Sustainability and Energy Efficiency Measures

University of Toronto Scarborough Environmental Science and Chemistry Building

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Agenda

- Project Overview
- Review of Mechanical Systems, lighting
- Design Considerations and Energy Efficiency

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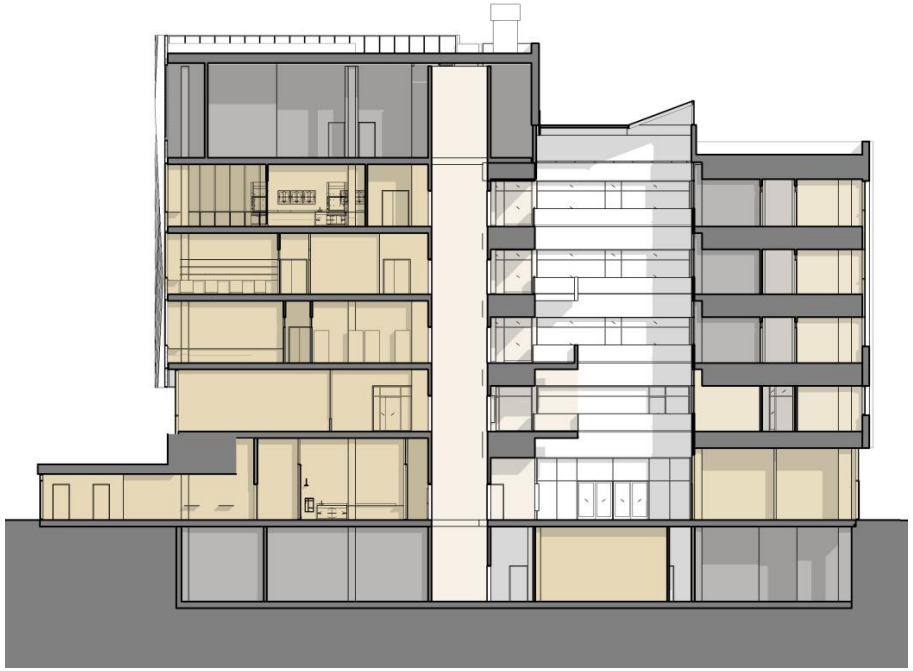

