Reworking Wenatchee :
High Performance in a New & Existing Building

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Abstract

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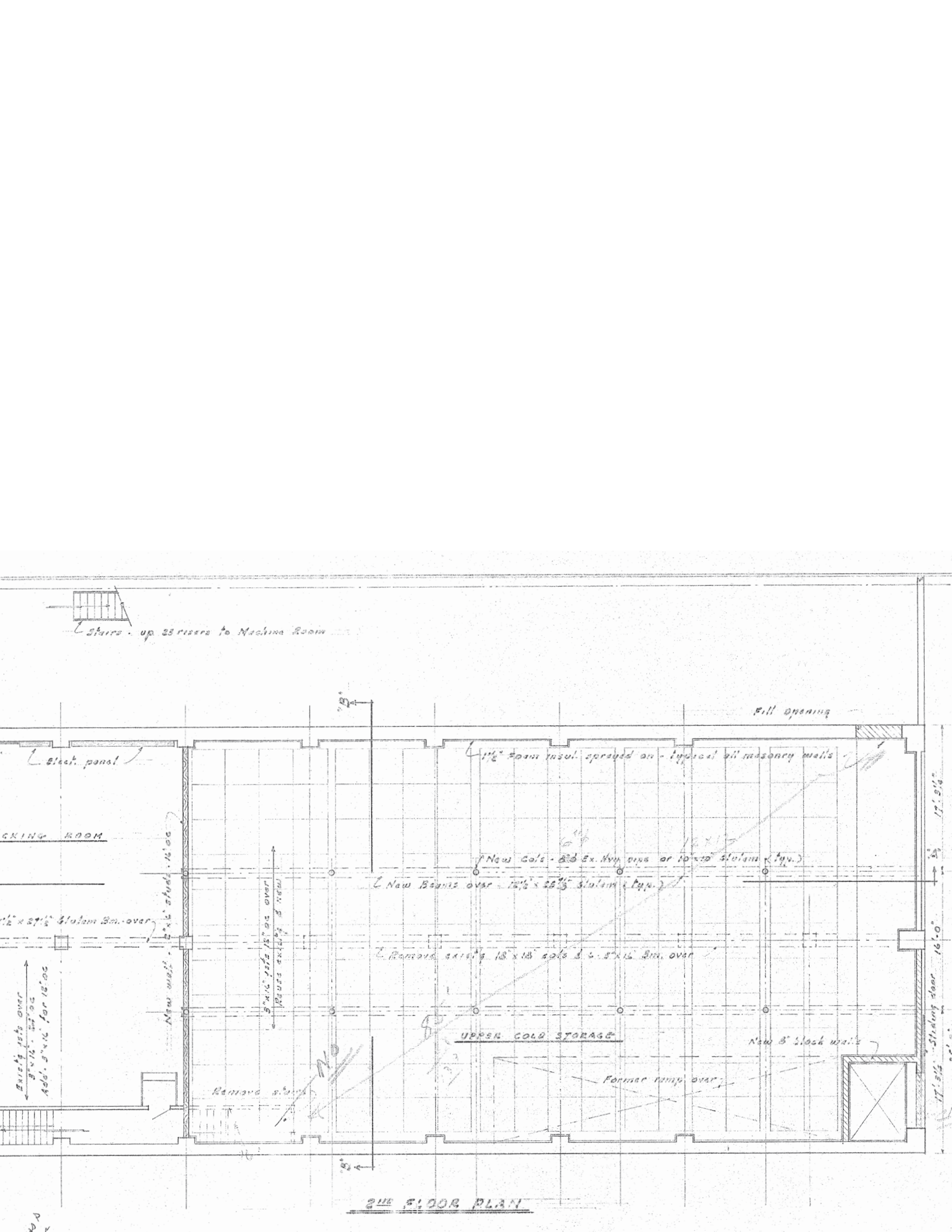
Building operations consume almost half of all the energy produced in the United States each year. Construction and materials, alone, consume approximately six percent of the total energy use of the United States. As the issues of climate change have become more important, there is an imperative for architects to look for new solutions. New high performance design strategies have set goals for lowering buildings impacts but these design strategies have predominantly focused on operations, in the future, a more holistic approach to design for carbon reductions is needed. This new method could be considered a total carbon design approach.

Building reuse in combination with high performance design strategies can greatly lower, both the short term and long term carbon impacts of a building. This thesis is an exploration of total carbon design which examines the initial carbon impacts of construction through life cycle assessments along with operational impacts through the use of EUI and operational carbon emissions. This thesis explores these issues through the design of an adaptive reuse project along with a new high performance addition were the advantages and disadvantages of these distinct kinds of projects can be fully realized and explored through a combination of architectural solutions as well as data driven design.



2ND FLOOR PLAN

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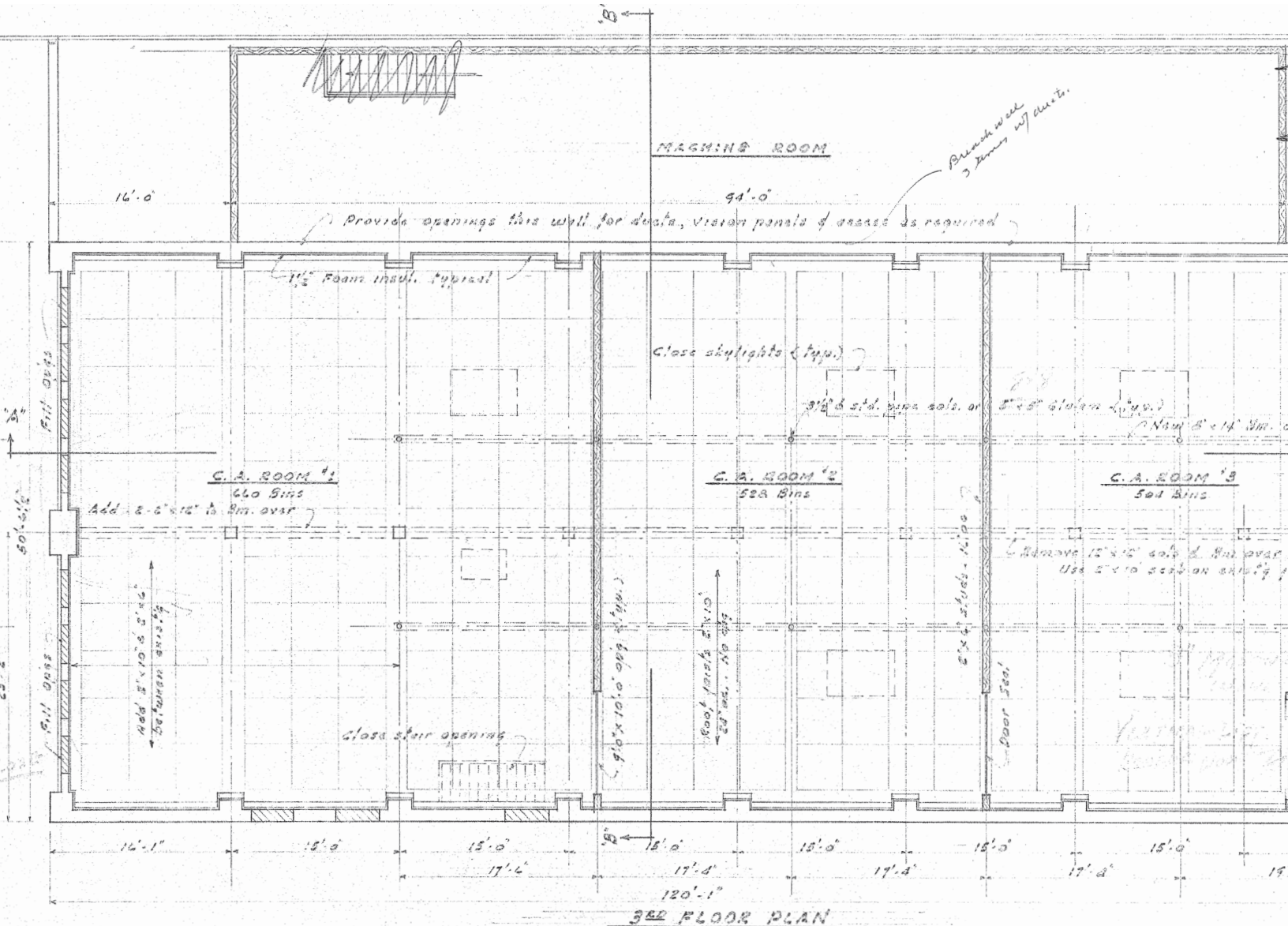

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Introduction

Buildings and Climate Change

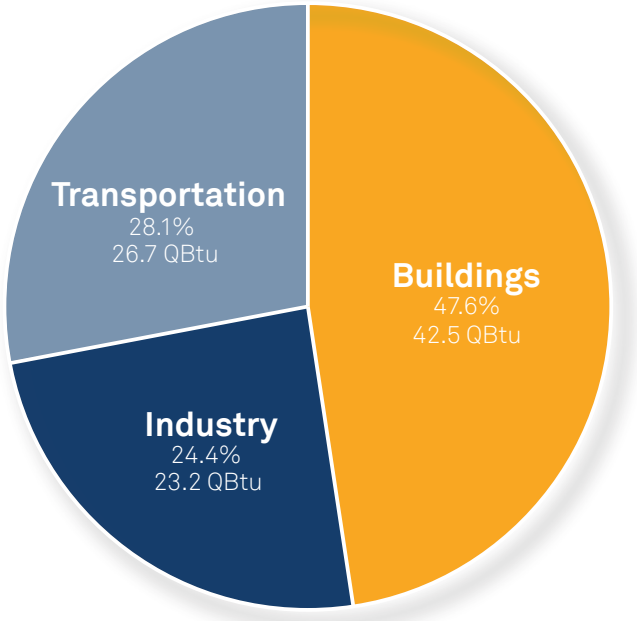
The scientific community has identified that CO_2 emissions have a negative effect on the Earth's temperature and that an increase in the global climate of 2ºC is a possible global tipping point with catastrophic damage to the Earth.[1] Buildings comprise about half of all the energy consumed in the United States and about half of all CO_2 emissions.[2] Limiting carbon emissions from buildings is a key to reducing the damage of climate change on the Earth. Governments and green building programs have already set goals on how to achieve lower carbon emissions from buildings with the main objective of, eventually, low or zero carbon buildings but future carbon reductions are only part of the solution.[3]

Understanding buildings as a set of holistic impacts is an important step to finding solutions. For example, building construction and materials account for approximately six percent of the total energy consumption in the United States, resulting in a similar level of carbon emissions.[4] Limiting the carbon emissions from building operations while disregarding the construction and material impacts provides limited long term benefits.

High Performance Design and Carbon Emissions

As the issues of climate change have become more important there is an imperative for architects to look for new solutions. New high performance design strategies have set new goals for lowering buildings impacts but these design strategies have predominantly focused on operations, in the future, a more holistic approach to design for carbon reductions is needed. Building reuse in combination with high performance design strategies can greatly lower, both the short term and long term carbon impacts of a building. This new method could be considered a total carbon design approach.

This thesis is an exploration of total carbon design which examines the initial carbon impacts of construction through life cycle assessments which calculates the carbon emissions during the production of materials and the construction process along with operational impacts through the use of EUI and operational carbon emissions. This thesis explores these issues through the design of an adaptive reuse project along with a new high performance addition were the advantages and disadvantages of these distinct kinds of projects can be fully realized and explored through a combination of architectural solutions as well as data driven design



Energy Consumption By Sector

fig. 1 - Energy Consumption by Sector in the United States (adapted from data collected by Architecture 2030)

Literature Review

In the last decade, carbon emissions and climate change have elevated interest in finding solutions to lower building's operational energy use. Many organizations including The Living Futures Institute and Architecture 2030 have been pushing improvements of building operations through research of current energy use and setting new targets. These new targets are exhibited by high performance design. While these energy targets are important to long term carbon reductions, understanding a building's total impact is critical at this tipping point of climate change.[5]

Overall, the study of building's embodied energy comes from the energy crisis of the 1970s and the push towards more energy efficient buildings. This push towards energy efficiency resulted in the demolition of historic buildings for their lack of energy efficient systems.[6] The Advisory Council on Historic Preservation recognized the issue with this logic and published a report in 1979 that highlighted that the energy to demolish and construct a new energy efficient building was normally greater than the energy used to adapt the existing building to the same standard.[7] The discussion during the energy crisis was about the financial expense of fossil fuel in the operation of inefficient building. Currently, the discussion is about the environmental impacts of building construction and demolition but the argument is similar to the one in the 1970s. Does a new energy efficient building lower the overall impact of the building through lower operating emissions to an extent that the initial construction impacts are meaningless?

Presently, the literature on this subject take two directions: theoretical writings that outline the merits of reusing existing buildings / environmental impacts and case studies that outline specific quantitative data between comparable projects and their respective environmental impacts.

Theoretical Writings

An important recent paper on the subject of buildings and environmental impacts is the "Time Value of Carbon" by Larry Strain, FAIA. Strain argued that carbon reductions now are more important than carbon reductions in the future. He stated,

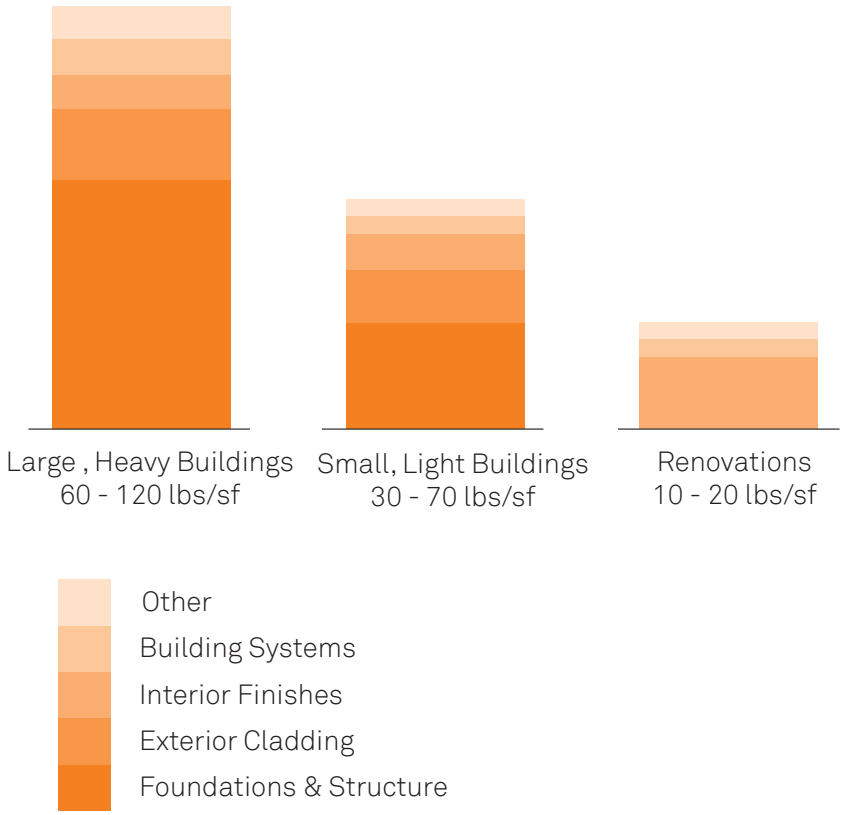
> "When we evaluate emission reduction strategies, there are two things to keep in mind: the amount of reduction, and when it happens. Because emissions are cumulative and because we have a limited amount of time to reduce them, carbon reductions now have more value than carbon reductions in the future."[8]

Strain argued that along with a long-term transition to carbon-neutral buildings, there needs to be a shift in thinking when it comes to the existing building stock. Reuse needs to be seriously considered before the decision to demolition is made.[9]

Historic preservation is an important aspect of this discussion because preservationists are currently the primary advocates for the reuse of buildings. Mike Jackson, FAIA, believes there needs to be a rethinking in the field of historic preservation in terms of sustainability. In his paper, "Embodied Energy and Historic Preservation: A Needed Reassessment", Jackson addressed the view point that preservationists typically have looked at historical significance and building characteristics as the deciding factor for preservation.[10] Jackson argued that preservationists need to look at environmental impacts (past and future) of buildings as well.[11] He added as well the need to restructure commonly used rating systems for sustainability like LEED to enhance the incentives to reuse existing buildings.[12]

The largest gap in the discussion about the impacts of buildings has been what the actual levels of embodied carbon. Without a clear understanding of a building's carbon impacts, decisions can be made solely on the basis of financial factors.

The "Embodied Carbon Benchmark Study" by The Carbon Leadership Forum (CLF) attempted to fill that gap in the data by clearly identifying the average impacts of buildings based on building size. The CLF compiled the embodied carbon data for over a thousand structures throughout the world; documenting the impacts of construction and demolition.[13] These buildings ranged from single family homes to high-rise buildings. The specifics are presented in categories of building uses with per square meter metrics allowing for clear comparisons. This benchmark data is critical for an understanding of the scale of the issue and the impacts that a single building can have.



Benchmark Carbon Impacts from Construction

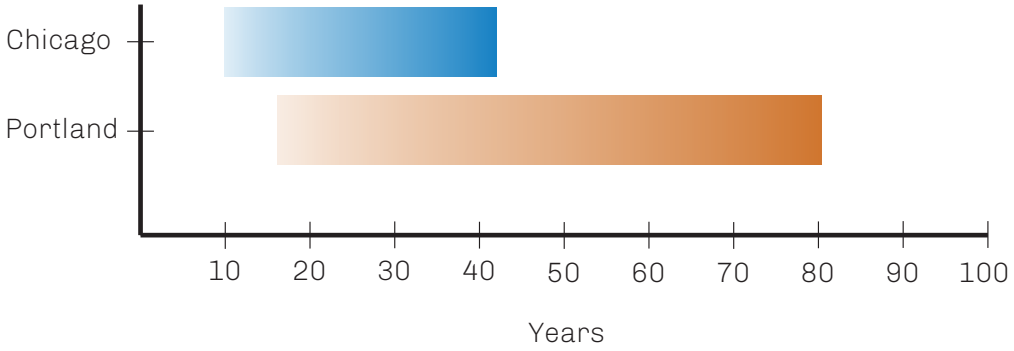
fig. 2 - Benchmark carbon impacts from construction (adapted from Larry Strain, "Time Value of Carbon")

Literature - Case Studies

As major building owners like the United States government and sustainability-minded companies have become more aware of the impacts of new construction, studies have been performed that analyze impacts through direct comparison.

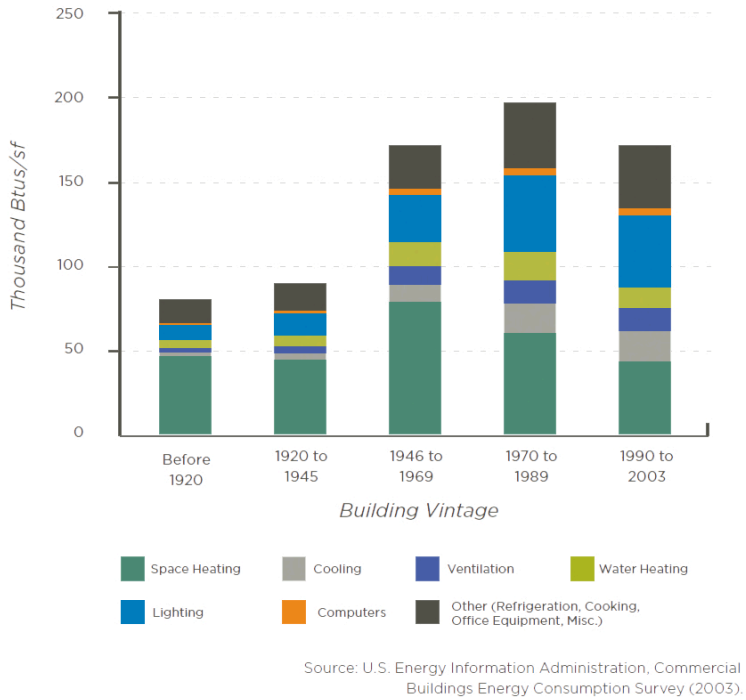
The United States Department of Defense (DoD) funded a study in 2013 to identify the relationship between adaptive reuse and economics in military buildings. The DoD, as one of the largest real-estate owners in the world with over 300,000 buildings, is focused on reducing their carbon "bootprint". [18] They initiated a study to analyze the impacts of retrofitting existing buildings. The study, "Demonstrating the Environmental and Economic Cost – Benefits of Reusing DoD Pre – WWII Buildings" analyzed buildings at military installations all around the United States for these impacts.

The study used the hypothesis that the reuse and modernization of existing buildings, in particular pre-World War II buildings, could greatly influence the DoD's goal of lower greenhouse gas emissions.[14] The DoD defined success as being at least a 15% reduction in both cost and GHG emission as compared to new construction.[15] After a detailed study of buildings and alternatives, the study clearly identified that "Modernization of DoD's Pre-War masonry buildings can be significantly less expensive than new construction" and that adapting these masonry buildings could "contribute significantly to the DoDs goal of lower GHG emissions." [16] The study also showed DoD's goal of LEED Silver can be met with lower costs by "leveraging the original design features for thermal comfort ("original design intelligence") with new energy efficient systems."[17] Overall, this study highlighted not only the environmental impact of reuse but also positive economic benefits.



Number of Years until Initial Carbon Impacts of New Construction equal Improved Energy Efficiency Gains

Adapted from "The Greenest Building" National Trust for Historic Preservation



Source: U.S. Energy Information Administration, Commercial Buildings Energy Consumption Survey (2003).

fig. 3 - Initial carbon impact versus operational impacts over the long term (adapted from Preservation Green Lab, "The Greenest Building…")

fig. 4 - Energy consumption by building vintage (Preservation Green Lab, "The Greenest Building…")

The Preservation Green Lab at the National Trust for Historic Preservation in 2011 conducted what was described as the most comprehensive study on the topic of carbon emissions and building reuse to date.[19] This study, "The Greenest Building: Quantifying the Environmental Value of Building Reuse", stated that a "paradigm shift is needed to account for the relative environmental benefits of reuse and to ensure that reuse be seriously considered in decisions regarding demolition and new construction."[20] The study used whole building life cycle assessment to compare the environmental impact of reuse versus new construction over a 75-year life span.[21] The study compared multiple building types and multiple regions in the United States with the conclusion "that retrofitting existing buildings with appropriate energy upgrades offers the most substantial emissions reductions over time."[22]

Another major property owner that has been interested in the total impacts of new construction has been Parks Canada. As the Canadian governmental agency directed to administer the system of national parks and significant sites throughout Canada, issues of historic buildings and sustainability are key to its mission.[23] In 2009, Parks Canada commissioned the Athena Institute to conduct a study that analyzed four buildings throughout Canada with the goal of "[quantifying] the potential environmental gains available with keeping and renovating a building versus demolishing it and building new." Through the comparison of the renovation of existing buildings with a similar new building, the study was able to illustrate that, in each case, there was an overall avoided impact of renovating the existing building versus new construction.[24]

While the three previous studies have all been conducted by governmental organizations, private companies with sustainability-minded executives have also been studying these issues. Larry Strain published a detailed case study comparing the carbon impacts of a renovation versus new construction.

