

*Raze-or-Retrofit:
Evaluation of Seattle's Commercial Building Stock for Energy Efficiency*

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Abstract

Raze-or-Retrofit:

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Both my Architecture (M.Arch) and Planning (MUP) theses work around the rubric of the Architecture 2030 Challenge and the efforts of the Seattle 2030 District to meet it (2030DC - see <http://www.2030district.org/seattle/>). In taking up this challenge, the City of Seattle and the 2030DC have teamed up with major property owners, property managers, developers, architects and the Integrated Design Lab at UW to target and benchmark existing opportunities in Seattle's commercial building stock for potential deep retrofits and redesign. The goal of both theses is to provide the 2030DC with tools and intelligence that will assist in targeting its program and outreach efforts.

Both the M.Arch and MUP theses examine the behavior of commercial property owners and their propensity to either retrofit their buildings for energy efficiency or raze them in favor of redevelopment. To determine this, in the M.Arch thesis I developed a scoring system that utilizes various algorithms to process publicly available data combined with other data developed locally to derive a score that permits an apples-to-apples comparison of that propensity. The M.Arch thesis reviews these conditions at the building level; cites several case studies, and presents in-depth analysis of a selected commercial building in the Pike-Pine corridor, serving as an example of a typical Seattle property.

The MUP thesis scales the building owner propensity up to the neighborhood and district levels, and investigates the potential impact of development in Major Institutional Overlay (MIO) districts upon properties immediately adjacent to those districts. It applies the scoring system developed in the M.Arch thesis to demonstrate a correlation between proximity to an MIO district and the presence of predictive indicators of redevelopment. Thus, the scoring system can be used to indicate the likelihood of redevelopment in districts adjacent to an MIO district. The MUP thesis concludes with suggested policy changes to MIO districts to reduce the abrupt spatial transitions that are currently evident.

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LIST OF ACRONYMS

<u>Acronym</u>	<u>Element/Word</u>
2030C	2030 Challenge for Planners
2030D	Seattle 2030 District
2030DC	2030 District Committee
400EPS	400 East Pine Street
A2030	Architecture 2030
AIA	American Institute of Architects
AMZ	Amazon.com
ARRA	American Recovery and Reinvestment Act
BASIX	Building Sustainability Index
BBI	Better Buildings Initiative
BCA	Building Code of Australia
BMGF	The Bill and Melinda Gates Foundation
CAC	Citizens Advisory Committee
CCAP	Chicago Climate Action Plan
CCI	Clinton Climate Initiative
CDP	Chicago DeCarbonization Plan
CPDP	Climate Positive Development Program
DPD	Seattle Department of Planning and Development
EPA	U.S. Environmental Protection Agency
EPBD	Energy Performance of Building Directive
E-RIC	Energy-Regional Innovation Cluster
ES	Energy Star
EUI	Energy Use Intensity
FHCRC	Fred Hutchinson Cancer Research Center
FHD	First Hill District
GBCI	Green Building Certification Institute
GGAS	Greenhouse Gas Abatement Scheme
GGHC	Green Guide for Health Care
GHG	Green House Gasses
GSA	General Services Administration
HEB	High Efficiency Building
HMC	Harborview Medical Center
HVAC	Heating Ventilation Air Conditioning
ID	Institutional Development
KCDA	King County Department of Assessments
KGC	Kline Galland Center
LEED	Leadership in Energy and Environmental Design
LEED-CI	Leadership in Energy and Environmental Design - Commercial Interiors
LEED-CS	Leadership in Energy and Environment Design - Core & Shell
LEED-EB	Leadership in Energy and Environment Design - Existing Buildings

LIST OF ACRONYMS

<u>Acronym</u>	<u>Element/Word</u>
LEED-HC	Leadership in Energy and Environment Design - Health Care
LEED-ND	Leadership in Energy and Environmental Design - Neighborhood Development
LEED-SCH	Leadership in Energy and Environmental Design - Schools
LLR	Seattle Link Light Rail
Low-E	Low Emissivity (glass)
M.Arch	Master of Architecture (degree)
MIMP	Major Institution Master Plan
MIO	Major Institution Overlay
MIOD	Major Institutional Overlay District
MUP	Master of Urban Planning (degree)
MUP	Master Use Permit
NABERS	Australian Green Star Program
NGACS	New South Wales Green House Gas Abatement Certificates
NLLR-FH	North Link Light Rail First Hill (station)
NLRB	National Labor Relations Board
NREL	National Renewable Energy Laboratory
REIT	Real Estate Investment Trust
ROI	Return on Investment
RRC	Raze-Retrofit Continuum
SAC	Standing Citizens Advisory Committee
SAVE	Specific Actions for Vigorous Energy Efficiency
SBRI	Seattle Biomedical Research Institute
SCL	Seattle City Light
SF	Square Feet
SMC	Swedish Medical Center
UAE	United Arab Emirates
USCM	U.S. Conference of Mayors
USDOE	United States Department of Energy
USGBC	U.S. Green Building Council
USPAP	Uniform Standards of Appraisal Practice
VMMC	Virginia Mason Medical Center
VMT	Vehicle Miles Traveled
VOCs	Volatile Organic Compounds
WBBA	Washington Biotechnology and Biomedical Association
WW2	World War 2

SECTION .I - INTRODUCTION & BACKGROUND

Section Summary

In order to understand the logic of this thesis and why it is important, one must first understand the background in which this study was formed. The following section looks at the underlying reasons for the creation of the initiatives discussed, the historical background of the initiatives' formation, and what it is they now seek to accomplish. The goals of the initiatives discussed form the basis of the larger questions raised in this thesis.

THE BASIS OF CONCERN: CLIMATE CHANGE

Climate Change is the summary expression that refers to the body of science which has concluded that an increase in overall temperature of the Earth's atmosphere is correspondent to and resulting from the creation of greenhouse gasses (GHG) by human activity. Specifically, that the mass creation of GHGs (predominantly CO₂) resulting from various human activities is in and of itself the primary cause for the changes in the global climate and associated weather systems.

Members of the scientific community are consistent in their agreement that while there have been fluctuations in Earth's atmosphere CO₂ content, the period coinciding with that of the Industrial Revolution to present day has witnessed an unprecedented increase in the gas. Subsequently, many of the dramatic changes to the Earth's atmosphere have been attributed to the increase in GHGs.

BUILDINGS AS A MAJOR CO₂ SOURCE

Traditionally, the sources of greenhouse gases were divided among the various segments of economic activity, and their associated consumption of energy arising from fossil fuels. Data from 2004 clearly shows that transportation and industrial sources accounted for the majority of the energy consumed in the US, followed by commercial activities (Figure 1.1).

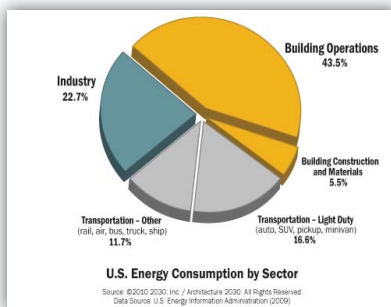


Figure 1.1 – US Energy Consumption by Sector Source: Architecture 2030

In 2009 however, this data was re-categorized, focusing on the point sources rather than the various economic segments, revealing for the first time that

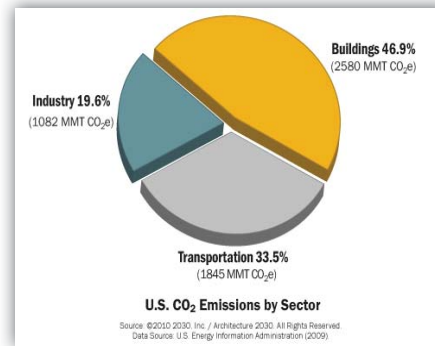


Figure 1.2 – US CO₂ Emissions by Sector Source: Architecture 2030

commercial buildings (regardless of their use) were responsible for the majority of greenhouse gases, followed by transportation and industrial activities, respectively (Figure 1.2). This change was significant because it permitted an approach in seeking the sources of Global Warming that focused on the specific contributor, rather than the type of activity it was engaged in.

The 2009 study also found that the buildings, including the creation and shipment of the materials which go into their construction, account for 46.9% of the CO₂ emissions within the United States – more than that of industry (22.7%) or transportation (27%).¹

Moreover, it revealed that more than three quarters (77%) of the electricity produced in the United States is dedicated to the operation of the buildings in which we live and work alone. That amount is far greater than that used by both industry (23%) and transportation (1%), and thus has become the focal point of

1 Architecture 2030. (2009). "Buildings Consume More Energy Than Any Other Sector." Retrieved July 4, 2011, from http://architecture2030.org/the_problem/problem_energy.

attention.

OTHER PATHS: RATING, MONITORING & REDUCING

This section looks at alternative paths of development than those which we've discussed. Specifically, it looks at a number of schemes currently (or recently) active within the United States, Europe and Australia to make buildings more efficient and reduce the level of GHG emissions.

Energy efficiency efforts in most countries have historically fallen into two major camps:

- Performance Based
- Design or Asset Based

Performance-based energy plans are more common outside the United States, in that they are derived from the actual environmental performance of the building in question, and not from its potential performance. In Europe, this typically meant that the utility supplying the energy would also provide the regulatory body with the energy use data, and then the law could be applied, dependent upon the goals of that country.

Design or asset-based energy plans are also common, both in the United States and elsewhere and are instead focused on the designed energy rating or the potential level of energy efficiency that building (or auto, consumer product, etc) might be capable of achieving.

Both approaches have shortcomings, both relating to the application of efficiency (described by the rating) the building receives. In the case of performance-based rating, the data lags behind the construction and sale of the building, and cannot be verified until a few years after the building has been occupied. Design or asset-based ratings have the reverse problem: while the rating is derived from a calculated potential to be efficient, and is useful in planning, marketing and selling the property, the building may or may not actually be capable of achieving those goals.

The Europeans, Australians, and Americans have all drawn up energy efficiency plans in recent history. While not an exhaustive survey, major movements in energy efficiency cited here serve to illustrate the means of implementation that were used to achieve those goals. And, while a great deal of similarity

exists among the countries and their plans for efficiency, as we'll see, much of the deployment and actual resulting performance from those policies are actually more closely tied to the legal and regulatory framework of the programs - including the disclosure of energy usage (as the Seattle 2030 District, coming up, leverages). For a complete discussion of the European, Australian and American to draft energy efficiency plans, please see "Appendix 4.0 - Energy Monitoring Programs" on page 106.

The Seattle 2030 District

The Seattle 2030 District (2030D) is a public-private partnership of property owners, property managers,

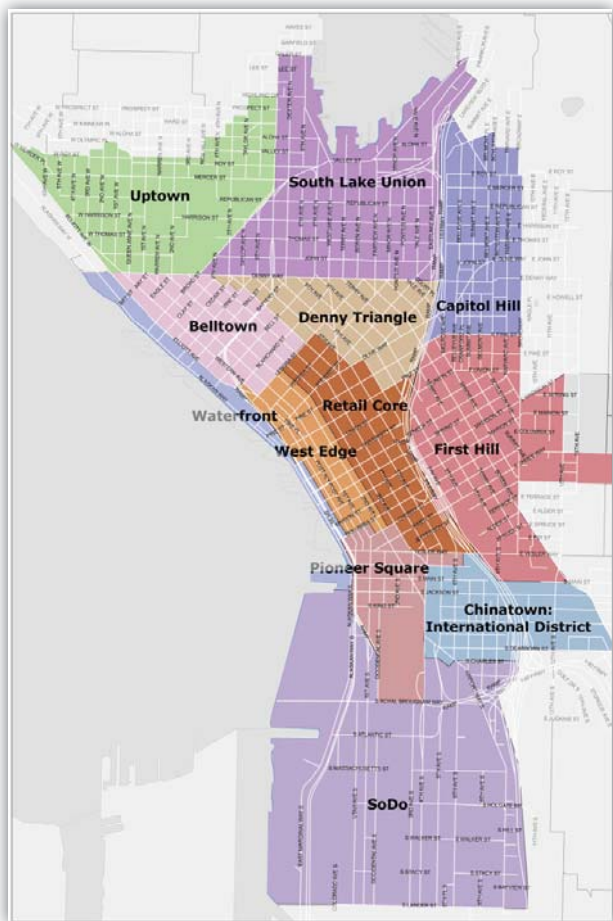


Figure 1.3 – Seattle 2030 Districts.
Source: Seattle 2030 District

city planners, utilities, designers and developers brought together for the purpose of improving the efficiency of the Seattle commercial building stock. Geographically, the 2030D is actually a conglomeration of 12 smaller sub-districts, each comprising a

discreet portion of the city of Seattle city core, and matching more or less the existing neighborhood or city-district boundaries (Figure 1.3).

In 2009 Seattle architect Brian Geller, inspired by the

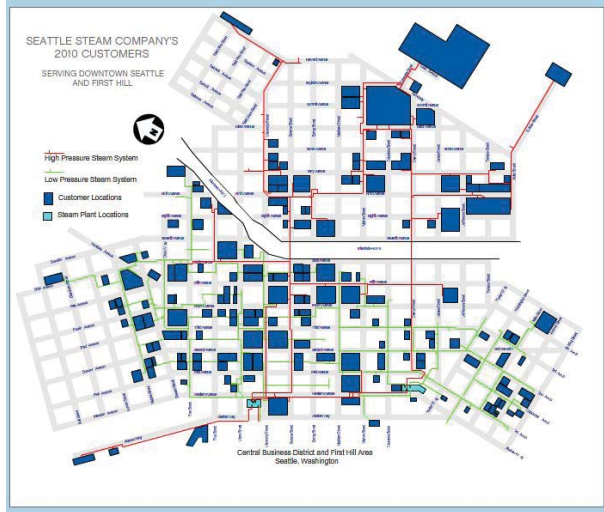


Figure 1.4 – Seattle Steam service map.
Source: Seattle Steam

efforts of the CCAP, the 2030C, and the CDP, noticed that the downtown core was compact enough that district-wide efficiencies might be gained. Using a modified version of the Seattle Steam Service Area Map Geller hosted a series of meetings with most progressive property owners and management companies in the city to gauge the degree of mutual interest in a public-private partnership to create the most efficient district of commercial buildings in the country, and to reduce Seattle’s carbon footprint to 2030C standards (Figure 1.4). Encouraged by the response of the stakeholders, Geller began to assemble what would eventually become the 2030D.

By December of 2010, the 2030D had gathered the support of major stakeholders in Seattle’s downtown, including major property holders and managers, the City of Seattle, the Mayor of Seattle, the Seattle City Council, major utilities and members of the energy efficiency community. By the end of that year, Letters of Commitment were signed and the group Mission Statement was formally released:

“The Seattle 2030 District Planning Committee (the Committee) is an interdisciplinary public-private collaborative working to create a ground breaking high-performance building district in downtown Seattle.

With the Architecture 2030 Challenge for Planners as the foundation for the Committee, we seek to develop realistic, measurable, and innovative strategies to assist district property owners, managers, and tenants in meeting aggressive goals that reduce environmental impacts of facility construction and operations. These collective efforts will establish the District as an example of a financially viable sustainability focused private sector driven effort that maximizes profitability and prosperity for all involved. Through collaboration among diverse stakeholders, leverage of existing and development of new incentives and financing mechanisms, and development and communication of shared resources, the 2030 District seeks to prove the business case for sustainability. Property owners will not be required to achieve the goals of the District by legislative mandates, or as individuals. Rather, this type of goal achievement requires sharing of resources and ongoing collaboration to make high-performance buildings the most profitable building type in Seattle.²

- The goals of the Seattle 2030 District fall within six areas:
- For existing buildings and infrastructure improvements:
- Energy Use: minimum 10% reduction below the National average by 2015 with incremental targets, reaching a 50% reduction by 2030.
- Water Use: A minimum 10% reduction below the National average by 2015, with incremental targets, reaching a 50% reduction by 2030.
- CO₂e of Auto and Freight: A minimum 10% reduction below the current District average by 2015 with incremental targets, reaching a 50% reduction by 2030.³
- For new buildings, major (or deep) renovations and new infrastructure:

2 Seattle 2030 District (2009). Seattle 2030 District Planning Committee - Information Sheet.

3 Northwest Energy Efficiency Council (2010) “Seattle “2030 District” Takes Shape.”

Section .I - Introduction & Background

- *Energy Use: An immediate 60% reduction below the current District average by 2015 with incremental targets, reaching a 50% reduction by 2030.*
- *Water Use: An immediate 50% reduction below the current National average.*
- *CO₂e of Auto and Freight: An immediate 50% reduction below the current District average”*

2030D functions as an informational clearing house for property owners, developers and city government in Seattle. Utilizing data on national energy use (by sector and building type), the 2030D is establishing foundational benchmark data by obtaining current statistics as a result of teaming with building owners, Seattle City Light (SCL) and the City of Seattle Department of Planning & Development (DPD). By establishing benchmarks and then following up on a monthly basis, building owners and other stakeholders can monitor the increased energy efficiencies gained.

“The Seattle 2030 District committee strategies include:

- *Inviting those who are already benchmarking their properties and/or already taking proactive steps to reduce energy use to join.*
- *Engage building owners and users in a collaborative district and develop elegant strategies and solutions to increase building performance.*
- *Map buildings for which current data exists.*
- *Develop common metrics for all buildings, considering EB Portfolio Manager and the Seattle Climate Partnership Carbon Footprint Calculator as good starting points.*
- *Create a mechanism to reward good performers and to help poor performance improve.*
- *Create a next step for property owners to follow after benchmarking their building in PortfolioManager for the City disclosure requirement.*
- *Create an “economic development umbrella” for participants.*

- *Investigate funding/financing possibilities to support goals and strategies”⁴*

(Seattle 2030 District)

In April 2011, the 2030D was funded by a \$454,000 grant from the Environmental Protection Agency (EPA) Climate Showcase Communities program, with another \$225,000 coming from in-kind member contributions effectively funding operations through the end of 2013. Following 2013, it is planned for 2030D to have developed sustainable funding strategies to support its operations going forward.⁵

During 2011, 2030D began the process of creating an organizational framework, and then developed strategies for training building managers to use the EB Portfolio Manager to track the buildings energy efficiency/performance. The City of Seattle will also begin meeting with approved Energy Service Contracting companies (ESCOs) to develop Energy Efficiency Contracting Packages which will comply with the 2030D reduction targets, and DPD will be developing methods of streamlining the permit process, among other things.⁶

How does 2030D differ from the Chicago plan?⁷ There are a number of differences between the establishment of 2030D and the CCAP:

- The 2030D is a public/private partnership: The 2030D is not a part of the Seattle City or Washington State governments. The approach taken by 2030D toward energy efficiency and the building owners is one of information sharing and encouragement, not a mandated, top-down approach (although the disclosure ordinance and state law gives it teeth).
- The 2030D achieves energy efficiency with cost

4 Seattle 2030 District (2009). Seattle 2030 District Planning Committee - Information Sheet.

5 Environmental Protection Agency. (2011). “Activating the Seattle 2030 District.” Retrieved July 01, 2011, from <http://www.epa.gov/statelocalclimate/local/showcase/seattle.html>

6 Seattle Department of Planning and Development. (2011). “Seattle 2030 District.” Retrieved May 1, 2011, from <http://buildingconnections.seattle.gov/2010/06/30/442/>.

7 See “Appendix 4.0 - Energy Monitoring Programs” on page 106 for a full description of the Chicago Climate Action Plan.

effective methods: Many of the 2030D methods of achieving energy savings comes from no- or low-cost measures such as retro-commissioning all the way up to deep building retrofits. The savings resulting from lower energy costs after the retrofit, translates back to the cost of the retrofit itself.

- The 2030D works within existing (and new) ordinances: The functional nature of the organization is that it operates within a space that the law/ordinance itself has dictated, and provides an interface to the private sector which would otherwise have to be filled by the public sector. The laws however, also give the organization legitimacy to operate within the public-private gap.
- The 2030D encourages the development of local commerce: Because the majority of retrofitting is paid for by the expected savings from lower utility bills, the 2030D actually increases the likelihood of creating new businesses as a result of their combined knowledge in the areas of design, retrofitting, technologies and construction. City analysis shows that more than 150 jobs have been created by the existence of this disclosure ordinance alone.

The 2030D will serve as a model of public-private cooperation: The 2030D serves as an opportunity to showcase those properties which have become more energy efficient. Utilizing tools such as the efficiency dashboard, 2030D has the capability of putting a positive spin on the experience, thus encouraging other owners to join in the effort. Without the 2030D, the effort would remain a ordinance-enforcement issue between DPD and property owners.

SUMMARY & APPLICATION TO INDIVIDUAL BUILDINGS

This section has outlined in very broad terms the overall goals of the 2030DC, as well as the foundational issues underpinning them. It has touched on the efforts of the Europeans and Australians at addressing these issues which impact the built environment in all nations, and pointed toward other American efforts to achieve the same results.

In seeking to increase the amount of highly efficient commercial buildings in Seattle, the 2030DC has undertaken an effort which will require the reader to possess an understanding of various aspects of building ownership and motivation and the construc-

tion methods and materials of the buildings themselves.

The issues surrounding the physical nature of highly efficient buildings, and the question of their (potentially) higher value have become a lightning rod of controversy in the last few years as efforts such as LEED and the sustainable building movement have gain momentum. Because of this, understanding the task that lays before the 2030DC requires the reader to have an understanding of the fine details involving building construction and its subsequent value.

The next section examines common considerations made in the construction of modern commercial buildings, and the elements therein. The section will look at the actions and motivations of the owners of these types of buildings, and the construction components and principles needed to actually fulfill the goal of becoming a highly efficient building.

SECTION .II - COMMON GREEN BUILDING CONSIDERATIONS

Section Summary

This section explores the components of the high efficiency building (HEB), both in the form of new construction, and in common retrofit scenarios. This section is not intended to be a complete survey of all the options of the design and construction of a HEB (nor a complete survey of all of the possible), but rather to provide the reader with a base understanding of the core components typically found in new buildings, as well as some of the techniques commonly used in retrofitting a building for energy efficiency.

THE HIGHLY EFFICIENT BUILDING: RETROFITS & NEW

HEB - New Construction

New construction is more of a straight-forward proposition when considering the creation of an HEB (extend discussion here - talk about AHSRAE standards increase and Seattle Energy Code improvements).

HEB - Retrofits

Retrofitting an existing structure for energy efficiency can be, depending upon the building to be retrofitted, either a fairly straight forward process, or one that is difficult and limited in its potential effectiveness. However, since even in the positive economic climates only a small percentage of existing commercial building stocks are replaced each year, the consideration for retrofitting existing stocks is critical.

There are four primary components in retrofitting existing building stocks, and five major barriers to doing so.¹ The major components are:

- Improved Building Insulation
- Higher Heating and Cooling Efficiencies
- Energy Efficient Lighting
- Reduced Plug Loads

These major components seem quite straight forward as presented above, however when considering improving these areas in a wide variety of existing building stocks, the barriers can become numerous:

- Financial Considerations
- Disconnect Between Costs and Benefits
- Lack of Knowledge and Experienced Workforce

¹ Tobias, L., and George Vavaroutsos et al (2009). Retrofitting Office Buildings to be Green and Energy-Efficient: Optimizing Building Performance, Tenant Satisfaction, and Financial Return. Washington D.C., Urban Land Institute. p.6

- Increase in Risk and Uncertainty
- Ignoring Small Opportunities for Conservation

The task of retrofitting the major components (above) into buildings controlled by owners with the types of barriers to doing so (above) is difficult enough. When multiplying this task against the myriad of building types and conditions, each of which have a profound impact upon the potential success of the project (and thus upon the willingness of the owner to do so), the entire process can become intractable. In seeking a way in which to locate a viable path to identifying candidates for retrofitting, one must first understand first the issues driving the motivations of the owner(s), and then also the general types of technology and principles utilized in developing an HEB - regardless if new or retrofit.

Motivations & Inhibitions in Green Construction

People purchase developed commercial property for a variety of reasons. The reasoning leading up to the time of purchase may dictate in many respects the reaction that the owner will have when faced with the decision to raze or retrofit a property holding for additional energy efficiency.

The following scenarios outline some of the possible motives that owners have in purchasing, holding and selling commercial property - those which directly impact the decision of whether or not to retrofit.

Long Term Investment

Long-term Investment in commercial real estate provides probably what is the best scenario for the possible retrofit. If a property has been purchased with the intent of holding it for the long term (defined as at least 15 to 30 years), then many of the retrofits being considered are more likely to be considered financially feasible.

For instance, the retrofitting or the upgrading of a building's heating system may have capital costs in excess of \$100,000 or more, stretching the potential

payback time from energy savings out to 15 years or more. If the building's owners are committed to holding the property for a longer period, then the likelihood of a more aggressive retrofitting schedule going forward is much greater.

Uncertain Economy

Owners who are holding property because of an uncertain future are also a typical scenario, and as of this writing, a very common phenomenon in our current economic climate. Owners (and purchasers) will hold back on committing themselves to selling (or buying) property when the overall economy is in turmoil due to the added difficulty in financing and the risk of assuming added liability going forward.

Currently, the US and UK are undergoing a contraction of this type, wherein both buyers and sellers are holding back on purchasing/selling property due at least in part to the unknown future, and the potential for losses of their investment.²

Simple Income

Often owners will obtain, purchase or otherwise come into ownership of properties which are held in their families, are willed or ceded to them, or via other methods of acquisition. In some cases, such properties come with existing tenants, and thus a dependable stream of revenue. In these cases, the revenue is the attraction of holding the property.

In such cases, depending upon the long term intentions of the owner, retrofitting for energy efficiency may or may not be of interest, as often it is the tenants themselves who pay the utility bills, and thus the owner has little incentive to invest his own money into a building for which he would have difficulty justifying a rental increase especially for an existing tenant, who is already providing an income stream.

Changes in Regulations

Often owners will hold property and not improve it and not sell in the hopes of existing regulations (most often zoning, height or use restrictions, etc) changing. Most often this scenario is played out in an expanding economy, wherein an owner believes that his property will increase in value as a result of regulations that loosen restrictions of use on his property. This was seen in Seattle in 2005 when the owner of the old

Broadway QFC site refused to develop his vacant property until the City revised the height limit, thus making his project more profitable.³

Short Term Increase Value of Property

Owners who are interested in purchasing commercial property solely for a short term gain in the property's value are commonly found in very active real estate markets or in other locations where property is expensive and/or scarce.

In these kinds of purchases, the owner of the building is usually not interested in holding the property long enough for a return on a light or medium retrofit. If the retrofit is more substantial, such as that found in deep retrofits, and the added capital costs are considered a necessary component to reselling the property at a higher cost, then a retrofit is likely to occur.

Decreasing Value & Obsolescence

In some cases, properties are held and leased out for as long as possible without major upgrades or retrofits, and the majority of changes to the building come from tenant improvements. At some point however, the building degrades to such a degree that it is no longer leasable, and it begins to sit vacant.

At this point, the owner may decide to sit and wait for a redevelopment plan to be developed and simply pay the taxes on the property in the meantime. This scenario can occur concurrently with the waiting for regulations scenario above, or (more often), the wait is simply a product of the owner putting a new project together that makes sound financial sense.

ARE HIGH EFFICIENCY BUILDINGS WORTH MORE?

Much of the debate surrounding green building, energy efficiency retrofitting and high efficiency buildings is the notion that structures which comply with the general principles discussed earlier are often valued more highly than the standard, non-green comparison. Is this true?

In this section, we will explore some of the current thinking on green building and address the question of high efficiency buildings being worth more.

2 Unknown (2011) "Uncertainty over jobs and economy puts property market on hold." urbanpad.co.uk.

3 For an full description, please see "Appendix 2.0 - Anatomy of Need: The Revitalization of Broadway" on page 95

Evaluative Financial Models - Property Value vs. Improvements

The question asks whether there is a linkage between the principles of sustainable development and the market value of any given building. Traditionally, market value of any property is determined by the outcome of a series of exhaustive studies aimed at ascertaining the relative demand value for any piece of property.⁴

To achieve this, three types of evaluative assessments are run against the property in question, and in doing so, a large amount of data collection must be done; including market studies, land analysis, site analysis, improvement analysis and the determination of best/highest use for the property and project located there.

Cost Approach

The cost approach to determining the relative value of a property is simply the concept that all market participants relate value to cost. Often used where there is little real estate activity and few transactions to compare the property to, this cost approach utilizes concepts such as functional depreciation, condition and other technical measures to arrive at a value.

Because most of the sustainable features discussed within the context of this report have longer time horizons, it would be difficult to use this approach to evaluate energy efficient properties.

At a minimum, one would need to consider issues such as what materials were used, and how they might eventually impact the value of the project; and if the use of sustainable projects alter or extend the rate of depreciation and eventual building obsolescence.

Sales Approach

A much more common and well used method to determining value is the sales approach. In the sales approach, the property in question is compared to other, similar properties which were recently sold or are for sale during the same period. Unfortunately, the number of green, high efficiency buildings is still relatively small, making such comparisons difficult to undertake. Moreover, the standards assigned within

4 Chappell, T. (2009). High Performance Green Building: What's It Worth? Investigating the Market Value of High Performance Green Buildings, Cascadia Foundation; Vancouver Valuation Accord; Cushman & Wakefield., pp.14-18

the components of green building have yet to be fully established, and thus, in the aggregate are very difficult to evaluate - just within themselves.

For example, since LEED certification is achieved somewhat differently project to project, two similar buildings can achieve the same certification through two different routes of obtaining points and can use differing product which may or may not have the same basis as "sustainable"; the certification itself is not a basis of financial comparison.

Issues, at a minimum, to be considered with this approach include the different features that a sustainable, highly efficient building would offer; whether a tenant would be willing to pay more for them; if the sustainable features will impact the marketing effort; and finally, what the physical differences are between the sustainable building and those in the market being compared to it.

Income Capitalization Approach

When a project is valued by determining the current value of benefits which will occur in the future as the property is utilized, then the income capitalization approach is used. This "...approach incorporates concepts such as life cycle cost analysis and other methodologies to appropriately compare components and assess performance over either the life or holding period of an investment ...(which is) ...necessary to provide a true and accurate indication of value."⁵ Since this model of valuation utilizes future performance of the project, it offers the most accurate and dependable approach for valuing a highly efficient building.

Issues to be considered with the income capitalization approach include the leases; to whom the benefits will accrue; how quickly the building leases out; tenant retention; downtime between leases; maintenance costs; and the associated overall risk (taking all the other issues into account).

There is not a requirement for one of these approaches to be used in lieu of another. The Uniformed Standards Appraisal Practice (USPAP) only requires what is considered "most appropriate" for any particular valuation.

In the end, the issue of whether or not highly energy efficient buildings are worth more is a question which ultimately will be left to the market place. Early indica-

5 *ibid*, pg. 33

tions however seem to show that indeed, the very sustainable qualities that the buildings possess (those which can be monetized) provide a glimpse into the added value that such structures have over their more conventional counterparts.⁶

COMMON COMPONENTS & PRINCIPLES OF THE HEB

Some of the most common components and principles found in HEBs, and many of the issues relating to each of them are discussed in Appendix 5. This list is not exhaustive, and like the discussion of building efficiency itself, the components that might be found within any HEB are likely to reflect the particular circumstances of that project or site. For additional information, please see “Appendix 5.0 - Green Building Considerations” on page 116.

6 Ceres Corporation (2009). Energy Efficiency and Real Estate: Opportunities for Investors, Merck Family Fund. p.7

SECTION .IIIA - RESEARCH METHODOLOGY

Section Summary

This section outlines the method of research and analysis and how the results will be determined.

STUDY MODEL USED IN ANALYSIS

This section outlines the model to be used in the analysis of the KCDA data, the parameters set for examination and the results.

The Question

Is there a broad raze/retrofit trigger that will assist the 2030 District Committee (2030DC) in determining where best to its efforts and resources?

Where would the trigger lie on the raze-retrofit continuum of profiles (mentioned previously) that property owners utilize when considering the energy efficiency of their properties?

What would a deep retrofit scenario look like for a building within the study area?

To answer these questions, this thesis will establish that:

- The districts of interest as described by the 2030D contain a large number of buildings which cover a breadth of age materials and existing efficiencies.
- When considering the buildings within the 2030D, there exist a series of second tier candidates beyond the “low hanging fruit” of the commercial high rise buildings currently under consideration by the 2030DC.
- Following the large number of candidates in the tier one category, this tier two group of buildings is in fact the second largest cohort in terms of gross square footage and numbers of buildings.

Research Methodology

Preliminary Analysis: Existing Building Stocks

In order to respond to the questions above, this report will first conduct a preliminary analysis on the existing building stock within the 2030D area of interest, utilizing a combination of data supplied by the King County Department of Assessments (KCDA), the

2030DC itself and from other sources.

The data is primarily descriptive in nature, and consists of tables describing various aspects of the buildings located on any given parcel within the 2030D. It contains primary information to be used in this report, reflecting on the physical nature of the building stock within Seattle, including: the parcel identification number; the gross and square footage of the building; its year of construction; year of major update, renovation improvement; number of stories found therein; the buildings current use; the buildings existing zoning; the presence of an elevator; and the type of heating system located in the building.

In addition, the KCDA has also provided data on the property taxes assessed for the given parcels within the 2030D. This data is contained in a number of tables which have been joined by combining common fields. The data in these tables includes: the parcel identification number; the buildings tax assessment account number; the amounts of the most recent property taxes assessed and paid; the name of the tax payer; the address of the tax payer; the amounts of previous payments within the last ten years; the assessed land value; and the assessed building value.

The analysis will be undertaken by utilizing software such as GIS-10 and Microsoft Access to manipulate the data and seek out trends which respond to the questions posed. Specifically, the preliminary analysis will determine the current state of Seattle’s commercial building stocks, specifically as it relates to:

- The number commercial buildings contained within the 2030D area of interest.
- The most common building type within Seattle’s current commercial building stock
- by number of stories
- by square footage (net and gross)
- by building method/material
- by the year of construction

- year of major update, renovation improvement

The goal of the preliminary research is to provide a basis of justification for analysis at the building level itself (complete this thought).

Secondary Analysis: Choosing a Sample Seattle District

In order for building-level analysis to occur, a sample district among the eleven established by the 2030D was selected for secondary analysis based on the mix of commercial building contained within those districts. The secondary analysis was undertaken to assist in choosing specific buildings to stand in as those “typically Seattle” based on the commonalities found in the preliminary analysis, and mitigate against factors which might otherwise skew the results. Such factors include choosing a district which contains: a lack of numerically overwhelming use types; a lack of commercial building types; an absence of any new large scale redevelopment; and one with a potential for a basis of study in the MUP thesis.

In order to conduct the secondary analysis, GIS-10 subset data was used to screen the city-wide data described within the preliminary analysis - for each district of the 2030D. As before, each district was examined for number of buildings, square footage, number of stories, year built, etc - however at this level only those buildings contained within any given district were considered.

In addition to a comparison of existing building data, historical policy data was also utilized in choosing a representative district. Such data includes major efforts by the DPD or Seattle’s Office of Economic Development (DOED) to attract particular business segments or institutions, the presence of which in turn create demand for particular building types.

Primary Analysis: Building Criteria Used in Analysis

Once the broad 2030D data was established and the district was chosen, four buildings were selected which were examined in an effort to determine where the raze-retrofit decision point is. While not absolutely representative, those buildings were chosen for their commonality among Seattle’s commercial building stock and their individual condition/circumstances; criteria which will help to determine their location on the Raze-Retrofit Continuum, discussed in the following portion of this report.

The primary analysis examined each building selected,

and discussed the structures history, construction, materials, existing environmental systems, current use and location. The buildings placement along the raze-retrofit continuum will then be determined and justified based on those conditions discussed - utilizing the Raze-Retrofit Continuum scoring system.

In any given building in any given market is truly on its own raze or retrofit continuum, with decision points unique to each structure. Thus, the determination to raze or retrofit each of the sample buildings described here is solely a reflection of local conditions and those issues described earlier in this report.

SECTION .IIIb - MODEL & METHODOLOGY OF RESEARCH

Section Summary

This section outlines the basis for research conducted in the core of this report, and explains why the research will be conducted in that manner. It discusses the multi-level approach to research which will be utilized, and explains how the results will be determined, why they are important and in what manner the conclusions will be made.

THE RAZE-RETROFIT CONTINUUM

Three Spheres of Influence

Before describing the Raze-Retrofit Continuum (RRC), one must understand the nature of individual decision making, how it impacts the retention or sale of property, and how those decisions are derived. One way of considering the relationship of forces which influence the eventual decision to raze or retrofit a building is found in the diagram entitled the "Three Spheres of Influence" (Figure 3.1) . This diagram lays out the three major components resulting in the eventual decision to raze or retrofit: the owner themselves; the building/parcel itself and the city/locale in which that structure is located.

In this diagram, each sphere contains significant influence - and three work in concert with one

another - exerting different influences at different times. Typically two of the spheres tend to dominate the decision to raze or retrofit - that of the owner and that of the building itself. Increasingly however, the influence of the city or community in which the building resides is playing a more significant role. In the end, the goal of the diagram is to have a balanced approach to the decision - resulting in the portion of the diagram where the three spheres intersect.

Examples of this diagram in action could include:

- Building owner who seeks income only from his building and is interested only in the minimal upkeep costs to keep that income coming in. Here, the bottom sphere plays only a very small role in the decision making.
- An owner whose building is capable of

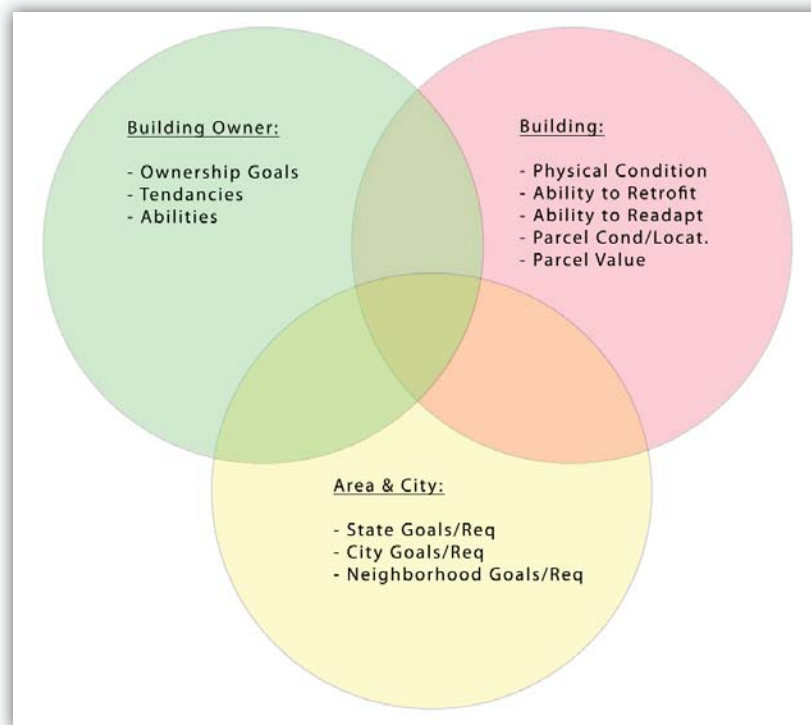


Figure 3.1 – Three Spheres of Influence Source: Author

becoming a recycling center for industrial plastics and rubber - except that the building is located in South Lake Union. Here the upper two spheres exert a strong influence, but are overruled by the bottom sphere which will prohibit that type of activity from taking place in that particular district.

- The Bullitt Foundation - seeking to build a high profile, environmental show piece, works with the city to acquire a parcel which will show the building off, and meets the owner's intentions of investment in efforts of the public good. In this case, all three spheres are working together to derive an outcome - and thus comes into the middle section of the diagram.

In the end, the Three Spheres of Influence diagram only begins to explain the decision to raze or retrofit - it is one way of looking at individual decision making. When those decisions are collectively placed next to one another - a hierarchy is formed wherein the decision to raze or retrofit appears along a linear scale - the scale which is The Raze-Retrofit Continuum.