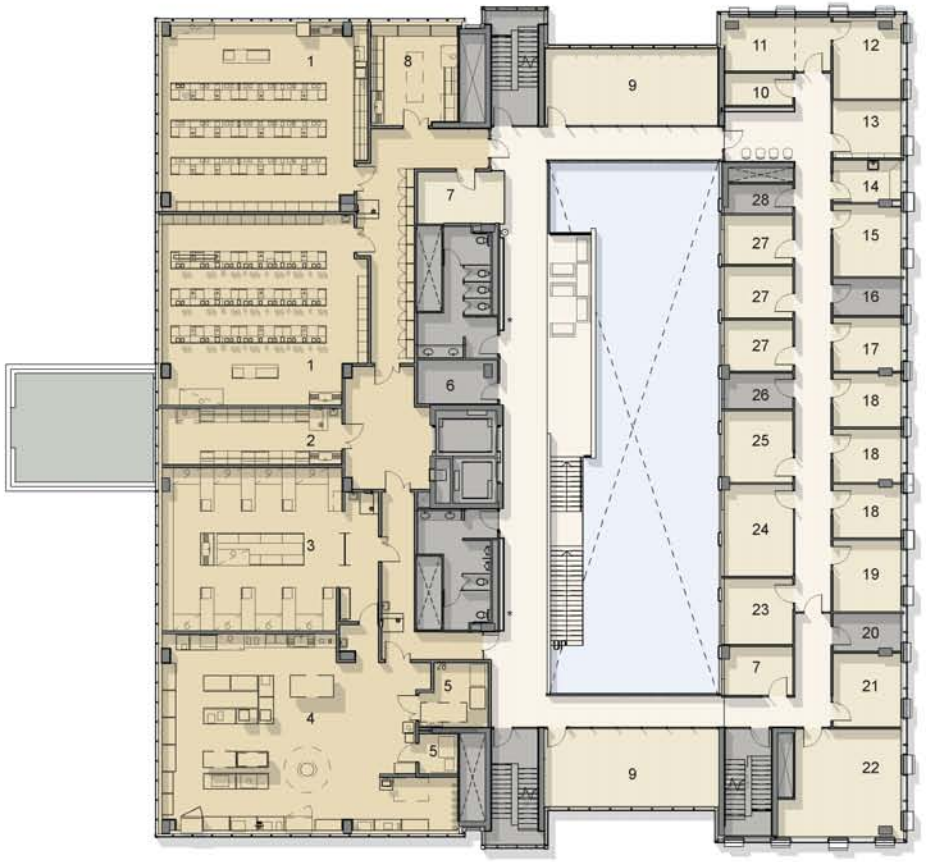

Project Basics

- University of Toronto Faculty of Applied Science and Engineering
- 60% Wet and Dry Research and Teaching Labs, 40% Office
- 9,400 m^2 (101,000 sq ft); Six occupied floors (B + 5) + mechanical penthouse
- Targeting LEED Gold and Toronto Green Standard Level 1
- Owner mandated eight (8) LEED energy points (>37% cost savings over MNECB)

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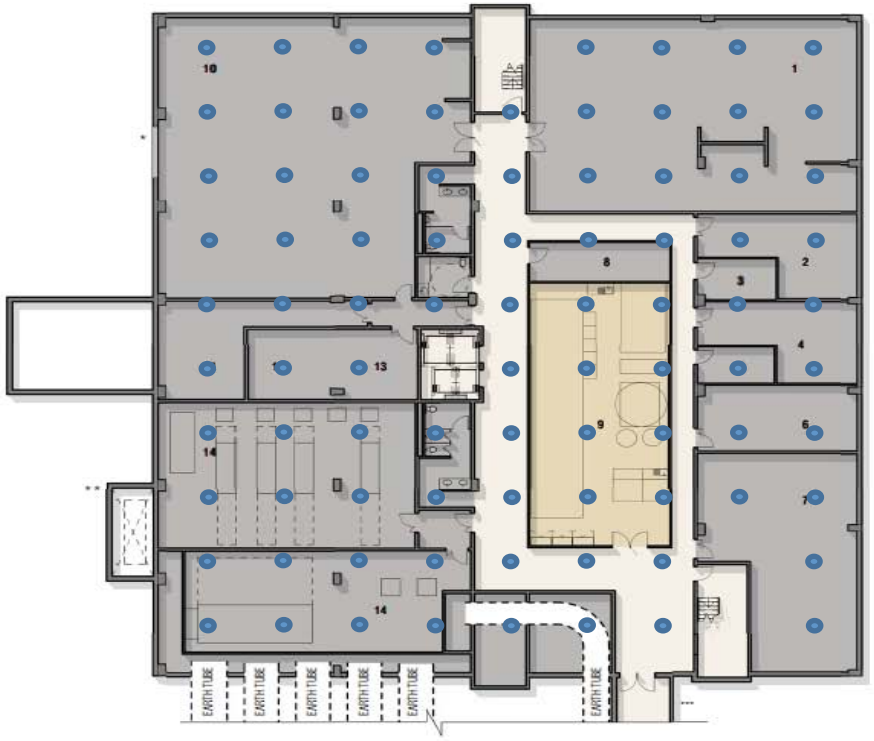

Geothermal System

- 66 Boreholes at 186m (613 ft) deep below the building
- Geothermal system sized to provide approximately 210 tons of cooling and 1350 MBH heating
- Nearly 25% of the building cooling load.
- Scroll geothermal heat pump converts the geothermal loop temperature to usable heating and cooling temperatures in the building