In “The Total Carbon Study”, Strain analyzed an office renovation for DPR Construction. The clients were moving their operations to an existing two story, 24,000 square foot office building in San Francisco with the goal of certified net-zero energy.[26] This was an ambitious goal for new construction but even more challenging in an existing building with limited control on building design features. Strain identifies the carbon impact of renovating the existing office and the largest impacts coming from the reuse of the floors, structure and enclosure of the building.[27] He states that the “avoided emissions to remodel the building were less than one third of what they would have been to build the same building from the ground up...” [28]

These major studies highlight a current discussion in the design and construction industry about the true impacts of buildings. “Too often, decisions about whether to keep or demolish a building revolve only around cost considerations without taking account of the environmental implications.”[25] These studies have added immensely to the current literature on the topic but more examples of with quantifiable data are needed to advance the issue forward. This project will add another important case study with quantifiable data to this grow body of literature.

fig. 5 - Aerial view of downtown Wenatchee looking south down Wenatchee Avenue

2

Site Selection

The impacts of climate change will be felt throughout the world and the imperative to reuse buildings must be global. Currently, in the early stages of projects, existing buildings are considered a cost burden and often become subjects of demolition.[29] These buildings though, have the opportunity to both be revitalized and to revitalize their surrounding areas. A number of different places in Washington could benefit from building and district revitalization. Currently, places like Seattle, Tacoma, Vancouver and Bellingham have all begun processes of adapting large areas of their respective cities into new developments.[30] An area that so far has not seen the same level of redevelopment has been small town Washington, especially east of the Cascades. These places have economies central to the overall success of the state but have not seen the booming economies like cities west of the Cascade Mountains. As a result, these cities are ideal locations for this project as they have not already been effected by extensive downtown revitalizations.

The size of the community for this project will be key for a couple a reasons including: the implementation of the workforce training program will require an established community/region to be successful (have students and employers), and the size of the community relates to the number of building options suitable for this project. This project focuses on buildings with construction prior to World War II because of their current benchmark energy consumption and inherent design intelligence in terms of thermal mass, natural ventilation and natural lighting.[32/33]

The criteria for a site will be small town Washington (east of the Cascade Mountains), a current population of average size (approximately 33,000 people), a number of building options from the identified era and an area that would benefit from new revitalization.

Wenatchee, Washington

A number of places fit parts of the criteria and do not fit with other parts. Through this exploration of site options, Wenatchee, Washington fulfilled the criteria better than other options. Wenatchee is located almost directly in the center of Washington in the foothills of the Cascade Mountains and the edge of the Columbia River Basin. Wenatchee, so far, has been removed from the economic boom that has effected many cities on the west side of the Cascades Mountains. Wenatchee has not seen the same level of revitalization and, as a result, is ideally suited for revitalization especially in its downtown core.[31]

The Wenatchee Historic Downtown core contains a large number of the buildings constructed prior to World War II which is the era of interest for this project. This large number of building options will allow for a careful selection of a case study building for this project that will both maximize impacts to the building as well as to the community.

The population size of Wenatchee also is a key factor into why Wenatchee is an ideal location for this project. The average population for a city in the state of Washington is approximately 33,000 people.[34] The current population of Wenatchee is approximately 34,000 people.[35]

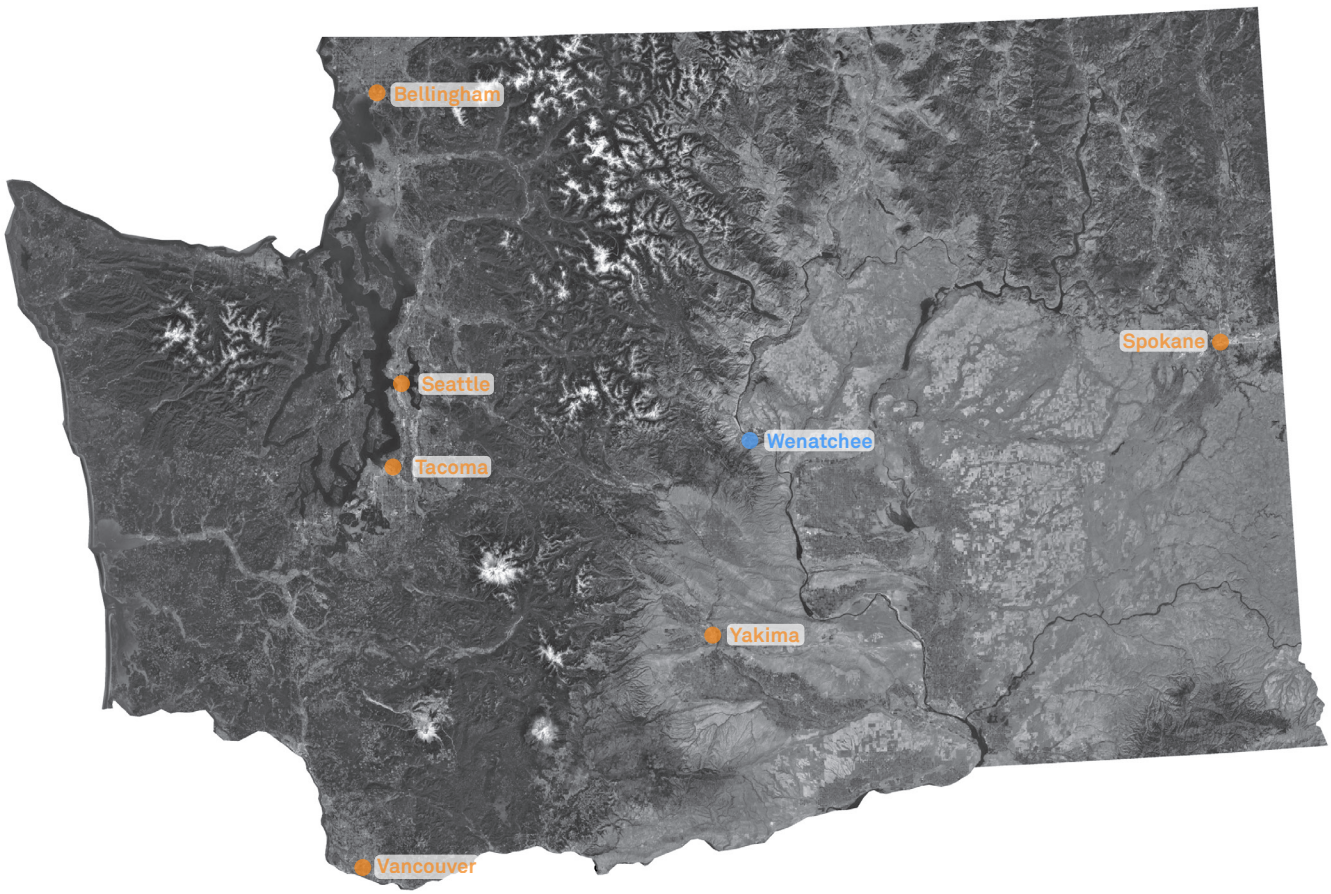


fig.6 - Map of Washington State

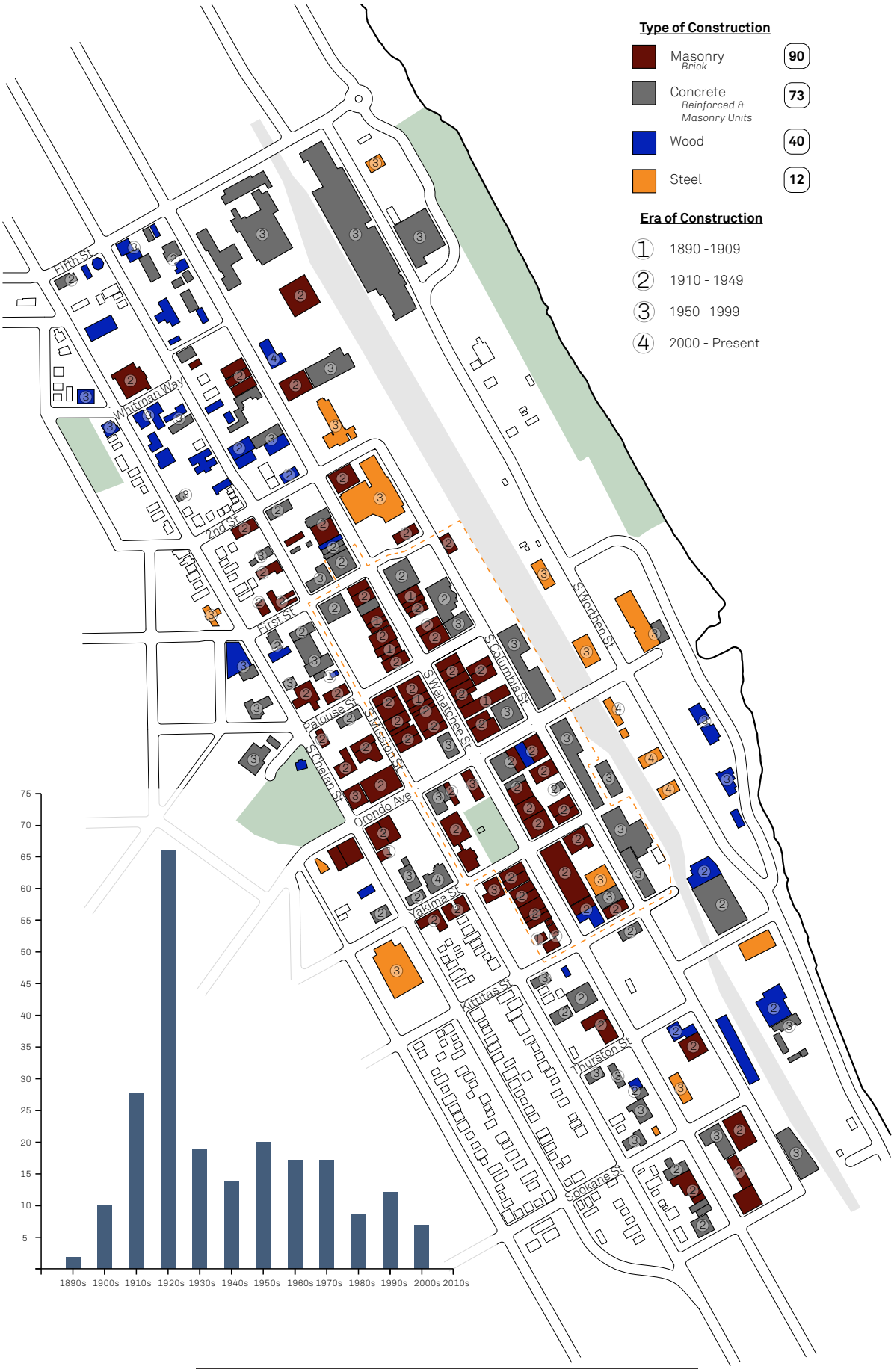


fig. 7 - Building construction type and era of downtown Wenatchee

3

History of Wenatchee

Indigenous Peoples and Early Settlers

The City of Wenatchee was the direct result of movement of Euro-American settlers into the Wenatchee Valley in the mid-1800s but the history of Wenatchee as a settlement on the Columbia goes back much further and highlights the great economic and agricultural potential of the Wenatchee Valley.

Prior to the permanent settlement of Euro-American businesses in the 1870s, indigenous peoples lived in the fertile lands of the Wenatchee Valley for thousands of years.[38] The main group was the *Wenatchi,* they were a nomadic people that subsisted on salmon, fruits, berries and nuts which were abundant in the region.[39] Though the *Wenatchi* had called the Wenatchee Valley home for generations, by the 1850s the area was in a state of flux.

Indigenous people including the Wenatchi call the Wenatchee Valley home for thousands of years[36]

1811 - Traders with the Hudson Bay Company travel along the Columbia River trading with the Indigenous people; the first Europeans to come the Wenatchee Valley[37]

The United States government, in 1853, created the Washington Territory and tasked Isaac I. Stevens, governor of the territory, to enter into a treaty with the indigenous people of the area.[40] The *Wenatchi* along with the thirteen other indigenous tribes of the region entered into the Treaty of 1855. The Treaty conceded eleven million acres of their ancestral homeland to the United States government and created two Indian Reservations, Colville and Yakima, where the indigenous people were resettled to.[41] The *Wenatchi* mostly settled on the Colville Reservation over one hundred miles from their ancestral homeland.

The natural features of the Wenatchee Valley; the fertile land, the connection to the Columbia River and potential for economic growth attracted the Euro-American settlers to the area. After the Treaty of 1855, newly available land allowed for an influx of the Euro-American settlers.[44]

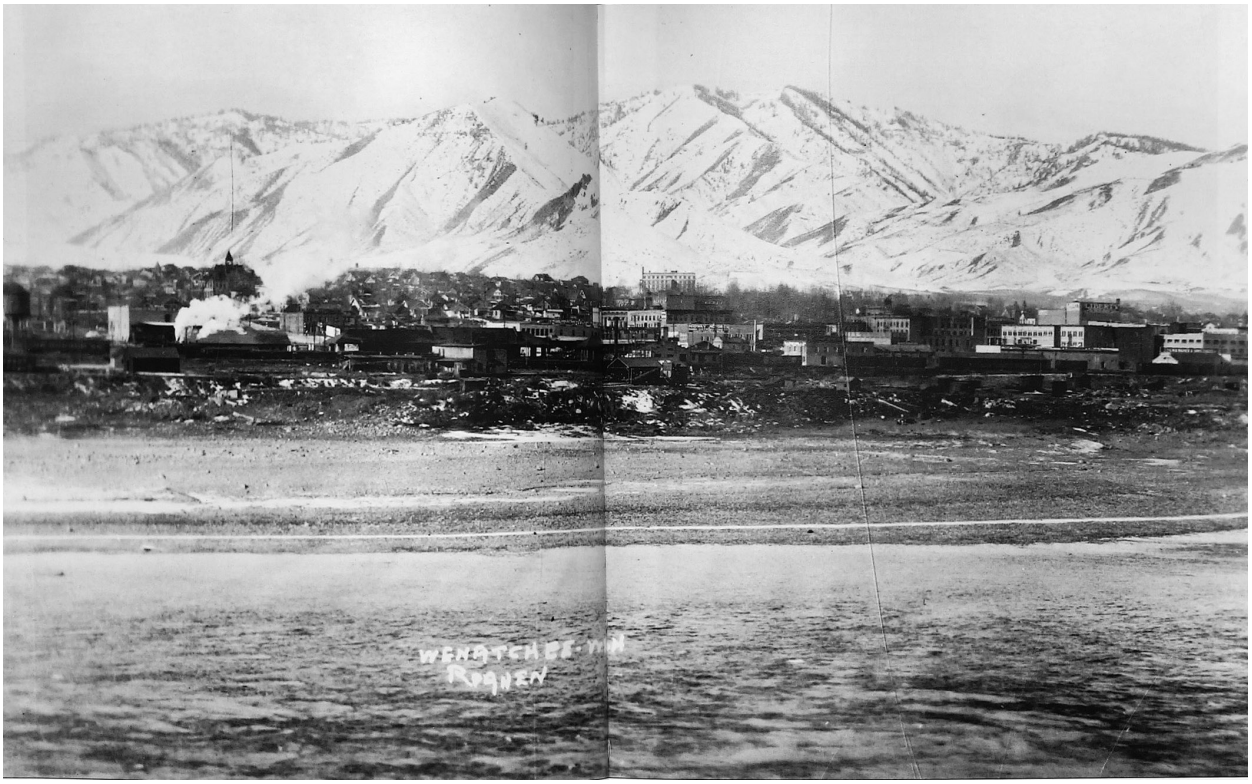
Wenatchee: Growing Frontier Town

Through the 1860s and 1870s, business interests focused on the Columbia River and its potential for transportation of goods.[45] By the 1880s, the Wenatchee Valley was on the verge of a dramatic change from a sleepy trading post to a major transportation hub in central Washington.

The growth of Wenatchee was closely linked with the growth of the railroad. Prior to the arrival of the railroad, the Wenatchee Valley was mostly an inaccessible area with the North Cascades and its foothills surrounding the region forcing all access to come from the Columbia River.[46] Although the area was topographically challenging, geographically it had great potential. The Wenatchee Valley, located mid-way between Spokane and Seattle, was chosen by the Great Northern Railway as a rail hub with the goal of developing a major city in Central Washington.[47]

1853 - Washington Territory created by the United States government[42]

1855 - Treaty of 1855 signed by the Indigenous tribes of Central Washington and United States government, moving the fourteen tribes to Indian Reservations[43]



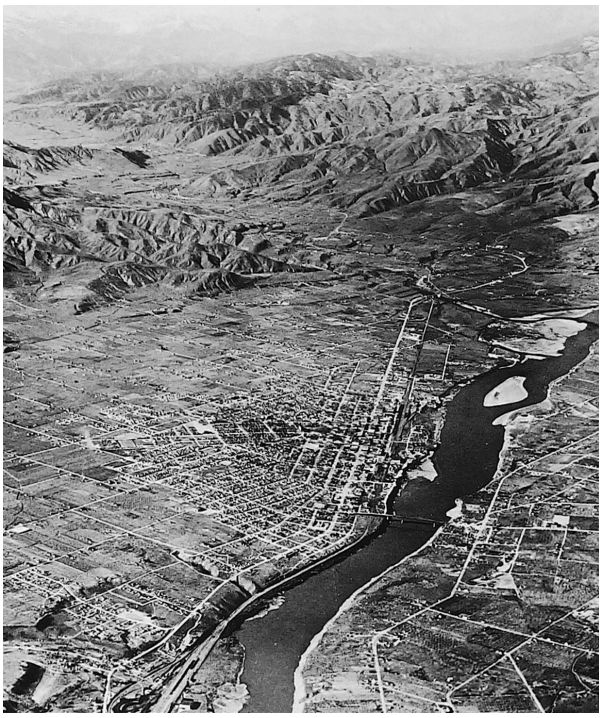


fig. 8 - Historic photo of Wenatchee from the east side of the Columbia River looking west (1925)
fig. 9 - Historic Aerial view of Wenatchee (1930s)
fig. 10 - Historic aerial view of downtown Wenatchee looking south (1945)

In Wenatchee's history, 1892 was a critical year for a couple of reasons: 1) the construction of the railroad was completed which connecting Wenatchee to the rest of the United States, and 2) the town was platted by Great Northern's Wenatchee Development Company.[48] These plats located south of the confluence of the Wenatchee and Columbia Rivers would become the current historic downtown Wenatchee. Through the 1890s, Wenatchee steadily grew with incorporation in 1894 and became the county seat for the newly created Chelan County in 1899.[49] Wenatchee as a regional hub for the railroad laid the foundation for future growth.

Wenatchee: Regional Power

Two major industries, agriculture and steamboat transportation, grew in Wenatchee during the 1900s with the support of the railroad.[52] The Wenatchee Valley combines an arid climate, rich volcanic soil, as well as its proximity to the waters of the Wenatchee and Columbia Rivers.[53] This combination of factors led to the agricultural success of the area.

By 1903, agriculture and, in particular, apple production, had become a cornerstone of the Wenatchee economy.[54] This growth was to such an extent that the Wenatchee Chamber of Commerce started marketing the area as the *Apple Capital of the World*.[55] Though, at this time, most of the growth of the agriculture industry was limited to the west side of the Columbia due to established irrigation networks. That changed in 1908 with construction of a bridge across the Columbia River that carried both transportation and irrigation to the east side.[56] This opened areas that prior to 1908 were arid and unsuitable for agriculture.

1872 - First permanent Euro-American settlement formed at the confluence of Wenatchee and Columbia Rivers[50]

1892 - Great Northern Railway connects Wenatchee with rest of United States; city of Wenatchee platted in its current location[51]

Even though downtown Wenatchee was outside the area of agricultural production, it saw tremendous growth. Wenatchee Avenue was the commercial hub of the area with businesses catering not only to the agricultural community but a wide range of clients. Hotels, stores and saloons all grew along Wenatchee Avenue during this period transforming the area from frontier town into an established community.[57] Located one block east of Wenatchee Avenue, Columbia Street grew as the industrial hub of Wenatchee. Adjacent to the rail yards, Columbia Street was lined with warehouses and rail depots dedicated to the service of the agricultural community, storing their products before they were shipped out to the world. This area was nicknamed Produce/Fruit Row because of all the activity related to these industries.[58]

The other major industry to boom in this area during the early 1900s was the steamboat transportation industry.[59] The growth of the steamboat industry included two parts: shipping/transportation and building/repair. Lines like the Okanogan and the Columbia connected communities all along the Columbia River that previously were inaccessible.[60] The center of these transportation networks was located in Wenatchee along with the industries building new steamboats and repairing existing steamboats.[61] These two industries allowed the town of Wenatchee to grow into a city during these early years.

