Project Background

- Client seeking solution for previously acquired property in Oak Park
  - Building must accommodate client’s business
    - Trading firm: 12-25 employees
  - Client is interested in a live / work solution
    - Client’s residence must accommodate family of 7
      - Minimum size of 4,000 square feet
  - Ground floor retail recommended
  - Sustainability is a goal
Mission

We aim to find a balance among economy, need, and sustainability to satisfy the unique needs of the owner. Our design must not only create a functional and comfortable live/work space for the owner but must also be financially viable. The consolidation of the owner’s home and business into a single building will provide a basis of efficiency which we will employ to achieve increased performance in sustainability and economy.
Goals

- Create groups to address various aspects of project
- Create a business plan
- Determine a scheme to meet the owners needs
  - Study possible uses on site
  - Compare possible schemes in terms of owner’s needs, comfort, and economic benefit
- Create a schematic design of the building
- Determine construction methods and materials, including finishes
- Select mechanical systems to be utilized in building
- Design using sustainable practices and incorporate sustainable systems
Presentation Overview

- Team Organization
- Market Research
- Construction
- Building Systems
- Construction Cost
- Sustainability
- Business Plan / Economics
- Future Prospects
- Design
Building Systems Group

- Objectives
  - Engineer structure and select materials
  - Engineer and design building systems
  - Cost estimation of all built elements

- Team Members
  - Alejandro Aguilar, Architectural Engineering
  - Leon Chan, Civil Engineering
  - Joe Kerrigan, Architectural Engineering
  - Bryan Zacharias, Architecture
Sustainability Group

- Objectives
  - Research sustainable technology and design
  - Design of sustainable systems
  - Analyze building performance

- Team Members
  - Aubrey Vander Heyden, Architectural Engineering
  - Michael Walters, Electrical Engineering
Business Plan Group

- Objectives
  - Correlate data from other groups
  - Establish financial guidelines
  - Develop Business Plan

- Team Members
  - Chinedu Azodoh, Electrical / Computer Engineering Minor in Business
  - Melissa Cheviron, Architectural Engineering
Design Group

- Objectives
  - Research Building and Zoning Codes
  - Design architectural elements
  - Develop presentation visuals

- Team Members
  - Jon Achs, Architecture
  - Yehuda Gutsein, Architecture
  - Madison Kelly, Architecture
  - Tyler Stellwag, Architecture
Preliminary Building Use Research
# Preliminary Building Use
## Financial Summary

<table>
<thead>
<tr>
<th>SCHEME</th>
<th>USE</th>
<th>CONSTRUCTION COST</th>
<th>35% DOWN ON CONSTRUCTION LOAN</th>
<th>IMMEDIATE RETURN ON INVESTMENT</th>
<th>RETURN ON INVESTMENT IN 10 YEARS</th>
<th>% IMMEDIATE RETURN</th>
<th>YEARS FOR FULL INVESTMENT RETURN</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>RB</td>
<td>$1,423,516</td>
<td>$498,231</td>
<td>$373,000</td>
<td>$673,000</td>
<td>26%</td>
<td>21.2</td>
</tr>
<tr>
<td>B</td>
<td>RBAA</td>
<td>$1,824,271</td>
<td>$638,495</td>
<td>$373,000</td>
<td>$1,252,600</td>
<td>20%</td>
<td>14.6</td>
</tr>
<tr>
<td>C</td>
<td>RBCC</td>
<td>$3,306,197</td>
<td>$1,157,169</td>
<td>$1,822,000</td>
<td>$2,122,000</td>
<td>55%</td>
<td>15.6</td>
</tr>
<tr>
<td>D</td>
<td>RB AH</td>
<td>$3,384,072</td>
<td>$1,184,425</td>
<td>$922,000</td>
<td>$1,511,800</td>
<td>27%</td>
<td>22.4</td>
</tr>
<tr>
<td>E</td>
<td>RBCH</td>
<td>$3,581,243</td>
<td>$1,253,435</td>
<td>$1,646,500</td>
<td>$1,946,500</td>
<td>46%</td>
<td>18.4</td>
</tr>
<tr>
<td>F</td>
<td>RB HH</td>
<td>$3,856,289</td>
<td>$1,349,701</td>
<td>$922,000</td>
<td>$1,222,000</td>
<td>24%</td>
<td>31.6</td>
</tr>
</tbody>
</table>
Preliminary Scheme Selection

- Scheme F Revised
- 4,500 square feet for owners residence possible
- Parking can be accommodated on site
- Actual construction cost is expected to be lower than this estimate