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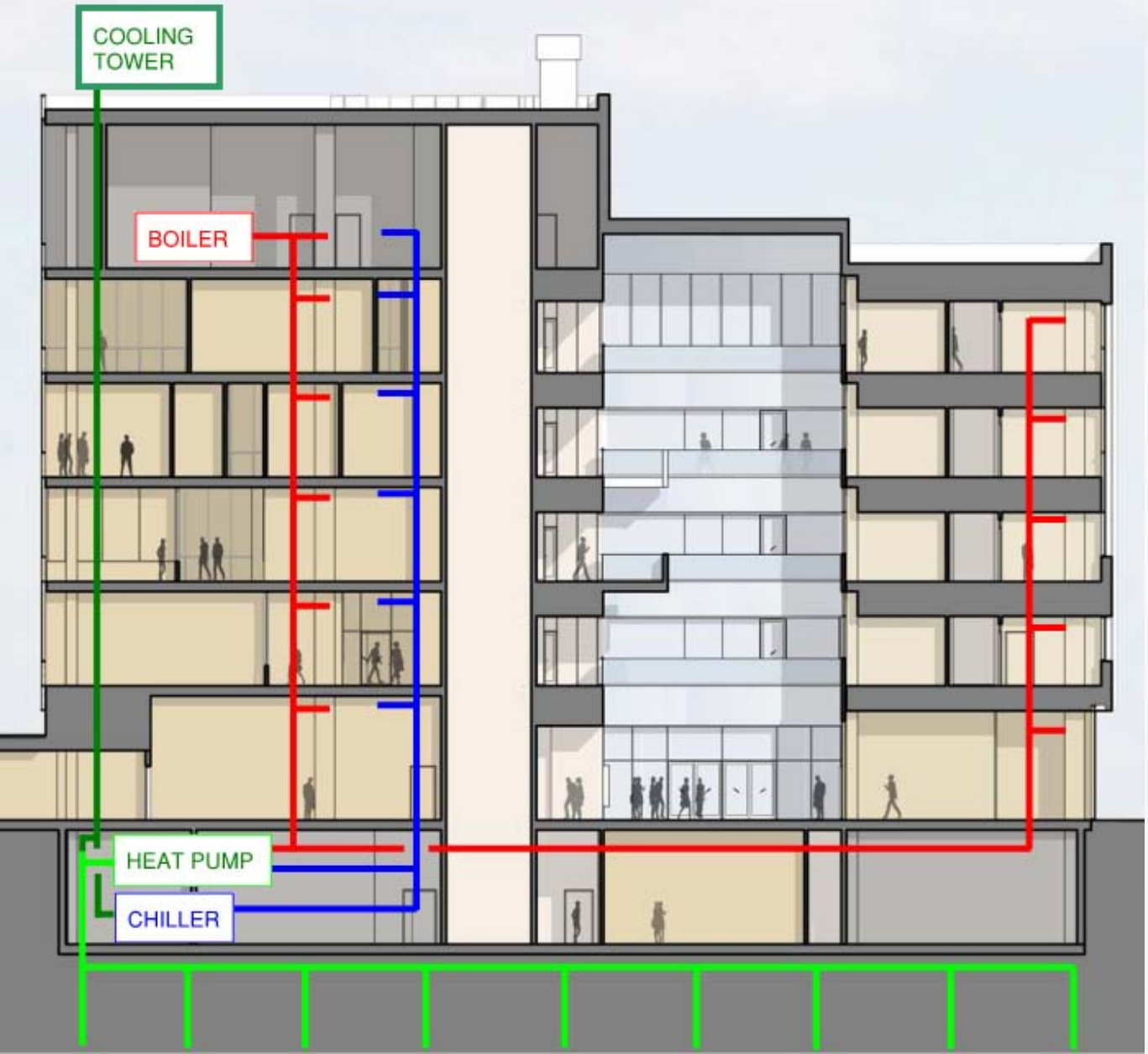
Heating/Cooling Plant



- 860 Tons cooling
- Magnetic Bearing Chillers
- Geothermal Heat pump
- Variable Speed Cooling Tower
- 12300 MBH Heating
- Variable Flow Boiler Plant with N+1 Redundancy
- 30 degrees F ΔT Heating
- 14 degrees F ΔT cooling

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ENERGY BASIS

Geothermal and Plant System - Energy and Controls

- Energy and Cost Implications
- Sequence of operations – cooling, heating, simultaneous
- Loop temperature controls