THE RAZE-RETROFIT CONTINUUM - DEFINED

The RRC is a linear scale which connects the common decision making processes of many commercial property holders, and ranges (on the high end) from a high probability of a complete retrofitting the building in question to (on the low end) a high probability of razing the building and completely redeveloping the site. It holds that the owner's decision to choose either an energy efficiency retrofit (to whatever degree) for their building or, to completely raze that building in favor of redevelopment, are decisions which are made in response to a myriad of different building conditions, values, locations, uses and other factors (some outlined in the Three Spheres). Indeed, that in the decision to raze-or-retrofit, there are endless differing conditions; so much so that each building in reality becomes a case study unto itself, and thus making any broad, sweeping conclusion regarding a particular district or city impractical and ineffective.

General conditions can be described however, which commonly surround this decision making process, and give some form as to its general nature, thus removing some of the uncertainty as to the outcome of the decision maker. In the conditional descriptions of razing/retrofitting are found common conditions

which might also exist elsewhere enough to assist the reader in determining where any particular building might be located on the continuum, and thus how particular policies or investments might be made.

Scoring the Raze-Retrofit Continuum: The Data Points

The RRC is a scoring system built upon various points of publicly available data, combined with scores and weights established by a careful review of the data and consideration of typical market behaviors. Since the behaviors of the market are most often under-pinned and driven by human behaviors, for this analysis, both conditions are considered in synch, and thus specific, narrow events located well away from the average data set are assumed to be outliers, and have been dismissed from consideration.

The data used to provide initial placement along the Raze-Retrofit Continuum has to be broad enough to be common to all types of commercial buildings in Seattle, while at the same time possess enough individuality to enable useful analysis. Ideally, such information would include information such as existing energy efficiency measures, owner status, the type of business the tenant is engaged in and other measures which might illuminate. Due to existing American property law, however this type of data is considered to be private in nature.

What is available is a combination of the data used earlier in this report to describe the broader make up of Seattle's existing commercial building stock, combined with current and historical property tax assessment data from the KCDA.

The RRC is based on the following data points. The data was either made available by the DPD and KCDA, or was developed separately by the author:

- 2011 Value Ratio
- Improvements and Land Value Volatility
- Construction Class
- Decade of Construction
- Effective Year
- Owner Locale
- Use Sensitivity
- Proximity to a Major Institution

Section .IIIb - Model & Methodology of Research

Table 3.1 – Evaluation Criteria and Scoring. Source: Author

RRC Evaluation Criteria and Scoring		
Value Name	Description	Values Created
2011 Value Ratio	This measurement point is a common one used in the assessment of property for redevelopment. While building owners amortize the value of their building over time, once it reaches a point of no value, or significantly less value than the lot it is residing on, the property theoretically becomes more likely for development.	(-1) = building is worth less than land. (0) = building and land are of equal value (1) Building is worth more than land
Improvements and Land Value Volatility	This is a seven state stage value set - which looks at the behavior of the Land/Imps value change over the preceding ten years - in two five year average values. Specifically, this value set looks for volatile changes in the change of the value of the property and/or improvements - especially those which have changed by (on average) more than 100% within five years. Values exceeding 100% in five years indicates full redevelopment, those having dropped 100% or more in five years indicates imminent redevelopment. These are actually FOUR fields - two sets of two - for improvements and land, both for the periods 00-05 and 06-11.	Value/Score 4 where >=1.0 2 where >=0.5 And <1.0 1 where >0 And <0.5 0 where they are equal -1 where they are <0 And >-.5 -2 where they are <=-0.5 And >-1.0 -3 where they are <=-1.0
Construction Class	This valuation point considers at the materials the building is constructed of, and assigns a value based on general assumptions of those materials and their value to energy efficiency. Generally speaking, the more robust the material, the greater the mass, the more likely it is to work in favor of energy efficiency.	Description/Score Unknown 0 Structural steel 1.0 Reinforced concrete 2.0 Masonry 1.5 Wood frame -1.0 Prefab steel 1
Decade of Construction	This value considers the decade in which the building was constructed, and then assigns a value based on general assumption of that period with respect to how buildings were constructed relative to their intensity of use of energy. Generally speaking, the period of the 1950s to 1970s receive lower values while those prior to World War II are higher (due to the buildings generally carrying more building mass and possessing higher ceilings/taller windows).	Decade/Score 2000 1.00 ; 1990 0.75 1980 -2.00 ; 1970 -3.00 1960 -4.00 ; 1950 -3.00 1940 -2.00 ; 1930 2.00 1920 2.00 ; 1910 2.00 1900 2.00 ;
Effective Year	This value considers the last registered major upgrade was made to the building. Typically this record is updated when building permits are applied for making major changes to the building envelope, physical plant, etc - and this value makes the assumption that the more recent a effective year value the more current the HVAC system may be, or building envelope, etc. For example, if the building is from the 60s-80s, and the effective date is also from that period, then it could be an indicator that the system is out of date, etc. The score works by subtracting the effective year from the present year - giving an indication of how long it's been since the last major upgrade at that building.	EffYr Range/Score 00-06 years = 1.0 07-10 years = 0.5 11-15 years = -0.5 16-25 years = -1.5 26-50 years = -2.5 51+ years = -5.5
Owner Locale	This value considers the locality of the building owner - as a measure of the owners intent. To determine the locale of the owner, the registered tax payer zip code is utilized. If a local owner, it is seen as more likely to retrofit, whereas if the owner is out of state, then it's more like to raze the building. Three levels of sensitivity are given, local (Seattle), State and Out of State.	Owner Local = 1 Owner in WA = 0 Owner Not = -1
Use Sensitivity	This is a five stage value; used to determine the degree of uniqueness the mission of the building has - whether or not other buildings nearby could offer the same service/housing - making the first building less valuable, and more likely to raze. Originating from the Predominate Use field, each use is assigned the values shown at right based on the likelihood that particular use will behave in a certain way when the building ages and becomes less efficient. See the complete list for more detail.	Very Likely Retrofit = 2 More Likely Retrofit = 1 Neutral = 0 More Likely Redevelopment = -1 Very Likely Redevelopment = -2
Institution Nearby	This is a four stage value - which indicates if that property is within a specified distance from a major institution. It is used to indicate the sensitivity of a building/its value/its propensity to retrofit or redevelop arising from that location. Ranges are: 0 to 1/8 mile; 1/8 to 1/4 mile; 1/4 to 1/2 Mile and Greater than 1/2 mile.	Distance from Inst./Score 0 to 1/8 Mile: -2.00 1/8 Mile to 1/4 Mile: -1.00 1/4 Mile to 1/2 Mile: -0.50 More than 1/2 Mile: 0.00
Building Quality	This is a eight stage value - that looks at the stated quality of the building and assigns a score based on that value. Essentially, a rating of "average" is neutral, whereas "Low to average" receives a negative value and "Good" and above receives a positive value.	Quality Rating/Score No Value 0.0 Average to good 1.0 Low cost -2.0 Good 2.0 Low to average -1.0 Good to Excellent 2.5 Average 0.0 Excellent 3.0
Heating System	This is a simple evaluation which considers the type of heating mechanism the building in question possesses. Since this data is not always accurate, and owners sometimes update or change their systems without notice, this particular metric has a lower value rating generally. The values for the various systems reflect a higher value for more energy efficient heating systems, and lower ones for less so.	Type of Heating System/Score Electric -2.00 ; Electric wall -2.00 Forced air unit -2.00 ; Hot water 2.00 Hot water-radiant 2.00 ; Space heaters -2.00 Steam 2.00 ; Steam without boiler 1.00 Ventilation 0.00 ; Wall furnace -1.00 Package unit -1.00 ; Warmed and cooled air 0.00 Hot and chilled water 1.00 ; Heat pump 0.00 Floor furnace -1.00 ; Thru-wall heat pump -1.00 Complete HVAC 0.00 ; Evaporative cooling 1.00 Refrigerated cooling -1.00 ; No heat 0.00 Unknown 0.00;

- Building Quality
- Heating System

The evaluation data and related scoring logic are set forth in more detail in Table 3.1 on page 14.

After selecting the specific points of data, a hierarchy was then established for the eventual scoring weights. Weighted scoring was utilized in order to adjust the sensitivity of the individual data set - to give particular data sets a greater impact on the final score. The hierarchy was established using a standard priority grid. Upon initial scoring, sample building scores were utilized to further tune the weights, to make them more reflective of reality. Tables shown on the following pages provide information on the root scoring points (Table 3.1 on page 14), the priority grid used to establish a hierarchy (Table 3.2 on page 16) and the final weighting assigned to the resulting raw scoring (Table 3.3 on page 17)

Four Conditions on the RRC - Described

For the purposes of this study, and for simplicity, there will be four conditions along the raze-retrofit continuum cited: minor retrofit, intermediate retrofit, deep retrofit and the condition where the entire building would likely be razed and redeveloped - regardless of its state. Generally speaking, these conditions represent a wide variety of conditions, but often consist of the following:

Minor Retrofit:

The mildest condition, the minor retrofit often is undertaken when smaller elements or adjustments to existing elements are all that is required to make the needed increases in energy efficiency.

Such elements include changing lighting fixtures, water fixtures, adjusting physical plant settings and adding additional insulation to existing bays (where easily completed), among other things. Minor retrofits are most often undertaken in structures which are in service and cannot have on-going construction occurring within them.

Intermediate Retrofit:

The middle condition, the intermediate retrofit is undertaken when a building or part of a building is going to be temporarily unoccupied and not in active service. Most often, these types of retrofits involve the replacement of more major elements of a building,

making extended, on-going occupation of those spaces (by lease holders) impractical.

The elements included in this level of retrofitting includes the replacement of physical plant elements; replacement of doors and/or windows; replacement of roofs; adding or replacement of cavity insulation, necessitating the opening of walls, ceilings and floors.

Deep Retrofit:

The most extreme of the retrofit choices, the deep retrofit is undertaken when a building or part of a building can be taken out of active service for a longer period of time, so that major elements of a building can be changed - but that the function of the building - or its existing primary mission will remain the same.

These types of elements can include the demolition and replacement of exterior walls and wall systems; the demolition and replacement of entire roof assemblies; the exposure of building foundations (from both sides); and the complete replacement of a buildings physical plant. A deep retrofit can also include these elements combined with an expansion or extension of an existing space, when the new and old spaces are intended to work together under the new regimen.

Raze - Complete Redevelopment:

The alternative to retrofitting all together - when the entire building is torn down and redeveloped rather than try to amend its existing condition. Usually, in these cases such buildings have become obsolete, or the conditions around the building have changed to such a great degree as to make the existing use of the building impractical or financially unsound.

In other situations, the building condition may be quite functional or serviceable, however the owner of the property has elected to raze the building nonetheless. In these circumstances, the most common scenario is one wherein the value of the parcel the building sits upon has become excessively valuable, and forgoing redevelopment would actually represent a potential loss for the owner's investment.

Under these types of circumstances, the building owner will seek to redevelop the site into a new building of greater value, or sell the property to another who will undertake the project themselves. In either case, the owner is seeking to collect the maximum return on his investment.

Table 3.2 – Raze or Retrofit Priority Grid. Source: Author

		Raze or Retrofit Priority Grid										
		01.) 2011 Value Ratio	02.) Particular Construction Class	03.) Decade of Construction	04.) Effective Year Listed	05.) Owner Local or Distant	06.) Use Sensitivity	07.) Institution Nearby	08.) Building Occupied	09.) Building Quality	10.) Value Volatility	11.) Heating System
01.)	2011 Value Ratio	1										
02.)	Part. Const. Class	1	3									
03.)	Decade of Const.	4	4	4								
04.)	Effective Yr.	1	2	3	4							
05.)	Owner Local	1	2	3	4	6						
06.)	Use Sensitivity	7	7	7	4	7	6					
07.)	Institution Nearby	8	8	8	8	8	8	8				
08.)	Building Occupied	9	2	9	9	9	9	8	8			
09.)	Building Quality	10	10	10	4	10	10	10	10	10		
10.)	Value Volatility	1	2	4	5	5	7	9	10	10	10	
11.)	HeatingSystem											

In DB	9/28/2011	winner	choice	# times selected
*	Building Occupied*	#1	08 =	10
*	Value Volatility	#1	10 =	10
*	Eff. Year	#2	04 =	8
*	Building Quality	#3	09 =	6
*	2011 Value Ratio	#4	01 =	5
*	Inst. Nearby	#4	07 =	5
*	Const. Class	#5	02 =	4
*	Decade Const.	#6	03 =	3
*	Owner Local	#7	05 =	2
*	Use Sensitivity	#7	06 =	2
*	Heating System	#8	11 =	0

* Under evaluation - may be dropped due to lack of available data.

This grid functions as a simple priority grid in order to establish a hierarchy of values used in the assessment of the various criteria. Each criteria is considered against one another, and those deemed having the highest value will be awarded a higher weighting in order to provide clearer separation in the final continuum.

Table 3.3 – RRC Criteria Scoring Ranges, Weights and Range. Source: Author

Criteria Scoring Ranges, Weights and Total Score Range						
Criteria	Score Range	Max Low Score	Max High Score	Weight	Max Wt Low Score	Max Wt High Score
Scoring_2011ValueRatio	-1 to 1	-1	1	1.75	-1.75	1.75
Scoring_ConstClass	-1 to 1	-1	1	1.5	-1.5	1.5
Scoring_DecadeConst	-3 to 3	-3	3	1.25	-3.75	3.75
Scoring_EffYr	-5 to 1	-5	1	2.25	-11.25	2.25
Scoring_OwnerLocal	-1 to 1	-1	1	2	-2	2
Scoring_UseSensitivity	-2 to 2	-2	2	1	-2	2
Scoring_InstNearby	-2 to 1	-2	1	2.8	-5.6	2.8
Scoring_BldgOccupied*	-1 to 1	0	0	3.5	0	0
Scoring_BuildingQuality	-2 to 3	-2	3	2.1	-4.2	6.3
Scoring_ImpsValueVolatility_00-05	-3 to 4	-3	4	1.75	-5.25	7
Scoring_ImpsValueVolatility_06-11	-3 to 4	-3	4	2.5	-7.5	10
Scoring_LandValueVolatility_00-05	-3 to 4	-3	4	1.75	-5.25	7
Scoring_LandValueVolatility_06-11	-3 to 4	-3	4	2.5	-7.5	10
Scoring_HeatingSystem	-2 to 2	-2	2	1.25	-2.5	2.5
Total Max Points		-31	31		-60.05	58.85
		RANGE OF SIMPLE SCORING		RANGE OF WEIGHTED SCORING		

* This criteria in development; may be dropped due to unavailability of data.

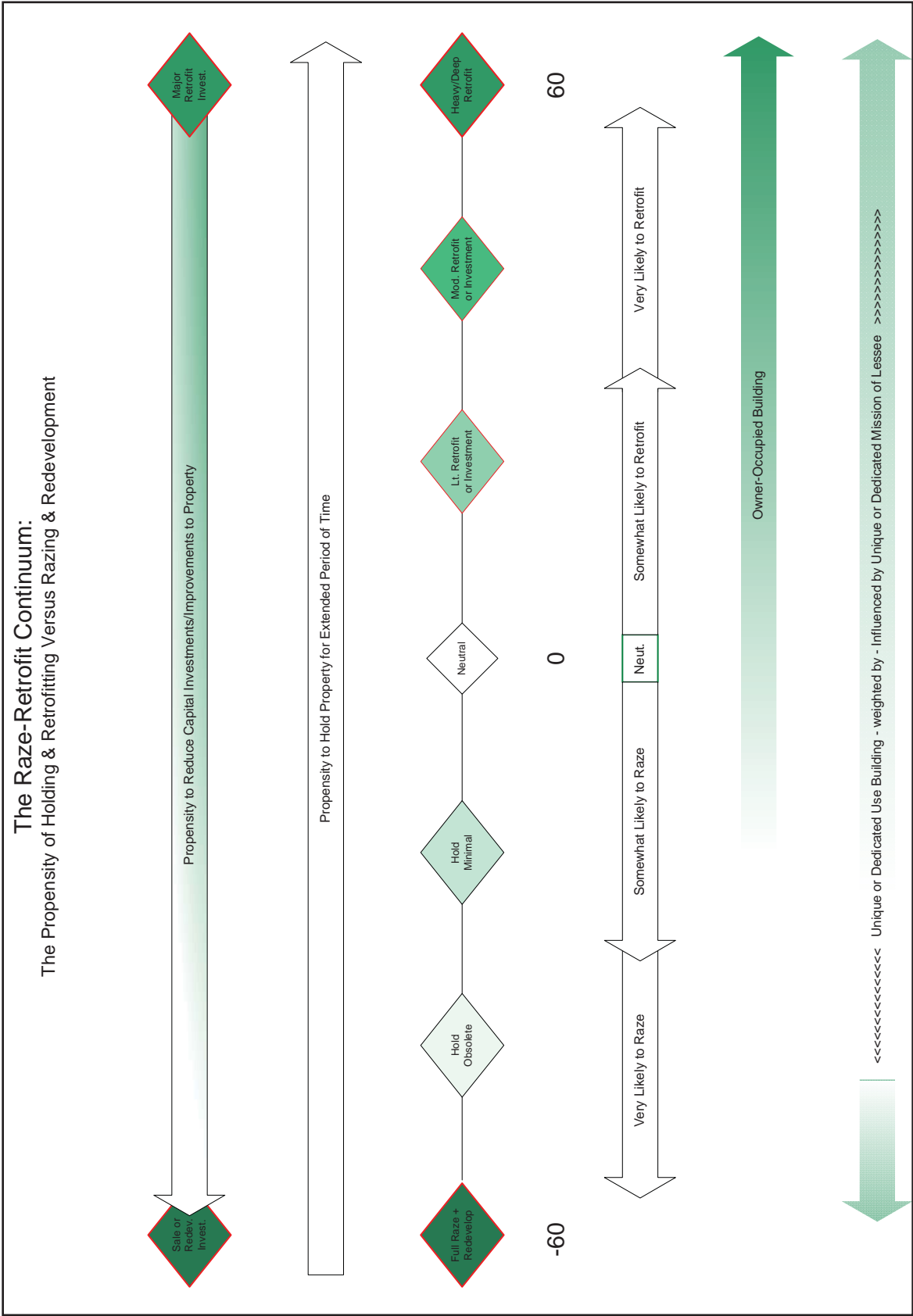


Figure 3.2 – Raze or Retrofit Continuum. Source: Author

Four Cases on the Continuum - Displayed

Figure 3.2 on page 18 contains a graphic display of the RRC and shows the relative location of each of the conditions described above. Generally speaking, this chart demonstrates that as properties move along the RRC to the right - toward deep retrofitting and a higher financial investment, the likelihood of long-term ownership increases. Correspondingly, the inverse is also true: as one moves left along the RRC, the likelihood of long-term ownership decreases as one descends past building obsolescence and eventual redevelopment (Figure 3.2 on page 18)

When combined, these factors provide the underpinning for the scored evaluation of the properties, and allow the evaluation to be broken into five sub-conditions of (from left-to-right):

- Very Likely to Raze
- Somewhat Likely to Raze
- Neutral
- Somewhat Likely to Retrofit
- Very Likely to Retrofit

In addition, factors such as the owner-occupation of the building tends to increase the likelihood of retrofitting, while the uniqueness of the buildings mission can also move it to the right - or, in the event of obsolescence or excessive high property value, can snap it to the left.

Surrounding Area Influences

As previously outlined, the primary study area for this project is within the First Hill District of Seattle, and contained within the streets of Broadway to the east, Madison Avenue to the south, Minor Avenue to the west and Union Avenue to the north. The four study buildings that will be discussed are on the relative corners of the study area, and represent the most common building typologies in Seattle - with the sole exception of the fourth building, which was chosen as being representative of buildings in the path of rapid growth.

First Hill is home to three major hospitals, and because of this, much of the associated commercial activity is medical related. There are also a significant number of multi-family buildings on First Hill. Both of these facts combined result in an area with concentrated

economic activity, and one which provides fertile grounds for additional retail activity, entertainment and other types of businesses (Figure 3.3 on page 20)

In addition to the existing bases of activity on First Hill, is the development of two additional large economic activity corridors: the formalization of the Pike-Pine overlay district, and the First Hill Streetcar, currently under construction. In both cases, the planned changes to these corridors will have significant impacts upon the level of development on First Hill, and thus upon the individual buildings located there - relative to their location, use, size, and condition.

The Pike-Pine overlay district, is a linear area of economic and residential activity extending between Pike Street and Pine Street (on an east-west axis); running from the Interstate 5 throughway eastward the termination at Madison Avenue (at the intersection of 15th Avenue). The area essentially rises up the common slope east of downtown between Capitol Hill and First Hill, and known as "the saddle" (as it sits astride the Capitol Hill and First Hill ridge, and slopes down in the middle where the Pike-Pine corridor intersects it.) It is an area that has been developed over a long period of time, and is now being recognized by the City of Seattle as a definable neighborhood in its own right because of its level of economic, cohesiveness and function as a gateway to Capitol Hill and First Hill.

The First Hill Streetcar is a street-level transit system planned to run from Occidental Park in Pioneer Square, east through the International District, then north along Broadway, making stops along First Hill, and then continuing over the long spine of Capitol Hill, past the new Sound Transit Link Light Rail station, finally terminating at Denny Way (north end of Cal Anderson Park). The street car is designed to provide needed linkages between the Pioneer Square, International District, First Hill and Capitol Hill neighborhood, as well work as a feeder for the new Sound Transit station located on Broadway. Its design closely mimics the original Broadway street car line, built in the same location over one hundred years ago.

Both the Pike-Pine corridor and the First Hill Streetcar are significant because of the impacts they will have upon First Hill. A recent economic activity study conducted by the Seattle Department of Transportation (SDOT) in conjunction with the Capitol Hill Streetcar planning phases showed that relative to existing economic activity on First Hill, the addition of

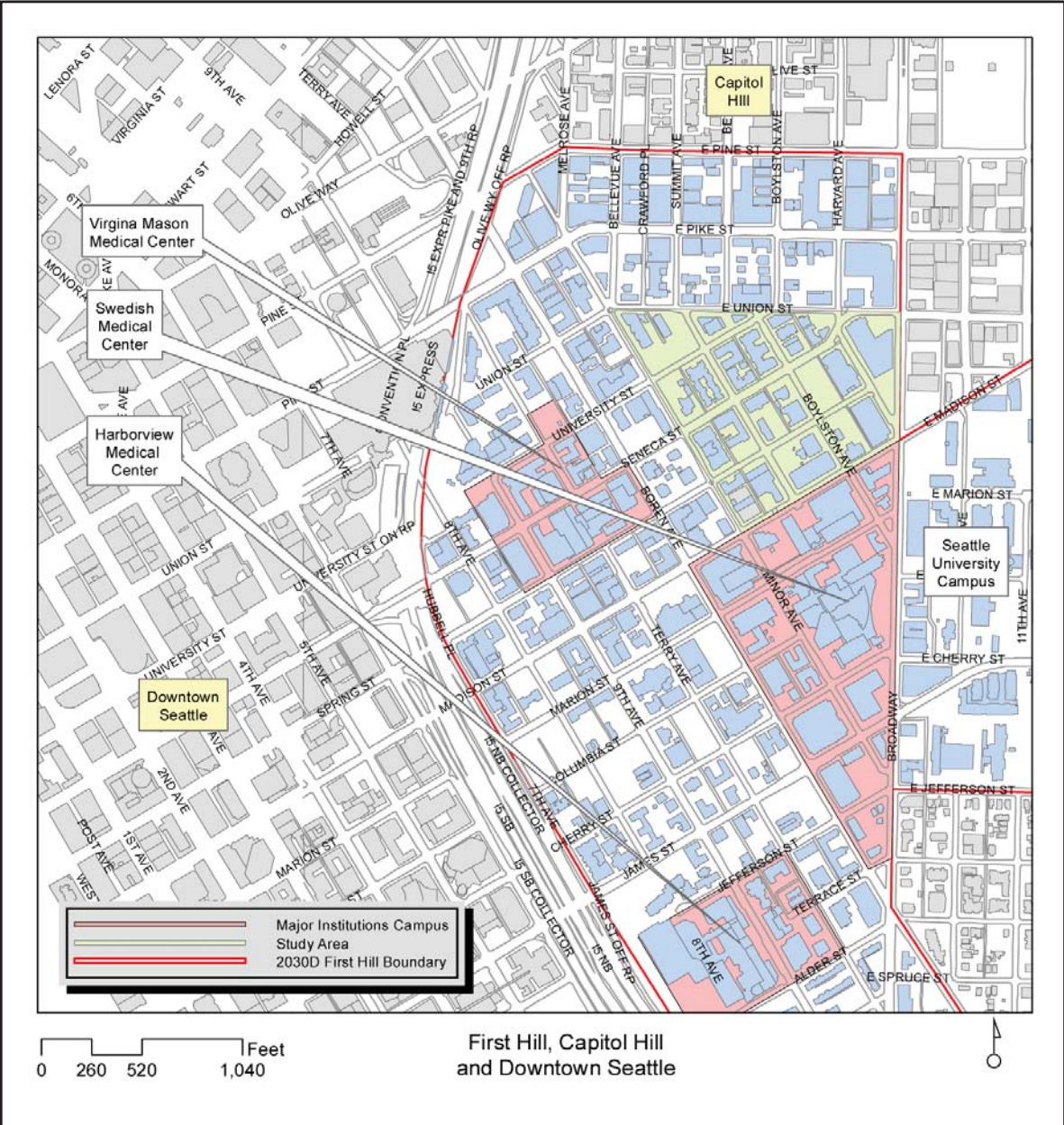


Figure 3.3 – First Hill in context to downtown Seattle and the study area. Source: Author

the street car line through the district will increase the capacity of the area with respect to the establishment of new businesses, additional residential opportunities and a general increase in the stability and livability of the First Hill Urban Village (Figure 3.3 and Figure 3.4 on page 21).

SECTION .IV - ANALYSIS

Section Summary

The following section provides three levels of analysis on Seattle's commercial building stock. Beginning at a wide angle, the preliminary analysis reviews the development and history of Seattle's commercial stock, culminating in the current day statistics of what that stock consists of. The secondary analysis narrows the focus to a chosen district and study area, and the primary analysis closely reviews four buildings chosen as "representative" for Seattle, outlines common issues found in such structures, and provides scoring from the Raze-Retrofit Continuum.

PRELIMINARY ANALYSIS

History of Development - Seattle's Commercial Building Stock

The development of Seattle's commercial building stock is very similar to that of other cities on the west coast of the United States. Settled in the mid nineteenth century, a defining moment for Seattle's commercial buildings came on June 6th, 1889, when an accident in a local wood shop on Front Street (First Avenue) ignited a fire which quickly spread to adjoining buildings. Due to dry weather conditions, the ensuing fire burned nearly through the night, and consumed approximately twenty-five square blocks of downtown Seattle, from the waterfront to up to beyond Fourth Avenue .

Following the fire, the citizens and businessmen of Seattle worked for the next year to build 465 new commercial buildings - from brick. In addition, the streets of downtown Seattle were raised up to 22 feet in places, creating more level areas in what had been an extremely hilly city, and a professional fire department was established, with the necessary infrastructure (steel water piping and water hydrants) to support it. In the end, the fire of 1889, rather than having hobbled or diminishing the city, provided Seattle with a stable base of commercial building stock and the infrastructure to help maintain it.

If one examines at the period of construction of many of Seattle's commercial buildings, they will find the earliest dates to be fairly consistent at or near the turn of the 19th to 20th centuries. Due in large part to the fire, the profile type of construction class is also very consistent in the early years: that of masonry. From 1900 to 1910, masonry construction made up 79% of the commercial building.

Construction with masonry declined during the depression of the 1930s, but regained strength after WWII with post-war peak of 40% from 1950-1959

and then declined thereafter. Reinforced concrete, continued gaining a foothold during the depression, and after the war became a primary construction material, along with structural steel preferred for framing. The legacy of the early twentieth century was set however, in that Seattle's downtown would be pre-dominated by masonry construction until the arrival of the modern high-rises in the 1960s .

State of Seattle's Commercial Building Stocks

Distribution of Building Heights

As Seattle developed its commercial building stocks, the outlines of what would become the most common building type began to emerge. Examining only the number of stories of commercial construction over the years reveals that while the materials used in the construction of commercial buildings was occurring, so was their height. A scatter plot of commercial buildings within the 2030DC districts of interest shows that while the high rise buildings began to assume a dominate role in the downtown districts of Seattle, numerically, the low rise and mid rise buildings were by far the most often built. By plotting all the commercial construction since 1900, a linear regression reveals the most numerous type; that the progression within the last one hundred years has been from two story to buildings of four to six stories.

That fact that Seattle's predominant building height - measured solely by building count - should be in the smaller buildings comes as no surprise. Most commercial projects are completed by smaller builders, the owner's needs are most often met by smaller buildings, and the outlying districts have more restrictive height limits which would prevent high-rise buildings from being constructed.

What is surprising is that the general assumption is that while the smaller buildings may outnumber the

larger high-rises, that the high-rises themselves are assumed to have the greater amount of gross floor area overall. This analysis shows this to be correct - but only slightly so. In examining the numerical occurrences of low-rise and mid-rise buildings in Seattle, one finds that indeed, the street level and low-rise building far outstrip the high-rise structures.

When gross floor area is examined however, and totaled for each of the four height classifications (street level for 01-02 stories, low-rise for 03-06 stories, mid-rise for 07-10 stories and high-rise for 11 plus stories), the high-rise structures do dominate the total gross floor area - but only by a narrow margin . In fact, when examining the gross floor area for Seattle's high rise buildings, they are found to contain approximately 38.10% of the total floor area for the city, while the mid-rise buildings come close with 36.56% of the total floor area.

Distribution of Const. Methods (materials)

As was shown earlier, the material makeup of Seattle's commercial building stock is closely related to the fire the city experienced, as well as the subsequent development through the Great Depression and WWII eras, leading to the modernist buildings of the 1950s-1960s, and finally to the more minimalist, regional approaches taken from the 1990s onward. Because of this, the profile of construction for Seattle became one of mostly masonry in the earlier years, followed by the growth and eventual majority of reinforced concrete.

Structural steel has also become a primary material for construction; however the growth in its usage is largely tied to the increased construction within the high-rise category, as well as a decrease in the cost of steel during the 1980s and 1990s (when its use began to be seen in smaller buildings). Wood is also very popular in Seattle, and is used largely in the construction of multifamily buildings (apartments and condominiums), both with and without concrete bases, commonly used for mixed-use developments.

The result of all of these factors is that numerically speaking, most commercial buildings found in Seattle today are of masonry construction, followed by reinforced concrete, wood and structural steel, respectively.

Predominate Uses

Reviewing Seattle's predominate uses for the existing building stock shows that the most common uses are

for multifamily housing, office space, retail space and parking/warehouses, respectively .

Physical Plant & Heating Methods

A review of the methods used to heat Seattle's commercial building stock yielded similar results. Starting in the early 1900s, the primary preference for heating was for radiant systems supplied by Seattle's district heating system (now Seattle Steam). Through the development of the city in the 1920s and 1930s this trend continued, up until after WWII.

After WWII, like many other cities in the United States, the complete HVAC system became the predominate method of conditioning buildings. However even though new projects picked that method, those who were still using water/steam - particularly those who were still attached to the district heating system - stayed on those systems.

Summary - Which Building is "Representative"?

In choosing three buildings to represent those most common to Seattle, those for which case studies would be drawn up, a list of criteria were developed to guide the selection:

- Selected buildings should be of the most common construction classes of the existing commercial building stock in Seattle.
- Selected buildings should be located in a district that meets criteria for district selection (see district selection below). Buildings should also be located in a definable neighborhood, or on a definable neighborhood edge.
- Selected buildings should be of the most common use types found in Seattle; and of similar or common use in the selected district.
- Selected buildings should be of a size which is consistent with the average gross square footage for similar buildings found throughout Seattle, within at least 10%
- Given these criteria, the resulting profile for the purposes of section of three representative buildings consists of the following values:
- Buildings consisting of 3-6 stories.
- Buildings built from masonry, those built from reinforced concrete and those built from wood.

Section .IV - Analysis

- Buildings located in the First Hill District of Seattle (see District Selection below).
- Buildings serving as dedicated offices, multifamily housing (or medical offices in the First Hill District).
- Buildings which consist of 66,000 to 83,000 gross square feet, in conjunction with the average gross square footage calculations discussed earlier (FIG_A04.10 - SEA-GSF Averages for Seattle).

SECONDARY ANALYSIS

The secondary analysis was conducted at the district level, in order to ascertain the degree of similarity of what has so far been described as typical Seattle. In order to do this, a district of the city was chosen based on a series of criteria, and then locations within that district examined for possible specific buildings to represent the typical Seattle commercial building.

District Profiles

When selecting a Seattle district to work within, a series of criteria was developed in order to evaluate each area on the same or similar merits. Like other US cities, one Seattle district can vary wildly from another in terms of its commercial building stock, its percentage of residential and commercial buildings and other factors. Because of this, some common conditions were identified as critical in the assessment of all the districts, and in the final designation of the representative district.

The assessment criteria used for choosing a district was:

- District has not experienced any large-scale development recently: Some districts in Seattle have recently undergone major redevelopment. As a result, the building stock in that district has changed substantially, and may not represent a more typical condition that could be found in other districts.
- District is not dominated by one owner or organization: Some districts in Seattle are dominated by a single owner or company. As a result, the building stock in that district may be more homogeneous than it would be otherwise.
- District is balanced among building types: This analysis seeks a fairly well balanced district - one

at least with a general representation of most classes of buildings and uses. Most of Seattle's districts meet this requirement.

- District has specific neighborhoods with definable edges: Because of additional analysis planned at a neighborhood level, the district chosen needs to have definable edges.
- District has at least one institutional presence in it: Also because of additional analysis planned following this study, the district chosen must meet this requirement; most Seattle districts meet this requirement.
- District should be balanced between commercial and multifamily: Since the second largest commercial building type is multifamily housing, and the first office buildings, this requirement is critical.

A decision matrix was then created, and all districts entered into it. Following careful analysis and evaluation of each of the districts, First Hill was chosen as that which most closely meets all the requirements. In addition, the district Uptown was a close choice - but was too weighted toward smaller buildings and had less institutional influence than that of First Hill.

First Hill District Similarities to Seattle

The First Hill District is that which rises immediately to the east of the downtown core - on the east side of the Interstate 5 freeway. It consists of a hill which rises from the International District (south-southeast of the downtown core) and then slopes downward into a saddle where ridge of Capitol Hill, running north and south, begins.

The district was established early in Seattle's history, and has housed many of the city's institutions, including its county courthouse, St. James Cathedral and Seattle University. The district is best well known however, for the hospitals and other medical facilities which are located there. Known as "Pill Hill" to local Seattleites, First Hill is home to the three major hospitals Harborview Medical Center, Swedish Medical Center, and Virginia Mason Hospital & Medical Center, many more medical offices and clinics.

Distribution of Const. Methods (materials)

Since First Hill is immediately adjacent to downtown, it shares in much of the city's history of development; including the classes of construction used since 1900.

Like downtown, First Hill experienced a long run on masonry construction up until WWII, and then increasing use of reinforced concrete up to the current day. The district also has a number of multi-family residential buildings, many of the 1920s and 1930s vintage. It also has a number of newer (1990s) multi-family buildings, nearly all constructed in the familiar (for Seattle) five-over-one or five-over-two configurations (five stories of wood framed construction over two stories of reinforced concrete).

Since First Hill shared a common development history with downtown, its construction class, or materials is very similar, as is its share of high-rise buildings. In this district, the count of buildings which are one to two and three to six stories make up the majority, but it is the three-to-six which carry the majority of the gross square footage, with the mid-rise and high-rise buildings following. Within

Choosing the Study Area

The neighborhood selected on First Hill for this study is located on the eastern boarder of the district, along Broadway, between East Union Street and Madison Street, and runs west along Madison Street to Minor Avenue, and then north-northwest to meet again with East Union . The area is comprised of twelve city blocks, and contains more than 45 individual parcels. All four streets create very strong edge conditions, and the parcels within these boundaries contain a variety of small clinics, retail, multi-family housing, offices and a larger clinic on the northeastern corner. This neighborhood was selected because of the strong edge conditions, its proximity to Swedish and Virginia Mason Medical Centers, and because it contains three buildings which meet the requirements for case study selection mentioned earlier.

PRIMARY ANALYSIS

The preliminary and secondary analyses conducted have demonstrated that the most numerous buildings in Seattle and First Hill itself are those with the second greatest gross square footage, and those between three and six stories in height. The most common materials used in their construction are masonry, reinforced concrete and wood.

This section will evaluate three buildings which meet the eligibility criteria mentioned in the previous section, and will demonstrate that the buildings fall along the raze-retrofit continuum, with varying responses in the effort to become more energy

efficient. Additionally, a fourth building will also be introduced to demonstrate the most extreme condition of full redevelopment.

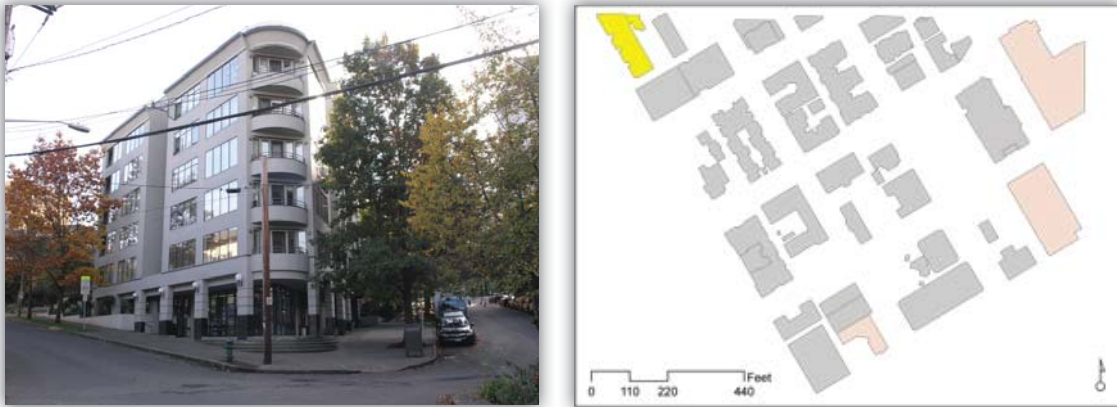


Figure 4.1 – Area Map and Image of 1310 Minor Avenue. Source: Author

Four Case Studies on the Continuum

The following section will outline four case studies are buildings which meet the criteria being one of Seattle’s most common buildings, and whose condition, location and histories vary greatly from one to another.

These case studies will show that an individual building’s condition and location combine with its owners goals and objectives - thus impacting it’s final disposition and position along the raze-retrofit continuum.

1310 Minor Avenue (multi-family)

Why it was chosen: 1310 Minor Avenue was chosen because it is the building within the study area which best represents the three to six story, wood framed, multi-family building. The building type is a fairly common sight in Seattle: the “five over two” or “five over one” mixed use apartment building with a concrete base and wood framed above.

Background:

Designed by RAS Architecture of Seattle, this building was constructed in 1989 as an apartment building. Located in the northwest corner of the study area at 1310 Minor Avenue, this apartment building is fairly typical in that its wood frame construction sits atop a concrete base which houses retail, several levels of parking, a manager’s apartment and some common amenities (Jacuzzi, workout room, etc).

The primary apartment levels are on four floors, and consist of a single double-loaded corridor, running north and south, with fire stairs and elevator cores at either end. On apartment levels one through four, there are sixteen standard efficiency and one bedroom

apartments radiating from the corridor, each with east or west facing windows, respectively.

On the fifth level, there additional one-room apartments; fifteen of which have living rooms with vaulted ceilings and mezzanine lofts above. On the fourth level, on the north-facing end of the building are two large two-bedroom luxury residences, with two full floors and roof-top balconies.

Potential Issues

There are a number of potential issues which could arise with a wood framed multi-family property such as this. While the following is not a complete list, it provides a starting place for discussions regarding these types of properties.

- Owner Objectives

The objectives of the owners versus those of the tenants they rent to are probably one of the largest hurdles to be overcome when seeking to retrofit a building for energy efficiency. When a multifamily property such as this is constructed, the goals of the original owners have to be taken into consideration, as the current owners may not possess the same goals, and the impact upon the building.

Additionally, the on-going operation of the building and the owner’s objectives with respect to it is a common area of difficulty. It is a fairly common situation that unless the utilities are included in the cost of the rent, many owners of multi-family buildings are less concerned about the relative heating/cooling efficiencies of the building in question simply because the costs are not borne by them.

