IPRO 337: Zero Energy Lab and Designing the IPRO Team Collaboratory Space

Goals

- To evaluate the spacial needs of the IPRO program and create a detailed program for a dedicated IPRO facility

- To analyze the site and energy consumption of the existing CTA building for such a facility

- To develop an appropriate Zero Energy concept for the new IPRO facility

- To plan the new facility with these sustainable and Zero Energy techniques

Methodology

IPRO 337: Zero Energy Lab and Designing the IPRO Collaboratory Space

- Zero Energy Lab
- Designing the IPRO Collaboratory Space
  - Zero Energy Concepts
    - David Babnigg
    - Jay Patel
    - Mark Chiu
    - Konrad Kawa
    - Jon Reinecke
  - Building Feasibility
    - Evan Vice
    - Brian Parkes
    - Bentan Dosky
    - Clayton Shive
  - Programming the Facility
    - Theresa Zappala
    - Kai Hansen
    - Lillian Park
    - Abraham Akutagawa
    - Teddy Mensah

Zero Energy Lab

Mission: To design a universal format to occupying laboratories that utilize the minimum amount of energy

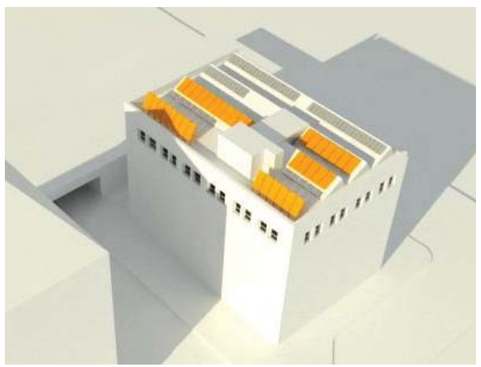
Spring 2007

-Researched lighting (passive)
-Created 3D model of ZEL

Fall 2007

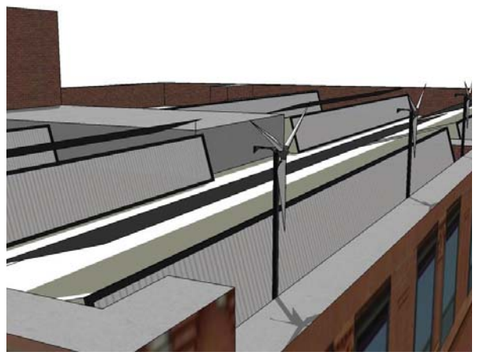
-Calculated total energy needed to power the ZEL
-Designed a solar cell
-Developed a passive cooling system using a photovoltaic

Spring 2008



-Created a website about the ZEL
-Researched various energy efficient lighting solutions

Fall 2008



-Determined local wind readings
-Designed a Solar Energy Cart to expand the battery bank

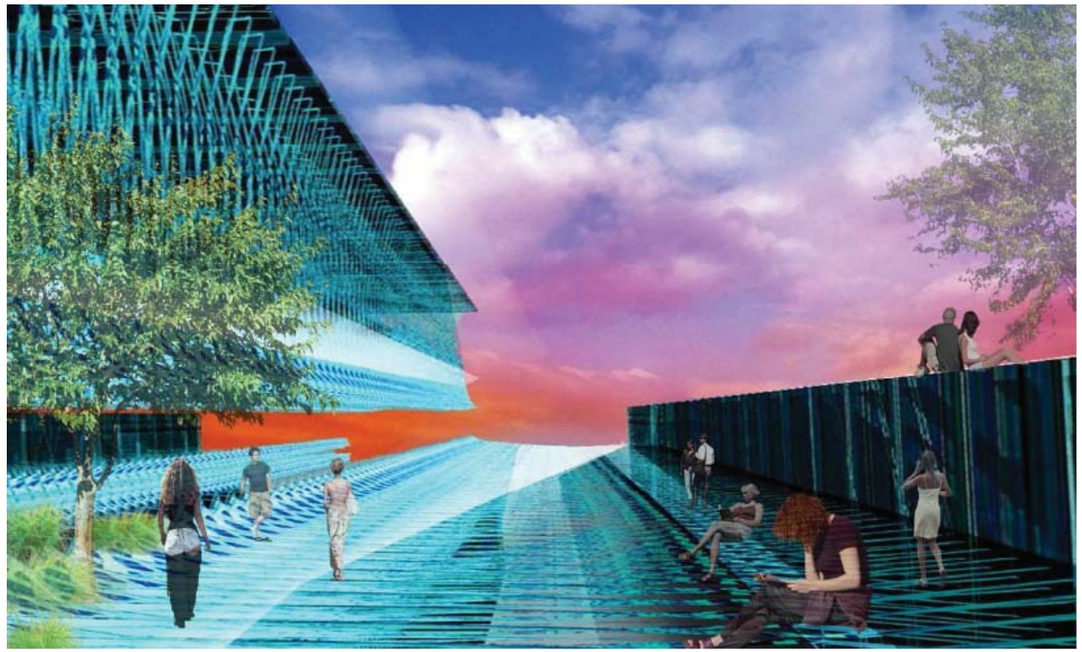
Spring 2009

-Finished the Solar Energy Cart
-Produced a prototype of a solar thermal collector
-Prototyped an automatic window system

Summer 2009

-Created a plan for a biodiesel generator
-Conducted testing of various lighting materials and methodologies

Building on IPRO 301



‘Ideal’ IPRO facility

Conversion of Machinery Hall

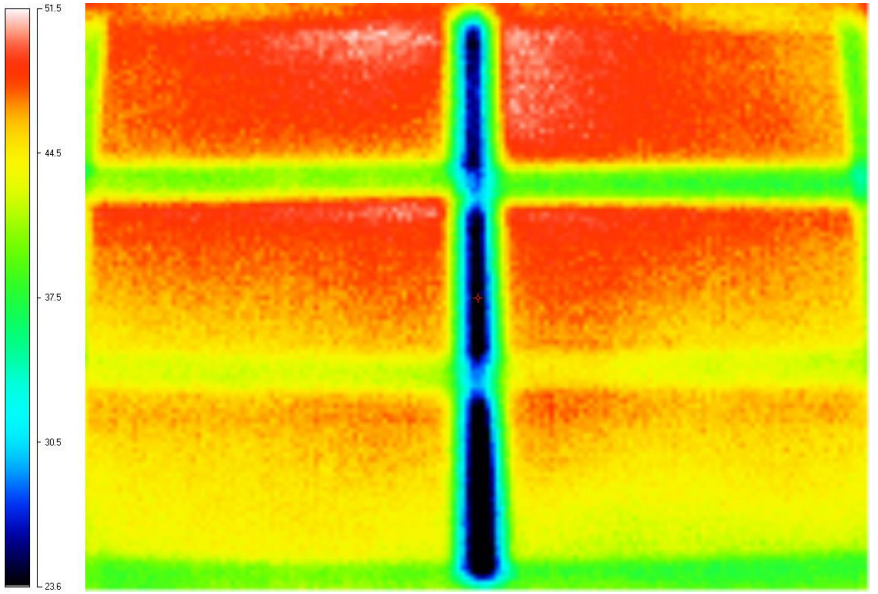
Renovated CTA Building

Building Feasibility Objective

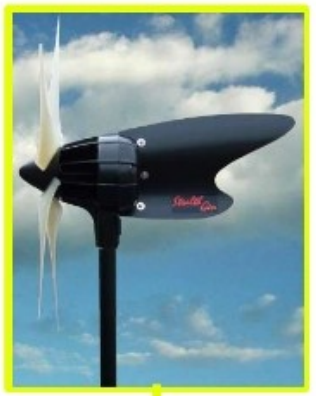
To analyze and improve upon the energy consumption of the CTA building.

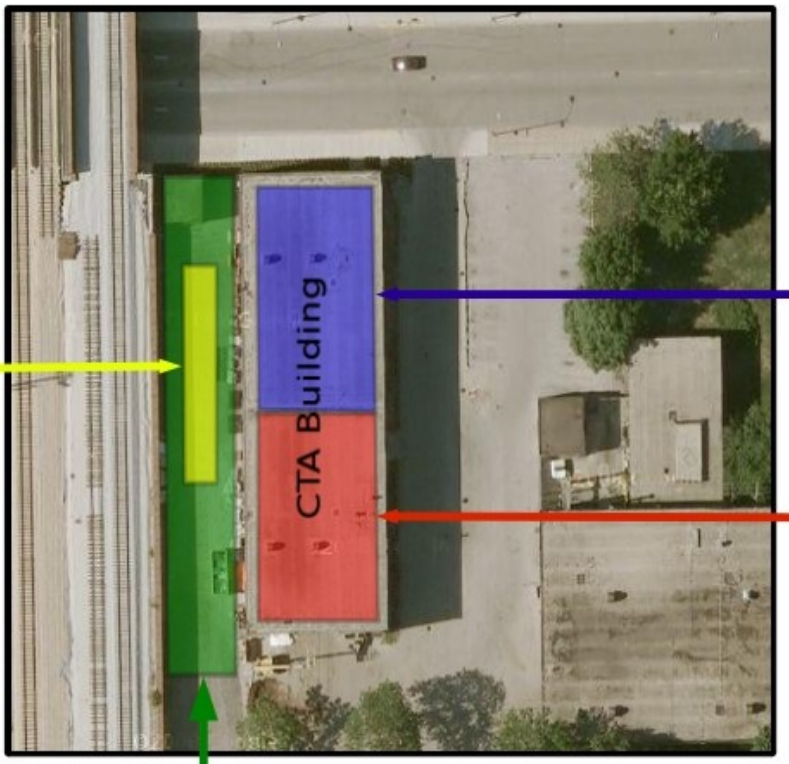
Research

- Thermal Imaging
- Technical Drawings
- HVAC
- EQUEST energy modeling
- Renewable energy technology



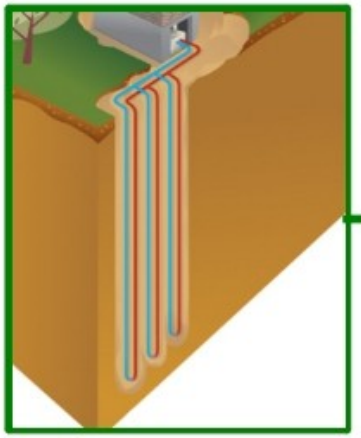
Wind Turbines





Solar Thermal Panels

Photo-voltaic Cells



Geothermal Energy

Proposed Zero Energy Technology Additions to CTA Building

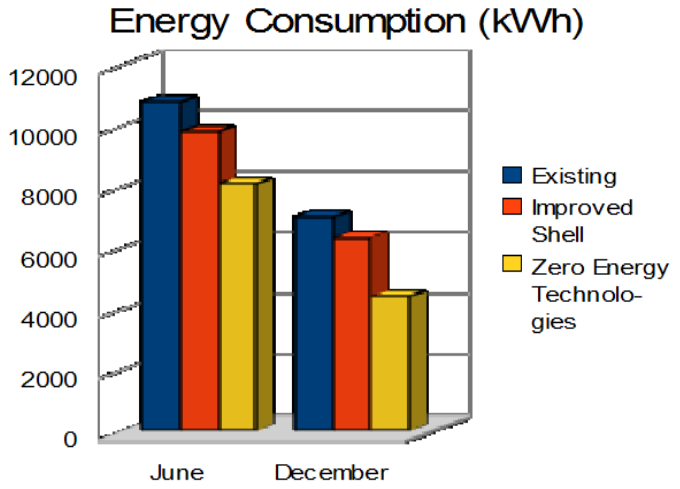
Proposed Building Modifications

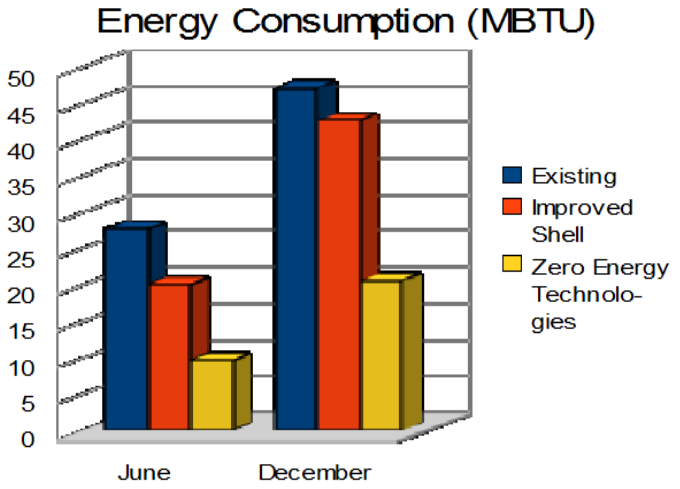
- Roof:
  Existing: 2 in polystyrene
  Improved Shell: 6 in polyisocyanurate R-42

- Walls:
  Existing: none
  Improved Shell: 3 in polyisocyanurate R-21

- Windows:
  Existing: Single pane, blue tint, 1/4”
  Improved Shell: Kalwall translucent FRP R-20