<table>
<thead>
<tr>
<th>SCHEME</th>
<th>USE</th>
<th>CONSTRUCTION COST</th>
<th>35% DOWN ON CONSTRUCTION LOAN</th>
<th>IMMEDIATE RETURN ON INVESTMENT</th>
<th>RETURN ON INVESTMENT IN 10 YEARS</th>
<th>% IMMEDIATE RETURN</th>
<th>YEARS FOR FULL INVESTMENT RETURN</th>
</tr>
</thead>
<tbody>
<tr>
<td>F Revised</td>
<td>RBHH</td>
<td>$3,004,819</td>
<td>$1,349,701</td>
<td>$922,000</td>
<td>$1,222,000</td>
<td>31%</td>
<td>24.6</td>
</tr>
</tbody>
</table>
Building Overview

- **4th Flr:** 2000 SF Residence
  - 750 SF Outdoor

- **3rd Flr:** 2100 SF Residence
  - 540 SF Outdoor

- **2nd Flr:** 2650 SF Office

- **1st Flr:** 1080 SF Retail
  - 8 Parking Spaces
  - 2 Car Garage
Construction Methods and Materials

- **Goals:**
  - Cost effectiveness
    - Cost estimation
    - Affordable / money saving systems
    - Do more with less
    - Enforce budget
  - Sustainability
    - Efficiency of energy and materials
## Building Cost Overview

- **Summary of hard and soft costs**

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Total Incl. O&amp;P</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Civil</td>
<td>$21,658.60</td>
<td>$25,183.40</td>
<td>2.52</td>
</tr>
<tr>
<td>Structural</td>
<td>$330,107.60</td>
<td>$430,601.41</td>
<td>43.10</td>
</tr>
<tr>
<td>Architectural</td>
<td>$197,523.36</td>
<td>$247,301.64</td>
<td>24.76</td>
</tr>
<tr>
<td>Electrical</td>
<td>$121,025.39</td>
<td>$147,828.00</td>
<td>14.80</td>
</tr>
<tr>
<td>Mechanical</td>
<td>$124,755.00</td>
<td>$148,067.00</td>
<td>14.82</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$795,069.95</strong></td>
<td><strong>$998,981.45</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

- Spaces are not built out
Sustainability

- Goals:
  - Reduce energy usage up front
    - Efficient / effective design
    - Energy conservation
    - Passive systems
  - Harness natural energy
    - Active systems
  - Affordability
    - Take advantage of incentives
    - Reduce energy costs
Site

- Permeable Pavers
  - Reduces site runoff
  - Attractive

- Green Roof
  - Rainwater retention
  - Cools by evapotranspiration
  - Extends living space
  - Reduces heat island
Structure and Enclosure

- Insulated Concrete Forms / Precast Concrete Planks
  - ICF’s highly insulated
  - Reduce construction waste
  - Reduce construction time / cost

- Insulation
  - Reduces heating / cooling loads
Passive Solar

- **Sunshades**
  - Controls sunlight seasonally
  - Reduces summer cooling loads
  - Reduces winter heating loads

- **Thermal Mass**
  - Retains heat from sunlight
  - Emits stored heat gradually
  - Reduces winter heating loads
Daylight Harvesting and Controls

- High efficacy lighting
  - Lighting $= \frac{1}{2}$ total energy consumption
  - LED up to 8 times more efficient

- Daylight Harvesting
  - Southern exposure
  - Light shelves
  - Light well

- Lighting Controls and Zoning
  - Lighting sensors near windows
  - Adjusts automatically based on sun
Active Solar

- **Solar Thermal**
  - Uses sun to heat water
  - Works all year round
    - Even on cloudy days
  - Couples well with radiant floor heating
  - Supplements hot water heater for household water needs
Radiant Floor Heating

- Highly efficient
- Increased comfort
- Low maintenance
- Can be zoned
- Couples well with solar thermal and concrete structure
Incentives

- Illinois - Residential Energy-Efficient Appliance Rebates
  - 15% point-of-sale

- Peoples Gas - Chicagoland Natural Gas Savings Program
  - Save $750 on cost of insulation
  - Save approx $750 on water heater and furnace

- Illinois Finance Authority Renewable Energy Project Financing
  - Provides tax-exempt bonds for commercial renewable energy projects
    - Passive Solar Space Heat, Solar Water Heat,
    - Amount varies by project
Building Performance Analysis

- eQUEST
  - Accurately simulates building performance
  - Accurately compare systems
  - Allows calculation of savings