In most cases, those who lease the spaces pay for the

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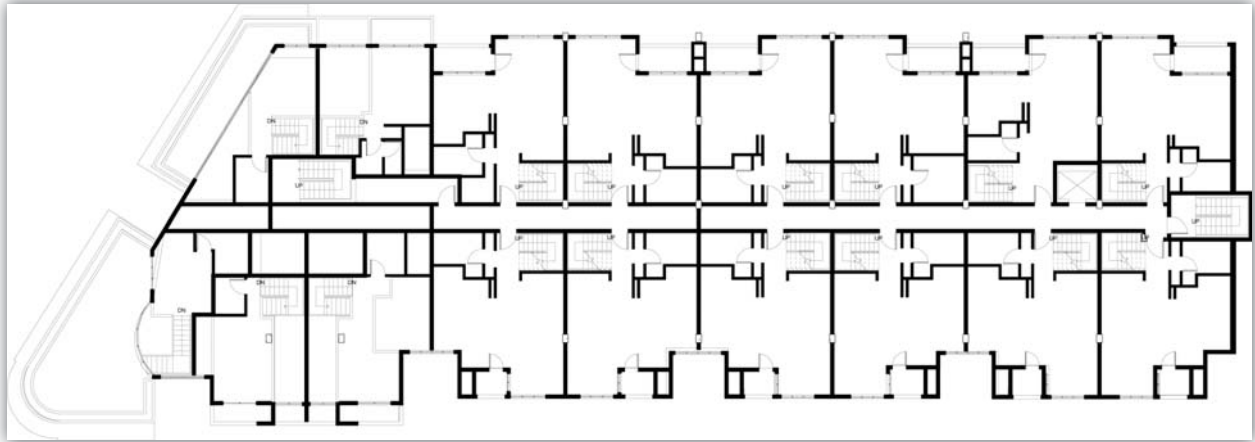


Figure 4.2 – Floorplan of 1310 Minor Street, fifth floor. Source: Author



Figure 4.3 – Plan perspective of 1310 Minor Street. Source: Author

energy to heat or cool the space. Unless those spaces are so energy inefficient as to make them uncomfortable or economically infeasible to condition, the relative inefficiencies may not be important enough to the lessees of the space to mitigate them, if that is at all possible.

In this case, the original owners of this 1310 Minor Avenue was the developer, Pacific Properties who in 1995 transferred ownership of the building over to

Steven Fuller of Edmunds who in 1999, transferred ownership to the Kline Galland Center of Seattle(KGC) - a non-profit Jewish faith organization which manages properties used for elder care facilities, retirement homes, etc. In addition, the KGC also owns The Caroline Kline Galland Home (a nursing facility), The Polack Adult Day Center, and most importantly, The Summit at First Hill.

The Summit at First Hill is a large high-rise retirement community; located immediately to the south of 1310

Section .IV - Analysis

Building Stats:

Parcel Number:	8808950000			
Name:	Union Park Apartments			
Location:	1310 Minor Avenue, Seattle			
Tax Payer:	Fuller, Steven			
Highest/Best Use Vacant:	Multi-family Dwelling			
High/Best Use Imp:	Present Use			
Construction Date:	1989			
Effective Year:	1996			
Const. Class:	Wood (5-over-1)			
Value of Land:	\$3,962,600 (\$165 sq ft)			
Value of Building:	\$8,674,400			
Bldg Gross Sq Ft:	113,665			
Bldg Net Sq Ft:	60,305			
Lot Size	24,016			
Zoning:	HR (adjoining MIO-160-HR)			
Units:	84			
Avg. Unit Size:	839 sq ft (28% with view)			
Unit Breakout:				
<u>Unit Type</u>	<u>No.</u>	<u>Sq Ft</u>	<u>BdRm</u>	<u>Bath</u>
flat	7	557	eff.	1
flat	56	636	1	1
flat	4	910	2	2
townhouse	13	839	1	1.75
townhouse	1	890	2	2
townhouse	2	1020	2	1
townhouse	1	840	1	1.25
Heating:	Electric (apt) and HVAC (commercial)			
Number of Floors:	6			
Parking:	Two Lvl Garage; 97 spaces.			

Minor Avenue, at 1200 University Street - The Summit at First Hill is a 200,000 sq ft complex consisting of 126 apartments of varying size and support levels, plus a penthouse and sky lounge. The building was constructed in 2000 and consists of 13 stories of structural steel and concrete.

The proximity of the Kline Galland Center to 1310 Minor, and the transfer of the property to it, indicates that the long term plans for the apartment complex could be to simply function as an income producing property for the owners while the long term mission of The Summit at First Hill is developed. While the specific long term plans for 1310 Minor Avenue may not be known at this point, one could assume that were the Kline Galland Center to expand at some point in the future, the 1310 Minor Avenue property would likely be consumed in that effort.

- Building Construction and Condition

1310 Minor Avenue is a six story wood framed building atop post tensioned concrete slabs, above a concrete base with mixed use (retail store) present. While the building quality for 1310 Minor Avenue is listed by the city is rated as "good", this building was designed in 1989, and has a number of period features which are less energy efficient that would otherwise be constructed today. These include:

Loft Ceilings:

The building has fifth floor lofts on the sixth floor, with immediate ceilings on the bottom of the building's roof. The roof in these locations consists (from outside in) of: 1' metal strip roofing; moisture barrier; 1/2" plywood CDX sheathing; 2x10 roof framing - or - prefab wood truss; R30 batt insulation; 5/8" Type X gypsum wall board.

Vaulted ceilings are quite common from buildings of this period and offer the tenant a greater sense of openness. Unfortunately, the vaulted ceiling also pools heat from the apartment up along the ceiling, making the heating system in ineffective, and reduces the opportunities for adding insulation that might otherwise fit into more traditional attic spaces. At R30, this roofing does not approach the types of insulation sought in more efficient buildings (R60 being a common goal, currently).

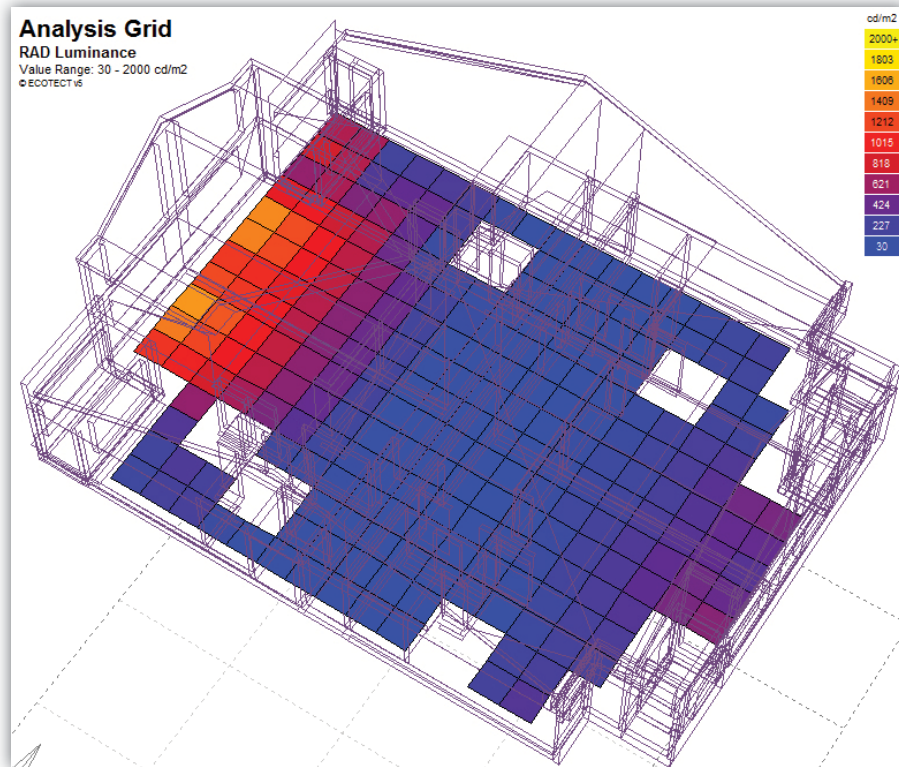


Figure 4.4 – RAD luminance analysis of a fifth level apt. at 1310 Minor Avenue. Source: Author

Exterior View Windows Orientation:

The building axis is north-south, creating the primary viewing windows for the apartments on an east-west axis. In addition, apartments with loft spaces have vaulted ceilings, and additional upper glazing (above 8').

As discussed in previous sections, preferred orientation for vertical glazing is east-west, with the long axis of a building facing south. Since the primary orientation of these windows is east-west, they face significant risk of solar gain and glare. Shading devices would help, but could not eliminate the total gain.

An Ecotect analysis was performed upon a typical apartment unit in the complex (Figure 4.4). It showed that while the west or east facing windows permitted in sufficient ambient light for a living space (20-40 footcandles).

Because of the west and east facing orientation, however there are points of too much light coming in, and the potential of both glare and solar gain occurring. To mitigate this issue, the apartment building has mature trees on both sides of the

building, providing shading during the summer months, and reducing the incidence of glare and solar gain.

Exterior Windows:

The buildings windows are typically double-paned, aluminum framed, with clear glass, set flush against the exterior wall. The windows are operable aluminum cased windows, and crank open on the vertical axis.

Aluminum window frames are a common element of late 1980s construction, and there is no indication that these windows have been updated since construction. The primary issue with these windows is that the aluminum is a major thermal conductor, and, in the absence of a thermal break, will readily transmit the heat out of the apartment.

Additionally, since the windows do not have a low emissivity coating, or an air gap filled with an inert gas, they will transmit ultraviolet light into the apartments during sunny periods, increasing the likelihood of solar gain and glare for the occupants.

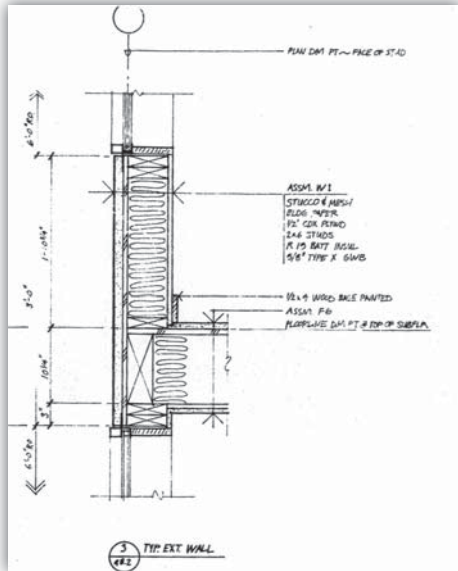


Figure 4.5 – Wall section of 1310 Minor Ave. Source: RAS Architecture

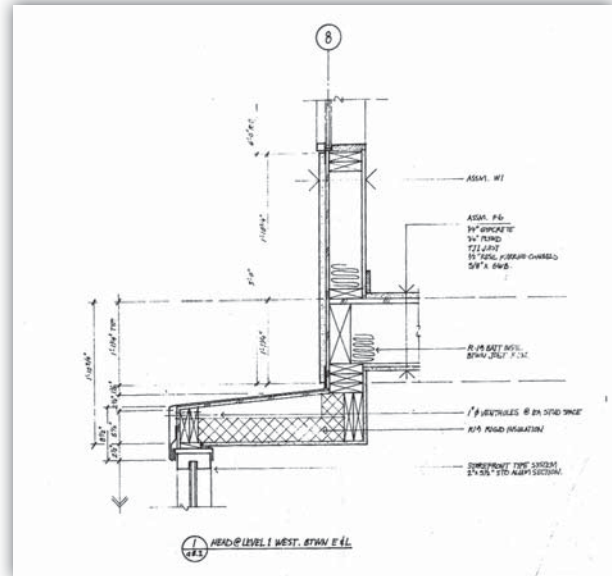


Figure 4.6 – Wall section at roof of 1310 Minor Ave. Source: RAS Architecture

Exterior Doors:

The exterior doors at 1310 Minor Avenue are solid wood, with solid cores and an exterior aluminum storm door in place.

External Wall Construction:

The typical external walls of 1310 Minor Avenue consist of 2x6 dimensional lumber construction, made up (from exterior to interior) of: stucco and mesh; building paper; 1/2" CDX sheathing; 2x6 studs; R19 batt insulation; and 5/8" Type X gypsum wall board (Figure 4.5 and Figure 4.6).

A common exterior wall treatment for wood framing during the 1980s, this wall lacks both the mass necessary to slow thermal swings, as well as the overall cavity depth necessary for a higher level of insulation. One solution might involve cladding the building in an insulated metal siding, adding both a layer of insulation and a separation from the (new) exterior shell and (original) exterior wall.

Garage/Apartment Level Floor Connection:

The connection between the floor of the first level of apartments and the unconditioned parking garage space beneath it consists (from top to bottom) of: 1" of gypcrete; 2" rigid insulation; 10" post-tensioned concrete slab; 4" semi-rigid vinyl faced fiberglass batts - all resulting in an R19 insulation value (Figure 4.7).

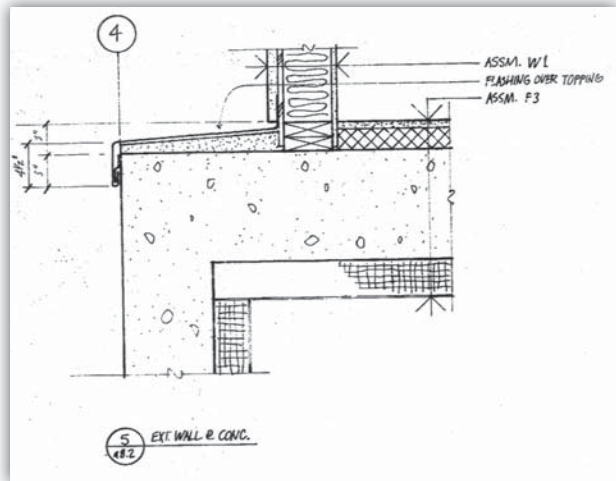


Figure 4.7 – Wall section of 1310 Minor Ave. Source: RAS Architecture

Immediate Area Influences

1310 Minor Avenue is located on a quiet street, immediately adjacent to several retirement facilities and is within walking distance to two major hospitals plus numerous clinics, medical offices, and retail outlets in the First Hill Urban Village core located along Madison Avenue.

The apartment complex is also located immediately to the south of the Northwest School, a college-preparatory day and boarding school with 470 students in grades 6 through 12. In addition, the Northwest School takes the entire block northward, from Union Avenue to East Pike Street and the Pike-Pine corridor mentioned earlier. (Reference to earlier map with data on it).

To the immediate south of the apartment building is the Summit at First Hill retirement complex, and three blocks further to the south, the busy Madison Avenue arterial. The area between 1310 Minor Avenue and Madison Avenue to the south, as well as one block west to Boren Avenue is largely dominated by either multifamily apartment buildings and/or retirement centers. Four blocks to the east of the apartment building is the busy Broadway corridor.

Building System(s)

The most common heating systems utilized by tenants at 1310 Minor Avenue are individual electric baseboard heaters, controlled room-to-room. There are no separate ventilation systems for the individual apartments, and the primary viewing windows are operable case window. The windows looking onto the apartment's balcony are operable, however, and there is a deck door which can be opened for fresh air.

The commercial space on the first floor has a separate HVAC system which consists of two air handling units (with 8 kw and 10 kw electric heaters) and two air conditioning condensers installed in 1991. The commercial space is located on the ground floor, and faces north, receiving little to no direct sunlight.

Evaluation Scoring:

Overall = (-10.62 pts) Somewhat likely to redevelop than fully retrofit.

Major Drivers: Ownership of the property would make the building a holding property until the mission of the larger Summit at First Hill requires its parcel; then it would be razed in favor of expansion of that project.

In addition, the structural components of the building, combined with the small size of the apartments make it less competitive going forward - in the absence of a deep retrofit - which would not be financially feasible.

Discussion

1310 Minor Avenue is a typical 1980s multi-family building type found throughout the Pacific Northwest where the mild climate and inexpensive construction make it popular among developers. The construction quality of 1310 Minor Avenue is listed as good, and appears to be just that; the building lacks the increased robustness however, which it would need to enable it to meet the requirements of the 2030D. Why?

Construction of the exterior walls has resulted in smaller wall cavities and materials used which result in an overall wall assembly which permits the rapid change of temperature within the structure of the wall itself. The stucco exterior, combined with common 1/2" sheathing and R19 batt insulation within a 5.5" wall cavity lacks the overall mass to resist the rapid temperature swings, and in order to achieve that level of mass, the exterior walls would have to be deepened; made more dense with an increased R value. In this case, such a modification is unlikely to happen. Why?

The common answer to this question falls largely upon the owner, and what their plans are for the property going forward, and how those plans fits against the potential costs of retrofitting the building. Depending on the level of retrofitting done, the period of time needed to recoup the expense may surpass the owner's timeframe for holding the property, thus making such efforts impractical.

Since this property is off the main arterials; is not immediately adjacent to either of the major retail corridors; is situated among other buildings of a similar use; and serves a residential market, the likelihood is that the owners will make only the minimal maintenance investments necessary in the building to keep it fully occupied, and make any retrofitting decisions based on the period of time needed to recoup the cost. This is largely because the cost of utilities are borne by the tenants and not the owners of 1310 Minor, and because of this, the building only needs to be kept in good repair to continue attracting tenants.

The likelihood of a retrofit beyond just a minor or light

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treatment - or perhaps even up to a replacement of the windows - is minimal because of the relationship of the owners and the proximity of the apartments to their other venture, the Summit at First Hill. Because the apartment property adjoins that property, it is very likely that once the value of the property exceeds the rental income possible, and the growth of the retirement market has expanded sufficiently (as it is projected to), 1310 Minor Avenue will be redeveloped into part of the Summit at First Hill retirement community as well.

The likelihood of this scenario is evident in a simple examination of the zoning for 1310 Minor Avenue (which is HR), and those immediately adjacent to it (also owned by KGC). All of the other parcels on the block are zoned MIO-160HR - the major institutional overlay designation. It is conceivable that having the HR designation up-zoned to an MIO-160HR would present little difficulty to the owners, and would be viewed as a likely scenario for additional development.

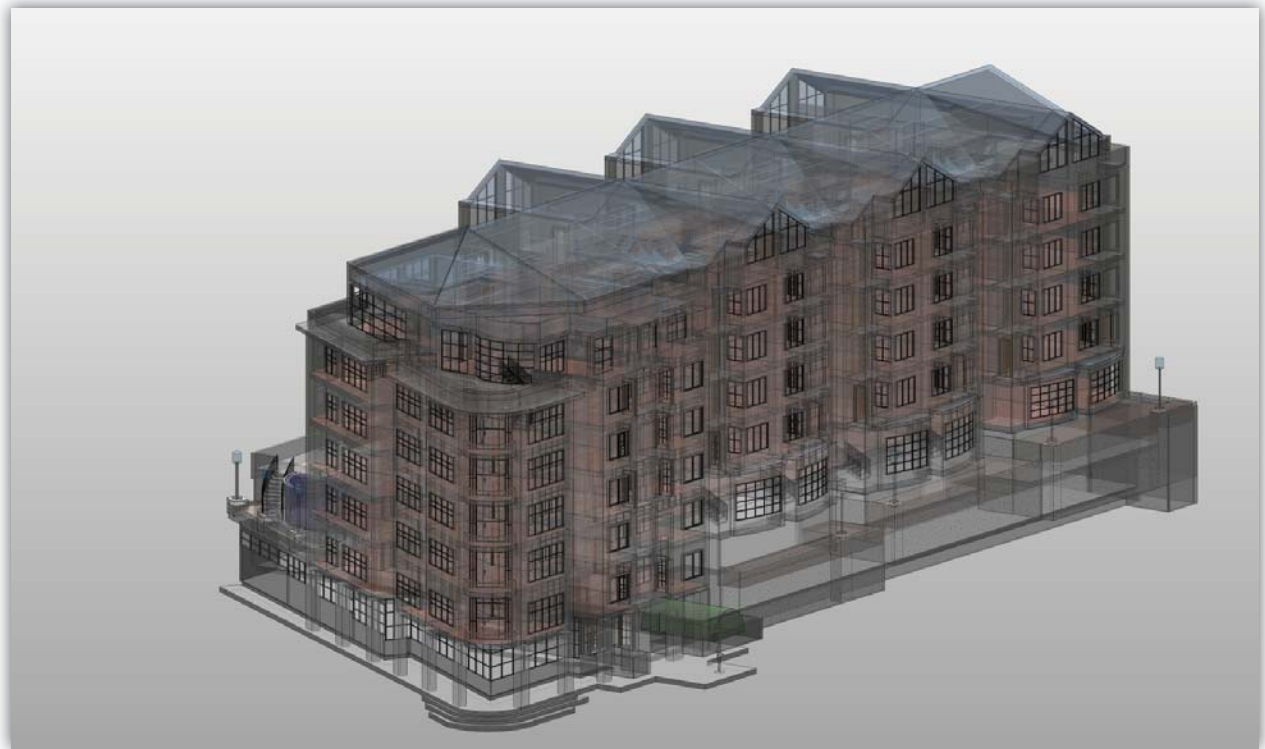


Figure 4.8 – Revit model of 1310 Minor Avenue. Source: Author



Figure 4.9 – Area map and image of 1001 Broadway. Source: Author

1001 Broadway (medical office building)

Why it was chosen: 1001 Broadway was chosen as it is the best building within the study area to represent the three to six story, masonry construction, dedicated office building. This building also represents the large contingent of buildings in Seattle which were constructed in the early 20th century, and has shown flexibility over time, with many different tenants and owners.

Building Stats:

Parcel Number:	1978201145
Name:	Northwest Medical Center
Tax Payer:	BSOP3, LLC (Daniel R. Baty and Stanley Baty)
Highest/Best Use Vacant:	Commercial Service
High/Best Use Improved:	Present Use
Construction Date:	1928
Effective Year:	2000
Const. Class:	Masonry
Value of Land:	\$4,734,600 (\$165 sq ft)
Value of Building:	\$14,480,100 (\$230 sq ft)
Bldg Gross Sq Ft:	83,448
Bldg Net Sq Ft:	62,940
Zoning:	NC3P-160
Number of Floors:	3
Heating System:	Complete HVAC
Parking:	Garage; 28 spaces

Background:

Designed and constructed in 1928, 1001 Broadway began its life as a two story, mixed use office building, located at the corner of Broadway and Madison Street on Seattle’s First Hill.

Constructed in masonry with timber columns, the initial structure was little more than a two story, rectangular (240’ north-south by 120’ east-west) building, placed on a sloping site (slopes upward east-to-west, about 6’ across the narrow axis of the building) hoping to take advantage of the major intersection it sat on (Figure 4.10 on page 34). The building’s first level, burrowed into the slope, contains a small parking garage with small street-level retail spaces ringing it on the east side.

The walls of 1001 Broadway were constructed of concrete, with decorative tile adhered to the exterior, and a plaster finish on the interior. The second floor was constructed of 2x14 joists and 2x6 decking (laid on the long axis), and consisted of office spaces radiating around the perimeter and a stairwell/ elevator core in the center, next to a small center spine of offices (Figure 4.11 on page 35). The garage was not heated, and had a ramp in from the south (via Madison Street) and a ramp out to the north (via East Union Street).

From 1928 to 1958, 1001 Broadway was the home to a number of different kinds of businesses including offices for attorneys, doctors and associated retail. In 1958 and 1959, a third story to the building, nearly doubling the leasable space. To accomplish this, a third story (also masonry) was built atop the existing structure, utilizing the existing timber columns and

bearing walls, and without removing the original structure's roof. At that time, major renovations were made in order to dedicate the 1001 Broadway as a medical office building. Today 1001 Broadway, now known as the Pacific Medical Center, the building has nearly 63,000 sq ft of leasable space, 8 tenants, with an occupancy rate of approximately 75%.

In February 2008, the 1001 Broadway was sold for \$21m to BSOP3, LLC, a holding company owned by Daniel R. Baty and his son Stanley L. Baty.¹ Two years prior to that sale, in 2006, the building was purchased by its previous owners for \$13m. The growth in value for the 1001 Broadway property most likely reflected the anticipated development of the Sound Transit Link Light Rail First Hill Station, nearby along Madison Street, which was in planning stage at that time, combined with the expected economic growth on First Hill in general.

Since 2008 however, the Link Light Rail (LLR) was moved due to the cost of the project and technical concerns. Sound Transit LLR plans now call for the construction of the Capitol Hill station, and the First Hill Streetcar, which will run from Occidental Park to

Capitol Hill, providing a transfer point, thus connecting the two systems. Currently, a street car's path is planned to bring it down Broadway, across Madison Street, and planned for completion in 2013. A streetcar stop has been planned across the street from 1001 Broadway.

Potential Issues

There are a wide variety of issues which could arise with an office building such as 1101 Broadway.

- Owner Objectives

Unlike the owners of 1310 Minor, the objectives of the owners of 1101 Broadway, Daniel and Stanley Baty, appear to be unrelated to the types of businesses the building supports (predominantly medical offices and some retail). While Daniel Baty is involved in the field of elder care, the purchase of this office building appears to have made solely for investment purposes, in anticipation of the Sound Transit construction, and purchases of property needed for the station.

The assessed value of the building remains at \$21m (\$16m building value, \$4.7m land value), and the likelihood of increased economic activity in the First Hill area (as cited earlier) to increase is good. While the occupancy rate of the building is likely to improve from this increased activity, the lease rate for space in the building will remain on par with other medical office buildings nearby (there are several). Currently

¹ Brian Baty is principle investor in Columbia Pacific Advisors and Founder and Chairman of Emeritus Corporation, a national provider of senior living services. Both companies are joint owners of Seattle-based Cascade Healthcare, which is poised to be the first foreign-owned, for-profit senior care facility in China; first 100 bed facility of which begins construction in May, 2012.

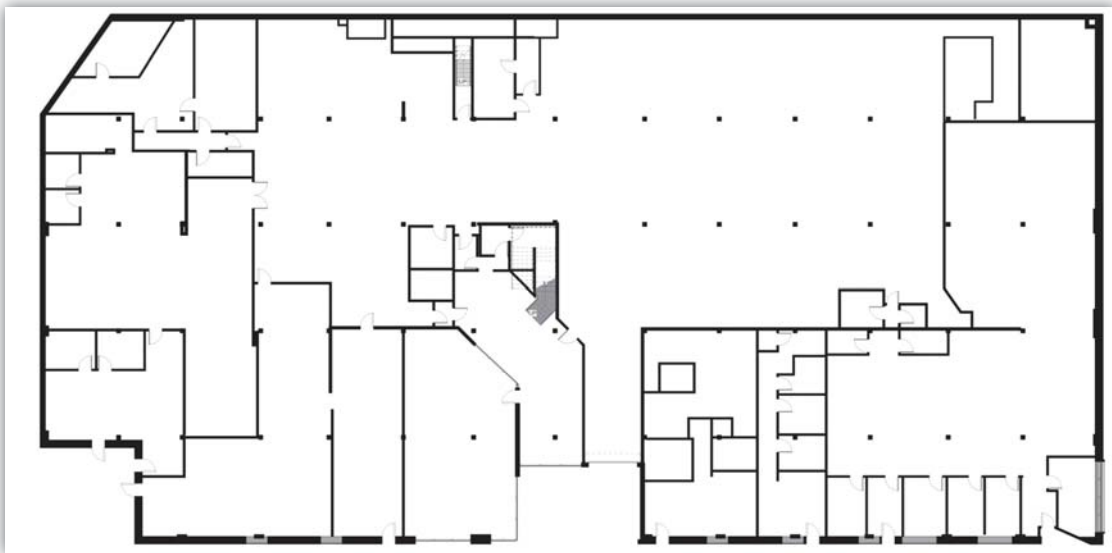


Figure 4.10 – Floor plan of first level. Source: Revit drawing by Sean Engle; from construction drawings.

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offices in 1001 Broadway lease at \$30 to \$35 a square foot, which would yield approximately \$1.9m to \$2.2m per year in revenue. At these rates, it will take approximately six years to overcome the 40% premium paid in the 2008 purchase based on rental income alone.

- Building Construction and Condition

Building/View Windows Orientation:

1001 Broadway has a general rectangular shape - and is situated parallel to Harvard Avenue where it intersects Broadway; so the long axis of the building runs northwest to southeast. Because of this, the windows

on both long sides of the building are exposed to direct (summer) morning sunlight as well as direct afternoon sunlight.

Roof/Floor Cavities:

The cavities between the first and second floors consist of 12" x 24" timber girders, smaller floor joists, supported by timber columns and topped with a 2x6 decking subfloor. Insulation in this cavity is indicated as R19 fiberglass batts, which are located between the floor joists (Figure 4.12 on page 36).

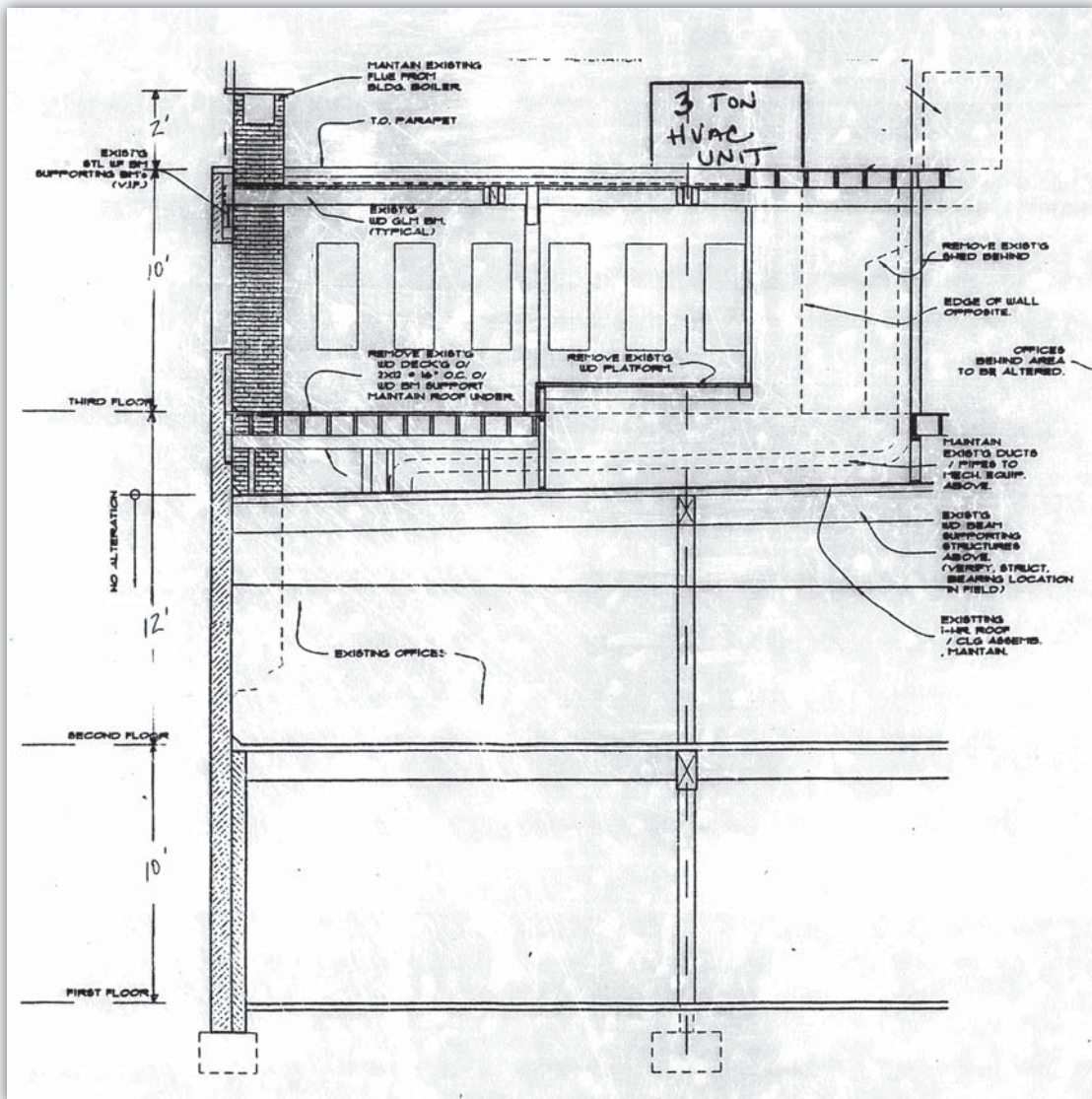


Figure 4.11 – Building section at north end. Source: Seattle DPD.

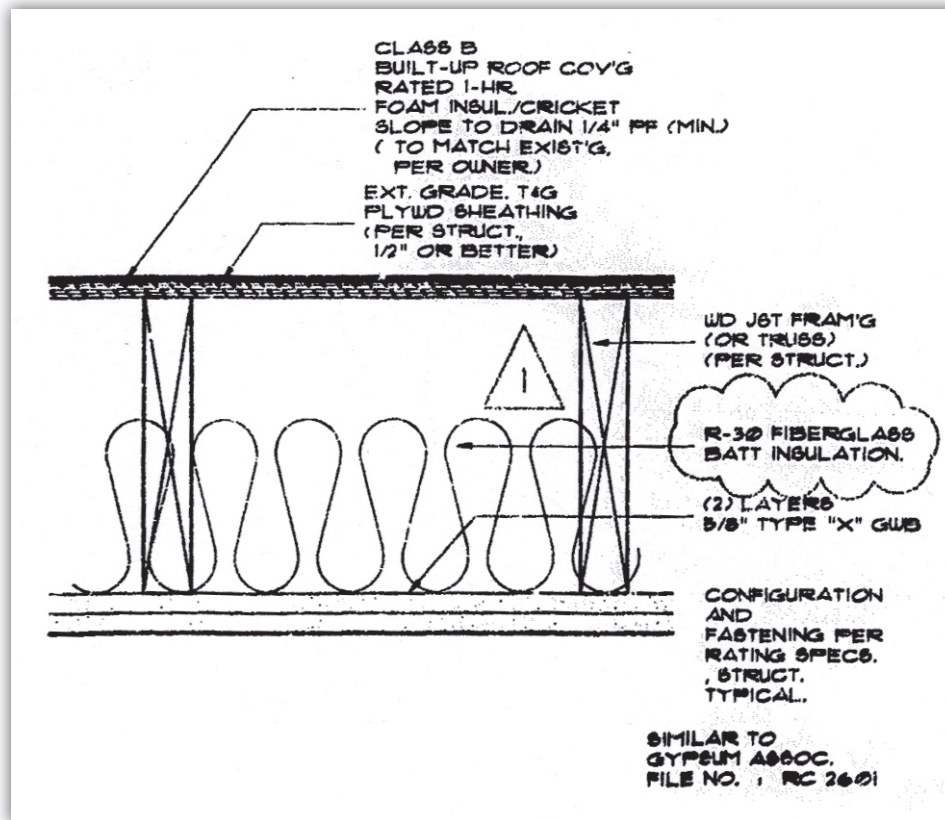


Figure 4.12 – Roof section showing composition. Source: Seattle DPD.

Between the second and third floors a larger cavity exists consisting of the original roof of the second story, with the floor joists for the third story immediately above. R19 fiberglass batt insulation is in this cavity as well - between the floor joists - but it has not been confirmed.

The new roof - that constructed in 1958 - is a class b, one hour built up roof consisting of (from the outside in) a roof membrane, rigid foam insulation/cricket (for drainage) on 1/2" exterior grade tongue-and-groove plywood sheathing. Below the roof are 2x12 trusses and batts of R30 fiberglass insulation, below which are two layers of 5/8" Type X GWB.

Garage/Floor Connection:

The garage, once accessed via ramps from Madison Street to the south and Spring Street to the north, is now only accessible via a roll down door located at the front of the building, facing (northeast toward) Harvard Street.

The connection between the garage and the floor immediately above it consists of the floor joists mentioned earlier, in addition to two layers of 5/8" Type X GWB. While the garage is not conditioned, it is ventilated, and the assembly of GWB, insulation and the 2x6 floor decking above it should provide sufficient thermal barrier properties.

Exterior Wall Construction:

The exterior wall of 1001 Broadway, at the first and second levels (constructed in 1928) consist non-reinforced load-bearing masonry with brick veneer on the second and third levels and stone veneer on the first. The original construction had interior walls with a 3/4" plaster finish however; these have since been replaced with 5/8" GWB atop wood framing, and R19 fiberglass batt insulation.

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Floor-to-Floor Heights:

The floor-to-ceiling heights at 1001 Broadway are 8'-6" in height, but also vary some at different points in the building.

Exterior View Windows:

The windows on the first level are little more than rectangular punched openings through each side of the building. Windows are present in the leased spaces on this level, and consist of double panes, but appear not to have a low-e coating on them. On average these windows are only about three feet in height, perhaps eight feet in length and begin at about a height of about four feet.

The windows on the second level are larger than that of the first, and consist of continuous cast stone window frames, wrapped around the building. Within these frames are long strips of vertical glazing, interrupted only by the occasional cased column, which serves to emphasize the horizontal nature of the building (long and low). While the overall amount of glazing on the second level is much higher than that of the first, the windows themselves are actually shorter than those on the first level, and also start at about a height of four feet.

The windows on the third level are very much the

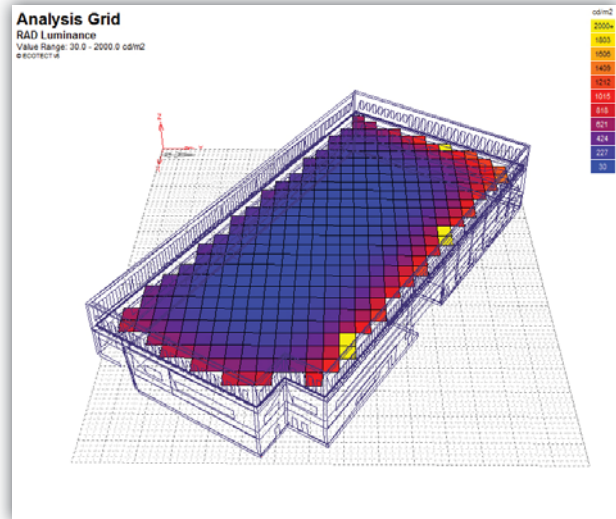


Figure 4.13 – Ecotect analysis of 1001 Broadway, third floor. Source: Ecotect analysis by Sean Engle.

opposite of the second level. They consist of tall, narrow, recessed masonry frames which also wrap about the building, providing a vertical finish to what is otherwise a very low, long building.

When an Ecotect analysis was conducted on 1001 Broadway, it revealed (not surprisingly) that there was the potential for glare and solar gain within a short distance to the windows (Figure 4.13). The interior



Figure 4.14 – Revit model of 1001 Broadway. Source: Author

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spaces, however beyond the range of the windows fell off to levels below that which would be required for an office environment.

This is due (in part) to the depth of the floor plate, which at over 100' does not lend itself to an effective configuration for daylighting.

Immediate Area Influences:

1001 Broadway is located at the intersection of Broadway and Madison Street on First Hill. Both streets are major arterials, and both streets carry large volumes of traffic. The building is the next block north of Swedish Medical Center, one block south of The Polyclinic, and across the street from the Seattle University campus.

The building also sits at the transition point of the major economic corridor of Madison Street, from Broadway west to Interstate 5, toward downtown Seattle. This corridor contains a large volume of medical facilities and medical offices, associated with Swedish Medical Center, Virginia Mason Medical Center or other smaller clinics. Some volume of retail also exists within this corridor; however it is anticipated to increase in volume (Reference to earlier map).

In addition to the medical-related facilities, 1001 Broadway is within walking distance to a large number of multifamily buildings and retirement centers. Currently 1200 Madison is under construction, a thirteen story mixed use apartment and retail building. Continued development of these types of apartment towers and associated retail is anticipated to continue in the study area and within First Hill itself.

Building System(s)

Historically, the offices at 1001 Broadway were heated utilizing a single boiler and hot water radiators in the office. This system was replaced in the 1980s with a full HVAC system, which provides both heating and air conditioning system.

Because the primary view windows on the second and third levels are fixed and not operable, there exist a number of smaller square ventilation windows on both floors. It appears however that the majority of ventilation comes from the HVAC system. Evaluation

Scoring:

Overall = 8.03 pts = Neutral/Somewhat likely to retrofit than redevelop.