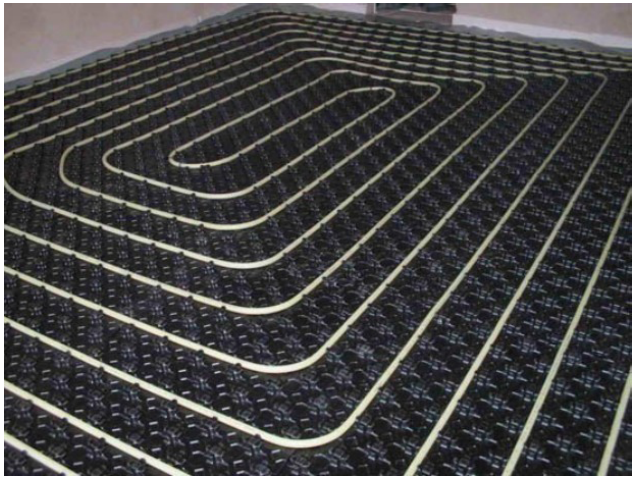
- Skylights:
  Existing: none
  Improved Shell: 15% of roof as Kalwall skylights R-20

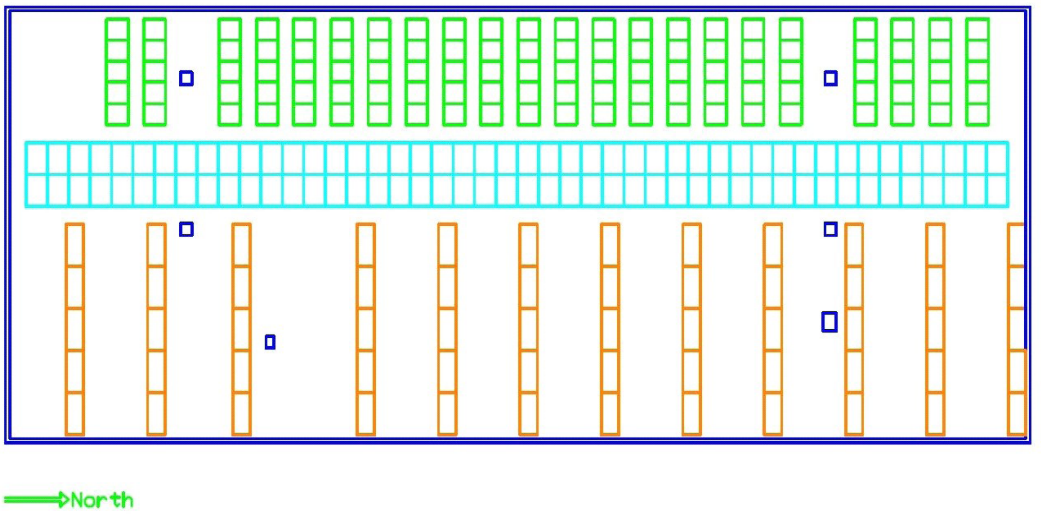




Proposed Supplementary Systems

- Radiant floor
- Occupancy sensors
- Daylighting sensors
- CO2 sensors
- Automatic operable windows





Programming a Collaboratory Space

SURVEY

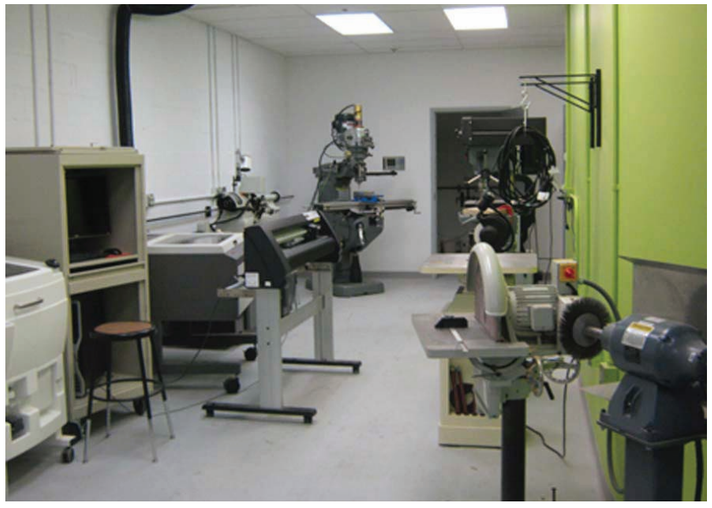
- IIT needs a dedicated IPRO facility that reinforces its importance to the university.
- IPROs need open, □ exible workspaces to foster a productive environment.
- IPROs need small, comfortable breakout areas with ready access to computers, whiteboards, prototyping, and assembly spaces.
- The IPRO program needs dedicated equipment and assembly space in its new facility.
- The IPRO program needs assigned, secure storage for each IPRO team in the new facility.