1899 - Chelan County established with Wenatchee as the county seat[62]

1908 - Irrigation pipe crosses the Columbia River created new agricultural opportunities on the east side[63]

1920s - Agriculture booms in the Wenatchee Valley with numerous new buildings related to the industry constructed in Wenatchee[64]

1930s - Great Depression slows the growth of Wenatchee dramatically, Wenatchee is able to survive through its diverse economy[65]

fig. 11 - Photo the Apple Capital of the World sign (1962)
fig. 12 - Steamboat construction in Wenatchee (1910)

Steady and Slow Growth

From 1920 to the present day, the economy and history of Wenatchee has been punctuated by periods of economic booms and busts. The Great Depression hit the region very hard like the rest of the United States, with only two buildings constructed during those years.[66] But the diversification of industries in Wenatchee prior to the Great Depression allowed Wenatchee to survive better than some other areas in Washington.[67] This push towards greater diversification of industries continued into the 1940s and 1950s as hydroelectric power plants started to be constructed along the Columbia River. Industries catering to the construction of dams like Grand Coulee (1942) and Rock Reach Dam (1952) began a new wave of development of Wenatchee.[68] The construction of the hydroelectric dams on the Columbia River also produced a new abundance of affordable energy to the area which, in turn, spurred the growth of energy intensive industries like metal ore extraction and refining.[69] The 1960s and 1970s saw steady growth with a slow sprawl of Wenatchee out of its urban core into a more suburban development. These growth trends continued in the 1980s and a push towards a revitalized downtown during the early 1990s.[70] Wenatchee never repeated the boom that it experienced in the first twenty years of the century but it has steadily grown to the second largest city in central Washington.[71]

1942 - Grand Coulee Dam and other hydroelectric projects spur new industries in Wenatchee[72]

1990s - New efforts to revival Wenatchee's Historic Downtown begin with efforts to bring new business and tourism to the area[73]

fig. 13 - Present day Wenatchee looking west across the city to the mountains
fig. 14 - Sign for the new Pybus Public Market on the east side of the railyard
fig. 15 - View up Orondo Street towards the heart of downtown Wenatchee

4

Wenatchee : Site Analysis

Location

Wenatchee is located at the foothills of the eastern slope of the Cascade Mountain Range along the banks of the Columbia River. Wenatchee is the second largest city in Central Washington and it is only a two and half hour drive from Seattle.[74] The city is bisected by State Route 285 which connects Wenatchee to the north with the rest of Chelan County while south connects Wenatchee to the rest of state via Interstate 90. Wenatchee's downtown is regarded for its history, architectural character, and businesses which make it a highly desirable area in the city.[75] A major portion of the downtown core is located in a National Historic District which consists of 57 buildings and 340 acres and it is considered historic for its connection with the growth of the railroad in the West and the collection of early Commercial style buildings.[76]

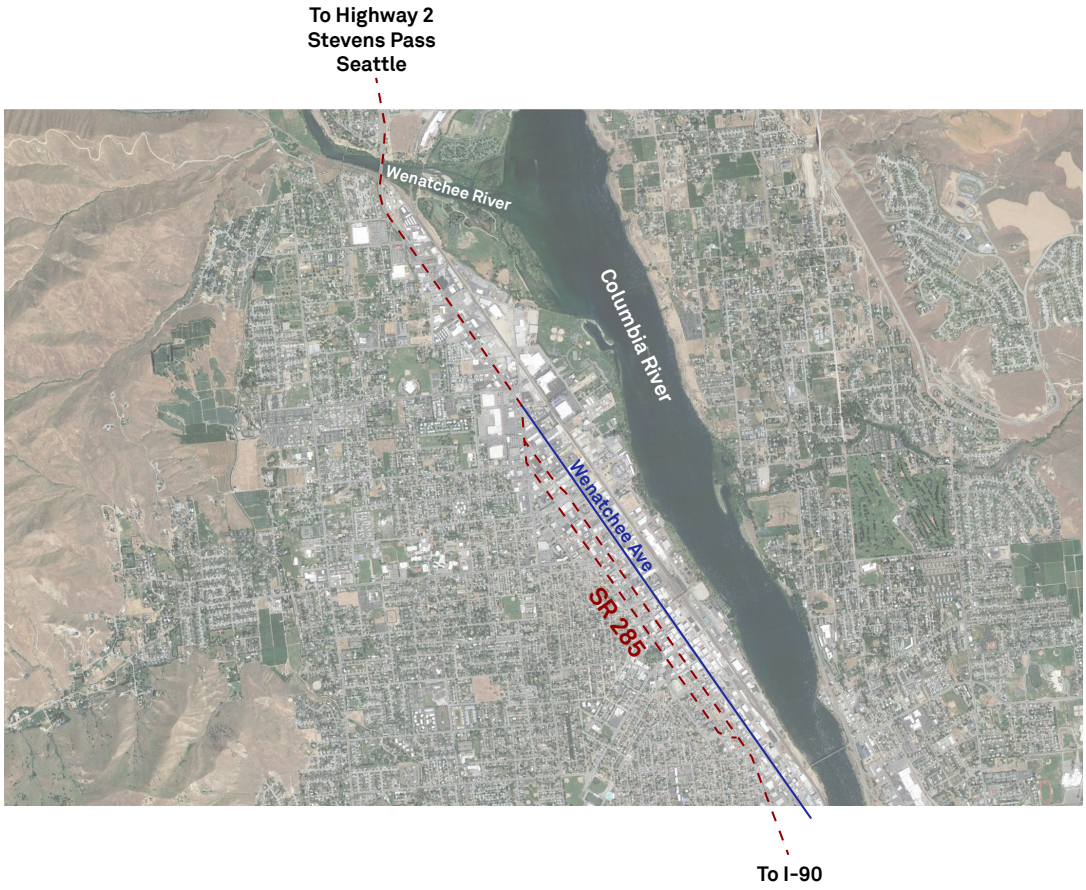
Economy / Demographics

Currently Wenatchee has an employment rate of 4.5% and a median income of $55,000 per year which is about the average in the state of Washington.[77] Though Wenatchee also has lower education completion rates and high drug use rates as compared to the rest of the state.[78] Wenatchee currently has one of the more diverse populations in all of Washington.[79]

Most of the current economy is connected to the agriculture industry which accounts for about a quarter of the labor force in Chelan County but with other major industries being health care and retail / hospitality.[83]

Future Outlook

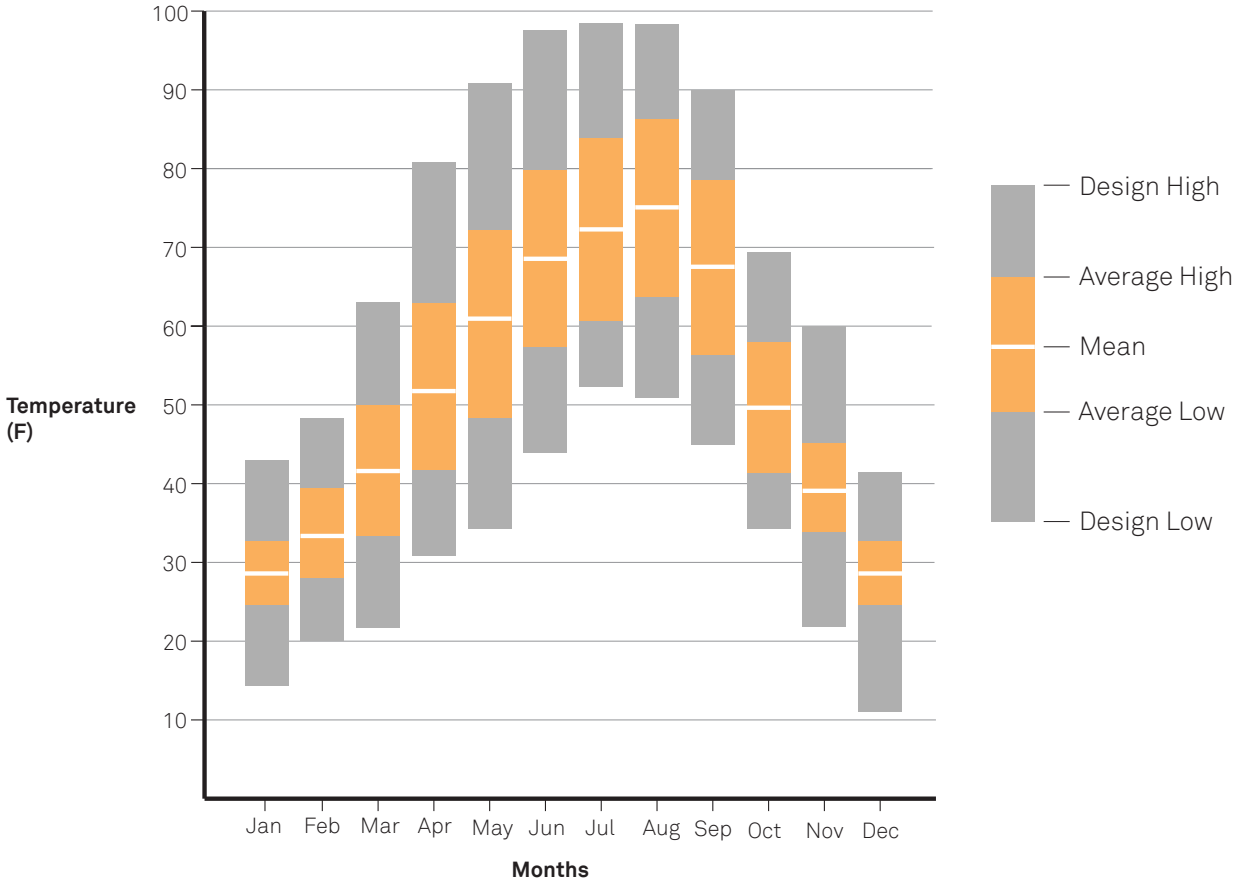
The historic growth of Wenatchee has been rooted in the growth in agriculture in the area. While this is still a solid foundation for future generations in Wenatchee, the city of Wenatchee has larger goals for the area. As outlined in the master plan, Planning to Blossom 2037, the city of Wenatchee envisions Wenatchee as a vibrant center of the central Washington community with the downtown core as the center of economic activities.[80] Already, Wenatchee accounts for almost 40 percent of the total retail activity in the five counties area, an area of almost 300,000 people.[81] Wenatchee has even been attracting new industries to the area with the help of Chelan County Public Utilities including a multi-million dollar data center.[82] With the recent growth in high tech and other industries coming to the Wenatchee Valley, the economics of Wenatchee are changing.



	Population	Unemployment Rate	Drug Use Rate*	Major Industries	Median Income
Seattle	668,342	3.9%	9		$85,000
Yakima	93,357	5.8%	5.5	Agriculture	$47,000
Bellingham	83,365	4.3%	7	Services	$56,000
Wenatchee	33,261	4.5%	8.6	Agriculture	$55,000
Ellensburg	18,774	4.5%	9.1	Retail / Food Services	$49,000

*Rate per 100,000 Population (2012-2016)
Opioid Overdose Deaths

fig. 16 - Major routes of access in Wenatchee
fig. 17 - Demographics of major Washington cities including Wenatchee



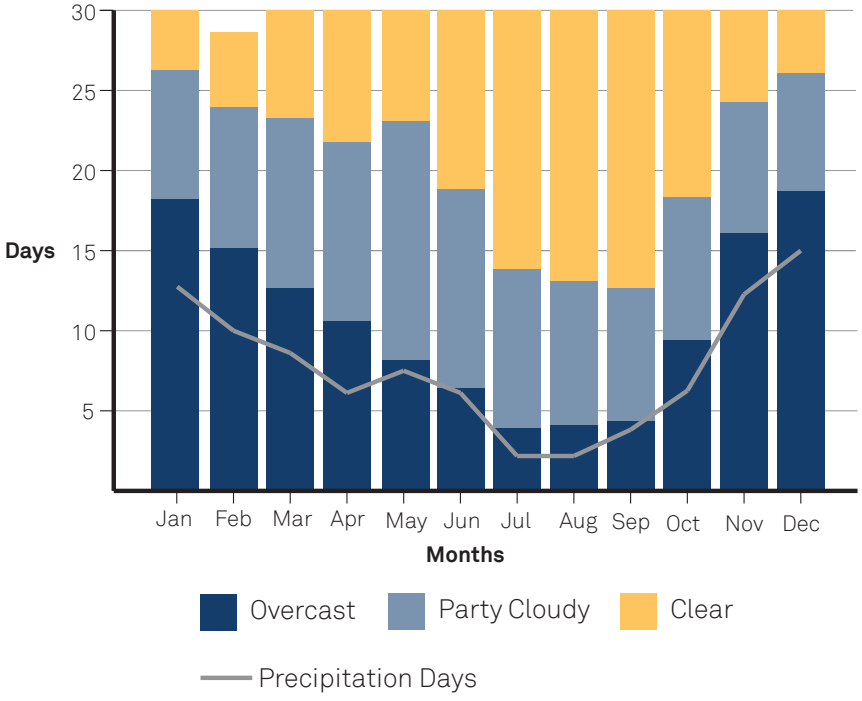


fig. 18 - Annual average temperature data for Wenatchee with design targets
fig. 19 - Sky cover and precipitation days for Wenatchee

Climate

The Wenatchee Valley bridges the wet Cascade Mountain Range and the dry plains of the Columbia Basin. The climate of the region can be characterized by elements of both climate zones with range in temperatures and differing sky conditions throughout the year.

Wenatchee sits at 1,243 feet elevation and latitude 47.2º North. This combination of elevation and latitude means the majority of the year, the sky conditions are either clear or partially cloudy producing an ideal environment for solar energy production.[84] While the clear skies are ideal for energy production shading interior spaces during the summer months is a key for maintaining a comfortable interior temperature. The range of temperate swings during the year requires a building design that can be appropriate for warm summers and cold winters. The summer months in Wenatchee vary greatly, as well, with an average summer temperature of 71º F but possible temperatures in the range of 98º F - 45º F.[85] The winter months average about 32º F but, like the summer months, they vary greatly with possible temperatures in the range of 48º F - 12º F.[86] The design of a building will need to factor a dramatic range of temperatures from 98º F during the hot summers but also as low as 12º F during the winter. Precipitation in Wenatchee varies greatly by the seasons with very dry summer months and wetter winter months. In total Wenatchee only averages about 9 inches of precipitation and 27 inches of snowfall each year. This leads to approximately 96 precipitation days each year.[87]

The climate information of Wenatchee highlights the need to design for a wide range of temperatures as a key for success. The sustainable design strategies that work with this goal include passive solar heat gains, sun shading, natural ventilation and winter heating.

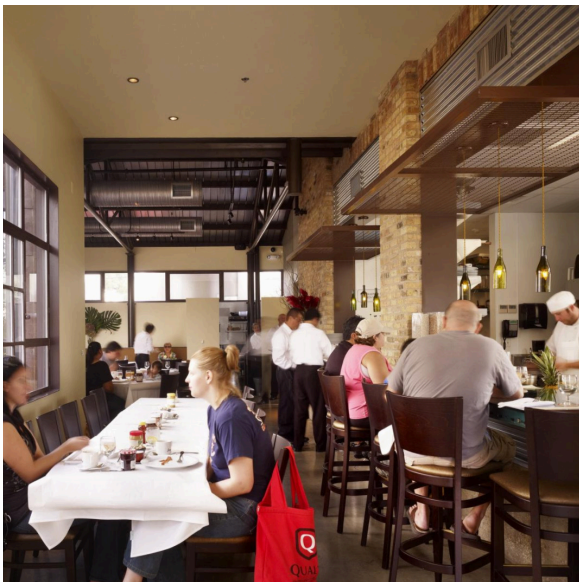


fig. 20 (left top) - Seattle Culinary Academy (Schacht Aslani Architects)
fig. 21 (right top) - Il Sogno Restaurant (Lake Flato Architects)
fig. 22 (left bottom) - Charles Smith Winery (Olson Kundig Architects)
fig. 23 (right bottom) - Seattle Culinary Academy (Schacht Aslani Architects)

5

Wenatchee and a Culinary Institute

The design program for this project must be connected to the historic building and the surrounding context. As Jack Pyburn states in his essay on architectural programing for historic buildings, “When considering a new use for a historic property, it is essential that there be a deep understanding of the building and its history as a component of the programing exercise...”[88] The connection between both the history of the building and physical constraints of the building are extremely important to determining an appropriate future use. Regarding the physical constraints of the existing building, Pyburn makes the point that understanding the physical constraints of a proposed building renovation are critical to an overall successful project. He uses the example of a building that has historically been a dormitory building would not make an ideal candidate for a program that requires a raked floor lecture hall. Such a drastic program change would have negative impacts on the character of the building as well as the budget.[89]

This project will require an adaptable program that has a variety of spatial (large spaces and small spaces) requirements to allow a flexible implementation of the program. A culinary school satisfies the requirement of an adaptable program type. A culinary school also satisfies the requirements for community revitalization with a clear connection to the history, current conditions and future of Wenatchee. These connections can be seen in the agriculture, future labor market, and the lack of a culinary school in the area.

Agriculture

Agriculture is a pillar of the economy of Washington State particularly in central Washington where agriculture is the leading employer in many counties.[90] Chelan County is no different with almost 25% of the labor force employed in an agriculture-related industry.[91] This is a common thread that connects all the counties of North-Central Washington. This five county area (Chelan, Okanogan, Douglas, Kittitas and Grant) accounts for over 3.2 million acres of farmland (22% of the total farmland in WA) while also accounting for almost $2.6 billion (28% of the total value of Washington's agriculture industry) worth of crops like apples, potatoes and wheat.[92] Wenatchee, the largest city in Chelan County and the area, sits at the center of this massive area of agricultural production.

Current trends in the culinary world highlight the entire cycle of food from the fields to the forks. The Farm-to-Table movement has created a more holistic understanding of dining as part of a larger system.[93] Many culinary schools have tailored their education programs to focus on these holistic studies of food systems. Seattle Central's Culinary Arts Program has customized its curriculum towards these holistic views. Seattle Central offers options for students to concentrate their degrees in sustainable farming and cuisine.[94]

With a downtown Seattle campus though, the actual connection to a farm is rather difficult. As a result, Seattle Central has partnered with a farm in the Skagit Valley (an hour and half drive from Seattle Central) and a farm in Spokane (five and half hour drive from Seattle Central). These connections allow students a hands-on experience in the food system but, with a considerable distance between the farms and Seattle Central, these connections can not be regular. The Wenatchee area has an opportunity to develop a culinary program with closer connections to farms in the Wenatchee Valley allowing an enhanced educational experience as well as an opportunity to highlight agriculture as the economic pillar of central Washington.

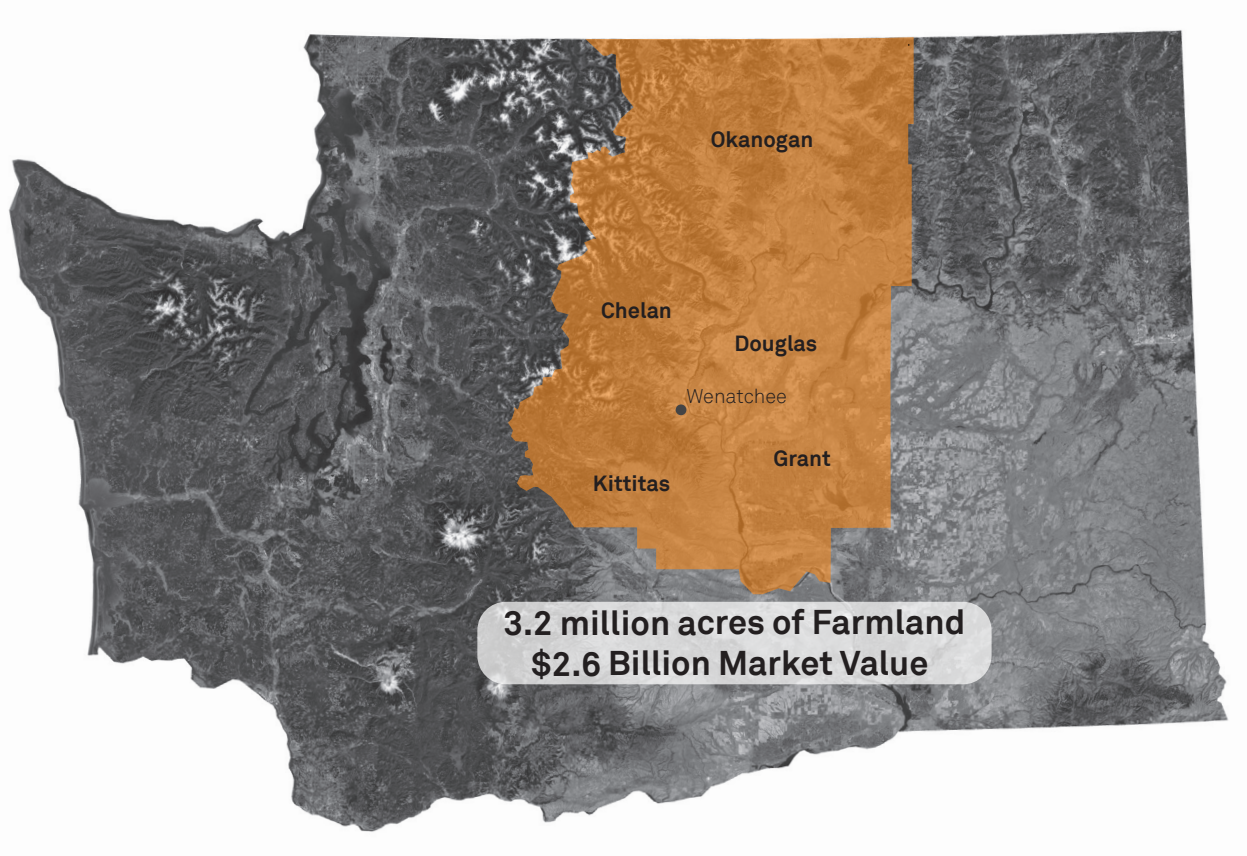


fig. 24 - The agricultural impact of the five county area

Future Labor Market

As a workforce training program, a culinary school needs a community with a demand for chefs to be successful. One factor that can greatly impact the demand for chefs is tourism; as more people travel to Wenatchee, more restaurants will be needed. Wenatchee's location at the base of the eastern slope of the Cascades Mountain Range and at the confluence of the Columbia and the Wenatchee Rivers has an excellent combination of natural features to attract recreational sports tourism. The area is considered to be a four-season outdoor recreation mecca.[95] Winter sports areas are within a short drive. Spring, summer and fall activities like hiking, biking, and rafting are all great options in the Wenatchee National Forest or along the Columbia River and its tributaries. These connections to Wenatchee highlight a possible level of tourism growth in the near future. This increase in tourism will create a demand for skilled chefs in the Wenatchee area and the Wenatchee Valley Culinary Institute satisfies that need by educating the future chefs of the Wenatchee area.

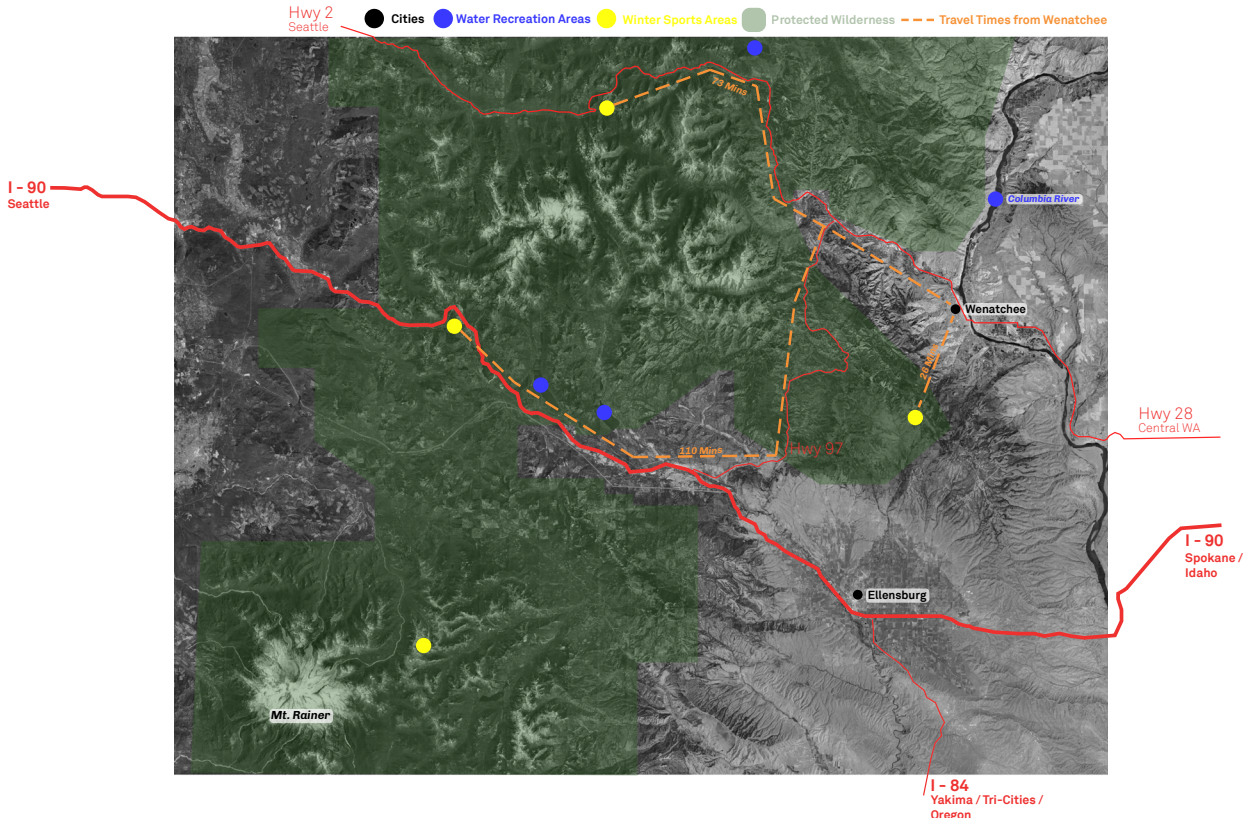


fig. 25 - Major recreational opportunities near Wenatchee with travel times

Lack of a Culinary School

The traditional model for establishing a culinary school is a connection to an existing larger institution like a community college. Certain schools like the Culinary Institute of America exist as a self-contained educational organization but those are not the standard. In the five county area of North-Central Washington there exist four community colleges including the Wenatchee Valley Community College in Wenatchee. None of these community colleges currently offer a culinary arts program. As the center of this five county region, Wenatchee has the opportunity to serve the entire area and fill a need for culinary education in the region.