Major Drivers:

Owners are holding the property as an investment (initially) for an expansion of the Link Light Rail - and now for the increasing First Hill business corridor. Swedish Medical Center is immediately to the south of this property, and the building appears to be in good shape; making the extension of its useful life probable.

Discussion:

The structure at 1001 Broadway is a sufficiently constructed building, given its age, materials, condition and current use; additional gains could be achieved with the employment of basic minor retrofitting however, and the building could be more heavily retrofitted to become a boutique/classic office building with better ground floor retail offerings than currently exist. In addition, when the First Hill Streetcar is constructed next year, the level of foot traffic next to the building will increase dramatically, making the ground-level retail spaces more attractive (assuming their appearance is improved).

The ownership of 1001 Broadway makes it likely that the property will not be sold in the near future for redevelopment, so improvements in the leased office spaces will be needed in order to keep the building competitive with other nearby medical office buildings. The building is within the 160' height limit, however - so if the property were to shift, it would most likely be very sudden, and come as a result of a purchase or decision to redevelop the entire parcel; possibly placing a Class-A medical office or mixed use tower there instead.



Area map and image of 1110 Harvard Avenue. Source: Author

1110 Harvard Avenue (outpatient clinic addition)

Why it was chosen: 1110 Harvard Avenue was chosen because it is the best building in the study area to represent those buildings which have three to six stories, and are constructed with reinforced concrete. Since the building is located in the First Hill District, it is also appropriate that the building functions as an outpatient surgical clinic.

Background

The site at 1110 Harvard Avenue is triangular in shape (with the long side running parallel to Broadway) with a significant slope of about 114' elevation gain in 225', east to west. The site is originally that the Scottish Rite Cathedral, a Masonic lodge built in 1910 by Seattle architect/builder Frank Allen and remained there until 1990 when it was torn down to make room the new Polyclinic addition (the focus of this case study).

Until that time, the Scottish Rite Cathedral shared the triangular block with a number of small medical clinics, located across the street from the Minor Hospital. Those clinics ran along Harvard Avenue, with their primary facades facing west and several wings built west-to-east toward Broadway. These clinics, designed and built in 1951 by George Willington Stoddard, were of brick and concrete construction, and were narrow, low-slung blocks supported in front with narrow columns beneath a ribbon of windows on the second floor.

In 1965, the portion of the Polyclinic now considered the "original" - that in the northwest corner of the site - was designed and built by Stoddard & Huggard Architects; consisting of a five story, brick and concrete

<u>Building Stats:</u>	
Parcel Number:	1978201270
Name:	The Polyclinic
Tax Payer:	The Polyclinic
Highest/Best Use Vacant:	Commercial Service
High/Best Use Improved:	Present Use
Construction Date:	1989
Effective Year:	1980
Const. Class:	Reinforced Concrete
Value of Land:	\$8,378,200 (\$150 sq ft)
Value of Building:	\$16,931,364
Bldg Gross Sq Ft:	60,601
Bldg Net Sq Ft:	57,882
Zoning:	NC3P-65
Number of Floors:	3
Heating System:	Steam (locally generated)
Parking:	Garage, 300 spaces

clinic of 45,500 sq ft, with a parking 10,300 sq ft garage in its basement (accessible via Union).

By the late 1980s, the Polyclinic was badly in need of additional space, and accordingly purchased the remainder of the block; making plans to construct a three story concrete addition to the south of the existing clinic and razing the old Scottish Rite Cathedral (known then as "Club Broadway") in the process. Designed ARC Architects in 1988, the

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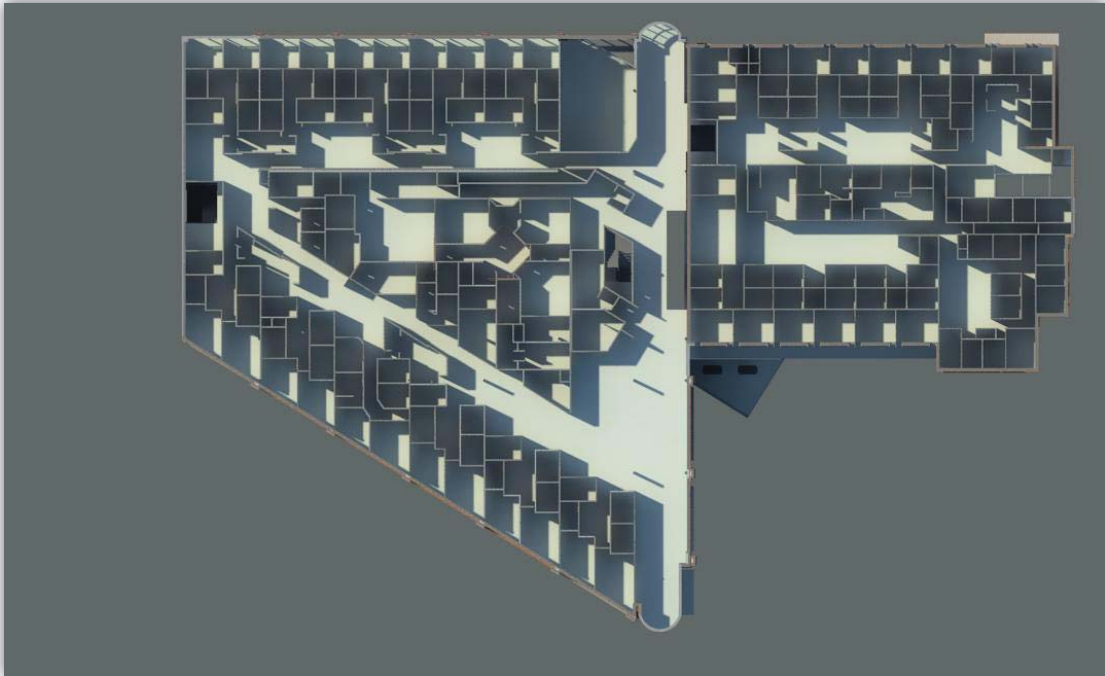


Figure 4.15 – Revit perspective plan of second level. Source: Author

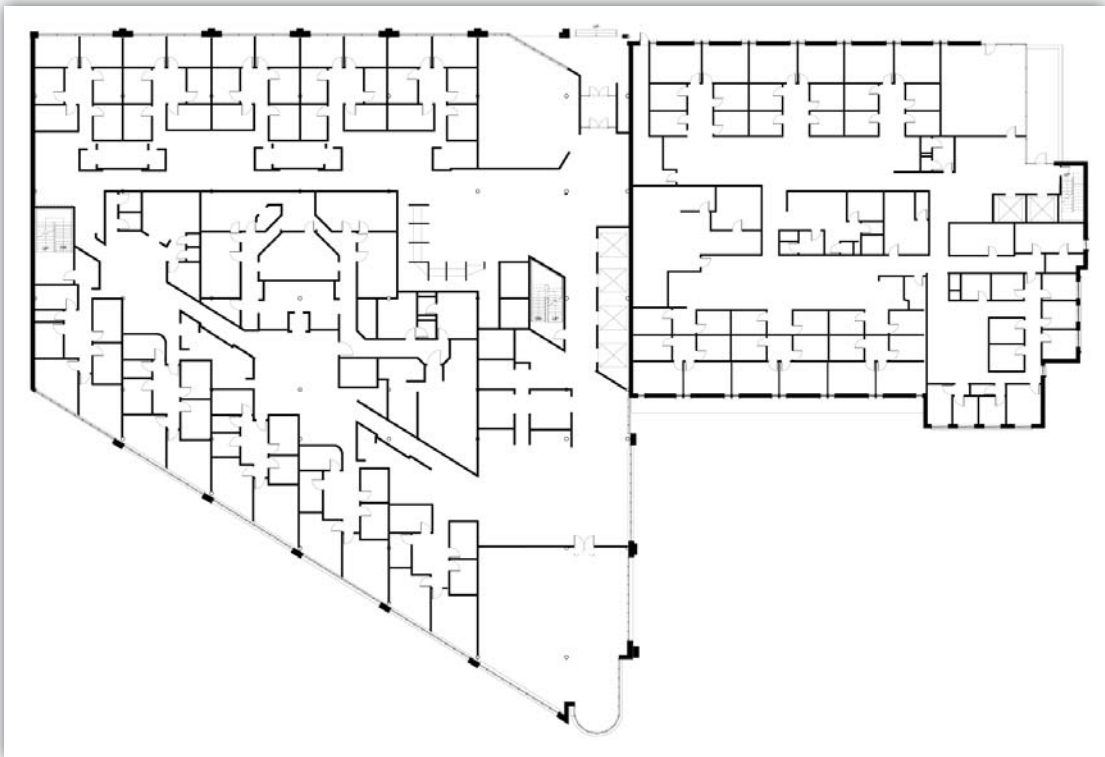


Figure 4.16 – Floor plan of first level. Source: Author

addition was envisioned as a 61,400 sq ft of clinical space on three stories, supported by 115,000 sq ft of parking garage, six stories into the ground.

The ARC addition has served the organization well to date; however as was true in past years, the Polyclinic is one again in need of additional space, and has recently leased the newly constructed tower at 7th and Madison, with the intention of moving 500 employees and the bulk of its cardiac care and testing facilities there. While the move does assist in reducing the burden on the main Broadway campus, the Polyclinic is still in need of additional space. Those needs will form the focus of my design study following the discussion of the existing building at 1110 Harvard Avenue.

Potential Issues

There are a wide variety of issues which could arise at a building such as 1110 Harvard Avenue. The addition created features post-tensioned concrete slabs making up what currently be considered a very deep floor plate. The face of the Polyclinic is still on Harvard, with the main entry to the west, effectively turning its back on Broadway, and presenting a face there which is primarily about entering the garage. The addition feels very horizontal in nature, with strip windows wrapping around the (effectively) two story structure, itself looming some 32 feet above the street (Figure 4.15 and Figure 4.16 on page 40).

Owner Objectives

The objectives of the owners of 1110 Harvard Avenue additions - the Polyclinic itself - are to serve the public as an out-patient surgical center:

"The Polyclinic is one of the largest multi-specialty clinics in the Puget Sound area, with more than 150 primary care and specialty physicians in most areas of medicine. Established in 1917, The Polyclinic's mission is to promote the health of our patients by providing high-quality, comprehensive, personalized health care."

To that end, the intentions that the organization has for its primary campus, will, for the purposes of this report, be assumed. As a non-profit 501c3 organization, the Polyclinic appears to be solely motivated by providing service the community in which it operates, and because of that, it is unlikely that they would choose to sell or fully raze their primary campus in the

near future. Instead, this report assumes that the clinic would choose to heavily retrofit and add onto the structure (indication of future expansion are noted in the original construction documents for the addition) in order to meet their space demands.

Founded in 1917 by H.J. Davidson MD and his brother C.F. Davidson, both surgeons, the Polyclinic began life as a six physician association, functioning as separate practices, but providing referrals to one another, etc. Over the next 40 years, the Polyclinic grew, and by 1965 had grown sufficiently large enough to move to its new facility on First Hill and in 1989 expanded the campus to its current state. Today the clinic has more than 125 physicians, 22 specialists, 11 locations and employees nearly 800 people.

The following sections will review the addition, discuss potential issues within it, and then provide a design study demonstrating how some of those issues might be mitigated.

- Building Construction and Condition

Building/View Windows Orientation:

1110 Harvard Avenue is an addition to a smaller clinic to the northwest. The addition is a large polygon shape, with a narrowed end at the south, and northward sweeping walls following the Harvard Street to the west and Broadway to the east. The south wall of the building, that which faces the remaining triangle portion of the lot, is constructed from CMU and has no windows or openings in it at all. At one time, this wall was to be the party wall with the (now razed) Scottish Rite Cathedral.

Because of the buildings footprint, the primary windows of the addition - long strip windows on both floors, on both sides of the building, point toward the southeast and southwest respectively, and are very likely subjected to considerable solar gain during summer mornings and afternoons. In addition, the south wall of the building - that which might be used to bring light to the building's interior, provides no light what so ever

When a Ecotect analysis was conducted upon 1110 Harvard Avenue, it found that like 1001 Broadway, the depth of the floor plates made light penetration difficult (Figure 4.17 on page 42). This difficulty is compounded by the configuration of the partitions within the addition. The doctors offices run the perimeter of the addition, and with opaque walls, it is assured that

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daylight will not penetrate more than ten feet into the building.

Roof/Floor Cavities:

The floors of the Polyclinic addition consist of post-tensioned, reinforced concrete slabs. In addition, the bottom of the first level slab is covered with rigid foam insulation rated to R19. The roof consists of a roofing system and contains (from the outside in) roof lapping (24" minimum); 1/2" layer of Perlite; 24" of rigid polystyrene insulation to create slope and provide insula-

tion; 5/8" GWB and steel deck roofing, supported by angles and trusses.

At an R value of 5 per inch of polystyrene, this roof assembly has a total R value of 120 - which is excellent for thermal efficiency - both in keeping the buildings heat in, and keeping the heat from solar gain out.

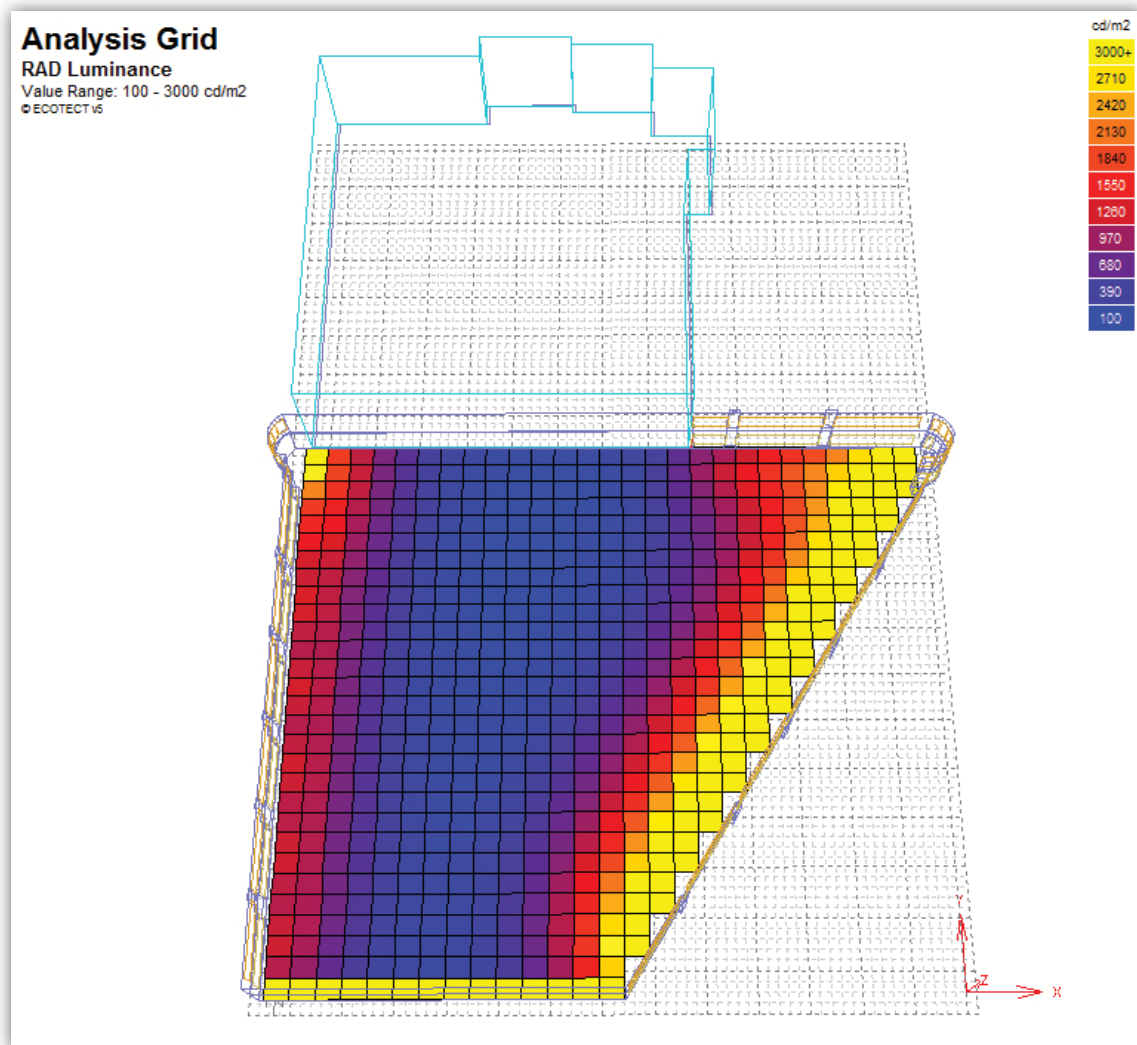


Figure 4.17 – Ecotect RAD luminance analysis of 1110 Havard Ave, second level. Source: Author

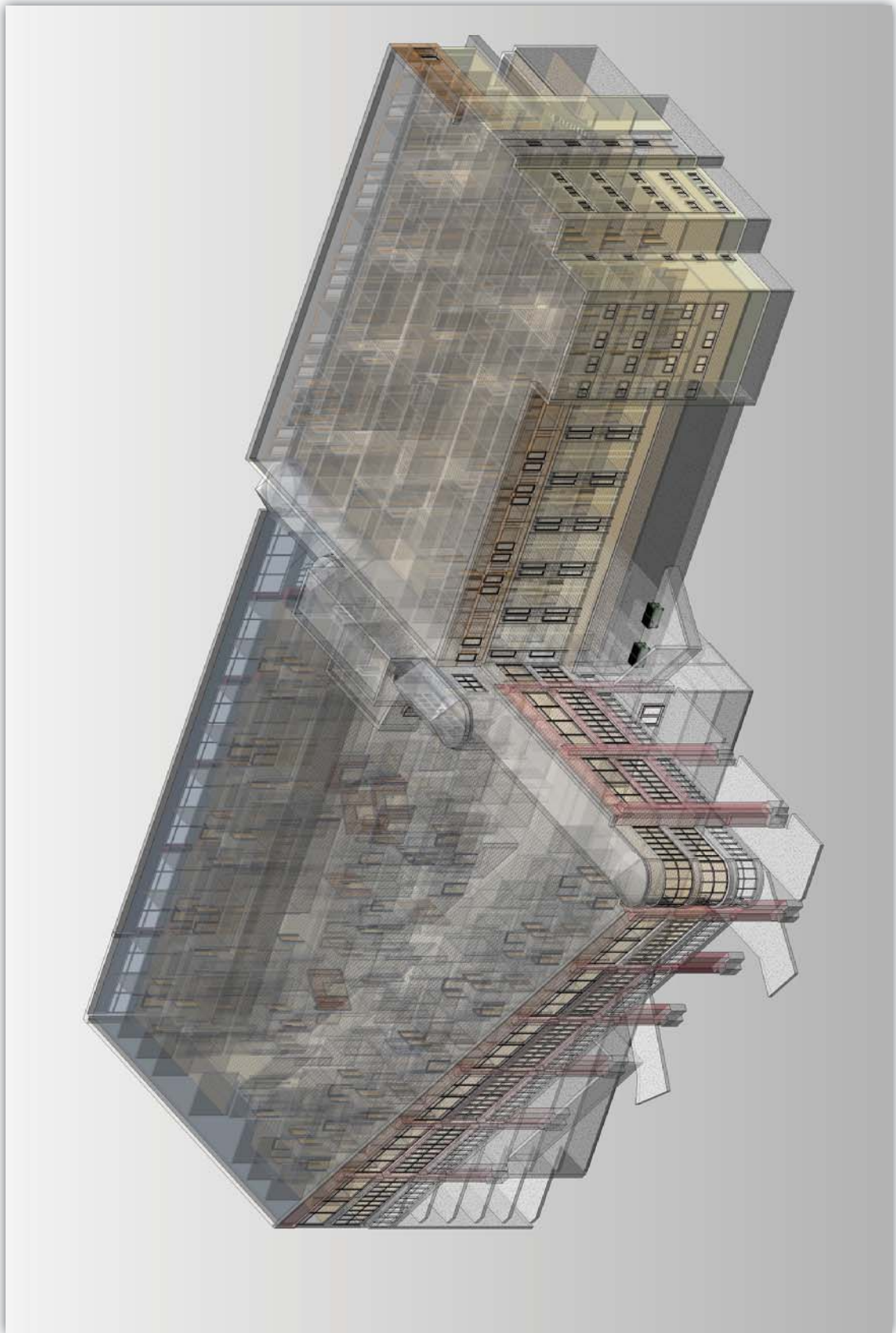


Figure 4.18 – Revit model 1110 Harvard Avenue. Source: Author

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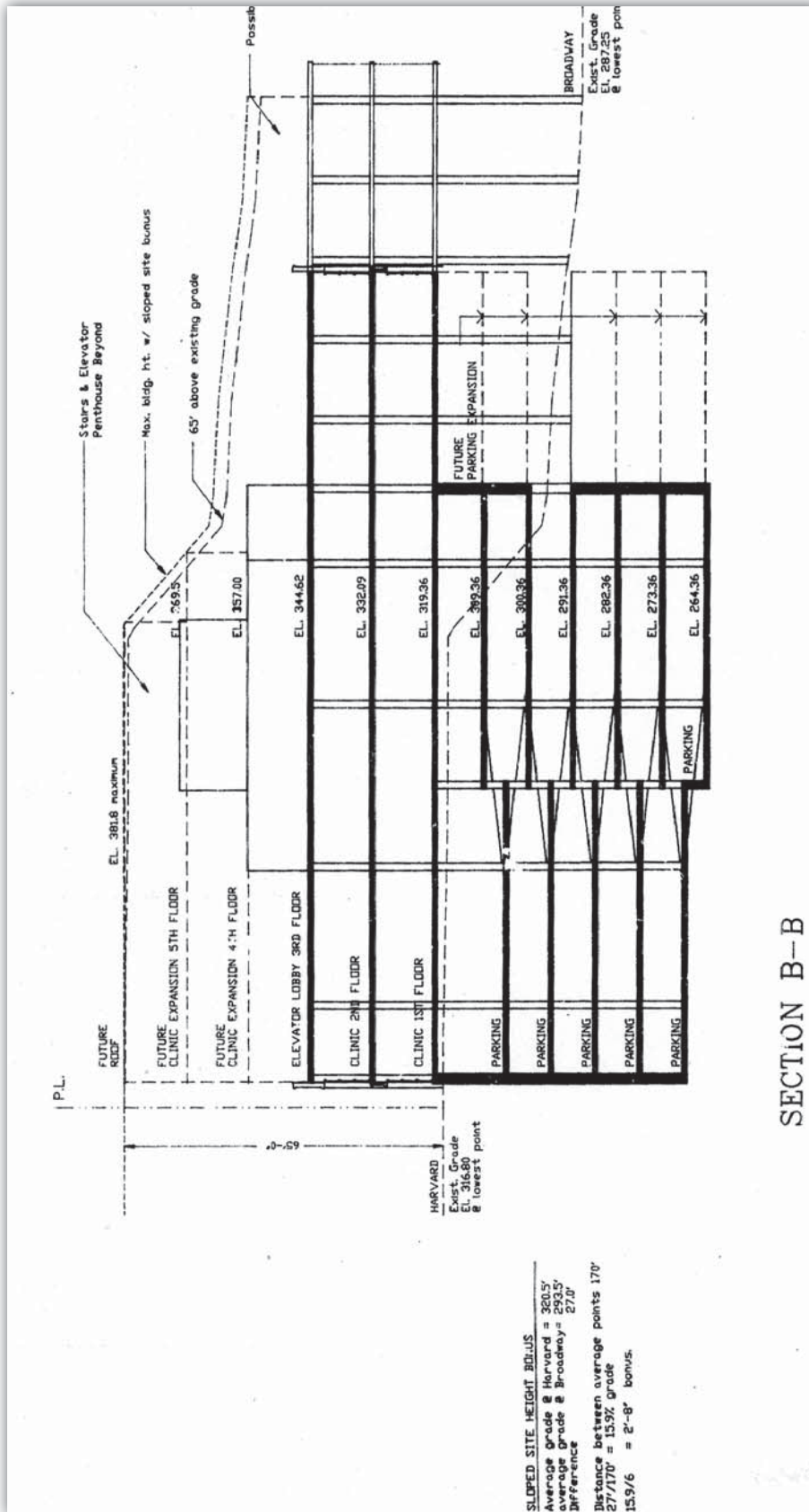


Figure 4.19 – Building section of 1110 Harvard Avenue, cut E/W, looking north. Source: RAS Architecture.

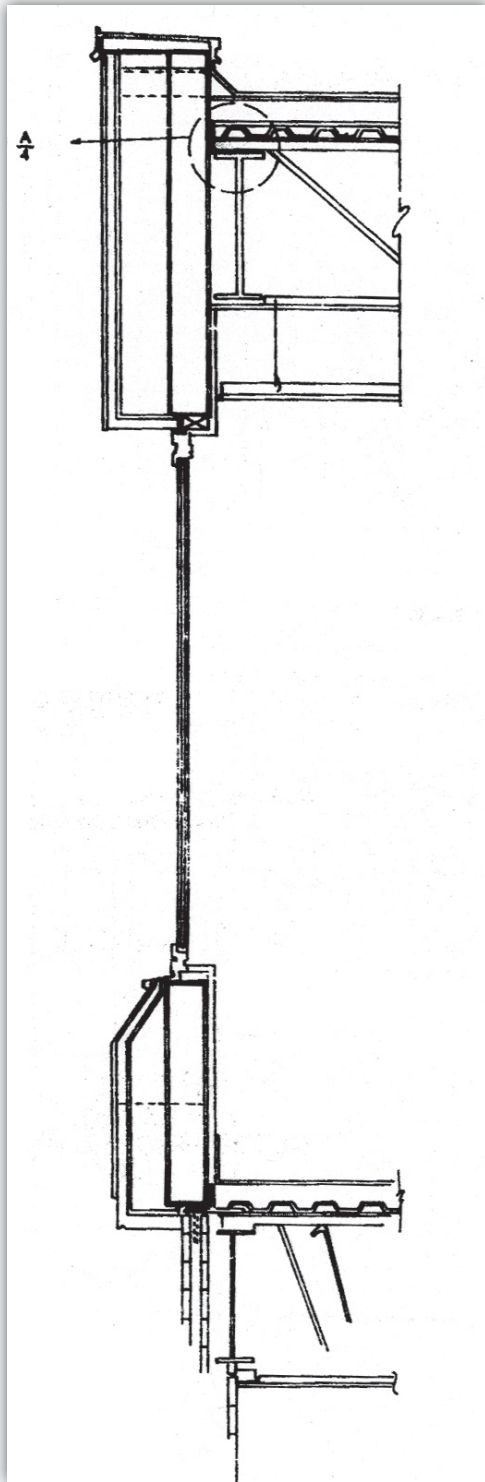


Figure 4.20 – Curtain wall section, 1110 Harvard Avenue. Source: RAS Architecture.

Garage/Floor Connection:

The garage is not conditioned, but does benefit from air being pumped through the space, slightly warming it during the winter. As previously mentioned, the connection between the first floor and the garage is a 1 foot thick post-tensioned concrete slab, with rigid insulation board (R19) attached to the bottom of it.

Exterior Wall and View Window Construction:

The exterior walls of the addition are modular curtain walls, and consist of sections with spandrels, vertical glazing and a header section (Figure 4.20). The panels are highly insulated (R30) with rigid polystyrene and the glazing is double paned - although may or may not be low-e .

Floor-to-Floor Heights:

The floor to floor height of the Polyclinic addition is 14 feet. When one subtracts eighteen to twenty-four inches for the post-tensioned structural slab and ribs, and an additional two to three feet varying plenum depth for services, the floor-to-ceiling height drops to about ten feet on the first level (Figure 4.19 on page 44). On the second level the ceiling height is about the same, however it does open up in some areas where the roofline vaults upward.

Immediate Area Influences

The addition at 1110 Harvard Avenue resides in the northeast corner of the study area; at the southwestern corner of the Broadway and Union Street intersection. At this location is what many people consider to be the "saddle" or transitional point between First Hill and Capitol Hill. To the immediate north of the Polyclinic campus lie the Pike-Pine Corridor and large increases in commercial, retail and residential traffic. To the west lay mostly multifamily residential buildings (eventually including 1310 Minor, discussed earlier), and to the east, the campus of Seattle University.

To the south of the Polyclinic are the large hospitals of First Hill, as well as the Madison Street corridor which makes up the study areas southern edge. At nearly 1/8 of a mile from the closest major hospital, Swedish Medical Center (with whom the Polyclinic has a strategic partnership) 1110 Harvard Avenue resides in a zone that is heavily impacted by the areas to the north and the traffic along Broadway; more so than that coming from the south.

Section .IV - Analysis

The traffic along Broadway - both foot and automobiles - is considerable, and strongly defines the character of the street in this area. The First Hill Streetcar is planned to run along Broadway, right past the Polyclinic. Because of this, traffic at the clinic is expected to continue increasing and additional capacity will be required for clinics operations.

Additionally, since the Polyclinic is an out-patient surgical center, it competes with the larger hospitals to the south only in a smaller number of specialties, and generally provides more common procedures; thus it tends to work more in concert with the hospitals as it reduces traffic for more routine matters.

Building System(s)

The primary heating system at the Polyclinic comes from the creation of steam in a local physical plant. The system consists of four boilers which provide steam for sterilization of surgical equipment, heating/conditioning of interior spaces and heating of domestic water supplies.

The clinic also utilizes a great deal of electricity in the operation of its surgical center, server room, air conditioning and area and task lighting. The amount of power utilized is not known at this time.

Evaluation Scoring:

Overall = 6.61 pts Somewhat likely to be retrofitted.

Major Drivers: The building is owned by those engaged in the buildings mission - community healthcare. Because of this, plus the tremendous investments in the late 1980s for the ARC Architecture addition, combined with the ever-increasing demands for space by the clinic's staff make redevelopment 1110 Harvard Avenue very unlikely.

Discussion:

The addition to the Polyclinic at 1110 Harvard Avenue created a structure which responded to a 1980s need for additional office and examination room space, expanded surgical centers and increased parking. In retaining the focus on entry on the Harvard Street side, the addition simply continued what to that point had become a tradition for the clinics residing at that site.

While the addition that ARC Architecture designed was well constructed with high quality materials, and appears to be fairly energy efficient in terms of

the actual use of the energy it consumes, it appears however that an opportunity to design and build a more efficient and engaging building was missed. Specifically, the addition that was constructed resulted in a structure which consists of two very deep floor plates (120' at the south end, 220' at the north end) which have relatively low floor to floor heights (at fourteen feet).

Because of these conditions, even with the total absence of internal partitions, daylight can penetrate only a short distance into the building's interior. Additionally, it would be very difficult to improve the depth of penetration because the heights of the post-tensioned, concrete floor plates at fourteen feet limit options with expanding window heights, etc.

Because the building is structurally supported by post-tensioning, cutting into the floors to allow light to penetrate to the lower levels is not practical. In addition, since the building is owner-occupied, it is likely that it will be occupied until it needs to be replaced, at which point it will be razed and redeveloped.



Figure 4.21 – Area map and image of 1224 Madison Street. Source: Author

1224 Madison Street (retail bank branch)

Why it was chosen: This building was chosen because it is the best building within the study area which represents the extreme case of nearly-assured razing. Additionally, the property is on the Madison Street corridor, which adjoins the north boundary of Swedish Medical Center and is only blocks from Virginia-Mason Medical Center.

Background

Constructed in 1924 by Seattle architect Lister Holmes, 1224 Madison Street was initially designed as a clinic for area doctors, complete with x-ray and surgical facilities. Since its construction, the building has primarily served as a clinic/medical office, but has also served as a retail business structure (earlier a boutique and then three times a bank).

The building began service as a single north-south bar of offices, examination rooms and surgical facilities. Masonry was the primary building material at the time, so 1224 Madison is stoutly constructed of red brick bearing walls, nearly one foot thick.

The roof line has been altered from its original configuration (see below) and the interior partitions relocated several times, but the building essentially remains the same.

Since the building has been owned by financial organizations, the building has been upgraded time and again, resulting in a well maintained, very solid structure.

Potential Issues

There are a number of potential issues which could arise with a building such as this...

- Owner Objectives

1224 Madison Street is owned by Key Bank - a subsidiary of KeyCorp, a regional banking interest with 985 locations in thirteen states and its headquarters in Cleveland, OH. KeyCorp wholly owns the building and parcel at 1224 Madison Street.

<u>Current Stats:</u>	
Parcel Number:	1978200730
Name:	Key Bank of Washington
Tax Payer:	Kay Bank of Washington
Highest/Best Use Vacant:	Commercial Service
High/Best Use Improved:	Present Use
Construction Date:	1924
Effective Year:	1987
Const. Class:	Masonry
Value of Land:	\$3,465,700 (\$165 sq ft)
Value of Building:	\$1,000
Zoning:	NC3P-160
Bldg Gross Sq Ft:	8,480
Bldg Net Sq Ft:	8,480
Number of Floors:	2 (main and basement)
Heating System:	Heat Pump
Parking:	Parking Lot

Section .IV - Analysis

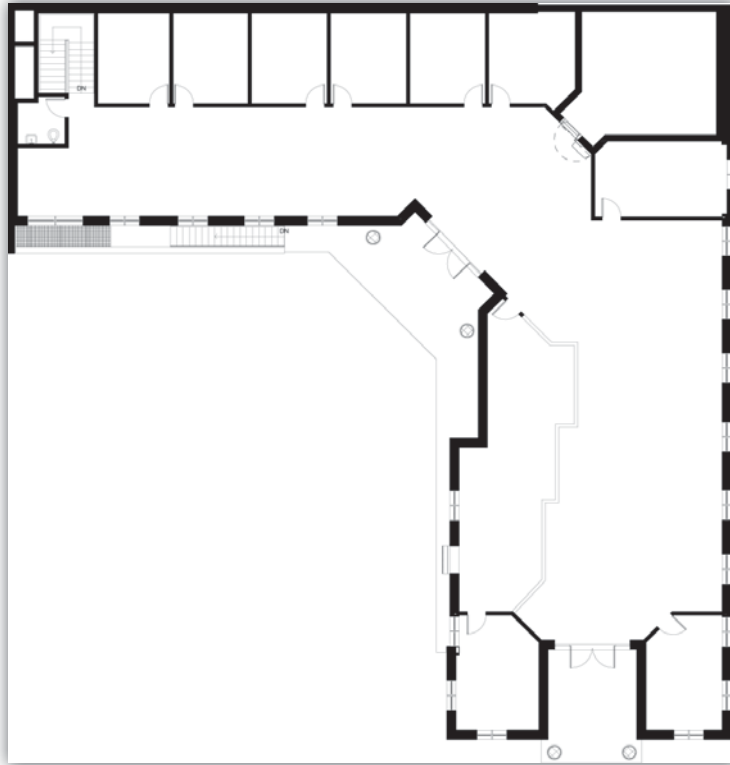


Figure 4.22 – Floor plan, 1224 Madison Street. Source: Author

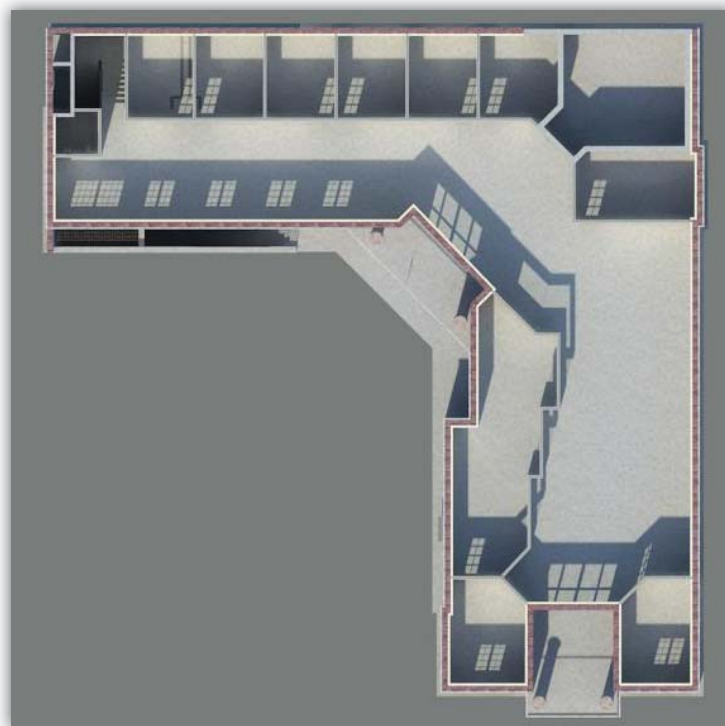


Figure 4.23 – Plan perspective of 1224 Madison Street. Source: Author

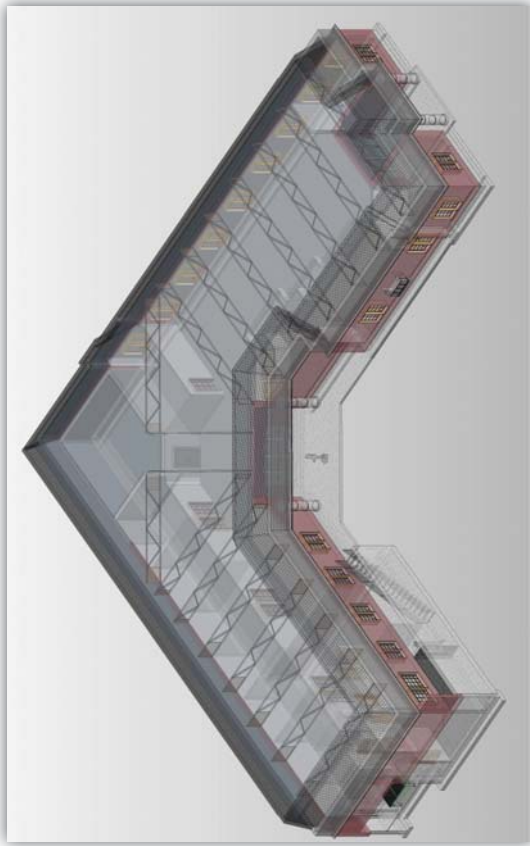


Figure 4.25 – Revit model of 1224 Madison Street. Source: Author

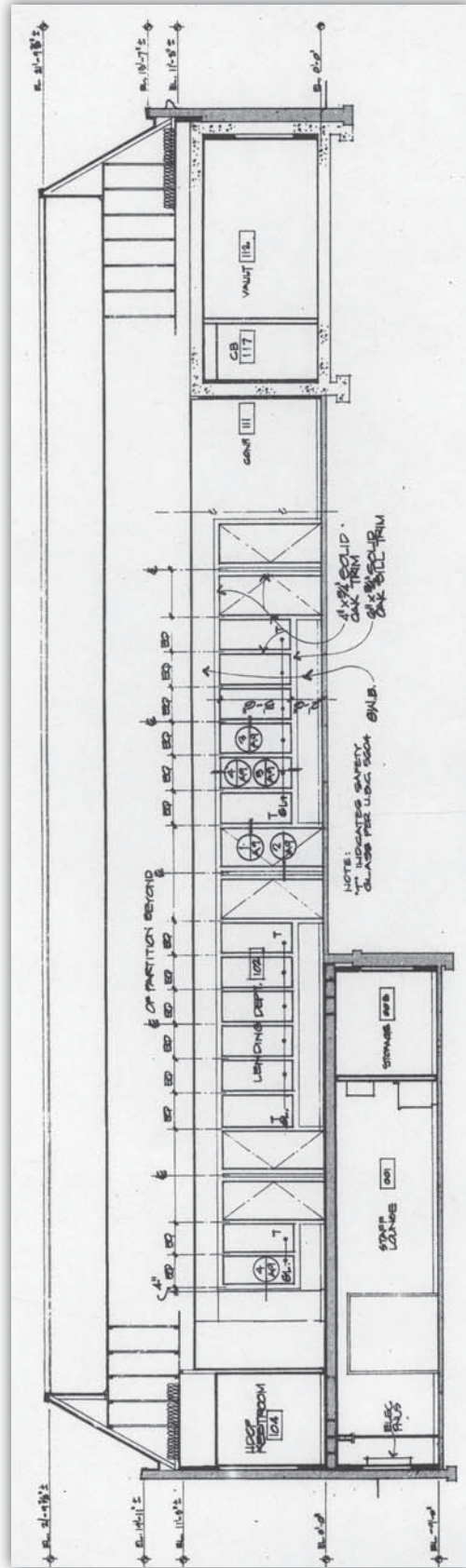


Figure 4.24 – Building section of 1224 Madison Street, cut EW along longitudinally along north wing. Source: DPD Seattle

Section .IV - Analysis

The ownership of the property is, as in the other cases, important in determining its likely placement upon the RRC. Since the owner is a major retail banking interest, it is likely that they will have interest in maintaining a position in the growing Madison Avenue corridor in order to capture the expected growth in banking there.