INTERVIEWS

SITE VISIT

Dedicated group workspaces

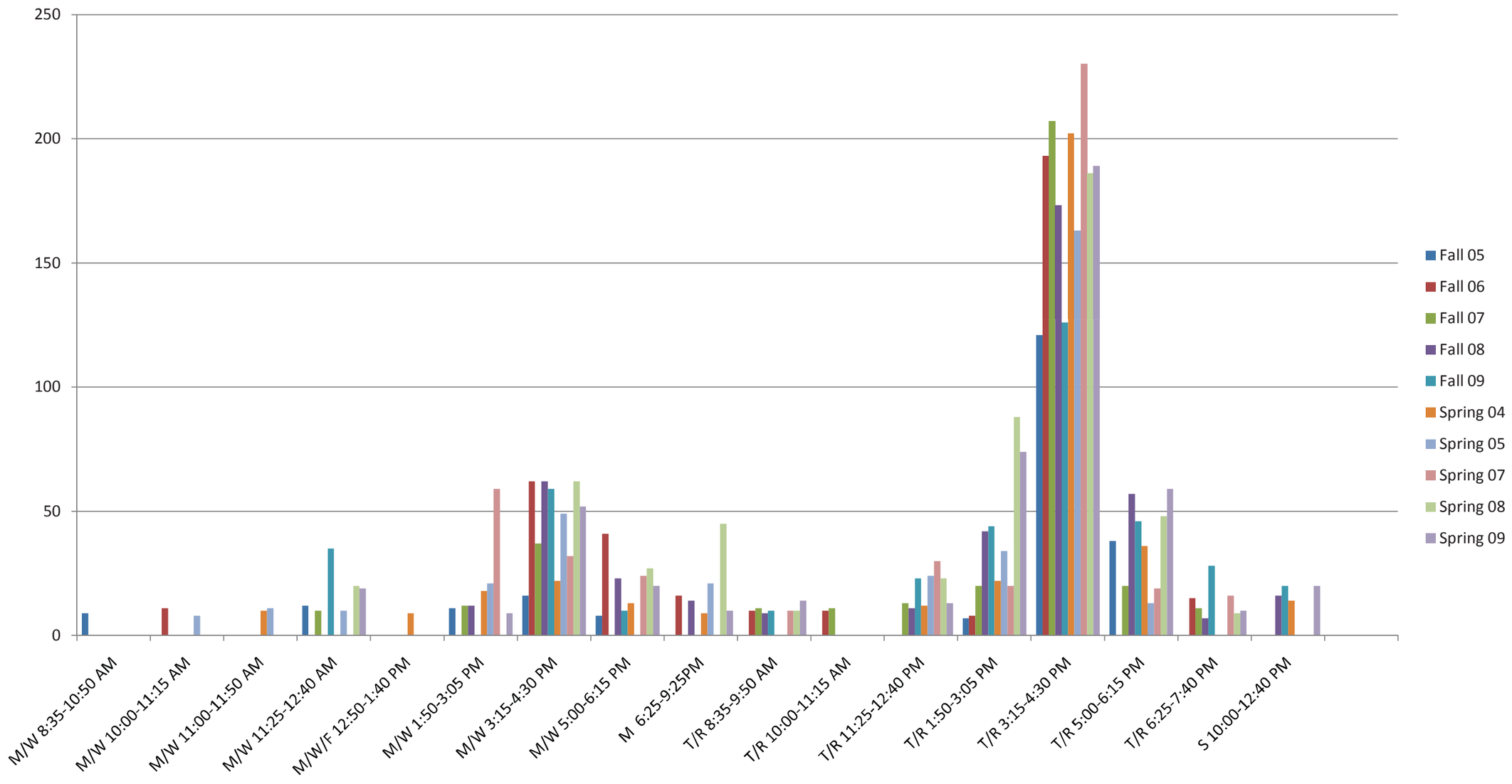
Large group workspace



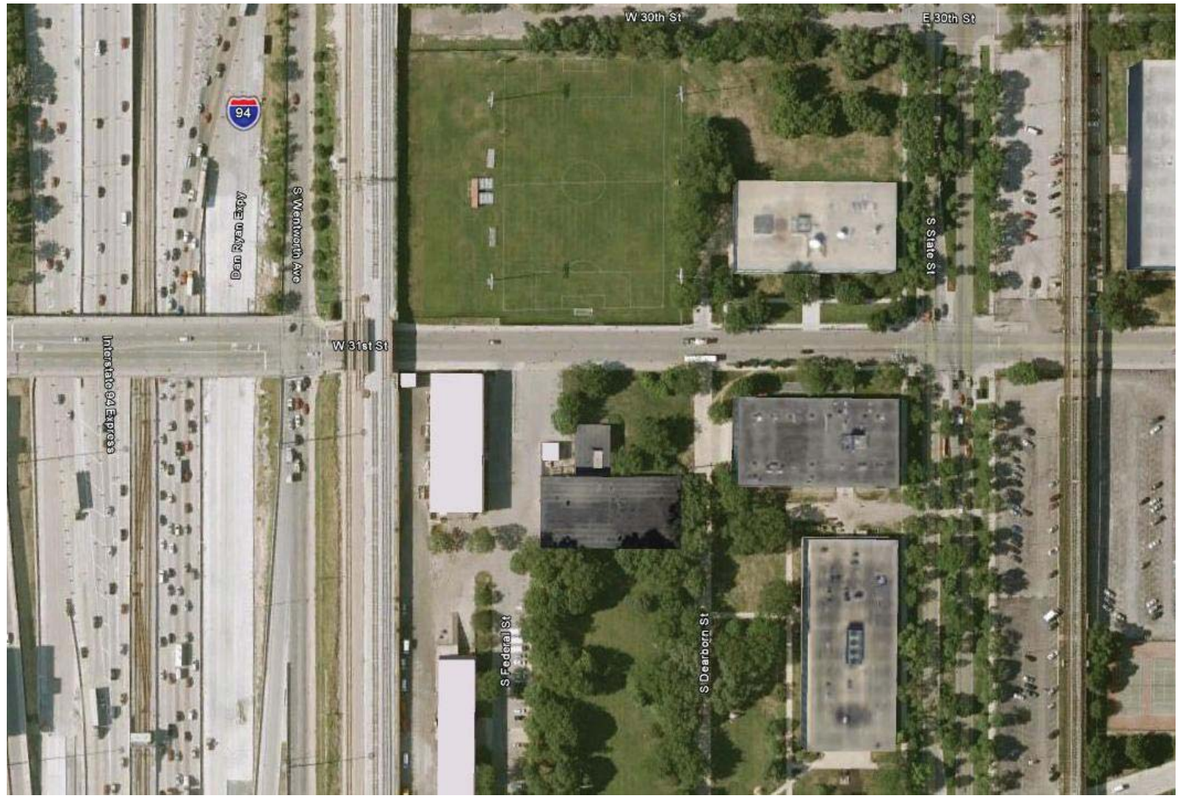
Prototyping shop

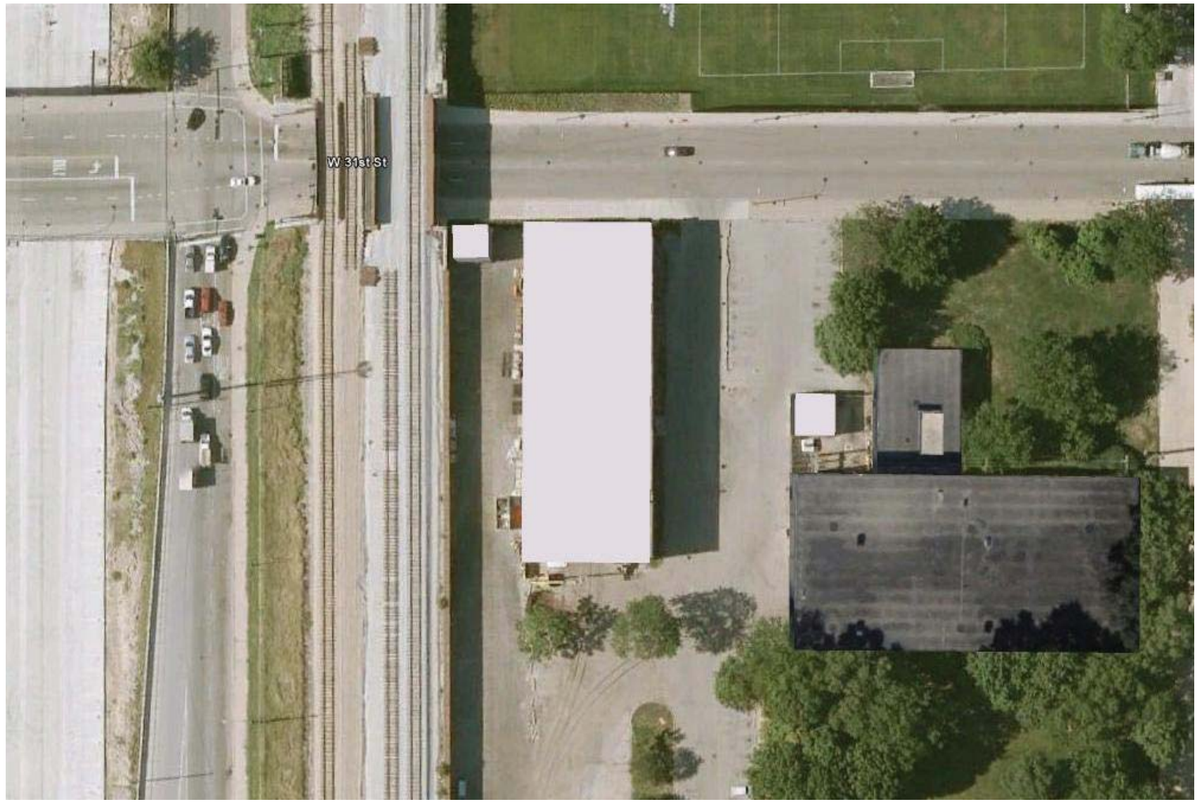
Analyzing Past IPRO Data

Analyzing Past IPRO Data

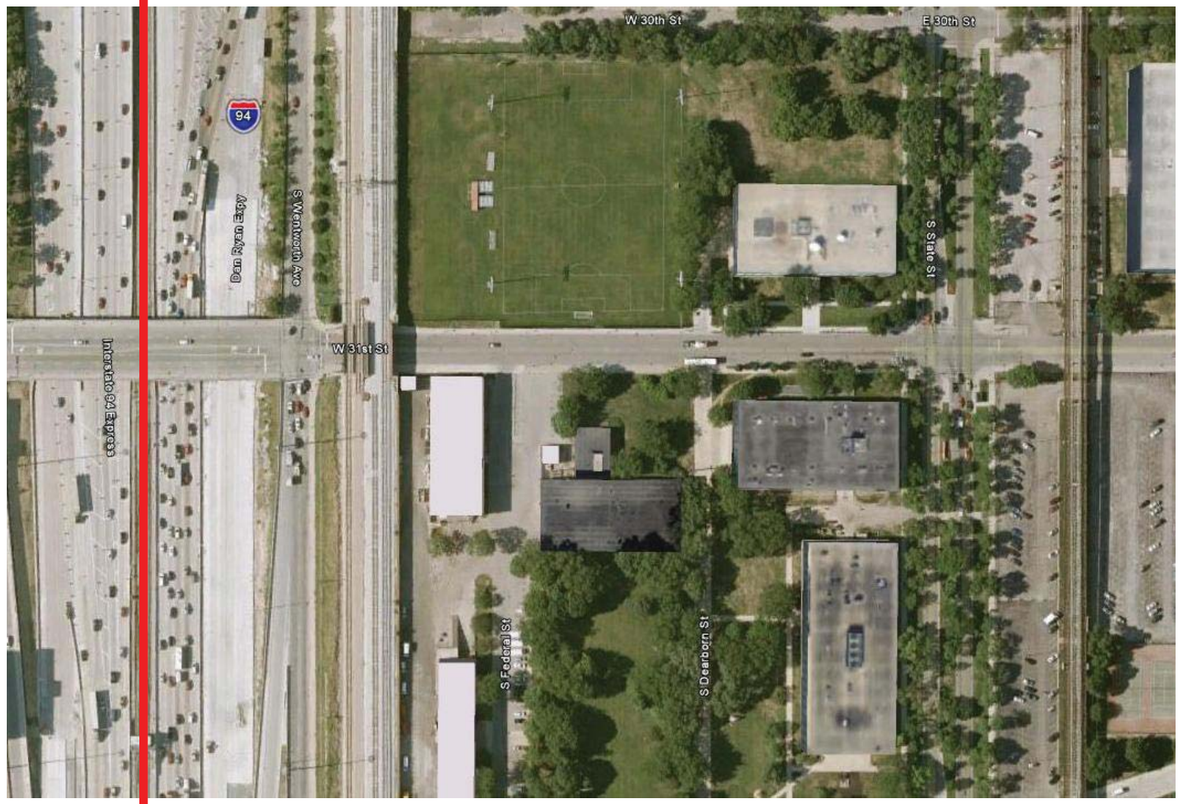


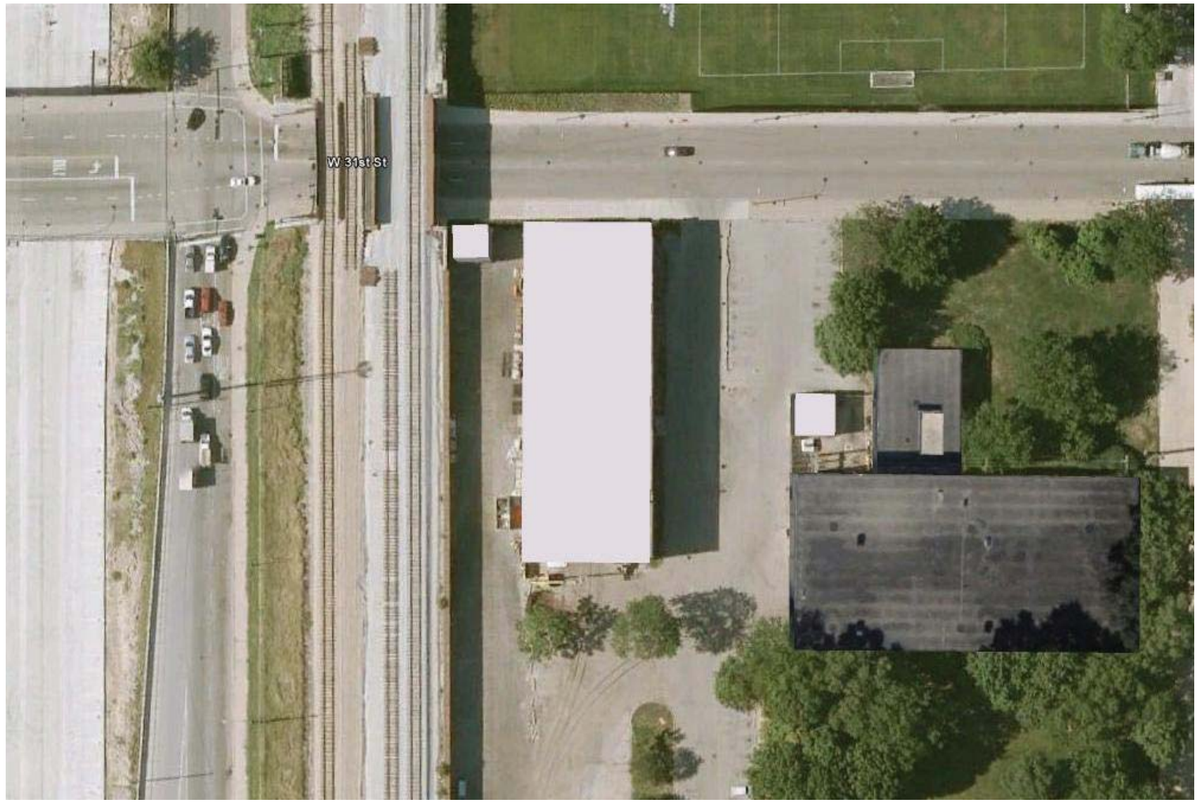
Analyzing the Site





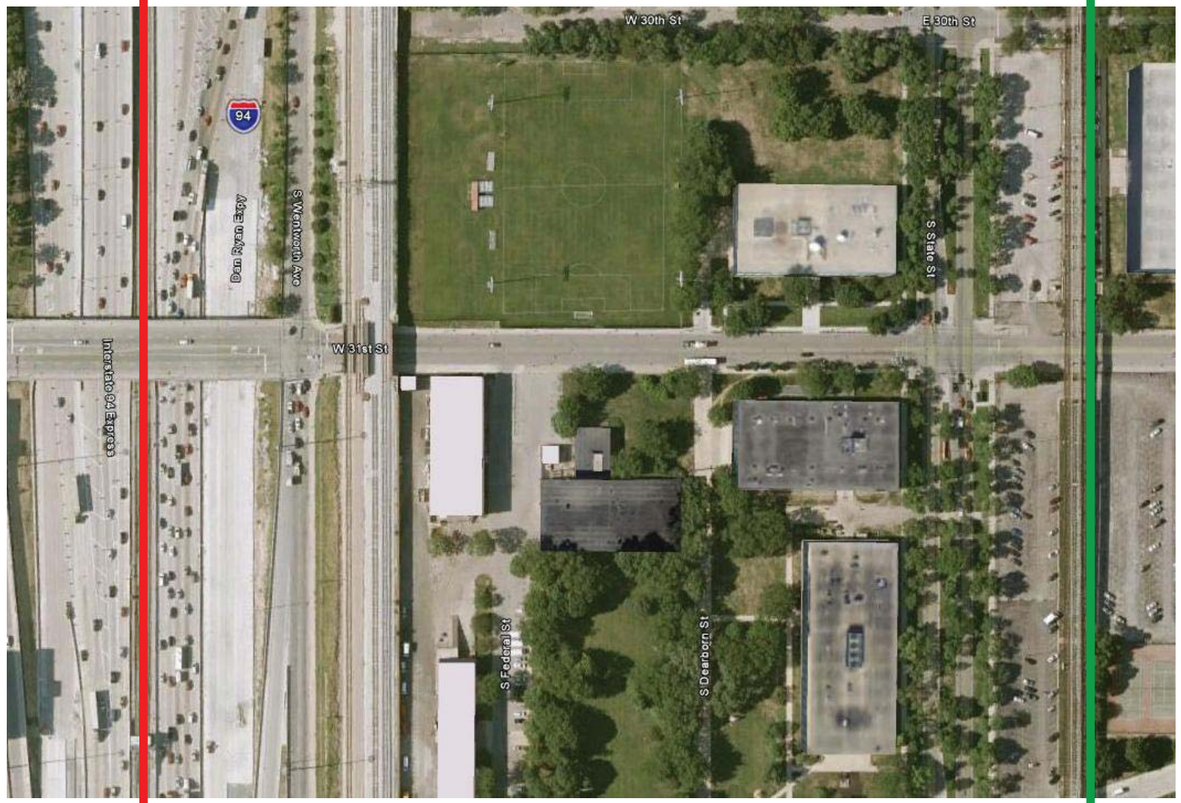
Analyzing the Site

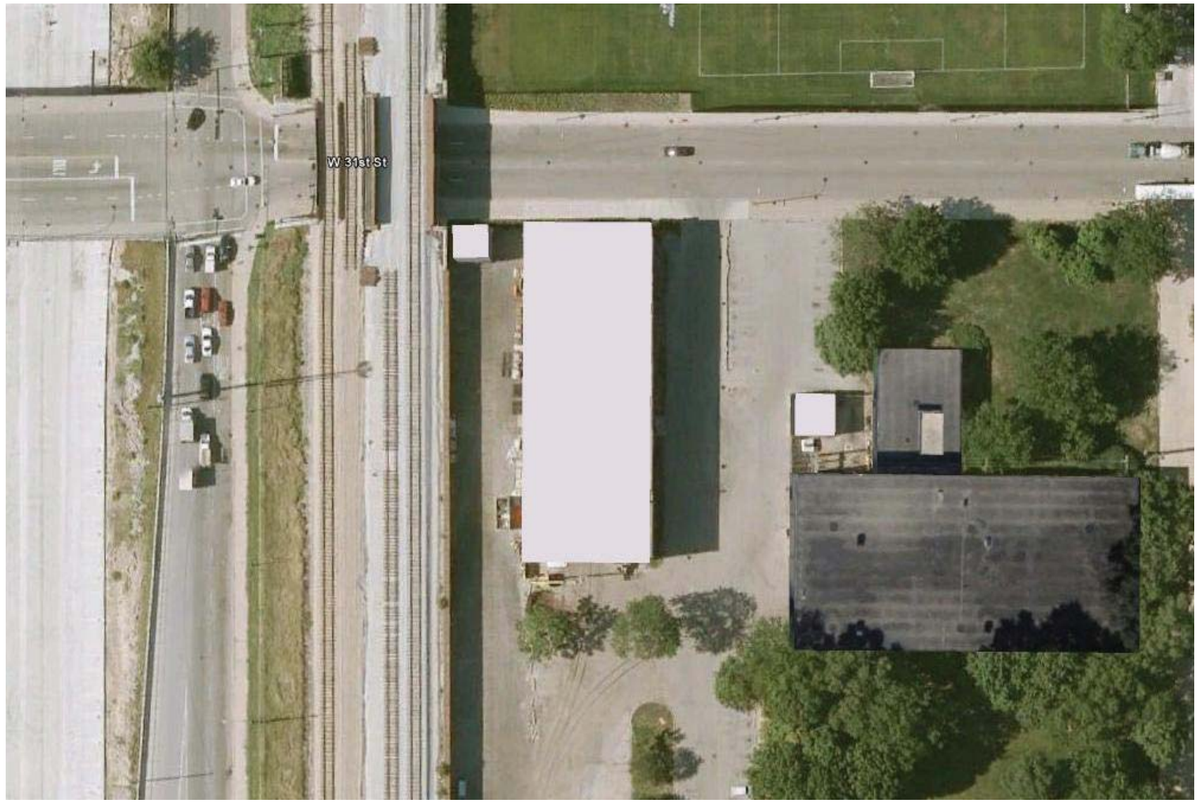




Red Line

Analyzing the Site