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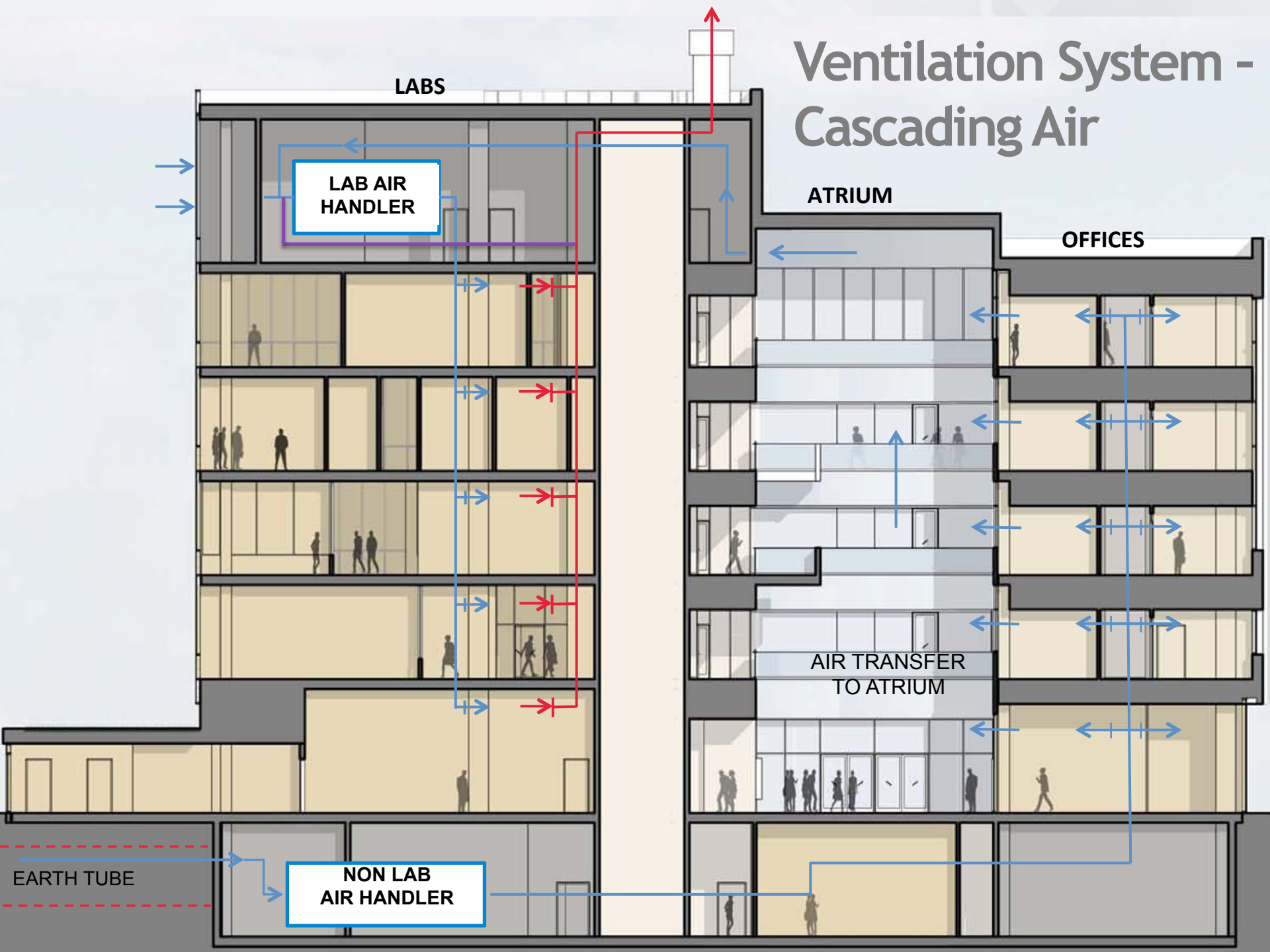
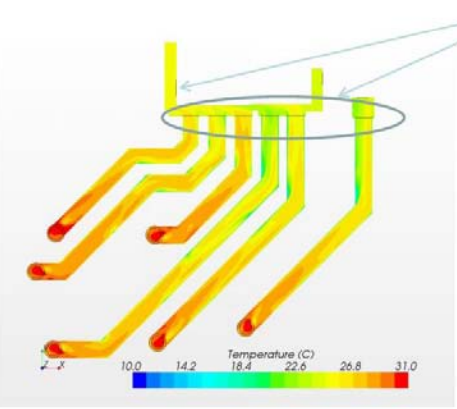
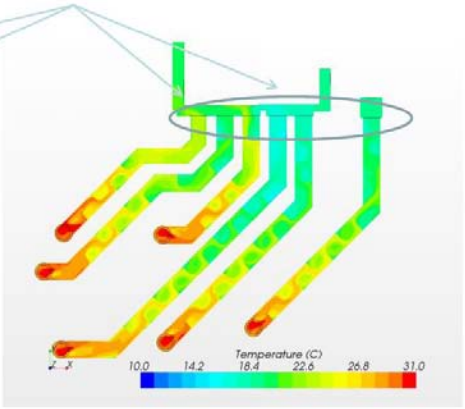
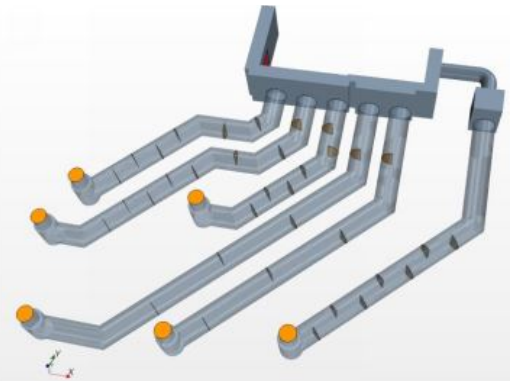
Ventilation System - Cascading Air