On the other hand, since the property is owned by a corporate interest with retail foundations, it is also very likely that the value of the property will play a role in the decision making process; and thus continued retail banking at that location, in that particular building may not be viewed as in the best interest of the organization. It is likely that given the current land value of \$3.5m, and improvements value of \$1000 is likely this property will be either fully redeveloped, or sold and redeveloped by another entity.

Also playing a role in this conclusion, is the property immediately to the west: 1200 Madison Street - which was, until earlier this year, an empty (former) Bank of America branch. That property, with nearly the same value profile, is currently in redevelopment, with a new thirteen story mixed use apartment building expected to open in 2012.

- Building Construction and Condition

1224 Madison Street is a three story (a split level, ground floor, basement and mezzanine) commercial property consisting of a single masonry building with the following characteristics:

Building/View Windows Orientation:

The building is an inverted "L" shaped structure, running north and south, then turning east and west at the north edge of the property (Figure 4.22 and Figure 4.23 on page 48). It has a narrow footprint of only forty-three feet, and has vertical glazing throughout the building, creating a well lit

A Ecotect analysis of 1224 Madison Street shows that the building's floor plate is sufficiently narrow, and the number, size and placement of windows sufficient for daylighting the interior (Figure 4.26).

Roof/Floor Cavities:

The floor is slab-on-grade reinforced concrete with additional structural elements below the floor above the basement (Figure 4.24 on page 49). The roof was originally a shallow gabled roof, but was altered in 1986 to a wood truss-supported hip/flat roof with an

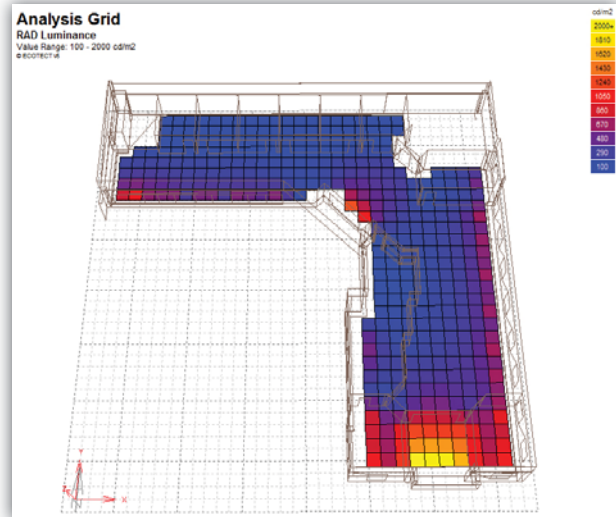


Figure 4.26 – RAD Luminance analysis 1224 Madison St. Source: Author

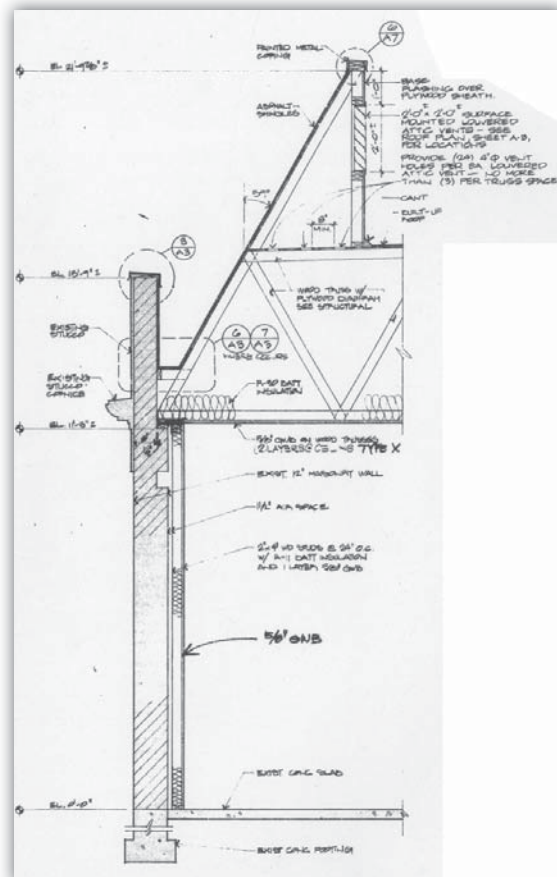


Figure 4.27 – Wall section of 1224 Madison Street; shows wall, parapet and roof. Source: Seattle DPD

attic area approximately four feet in height. The roof is a common built-up variety, and there are two layers of R30 and R11 fiberglass insulation between the trusses (Figure 4.27 on page 50).

Garage/Floor Connection:

None - a parking lot exists in the south and west portions of the parcel. From the drawings the slab appears to be non-insulated, however

Exterior Wall and View Window Construction:

The exterior walls consist of (from the outside in) 12 inches of brick masonry; 1.5 inch airspace; 2x4 studs, 24 inches on center; R11 fiberglass batt insulation and two layers of 5/8" GWB. The windows are primarily double hung double glazed, low-e windows.

Ventilation/Services:

Ventilation and heating/air conditioning are achieved with a heat pump system put in place in

Immediate Area Influences:

The subject property is located at Madison Street and Summit Avenue, in the heart of the Madison Street corridor. It is located in a 160' height limited zoning area, and directly across the street from Swedish Medical Center's office towers.

Along the north edge of Madison Street, there are several properties which have high land values and very low improvement values. As mentioned earlier, until January of 2011, a (former) Bank of America branch building stood next to the subject property at 1200 Madison Street. That property is currently under reconstruction with mixed used apartment tower (Figure 4.28).

To the west of this location is Downtown Seattle, and to the east the intersection of Broadway and Madison Street and then the Seattle University Campus.

Evaluation Scoring:

Overall: 7.08 Neutral - to -Somewhat likely to be retrofitted.

Major Drivers:

Major drivers include: the out-of-state ownership by a major banking interest; location of a small retail building in an up-zoned commercial corridor (with height limits of 160'); and nearby structures of similar



Figure 4.28 – 1200 Madison Street under construction (Nov 2011). Source: Author

size and vintage with equally low improvement values and high land values - making them ripe for development.

Discussion:

The property that 1224 Madison Street sits on far exceeds the value of the building itself. When this is combined with the ownership of the property, and its location relative to the Swedish Medical Center, downtown Seattle, Virginia Mason Medical Center and a whole host of multifamily apartment buildings, the likelihood is that the property will be redeveloped with a tower of either offices, medical offices or mixed-use residential.

As mention earlier, the entire south edge of the study area (that running from the intersection of Madison Street and Broadway west to Madison Street and Minor Street) is zoned 160' neighborhood commercial - making it ripe for development.

The only reason this property scored as low (in the negative values) as it did was the condition of the building - which is quite good. It is likely that this older, well built, well maintained, masonry and concrete building will be razed eventually for redevelopment.

SECTION .V - 400 EAST PINE STREET - CASE STUDY

Section Summary

This portion of the M.Arch thesis was undertaken in order to demonstrate what features a deep retrofit might include if it were undertaken in one of the case study buildings. This demonstration is intended to provide only a discussion of what options may exist in choosing a deep retrofit over razing it for redevelopment, and does not constitute an actual estimate of the buildings performance - before or after the deep retrofit.

Consequently, this paper does not include specific performance measurements of the property in question, nor does it make predictions about future performance. To do so would require a full energy audit of the building's historical performance, which was not provided by the buildings management, nor was it possible to undertake a deep invasive investigation into the structure of the existing thermal envelope, as it was beyond the scope of this report.

This section of the report is for discussion purposes only.

The property in question is located at 400 East Pine Street, Seattle WA 98122.

PRELIMINARY DISCUSSION

For a deep retrofit to be successful, the building in question must possess particular characteristics, and the building owner must be committed to the effort. While all situations are different, as are the buildings and owners found within them, some of the characteristics necessary can be teased out as common elements and described.

Among such common elements typically are found:

- Competitive location - The building in question must be located in a manner such as to be reasonably competitive with other buildings in its class, post renovation.
- Nearly fully development envelope - The building in question should exist within a potential development envelope, that which is nearly met. That is, the amount of remaining development available should not be so substantial that full redevelopment would yield a higher value asset than the retrofit.
- The building physically must be capable of accepting a deep retrofit without a great deal of difficulty, and structurally able to assume the new requirements, or be adaptable enough to have its structure augmented.
- The building must become functionally more efficient, with a minimal reduction in energy use of at least 50%, measured from a baseline established prior to the retrofit.

Adaptive Reuse of Buildings

As was discussed in earlier sections, the construction and operation of commercial buildings are responsible

for a large share of the creation of GSGs and related issues. Their construction/operations accounts for approximately 30-40% of the CO₂ emitted into the air, 70% of the electricity consumed, 65% of the waste created; not to mention all the related waste and power which go into associated car trips, materials and related GSG emissions.¹

Existing building stocks are often overlooked as a viable means of developing competitive, modern green buildings. Often building owners choose either less evasive (20% of a building's value or less) retrofits as a means of addressing efficiency, or they choose to raze the building entirely in favor of redevelopment.

Both of those choices ignore the fact that retrofitting a viable commercial building often cost much less than constructing a new one (about 40% less), and use only fraction of the energy and materials used in new construction. In fact, for the energy saved in the subsequent operation of a given building, to equal the amount of that used in new construction takes 10 to 80 years - while deep green retrofits can achieve the same building performance with only a 20-30 year impact.

Moreover, when choosing a deep retrofit over new construction, not only are new energy-intensive materials not utilized, but the workers needed to complete the retrofit ensures that local labor resources are engaged, thus aiding the local economy as well.

About the Neighborhood

The 400 East Pine Street (400EPS) is located east-northeast of Seattle's downtown area. It is located in

¹ Preservation Green Lab (2012). The Greenest Building: Quantifying the Value of Building Reuse, National Trust for Historic Preservation.

Section .V - 400 East Pine Street - Case Study



Figure 5.1 – 400 East Pine Street Site Analysis Poster. Source: Author

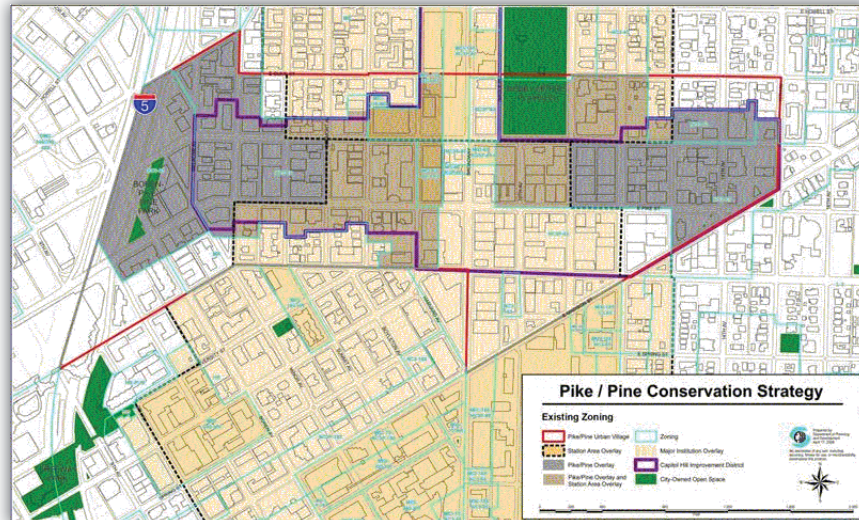


Figure 5.2 – Map of the Pike-Pine Corridor Overlay District. Source: City of Seattle

a linear neighborhood which runs from downtown east towards Lake Washington, terminating at 15th Avenue. This area is most commonly known as the Pike-Pine Corridor (PPC) because it is bounded by both Pike and Pine Streets, which run E-W, parallel to each other.

The PPC was always a defined neighborhood of Seattle, and created in 1995 by the City of Seattle to "... enhance the balance of residential and commercial uses, by encouraging residential development and discouraging large, single-purpose developments..."

The neighborhood/district runs from the Interstate 5 corridor east, up the slope, and up and over the "saddle" between First Hill to the south and Capitol Hill to the north (Figure 5.2). At the peak of the hill is Broadway, running north-south connecting the two hills.

The PPC is a district which is defined by older character buildings, those which are more commonly from the period of 1900-1940, and are often constructed of masonry. Many of the buildings in the immediate proximity 400EPS are of this type, however there are also a number of new projects which take design cues from the older buildings, but are decidedly more modern in character, and can be seen in a poster created for the site evaluation portion of this project (Figure 5.1 on page 53).

Since the PPC is designated as an overlay conservation district, zoning changes specific to that area apply. Restrictions about the demolition of historic buildings and character buildings, as well as regula-

tions about the type of configuration of the facade apply to different buildings in different portions of the neighborhood. In the case of 400EPS, the building is listed as a character building, however it is not listed as historic, and thus has fewer restrictions which would impact this project - other than normal massing, set-back and height limits zoning ordinances.

About the Property

400EPS is a three story, 28,000 sq ft office building located at the intersection of East Pine Street and Bellevue Avenue in Seattle (Table 5.1 on page 55).

400EPS has had an interesting existence, in that the building was originally constructed as an automobile and motorcycle dealership as part of Seattle's "Auto Row". As a result, the building was heavily constructed, framed with timber columns and girders; the floor decking made of 2x10 fir planks set on their strong axis (Figure 5.8 on page 59).

The exterior walls of the two street facing fronts of 400EPS consist of masonry spandrels finished in terracotta on the exterior, and furring, R-18 batt insulation and gypsum board on the interior. The two rear walls consist of brick columns and brick in fill with three window bays on the east wall (along the alley). The rear wall is also made up of brick columns and in fill, but also has half-hexagon cut out with windows on the third level and doors on the second level (for fire egress). The interior partitions are simple 2x4 or 2x6 stud walls finished in gypsum board, configured to lessee's specifications.

Table 5.1 – 400 East Pine Building Stats

400 East Pine - Building Stats:	
RRC Score:	14.68
PIN:	8725600520
Building Description	Office
Predominant Use	OFFICE BUILDING (344)
Construction Class	MASONRY
Building Quality	AVERAGE
Stories	3
Building Gross Sq Ft	27,544
Building Net Sq Ft	27,544
Year Built	1917
Eff. Year	1990
Percentage Complete	100
Heating System	COMPLETE HVAC
Sprinklers	No
Elevators	Yes
Zoning	NC3P-65
Building Height (Approx)	45' (3 stories @ 15' ea)
Highest Best Use Vacant	COM. SERVICE
Highest Best Use Improved	PRESENT USE
Present Use	Office Building
Base Land Value SqFt	\$135
Base Land Value	\$1,328,200
Land SqFt	9,839
Acres	0.23

The building dimensionally (95'x 110') is set in an east-west orientation on it's long axis into a hillside along the north side of East Pine Street; peaking just above level one. With floor-to-floor heights of approximately 15', the three levels of 400EPS top out at 45' - about 20' below the zoned height limit of 65'.

The two main entrances of 400EPS are located on the first level at the southwest corner of the building and on the second level at the southeast corner of the building. In addition there is a fire exit located on the north side of the building at its rear (Figure 5.3 and Figure 5.4 on page 57).

The first floor is SOG, which wraps around a large double height room set upon a six foot plinth. Currently the primary means of vertical circulation are achieved via the main staircase and elevator located

in the southeast corner of the building as well as by a stairwell toward the middle-rear of the building which accesses only the second and third floors. The second floor wraps around the double-height space mentioned previously, and the third floor is continuous from wall-to-wall.

The roof of the building is currently accessed via ladder from the third story of the rear stairwell. The roof consists of membrane roof system, with incorporated insulation (R30) and mounting for several HVAC units for the offices below. The roof has three lighting monitors set into it, each approximately 11'x11' and about 5' high, facing to the south. In addition, one of the three windows in the east wall opens into an atrium; to the glazed second level and first level below.

EXISTING RATINGS

The existing building at 400EPS was compared with the standard of other similar buildings across the United States. This was accomplished with the help of the US Environmental Protection Agency (USEPA), the US Department of Energy (USDOE) and the Energy Star website (www.energystar.gov) and their Target Finder tool. Target Finder has estimated 400EPS, or a building very much like it, to have an Energy Use Intensity (EUI) of approximately 58 kBtu/sqft/yr, using 4,500,000 kBtu of energy per year. To reduce that use to District 2030 levels, the EUI of 400EPS would need to drop to 29, or 2,521,000 kBtu/sqft/yr of energy every year.

In addition, the existing glazing ratio of 400EPS is rated at 28%, although that includes the nearly all brick north wall. The south wall has a ratio of just over 45%, and the west wall is rated at 36.2%. Any suggested changes would have to include lowering somewhat the existing ratios if possible while lowering the heat gain of the windows - without reducing the visible transmitted light coming in to light the space. For specific glazing ratios, please see "Appendix 6.0 - Glazing Ratios at 400 East Pine Street" on page 124.

POTENTIAL RESPONSES

The goal of any retrofitting response to this building would be to push the serviceable life of the building out another 50+ years. In addition, the building should be refitted to make it as flexible as possible with respect to the needs lessees, and to enable for future changes to its environmental systems as technology improves. Most importantly, the building

which results from the retrofit must also be able to complete with the expected new office space just two blocks away.

While on the face of it, new office space may seem like overwhelming competition, older buildings which are retrofitted have been shown to prove more competitive than new construction, as much of the “personality” of the building still exists, without the headaches of the old infrastructure and environmental systems.

In performing a deep renovation to a building such as 400EPS, hoped for success is very much linked to the existing framing of the building and the site. They are tied to the frame because it is the frame which decides ultimately how much the building can carry - and thus what type and how many future offices there may be in the building.

In this case, the frame is a very stout timber system with heavy decking for the flooring, which should greatly increase the number of potential options. Also, engineers have assured that the columns should be able to carry the weight of a light addition, as long as the seismic retrofitting is maintained and expanded from what is already there.

Three Deep Retrofit Options & More Choices

Given these types of resources, for this project there are potentially three different variations of this building that could occur under the envisioned retrofit. The following alternatives will be offered for this report, and discussion will be limited to these approaches. They are:

- Option A: A deep retrofit only of energy, lighting and associated systems and elements..
- Option B: A deep retrofit plus a rooftop edition to maximize the development potential of the property.
- Option C: A deep retrofit plus a rooftop edition to maximize the development potential of the property, plus an incision into the building, changing it's footprint and making it more unique.

The three options are very different from one another, and yet they all bring similar and different results to consider. One similarity would be common among all options, however - that the original entrance of the building (from the center bay along East Pine Street) would be restored - and that in doing this, a new

building core would be created on the north side (the rear) of the double height space.

The creation of a new building core in this manner would permit the removal of the southeast entrance, and the spaces contained within them to be returned to leaseable floor space. It would also create a grand entry into the building - something it lacks currently.

The layout of the three option plans above are also made in conjunction with a number of different configuration choices available to the building owner, regardless if they choose Option A, B or C. For the sake of brevity and clarity, the color coding has been reduced to either office leasing and service or retail leasing. Service and retail can assumed to be anything from the English language school (service) at is located at 400EPS presently, to a retail shop, restaurant, or small coffee shop in the front of the building. Please see the floor plans for more information (Figure 5.9 on page 60 to Figure 5.21 on page 65).

Common Retrofit Elements

To reduce the EUI of 400EPS, a number of changes would be made to the building - all of which would be common across the three different choices:

- Increasing roof insulation to R60 from R30
- Separation of ventilation and the heating/cooling system of the building; in combination with highly efficient (85%) heat recovery systems or heat exchangers, such as the DP Series by Semco Corporation. (Figure 5.32 on page 74)
- New Heating & Cooling: Replacement of existing HVAC systems with new more efficient systems, including hydronic and chilled beam technology.
- Increased use of daylighting in offices by expanding the daylighting zone, and reduction of lighting with perimeter switching systems to turn lights off when sufficient daylight exists. (Figure 5.31 on page 73)
- Shading Devices & Light Shelves: The south and west glazing will have new shading devices added, overhanging the windows to reduce the incidence of direct summer sun into the interior spaces of the building (see South Elevation on Figure 5.23 on page 66). The shading devices will incorporate both a shade for the window, and an interior light shelf to reflect summer sun deeper into the interior of the building (Figure 5.31 on






Section .V - 400 East Pine Street - Case Study



Figure 5.3 – Plan of Level 1 - Existing Building
Scale: 1"= 40'-0" Source: Author



Figure 5.4 – Plan of Level 1m - Existing Building
Scale: 1"= 40'-0" Source: Author

Leasable: Office =		Leasable: Residential =		Utility or Common =	
Leasable: Svc or Retail =		Circulation =			

Section .V - 400 East Pine Street - Case Study

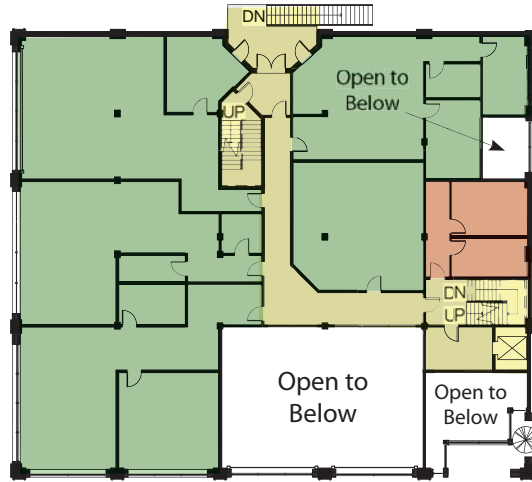


Figure 5.5 – Plan of Level 2 - Existing Building
Scale: 1"= 40'-0" Source: Author

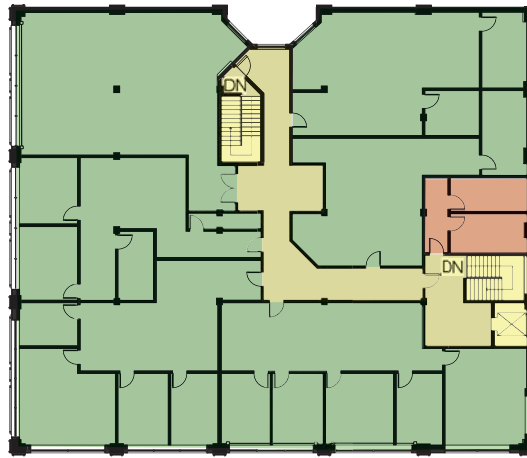







Figure 5.6 – Plan of Level 3 - Existing Building
Scale: 1"= 40'-0" Source: Author

Leaseable: Office =		Leaseable: Residential =		Utility or Common =	
Leaseable: Svc or Retail =		Circulation =			

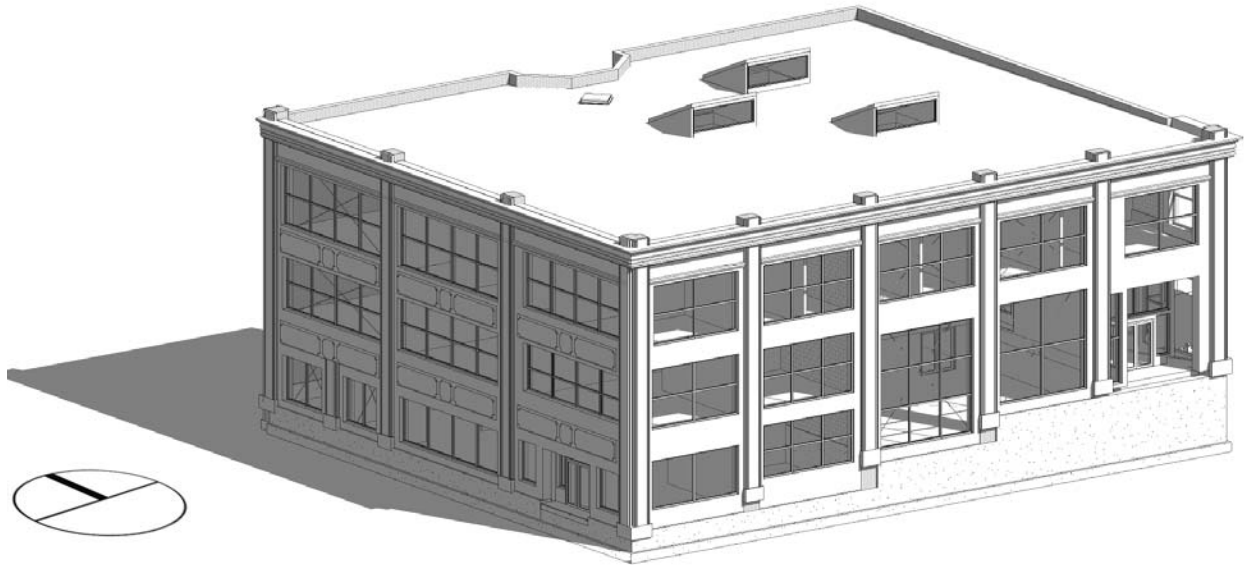


Figure 5.7 – Axonometric View - Existing Building
No Scale. Source: Author

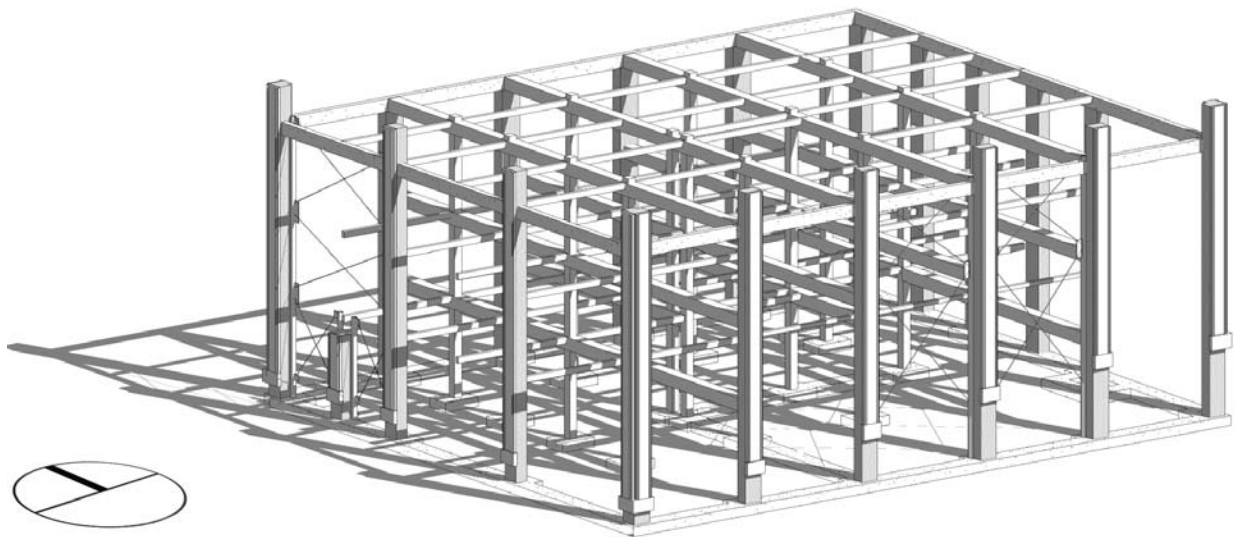


Figure 5.8 – Axonometric Structural View - Existing Building.
No Scale. Source: Author

Section .V - 400 East Pine Street - Case Study

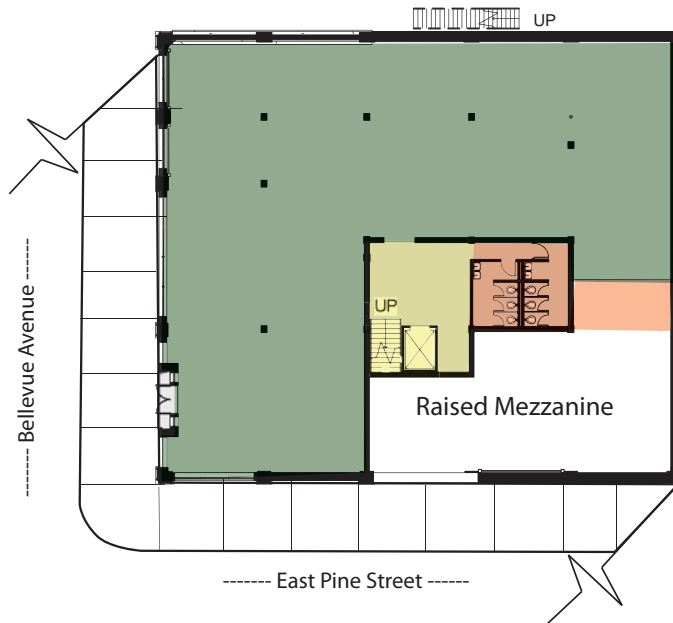







Figure 5.9 – Plan of Level 1 - Option A or B.
Scale: 1"= 40'-0" Source: Author



Figure 5.10 – Plan of Level 1m - Option A or B.
Scale: 1"= 40'-0" Source: Author

Leaseable: Office =		Leaseable: Residential =		Utility or Common =	
Leaseable: Svc or Retail =		Circulation =			

Section .V - 400 East Pine Street - Case Study

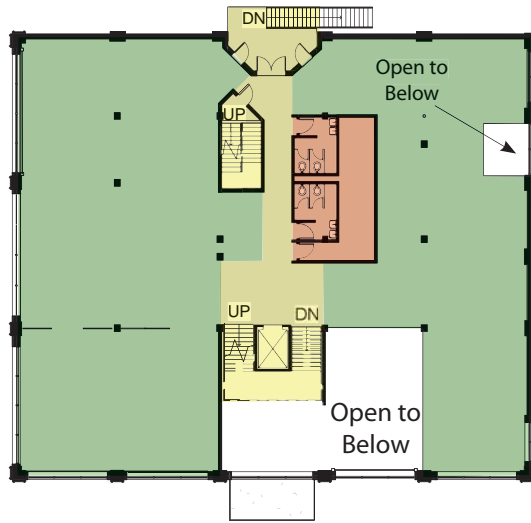


Figure 5.11 – Plan of Level 2 - Option A or B.
Scale: 1"= 40'-0" Source: Author

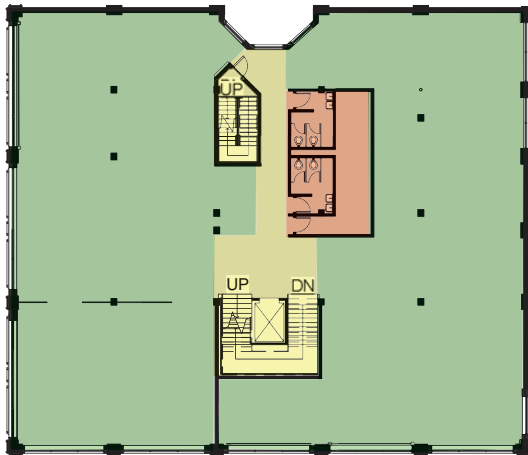







Figure 5.12 – Plan of Level 3 - Option A or B.
Scale: 1"= 40'-0" Source: Author

Leaseable: Office =		Leaseable: Residential =		Utility or Common =	
Leaseable: Svc or Retail =		Circulation =			

Section .V - 400 East Pine Street - Case Study

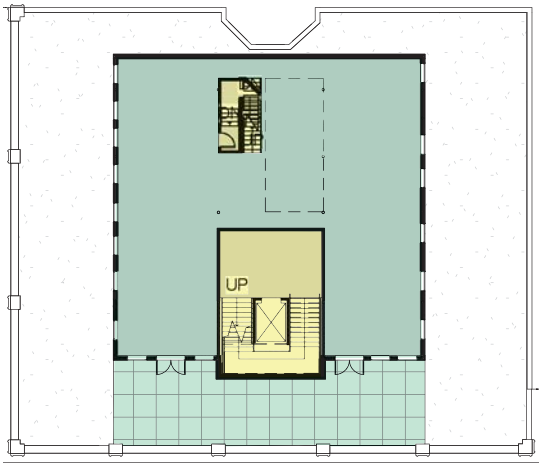


Figure 5.13 – Plan of Level P1 - Option C.
Scale: 1"= 40'-0" Source: Author

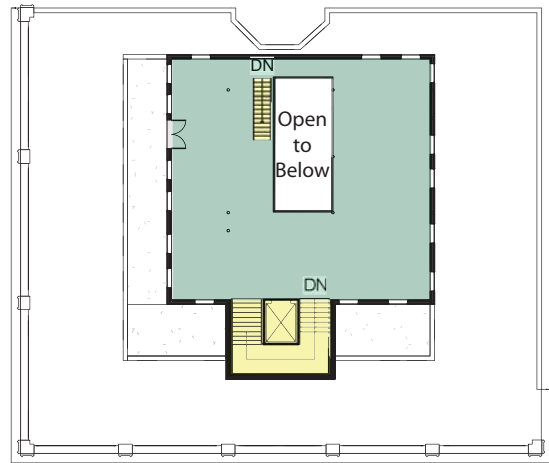







Figure 5.14 – Plan of Level P2 - Option C.
Scale: 1"= 40'-0" Source: Author.

Leaseable: Office =		Leaseable: Residential =		Utility or Common =	
Leaseable: Svc or Retail =		Circulation =			

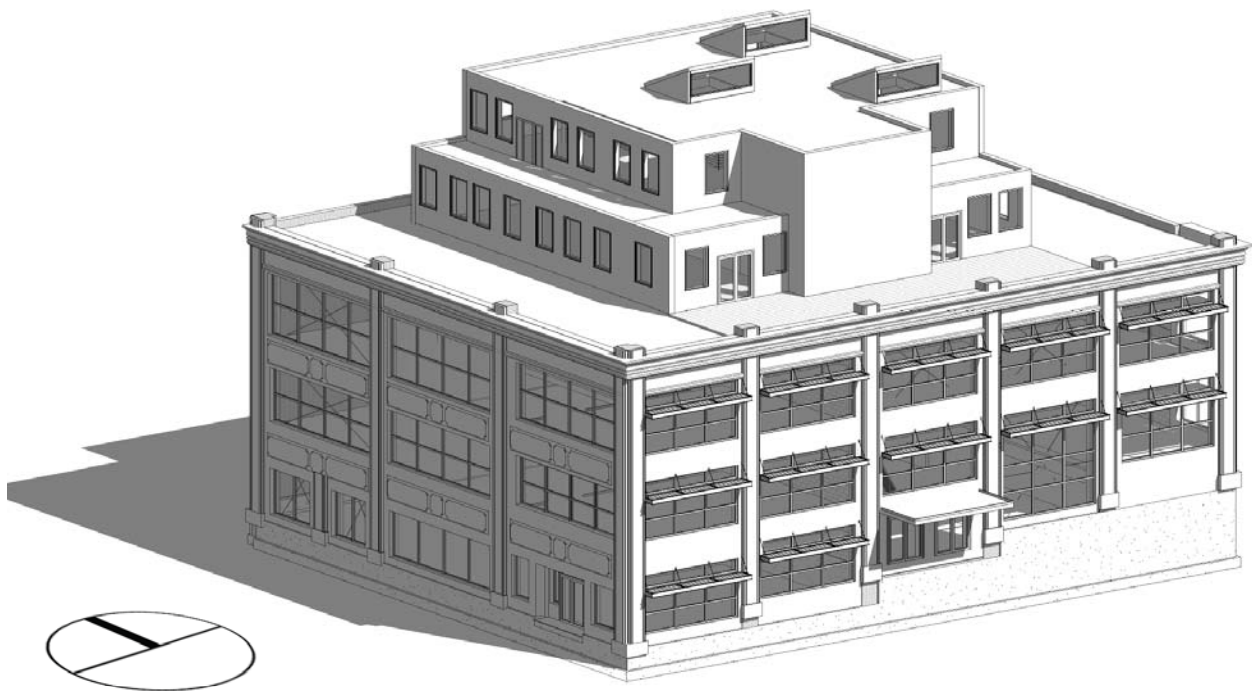


Figure 5.15 – Anaxometric View of Option B.
No Scale. Source: Author

Section .V - 400 East Pine Street - Case Study

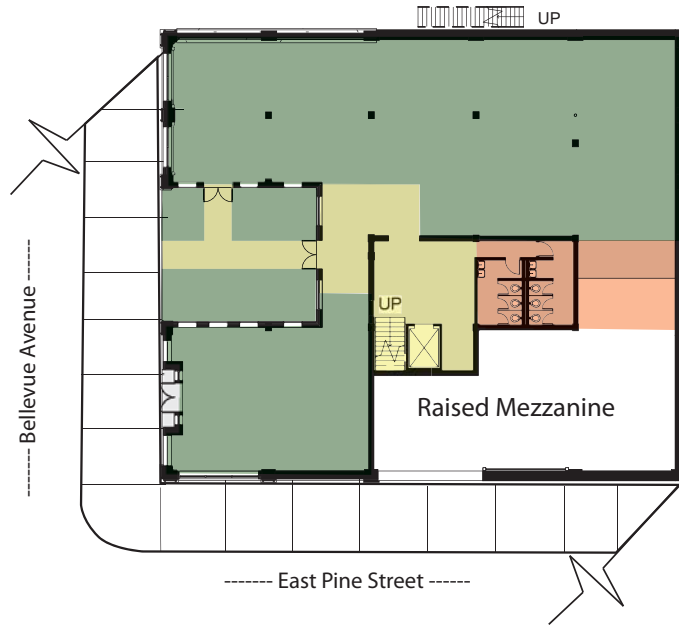


Figure 5.16 – Plan of Level 1 - Option C.
Scale: 1"= 40'-0" Source: Author



Figure 5.17 – Plan of Level 1m - Option C.
Scale: 1"= 40'-0" Source: Author






Leaseable: Office =		Leaseable: Residential =		Utility or Common =	
Leaseable: Svc or Retail =		Circulation =			



Figure 5.18 – Plan of Level 2 - Option C.
Scale: 1"= 40'-0" Source: Author.

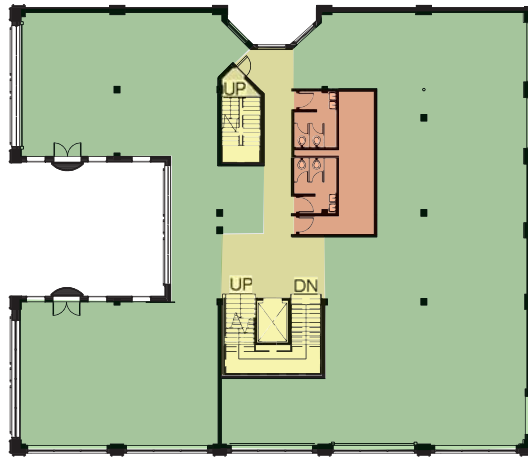







Figure 5.19 – Plan of Level 3 - Option C.
Scale: 1"= 40'-0" Source: Author

Leaseable: Office =		Leaseable: Residential =		Utility or Common =	
Leaseable: Svc or Retail =		Circulation =			

Section .V - 400 East Pine Street - Case Study

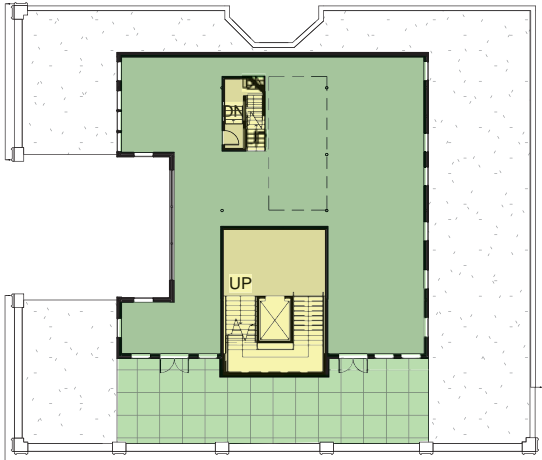


Figure 5.20 – Plan of Level P1 - Option C.
Scale: 1"= 40'-0" Source: Author

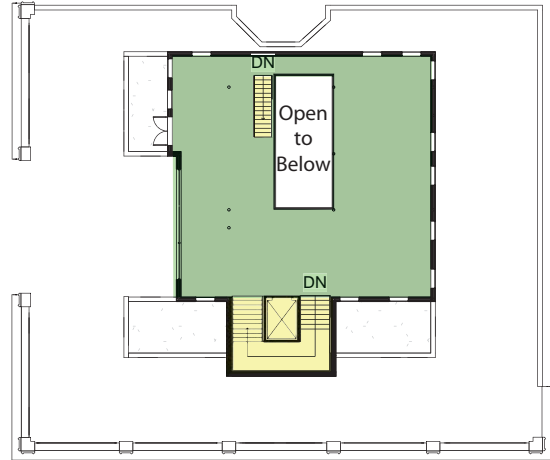


Figure 5.21 – Plan of Level P2 - Option C.
Scale: 1"= 40'-0" Source: Author.