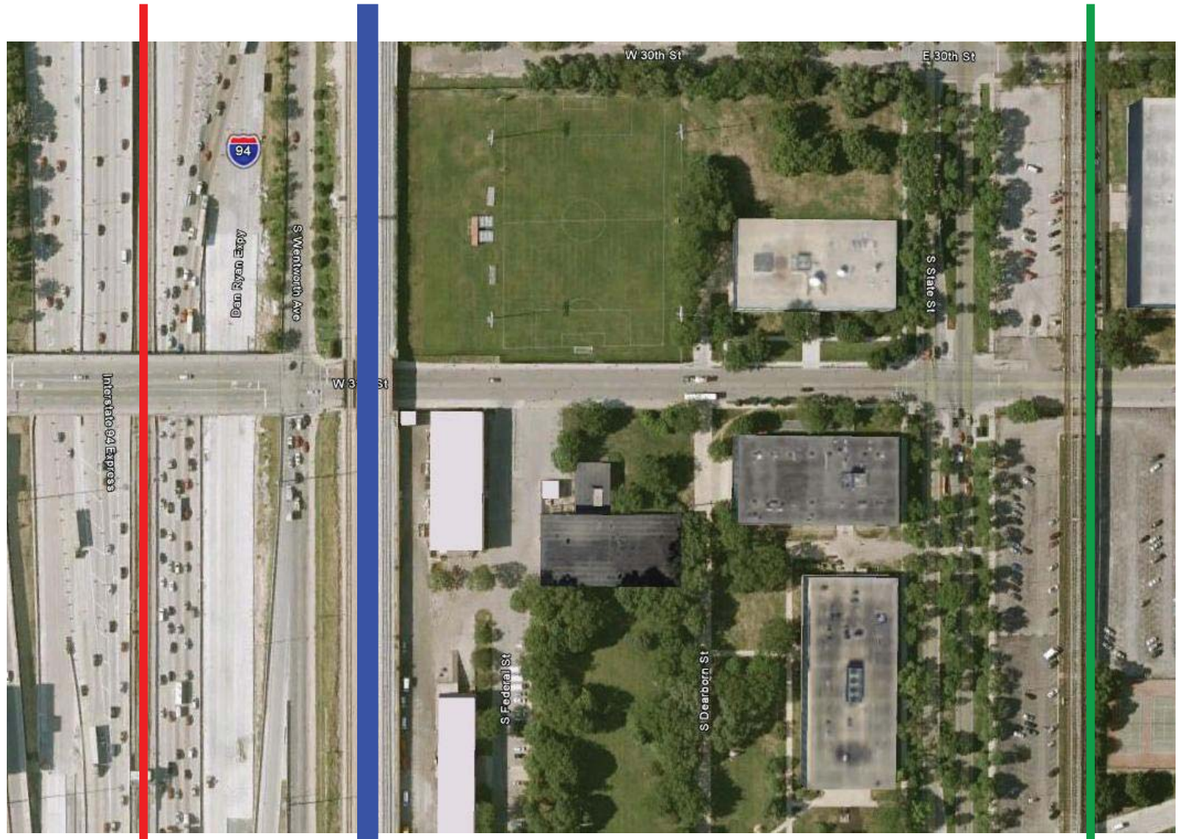


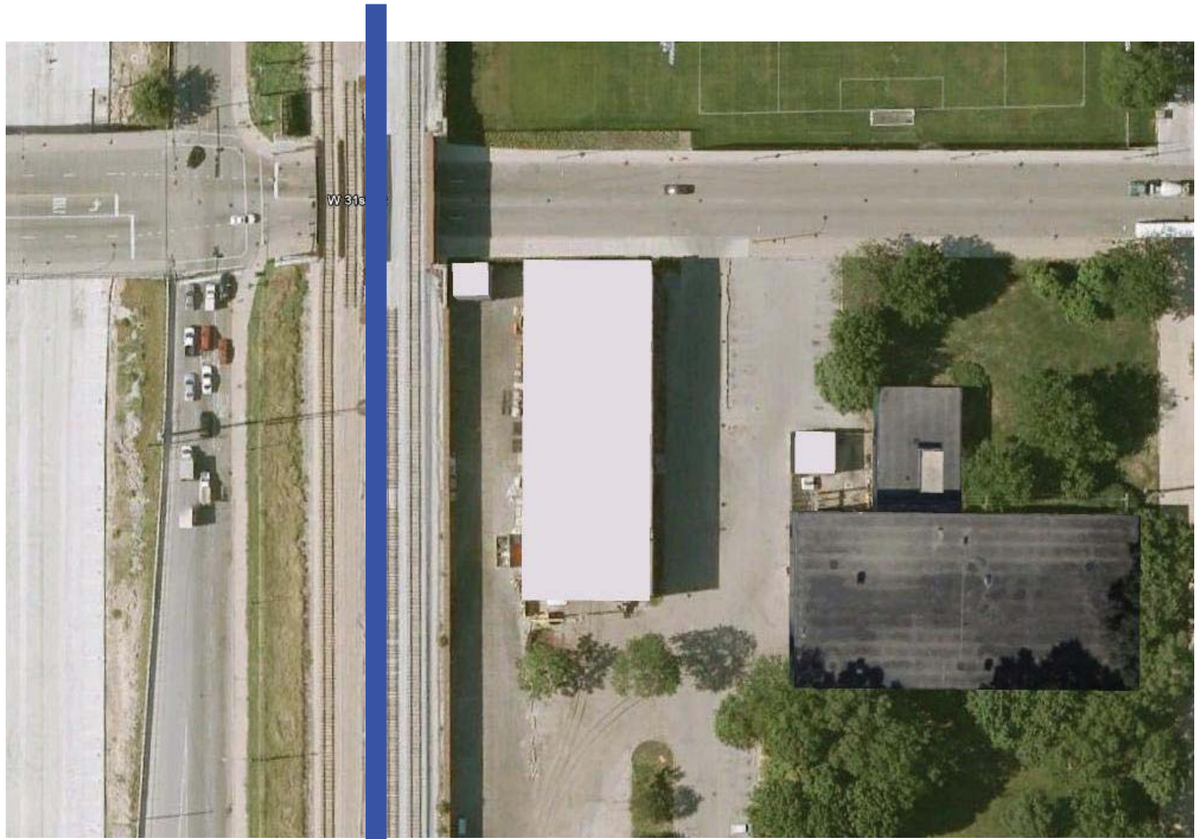


Red Line

Green Line

Analyzing the Site





Red Line

Green Line

Metra

Analyzing the Site

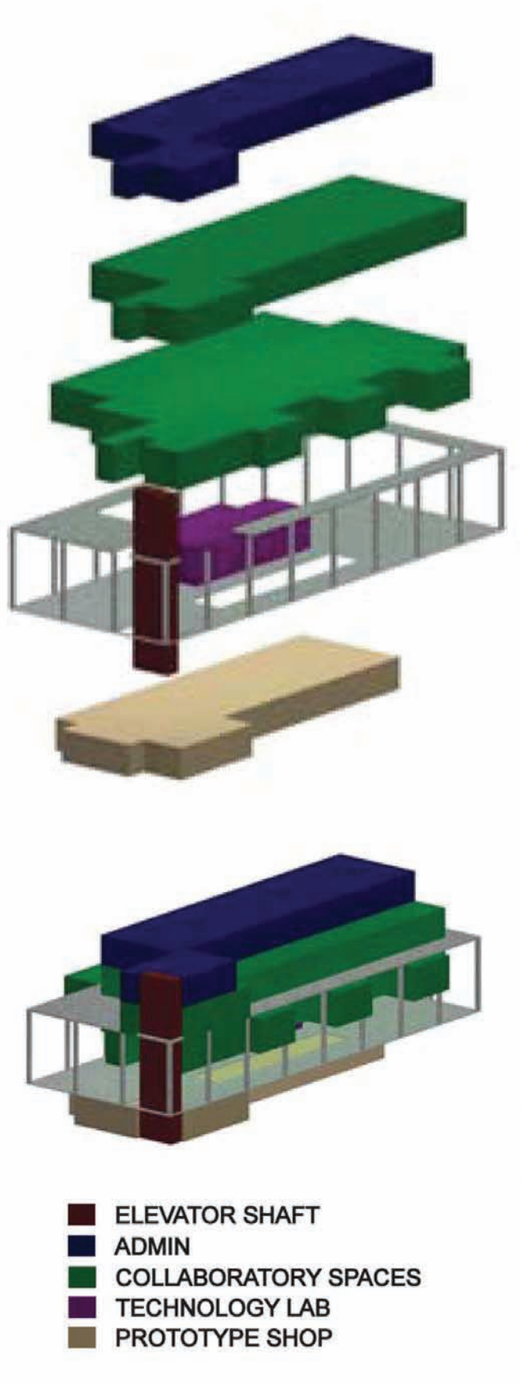
Red Line

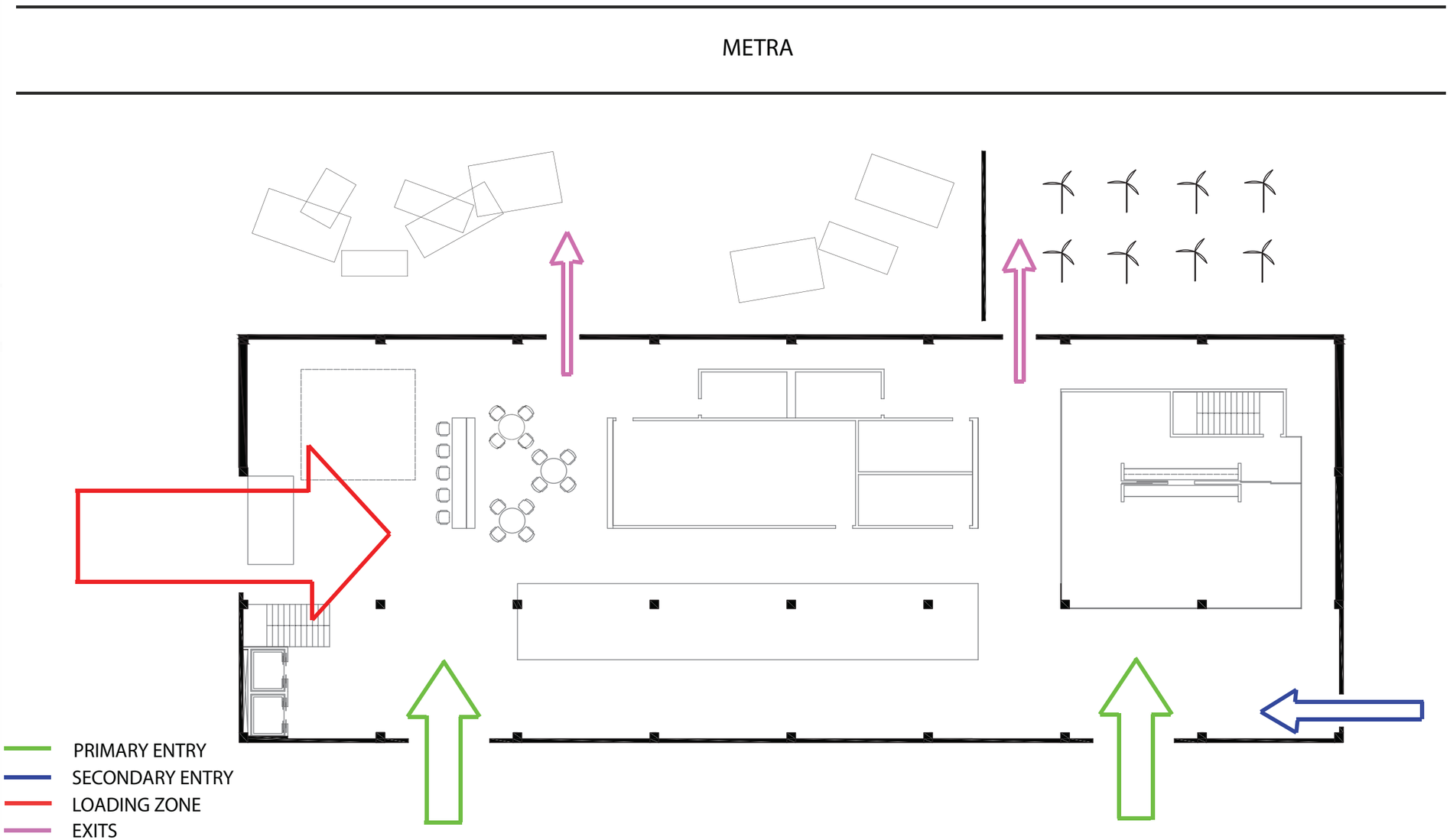
Green Line

Metra

Innovation Alley

New IPRO Facility

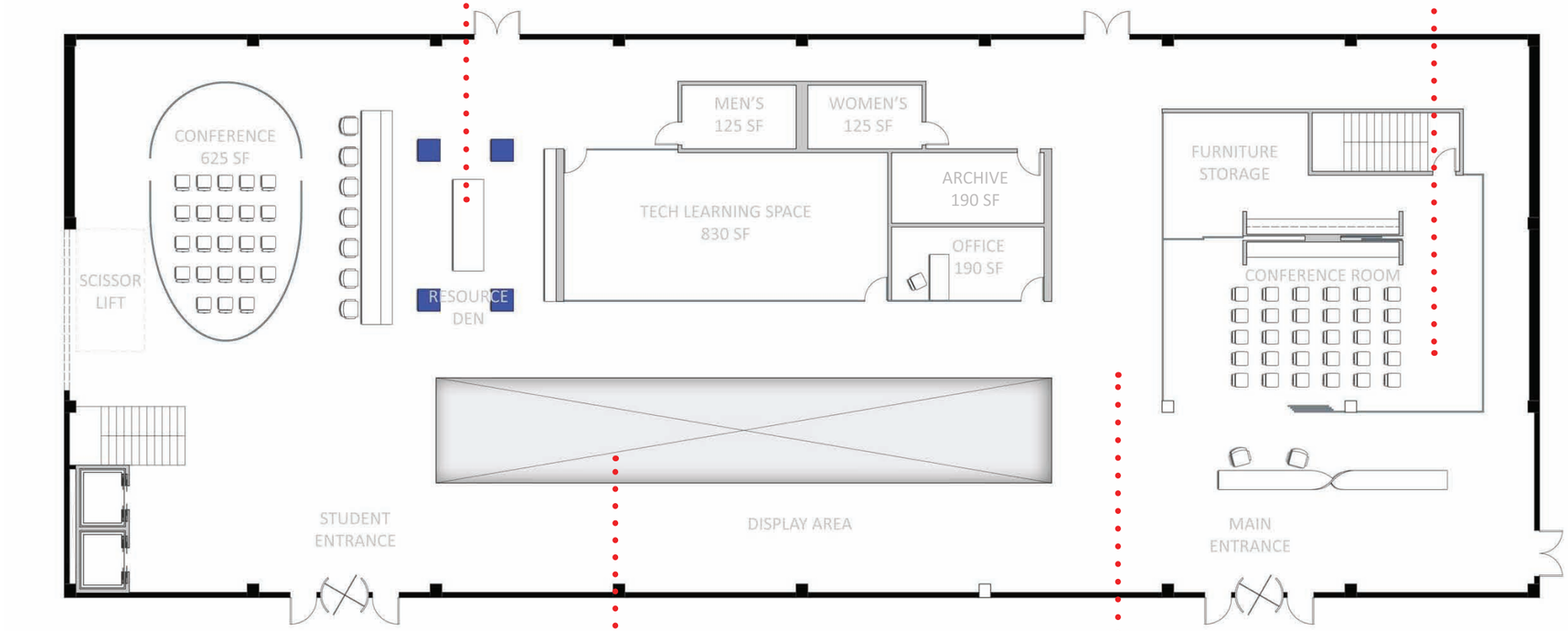




Analysis of new entries to the IPRO facility

New IPRO Facility

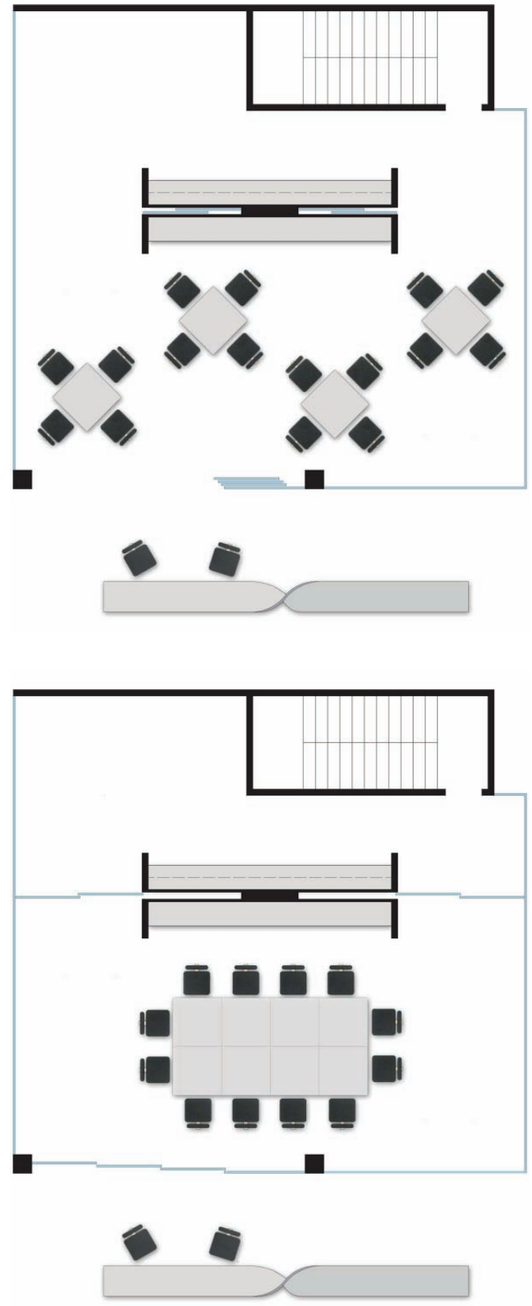