<table>
<thead>
<tr>
<th></th>
<th>Electricity kWh (x000)</th>
<th>Natural Gas MBtu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Cool</td>
<td>10.64</td>
<td>-</td>
</tr>
<tr>
<td>Heat Reject.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Space Heat</td>
<td>58.50</td>
<td>180.58</td>
</tr>
<tr>
<td>HP Supp.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hot Water</td>
<td>-</td>
<td>11.29</td>
</tr>
<tr>
<td>Vent. Fans</td>
<td>1.50</td>
<td>-</td>
</tr>
<tr>
<td>Pumps &amp; Aux.</td>
<td>0.45</td>
<td>-</td>
</tr>
<tr>
<td>Ext. Usage</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Misc. Equip.</td>
<td>31.41</td>
<td>-</td>
</tr>
<tr>
<td>Task Lights</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Area Lights</td>
<td>22.20</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>124.71</strong></td>
<td><strong>191.87</strong></td>
</tr>
</tbody>
</table>
# Conclusions: Economic Benefit

## ASHRAE 90.1 - Baseline

<table>
<thead>
<tr>
<th>Proposed</th>
<th>Total MBTU/ year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total kWh</td>
<td>135010</td>
</tr>
<tr>
<td>Total kbtu</td>
<td>207080</td>
</tr>
<tr>
<td>$11.72/1000cf</td>
<td>$2,358.58</td>
</tr>
<tr>
<td>$0.0834/kWh</td>
<td>$11,259.83</td>
</tr>
<tr>
<td>Total</td>
<td>$13,618.41</td>
</tr>
</tbody>
</table>

| Total kWh | 135010 |
| Total kbtu | 207080 |
| $11.72/1000cf | $2,358.58 |
| $0.0834/kWh  | $11,259.83  |
| Total       | $13,618.41  |

## Final Design

<table>
<thead>
<tr>
<th>Proposed</th>
<th>Total MBTU/ year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total kWh</td>
<td>112239</td>
</tr>
<tr>
<td>Total kbtu</td>
<td>180580</td>
</tr>
<tr>
<td>$11.72/1000cf</td>
<td>$2,056.75</td>
</tr>
<tr>
<td>$0.0834/kWh</td>
<td>$9,360.73</td>
</tr>
<tr>
<td>Total</td>
<td>$11,417.48</td>
</tr>
</tbody>
</table>

**TOTAL SAVINGS:**

$2,200 / year

or

$66,000 / 30 year mortgage + Incentives
Business Plan / Economics

- **Goals:**
  - Create budget
    - Provides guideline for design
  - Attain good cost to quality ratio
    - Determine important areas to spend money
    - Save money through good design
  - Achieve quick return of investment
    - Harness all possible resources
  - Determine possibility for expansion
## Construction Cost and Loans

- **Cost of building:** $1,000,000
- **35% Down payment:** $350,000

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Total incl O&amp;P</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Civil</td>
<td>$21,658.60</td>
<td>$25,183.40</td>
<td>2.52</td>
</tr>
<tr>
<td>Structural</td>
<td>$330,107.60</td>
<td>$430,601.41</td>
<td>43.10</td>
</tr>
<tr>
<td>Architectural</td>
<td>$197,523.36</td>
<td>$247,301.64</td>
<td>24.76</td>
</tr>
<tr>
<td>Electrical</td>
<td>$121,025.39</td>
<td>$147,828.00</td>
<td>14.80</td>
</tr>
<tr>
<td>Mechanical</td>
<td>$124,755.00</td>
<td>$148,067.00</td>
<td>14.82</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$795,069.95</strong></td>
<td><strong>$998,981.45</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>
Sources of Income

- **Retail**
  - Rental of retail space
    - $4,000 / month
  - Sale of retail space
    - $373,000

- **Home**
  - Sale of owner’s current residence
    - $449,000
Savings

- **Office**
  - Current rent for office
    - $2,500 / month

- **Energy**
  - Increased building performance
    - $180 / month
  - Incentives