Leasable: Office =		Leasable: Residential =		Utility or Common =	
Leasable: Svc or Retail =		Circulation =			

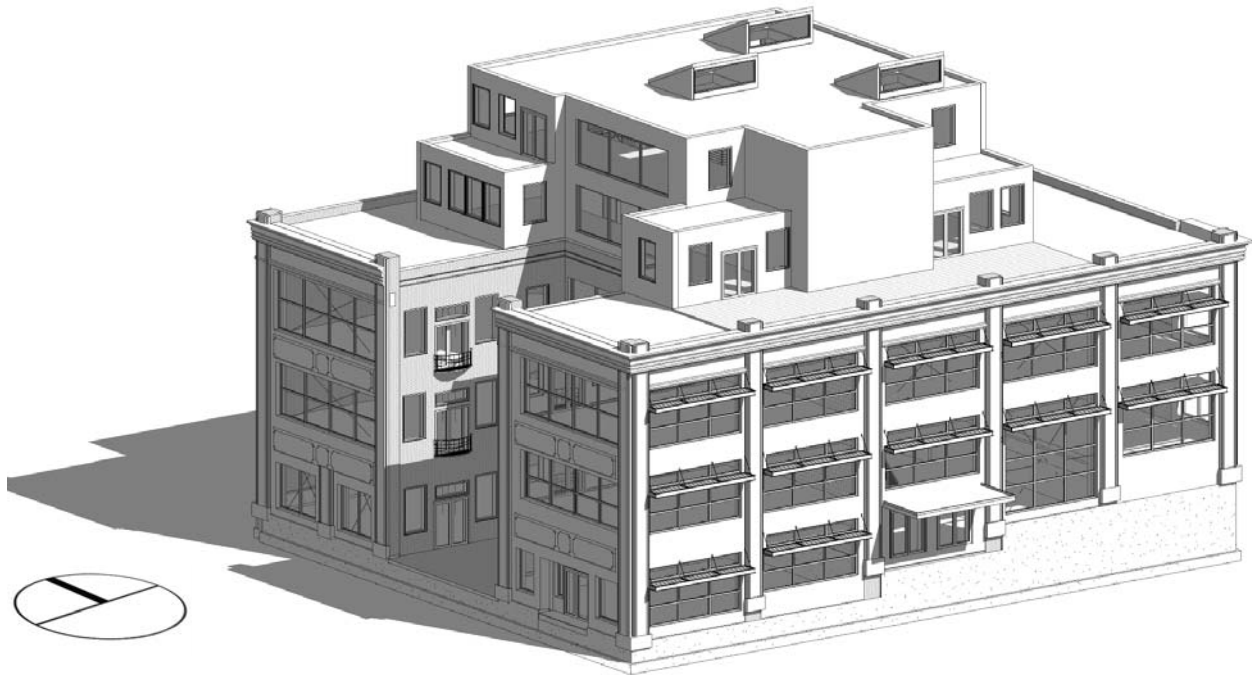


Figure 5.22 – Axonometric View of Option C.
No Scale Source: Author

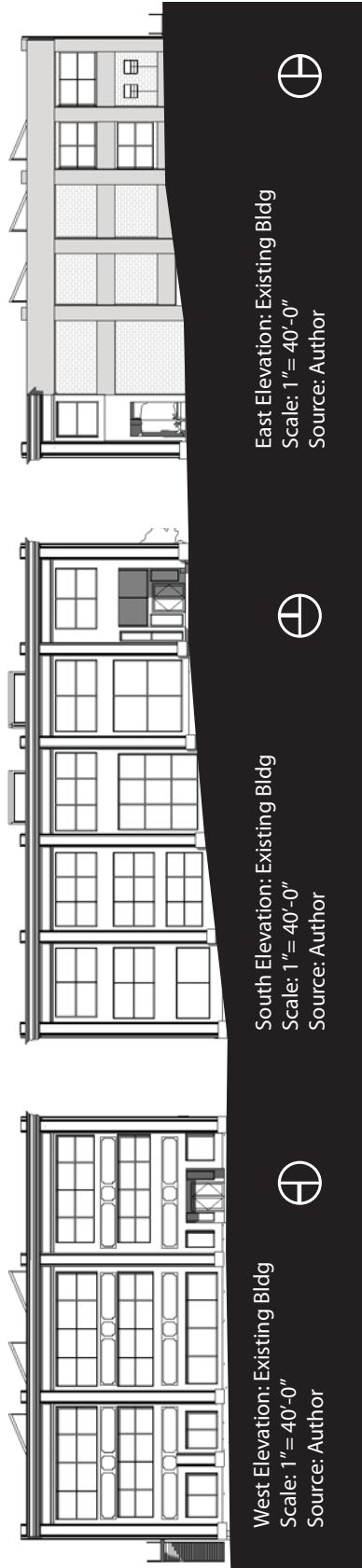


Figure 5.24 – Three Elevations of existing building.

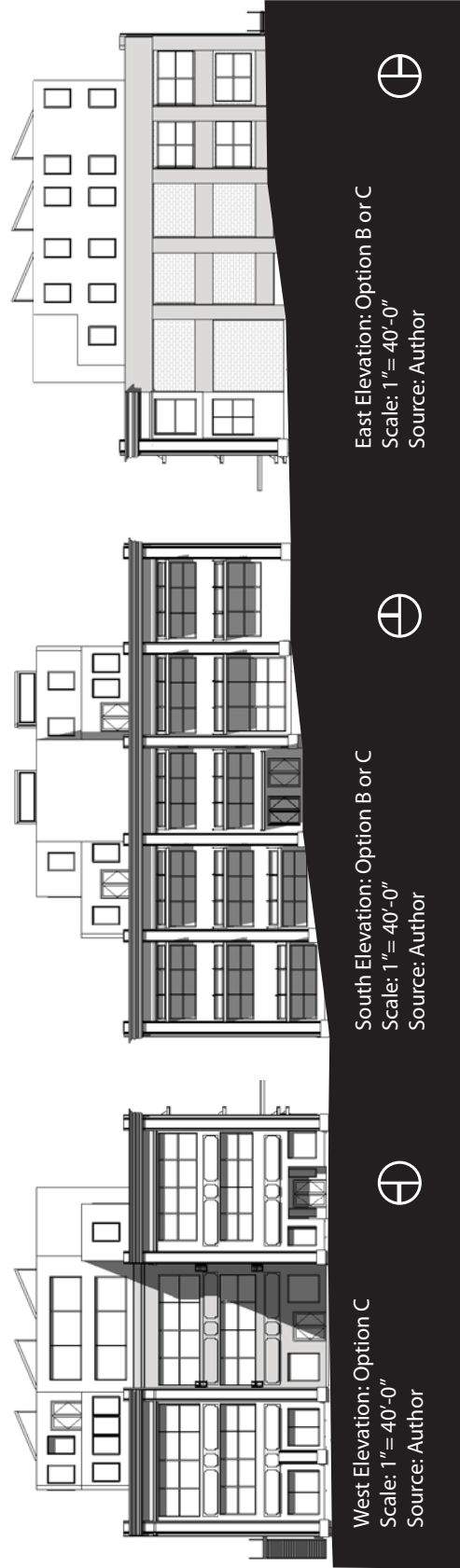


Figure 5.23 – Three Elevations of proposed retrofitting/addition options



Figure 5.25 – Section - Cut E/W - Looks South - Existing Building Stairwell. Scale = 1" = 20'-0" Source: Author



Figure 5.26 – Section - Cut E/W - Looks South - Option B, at New Core. Scale = 1" = 20'-0" Source: Author

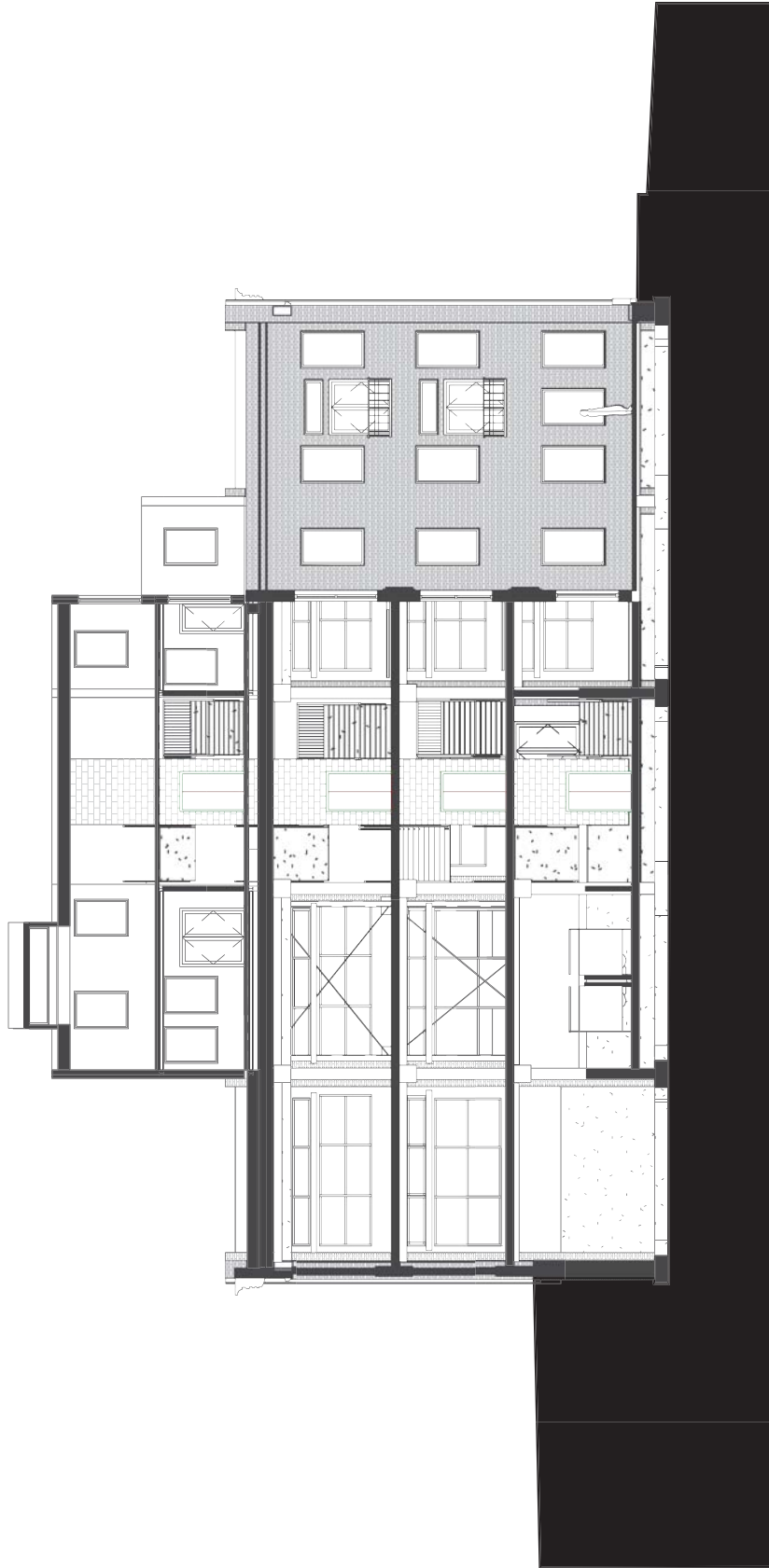


Figure 5.27 – Section - Cut E/W - Looks South - Option C, at New Core and Courtyard. Scale = 1" = 20'-0" Source: Author

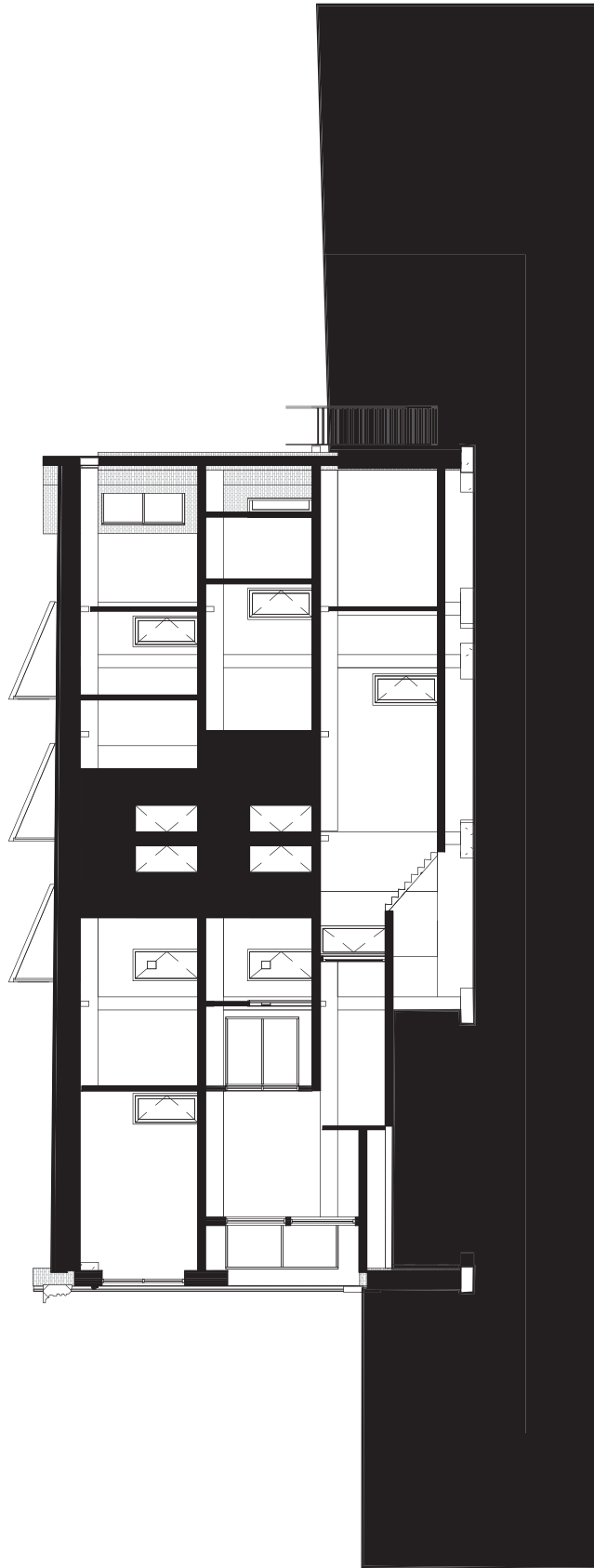


Figure 5.28 – Section - Cut N/S - Looks West - Existing Building, at East Entrance. Scale = 1" = 20'-0" Source: Author

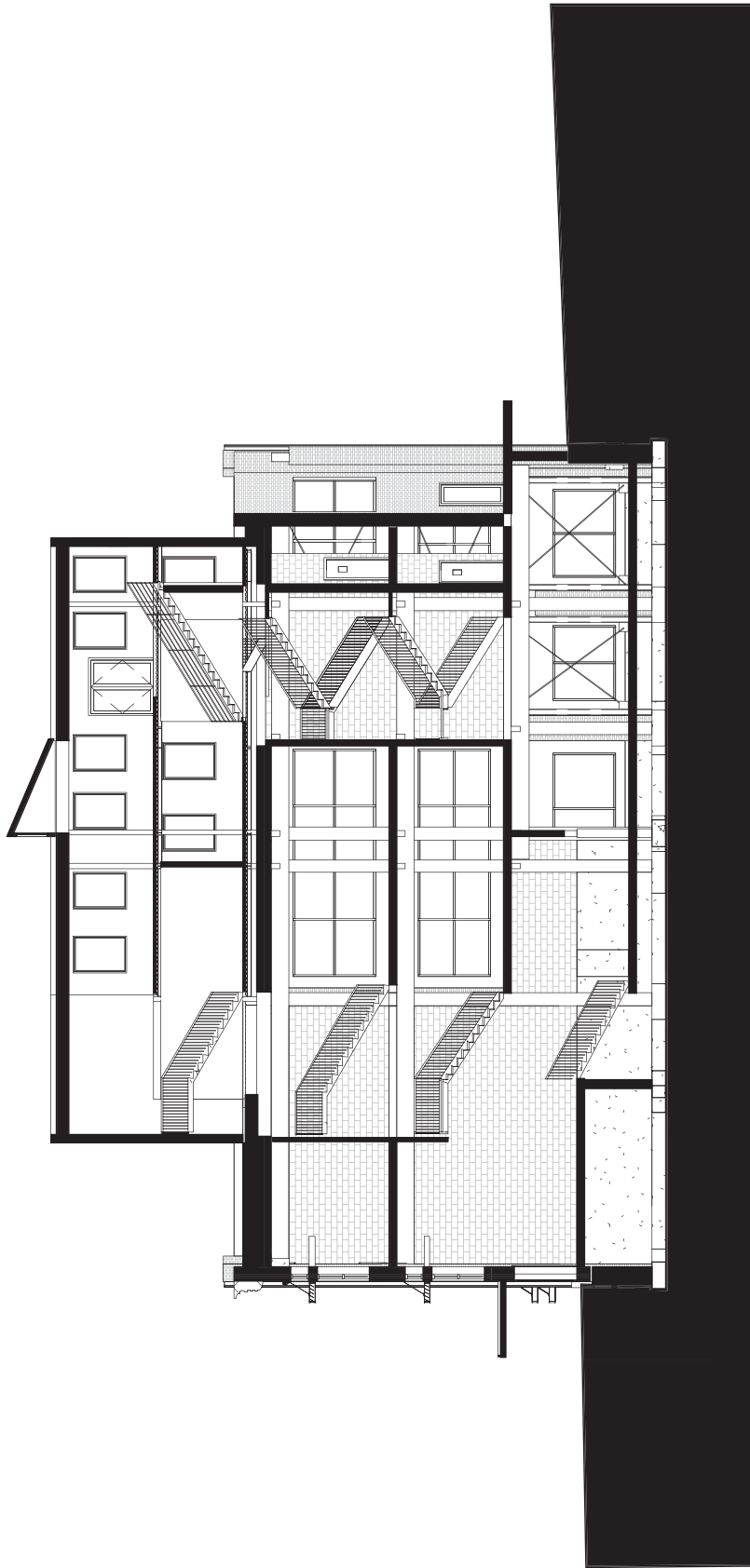


Figure 5.29 – Section - Cut N/S - Looks West - Option B, at New Core. Scale = 1" = 20'-0" Source: Author



Figure 5.30 – Section - Cut N/S - Looks West - Option C, Just Before Courtyard. Scale = 1" = 20'-0" Source: Author

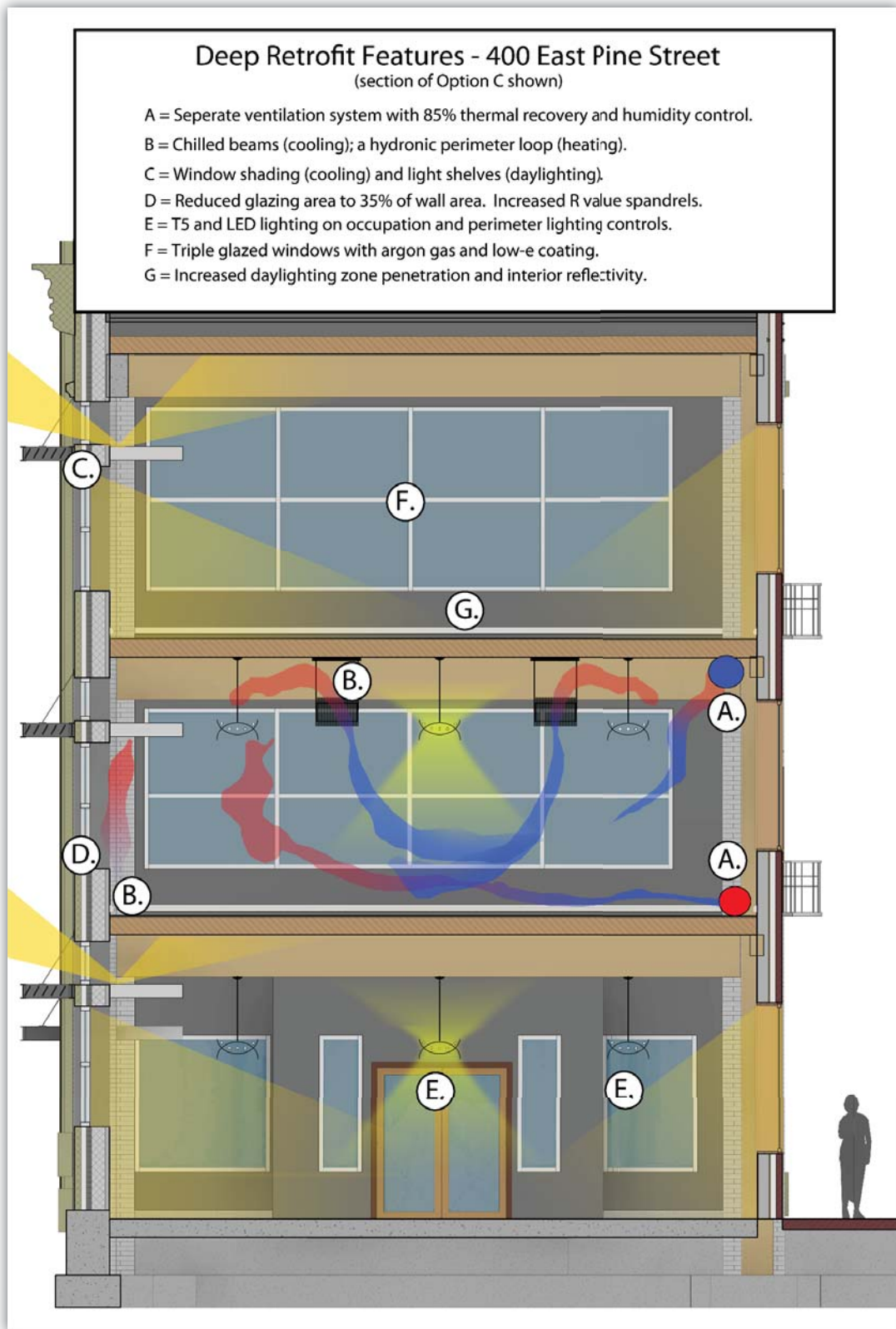


Figure 5.31 – Sectional View (Option B, south wing, looking west) of Environmental Package Functions.
Source: Author

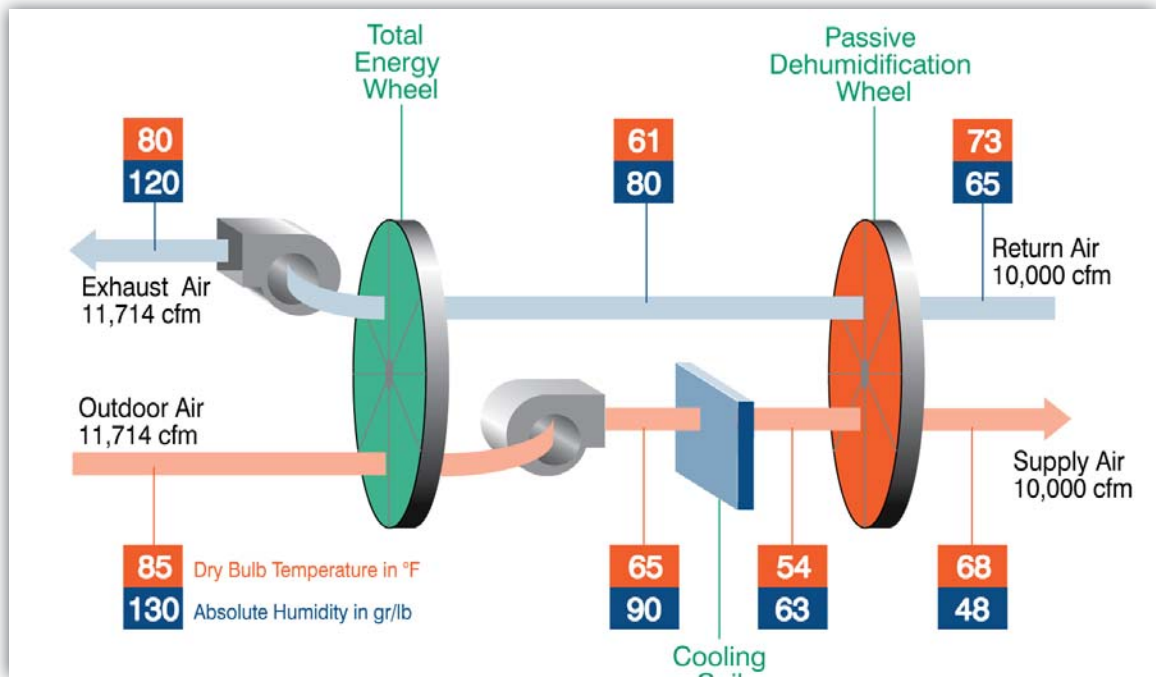


Figure 5.32 – Semco DP Series Heat Recovery and Dehumidification System. Source: Semco Corp.

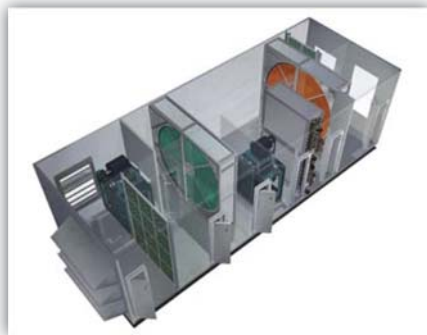


Figure 5.33 – Semco DP Pennicle Air Handling Unit. Source Semco Corp



Figure 5.34 – Semco Airstack air-cooled heating cooling roof unit. Source Semco Corp

page 73).

- **New Vertical Glazing:** Replacing all vertical glazing with more highly efficient low-e, argon filled, triple-paned glazing. The new windows would have a higher U factor, a higher heat gain coefficient, and a higher visible light transmittance rating. These qualifications are to ensure that the window is thermally stable (transfers little heat/cold), but is able to allow in winter sun for added warmth and visible light for day lighting the interior.
- **Reduction of vertical glazing area to 35% of the wall area -** by increasing the spandrel height 1' to 1.5'.
- **Potentially:** Addition of rooftop photovoltaic (PV) cells to generate/augment systems energy during sunny periods of the year.

In reviewing the potential responses to retrofitting 400EPS, the changes above will be assumed, and will be referred to as the "environmental package".

Option A: Deep Energy Retrofit Only

This retrofit option would be the least invasive of the building itself - and would essentially leave the same footprint and generally the same available floor area that was available before the retrofit. There would be one big change, however; the entire environmental infrastructure of the building and its glazing would be replaced, making it far more efficient than it is today.

In addition, the following would be included:

- **Old Bay - New Entrance:** The building's primary entrance on East Pine Street would be returned to its original location: in the middle bay of the south wall. Two sets of doors would be installed, and the new lobby will consist of the new core (below) and an area for small retail, such as a coffee shop.
- **Old Entrance - New Bay:** The old entrance from East Pine Street would return to being a single bay in the south wall. It would carry a spandrel, and be glazed in accordance with the other windows.
- **New Core:** The building would be gutted to the frame and existing spandrels and a new core consisting of a six foot wide stairway wrapping around an elevator shaft would be established at

the center.

- **New Environmental Package**

Option A would permit the owner of the building to essentially enjoy nearly the same leasable area, in a building with much great efficiency. The exterior of the building would change little with the exception of the shading devices and new windows and front door location.

The plan views show Option A, indicating on each level the available space for lease, circulation, and utilities (Figure 5.9 on page 60 through Figure 5.12 on page 61). The new circulation path on the second and third levels would be greatly simplified over that of the existing building and would actually take up less leaseable space.

Option B: Deep Retrofit + Rooftop Addition

Option B would have all the features of Option A, however it adds something to the very structure and mass of the building: two additional floors in a roof-top penthouse, of nearly 5900 sq ft.

Since 400EPS is only 20' below the maximum height limit for its zoning area, adding a two story penthouse would provide the owner with additional rental income, and make the building more unique than similar buildings of this type (Figure 5.23 on page 66). Although it would require 400EPS to be re-seismically retrofitted to carry the additional load placed upon the existing column grid, it has been deemed structurally sufficient to carry a light two story structure.

The penthouse is envisioned to be a light weight steel structure, with pan steel and 3" slabs of lightweight concrete floors (Figure 5.27 on page 69). It is shown in the plans for use as either an additional two stories of private offices, a conference center or even as a private residence.

Option C: Deep Retrofit + Addition + Notch

Option C would have all the features of Option A and B in that it has the deep retrofit, and adds the 5900 sq ft of additional floor space with the rooftop penthouse. This option however, also cuts a notch into the existing structure of the building - on the west side, pushing the middle bay back into the column grid two full spans. The cut removes about 2700 sq ft of interior office/retail/service space, but adds a 900 sq ft outdoor courtyard, protected on three sides (Figure

5.16 on page 63 through Figure 5.22 on page 65).

This move is suggested as a way in which to create a unique space in an existing character building; something unexpected for pedestrians turning the corner; perhaps creating a unique venue for a restaurant or bar. The move also allows the west end of the building to be configured into two wings, either as smaller leasable areas for retail (on the ground level) or as private office suites.

The notch cut into the west side building maintains the same window pattern as the remainder of the west side, while the north and south facing walls have punched windows on a brick facade. The west facing wall of the courtyard continues up seamlessly five stories - visually uniting the lower and upper buildings.

CONCLUSIONS

The property at 400 East Pine Street, in choosing the type of deep retrofit it will pursue, has the option of going one of three ways. Two of the choices involve either rooftop addition or a rooftop addition in conjunction with a notched west wall. The choice of any of these options would result in a more energy efficient building regardless, so the real consideration for the building lays in the original goal of the project: making the building competitive, adaptable and commercially viable for the next 50 years.

If Option A were chosen, the building would compete head-to-head with other older, newly updated buildings within the Pike-Pine Corridor, pretty much as it does currently, but would do so far more efficiently.

If Option B were chosen, it achieve those results of Option A, but with the added additional leasable floor space of the rooftop addition - configured for either commercial or residential use.

Finally, if Option C were chosen, it would also achieve the results of Option B - but the plan would also result in a notched west wall - making the building more unique and somewhat different than its competitors.

In considering these facts, the most obvious issue would be that while a notched wall would add some unique quality to to the building, it probably would not be enough to command higher rents, and thus offset the loss of total floor area - and contiguous floor space within the existing floor plate. Accordingly, Option C is probably not justified as a realistic design

option; thus leaving the only the rooftop addition to consider.

In the end, the true nature of the competitive qualities 400EPS possesses stem from its location, character, floor size (both contiguous and total), and its ability to adapt to the needs of new and potential future clients. By creating a new core, relocating the primary entry to the center, and creating a double height atrium/entry, the building's layout would no longer seem as confusing and in fact be a more pleasant place in which to visit or work.

The issue of the buildings total square footage is really beyond the control of the facility (beyond the addition), and so it is less of a factor of consideration. For the sake of this argument, the primary competition that 400EPS faces are assumed to be from buildings of roughly its same size and character.

From that standpoint, while the creation of an rooftop addition would contribute additional leasable space to the building, the most significant change such an addition would bring would be to build out the remaining development envelope; dampening any pressure for redevelopment of the site (400EPS is not a historic building - just a PPC 'Character Building' so redevelopment is a possible option).

Thus, since Option B does not detract from the other qualities of 400EPS, (assuming the design and construction are good), an addition can only be seen as positive, and would be the option to support.

SECTION .VI - CONCLUSION & DISCUSSION OF FINDINGS

Section Summary

This section summarizes the findings and conclusions from the analysis described in the preceding portion of this report, and provides recommendations to make Seattle's building stocks more energy efficient.

DISCUSSION OF FINDINGS - STATEMENT OF FINDINGS FROM ANALYSIS

The Continuum and Its Elements

There is no one trigger - but rather a series of triggers which exist in the decision making process along the Raze-Retrofit Continuum for any given commercial property - and those decisions depend to a great extent upon various property profile factors such as:

Method of Construction: The methods and materials that were used in the original design and erection of any given commercial structure can have profound impacts upon the decision making to raze or retrofit.

Period of Construction: The given nature of construction during different periods in time often drives the list of typical features found in buildings due to the era in which they were built.

Owner Intentions: The decision to invest or divest from a particular property is directly associated with the owners own goals - and those goals are the primary driver in how a owner chooses to respond to the call to retrofit their building or redevelop it.

Area Influences: The given the nature of the ownership, the surrounding district or neighborhood and the direction it is choosing (with respect to development) can influence that decision making significantly.

City/Policy-Based Influences: The policies or intentions of city government can influence or change what an owner decides to do with a particular property.

In addition, for most owners, the decision to raze or retrofit depends on expectations of return on their investment; the relationship between the property held and the mission of the owner/organization; and the changing influences/factors in the environment surrounding that property. Consequently, the utilization of property profiles - such as those used in this report - can be a valuable tool to ascertain the direction the property is taking relative to that decision.

Likely Outcomes for Existing Stocks:

Based on the profiles of Seattle's commercial stocks developed for this report, it is reasonable to conclude that there exist large semi-cohesive groups of building types which can be categorized in ranges from "very likely to redevelop" to "very likely to retrofit". As a result, groups of properties - well beyond the "low hanging fruit" of high rises and its smaller community of owners and developers - should be readily identifiable based on existing data. While additional data - particularly that of the intentions and/or missions of the property owner - would be very useful in making these identifications, data which is currently available from DPD and KCDA provide a good starting point.

This report has also provided an example of the type of solution to improve the energy efficiency of an existing building through retrofitting and building additions. While not wholly demonstrative of all the scenarios possible, the example shows how one owner could choose to retain the existing structure of their building while at the same time improving the building's performance and mitigating some of the negative aspects of the original design.

MOVING FORWARD: RECOMMENDATIONS

Beyond the Low Hanging Fruit:

The mission of the 2030DC is to help fulfill the goals of the 2030C by encouraging improvements in Seattle's existing building stocks and to make new construction in Seattle as energy efficient as possible. To that end, the 2030DC should begin considering its direction and efforts beyond its current engagement with the larger property holders, larger management companies and larger development firms in Seattle - and begin developing a strategy to assess and engage the smaller properties which make up Seattle's majority building stock.

New construction in Seattle is required to conform to the Seattle Energy Code - one of the strongest municipal-based energy codes in the United States today. Thus, as properties turn over and redevelop, the

focus and attendant resources will need to transition toward the remaining, older properties - those which continue to operate inefficiently, but are held in place by ownership and organizations which deem them acceptable, useful or effective in their current state. Working to change the mindset/decision making of that ownership circle will enable the 2030DC to reach the goals of the A2030.

To accomplish this, the 2030DC could leverage its planned Energy Dashboard website which assesses achievement based on the degree of change the owners have been able to make. In other words, the focus should not just be in comparing the inefficient buildings to the baseline buildings in the ES database but in recognizing the improvements made relative to the effort and cost expended to make those improvements. Such recognition could provide the necessary incentive to transform poorly performing buildings into energy efficient ones.

The 2030DC could also consider taking the statistical average building typology and developing a generalized approach toward retrofitting those types of buildings, an approach that would also address the issues commonly found there. In doing so, a profile of common issues in those building types can be established, providing a roadmap of how the owner might mitigate some of the current inefficiencies of the building. Cost considerations can then be addressed, and incentives at the federal, state and local levels can be engaged in order to encourage the owner to invest more in their aging property.

Utilization of existing resources - such as those proposed by the Integrated Design Lab to have architecture students perform exhaustive building analyses at no cost to the owner - serve as an example of this concept. Additionally, permitting the sale or transfer of development rights from one group of buildings to another may also prove useful in achieving this goal, in so far as the development of income from rights never exercised (or intended to be exercised) can provide an incentive to improve the existing building.

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APPENDIX 1.0 : MANS AFFAIR WITH FOSSIL FUELS

A LONG HISTORY

If one examines the 250,000 year history of man and his use of fossil fuels, only recently in our history has intensive use/abuse of this resource been undertaken. Prior to the Industrial Revolution, fuels which were utilized by man were essentially basic in nature, and close at hand.

The sun was our first energy source - providing the heat and light that man needed to survive. The next and probably more important fuel/process used was fire - the carbonization of existing fuels that could be found to provide heat and light. The major incentive for man's use of consumptive fuels via burning was the resulting energy (in the form of heat and light) - which could be released - on demand.

As time progressed, the uses of consumptive fuels were more or less in sync with passive forms of energy - those coming from the sun, wind and water. Since crops grew only from the sun for instance, man's agricultural pursuits often combined the more passive forms of energy with those which consumed stored energy. Tasks that could be completed via passive means were often preferred in order to conserve the stocks of consumptive fuels - which were more difficult to obtain, or were more expensive to utilize.

Varying region to region, the most common consumptive fuel was wood. In various parts of the world, shallow coal deposits were discovered and utilized by the local people, largely as a substitute for wood, either because of lack of resources or because of the characteristics of burning coal (burns cleaner and longer than wood coal). During this period oil, natural gas and geothermal resources were also locally discovered at utilized on a limited basis due to issues in storage, transport and/or extraction.

In all cases, uses of consumptive fuels was predominantly a static activity - in that to burn a consumptive fuel one had to maintain a supply of it and a place to burn it - so transportation early on was limited to the more sustainable animal and wind power. Even the increased use of coal in the eighteenth and nineteenth centuries, during the First Industrial Revolution, resulted in transportation systems which were limited due to their weight and speed. The development of the steam engine during this period is a

good example, in that while it was clearly a departure from earlier forms of labor, it was still limited by its weight and output in what transportation solutions it could provide. It was not until the Second Industrial Revolution, and the development of the steel making process, and resulting steel, chemical, petroleum, electrical and (later) the automotive industries that consumptive fossil fuels began to take off on a massive scale. By the early twentieth century, liquid fossil fuels - in particular petroleum products - had established a firm foothold in human society - and their impacts were only just beginning to be felt - particularly in the United States.

The rise of petroleum products is tied largely to its ability to deliver a great deal of energy in proportion to the cost of obtaining and transporting it. Gasoline, for instance, delivers more actual work by weight than other types of energy sources. Combined with the petroleum products being easily developed, stored and transported made it a popular choice. As we'll see, it is the very nature of petroleum (or crude oil) itself - that its construction is derived from complex hydrocarbons - permitting it to be manipulated into many other forms (making other products); making it the fuel - and material - of choice.

As the twentieth century started, coal began to be pushed aside in favor of petroleum products, and the economy began to expand at an increased rate (Figure 8.35 on page 93). As the use of petroleum products increased, and the economy along with it, more fuel was demanded. The Great Depression in the 1930s blunted this advance somewhat, so until the Second World War began in 1941, coal was still the nation's predominant energy source, providing primarily heating and fuel for the train network.