A computer/ resource area is open to students and guests on this level.



ENTRANCE LEVEL

The prototyping shop is visible from the entrance level.

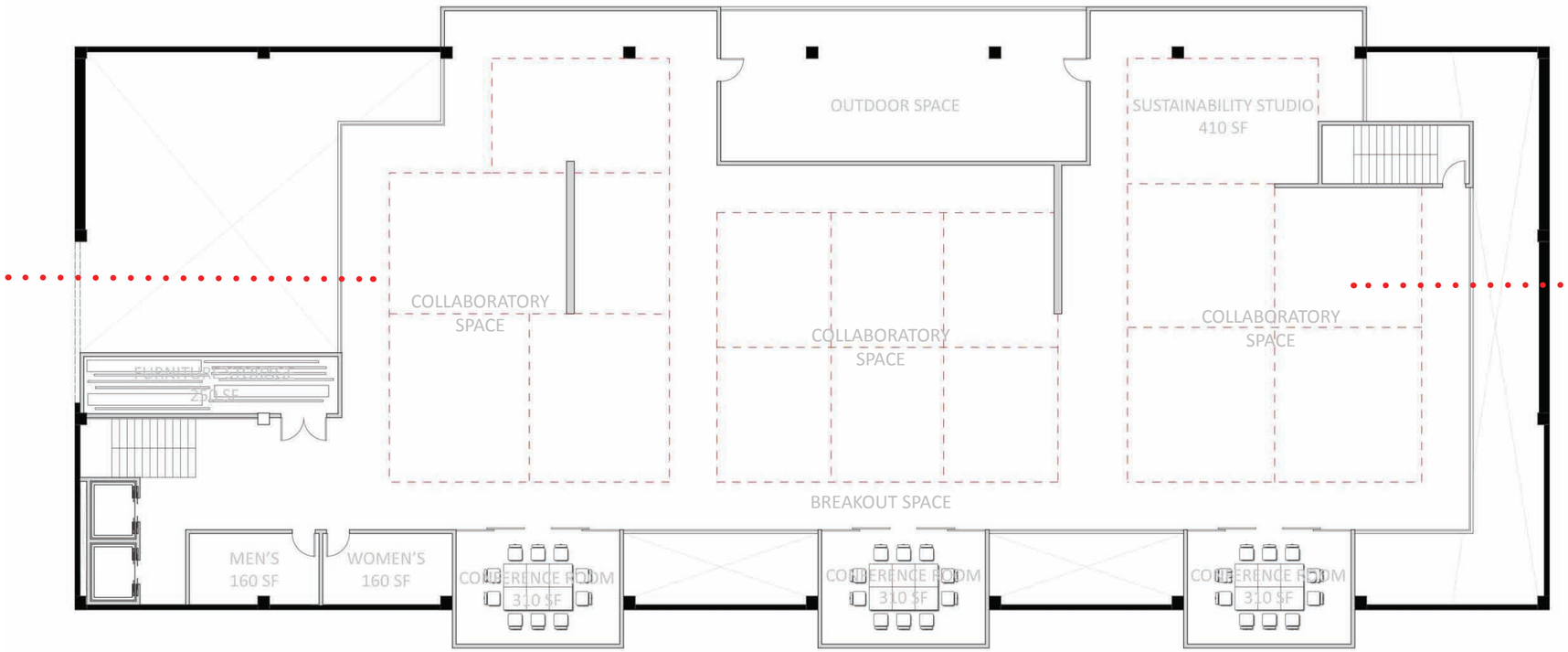
The circulation space on the first floor doubles as space to display past IPRO work.



Different configurations for the entrance level conference room

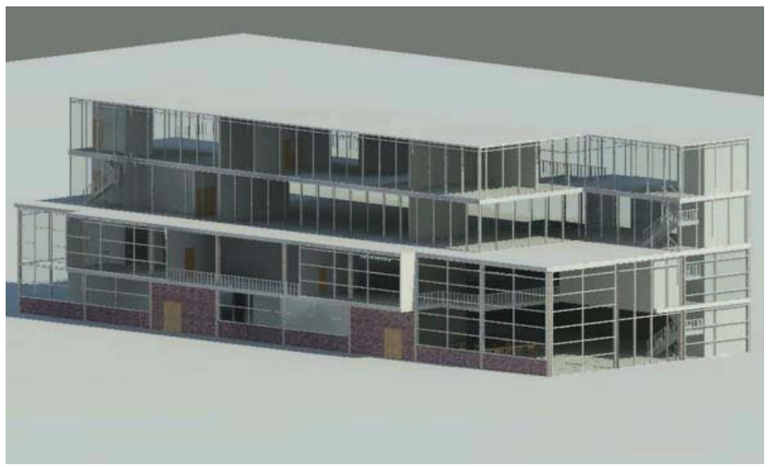
New IPRO Facility

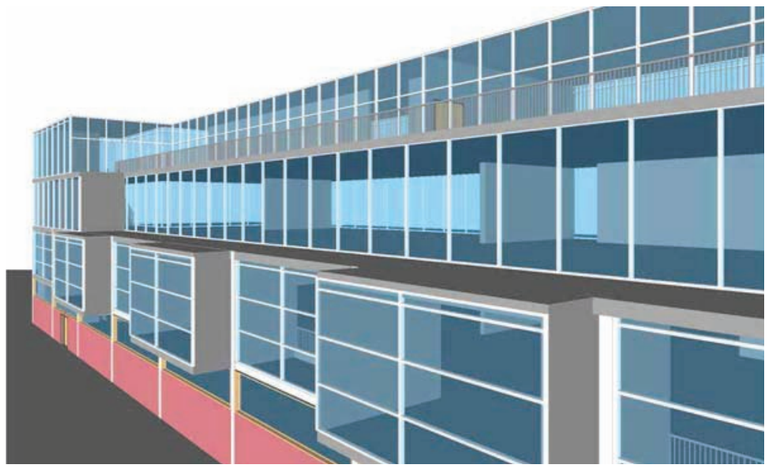
The program is pulled back from the exteriror walls, to allow more light into the building.