Ventilation System - Office

- Earth tube pre-treats ventilation air with bypass option
- Six tubes (2m diameter, varying lengths 20-30m)
- UV treatment of incoming air
- 100% Outside air with bypass 40,000 CFM max, 12,000 CFM min for by-pass
- Initial design: 29% effectiveness
- Baffles to improve heat transfer (~50% effectiveness)
- Peak: Δ21°F; Annual Average: Δ7°F
- Temperature Control: Compare OAT against tube outlet temp

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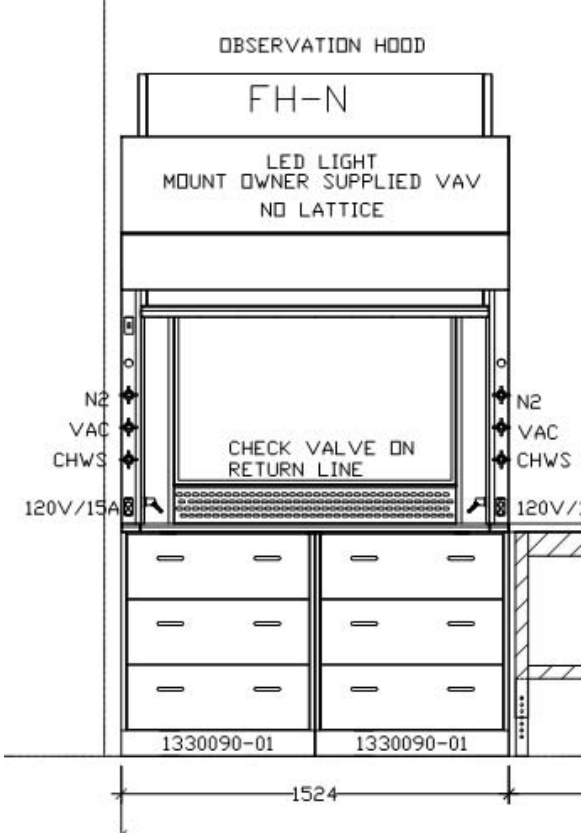
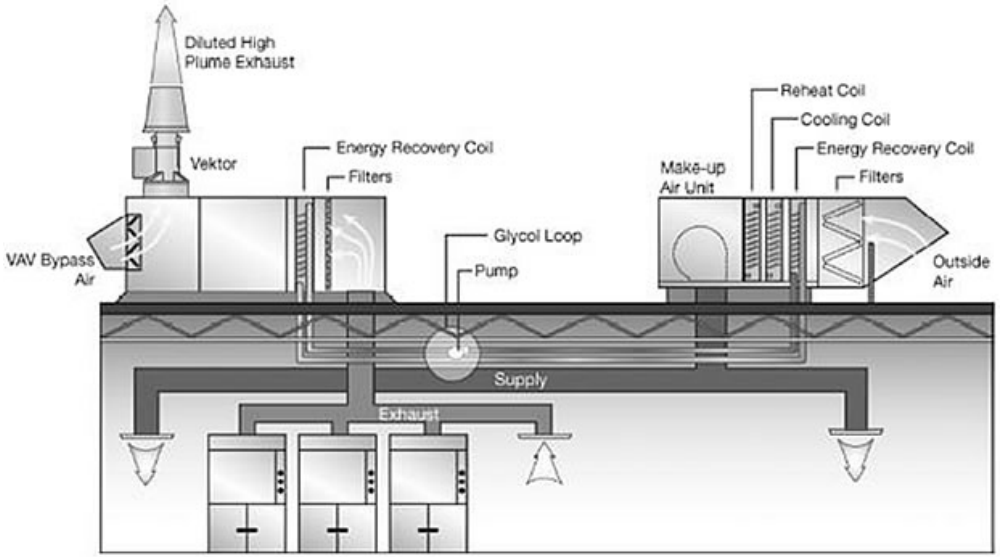
Ventilation System - Office





Ventilation System - Lab

- Low flow fume hoods: 60 FPM
- Heat recovered from laboratory exhaust for ventilation pre-conditioning
- 10ACH occupied labs, 4 ACH unoccupied, 12 ACH purge mode on 25%
- Optinet Aircuity system: Controls air flow to fume hood intensive labs down to 4ACH minimum or 20% fume hood flow rate