As the United States entered the Second World War, the demand for petroleum products began to soar to meet the demand of the new mechanized weapons systems. Once the war ended, the oil industry was fully rooted in the American economy, and turned its attention to the civilian markets of automobiles and the built environment. Combined with the expansion in the post-war economy, the late 1940s and 1950s witnessed a dramatic increase in the nation's consumption of petroleum products. The federal highway

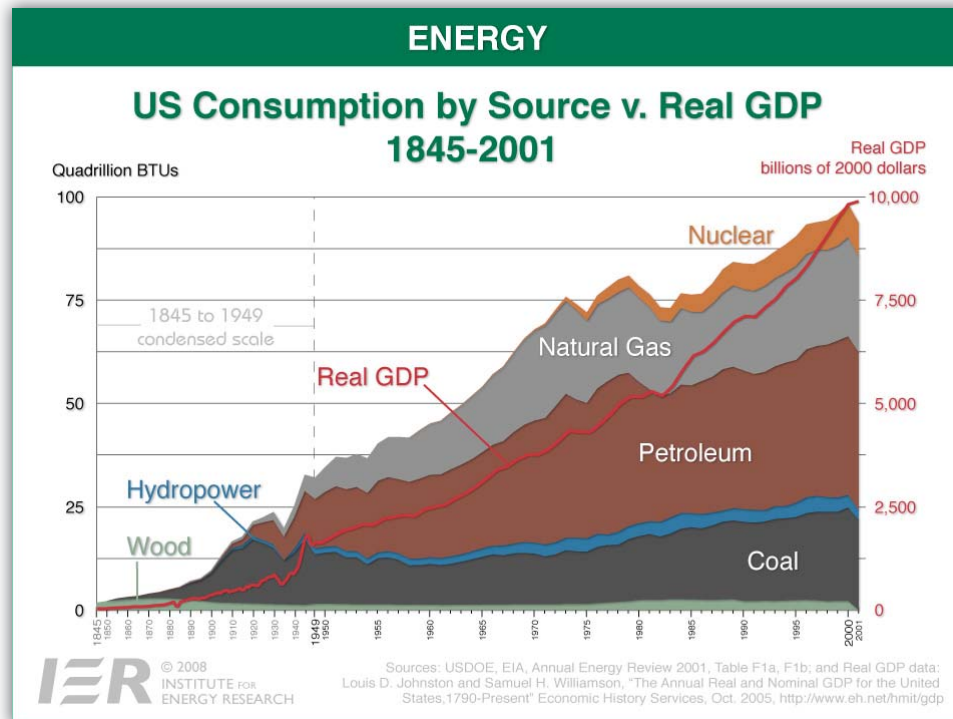


Figure 8.35 – US Energy Consumption by Source. Source: Institute of Energy Research

program of 1956 was one of most visible parts of this increase, as the roadways it constructed opened up the suburban areas around the major US cities, and made long distance commuting possible. Because of this, as the suburbs expanded, petroleum became the defacto energy source for the country's transportation network and the primary heating source for new residential and commercial buildings in the rapidly expanding suburbs. At that time, the United States was still the world's primary source for crude oil and the home of the burgeoning petrochemical industry which followed. By 1973, this would no longer be the case and the United States was superseded as the world supplier of oil by countries in the Middle East.

From October 1973 to March 1974, the United States faced an oil supply embargo by the Organization of Arab Petroleum Exporting Countries (OAPEC). Coming primarily as a response for our supporting the State of Israel during the Yom Kippur War and partially from on-going trade tensions relating to the departure of the United States from the Bretton Woods Accord, the Organization of Petroleum Exporting Countries (OPEC) dramatically raised the price of its oil from \$3 to \$12 a barrel. This action created fuel shortages, fuel rationing and high inflation (itself lasting until

the early 1980s) within the United States and other importing nations, and was the predominate cause of the US stock market crash of 1973-1974.

Following the 1973 oil embargo, the United States and other countries undertook various conservation measures to reduce the consumption of oil-based fuels. Strategies such as lowering the national speed limit, canceling of motor sports events, and Federal assistance in weatherizing and making homes and commercial buildings more efficient were common place in the United States. In Europe, more dramatic efforts were undertaken, including the banning of air travel on Sundays, rationing of gasoline and heating oil, imprisonment of those who exceeded their heating allowance and requests for home owners to only heat one room at a time.

The 1973 energy crisis also led to a greater awareness of alternative fuels and renewable energy technologies such as solar and wind power. There was also an increasing dependence on coal fired and nuclear power plants, and an increased awareness of mass transit.

By 1981, OPEC had failed to retain sole control over oil production, partially because of member-states failure

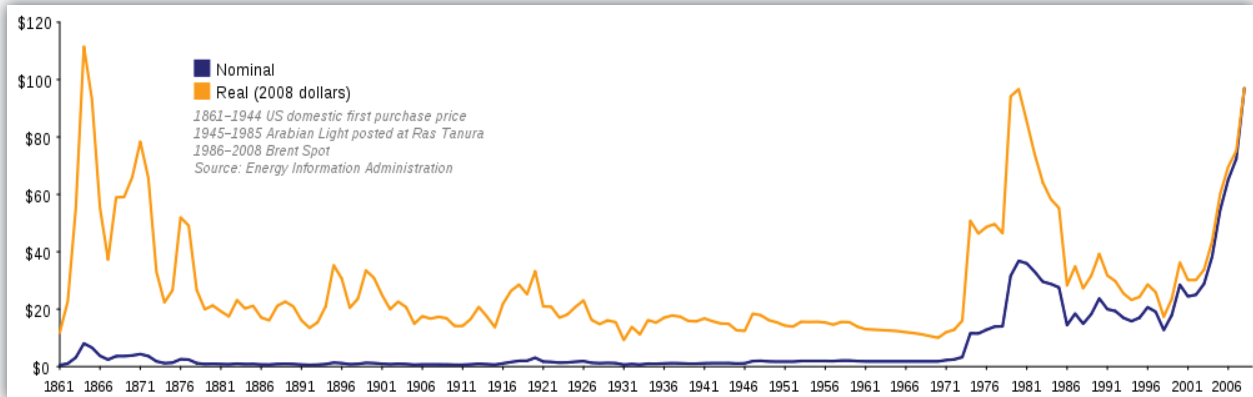


Figure 8.36 – Oil Prices 1861-2007 - In Nominal and 2008 Dollars Source: http://upload.wikimedia.org/wikipedia/commons/8/87/Oil_Prices_1861_2007.svg.

to comply with production limits, but also because of the reduction in demand from the consuming nation had greatly reduced their incomes. Also, during this period new oil deposits were discovered on the North Slope of Alaska and North Sea which, when combined with increased output of other producing nations, began the mid-1980s oil glut, with prices briefly falling back to pre-1973 levels (Figure 8.36).

Finally, with the exception of the 1991 price spike, the price of a barrel of oil stayed fairly stable, typically under \$25 a barrel, from the mid-1980s to the early 2000s. In the early 2000s, when it once again began to climb - reaching \$60 a barrel in 2005, and peaking at \$147.30 a barrel in July 2008.

MANS AFFAIR WITH FOSSIL FUELS = GLOBAL WARMING

The theory and science of Global Warming asserts specifically that the GHGs have been accumulating in the atmosphere, resulting both from the rate of accelerated burning of fossil fuels combined with an increased inability for the Earth's natural processes (such as transpiration of carbon dioxide and oxygen by the remaining forests of the planet) to keep up with the demand placed upon them. As a result, the earth captures more of the sun's energy and reflects less of it back into space – resulting in an overall increase in the average temperature of the atmosphere. That increase in turn sets up a chain reaction of reducing the amount of ice at the Earth's poles, thus retaining even more of the sun's heat, and in turn, more frozen GHGs, once sequestered in permafrost, ocean bottoms and elsewhere are released into the atmosphere.

The changes resulting from the minute increase in atmospheric temperature include the resulting less predictable and more violent weather systems;

increased desertification of some regions and flooding in others; increased sea levels resulting from the melting of the polar ice caps; the melting and dissolution of the planet's major ice sheets and glaciers; the resulting increase in crop failures and associated famines, among others. As of this writing, these relationships are in their early stages of being researched and understood, however the scientific community are in agreement that a link between Global Warming and the use/exploitation/dispensation of fossil fuels exists.

Thus, the consequences of Global Warming, and the changes it brings to the planet are considerable, and present a perilous and unsustainable condition to mankind at a level never seen before. Careful administration of our systems of industry, architecture, food supplies, city making, etc will ensure that those elements tied directly to fossil fuels - nearly everything within our societies - will minimize additional damage to the Earth and the natural systems that support us. Thus, addressing the consumption of, and dependence upon fossil fuels by man is an issue which will touch all aspects of our existence going forward.

APPENDIX 2.0 - ANATOMY OF NEED: THE REVITALIZATION OF BROADWAY

by Sean Shannon Engle

Summary

This article is one that I wrote for a planning studio in 2005 covering the on-going discussion on what to do to revitalize the Broadway corridor on Capitol Hill. The article is being placed within this paper because of its applicability in examining the decision making of property owners to redevelop or not, and what role the government plays in encouraging those actions.

Background

The Broadway Retail core - that which extends from Pike Street, north along Broadway SE to E Roy Street - has, for nearly five years, been experiencing a downturn in both sales and an erosion of its customer base. Currently, there are several large store fronts vacant on Broadway, and remaining merchants have been openly worried about declining sales and the future of their businesses. In addition, there also exists a mix of increased panhandling, homelessness and illegal drug use which has both local residents and businesses increasingly agitated.

Both Capitol Hill in general and Broadway in particular, have a history of being in flux. As recently as the 1970s, the culture of Broadway became dominated by younger, more urbane clientele, fueled in part from the presence of south Broadway's anchor, the Seattle Central Community College (SCCC). The eighties and nineties witnessed an increase and legitimization of the 'Culture of Broadway', with city tourist guides and newspaper articles touting the area as the 'hippest' and 'most happening' area in all of Seattle.

The 2000 downturn in both the national and local economies brought this period of Broadway to an end, however. The youth-oriented culture of Capitol Hill gave way to a seedier culture, creating a self-fulfilling scenario of a low demand retail mix, resulting in fewer shoppers, which prompted more businesses leaving, sending the district into further decline.

In October, 2004 Seattle Mayor Greg Nickels proposed legislation aimed at motivating private sector redevelopment of the Broadway business district. The history and source of the motivation, or need, of the legislation is the subject of this paper. Here I attempt to provide the reader with a sense of understanding in how the need for these policies came to be, and in doing so, assist the reader in determining if the suggested policies are an appropriate treatment for what ails Broadway.

The Initial Period: 1977-2001

As late as the 1965, the Broadway business district was impacted by the youthful culture of the existing high school and technical schools that were located at the foot of Broadway. In the mid 1970s, the SCCC was rebuilt to the large brick building we know today. With a substantial enrollment and no parking garages, one of the primary issues found in the 1977 Broadway Business District Study was the lack of parking, and its negative impact on merchants. At the time, the suggested approach to resolving this issue was the construction of two SCCC parking garages, and some other measures designed to create a definitive boundary or edge between the SCCC and the business district to the north.

These changes were implemented, and the SCCC-related parking issues somewhat abated. These issues did not impact the cultural character of the residents of the Broadway area, however. The area immediately around the Broadway district has a large youthful population component. Related somewhat to the presence of the SCCC at the south end of Broadway, and Cornish College at the north end, this youthful element is largely what has driven the translation of business on Broadway for the past three decades.

During the last seventies series of public investment mentioned above, Broadway was largely 'spruced up' with efforts such as a tile motif running along the store fronts, a series of decorative bronze 'dance steps' mounted into the side walks and new street-scapes and furniture. Significant improvements, such as the burying of telephone and power lines was also undertaken at this time.

Between the mid/late 1980s and mid/late 1990s the influence of an increasing gay population was most keenly felt on Broadway. Indeed, as an additional cultural group, the gay population on Broadway actually exerted a 'moderating' influence, and permitted the area to thrive as a 'counter-culture' district, and yet still manage to promote commerce

among many of the shops, who were catering to an increasingly narrow segment of the market. This combined with the roaring economy of the mid/late 1990s, created a 'funky-but-safe' atmosphere on Broadway that became its high water mark.

By the very late 1990s the culture on Broadway began to shift again. The aging population, with its increasing affluence, began leaving the district for other parts of Capitol Hill or the city and beyond, largely leaving a youthful, pierced-and-tattooed-counter-culture behind it. At this time, Sound Transit began looking at Broadway as a area for a light rail station, creating a cooling effect upon development/redevelopment (due to the uncertainty) and increasingly existing projects were shelved.

At the same time, sky-rocketing commercial leasing rates were forcing many of the mom and pop niche stores to leave Broadway, taking the 'friendly-yet-independent' flavor of the area with it. Inexpensive retail outlets and fast food restaurants moved in, attracting a still-younger crowd, one not associated with the SCCC, including many teen runways and homeless youth. The public street life began to exert more of a negative influence (an increase in public drunkenness and drug use, aggressive panhandling, overflowing dumpsters, and a low perception of police presence), adding more fuel to the exodus of businesses from Broadway.

The Transition: 2002-2003

In early 2002, the Businesses on Broadway organization (BOB), managed by Monica Mo in coordination with the Business Improvement Area (BIA) established by the Seattle Office of Economic Development (OED) was closed due to financial irregularities.

BOB had been a force on Broadway for more than a decade, working with local business owners and residents as a liaison between them and the City of Seattle. Funding for BOB came from the BIA funds levied from local businesses owners, and in 2001, with the national economy in decline, the City of Seattle faced a shortfall in its revenue. When BOB began posting debt of more than \$90,000, and began having trouble paying its creditors, the end came swiftly. BOB was disbanded, and the funds from the BIA were re-routed by the OED to Shirley Bishop, Inc - a financial management consultancy, who engaged the rate-paying business owners directly.

The recession of the early 2000s turned City Hall's

attention away from Capitol Hill and the Broadway district. With BOB removed, the representation of the needs of the residents and remaining businesses on Broadway was less substantial than those of other districts. Accordingly, when the few dollars that were available were dispensed, Broadway on Capitol Hill was overlooked in favor of locations such as Northgate, University Village and Fremont.

At the same time, more businesses continued to leave Broadway, and those that remained faced an ever increasing number of vagrants and drug addicts. Customers, afraid of confronting such issues began to stay away from the few remaining businesses that could support their needs (for basic goods, like clothing, shoes, etc), and instead chose to shop downtown or other locations. Because of the loss of customers, those businesses, in turn, left Broadway, further worsening the problem.

Commercial leasing rates on Broadway had not fallen, reflecting this loss, and were/are still among the highest in Seattle. Local residents began to complain of being unable to find the products they seek on Capitol Hill. The BIA membership made efforts to improve the business climate during this period, by utilizing funds available from the city to clean up the area and make it more attractive to shoppers, etc - all to no avail.

By early 2003, the call for City Hall to do something was becoming hard to ignore. The public on Capitol Hill, and the Broadway area specifically, began complaining openly that they were being ignored and overlooked. The membership of the Broadway BIA was unhappy as well - and demanded equal attention with the other districts of the city. Later that year, the city took notice of the issue, and acted.

That year, the city had the Gardner-Johnson consulting firm do an economic analysis of the vitality of Broadway and make recommendations. The study cited the issues of height and parking restrictions, split block zoning as the primary stumbling blocks to development. They recommended, among other things, a package of incentives (including the reduction of the mentioned restrictions mentioned above) in an attempt to jump-start development/redevelopment along Broadway. The report also mentioned a saturation of retail space on Broadway, indicating that retail redevelopment might run into roadblocks where there no additional revenue source (that whatever was developed would have to draw revenue from multiple

sources to be successful).

These include the removal of split-block zoning established in the 1970s, the increase of height restrictions along Broadway from 40 feet to 65 feet, and a reduction in the parking requirement in new development from 1.1 cars to .80 cars per unit. The report stated that only with the increase in height could the development of the area become economically viable for the private sector.

A New Vision: 2004 to Present

On November 23, 2004, Seattle Mayor Greg Nickels put forth a package of legislation aimed at jump-starting Broadway. Based largely on the Gardner-Johnson report, this package aims to generally roll back the restrictions that developers (not to be confused with the business operators or residents) have been citing as the reason for their avoiding the district, including those on building height and parking restrictions.

Since that time, a number of public hearings have been held, and while there has been some reservation at the reduction of the height/parking restrictions, the public, largely out of desperation, seems willing to go along with the changes. It would seem that most of the residents and business owners are more concerned about the lack of economic vitality and presence of crime than they are concerned about what outcome the regulation changes might bring.

This is in contrast to the Broadway of 1999 when discussion of development spurred strong opposition.

On May 3rd, 2005 another public hearing was held for the revitalization plan, and while some questions were raised, the overall environment was a positive one. As mentioned above, while there was some concern over the height issue, most at the meeting seemed more concerned about having changes made as soon as possible.

At that meeting, Seattle developer Bob Burkheimer stood to address Seattle City Councilman Peter Steinbrueck. Referring to his idle QFC property on Broadway, and its blank (and now tagged) wall, he exclaimed "...like that blank wall? Well, you get to keep it!" Developers like Burkheimer let it be known that they had no intention of considering properties like the old QFC site (Figure 9.37) for redevelopment until the city passed the zoning changes contained in Mayor Greg Nickel's revitalization package. Eventually, Burkheimer would get his way (Figure 9.38 on page 98).

On May 9th, the City Councilman Steinbrueck proposed some amendments to the legislation which should address the few residents concerns cited on May 3rd. These included, among other things, an amendment to require 20% affordable housing (for those below the 60% of median income cut off) in developments of 65 feet for a period of 50 years, upper



Figure 9.37 – Bob Burkheimer's old QFC supermarket on Broadway, May, 2005. Source: Author



Figure 9.38 – The Old QFC Site on Broadway - 2009, now the Joule Apartments complex. Source: Essex Property Trust, LLC

level setbacks to ensure access for light and air, and a codified linkage between the new development construction and the pending design guidelines for Broadway.

Toward the Future

From the perspective of this report, the problems that face the revitalization of Broadway are significant. In the absence of a new population base, the success of the existing Broadway retail district is largely dependent upon the local residents choosing to spend their money locally, foregoing other districts of the city. In order for that to occur, new businesses would need to relocate to the area to provide the goods and services that are either currently not available or are too far away, etc.

The proposed legislation is aimed at increasing the value of the existing parcels for those who hold them, and in doing so, encourage private sector investment and redevelopment. Sites such as the old Safeway site and old QFC site stand to benefit, as they are the only sites large enough to support significant development, and are properly positioned to benefit not only from direct access to Broadway, but also a closer association with the more affluent north end of the district.

If more moderately-priced, mixed-use residential units were to be developed on Broadway as has been suggested, it seems plausible that the new popula-

tion of residents would require additional products and services that the current population is either not seeking or (more likely) is unable to locate. In this, new demand would be created that could drive additional investment on the part of the private sector.

A resulting negative from this scenario, of course, is the potential displacement of (segments of) the existing population. Once residential development and resulting demand development occur (especially in conjunction with the Capitol Hill Light Rail Link station), the property values and rental rates would most likely climb significantly. While some percentage of the displaced population would be accommodated under the terms of development noted above (the 20% set aside in new development mentioned above), the vast majority would be permanently displaced, or would have to contend with higher rents or leases.

The opportunity for redevelopment can be found on Broadway, however what form the district takes following the next phase of change remains to be seen. If the legislation currently marked for approval spurs new development along Broadway, then the area could see a resurgence of growth.

- Sources used in "Anatomy of Need" were combined in this documents primary "Bibliography" on page 79.

APPENDIX 3.0 : USE SENSITIVITY & RRC SCORING ASSIGNMENTS

The RRC Scoring Assignments table utilizes Present Use data from the King County Department of Assessments property records, and assigns a scored key value based upon that use. Generally speaking, the scored is derived from knowledge of how likely that property would be likely dispensated should the Raze or Retrofit came into question.

Score values may be changed based on new information.

"Scoring Key

2	=	Very likely to retrofit.
1	=	Somewhat likely to retrofit.
0	=	Neutral - either way.
-1	=	Somewhat likely to raze/redev.
-2	=	Very likely to raze/redev."

<u>Predom Use Code</u>	<u>Description</u>	<u>UseSensitivity Score</u>
300	Apartment	2
573	Arcade	1
301	Armory	2
302	Auditorium	2
455	Auto Dlrship, comp.	-2
303	Automobile showroom	-2
410	Automotive center	-1
304	Bank	-1
442	Bar or tavern	-1
384	Barber shop	1
305	Barn	2
704	Basement - display	1
701	Basement - finished	-1
705	Basement - office	-1
706	Basement - parking	0
707	Basement - residential living	1
709	Basement - retail	1
702	Basement - semifinished	-1

Appendix 3.0 : Use Sensitivity & RRC Scoring Assignments

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<u>Predom Use Code</u>	<u>Description</u>	<u>UseSensitivity Score</u>
708	Basement - storage	0
703	Basement - unfinished	-2
306	Bowling alley	-2
498	Broadcast facilities	2
530	Cafeteria	1
309	Church	1
308	Church with Sunday school	1
310	City club	1
311	Clubhouse	0
441	Cocktail lounge	-1
447	Cold storage facilities	1
377	College (entire)	2
413	Community shopping center	-1
497	Computer center	1
852	Condo hotel, full service	-2
853	Condo hotel, limited service	1
845	Condo, office	2
850	Condo, parking structure	1
846	Condo, retail	2
849	Condo, storage	1
313	Convalescent hospital	2
419	Convenience mart	-1
482	Convention center	2
314	Country club	1

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<u>Predom Use Code</u>	<u>Description</u>	<u>UseSensitivity Score</u>
315	Creamery	0
316	Dairy	0
317	Dairy sales building	0
426	Day care center	-1
444	Dental office or clinic	1
318	Department store	1
319	Discount store	-2
320	Dispensary	1
321	Dormitory	2
365	Elementary school (entire)	2
470	Equipment (shop) building	1
472	Equipment shed	-2
477	Farm utility building	0
349	Fast food restaurant	-2
486	Field houses	-2
322	Fire station (staffed)	2
427	Fire station (volunteer)	1
483	Fitness center	-1
532	Florist shop	-1
323	Fraternal building	0
324	Fraternity house	2
528	Garage, service repair	1
326	Garage, storage	-1
327	Government building	2

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<u>Predom Use Code</u>	<u>Description</u>	<u>UseSensitivity Score</u>
491	Government comm. svc bldg	2
424	Group care home	1
417	Handball or racquetball club	1
329	Hanger, maint and office	1
328	Hanger, storage	1
418	Health club	1
484	High school (entire)	2
330	Home for the elderly	2
428	Horse arena	0
331	Hospital	2
841	Hotel, full service	2
332	Hotel, limited	-1
842	Hotel, suite	1
392	Industrial engineering building	0
453	Industrial flex buildings	0
495	Industrial heavy manufacturing	-1
494	Industrial light manufacturing	-1
489	Jail - police station	2
335	Jail, correctional facility	2
366	Junior high school (entire)	2
490	Kennels	1
496	Laboratories	2
336	Laundromat	2
337	Library, public	1

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<u>Predom Use Code</u>	<u>Description</u>	<u>UseSensitivity Score</u>
471	Light commercial utility building	-2
860	Line retail	-1
338	Loft	2
339	Lumber storage shed, horizontal	-1
340	Market	-2
391	Material storage building	1
341	Medical office	2
525	Mini warehouse - hi-rise	1
423	Mini-lube garage	-1
531	Mini-mart convenience store	-1
386	Mini-warehouse	1
459	Mixed retail with residential units	2
847	Mixed use - office condo	2
848	Mixed use - retail condo	2
840	Mixed use office	2
830	Mixed use retail	2
342	Mortuary	1
843	Motel, full service	0
343	Motel, limited	-1
844	Motel, suite	0
352	Multiple residence (low rise)	2
451	Multiple Residence (Senior Citizen)	2
589	Multiple Residence (Senior Citizen)	1
710	Mult. Resid (Senior Citizen)	1

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<u>Predom Use Code</u>	<u>Description</u>	<u>UseSensitivity Score</u>
451	Multiple residences (senior citizen)	1
527	Municipal service garage	-1
481	Museum	0
485	Natatorium	-2
412	Neighborhood shopping center	-1
344	Office building	1
820	Open office	-1
431	Outpatient surgical center	2
345	Parking structure	-1
582	Post office - branch	1
583	Post office - mail processing	-1
581	Post office - main	1
475	Poultry house - floor operation	0
414	Regional shopping center	-1
348	Residence	2
350	Restaurant, table service	1
432	Restroom building	-2
353	Retail store	1
551	Rooming house	-1
468	Shed, material storage	1
405	Skating rink	0
529	Snack bar	-1
378	Stable	2
406	Storage warehouse	1

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<u>Predom Use Code</u>	<u>Description</u>	<u>UseSensitivity Score</u>
446	Supermarket	-2
416	Tennis club, indoor	1
409	T-hanger	1
380	Theater, cinema	1
379	Theater, live stage	2
387	Transit warehouse	1
851	Underground condo parking	1
388	Underground parking structure	-1
0	Unknown	0
381	Veterinary hospital	1
574	Visitor center	-2
487	Vocational schools	2
810	Warehouse - office	-1
458	Warehouse discount store	-2
533	Warehouse food store	1
534	Warehouse showroom store	1
407	Warehouse, distribution	1

APPENDIX 4.0 - ENERGY MONITORING PROGRAMS

Section Summary

In order to understand the logic of this thesis and why it is important as it is, one must understand the full scope of the other efforts made by developed nations to reduce GHGs. This section outlines those efforts in Europe, Australia and earlier efforts in the United States up to the disclosure laws enacted in Washington State and the City of Seattle, which the Seattle 2030 District now utilizes in its programming.

OTHER PATHS: RATING, MONITORING & REDUCING

This section looks at alternative paths of development than those which we've discussed. Specifically, it looks at a number of schemes currently (or recently) active within the United States, Europe and Australia to make buildings more efficient and reduce the level of GHG emissions.

Energy efficiency efforts in most countries have historically fallen into two major camps:

- Performance Based
- Design or Asset Based

Performance-based energy plans are more common outside the United States, in that they are derived from the actual environmental performance of the building in question, and not from its potential performance. In Europe, this typically meant that the utility supplying the energy would also provide the regulatory body with the energy use data, and then the law could be applied, dependent upon the goals of that country.

Design or asset-based energy plans are also common, both in the United States and elsewhere and are instead focused on the designed energy rating or the potential level of energy efficiency that building (or auto, consumer product, etc) might be capable of achieving.

Both approaches have shortcomings, both relating to the application of efficiency (described by the rating) the building receives. In the case of performance-based rating, the data lags behind the construction and sale of the building, and cannot be verified until a few years after the building has been occupied. Design or asset-based ratings have the reverse problem: while the rating is derived from a calculated potential to be efficient, and is useful in planning, marketing and selling the property, the building may or may not actually be capable of achieving those goals.

What follows is a survey of European, Australian and American energy efficiency plans developed in recent history. While not an exhaustive survey, major movements in energy efficiency are provided which serve to illustrate the means of implementation that were used to achieve those goals. And, while a great deal of similarity exists among the countries and their plans for efficiency, as we'll see, much of the deployment and actual resulting performance from those policies are actually more closely tied to the legal and regulatory framework of the programs.

European and Australian Efficiency Efforts: Rating, Labeling & Disclosing

Early efforts in Europe were primarily based on supply and not efficiency. In 1973, following the entry of Denmark into the European Economic Community, the focus began to change as Denmark, whose own energy policy was based on controlling demand (by increasing fuel prices, increasing automobile prices, etc), began advocating similar methods for general European energy policy.¹

In 1987, the first calls for a European directive on efficiency in buildings came forward, and by 1989, resulted in Specific Actions for Vigorous Energy Efficiency (SAVE). SAVE was significant in that it was a departure in European thinking about efficiency, and resulted in six primary principles which would guide further work in this area:

- Energy certification of buildings.
- Separate billing for heating, hot water, and air conditioning, based on actual consumption.
- Third-party financing for energy savings in the public sector
- The need for thermal insulation of buildings.
- Inspection of boilers.

¹ David, H. (2007) "The 50 Years History Behind the EPBD: From the European Coal and Steel Community to the EPBD." EPBD Buildings Platform.

Appendix 4.0 - Energy Monitoring Programs

- Energy audits in big industrial installations.

Based on the commitment made by the EU at the United Nations Framework Convention on Climate Change in Kyoto (to reduce its emission of GHGs by 8% from a 1990 baseline by 2010), renewed efforts were begun in 2000 with the Action Plan to Improve Energy Efficiency in the European Community. In 2002, the Energy Performance of Buildings Directive (EPBD) was created in order to meet their Kyoto obligations, and increase energy security by reducing dependence on foreign sources of energy.

The EPBD established the guidelines for energy efficiency in Europe, and contained five major themes:

- Certification of buildings.
- Inspection of boilers.
- Inspection of air-conditioning systems.
- Methodologies for calculating the energy performance of buildings.
- Implementation of minimum energy performance requirements for new buildings and for major renovations.

As of January 2009, twenty-two of twenty-seven member states had fully complied with the directive, and had implemented the directive. The European Commission is now working on a second, updated version of the directive to close loopholes and simplify/clarify issues among member states. The second version plans to remove a threshold of 1000 sq meters for minimum energy performance requirements in new construction and major renovations and requires disclosure of the energy performance certificate at the time of sale or lease of the building in question.

In Australia, the approach to energy efficiency is a mix of market-based regulations, disclosure and financial incentives. Each of the Australian states began white certificate programs (known in the United States as "Cap and Trade") which would pressure the emitters to reduce emissions, or seek/purchase the white certificates of others. For example, starting in 2003 the state of New South Wales began a carbon-dioxide-trading program known as the Greenhouse Gas Abatement Scheme (GGAS). Under the program, major emissions sources of GHGs where to either reduce their emissions, or purchase offset credits (transfer rights) known as New South Wales Green House Gas

Abatement Certificates (NGACs). Under the GGAS program, building owners earn NGACs by improving the energy efficiency of their buildings.

These programs were a pre-cursor to the national carbon-emissions-trading program called the Carbon Pollution Reduction Scheme which was slated to begin on July 2010. The program lost public support however, and was never implemented.

In 2006 Australia revised the Building Code of Australia (BCA), proscribing more aggressive energy standards for nearly all aspects of building construction and for the major components within them (including heating and ventilation systems, insulation, and plumbing).

The state governments of Australia sought to meet the improvement in the BCA by creating complementary programs which supported the national effort. In New South Wales, this came in the form of the Building Sustainability Index (BASIX), a potential performance certification system utilizing an online tool component to configure and measure the energy efficiency of a given design.

The BASIX program was also tied to the Australian Green Star Program (NABERS), a five star rating system along the lines of the US Building Council's Leadership in Energy Efficiency and Design program (follows), wherein buildings are assigned a rating based on meeting criteria that can be fulfilled in a number of ways.²

In November of 2010, Australia also passed the Building Energy Efficiency Disclosure Act of 2010, which requires sellers or lessors of office space of 2,000 square meters or more to obtain and disclose an energy efficiency rating. The act requires each building falling within the guidelines to obtain a Building Energy Efficiency Certificate which is then valid for 12 months, as well as businesses consuming more than 0.5 petajoules, or 139 GWh per year, to perform Energy Efficiency Opportunities every four years.³

Australia has also sought to create grant programs for

2 Sustainability Unit - NSW Department of Planning. (2006). "BASIX - Building Sustainability Index." Retrieved May 01, 2011, from <https://www.basix.nsw.gov.au/information/about.jsp>.

3 Australian Government. (2011). "Commercial Building Disclosure." Retrieved July 20, 2011, from <http://www.cbd.gov.au/>.

increasing energy efficiency, but the budget has been very constrained. In 2008, the national government allocated AU\$90m (US\$64m) for competitive grants for energy efficiency improvements to buildings. The government was also considering a "Green Depreciation" program which would allow accelerated depreciation for buildings meeting particular energy efficiency criteria.⁴ Under the proposed program, building owners would be able to defer taxes on the building in exchange for immediate improvements in energy efficiency.⁵

American Efficiency Efforts: Rating, Labeling and Disclosing

American efforts to reduce the emissions from the commercial building sector have been similar to those in Europe and Australia in some ways - in that all three tend to be rooted in either performance or asset based programs. In the United States however, much of the policy and implementation differences stem from land use planning and development regulations (property law), which generally emphasize the inherent autonomy of the owners, and more narrowly define the role and scope of the regulatory or planning authorities which might seek to guide their behavior.

Historically, this relationship was defined by cities seeking to impose regulation to achieve a particular result - first via zoning laws and then through city ordinances. Depending upon the type of effort put forth by the city, the regulatory impact (upon the owners) could then be redressed or exempted via legal actions (litigation) or via pressure placed upon the regulatory body. This relationship can clearly be seen in the interactions between owners and the regulatory bodies in actions arising from recent growth management laws, and the owner's argument of their subsequent "loss of property value" as a result of the regulation.

In the United States, this public-private interaction has resulted in an interesting third component to the performance or asset based approaches, that of the intermediary role, or "public-private partnership" wherein the long term goals of the regulatory body are made more palatable to the property owners via engagement either directly between the two, or with

the assistance of a neutral third party. As we'll see, the goals of the regulatory body can also be achieved via policies pursued through the private market by appealing to the needs of the owners themselves.

From the following survey of programs, the reader should gain a sense of similarity of the policy's origin, goal, direction of development, and an understanding of where the ultimate resolution might exist. The following survey is provided in a more-or-less chronological order.

Energy Star

Energy Star (ES) is a performance-based rating and benchmarking system, begun in the early 1990s by the US Environmental Protection Agency (EPA) as an attempt to reduce GHGs by focusing on increasing efficiencies at power plants. Developed by John Hoffmann in 1995, the program initially began by identifying and labeling energy efficient computer products. By 2006 the ES label is now found on more than 40,000 products of all types, including major appliances, office equipment, lighting, home electronics and many others; with most using 20% to 30% less energy than similar units. In 2006, about 12% of new homes carry the ES label, and an approximate \$14 billion in energy costs were estimated to have been saved - in that year alone. The ES label is now found in Australia, Canada, Japan, New Zealand, Taiwan and the countries of the European Union.

ES has developed a performance rating system for commercial, institutional, multi-family buildings and manufacturing facilities. Based on a scale of 1 to 100, the ratings are used for benchmarking the energy efficiency of building types of like size, construction and other characteristics. The rating and benchmarking system is voluntary, and is facilitated by using a free on-line management tool called Portfolio Manager

Portfolio Manager creates profiles of buildings owned, managed or held for investment, and establishing a wide enough set of parameters, is able to assist the users in "...developing investment priorities, identifying under-performing building, verify efficiency improvements, and receive EPA recognition for superior energy performance."⁶ It does this by establishing a monitoring base from which to measure performance and utilizing data from other buildings, is able to provide a benchmark performance estimate (based on similar

4 Centre for International Economics (2007). Green Depreciation - A preliminary analysis. Canberra, Australia and Sydney, Australia, Property Council of Australia.

5 Charles P. Ries, J. J., Oliver Wise, (2009). Improving the Energy Performance of Buildings, RAND Corp.: pp.1-18.

6 Wikipedia.com. (2011). "Energy Star." Retrieved May 01, 2011, from http://en.wikipedia.org/wiki/Energy_Star

buildings performance) and an overall score for that particular building.

LEED

Leadership in Energy Environmental Design (LEED) is a third party voluntary asset (design) rating system developed in the United States and Canada to evaluate and verify that structures meet various levels of environmental sustainability in their design and construction. Begun in 1998 by Robert Watson and the U.S. Green Building Council (USGBC), LEED acts as a framework of evaluative metrics designed to provide building designers, builders, owners and tenants with tangible and measurable solutions to reduce their contribution to GHGs. The USGBC has since grown to include more than 7,000 projects in the United States and in 30 countries throughout the world, and maintains an accreditation system via the Green Building Certification Institute (GBCI) allowing individuals to become certified practitioners of green building.

In 1998, the LEED system sought to support the incorporation of green technologies within new construction. The first three versions of the LEED system were for new construction, and took just over ten years to the tune the ratings metrics into an effective system of evaluation. Currently, the LEED rating system is broken down into five sub-sections which cover major aspects of the built environment; focused on construction area or construction type. They cover:

- Design & Construction
- LEED for New Construction (LEED-NC)
- LEED for Core & Shell (LEED-CS)
- LEED for Schools (LEED-SCH)
- LEED for Healthcare
- LEED for Commercial Interiors (LEED-CI)
- LEED for Existing Buildings: Operations & Maintenance (LEED-EB)
- LEED for Neighborhood Development (LEED-ND)
- LEED for Homes

Each of the sub-sections of the LEED system contains major categories for evaluation and point assignment. These categories include

Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality. Each category in turn has individual conditions which must be met in order to obtain a variable number of points. The total number of points earned determines the LEED Status that the building will maintain: LEED-Silver, LEED-Gold or LEED-Platinum.

Each of the LEED categories maintains a library of rating systems guides, checklists, addenda listings, minimal program requirements and ratings system forms for users to complete. Most of the rating systems are self-explanatory, and provide a number of solutions that users can choose in order to obtain the credit for that category, and ultimately, the overall LEED rating itself.

For example, under the 2009 LEED-NC, SS Credit 2: Development Density and Community Connectivity category, a structure can earn a total of five possible points. The stated intent of the sub-section is "...to channel development to urban areas with existing infrastructure, protect green fields, and preserve habitat and natural resources." This indicates what the broader, underlying goals of the requirement are, and gives the applicant a contextual understanding of how the given condition should be met.⁷

In this example, the requirements section then provides the applicant with two possible choices for the site of the proposed project - each itself providing a number of possible condition choices that can be selected in order to fulfill the requirement. In this case, both requirements are aimed at building in areas where construction has also occurred; where existing infrastructure and other services have already been established, and where unit density average is fairly high; thus the suggested options all fulfill that condition in different ways, giving the applicant a number of choices.

The LEED system has been fairly successful during the time of its operation, and has mostly been criticized for its complexity in earlier versions. As time has progressed, the USGBC has been active in simplifying and clarifying its requirements, resulting in a growing list of LEED rated properties and a wider variety of LEED categories from which to address the plethora

⁷ USGBC Program Committee (2011). LEED-NC Program Guide for 2009. Washington, DC, US Green Building Council; pp.20-21.

building conditions to be met.

More substitutive claims against the LEED system include the seemingly less rigorous manner in which buildings may obtain points (for small items such as bicycle racks), and the impression the overall rating may give building owners, operators and prospective owners (that the impression it provides overstates the actual degree of sustainability or efficiency the building possesses). Specific discussion of how the LEED system compares to other systems will be presented later in this paper.

Architecture 2030

Architecture 2030 (A2030) is a professional advocacy organization and movement established to create and shape the discussion of ongoing efforts to reduce the amount of GHGs resulting from the construction and operation of commercial buildings. Founded by New Mexico architect Edward Mazria in 2003, the movement seeks to actively challenge the global building industry to reduce GHG emissions both in the materials chosen to construct commercial properties and within the design of the building itself; ensuring the structure would last longer and operate more efficiently over its life cycle.

In order to spur the needed changes in the method and manner in which commercial buildings are constructed, A2030 began the 2030 Challenge (2030C) in 2005. 2030C seeks to challenge the architecture and building communities to design, construct and retrofit existing buildings to meet much higher efficiency standards. To meet the new standards, the 2030C proscribes series of dated emissions reductions based on performance benchmarks for those specific buildings.

To this end, the 2030C targeted three over-arching goals in pursuit of reducing GHG emissions.⁸ First, the 2030C stipulates a series of specific targeted reductions within a given timeframe:

- That all new buildings and development be designed to use 50% of the fossil fuel energy they would typically consume – half the national average for that building type as benchmarked by the U.S. Department of Energy.
- That, at a minimum, an equal amount of existing building area be renovated annually to use 50% of the amount of fossil fuel energy that it is

currently using.

- That the fossil fuel reduction standard for all new buildings be increased to 60% in 2010, to 70% in 2015, to 80% in 2020, to 90% in 2025, and finally, to 100% (thereby becoming “carbon neutral”) in 2030.
- All new and renovated developments/neighborhoods/towns /regions immediately adopt and implement a 50% reduction standard below the regional average.
- Vehicle Miles Traveled (VMT) for auto and freight and
- Water consumption

The 2030C contends that many/most of the stated numeric goals above can be achieved via changes to the standard of design given new buildings; to incorporate passive standards of design which in and of themselves can significantly reduce the GHG emissions . Such changes vary from one region of the country to another, and can be dependent upon local climate, but generally include considerations such as:

- The shape of a given building and orientation to the sun;
- The roof/exterior colors and their associated reflectance values;
- The amount of glazing, the location of glazing and the types of glazing used within the structure;
- Shading strategies designed to reduce solar gain and/or glare;
- Daylighting strategies present for interior and perimeter zones;
- The insulation values found in the walls, floors, roof and foundation of the building;
- The general amount mass of within walls and floors;
- Use of passive heating, cooling and ventilation strategies;
- Specification of more efficient plant equipment;
- Specification of eco-friendly products throughout the structure.