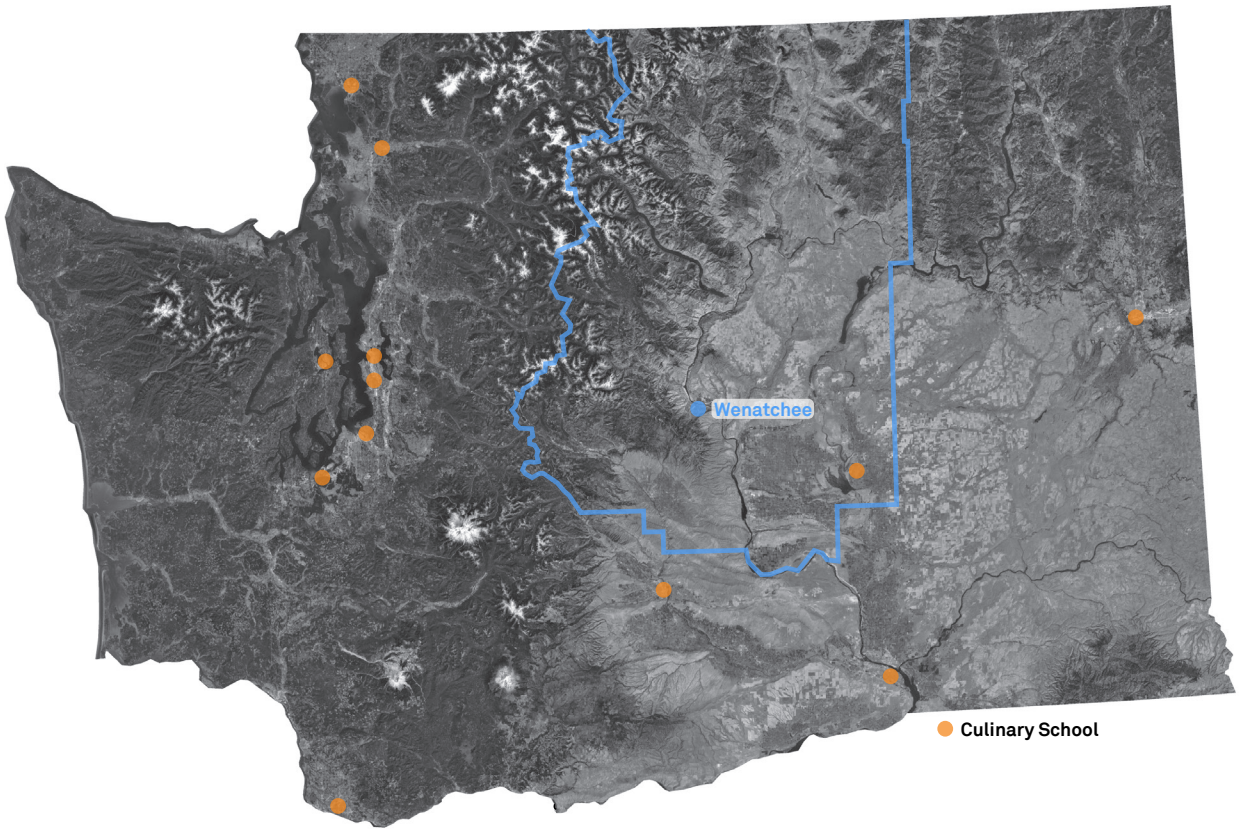


fig. 26 - Culinary schools of Washington

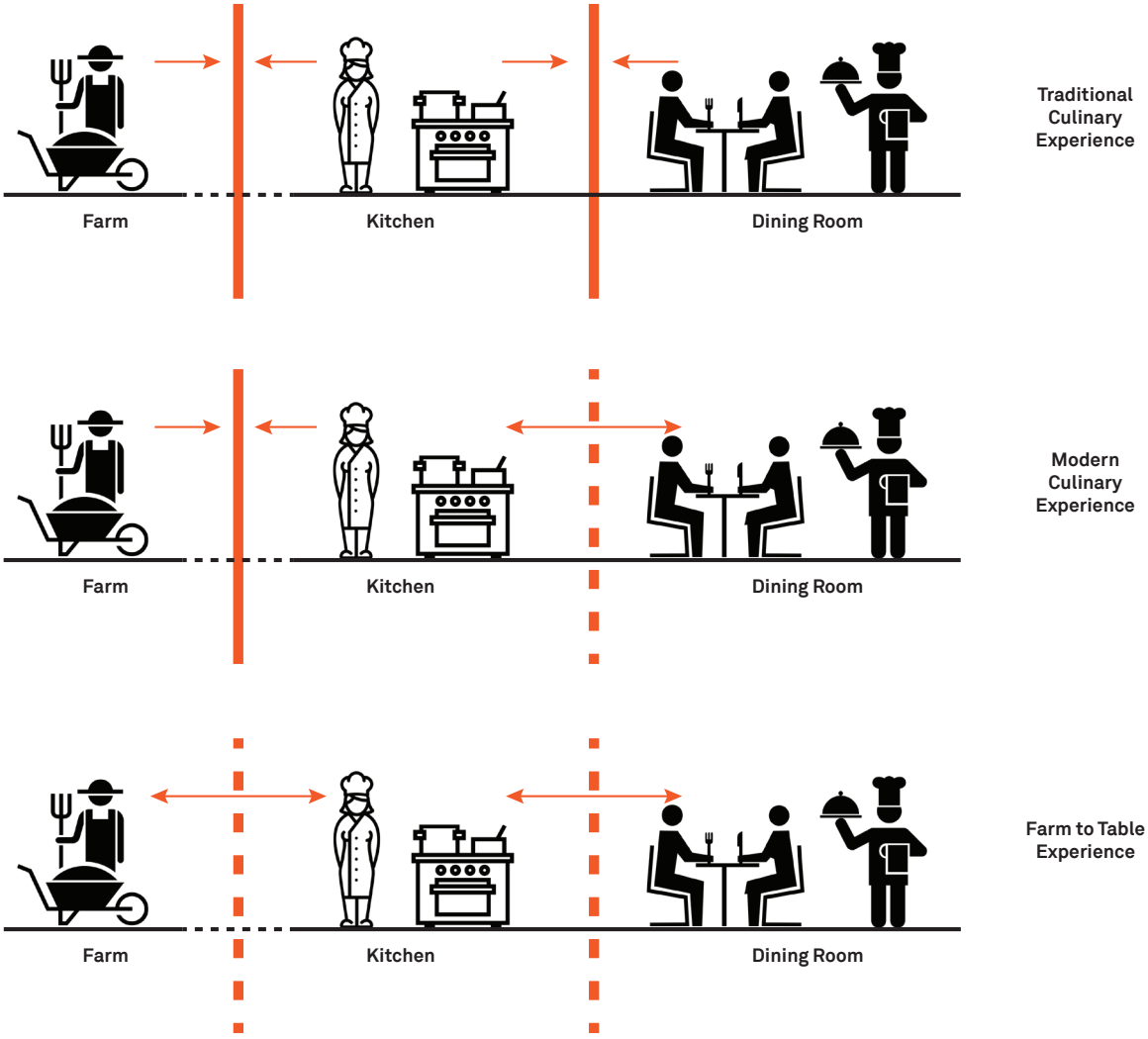


fig. 27 - Experience of Dining through History

6

Culinary Institute Program

History / Theory of Culinary Education

American culinary schools are closely tied to the history and development of French cuisine in the 18th century.[96] During this period of time, chefs for the aristocracy began to use of the rhetoric of art to distinguish their trade from the common people's cooking. The traditional European model of culinary education was based on the apprenticeship model common in many trades of the time. In this model, boys would work for a master chef for six years working on a variety of tasks but they were more viewed as a labor pool for the chef rather than an educational experience.[97] The apprenticeship model never gained popularity in the United States and by the late 1890s a model for a formal culinary education in the United States began to take form. This growth of the formal education coincides with American's cravings for fine dining opportunities.[98] Over the next couple of decades, the American model of culinary education begins to take the form that still exists today.

Culinary education in the United States currently exists in three forms: 1) private, non profit schools, 2) private proprietary schools, 3) public, vocational community colleges.[99] While the first two forms have more acclaim and publicity like the Culinary Institute of America or Johnson & Wales University, the majority of students are educated in the third type, public/vocational community colleges because of the lower costs and higher level of access. All three of these culinary education forms, have a main emphasis on the hands-on skills of cooking and restaurant management with differing levels of the theoretical and historical principles of cuisine.[100]

Culinary school programs commonly offer a variety of degree / certificate options for students to tailor their education including Associate's degrees, professional certificate programs and baking/pastry arts. Culinary education attracts a wide range of students including first time students, older career changers and industry professional looking for career advancement. This wide range of the students is due to the nature of culinary education which emphasizes hands-on training over classroom education as well as the flexible nature of programs to tailor programs to the working individual. The main skills that graduates are looking for are in: food preparation and kitchen management. Both of these skill areas lead to a graduate with the technical skills to succeed in the culinary world but also the skills to manage employees and kitchen processes which allows for career advancement.

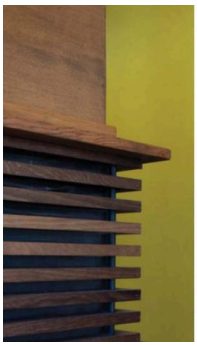
Culinary School - Specific Design Challenges

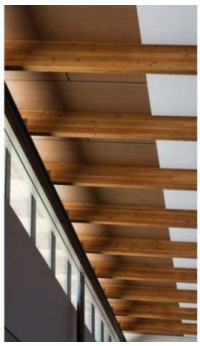
The design of a culinary school presents two specific challenges including varying program functions and energy consumption / equipment integration.

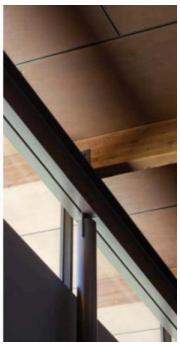
The culinary school program includes elements from educational facilities, restaurants and office buildings into single facility. All three of these programmatic elements necessitate their own set of requirements and design solutions to be successful. A culinary school has to combine all three elements together without comprising the individual requirements and the overall design strategies.

Energy consumption and equipment integration are critical issues for culinary schools because of the amount of energy needed to produce food and the necessary equipment to do that successfully.[101] Energy consumption data for culinary schools are not widely reported but considering a standard restaurant has an EUI 223 or about 4 times as much as a commercial office space and a culinary school combines the elements of multiple restaurants into one facility, the energy consumption for a culinary school is going to be high.[102] Along with the energy consumption, equipment integration is an important consideration for a culinary school design because of the size of the equipment needed to both cook the food and also vent exhaust air while still allowing for an effective learning environment.

The following case studies deal with these specific culinary school issues in a number of different ways and give a range of examples for how culinary schools are presently being designed. These case studies also highlight the need to not only fulfill the programmatic requirements for a culinary school but good design is integral to a successful culinary school project.







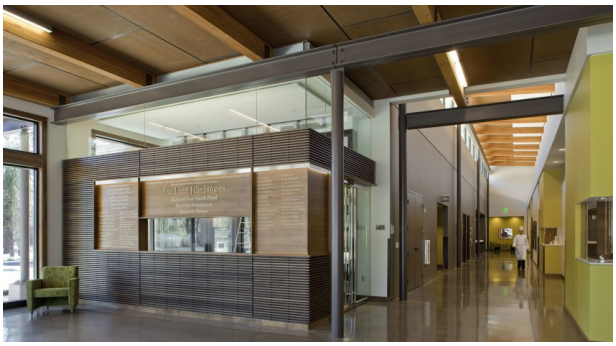


fig. 28 (photos) - Exterior and interior photos of Jungers Culinary Center
fig. 29 (plan) - Jungers Culinary Center plan with programmatic elements highlighted

Jungers Culinary Center - Central Oregon Community College

Yost Grube Hall | Bend, OR | 2012 | 15,000 square feet

Facility

The Jungers Culinary Center was designed from the outset to be a multi-functional facility. It consists of the standard cooking school components of teaching kitchens and classroom spaces along with dining opportunities for the public. The facility also has the ability to host community events in the large demonstration kitchen. The regional nature of the culinary program is highlighted through its use of materials (glu-lam beams and wood siding) which connect with the surrounding forests of Central Oregon.[103]

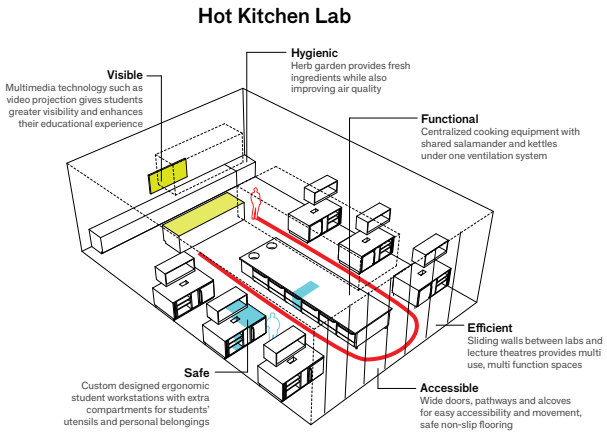
Culinary School Program

Central Oregon's Cascade Culinary Institute focuses its educational program on sustainable restaurant practices including farm-to-table cuisine and Eat Local principles. There are two program paths, a two year degree and a one year certificate program with both programs having a 70-30 ratio of hands-on training and culinary theory.[104]

Design Strategies / Lessons

The blurring of spaces of the culinary school and the public interaction is a key to the success of this building. While the culinary school program activates the facility during the hours of 9 - 5 during the week, the ability to have a restaurant with a dinner service and a demonstration hall for public use allows to expand the active hours of the building into nights and weekends as well. This could have been accomplished with separated spaces but by blurring the lines between the public and private (student) spaces the entire building is able to be used and not just certain sections.

80 Students | 3 Instructional Kitchens | 1 Demonstration Hall | 90 Seat Restaurant



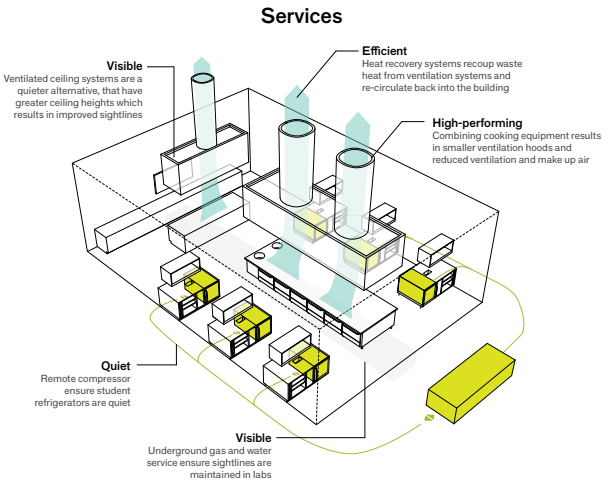


fig. 30 (photos) - Exterior and interior photos of the Centre for Food
fig. 31 (diagrams) - Gow Hasting diagrams of standardized kitchen design templates

W Galen Weston Centre for Food

Gow Hastings Architects | Whitby, Canada | 2014 | 36,000 square feet

Facility

The Centre for Food at the Durham College of Applied Arts and Technology anchors a wide variety of programs including culinary arts, horticulture and hospitality management. Located next to a small farm, the facility highlights the connection between food production and culinary arts with a combination of views and direct connections. The facility consists of a combination of kitchen labs, classrooms and a restaurants which all offer glimpses to other programmatic elements, overall enhancing the design narrative of Field-to-Fork which includes farming, preparing, serving and celebrating.[105]

Culinary School Program

Durham College's Culinary program focuses Field-to-Fork concept of cuisine in two programs offered, a two year and a one year program. Students are able to gain experiences in all aspects through hands-on experiences in the adjacent fields and greenhouses along with the large public restaurant.[106]

Design Strategies / Lessons

Gow Hastings, the architects for this project, are well known in Canada for their culinary school designs and they have developed a standard template for the kitchen spaces that prioritizes functionality and energy efficiency. This standardization of the design of these spaces allows them to focus on what they call "leftover" spaces as places of social interactions and educational explorations. The connection to the adjacent field is key to not only the success of Durham College's Culinary program but to the overall success of the building and the surrounding campus.

200 Students | 150 Seat Demonstration Hall | Atrium Event Space | 70 Seat Restaurant

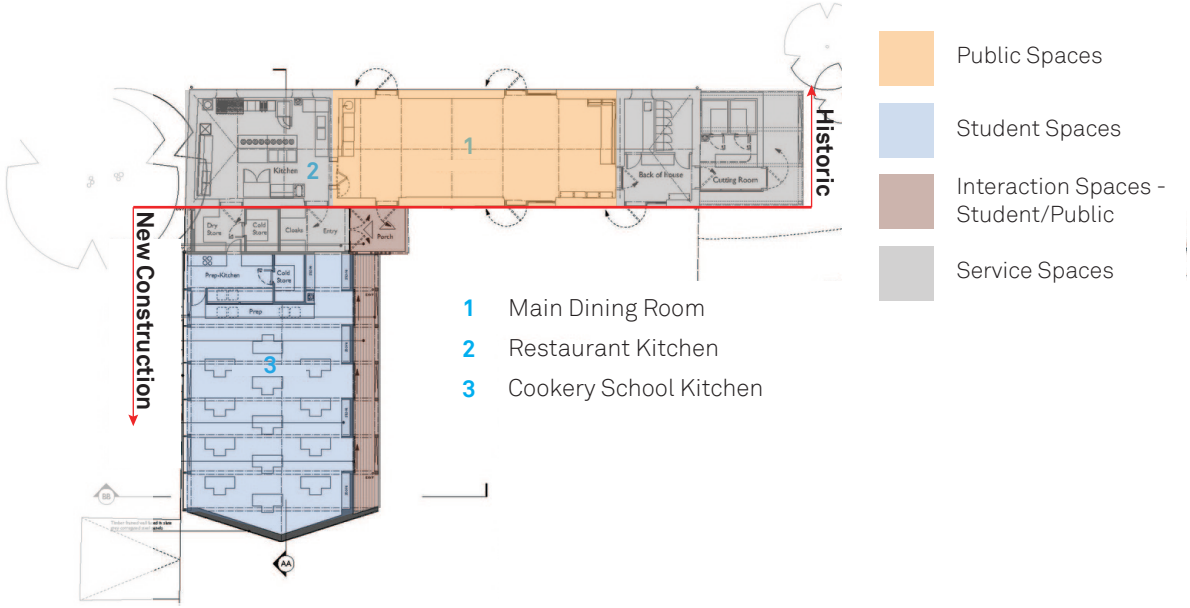


fig. 32 (photos) - Exterior and interior photos of the River Cottage Cookery School
fig. 33 (plan) - River Cottage plan with programmatic elements highlighted

River Cottage Cookery School

Satellite Architects | Devon, England | 2015 | 3,100 square feet

Facility

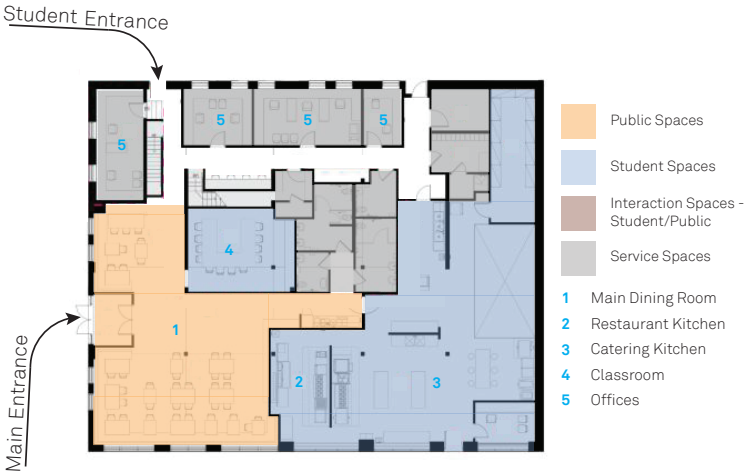
The River Cottage Cookery School located in the countryside of England combines a 17th century farmhouse and a new addition. The dining room / flexible event spaces is located in the historic farmhouse and the educational kitchen is located in the new addition. The school highlights the delicate nature of adapting historic buildings along with a modern addition. The exterior cladding of the new addition are in stark contrast with the historic structures but these contrasts are muted with the wood interior structure and building's gable form.[107]

Culinary School Program

The River Cottage Cookery School lacks a traditional culinary school model and offers programs ranging from one day to one week for the public. It also offers limited long term programs for industry professionals. All the programs highlight the connection between the working farm at River Cottage and the restaurant with training in the growth of produce and livestock and the culinary uses for them .[108]

Design Strategies / Lessons

River Cottage Cookery School offers an experience that most people would not be able to have in there normal lives; cooking education from professionals on a working farm. Since there are no traditional students at the Cookery School the blurring of public and student is important and achieved with a direct connection between the learning kitchen and the dining room. A major lesson from this project as well is the connection between the historic building and the new addition and the use of materials to make a bold contrast while still making the building complement the whole site.