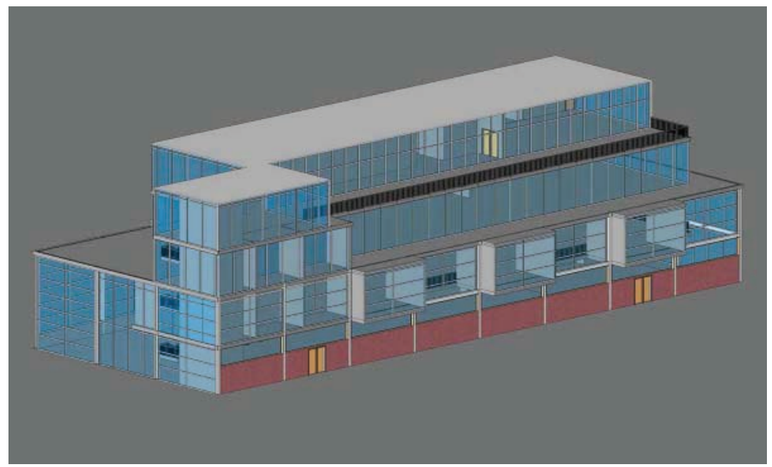


Flexible collaboratory spaces cater to IPROs with different needs.

COLLABORATORY SPACES



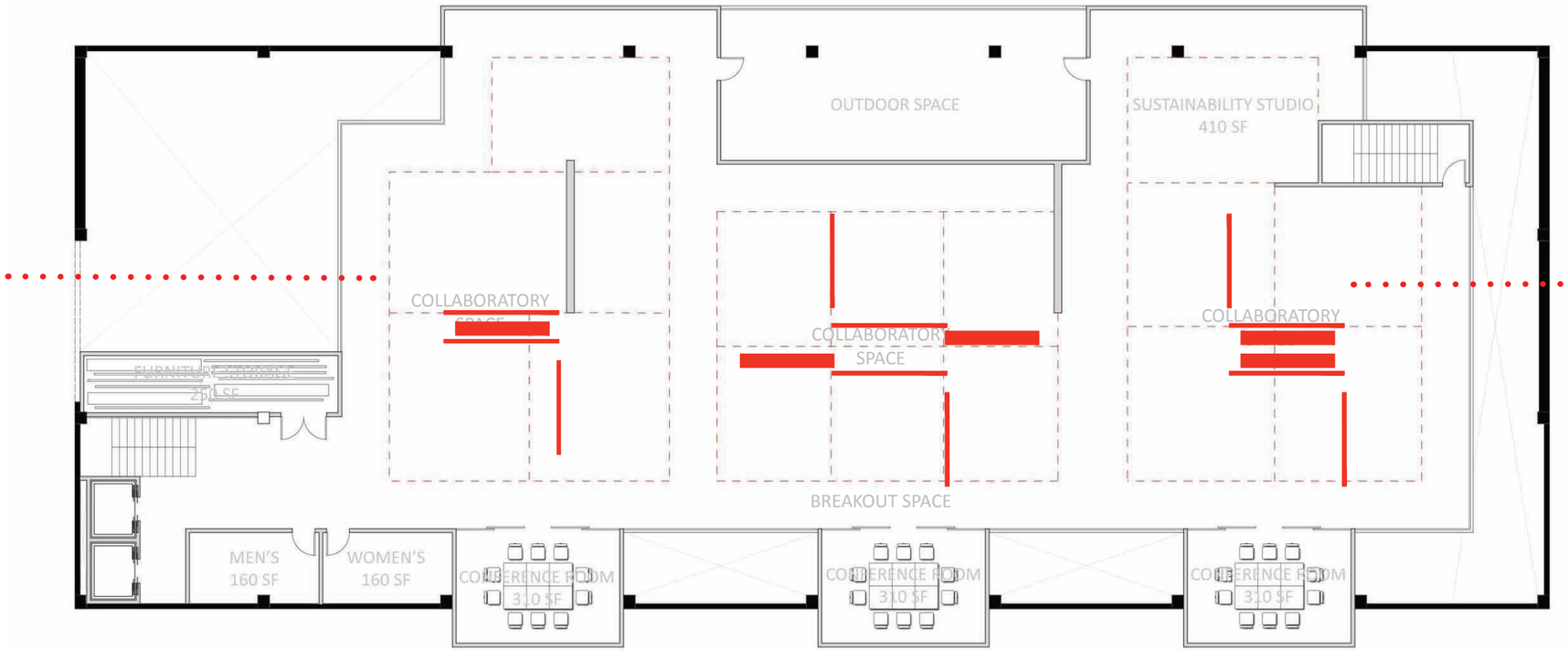




Exterior views of the new IPRO facility.

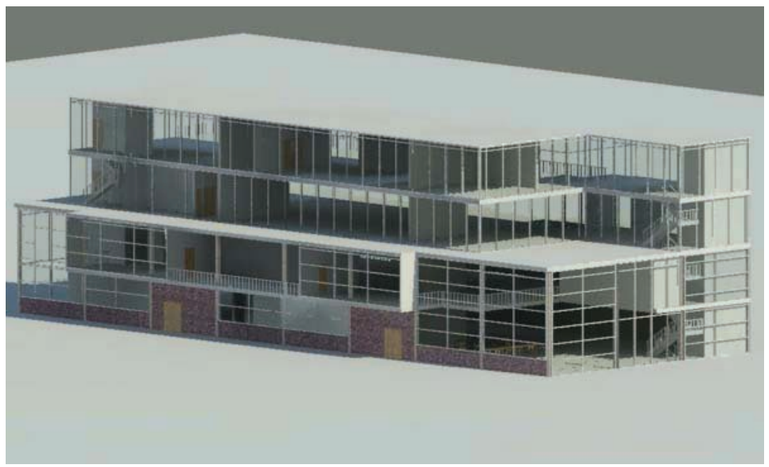
New IPRO Facility

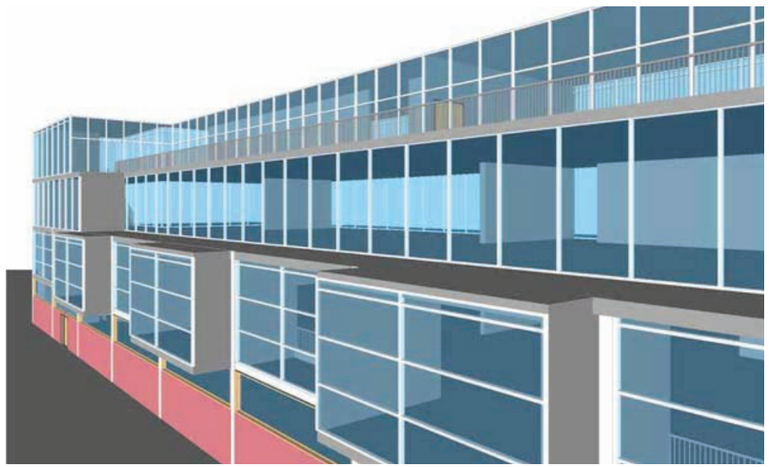
The program is pulled back from the exteriror walls, to allow more light into the building.

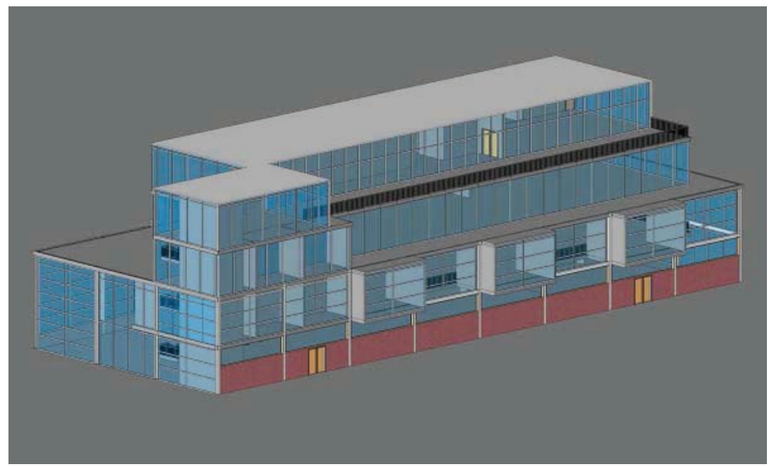


Flexible collaboratory spaces cater to IPROs with different needs.

COLLABORATORY SPACES

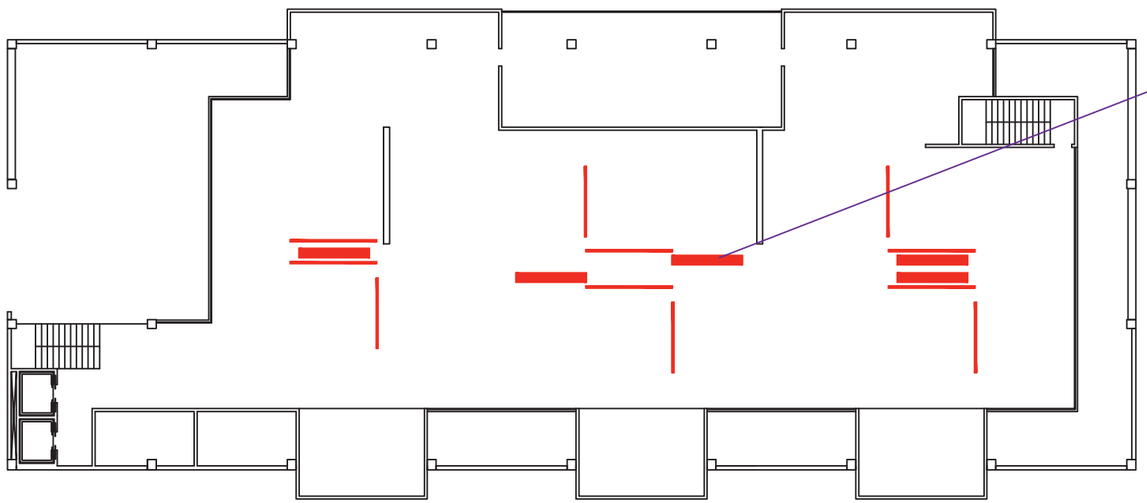




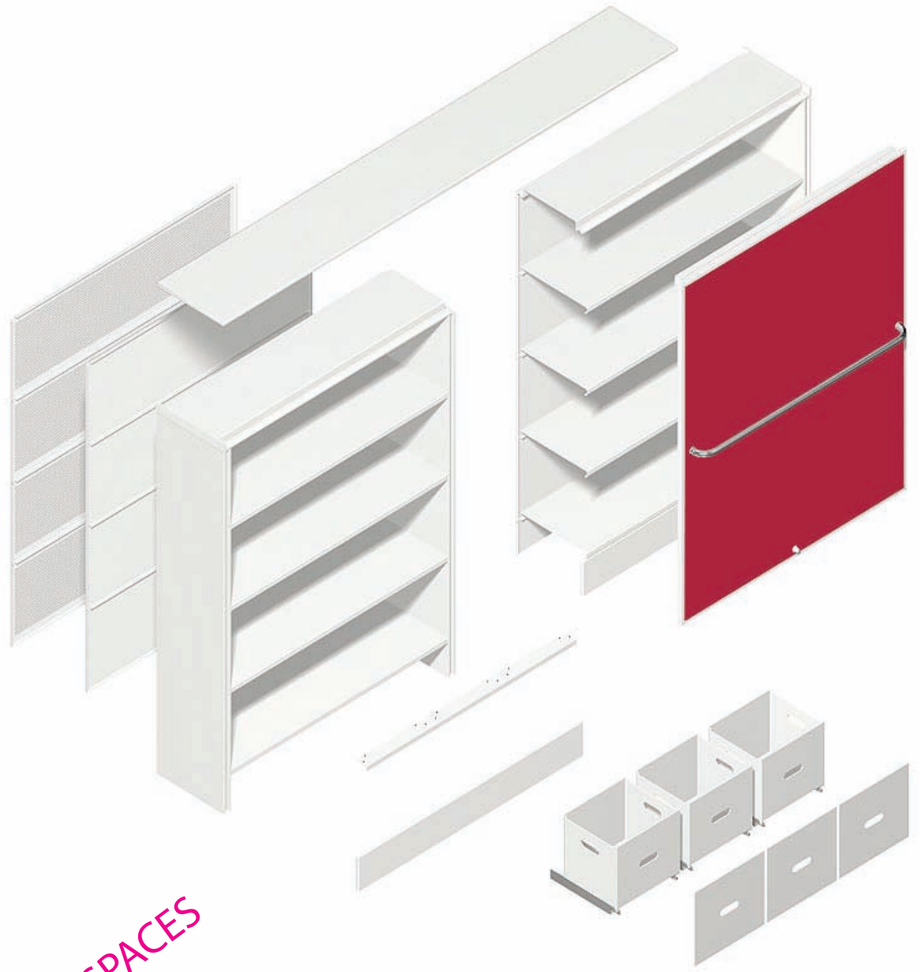


Exterior views of the new IPRO facility.