⁸ Vazquez, A. (2006) “Sustainable By Design: Setting A Timetable: The 2030 Challenge.” Today’s Facility Manager.

Secondly, following the changes to the standard of design, the use of more active strategies may be employed in order to reduce the emissions level further. Active strategies include the use of technologies such as:

- Photovoltaic panels for electrical generation;
- Solar water heating;

Finally, after the preceding efforts have been exhausted, if the numeric goals are still not met, the owners/operators of the buildings choose to purchase renewable energy from a centralized power source. (Vazquez 2006) Collectively, these efforts are seen as a viable method of moving toward the significant type of GHG reduction that is required under Global Warming.

The American Institute of Architects (AIA) was the first group to adopt the 2030C, with the agreement of roughly 80,000 members. By May of 2006, the US Conference of Mayors (USCM) unanimously adopted it, resolving their member city executives to pursue aggressive reductions in fossil fuel usage within buildings owned or operated by their cities. USCM Resolution 50, submitted by the Mayors of Chicago, Miami, Seattle and Albuquerque, committed their cities to meet the 2030C goals, and to actively pursue the same standards in the retrofitting of city properties.

Following the lead of the USCM, other groups began to adopt the 2030C:

"To date, the 2030 Challenge has made a significant national impact and has been adopted by many organizations including: The U.S. Green Building Council, The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Royal Architectural Institute of Canada, Ontario Association of Architects, Congress for the New Urbanism, American Solar Energy Society, Society of Building Science Educators, Association of Collegiate Schools of Architecture, National Wildlife Federation, Union Internationale des Architectes, American Society of Interior Designers, and numerous universities, businesses, professional offices, and organizations nationwide.

Government at all levels has also risen to the 2030 Challenge. In August 2006, the

U.S. EPA Target Finder incorporated the 2030 Challenge targets for building energy reduction into their web-based calculator. In December 2007, after being passed by the Senate and the House of Representatives, the Energy Independence and Security Act became law with the President's signature. Section 433 of this bill requires that all new federal buildings and major renovations meet the energy performance standards targets of the 2030 Challenge. California's Long Term Energy Efficiency Strategic Plan released in September 2008 includes two "Big Bold" strategies in line with the 2030 Challenge: to have all residential buildings achieve zero-net-energy use by 2020, and to have all commercial buildings achieve zero net energy use by 2030. The American Clean Energy and Security Act of 2009 was passed by the U.S. House of Representatives and contains national building energy code language shaped by the 2030 Challenge. Other governmental adopters include: The National Governors Association, The National Association of Counties, International Council for Local Environmental Initiatives, the states of Minnesota, Illinois, New Mexico, Washington State, and numerous cities and counties."⁹

For a complete list of current adopters to Architecture 2030 and the 2030 Challenge, please go to: http://architecture2030.org/2030_challenge/adopters_firms_organizations

Clinton Climate Initiative

The Clinton Climate Initiative (CCI) is one of several foundations/advocacy groups under the umbrella group the William J. Clinton Foundation, begun by President Clinton after leaving the White House in 2000, seeking to "...strengthen the capacity of people throughout the world to meet the challenges of global interdependence."¹⁰

Founded in 2006, the CCI functions as advocacy group

9 Architecture 2030. (2011). "Architecture 2030 Adopters." from http://architecture2030.org/2030_challenge/adopters.

10 Wikipedia.com. (2000). "Clinton Foundation." Retrieved May 14, 2011, from http://en.wikipedia.org/wiki/Clinton_Foundation.

and information clearinghouse which seeks to fight Global Warming with pro-business or business-oriented policies. The CCI creates strategic alliances with other advocacy groups, the private sector and governmental agencies in order to overcome the barriers typically found in trans-border problem resolution. In doing so, the CCI is able to achieve full buy-in from all stakeholders, often at lower cost to the public sector, than through regulation alone.

For example, in 2006 the CCI developed an alliance with the Large Cities Climate Leadership Group, a group of cities taking steps to reduce GHGs and adapt to changes brought by Global Warming.¹¹ Since cities contain about 50% of the Earth's human population, consume more than 75% of the Earth's energy, and create more than 80% of the Earth GHGs, pursuing the largest cities on the planet would go a long way in reducing the GHGs.

Since 2007, the CCI has continued the effort, with the creation of other programs such as the 1Sky Project, tasked at accelerating Federal policy, and targeting an 80% reduction in GHGs by 2050, and 2009 developed the Climate Positive Development Program (CPDP). Teamed with the USGBC, the CPDP seeks to promote "climate positive" urban growth policies which encourage actions to reduce GHGs.

Also in 2007, the CCI Energy Efficiency Building Retrofit Program was launched, seeking to join the efforts of large cities, building owners, energy service and technology companies and banks and investment groups to increase the efficiency of the existing building stocks and reduce the GHG emission rates. The CCI works to identify large scale, high visibility energy efficiency projects, and then marries them to the logistical, technical and financial resources necessary in order to achieve results.

Working with the major stockholders, CCI provides interested property owners with three major areas of information/logistical support:

"Project Development and Contracting Support - CCI offers assistance to building owners throughout the project development process in order to design and implement best-in-class energy efficiency projects. CCI's

support services include: defining financial and other project goals, incorporating best practices into project design and development, adapting contracting tools and templates for partner use, and providing technical assistance in review of supplier materials and proposals. CCI's processes are designed to reduce project cost, development time, and business risk.

Access to CCI's Building Technology Partnerships - Decisions about replacing building technologies and systems are often based upon "lowest first cost" rather than "true cost" analysis, thereby overlooking significant benefits such as energy efficiency or maintenance cost savings. CCI helps building owners engage with suppliers to assess energy efficient options for building systems and technologies. Building owners working with CCI can access information and discounted pricing on a range of best-in-class energy-efficient products, including heating, ventilation and cooling, building envelope, and lighting technologies.

Financial Advisory Assistance - CCI works with financial institutions and other providers of capital around the world to help building owners procure financing for projects on competitive terms. CCI can provide financial modeling support, solicit interest from capital providers, review proposals, and assist, where appropriate, in the negotiation process. CCI also helps public and private financial institutions develop sustainable, scalable, and market-driven solutions for financing retrofits across entire building market segments."¹²

Currently, CCI is working on projects totaling more than 500 million square feet of commercial office space in more than 20 cities, preventing the release of more than 120,000 tons of GHGs into the atmosphere annually.

Adopted by the City of Chicago in 2008, the Chicago Climate Action Plan (CCAP) is a strategy to reduce or mitigate GHG emissions by 80% (based on 1990 levels) by 2050. The plan sought to achieve this goal in five ways:

- Energy Efficient Buildings

11 Wikipedia.com. (2011). "Large Cities Climate Leadership Group." Retrieved May 21, 2011, from http://en.wikipedia.org/wiki/Large_Cities_Climate_Leadership_Group.

12 Clinton Foundation (2009). CCI's Energy Efficiency Building Retrofit Program. New York: pp.2-6.

Appendix 4.0 - Energy Monitoring Programs

- Clean & Renewable Energy Sources
- Improved Transportation
- Reduced Waste and Industrial Pollution
- Adaption to Climate Change

Accounting for nearly 70% of Chicago's GHG emissions, building energy usage was a primary target of the CCAP. Creation of a more efficient building strategy reduced that amount by 30%, and provided a host of other benefits, including the creation of new employment (via energy retro-fitting of buildings), reduced energy bills for property owners, among others. Actions called for the retro-fitting of 50% of Chicago's building stock (both commercial and residential) with updated standards of energy efficiency; the conservation of water via improvements in buildings resulting from retrofits; increasing the number of green roofs; and updating Chicago's Energy Conservation Code to current standards.

Addressing clean and renewable energy sources, the CCAP called for upgrades to power plants, higher efficiency standards, and increased distributed generation sources (via co-generation or smart grid technologies). These strategies resulted in 34% of the efficiencies gained in this area, and the associated reduction in GHG emissions. (Chicago Department of Environment 2008)

Transportation changes included increased investment in transit by the city, incentives for increased ridership, expanded bicycle and pedestrian routes through the city, improved movement of freight, improved fleet efficiency, and switching to cleaner, more sustainable fuels such as bio-diesel.

Finally, reduced waste and adaption strategies played a central role in the CCAP as well. These policies included the switch to alternative refrigerants, sequestering of storm water, employing cool roof technologies and increased vegetation to reduce the impact of heat islands, and substantial outreach to both businesses and residents in order to plan for the future and make additional changes.

In 2010 a summary report for the CCAP was issued, wherein lessons learned from plan implementation were reviewed. Among the findings was the acknowledgement that adaption and mitigation must be together in any action plan, and that the plan must realistically view the impacts of inaction in regard to

Global Warming. The report also highlighted some of the research that had been accomplished, its cost to the creation of the plan, and how that research might be of benefit to other cities – both those near Chicago and to others around the country.¹³

Chicago DeCarbonization Plan

In 2007, Chicago architecture firm Adrian Smith + Gordon Gill created the Chicago DeCarbonization Plan (CDP), itself an attempt to provide a workable methodology to implementing the CCAP. In providing this context it was the goal of the CDP to not only meet the goals of the CCAP, but also to meet those of the 2030C: a 100% reduction in carbon emissions for new and renovated buildings by 2030. (Adrian Smith + Gordon Gill Architects 2009)

In order to achieve these goals, the CDP articulated eight strategies which they felt would enable the city of Chicago to meet its goals:

"Eight Strategies of the CDP:

- *Buildings: Investigating how existing structures could be upgraded to improve energy efficiency, increase the value of aging building stock and tap in to the potential to transfer excess energy loads back to the grid; all while offsetting the need for new construction;*
- *Urban Matrix: Increasing the residential density of the Loop by enhancing amenities, adding schools and services and converting aging office buildings to residential;*
- *Smart Infrastructure: Examined how energy could be generated, stored, distributed and shared;*
- *Mobility: An assessment of transit and connectivity;*
- *Waste: An examination of the waste stream, and the city systems for reducing, recycling and disposal;*
- *Community Engagement: Proposed various programs to engage citizens in the green agenda;*

13 Chicago Department of Environment (2010). Lessons Learned: Creating the Chicago Climate Action Plan.

- *Energy: An examination of existing and new energy sources.”*

The concepts and proposals put forth in the CDP included the creation of a below-grade pedestrian walkway, making the Loop more walkable during harsh weather conditions; creation of below-grade inter-modal axis way on Monroe Street for residents, visitors and commuters; repurposing the existing Loop underground tunnels for waste removal; extending the Chicago riverwalk and bicycle paths within the Loop; and the creation of a public school text, *The Green City*, which would provide a primer on urban design and decarbonization

The CDP itself was an offshoot the firms work on the greening of Chicago icons such as the Willis Tower (formally the Sears Tower), as well as their work on the Energy Development Master Plan in Dubai, UAE.¹⁴ That plan envisioned a development of large, mixed use towers which would carry a LEED rating of platinum for community design, and would include a business center, luxury residential lofts and a myriad of amenities for pedestrians. Mention AIA award here?

Better Buildings Initiative

The Better Buildings Initiative (BBI) is part of the 2011 American Recovery and Reinvestment Act (ARRA), an effort on the part of the Administration of President Barack Obama to address both the issues of Global Warming as well as the stagnating economy. The plan includes goals of energy improvements in the commercial building sector of more than 20% by 2020, reduce the energy bills of businesses and home owners by about \$40b per year and by updating the series of incentives and challenges to the private sector to make the upgrades happen.

Specifically, the plan calls for a variety of proposals which will encourage the private sector to increase the energy efficiency of the existing commercial building stocks. These proposals include:

- A redesign of existing tax deductions for commercial building energy efficiency upgrades for owners and real estate investment trusts (REITs)
- Increased access to financing options for commercial retrofits, including increasing the loan limits set by most lenders. The proposal also includes federal loan guarantees via the US

14 Adrian Amith + Gordon Gill Architects (2007). *Energy Development Master Plan - Dubai, UAE*.

Department of Energy for energy retrofits at community critical structures such as hospitals, schools and related structures.

- Federal grants to state and local governments who streamline their standards and procedures for permitting, encouraging commercial upgrades.
- Challenging private sector CEOs and University Presidents to become showcase studies - leaders in their field - in energy retrofits. To commit to a series of actions in making their own spheres of influence more amenable to additional gains in energy savings and efficiency, and in doing so, become eligible for public recognition, technical assistance, and best-practices sharing via a network of peers.
- Implementing reforms which will seek to increase transparency on energy performance, including the creation of a Building Construction Technology Extension Partnership - itself modeled on the successful Manufacturing Extension Partnership at Commerce - and finally, by providing workforce training in areas such as energy auditing and building operations.

The proposed initiatives seek to building on existing successes such as the AARA investment in the Weatherization Assistance Programs, Better Buildings and the Energy Efficiency and Conservation Block Grant - which targets more than 600,000 residential structures to be retrofitted for energy efficiency. In addition, the effort supports proposals such as the HOMESTAR program, the improvement of government-owned buildings by the General Services Administration (GSA) - to become carbon neutral by 2030 - and grants to support innovation in the field - such as those provided to the Penn State-led Greater Philadelphia Innovation Cluster - the winner of the federal Energy-Regional Innovation Cluster (E-RIC).

Finally, the BBI serves in conjunction with the Executive Order signed by President Obama directing federal agencies to achieve net zero energy by 2030 and to pursue high-performance and sustainable design principles for all new construction and alterations. At least 15% of existing buildings need to meet this order by FY2015.¹⁵

15 The White House (2011). *President Obama's Plan to Win The Future by Making American Businesses More Energy Efficient through the "Better Buildings Initiative"*. Wash-

Benchmarking and Disclosure Laws: Washington State, the City of Seattle

In May, 2009, Washington Governor Christine Gregoire signed the Efficiency First bill (SB5854) into law. SB5854 requires the rating and disclosure of energy use of all commercial buildings within Washington State. The bill also made major improvements to the state energy code and energy performance standards and retrofits for public buildings.

SB5854 requires the owners of nonresidential buildings to rate their buildings energy performance using ES software (Portfolio Manager). Nonresidential buildings greater than 50,000 SF are required to disclose beginning January 1, 2011, and nonresidential buildings greater than 10,000 SF are required to rate and disclose starting January 1, 2012.

SB5854 also prohibits state agencies from signing new leases or renewing existing leases in a private building that has an EB rating of less than 75. An exception can be made when a building owner agrees to undergo an energy audit and make energy retrofits with the first year of the state lease, however.

Buildings which are owned by the state, which were greater than 10,000 SF were required to be benchmarked by July 1, 2010. Energy audits are also required for state buildings with EB ratings of less than 50, and associated energy retrofits must be in place by 2016.

On January 25, 2010, the Seattle City Council passed ordinance CB116731, establishing a means of assessing energy performance and data reporting for non-residential and multi-family buildings within the city. On February 1, 2010 Seattle Mayor Mike McGinn signed the ordinance into law.

CB116731 requires that nonresidential buildings are to be benchmarked annually, with the City of Seattle being the recipient and holder of the data.¹⁶ It also requires that multifamily buildings energy usage be rated and disclosed. In addition, the rating data must also be furnished upon request to existing tenants of benchmarked buildings.¹⁷

ington, DC.

16 City of Seattle (2011) "Energy Disclosure Ordinance identifies energy waste, gives property owners and tenants tools to improve energy efficiency." News Advisory.

17 Institute for Market Transformation. (2011). "Washington State and Seattle Energy Performance Laws." Retrieved

May 01, 2011, from <http://www.imt.org/rating-washington.html>.

APPENDIX 5.0 - GREEN BUILDING CONSIDERATIONS

Section Summary

This section explores those elements and principles that are determined to be common in development of sustainable buildings. This section covers common design and building issues, as well as site placement and use of new materials and methods.

ELEMENTS & PRINCIPLES OF THE HEB

This section outlines some of the most common components and principles found in HEBs, and discusses several of the issues relating to each of them. This list is not exhaustive, and like the discussion of building efficiency itself, the components that might be found within any HEB are likely to reflect the particular circumstances of that project or site.

Site & Local Environmental Conditions

Even at the most elemental levels, the role that the building site and the immediate environmental conditions play in the success of the HEB are undeniable. The level of importance of any of these elements is very much dependent upon the particular locale of the site, and the goals of the HEB project itself.

Site Placement & Solar Access

The placement of the building upon the site, and the shape or massing of the building is critical in the development of the HEB. In seeking to maximize the use of all resources on the site (light, air, water), the manner in which the building itself engages the site can make or break the ultimate success of the HEB. The building placement is dependent (among other things) upon the geographic location of the site, its relative latitude and orientation to the sun, future projects which might impact the HEB, and the major program elements of the project itself.

Solar access should be considered at the outset of the project, as should the potential for future projects which might neighbor the site and deny or otherwise change the assumed conditions regarding the quantity and quality of sunlight that the building receives. The degree and quantity of solar access alone can determine the ease or difficulty with which a building may utilize daylighting, passive heating, passive cooling, and a host of other HEB strategies.¹

¹ Tobias, L., and George Vavaroutsos et al (2009). Retrofitting Office Buildings to be Green and Energy-Efficient: Optimizing Building Performance, Tenant Satisfaction,

Local Climate & Environmental Conditions

In addition to the placement of the HEB upon the site, initial consideration should first be given to the local climate where the project is to be located. Factors such as the maximum/minimum temperature severity of the site, prevailing wind and weather patterns, typical levels of humidity and other factors such as seismic activity must be factored into the HEB's design and building systems.

Existing Site Assets or Obstacles

Beyond the local climate and solar access, the other major considerations (to be given) are those other elements which might already exist on the site, or otherwise be integral to it. Elements such as the slope of the topography, degree of covering by forest, presence of water (surface or sub-surface) and type of soil (degree of compaction, need for piling or other foundational support) are just a few elements to consider.

Building Footprint

The footprint of the building in question is also an elemental component of the HEB. The footprint - or general shape of the building - can easily determine the ease or difficulty in pursuing an HEB. Typically, buildings with a footprint that allows for the easy access of light and air provide a much better starting point for an HEB than those which do not.

Multi-story buildings with large floor plates (deeper than 35') for instance, will have difficulty in providing air to the interior without substantial heating-ventilation-air conditioning (HVAC) systems, or light without extensive lighting systems.

Historically speaking, buildings which were constructed prior to World War II (WW2) tended to pursue a footprint which resembled the shape of an alphabet letter, allowing the building's interior easy access to light and air. Pursued primarily because of a lack of

and Financial Return. Washington D.C., Urban Land Institute.

active conditioning and lighting systems, the technology which would allow a departure from those shapes would not appear until after WW2.

While not a complete list, those building footprints shape resembling letters of the alphabet such as C, E, F, T, U, L, or O were once a very common approach to delivering light and air without active conditioning or lighting (Figure 12.1). This is because the general requirement in delivering air and light to any interior zone of a building (without active systems) requires the building footprint to be fairly shallow - to approximately 30'-35' in single loaded corridor, and 50'-60' in double-loaded corridor buildings.

Building Elements of the HEB

Any given building is constructed of thousands of components, each having an impact upon the degree of efficiency that building might possess. Elements such as doors, windows and the materials used to construct the building each play a role in the overall efficiency, and the manner in which they are employed may also be a contributing factor.

The age and period of construction/manufacture are also critical, in that over any given time span, the very nature of all products changes - both in the manner and materials used in their construction, and the understanding of how they are constructed influences the building's operation and resulting level of efficiency.

Building Envelope: Method, Material & Period of Construction

The broadest of the components for consideration is that of the building envelope, or the exterior wall system - that which separates the interior of the building from the exterior. Traditionally, the walls on the exterior of a building were load-bearing; that is, the walls themselves carried the weight of the wall as well as of the building above them. Because of this, commercial buildings were often constructed with very heavy, thick walls, possessed smaller windows, were commonly made of materials such as masonry or stone and were typically not built higher than a few stories.

Starting in the 1920s, the combination of elevator technology and improvements in steel framing began to change the common building configuration. These elements, combined with the need for more space on a single parcel, literally pushed the building up and

created the first high rises in commercial building. Since the steel frame of the building was providing structural support, the exterior walls of the building - the building envelope - could be considered separately from the structural elements.

Frame construction in this manner revolutionized the design and construction of commercial buildings, and encouraged the transformation of the building envelope from masonry and stone eventually to glass and steel - developing what would eventually become known as a 'curtain wall'. The result was that the building envelope of larger commercial buildings became thinner over time, with view glazing taking up a greater percentage of the gross wall area. Eventually, the viewing window/wall became the primary

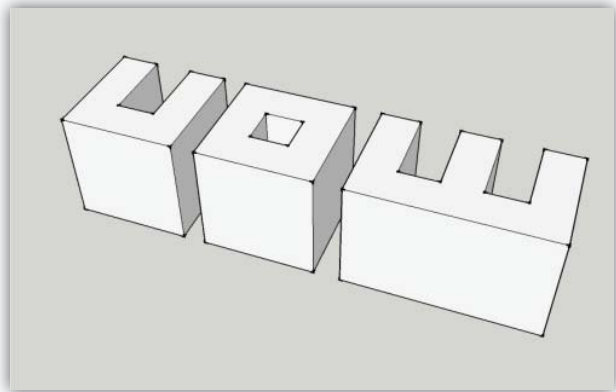


Figure 12.1 – Alphabet Building Shapes: Allowing light and air deep into the interior of buildings. Source: <http://planetgreen.discovery.com/fingers.jpg>.

element of focus of curtain walls in taller buildings, while the smaller buildings continued to be typically constructed of masonry exteriors and structural frames made of wood, steel or concrete.

When this change in construction initially occurred, the energy demands of the new high-rise buildings were not that great. Primarily, the energy was consumed in the heating of occupied spaces and in the vertical transportation within the building. Ventilation was primarily achieved via operable windows, and the lighting requirement was still very low - between 22 and 43 lux (neither air conditioning nor lighting systems had been invented yet), and the facade of the buildings maintained very low glazing-to-wall ratios of approximately 20% to 40%.²

² Oldfield, P. (2009). "Five Energy Generations of Tall Buildings: An Historical Analysis of Energy Consumption in High-Rise Buildings." *The Journal of Architecture*

The early high rise building also lacked thermal insulation within their exterior walls and the materials chosen for the exterior was traditional in nature, commonly stone and/or masonry. The lack of insulation was mitigated by the total amount of building materials used however, because by adding a great deal of mass to the building (both in the exterior materials and in the heavy plaster interior finish), thermal stability was created that would have otherwise been lacking. As a result, during the winters these buildings were able to hold heat fairly well, and during the summer they retained a good amount cooling, based in this mass alone.

By the 1950s, with the full advent of modernism, many new large and medium sized commercial buildings began to be constructed with curtain walls made of steel frames and glass rather than the more traditional stone or masonry. Large multistory buildings also began increasing their floor plates to 100' feet or more in depth in response to the increased availability of new fluorescent lighting systems.

The fluorescent lighting systems, when combined with the glass curtain wall, often sealed from the outside environment, necessitated the use of large HVAC systems to push fresh air deep into the interior. Not

only this, but because of the thin curtain walls, one side of the building - the shaded side - would often need to receive heating, while the other side - the sunny side - would need to receive air conditioning to keep it cool. The overall result were buildings with deep floor plates, workspaces lit only with artificial/ florescent light, poor air quality owing to the requirement of large HVAC systems, and vastly increased use of energy to support it all. (Figure 12.2)

In addition, once the demands of cooling caused by the glass curtain wall became evident, dark window tinting was employed, resulting in lowering the cooling demand, but also in the further decrease of lighting levels for the occupants! Window construction will be discussed in the Windows & Doors subsection below.

Other Elements

Building Foundation

Building foundations should be insulated to reduce/ prevent thermal transfer. Depending upon the depth and the type of foundation used, several inches of rigid foam insulation between the bottom of the foundation and the earth below will reduce heat

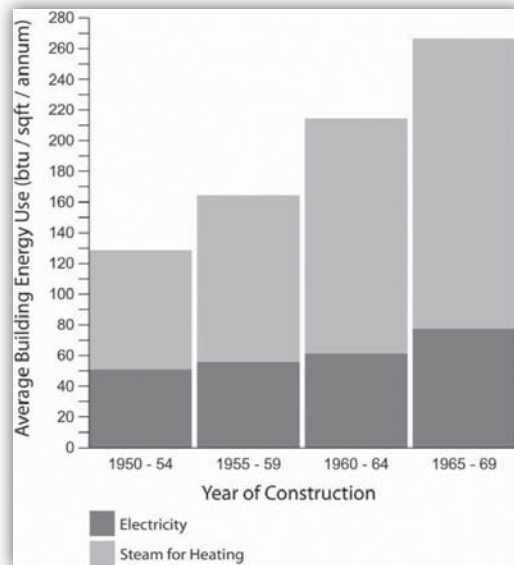


Figure 12.2 – Average Building Energy Use - 86 NYC Buildings from 1950-1970 Source: Oldfield, P. (2009)

transfer significantly. However, the amount of heat loss via foundation transfer is commonly minimized by the eventual heating of the earth outside of it, making foundation insulation (all others being equal) potentially less critical than the other portions of the envelope.

Roof Systems and Insulation

In most commercial buildings, flat or low sloping roofs are typical. The primary concern for the roof essentially comes down to three elements: making it water tight, making it highly insulated and reducing the impact of the building's presence, both in terms of the degree of heat buildup as a result of solar radiation, and/or the water runoff coming from the roof during rain storms.

Commercial roofs are most often made water tight by utilizing a roof system - that is, a series of layered membranes and sealants designed to adhere to each other and thus seal out water infiltration. Water infiltration into the roof layers may come as a result of leaks from rooftop penetrations (air vents, exhaust stacks, drains, etc) or failures in either the materials

themselves, or in the manner in which they were joined.

Historically, a traditional layered roof system was made up of multiple layers of roofing felt (asphalt impregnated paper) and hot tar, finished with an inch or so of small ballast stone in order to protect it from solar damage (Figure 12.3). In the last few decades, rubberized roofing systems have become popular due to the ease of installation and good track record of minimizing leaks.

In addition, rubberized roofing systems permit the use of lighter pigments within the upper sealing layers, making the roof more reflective of solar radiation, and thus reducing the amount of heat generated by the roof itself, as well as the amount of heat penetrating down into the roof structure and building below.

Insulation within the roof area may occur above or below the sealed roofing system. Insulation installed below the sealed roof system was historically made up of vented compartments containing fiberglass batting and/or rigid polystyrene board. More recent types of insulation are found above/outside the roofing system

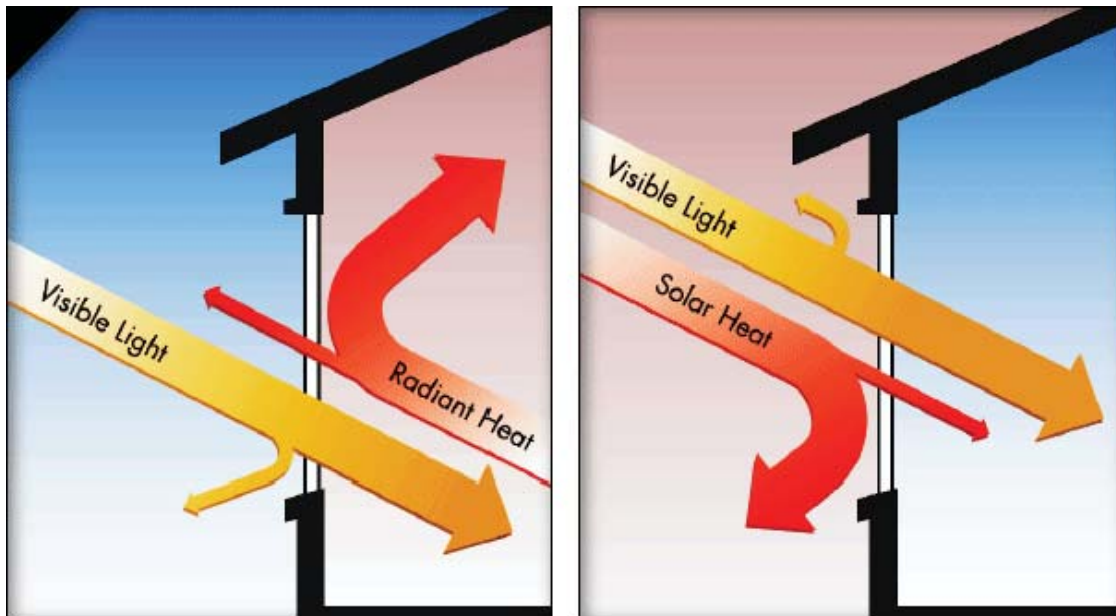


Figure 12.4 – Components of Modern Multipaned Windows. Source: <http://179windows.wordpress.com/tag/low-e/>.

and are typically made up of closed cell (water proof) polystyrene board and some protective layer above it for solar degradation and physical protection from foot traffic, etc

In addition to the conventional roofing system discussed above, a recent option developed for building owners consists of utilizing a living or green roof above the sealed roofing system. The green roof is actually a system consisting of a thin layer of planting medium and various types of vegetation (grasses mostly). The convention behind green roofs is to provide:

- A natural filter or temporary storage area for rain water; to filter it before it leaves the roof and/or retain it within the medium in order for it to be evaporated, thus reducing the amount of storm water runoff.
- A natural layer of insulation to the roof. Depending upon the depth of the growing medium and the roof configuration, insulation values can rise to as high as XR per inch of depth.
- A natural reflector of solar heat. It reduces the heat island effect coming from buildings using more traditional, radiation-absorbing roofing

methods/materials.

Doors, Windows & Skylights

Beyond the energy losses arising from poor roofing insulation, the weakest link in preventing thermal heat loss comes from exterior doors, windows and skylights. Glass panes contained in doors and windows have a thermal conductivity over 40 times greater than air alone, making them a primary source for heat loss.³ This section looks at the changes to the panes contained in doors, windows and skylights, made in an effort to become more energy efficient.

Originally, commercial buildings and homes maintained doors, windows and skylights containing single panes - or a single layer of glass. Because of the thermal properties of glass, the consumption of energy rose dramatically because the conductance of both heat and cold - arising from winter heating losses and from solar gain - were considerable. As a result of this, during the 1950s, the use of single pane glass in commercial curtain walls resulted in very inefficient and thermally unstable buildings.

³ Liu, A. (2007). A Study of Double Pane Windows and Heat Flux. Department of Mechanical and Aerospace Engineering. San Diego, CA, University of California, San Diego: 11. p.2

Tinting of glass was first used in an attempt to reduce the amount of solar gain experienced by glass curtain walls. Curtain walls constructed from more lightly colored, more traditional materials, such as stone or masonry provided the needed mass and reflection to avoid such gain and the accompanying heat. Since the typical glass curtain wall was inoperable, vast amounts of energy inefficient active cooling had to be employed to overcome the building heat, necessitating additional HVAC resources to keep the interior environment comfortable.⁴

A study conducted in 1977 showed that in the period from the 1950s to the 1970s, energy use for buildings with glass curtain walls more than doubled. The study showed that those buildings constructed in the late 1960s had energy use demands more than double of similar buildings constructed less than twenty years before - in the early 1950s.⁵

After the energy shortage resulting from the 1973 OPEC Embargo, building energy codes were improved, and an emphasis was placed on reducing the loss of energy - via heat or cooling. As a result, low emissivity, double paned windows were developed and became the new standard in commercial buildings. Low emissivity or 'Low-E' windows work by having a thin plastic film which filters infrared radiation on the exterior, and another which prevents thermal transmission on the interior. Between the two panes of glass is a sealed chamber filled with inert gas such as argon or krypton, which provide additional thermal insulation.

In this manner, solar gain is prevented by not allowing infrared radiation to pass through the exterior pane, thus having both panes prevents thermal passage of energy. Low-E windows have now become the standard in both commercial and residential applications - in windows, doors, and skylights alike (Figure 12.4 on page 120).

4 Oldfield, P. (2009). "Five Energy Generations of Tall Buildings: An Historical Analysis of Energy Consumption in High-Rise Buildings." *The Journal of Architecture* 14(FIG_A02.04.00). p.598

5 Stein, R. G. (1977). "Observations on Energy Use in Buildings." *Journal of Architectural Education* 30(3): pp.36-41.

Building Principles of the HEB

The following section will outline some of the more commonly known principles surrounding the HEB. Many of these ideas are not new; many were simply placed on hold following WW2, and were rarely implemented until just recently. For the sake of simplicity, I will restrict my discussion of these principles to the specifics of this locale - to Seattle, Washington; at approximately 48° north latitude. Variations in these principles are possible elsewhere in the country (however some degree of variation may apply).

Daylighting Capabilities

Daylighting is little more than utilizing the light provided by the sun to illuminate the interior of a building to a useable level (Figure 12.5 on page 121). Daylighting strives to maximize all levels of light from various orientations and at different times of year to eliminate or reduce the use of artificial (electric) lighting. Daylighting has been with man since the construction of his first shelter, but was on hiatus in the United States from the end of WW2 until the early 1990s.

Daylighting a space can utilize a number of different mechanisms, the success of which is largely dependent upon the relative latitude of the building, and the time of day and year. Generally speaking, when developing a daylighting strategy, one strives to minimize the negative aspects of sunlight (glare, solar gain) while maximizing the useful aspects of it (higher light levels for tasks). Again, for the sake of this discussion, I will assume our location at Seattle, Washington - at 48° north latitude.

What follows is a general description of some of the major aspects of daylighting, with an expanded discussion of each where appropriate.

- Orientation and Building Footprint - Generally speaking, for a commercial building seeking a workable daylighting strategy, the first principle to follow would be the orientation of the building relative to the sun's path throughout the year, and a corresponding thin building footprint which allows for daylighting of workspaces. For Seattle, that would mean a building which is generally narrow, and is oriented east-west; with its longer lines facing north and south, and its east and west ends being more opaque to avoid direct glare. In these cases, a reduction in glazing or the type of glazing

(clerestory versus view glazing for example) may be called for.

- Glare/Solar Gain - Access to the sun alone is not enough; if the access is too great or the wrong type, the resulting space can become overheated or suffer from light which is uncomfortably bright for human use.
- Light Balance - The light in the day lit space should be even in nature - not all from one side of a space. Both sides providing light are needed to reduce the presence of unusable dark areas.
- Light Levels and Uses - The level of daylighting available to users within the space needs to be tied directly to the expected uses within the space. Work spaces tend to need higher amounts of usable light on work surfaces, while transitory areas (hallways, etc) require only very low light levels.
- North Light - Light coming from the north can be a positive force, however it tends to be weaker and needs to be balanced with other types from other locations.
- Glazing - The glazing types, as mentioned above, should be matched to the light availability and the requirements of the space they are lighting. In many cases, reduced glazing may be appropriate. In all cases, a minimum of double-paned glazing should be utilized to reduce thermal transfer.
- Skylights - Horizontal glazing can offer wonder overhead lighting options, but must be balanced with the orientation to the sun and sky (to minimize glare and maximize light) as well as the potential for heat transfer.
- Atriums - Open interior light wells can allow light to penetrate deep into a structure, however the dimensions have to be great enough (relative to the depth penetrated) to ensure access. Also, atriums can contribute to heat loss.
- Lighting Controls - Controls on electrical lighting should be joined to daylighting to ensure that when daylight is available for use in a space, the electrical lighting is shut off to conserve energy.
- Light Shelves - Casting sunlight deep into a space, light shelves are an effective tool at both providing light and providing shading of direct

sunlight into a space. The penetration of light into a space is dependent upon direct sunlight striking the light shelf surface.

- Reflective Surfaces - The color and shade chosen in interior spaces should be light in nature to ensure the bouncing of daylight from one area of a space to another. Dark surfaces tend to absorb light instead of reflecting it.

Other HEB Principles

In addition to daylighting, the following also serve as basic principles to creating a HEB, whether from new construction or from retrofitting.

- Shading Capabilities - Providing some amount of shading on wall exteriors which receive excessive sunlight can assist in reducing cooling loads within a building.
- HVAC & Ventilation Systems - Use of more efficient ventilation systems, particularly zone-controlled systems which are managed for night cooling and economizer cycles provide excellent energy efficiencies.
- Passive Heating/Cooling - Better yet, creating spaces which create natural ventilation, either via cross ventilation (operable windows) or stack effect ventilation provide low energy fresh air.
- Rain Harvesting/Gray Water - Utilizing a green roof or a roof which harvests water is preferred to channeling the water directly into water treatment systems. Harvested water may be used for irrigation of plantings, flushing toilets, etc. In addition, the collection, filtration and reuse of gray water (from sinks, washers, etc) can greatly reduce the demands on fresh water systems.
- Low VOCs - The use of materials which contain low/no amounts of volatile organic chemicals reduces the demand for air changes within a space, lowering energy demand on HVAC and ventilation systems and creates a healthier environment.
- Embodied Energy - The reuse of buildings and materials with high-embodied energy ensures that the energy that it took to create those materials/structures in the first place is not lost, but will instead be continuously utilized.

- Source/Generation of Energy - Consideration of the source of energy plays a large role in the overall reduction of GHGs. Hydro and other forms of low/no GHG-creating means of generation should be the first to be utilized; with an emphasis on reduction/discontinuance of those generation means which contribute GHGs to the environment (coal, oil, natural gas, etc).
- Building Commissioning - The commissioning and re-commissioning of buildings is critical; testing to ensure that the predicted operational profile is in fact that which has resulted. Interface systems which inform the occupants of the a building when environmental systems are running, or when they might use passive systems can be part of the commissioning process.

APPENDIX 6.0 - GLAZING RATIOS AT 400 EAST PINE STREET

Summary

The following tables summarize the amount, location and percentage of glazing that are present at 400 East Pine Street. These tables are intended to guide the reader to an understanding of what particular design solutions would provide, and are not intended as absolute recommendations of any one plan.

400EPS: Glazing to Wall Ratios - Existing Structure

Summary:

Total Wall:	14151.7
Total Glazing:	3955.5
Total Percentage:	28.0%

North Wall		G/W Percentage:			7.8%
	<u>Descrip.</u>	<u>Qty</u>	<u>L/W</u>	<u>Ht</u>	<u>Total Area</u>
Walls:	Level 3	1	120	16	1920
	Level 2	1	120	13	1560
		1	60	14	840
					3480
Glazing:	Level 3	3	5	8	120
	Level 2	3	5	10	150
					270

East Wall		G/W Percentage:			15.7%
	<u>Descrip.</u>	<u>Qty</u>	<u>L/W</u>	<u>Ht</u>	<u>Total Area</u>
Walls:	Level 3	1	93	16	1488
	Level 2	1	93	13	1209
					2697
Glazing:	Level 3	1	10	8	80
	Level 3	1	12	8	96
	Level 3	1	8	9	72
	Level 2	1	10	8	80
	Level 2	1	12	8	96
					424

400EPS: Glazing to Wall Ratios - Existing Structure

Summary:

Total Wall:	14151.7
Total Glazing:	3955.5
Total Percentage:	28.0%

West Wall		G/W Percentage:			36.2%
	<u>Descrip.</u>	<u>Qty</u>	<u>L/W</u>	<u>Ht</u>	<u>Total Area</u>
Walls:	Level 3	1	93.5	16	1496
	Level 2	1	93.5	13	1215.5
	Level 1	1	93.5	14	1309
					4020.5
Glazing:	Level 3	2	25	9	450
	Level 3	1	23.5	9	211.5
	Level 2	2	25	9	450
	Level 1	2	9	8	144
	Level 1	1	25	8	200
					1455.5
South Wall		G/W Percentage:			45.7%
	<u>Descrip.</u>	<u>Qty</u>	<u>L/W</u>	<u>Ht</u>	<u>Total Area</u>
Walls:	Level 3	1	110	16	1760
	Level 2	1	110	13	1430
	Level 1	1	110	5	550
	Level 1	1	56	3.825	214.2
					3954.2
Glazing:	Level 3	5	16.5	9	742.5
	Level 2 & 1	4	16.5	8	528
	Level 1	1	16.5	7	115.5
	Level 1	2	15	14	420
					1806