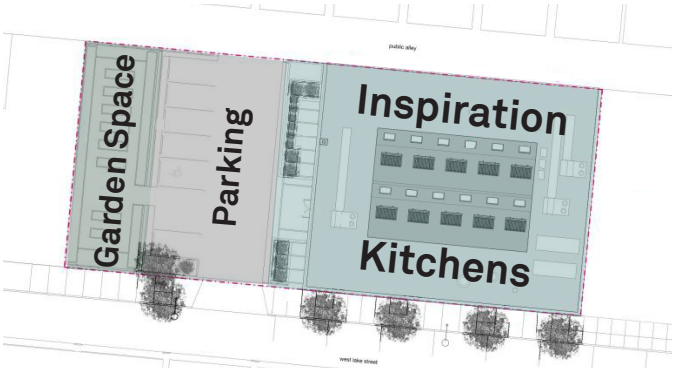


fig. 34 (photos) - Exterior and interior photos of Inspiration Kitchens
fig. 35 (plan) - Inspiration Kitchen plan with programmatic elements highlighted
fig. 36 (site plan) - The three underused lots enhanced by Inspiration Kitchens

Inspiration Kitchens

Wheeler Kearns | Chicago, IL | 2011 | 7,800 square feet

Facility

Inspiration Kitchens occupies a 1906 warehouse building in Chicago's Garfield Park area which has been renovated along with two adjacent lots. These lots now include parking and an urban garden used by the kitchen for herbs and vegetables. The interior highlights the character of the hundred year old building while the exterior has been renovated extensively to improve the performance of the building dramatically lowering the operational energy use but still has the character of the community.[109]

Culinary School Program

Inspiration Kitchens offers a free 13 week job training program to people in life transitions. Through the program these individuals learn hands-skills working in the restaurant's kitchen which serves both subsided meals to the poor along with full price meals and catering events. The program not only provides the hands-on skills but pre-employment skills training as well.[110]

Design Strategies / Lessons

Inspiration Kitchens operates on a traditional restaurant model of the separating kitchen space from the dining experience which allows the 20 students at anytime working in the kitchen to focus on their tasks of learning and cooking. The experience of the patrons of the restaurant is where the lessons of this project are clear. By renovating this existing building, a new experience was created in the restaurant space highlighted by the exposed beams and wood details. The other part of the project that has good lessons is in the outdoor garden space. The connection of culinary arts and food production is very important and by enhancing a formerly vacant spaces with a garden space there is a double impact.

20 Students | 1 Restaurant Kitchen | 1 Catering Kitchen | 80 Seat Restaurant

Case Studies - Programs

The case studies use a variety of different strategies to integrate the different program elements into a single facility. The case studies breaks down the program elements into three spatial groups. These three groups are:

Training

Training includes the spaces where students have their hands-on environment to learn through experience: the teaching kitchens and baking kitchens.

Learning

Learning consists of the spaces were the educational experience less hands on. These spaces include the large lecture hall, small lecture hall, classrooms and the library. The culinary arts curriculum focuses heavily on the hands-on learning but for a well-rounded student, classroom functions are necessary.

Along with the classroom environments, learning also consists of the spaces dedicated to the administration of the Institute. These spaces include the administration offices, faculty offices and student facilities. These spaces are critical to the overall success of the program.

Public

Public consists of the community front of the Culinary Institute including the lobby area along with the restaurant and bakery shop. These spaces are where the public not only is able to see the activity and experience the foods of the culinary school.

Through the analysis of the case studies and similar projects the appropriate size for this study will be 43,000 square feet. This gives rooms for all the programmatic elements defined above along with the other necessary spaces for a functional building

Case Studies - Design Strategies

Program Integration

The culinary school program has such a diversity of spaces with requirements for large open spaces in the lecture hall to small office spaces and the case studies all take a different approach to handling this diversity. A key that does connect all the projects together, though, is an integration of spaces. In the Jungers Culinary Center this meant a clear connection between the public and private (student) spaces of the center. While at Inspiration Kitchens, the use of the exterior garden connects the public on the street to the activities of the building.

Culinary School as Community Amenity

The idea of this culinary school as an amenity to the community is another connection between these case studies. The exterior garden at Inspiration Kitchens is a clear example of this amenity idea and the ability for this project to enhance the whole community by re-purposing underused spaces. This idea of exterior amenity is common in both the Jungers Center and G Weston Centre for Food which are both proposed as anchors for new additions to the current academic campuses.

Material and Form Contextuality

A clear connection to the context around the project will be key to success as well as shown in the case studies. The form and materiality of the River Cottage and the Jungers Center, both have clear connections to their respective surroundings. These connections root the buildings into places and enhances the quality of the surrounding spaces without overpowering.

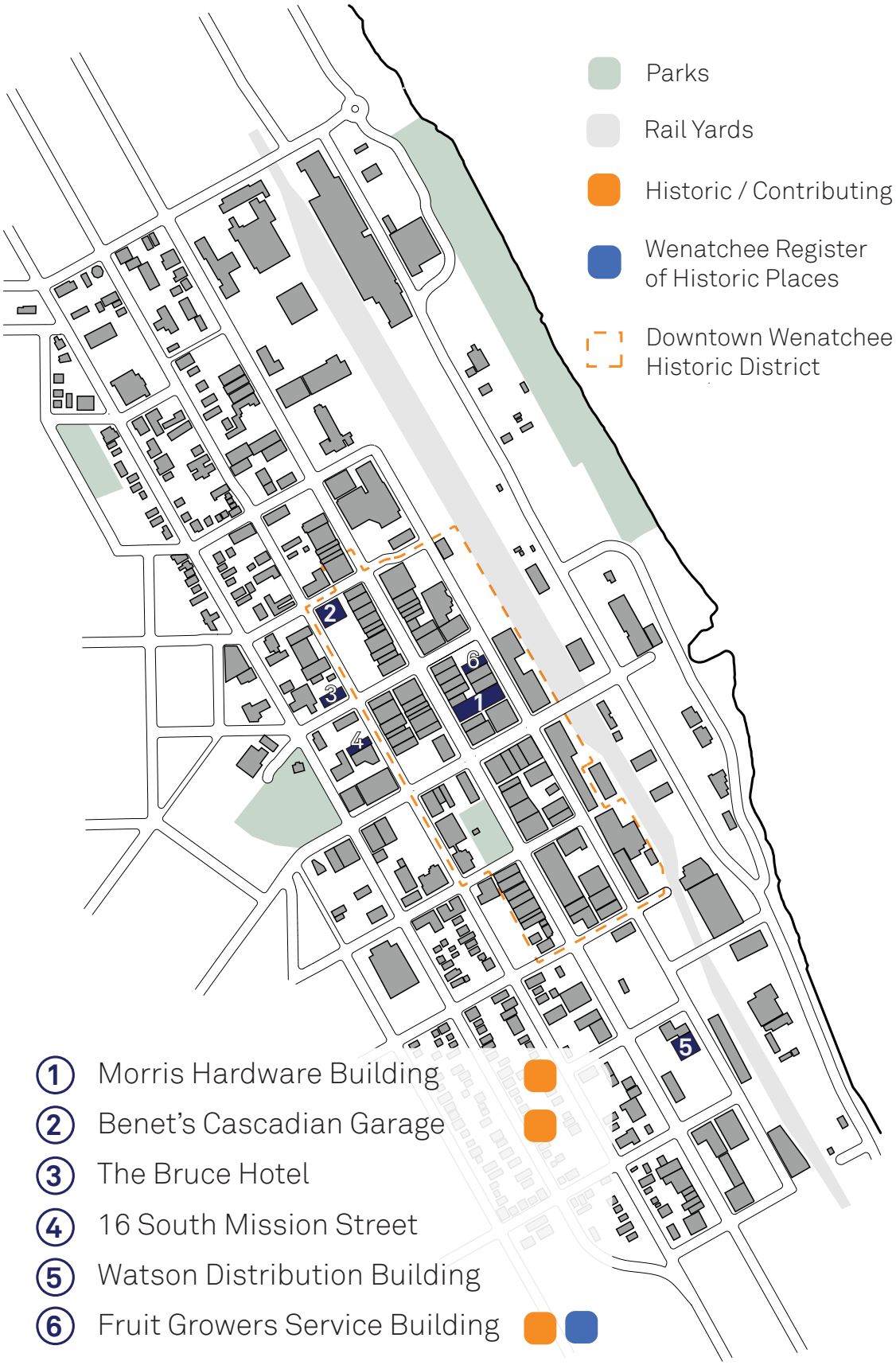


fig. 37 - Map of Wenatchee with the six building options

7

Building Selection

Criteria based on original construction era, location and building style were used to determine possible building options. The criterion of original construction era (pre-World War II) was determined by considering current energy use by construction vintage which shows that the lowest current energy use comes from buildings prior to World War II. Location was a key determining factor as a broad definition. The building needed to be located in the downtown core of Wenatchee as this area combined the existing historic building stock as well as the urban development opportunities to revitalize the area.

From these two criteria, the possible building options were narrowed to six and these buildings will be further analyzed below to determine the ideal location for this project.

1

Name - Morris Hardware Building
(23 South Wenatchee Avenue)

Year Built - 1910

Material - Masonry / Wood

Approximate Size - 36,000 square feet

History - Formerly a store and warehouse for Morris Hardware Company, the largest hardware firm in the region

2

Name - Benett's Cascadian Garage
(33 North Mission Street)

Year Built - 1927

Material - Reinforced Concrete

Approximate Size - 36,000 square feet

History - Auto repair garage (1927 - 1980) converted to mini-storage

3

Name - The Bruce Hotel
(206 Palouse Street)

Year Built - 1922

Material - Masonry / Wood

Approximate Size - 18,000 square feet

History - Luxury hotel converted into transitional housing for the homeless

4

Name - 16 South Mission Street

Year Built - 1922

Material - Masonry / Wood

Approx. Size - 11,000 square feet

History - Unknown history, currently offices for an insurance company

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5

Name - Watson Distribution Building (410 South Columbia Street)

Year Built - 1918

Material - Masonry / Wood

Approximate Size - 21,000 square feet

History - Warehouse for distribution of fruits/produce, currently a church

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6

Name - Fruit Growers Service Building (10 South Columbia Street)

Year Built - 1926

Material - Masonry / Wood

Approximate Size - 18,000 sq. ft.

History - Warehouse for distribution of fruits/produce, currently office space and gymnastics studio

* Building Information[111]

Building Selection Criteria

This study will use three criteria to determine which building will be best suited for the new Wenatchee Valley Culinary Institute: size of the existing building and location.

Size of Existing Building

The size of the existing building that will be adapted in this design proposal is extremely important. An objective of this design proposal is not only to renovate an existing building but addressing the challenges of adding to an historic existing building with high performance design. The size of the program for the Wenatchee Valley Culinary Institute is approximately 43,000 square feet with the goal of tactfully adding to an existing building, the ideal square footage for an existing building ranges from 15,000 – 25,000 square feet.

Location

Location is a key factor to the design proposal especially when considering that certain programmatic elements (restaurant, bake shop and café) would benefit from pedestrian activity. Currently, the majority of pedestrian activity in Wenatchee is concentrated along the historic Wenatchee Avenue. Proximity to Wenatchee Avenue is an important consideration for the success of this project.

Based on these criteria, the Fruit Growers Service Building was selected to serve as the location for this design case study.

	Building Name	Existing Square Footage
1	Morris Hardware Building	36,000 square feet
2	Benet's Cascadian Garage	36,000 square feet
5	Watson Distribution Building	21,000 square feet
3	The Bruce Hotel	18,000 square feet
6	Fruit Growers Service Building	18,000 square feet
4	16 South Mission Street	11,000 square feet

Ideal Range of Existing Square Footage

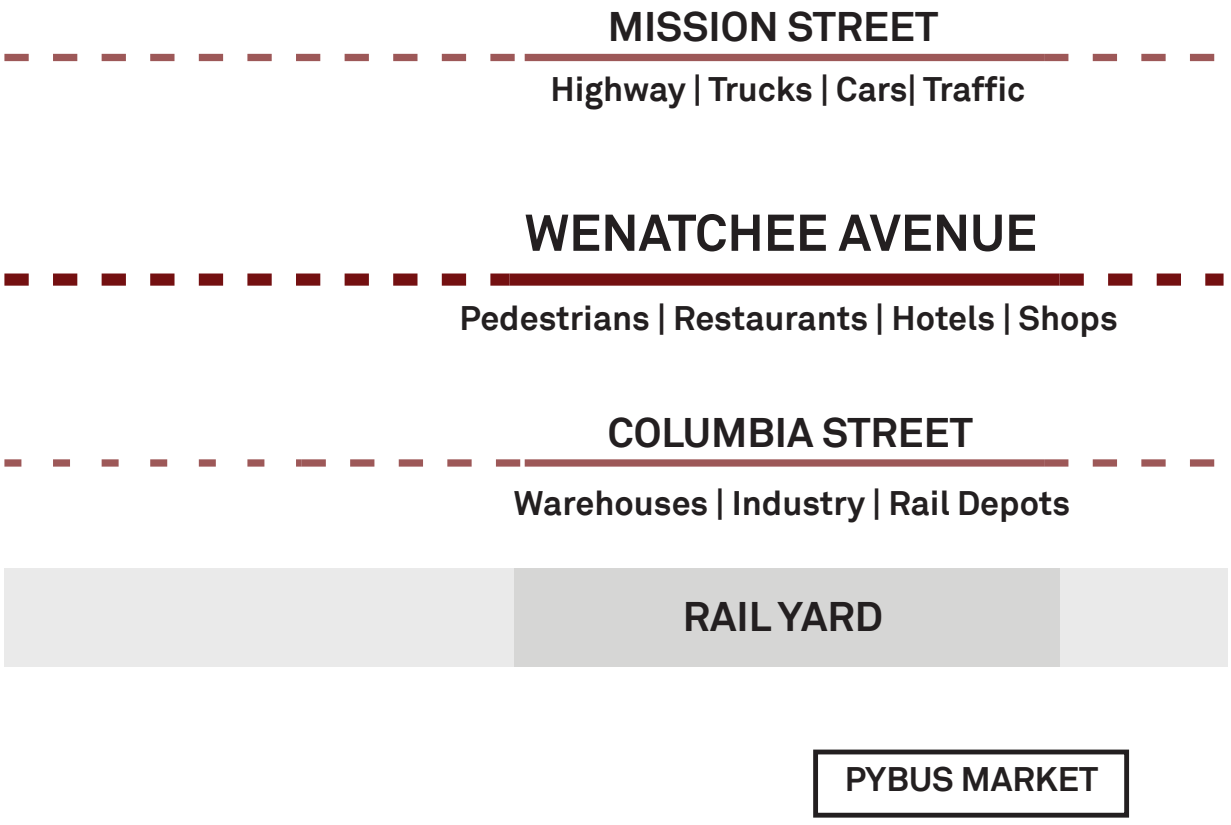


fig. 38 - Ideal range of the existing building for this project
fig. 39 - Diagrammatic map of downtown Wenatchee

fig. 40 - Fruit Growers Service Building - Corner of Columbia Street and Palouse Street
fig. 41 - Fruit Growers Service Building - Palouse Street Elevation

8

Fruit Growers Service Building

Physical Description

The Fruit Growers Service Building is a three-story unreinforced masonry building with a heavy timber interior structure. The building measures 120 feet by 51 feet and sits on a small slope from Columbia Street towards the alley with the first floor being partially underground. During the 1960s the interior was altered and most of the second floor was removed, creating a small mezzanine on the second floor. This altered interior resulted in large floor to floor heights of over 18 feet on the first and third floors. The building current lacks any seismic upgrades.[112]

Parts of the building are considered to be historic and others, through the years, have been altered and are not historic. The masonry structure is a defining feature of the building and is considered as a historic element of the building. The ground floor elevation and canopy on the east facade have been highly altered. All the windows except the eight second floor windows on the east facade have been replaced with energy efficient windows of similar color and style to the original.[113]

History

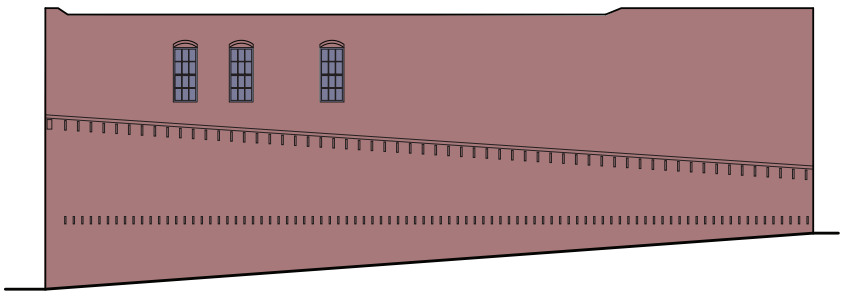
The Fruit Growers Service Building was constructed in 1926 as a warehouse for the storage of fruits and produce. Along Columbia Street, during the 1920s, numerous buildings related to the storage and transportation of agricultural products were built.[114] This growth gave Columbia Street the nickname of Produce Row. The building, for most of its life, has served as a produce storage facility but it is currently occupied by several small businesses including a gymnastics studio and office spaces. The Fruit Growers Service Building is an example of that period and style which has gained it historic significance to the Wenatchee community and listing on the City of Wenatchee Register of Historic Properties along with being historic and contributing the overall Downtown Wenatchee Historic District.[115]

Zoning

The Fruit Growers Service Building is located in the Central Business district of Wenatchee as well as both the Historic/ Entertainment Overlay and the Columbia Street Overlay. The Central Business District has the overall goal of developing the Wenatchee downtown into a vibrant economic district. This zoning designates the height limit for this project to be 85 feet tall.[116] The Historic/Entertainment Overlay outlines the main goal of the district as achieving active storefronts as a complement to the historic architectural character of the neighborhood.[117] In addition to the Historic district, the Fruit Growers Service Building is located in the Columbia Street Overlay which advocates the preservation of the industrial buildings along Columbia Street by allowing new uses.[118]

Overall the City of Wenatchee does not have guidelines for building in the historic district other than new buildings should be compatible with the size, scale, color, material, and character of the neighborhood.[119]

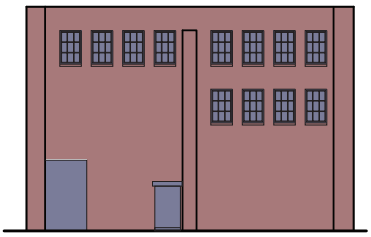
East Elevation



North Elevation

Historic Element

Non - Historic Element



West Elevation

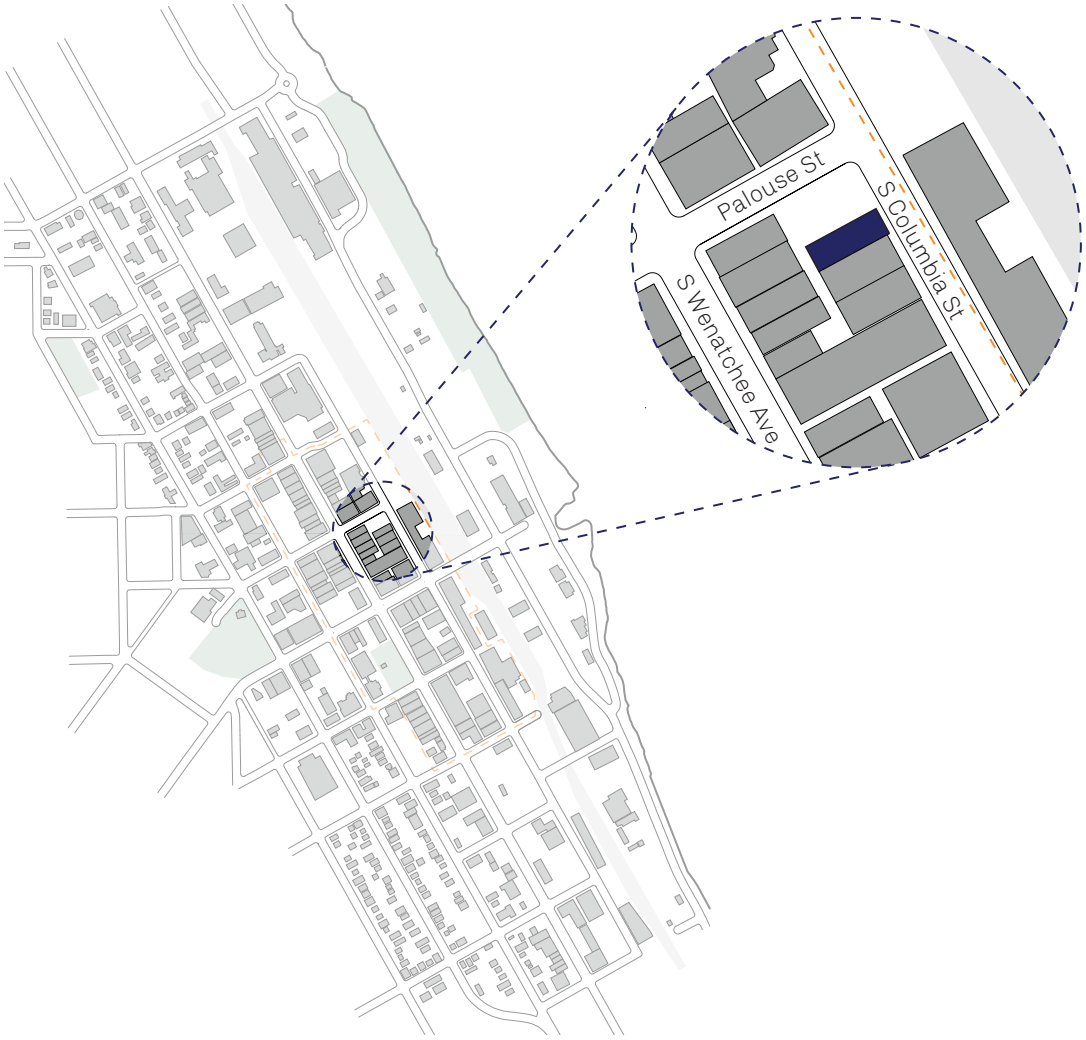


fig. 42 - Historic and Non - Historic Elements of the Fruit Growers Service Building
fig. 43 - Map of Wenatchee with Fruit Growers Service Building highlighted

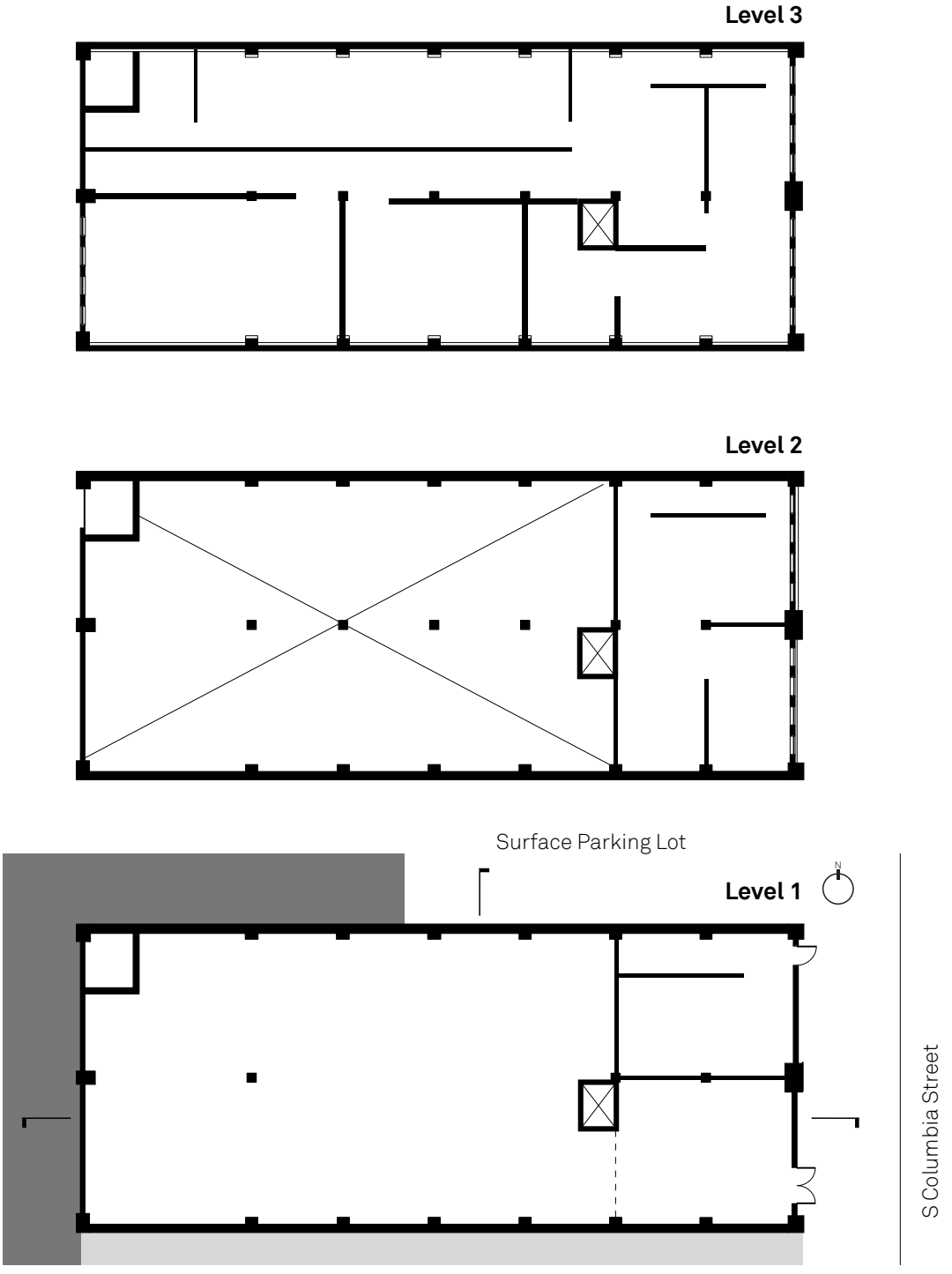


fig. 44 - As-Built Plans - Fruit Growers Service Building

Name - Fruit Growers Service Building
(10 South Columbia Street)

Year Built - 1926

Material - Masonry / Wood

Approximate Size - 18,000 sq. ft.