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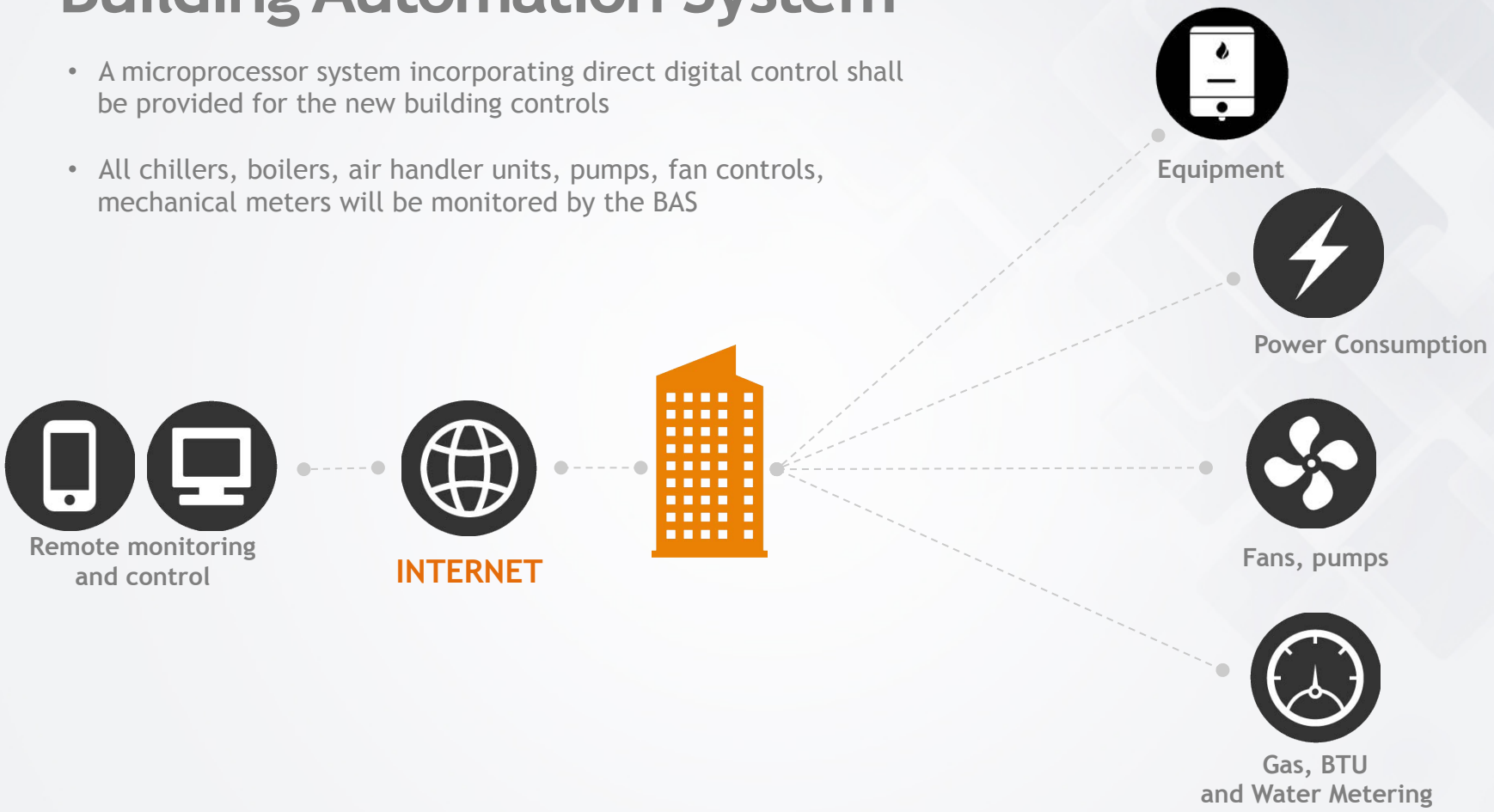
Building Automation System

- A microprocessor system incorporating direct digital control shall be provided for the new building controls
- All chillers, boilers, air handler units, pumps, fan controls, mechanical meters will be monitored by the BAS



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Credit: OICR - DSAI

Lighting

- LED light sources throughout the building
- Controls: Occupancy sensors, dimmable fixtures, daylight responsive lighting, zoned control schemes
- Installed lighting power density: 0.64 W/ft^2
- 45% better than code while maintaining required light levels
- 36% better than typical fluorescent scheme
- Estimated annual utility cost savings over fluorescent: $21,000