- **Taxes**
  - Consolidation of property
## Financial Comparison

<table>
<thead>
<tr>
<th></th>
<th>Proposed Live / Work Development</th>
<th>Typical Home / Office Arrangement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Cost</td>
<td>$525,000</td>
<td>$449,000</td>
</tr>
<tr>
<td>Construction Cost</td>
<td>$1,000,000</td>
<td></td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$1,525,000</strong></td>
<td><strong>$449,000</strong></td>
</tr>
<tr>
<td>35% Down Payment</td>
<td>$533,750</td>
<td>$22,450</td>
</tr>
<tr>
<td>Loan Amount</td>
<td>$991,250</td>
<td>N/A</td>
</tr>
<tr>
<td>Sale of House</td>
<td>$449,000</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Mortgage Amount</strong></td>
<td><strong>$542,250</strong></td>
<td><strong>$426,550</strong></td>
</tr>
<tr>
<td><strong>Monthly Expense</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly Mortgage</td>
<td>$4,300</td>
<td>$3,400</td>
</tr>
<tr>
<td>Mortgage Payment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilities</td>
<td>$950</td>
<td>$440</td>
</tr>
<tr>
<td>Rent Collected</td>
<td>$4,000</td>
<td>$0</td>
</tr>
<tr>
<td>Business Rent</td>
<td>$2,500</td>
<td>$2,500</td>
</tr>
<tr>
<td>Commute</td>
<td>$0</td>
<td>$470</td>
</tr>
<tr>
<td><strong>Monthly Total</strong></td>
<td><strong>$1,250</strong></td>
<td><strong>$6,810</strong></td>
</tr>
<tr>
<td><strong>30 Year Summary</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Mortgage</td>
<td>$1,500,000</td>
<td>$1,232,000</td>
</tr>
<tr>
<td>Total Expenses</td>
<td>$342,000</td>
<td>$3,410</td>
</tr>
<tr>
<td>Total Credits</td>
<td>$2,340,000</td>
<td>$0</td>
</tr>
<tr>
<td><strong>Profit / Cost</strong></td>
<td><strong>$498,000</strong></td>
<td><strong>$1,235,410</strong></td>
</tr>
</tbody>
</table>
Financial Comparison

- $1,733,400 difference from average over 30 years
- Convenience - No commute
  - Average American spends 100 hours / year
  - Possibly sell car
  - All hours access between home and work

- Lower utility costs
- Profit can be reinvested
Future Prospects

- Continued development
  - Many similar sites
  - Scheme could be re-used with little modification
  - Profit margin can be increased with different building types

### POSSIBLE MIXED USE - NO OFFICE

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Cost</td>
<td>$525,000</td>
</tr>
<tr>
<td>Construction Cost</td>
<td>$1,100,000</td>
</tr>
<tr>
<td>TOTAL COST</td>
<td>$1,625,000</td>
</tr>
<tr>
<td>35% Down Payment</td>
<td>$568,750</td>
</tr>
<tr>
<td>Loan Amount</td>
<td>$1,056,250</td>
</tr>
<tr>
<td>Sale of House/Condo</td>
<td>$1,169,000</td>
</tr>
<tr>
<td><em><strong>INITIAL PROFIT</strong></em></td>
<td><em><strong>$112,750</strong></em></td>
</tr>
</tbody>
</table>

### MONTHLY EXPENSE

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Mortgage Payment</td>
<td>$0</td>
</tr>
<tr>
<td>Utilities</td>
<td>$700</td>
</tr>
<tr>
<td>Rent Collected</td>
<td>$8,000</td>
</tr>
<tr>
<td>Business Rent</td>
<td>$2,500</td>
</tr>
<tr>
<td>Commute</td>
<td>$470</td>
</tr>
<tr>
<td><em><strong>MONTHLY TOTAL</strong></em></td>
<td><em><strong>$4,330</strong></em></td>
</tr>
</tbody>
</table>

### 30 YEAR SUMMARY

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL MORTGAGE</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>TOTAL EXPENSES</td>
<td>$172,400</td>
</tr>
<tr>
<td>TOTAL CREDITS</td>
<td>$2,992,750</td>
</tr>
<tr>
<td>TOTAL PROFIT</td>
<td>$1,320,350</td>
</tr>
</tbody>
</table>
Design

- **Goals:**
  - Study codes and site
    - Maximize useable square footage on site
    - Ensure feasibility
  - Sustainability
    - Incorporate sustainable methods and materials
  - Good design
    - Develop program
    - Unique solution for owner
    - Functional
Zoning and Site Analysis

- Maximum lot coverage
- Maximum building size
- Green space
- Accommodate parking
Design

- Site Plan
  - 8 parking spaces
  - 2-car garage for owner
  - Front and rear entrances
Design

- First Floor - Retail
  - 1080 SF retail space
  - Elevator for handicap accessibility
Design

- Second Floor - Business
  - 2,600 SF for owner’s business
  - Room for 18 workstations
  - Private office, meeting room, kitchenette, lounge, server room, and locker room
Design

- Third Floor - Residence
  - 2,100 SF
  - Elevator access
  - Living, kitchen, dining, master bedroom, and laundry
  - 350 SF 3-Season room
  - 350 SF Outdoor terrace
Design

- Fourth Floor
  - 2,000
  - Children’s bedrooms and play space
  - Family room
  - Double height space
  - 350 SF Green roof
  - 350 SF Outdoor terrace
Benefits of Live / Work Development

- **Financial**
  - $1.7 million advantage to current situation
  - Great possibility for future expansion
  - Even higher profit possible with varied schemes

- **Personal**
  - No commute = more free time
  - Quick access between home and work
  - Design customized to owner’s needs

- **Social**

- **Sustainable**
QUESTIONS?
East Elevation
Longitudinal Section
Office Interior
Living Room
Double Height Space