History - Warehouse for distribution of fruits/produce, currently office space and gymnastics studio

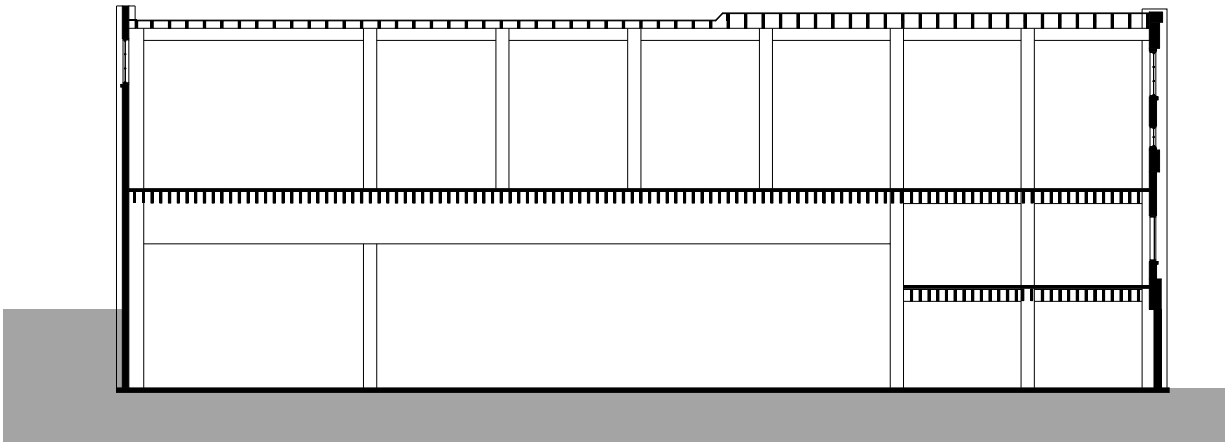


fig. 45 - Photo - Fruit Growers Service Building
fig. 46 - As- Built Sections - Fruit Growers Service Building

9

Total Carbon Design

Framework

A total carbon design approach, unlike high performance design that predominately accounts for operational carbon impacts, accounts for both initial carbon impacts from construction as well as operational impacts. To account for these carbon impacts, two metrics are used. Life cycle assessment (LCA) is used to account for initial carbon impacts. Site energy use intensity (EUI) can be used to determine operational impacts. This project accounts for both of these sources of carbon emissions and uses this quantifiable data as a point of comparison for similar sized projects with the variables of new construction, total retrofit and a hybrid strategies (new construction and retrofit). By comparing initial and operational carbon emissions, the long term benefits of a scheme can be fully analyzed.

Initial Carbon Impacts

Life Cycle Assessment (LCA) is a standardized accounting of the environmental impacts of a particular product or process throughout its life cycle, from product to end of life disposal.[120] It was originally used in the manufacturing industry as a way to track the impacts of particular products in an industrial process. These assessments vary in scale from single products, all the way to whole building assemblies where the impact of each product in a building is inventoried together.[121]

Evaluating the total impact of a building, all the phases of a product/materials life cycle must be considered. This project will use a cradle-to-grave approach to the life phases were the carbon impacts will be accounted for from initial material extraction, manufacturing, construction, building use (replacement/maintenance) and demolition/disposal. These phases constitute the three standard stages of an LCA; Stage A – Product / Construction Process, Stage B – Use, Stage C – End of Life.[122]

This project used simplified LCA data to determine the approximate impacts of the schemes analyzed. This simplified LCA data used square footages and levels of magnitude for structural, foundational and envelope components to determine the approximate impacts.

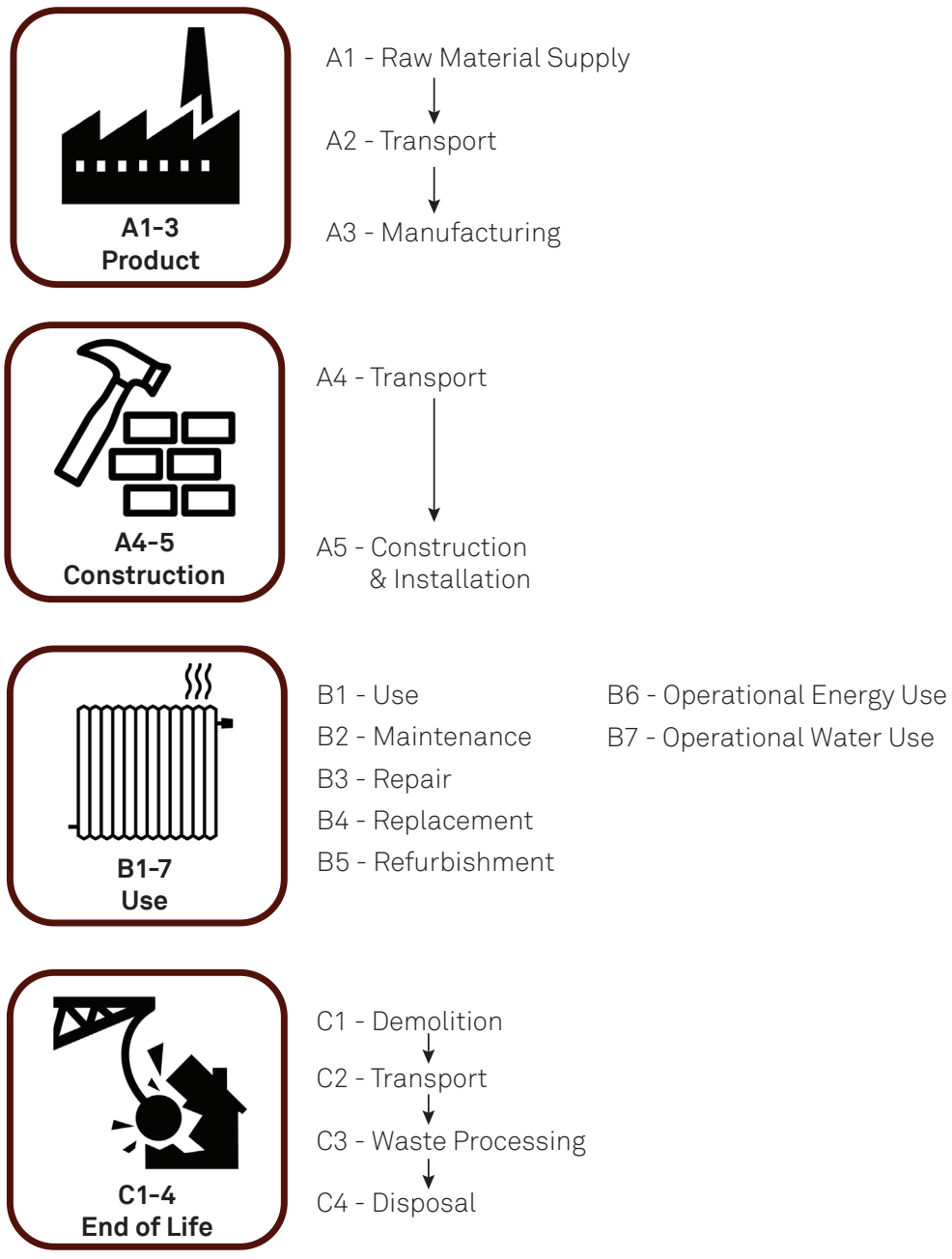


fig. 47 - Standard Life Cycle Assessment Stages

Operational Carbon Impacts

Operational carbon impacts can be estimated through the use of Site Energy Use Intensity (EUI). Site EUI accounts for all the space heating, cooling, ventilation, lighting and plug loads for building minus the on-site energy production during a year. The total building energy consumption can be used to estimate the carbon impacts of energy production based on the regional mix of energy sources on the grid.

This project used Architecture 2030's Zero Tool to estimate both the EUI and the yearly carbon emissions based on the mix of energy sources for a baseline culinary school in Wenatchee.

See figure 48 for culinary school baseline performance.

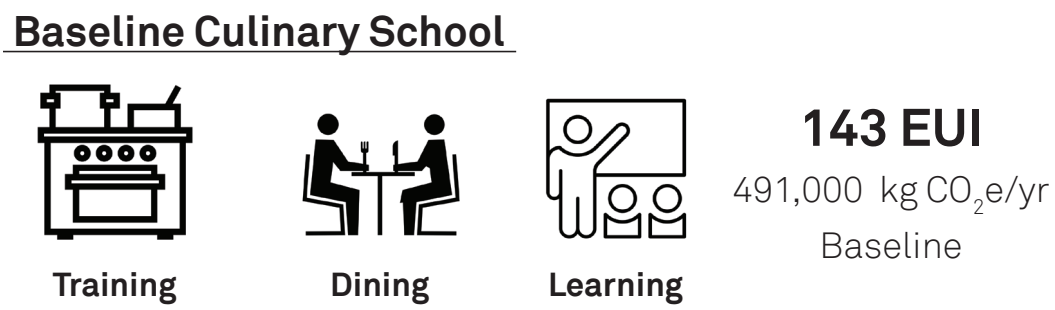


fig. 48 - Baseline Culinary School Energy Performance

Operational Carbon Impacts

Site Energy Use Intensity (EUI)

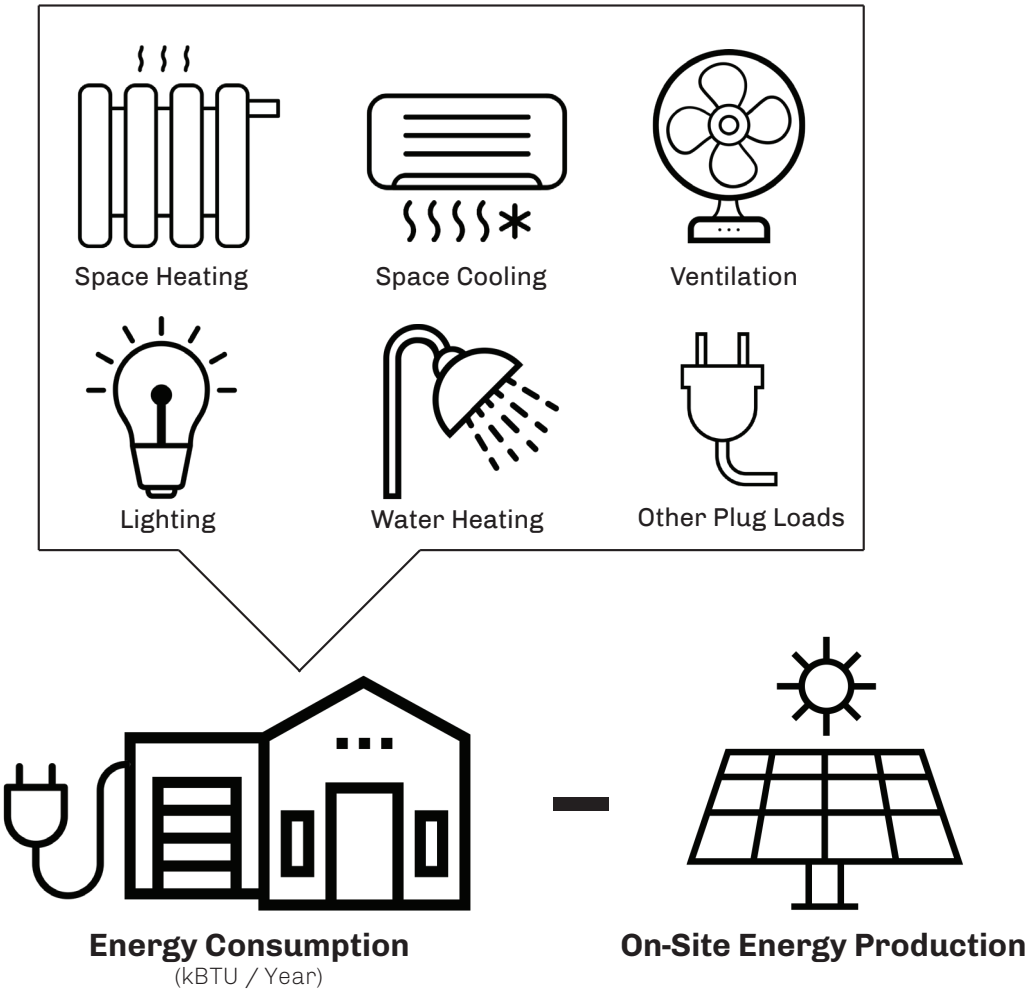
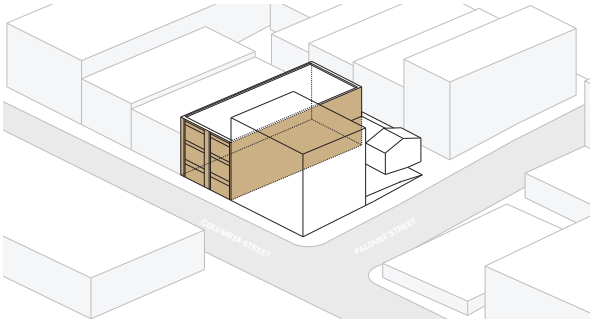


fig. 49 - Site Energy Use Intensity (EUI)

Operational Targets

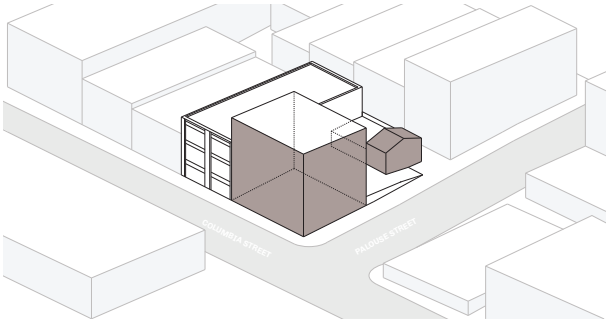
Based on case study examples, operational targets were different for the existing building and the new high performance addition. The existing building targeted a 40% reduction in operational energy. The 40% reduction was based on a combination of case study examples including the SEIRR Building (Spokane, WA) which achieved this level of reduction with a similar architectural approach as outline in reduction strategies. The new high performance addition targeted a 70% reduction based on the recommended energy reduction targets as outlined by Architecture 2030.



Energy Efficient Retrofit

89 EUI

Target
40% Reduction



New High Performance Addition

43 EUI

Target
70% Reduction

fig. 50 - Energy Reduction Targets - Retrofit and Addition

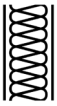
Reduction Strategies

A number of different strategies were used to achieve these reduction targets. More options for design strategies were available in the new building as compared with the available design strategies in the retrofit.

These reduction strategies are outline below in figure 51.

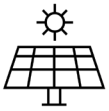
New High Performance Addition

Increased Insulation



High Performance Systems

Renewable Energy Sources



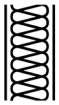
Natural Daylighting Design

Natural Ventilation

Low Carbon Materials

Energy Efficient Retrofit

Increased Insulation



High Performance Systems

Renewable Energy Sources

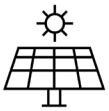


fig. 51 - Reduction Strategies

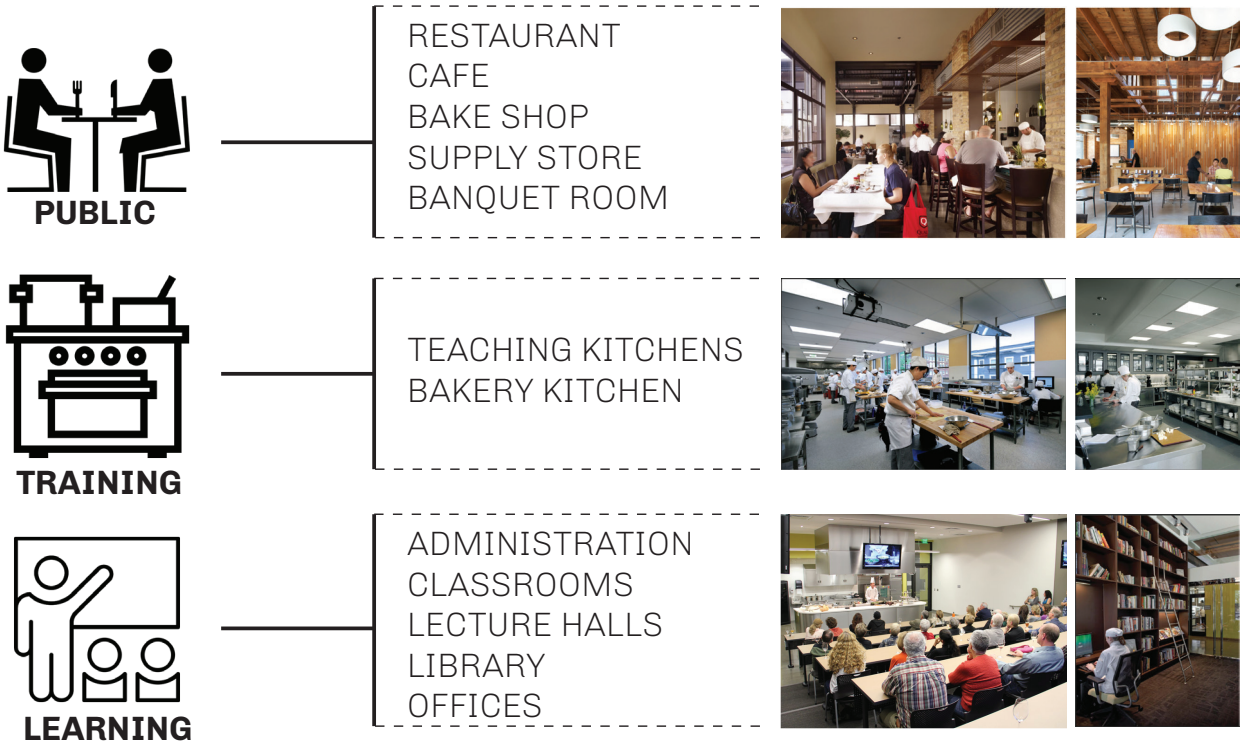


fig. 52 - Culinary School Program

10

Design Proposal

Wenatchee Valley Culinary Institute

"You don't have to cook fancy or complicated masterpieces - just good food from fresh ingredients." This quote from renowned chef Julia Child epitomizes the ethos of both the Wenatchee Valley Culinary School program as well as the architectural design approach. For the culinary school program, this means training the future generation of chefs with impeccable technique and a respect for the ingredients. Similarly, the design is rooted in its surrounds and its history with a clear vision for the future of Wenatchee where high performance design and historic buildings can work together in a sustainable way.

Design Principles

Site Response

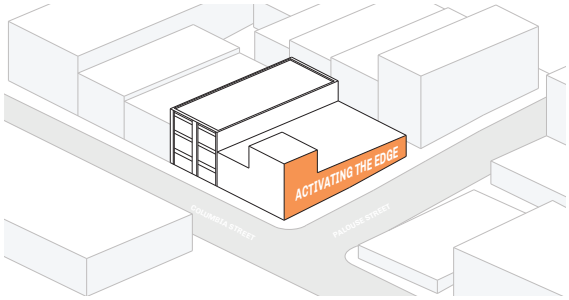
The site response works on the assumption that for the culinary school to be successful, the public needs to engage with the building. Many of the programmatic elements like the restaurant, cafe and bake shop, all require public patrons to be successful. As a result of these programmatic requirements and the knowledge that Wenatchee Avenue is, currently, the commercial center of the Wenatchee, a connection to Wenatchee Avenue is critical. The site response emphasizes the activation of edge along Palouse Street that will entice people to come to the culinary school from Wenatchee Avenue.

Program Response

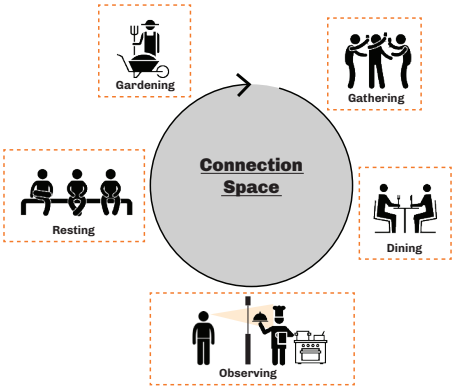
As mentioned before, the program for the culinary is diverse in its private and public elements and, as a result, has varied user groups including dining patrons, culinary school students, faculty and tourists. The program response works with these details and highlights the need for a space/s that can connect these groups together.

Environmental Response

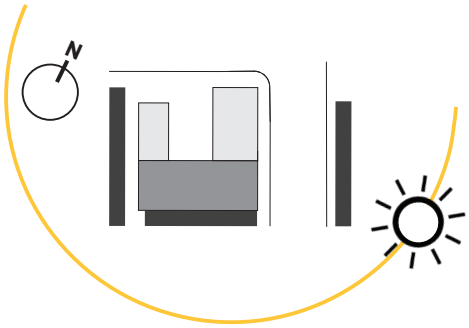
With the goal of total carbon design, the environmental response was critical to achieving lower operational energy use through architectural strategies. Solar orientation and access to light/air for user comfort, are crucial to these design strategies.

