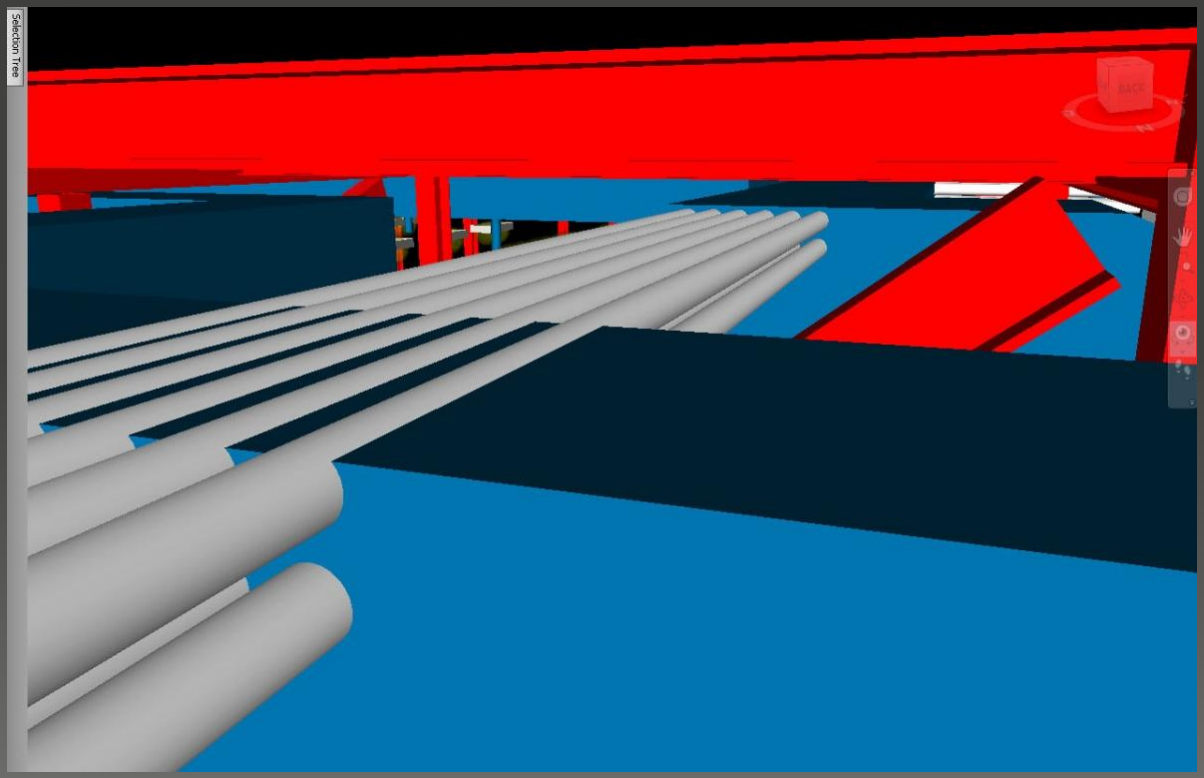
Model Coordination

- ***Revit Models to Navisworks Coordination***
  - ***Architecture***
  - ***Electrical***
  - ***Structural***
  - ***Mechanical***



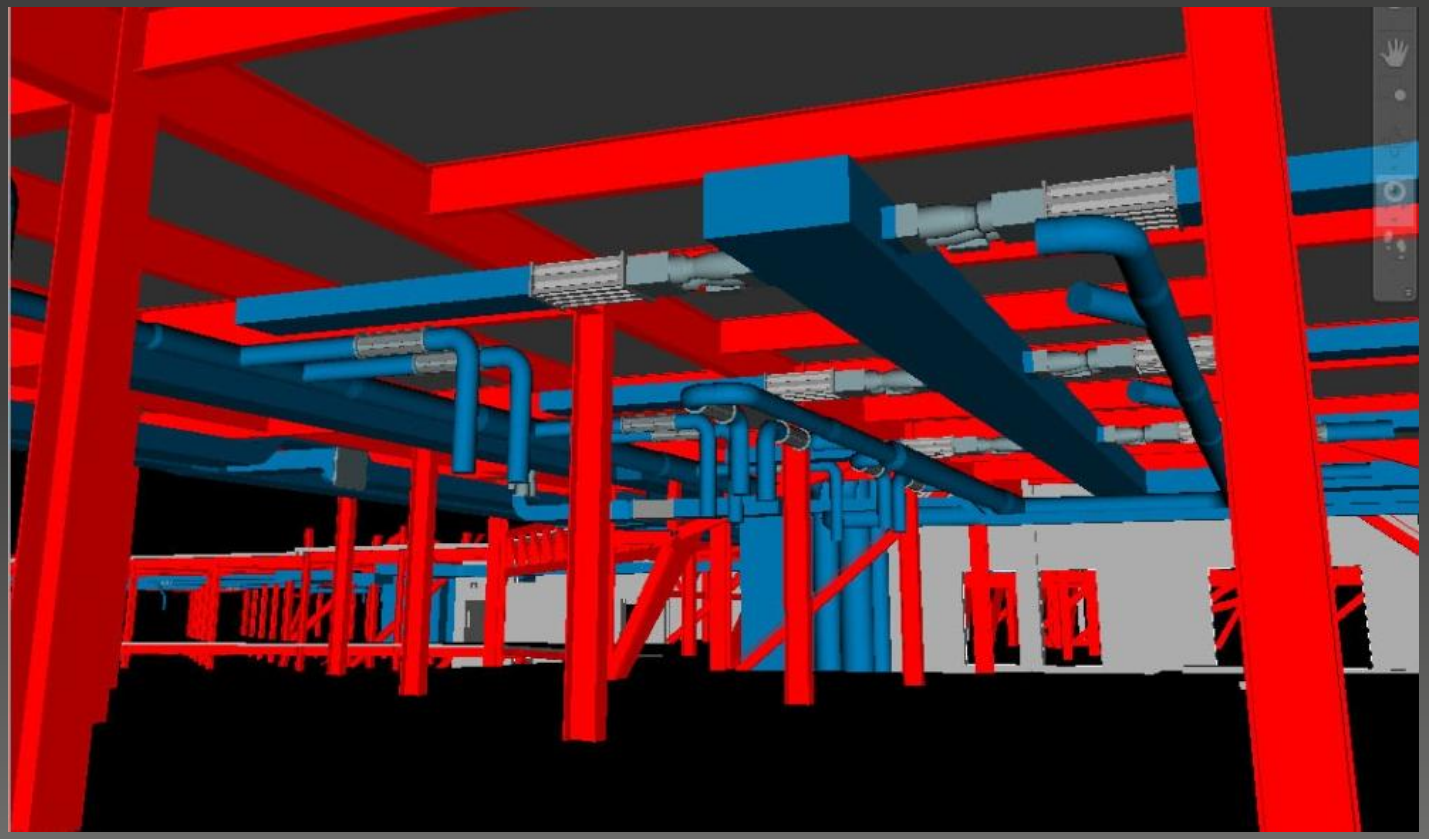
Mechanical Collisions

- ***Use Coordination to Minimize Collisions***
  - ***Only Main Ducts and Elements Currently Modeled***



Laboratory Design Modeling

- ***Unique Equipment and Room Arrangements***
  - ***Many Elements Not Modeled***
    - ***Piping, Gas Piping, Branch Ductwork***



Conclusions

- ***Energy Savings***
- ***Discipline Coordination***

Any Questions???