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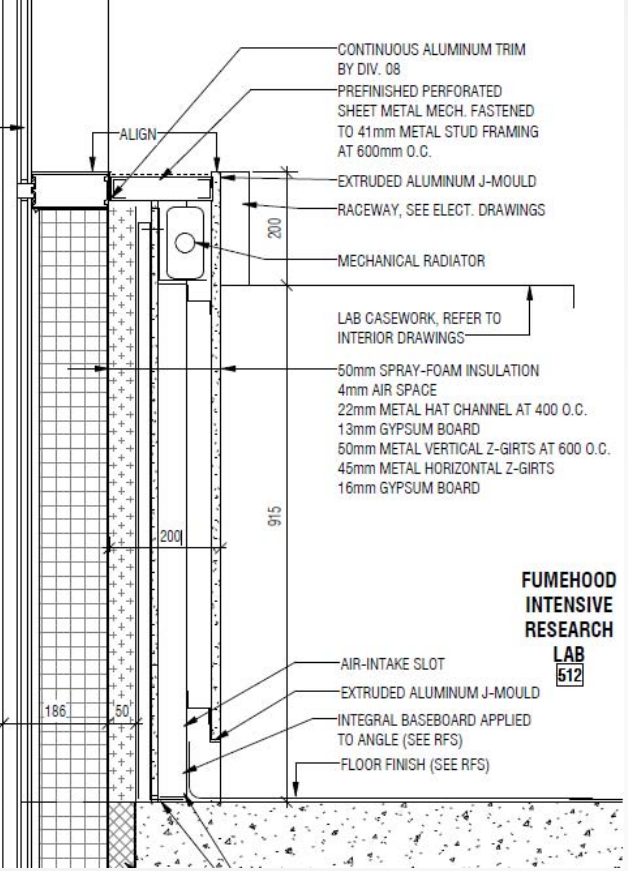

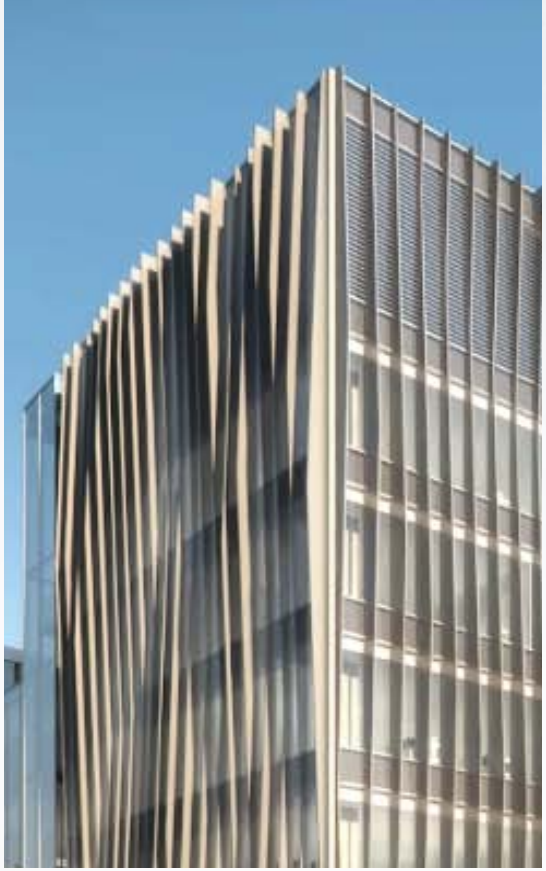

Envelope

- High performance opaque façade with minimized thermal bridging (R-20 effective)
- Spandrel: Cavity plus spray insulation (R-13 effective)
- Fenestration: thermally broken framing with low-e IGUs (R-3 overall)
- External shading: Custom aluminum vertical fins on laboratory curtain wall

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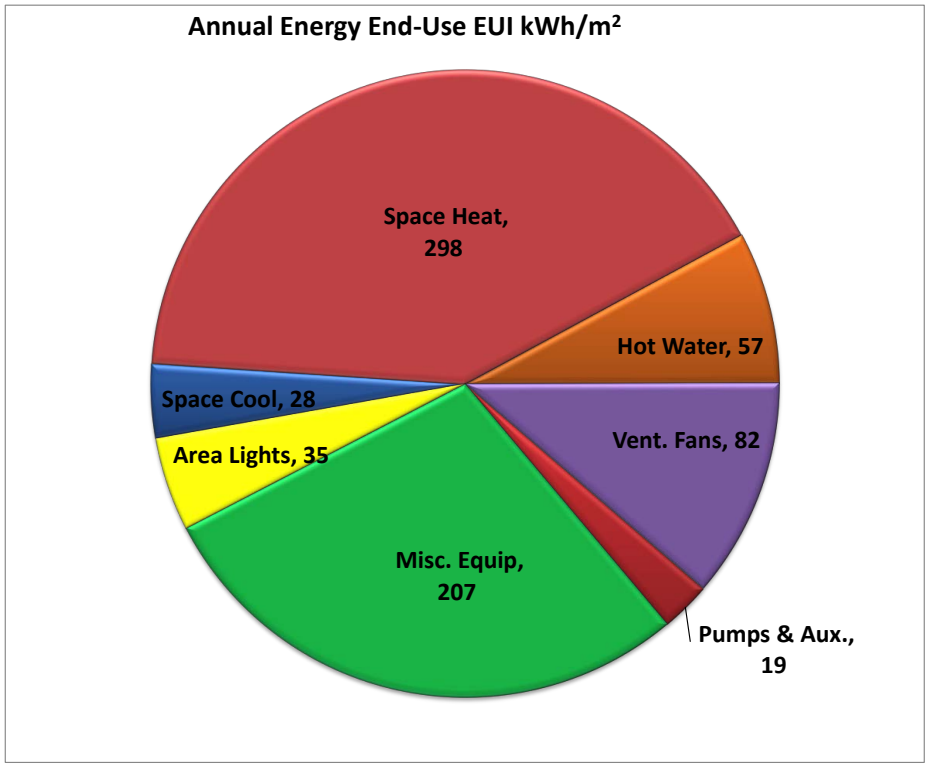