MOVEABLE STORAGE PARTITIONS



PLAN



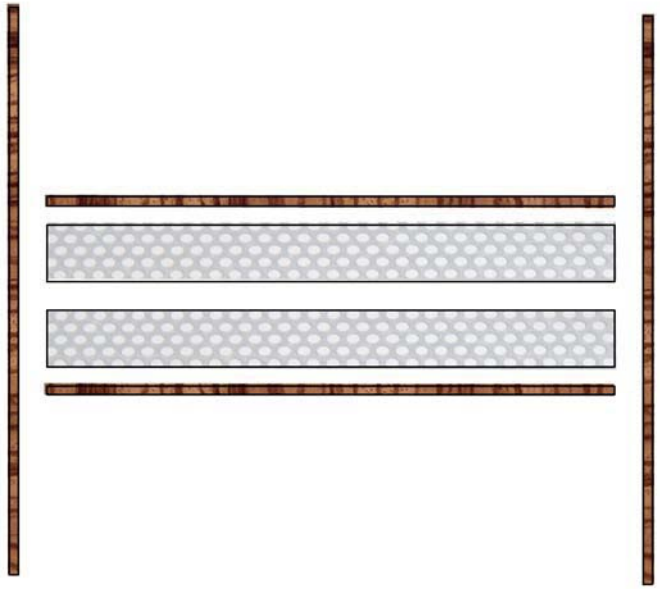
MOVEABLE PARTITION WALLS
ON WHEELS FOR QUICK AND FLEXIBLE
SPATIAL CONSTRUCTION

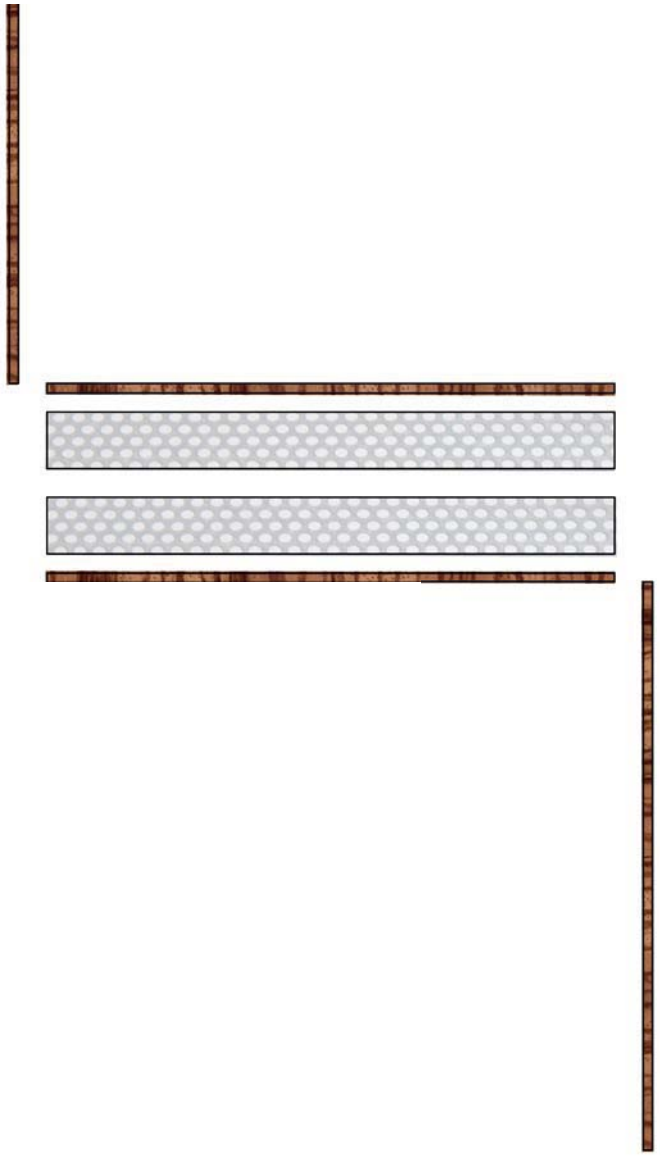
DEFINES SPACES

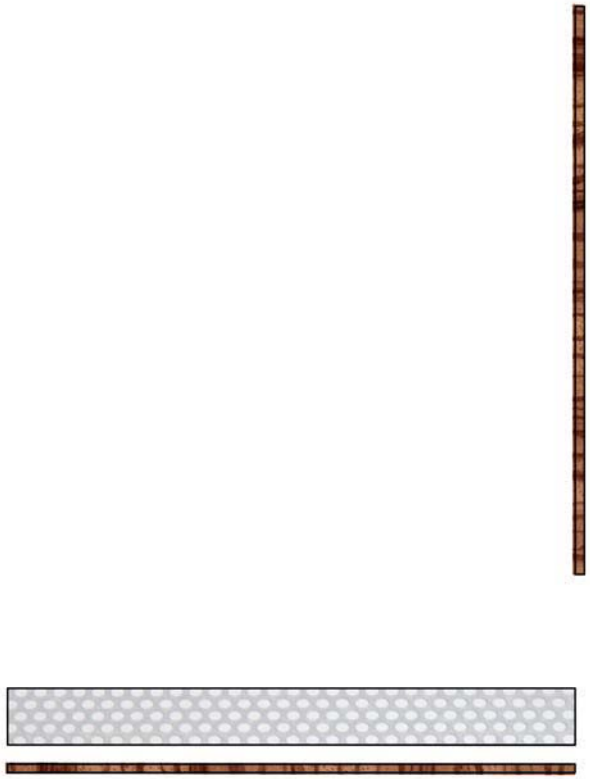
SUGGESTS DIRECTIONALITY

SUPER FLEXIBLE

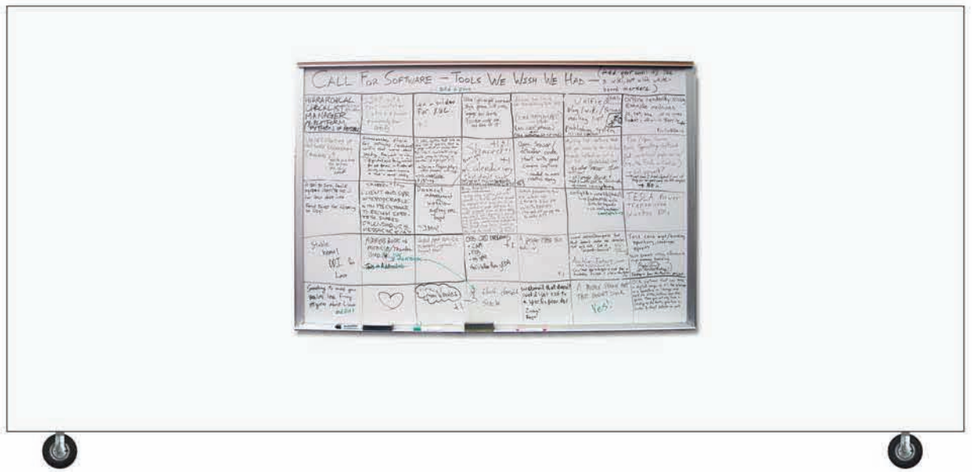
SOUND BARRIER







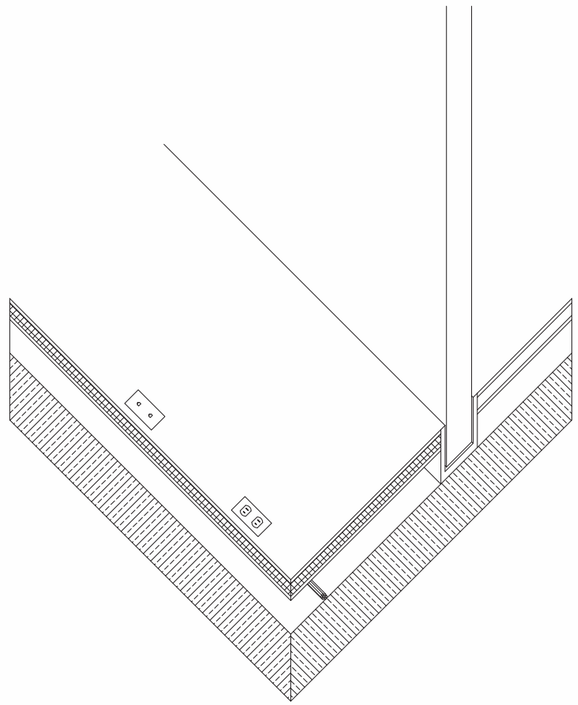
TYPES OF MOVABLE UNITS



Moveable panel with mounted white board and pin-up space

Moveable dividers with various sized storage spaces
'Ad Hoc' storage wall by Vitra.

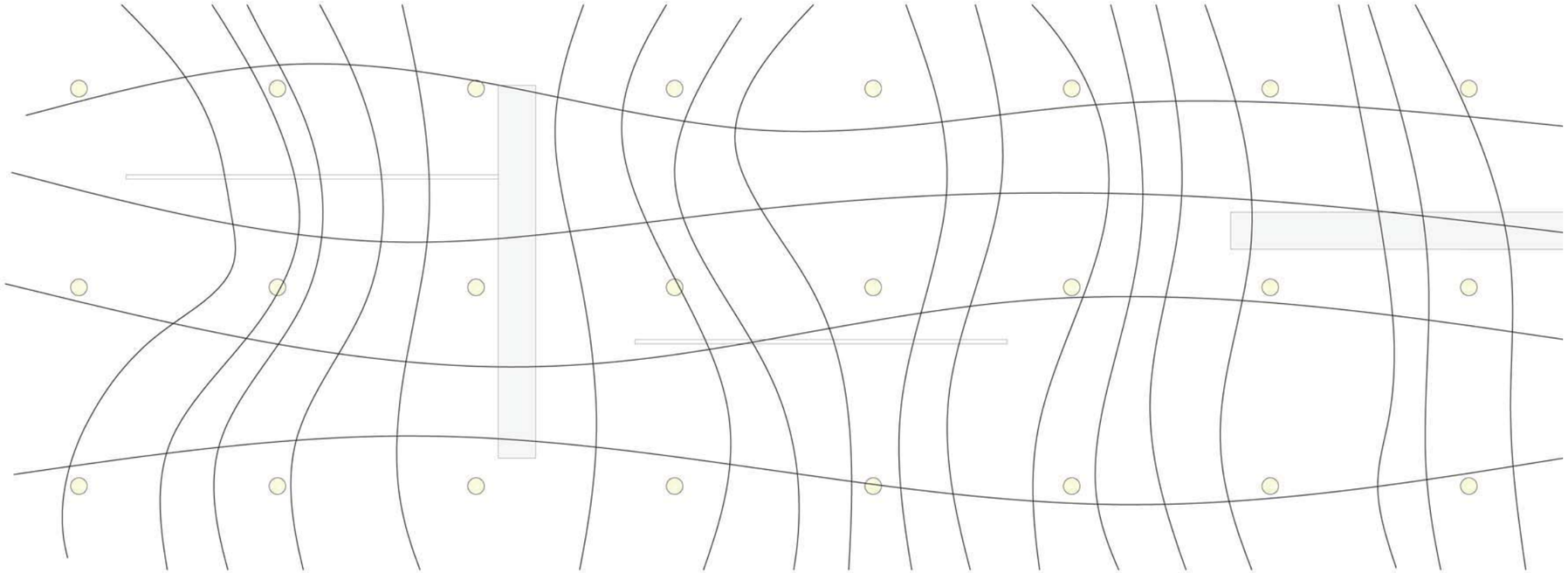
Blank moveable panel for a projection background or pin-up space



The collaboratory space levels have a raised floor that allows electric and data lines to run underneath the floor, leaving the space free to move the panels.