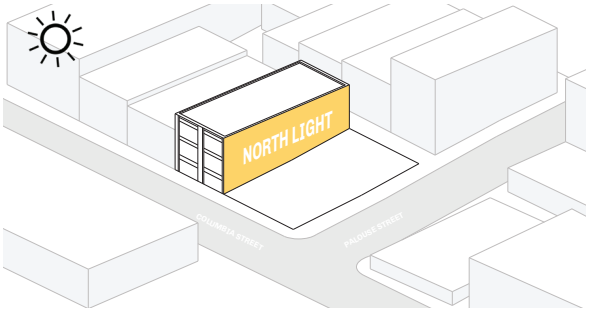


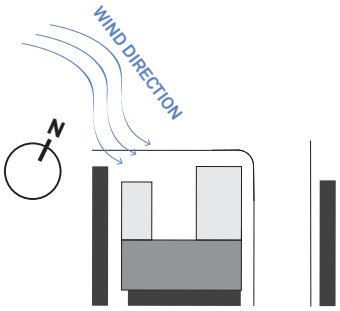
Site Response

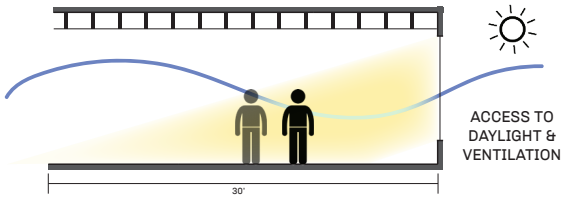


Program Response



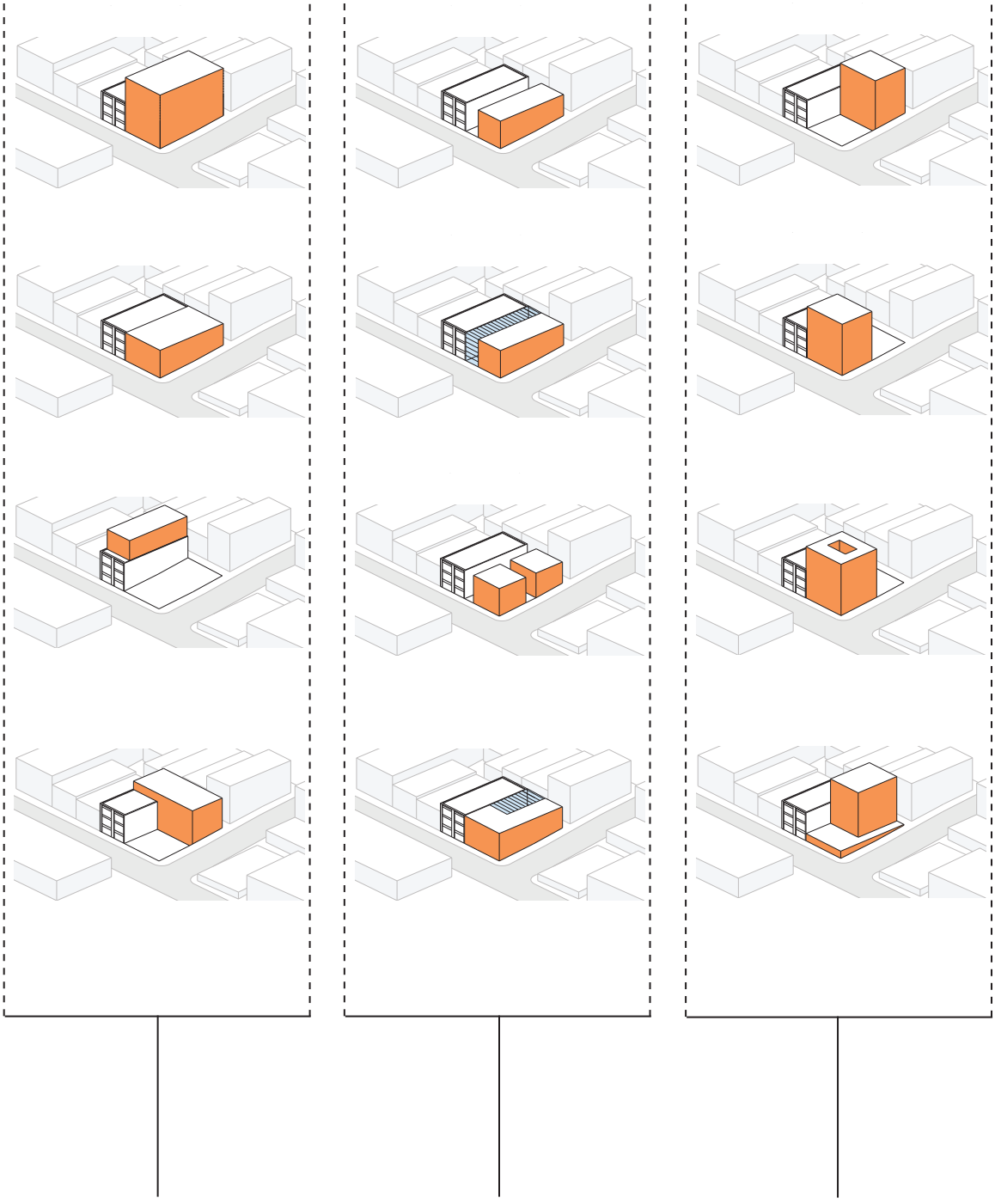


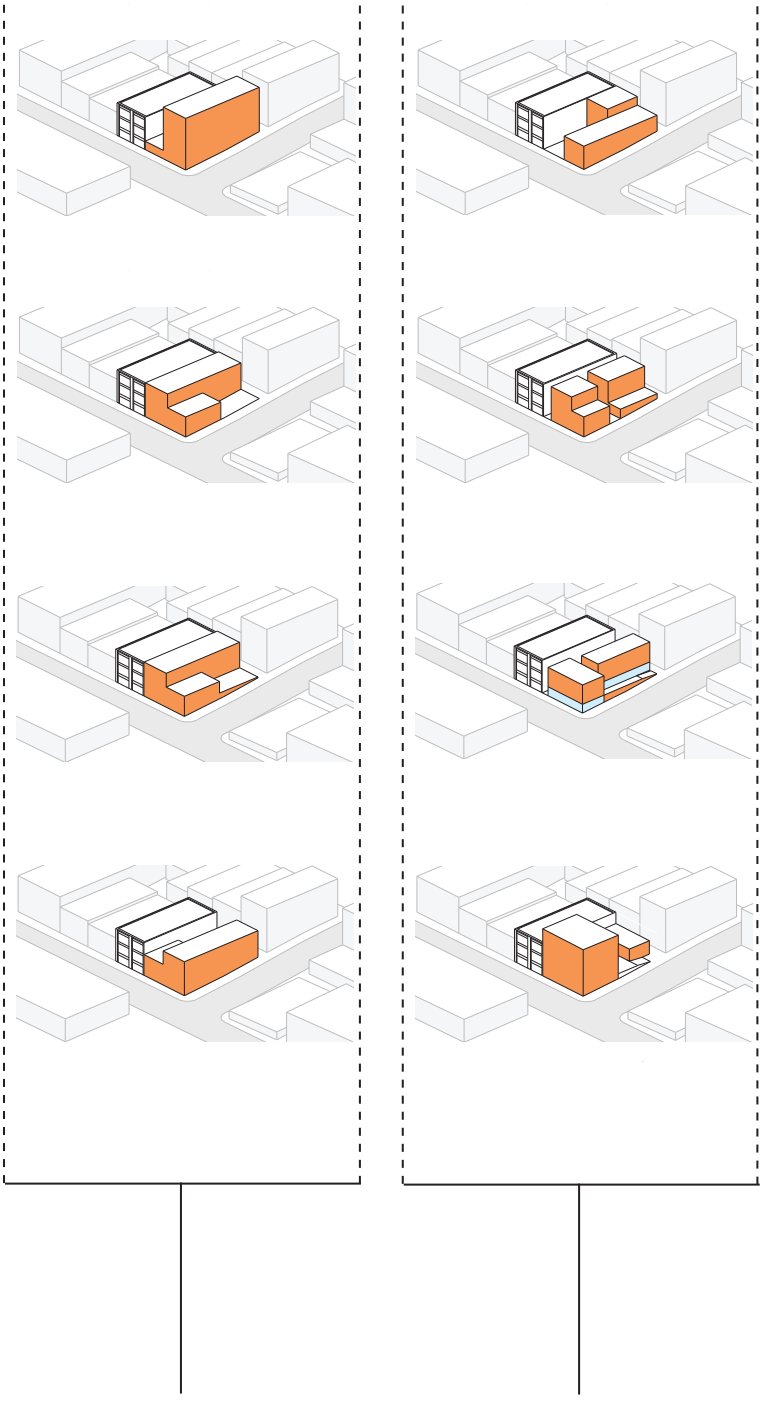




Environmental Response

fig. 53 - Diagrams - Design Principles


Block
Split
Tower

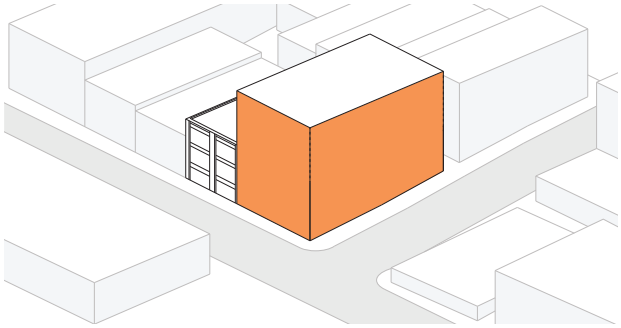


Massing Scheme

The design principles, outline previously, influenced the massing schemes explored in the project with this exploration focused on functionality, architectural experiences and environmental design strategies. During the design process, a number of possible massing schemes for the site were examined. The conclusion reached by the mass scheme approach was that the most successful based on the design principles and architectural experience was the hybrid scheme that used elements of the split, tower and stepped massing. The hybrid approach allows for a distinct relationship between the new and existing building while still allowing for connections between the parts.

fig. 54 - Diagrams - Massing Schemes

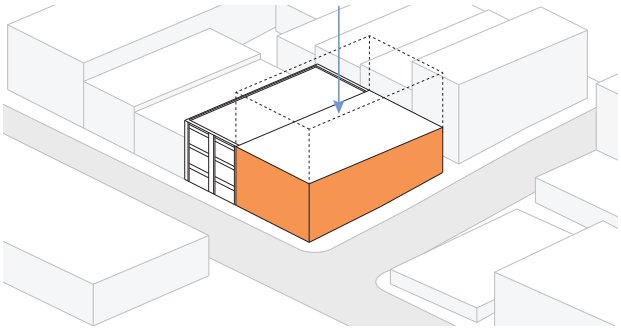
Fill



Fill

Compress

Program Response



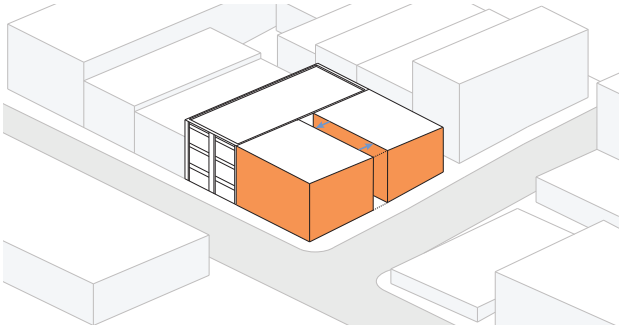
Fill

Compress

Program Response

Split

Site Response



Fill

Compress

Program Response

Split

Site Response

Condense

Environmental Response

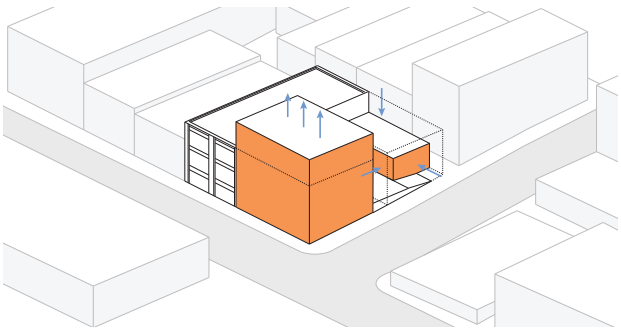


fig. 55 - Diagrams - Final Massing Approach

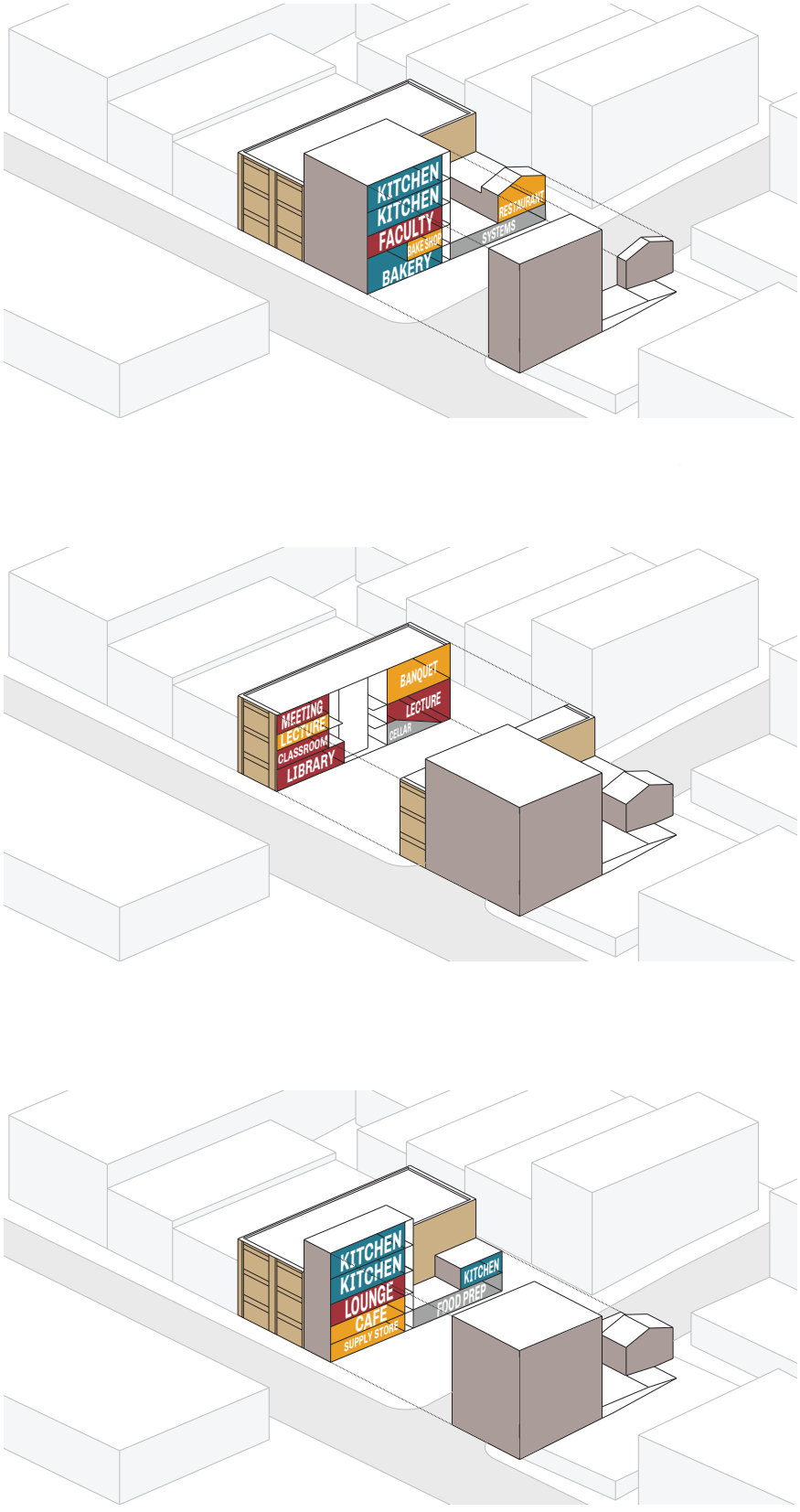
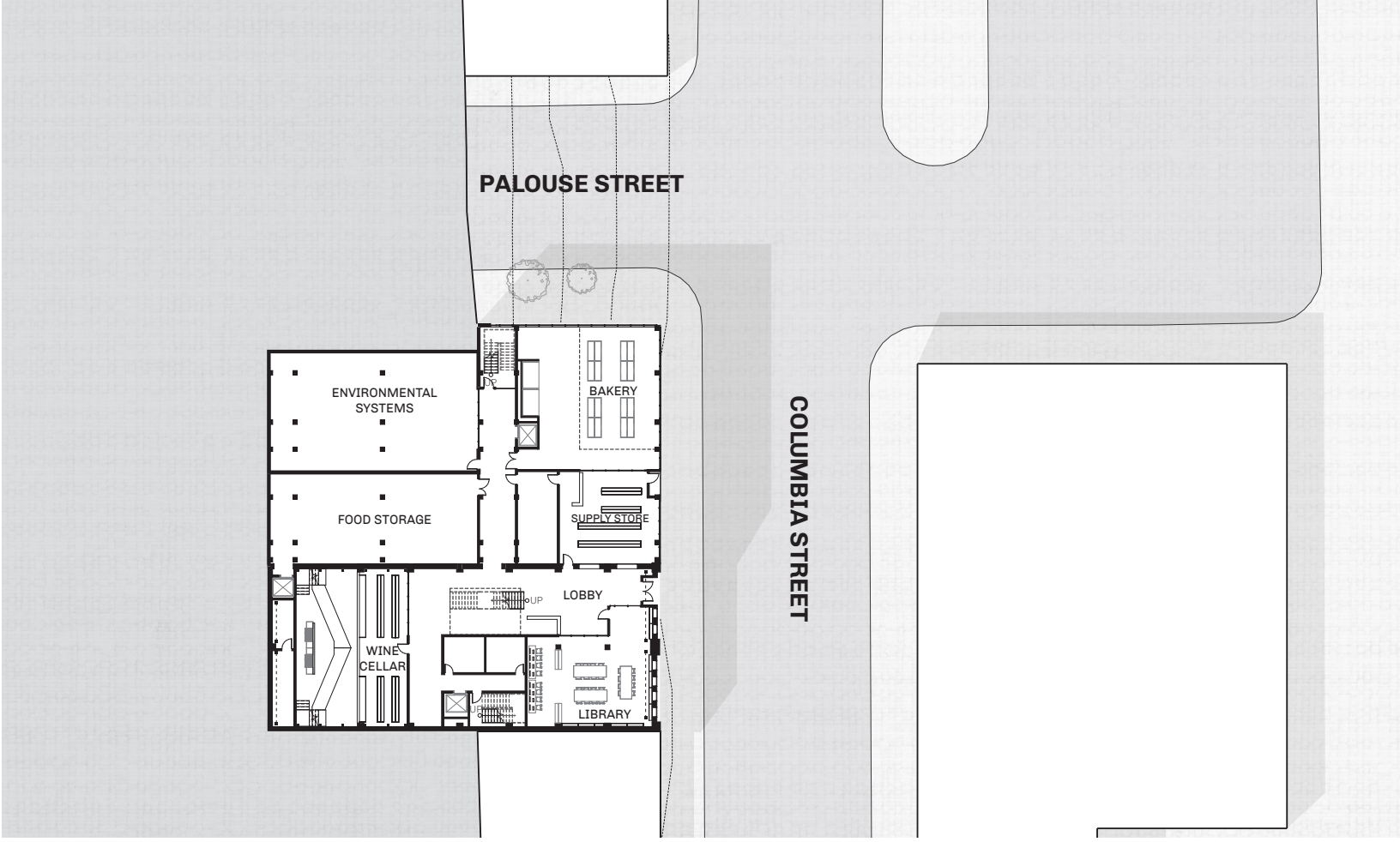


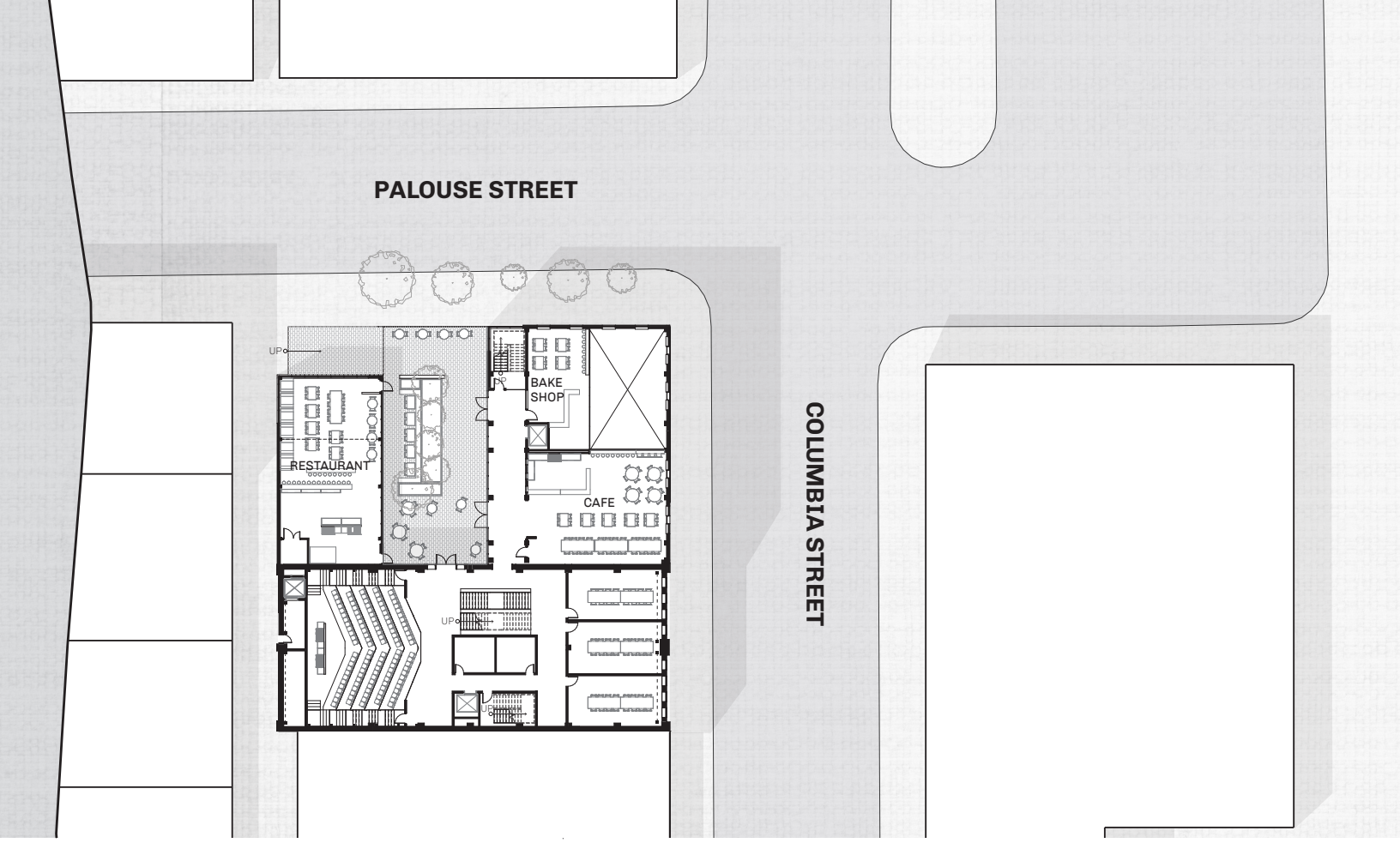
fig. 56 - Diagrams - Program



Level 1

Along Columbia Street, the contrasting character of the new and existing building can be fully realized. Level 1 is dedicated to the culinary school functions of the building with the main culinary school entrance, library and the bakery kitchen all along Columbia Street. While still the face of the culinary school, Level 1 also houses many of the important functional elements of the building. These functional elements include the food storage and preparation area, wine cellar and most importantly the environmental systems which allow both the existing and new building to operate efficiently.