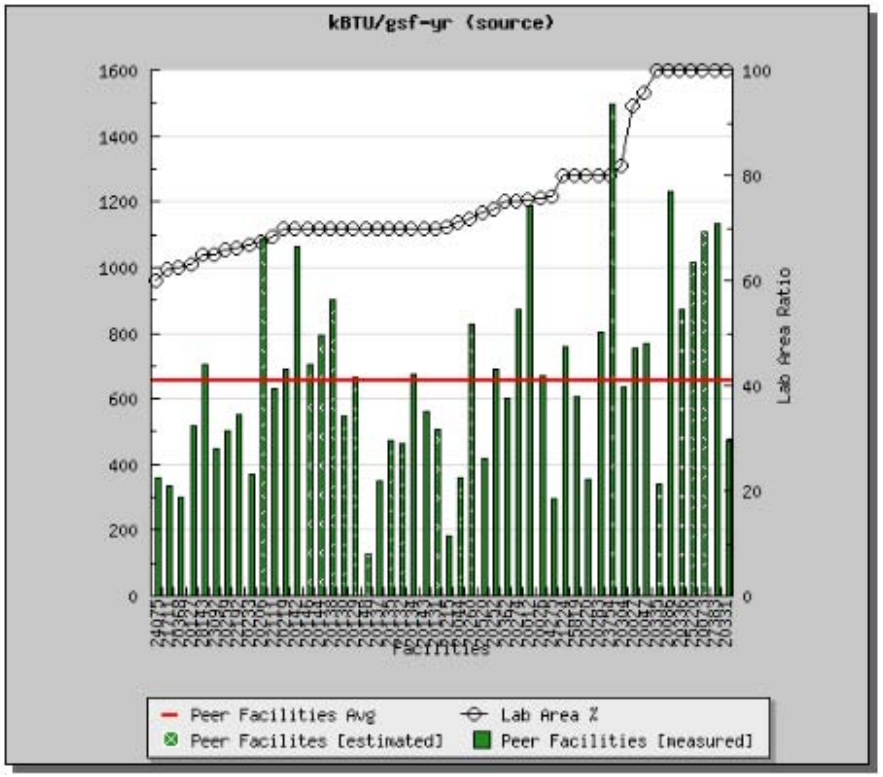

Energy Summary

- Ventilation dominated laboratory
- Hours of operation
- Modeled site EUI 720 kWh/m²
- Estimated annual cost savings: $280,000
- Future Flexibility

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Systems Overview

- Geothermal systems
- Hybrid chiller plant with magnetic bearing chillers and heat pump chiller
- Hybrid boiler plant with condensing boilers and heat pump
- Steam boilers for autoclaves and humidification
- Central air handling
- Earth tubes
- Cascading air use
- Low flow fume hood technology
- Lab exhaust heat recovery
- VFDs on variable and constant speed motors for testing and balancing
- Low flow plumbing fixtures
- Building automation system with integrated Aircuity Optinet System
- LED lighting complete with daylight and occupancy sensors
- Emergency Generator sized to accommodate full lab function in a power outage

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UNIVERSITY OF TORONTO SCARBOROUGH

Diamond Schmitt Architects

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EllisDon

We build on great relationships™

OZZ electric

powerful. together.

Design Team

Client: University of Toronto Scarborough

Architect: Diamond and Schmitt
General Contractor: EllisDon
Electrical Contractor: Ozz Electric

MEP and Sustainability: Smith and Andersen and Footprint
Mechanical Contractor: VR Mechanical
Specialty Consultants: RWDI, HGC

Questions?
Thank you!

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