CEILING TREATMENT

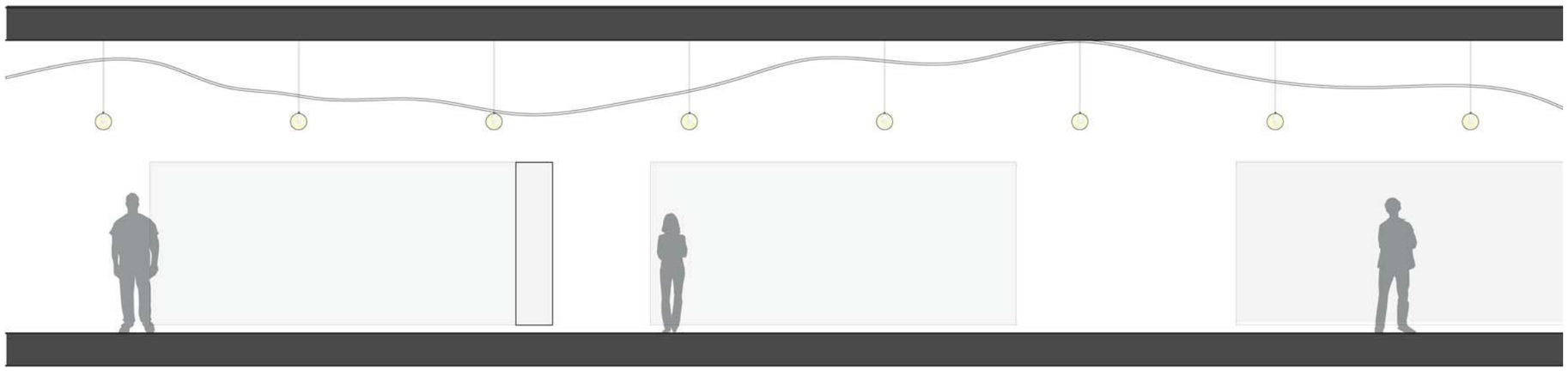
Airflake sound absorbing screen by Abstracta



Plan of felt ceiling treatment with lighting arrangment

Advantages to wool felt:

Flame retardant
Wear resistant
Easy to form and cut
An excellent sound insulator
Vibration damping qualities
Superior thermal insulating properties
Renewable and environmentally friendly resource



Section through felt ceiling treatment with lighting arrangment

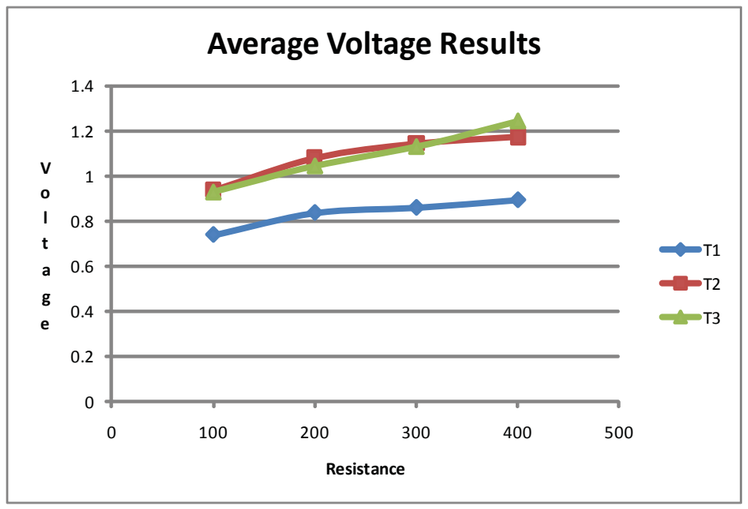
Zero Energy Lab Concepts (ZEL) Research

-Applying previous concepts from Machinery Hall to the CTA building

-Wind Energy is a good candidate to provide renewable energy to the CTA building

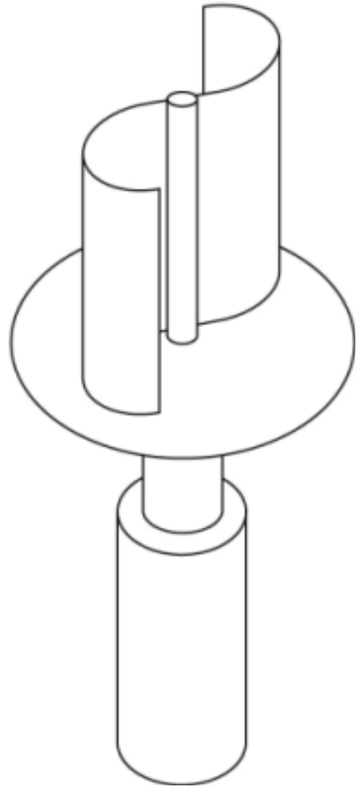
-Two designs of vertical axis wind turbines
  -H-Rotor
  -Savonius Rotor (double & triple blade designs)

H-Rotor



-Savonius Rotor triple blade design was the most efficient

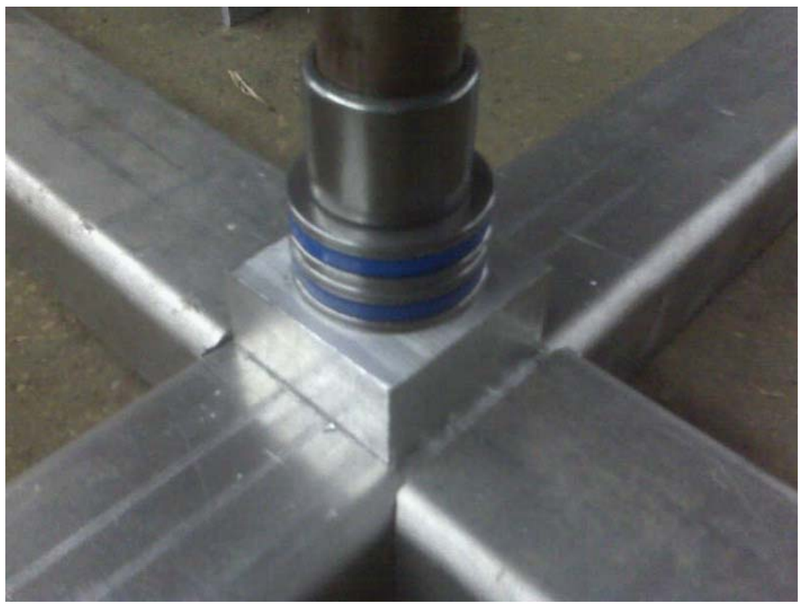
-Large scale model produced to test efficiency



Savonius-Rotor

Process of Design and Fabrication

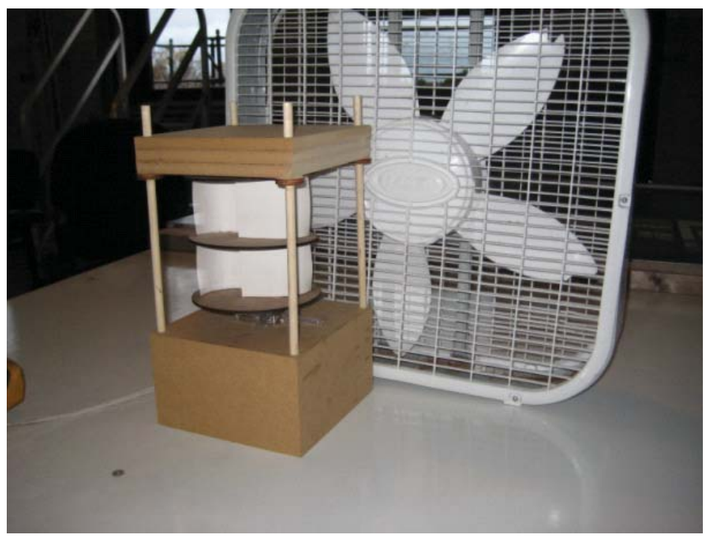
horizontal corss members before connection of vertical members



horizontal corss members with axial support block and ball bearings

Savoius-Rotor wind turbine with completed frame

Process of Design and Fabrication



testing of savoius-rotor triple blade design

cutting wind support discs with plotted template

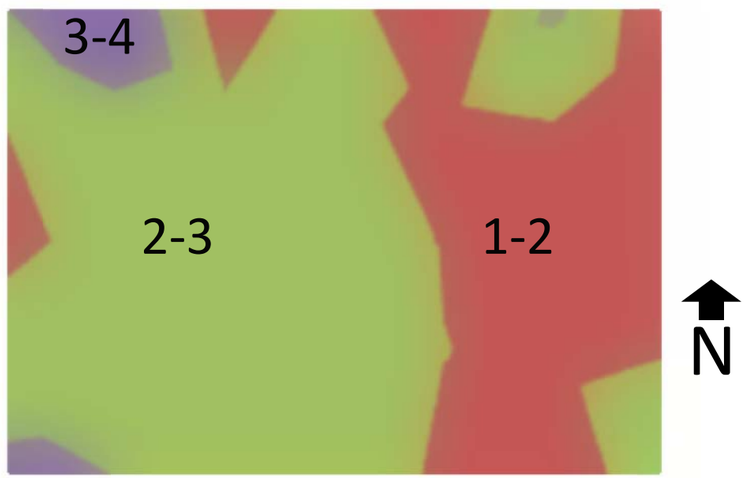
final cuts to wind support discs

sanding wind support discs to reduce wind drag

getting wind support discs into place

dry assembly of prototypical wind turbine

Power Generation



Machinery Hall rooftop
wind speed readings (m/s)

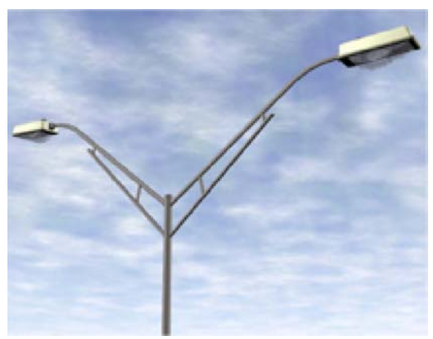
CHICAGO WIND SPEED

average	10.3 mph
maximum	62 mph

highest in spring

lowest in late summer

WIND TURBINE PERFORMANCE ESTIMATES

average output		20-50 Watts
absolute maximum output		200-400 Watts

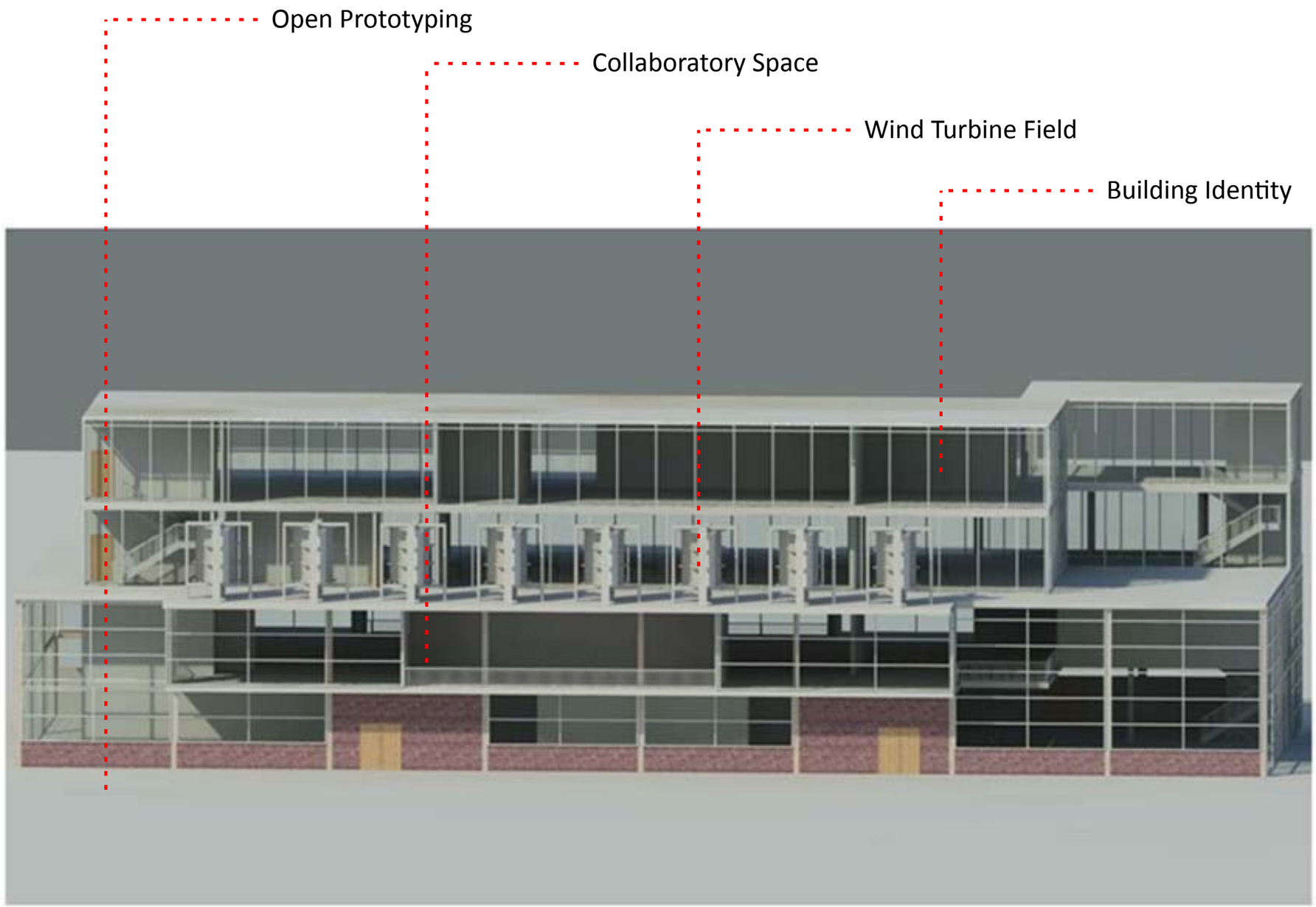
New IPRO Collaboratory Facility

western facade of building with a view of wind turbine installation

view of the wind turbines from the south west corner

view of the building from the north west corner

New IPRO Collaboratory Facility



western facade of building with a view of wind turbine installation

view of the wind turbines from the south west corner

view of the building from the north west corner


HYUNDAI
N/B LASALLE
TO 26TH /
WENTWORTH
DETOUR

Questions?