fig. 57 - Floor Plan - Level 1



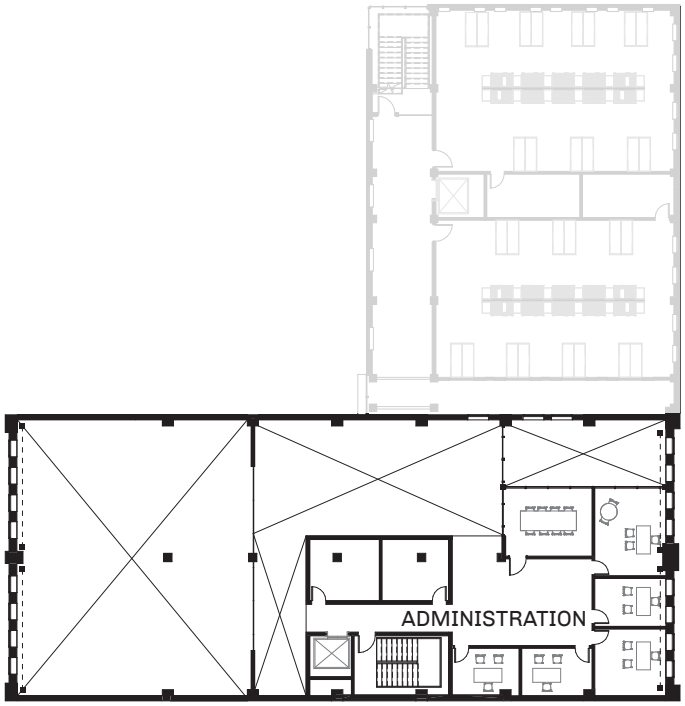
Level 2

The major design challenge of this project was the linking of the historic existing building with the new building. This linking was accomplished through the use of the courtyard space which also serves as the public entrance to the facility. The courtyard is defined by the fact that it is surrounded by the public functions of the culinary school including the bake shop, cafe, and the restaurant which all have the opportunity to spill out into the courtyard space. Level 2 also provides important sectional relationships between programmatic elements. These relationships include the culinary school entrance on Level 1 and the public entrance on Level 2 as well as the relationship between the bake shop/cafe to the lower bakery kitchen highlighting the function of this building as culinary school for the patrons.

fig. 58 - Floor Plan - Level 2

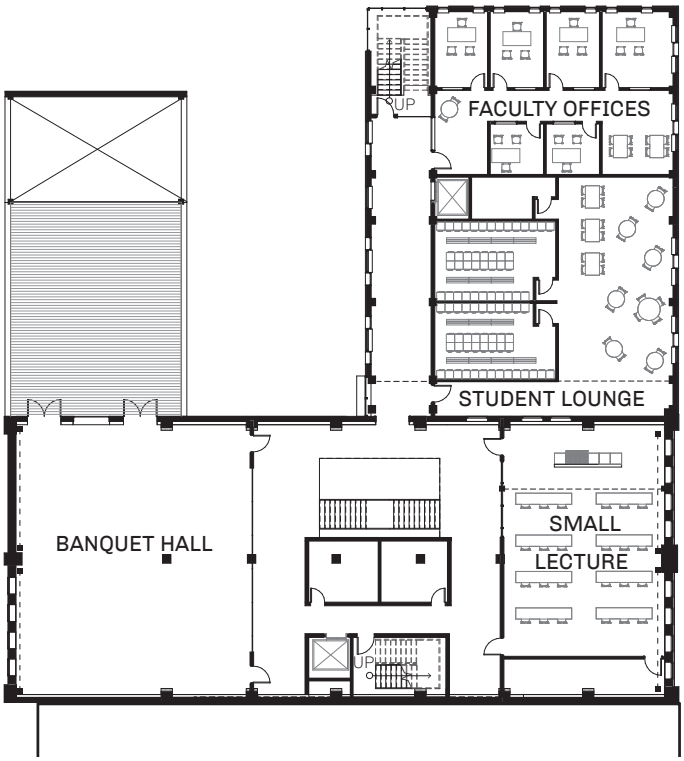
Level 3.5

With the goal of total carbon design, utilizing as much space in the existing building lowers the need for more new square footage. This was accomplished on Level 3.5 by adding density to the existing building with a new floor in-between the roof and Level 3. This approach utilized the already generous floor-to-floor heights in Level 3 to house the administration area of the culinary school.



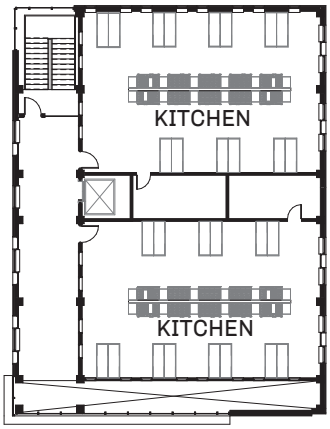
Level 3

Level 3 marks the transition from public space towards semi-public and private spaces. Both the small lecture hall and the banquet room have the possibility for the community to use these spaces as well as the culinary school. The student lounge and the facility offices are heart of the culinary operations and as a result are sectional located in the center of the building.



Level 5

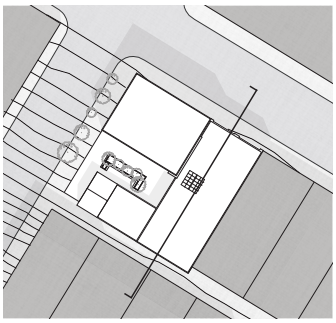
The most private functions of the culinary school are located in the training kitchen spaces. These spaces, only accessible to students and facility, are located on the top two floors of the new addition. These levels provide both views out to the Wenatchee Valley as well as access to light and air for the high energy and technical work of the training kitchens.

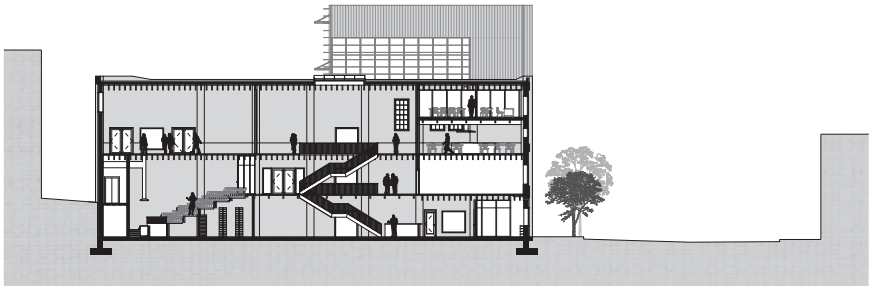


Level 4

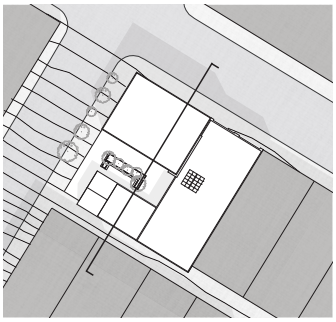
Stacking the training kitchens allows for the energy intensive systems to be located in a central location. This centralization allows for more efficient air and energy handing in the building.

fig. 59 - Floor Plans - Level 3 - Level 5

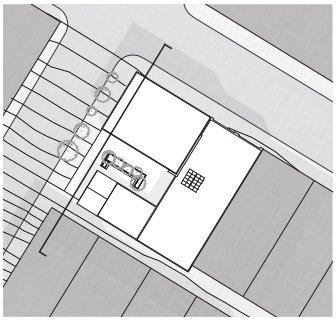


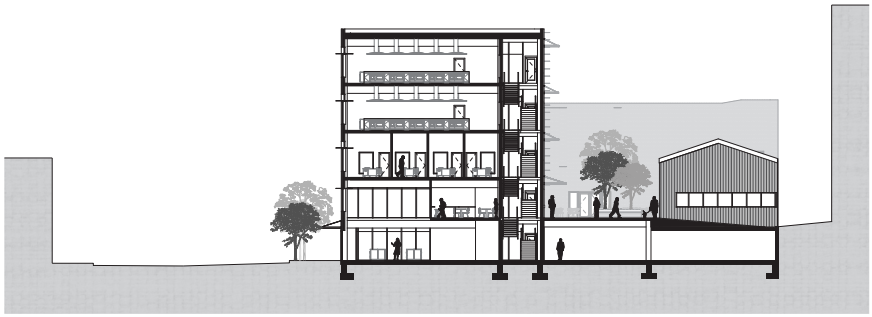


Section 1



Section 2





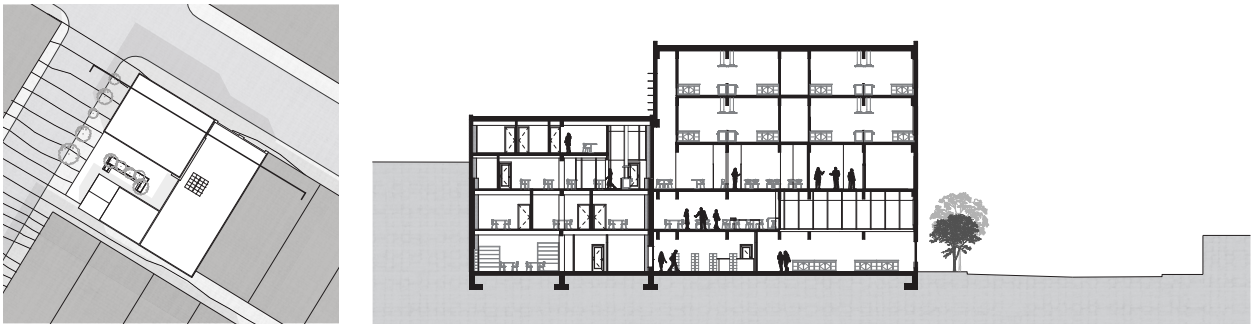
Section 3

1) The central atrium stairs in the Fruit Growers Service Building connects the various programmatic elements and allows for the movement of students and the public together through the existing building.

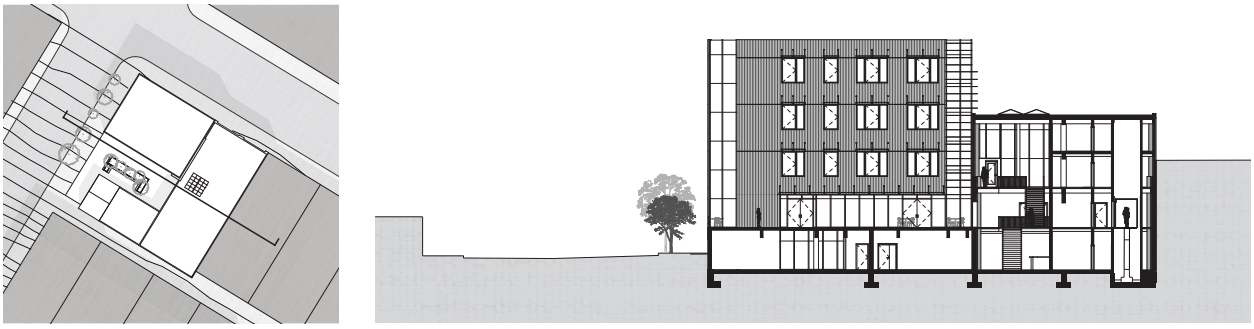
2) Linking the three buildings together, the public courtyard is defined by the cafe on one side and the restaurant on the other.

3) Access to the courtyard off the alley allows for a smooth and easy transition from the public street to the semi-public courtyard.

fig. 60 - Sections - East/West



Section 4



Section 5

Section 6

4) The sectional layering of public spaces between education spaces highlights the purpose of the building as a place of culinary education.

5) The exterior courtyard transitions into the historic building creating a new entrance and experience.

6) The banquet hall deck allows views into the restaurant, down into the courtyard and across to the new culinary building.

fig. 61 - Sections - North/South

Columbia Street Elevation

fig. 62 - Elevations - Palouse Street | Columbia Street

Palouse Street Elevation

fig. 63 - Corner of Palouse Street and Columbia Street

fig. 64 - Public Entrance on Palouse Street

fig. 65 - View from Wenatchee Avenue
fig. 66 - Courtyard towards the restaurant

Corner of Palouse Street and Columbia Street

Figure 63 - pg. 90/91

From this view, the contrast between the historic building and new addition can be fully realized. The historic building is rooted in its place by its masonry materiality while the new addition clearly contrasts the existing materiality of the area. The new addition though connects to the area as a whole through the existing urban fabric and building scale.

Public Entrance on Palouse Street

Figure 64 - pg. 92/93

The public entrance places people right in the heart of the building. The three built sides of the courtyard frame the experience of the user as an intimate and active space. This space while separated from the street with a level change, the ramp off the alley allows for an easy transition from the street edge to the courtyard.

View From Wenatchee Avenue

Figure 65 - pg. 94

This view from Wenatchee Avenue is critical to the success of the project in terms of enticing people to come off of Wenatchee Avenue and visit this building. The glass stair core on the edge and the small unique structure along the alley entice people to make the journey to the culinary school.

Courtyard towards the Restaurant

Figure 66 - pg. 94

The restaurant standings out in the historic core of Wenatchee through its roof form and scale, it marks itself as being different from the rest of the area, engaging people to come and visit.

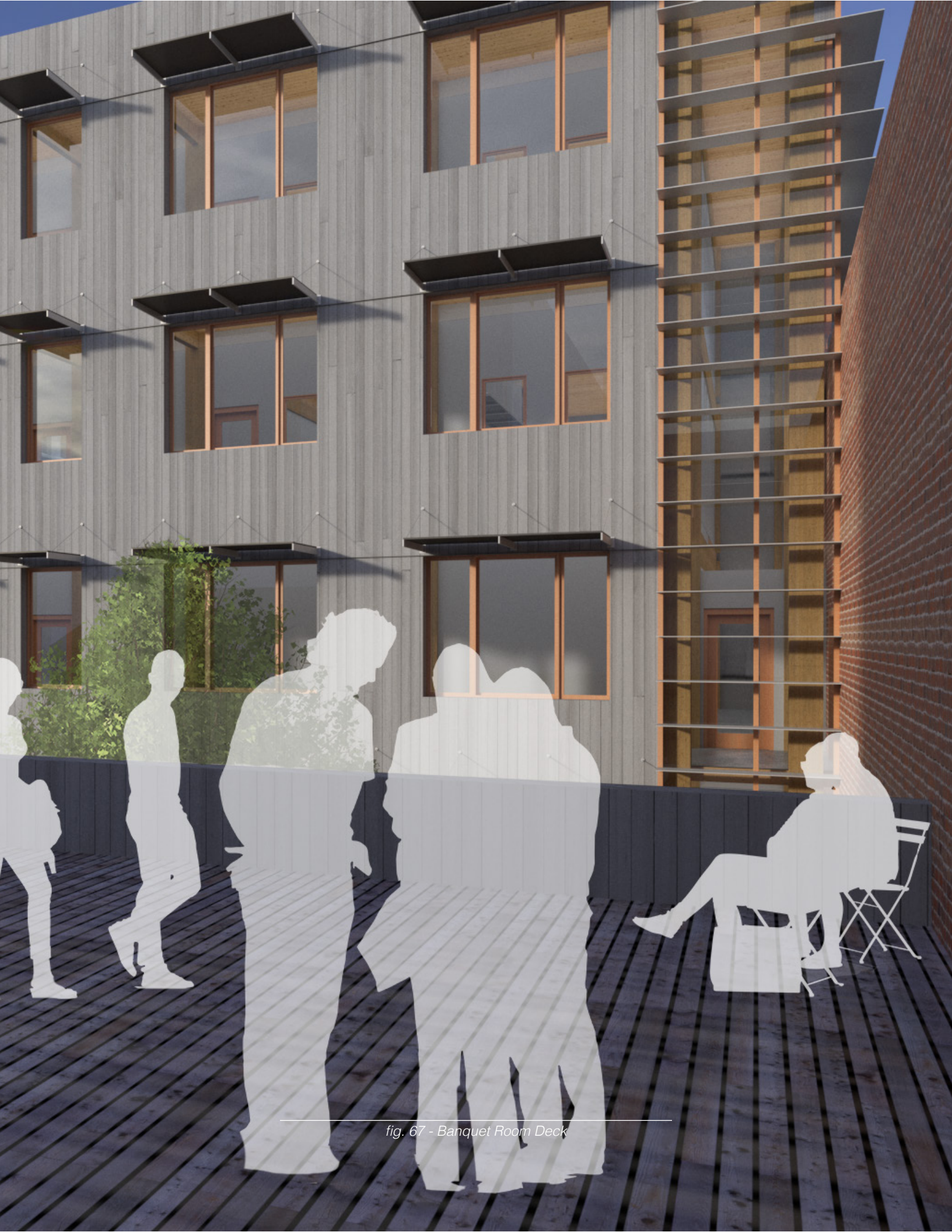


fig. 67 - Banquet Room Deck

fig. 68 - Courtyard
fig. 69 - Public Arcade

Banquet Room Deck

Figure 67 - pg. 96/97

From the banquet room deck, views into the restaurant, down to the courtyard space and out towards the mountains are all possible. This space allows for when the weather is good, an expanded space for the banquet room to serve the community as a whole.

Courtyard

Figure 68 - pg. 98

The core of the public experience of the building is in this courtyard space. The restaurant, bake shop and cafe all spill out into the courtyard providing a resting place from the urban environment of downtown Wenatchee. During the lunch or dinner hours, this space would be bustling with people coming to enjoy the foods of the culinary school.

Public Arcade

Figure 69 - pg. 98

The public arcade, acts as a threshold between the courtyard and the cafe/ bakeshop spaces, allowing for seamless transition between exterior and interior spaces while still offering protection from the harsh summer sun or cold winter breezes.

fig. 70 - Fruit Growers Service Building Atrium

fig. 71 - Training Kitchen
fig. 72 - Lecture Hall

Fruit Growers Service Building Atrium

Figure 70 - pg. 100/101

The atrium space of the Fruit Growers Service Building is the social space of the building were both the public and students intermingle as they are moving between levels. The atrium's materiality is grounded in the historic building but the introduction of new skylights and vertical circulation creates a new experience for the community.

Training Kitchen

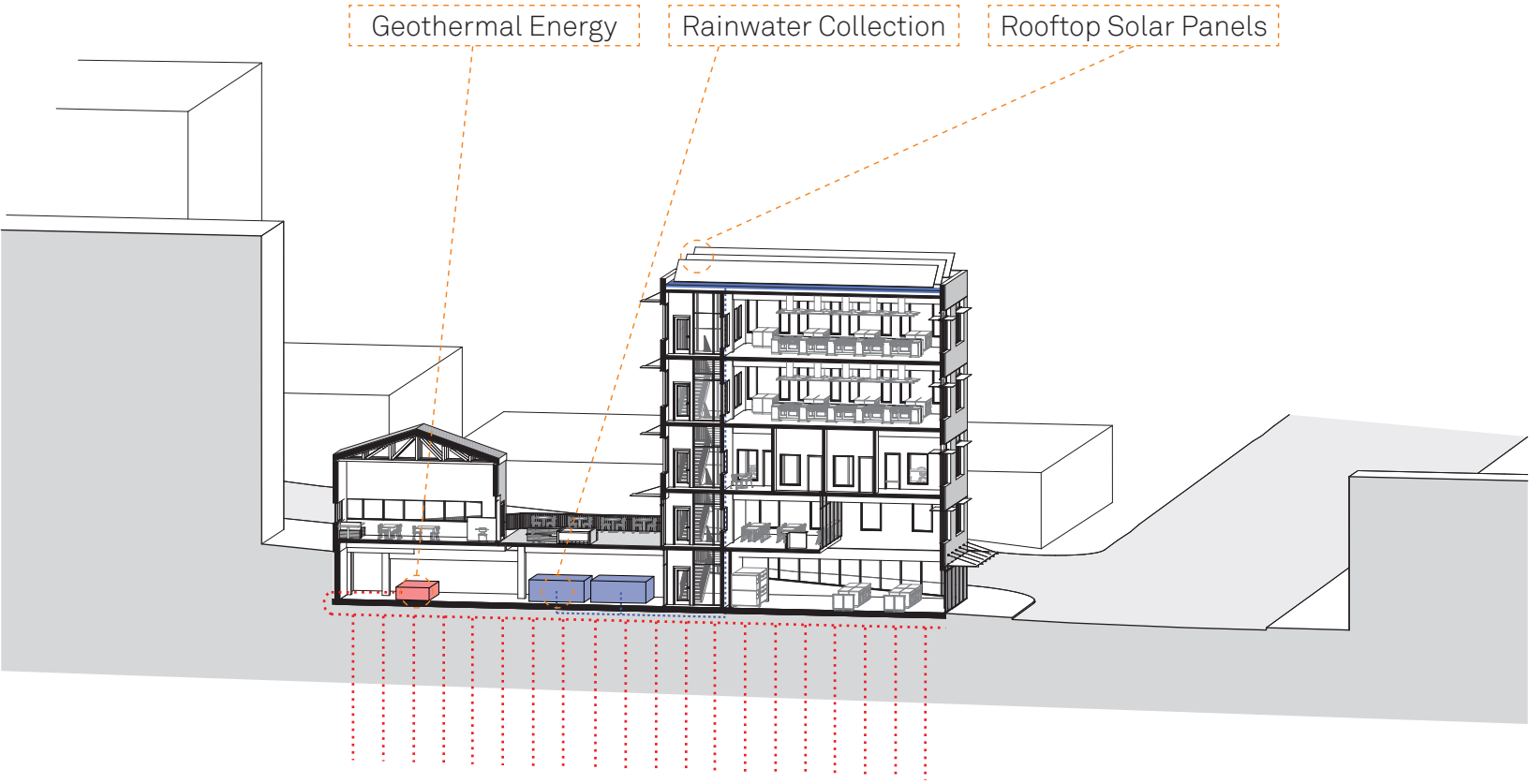
Figure 71 - pg. 102

The jewel of the culinary school are the training kitchens. This is the place were future chefs are pushed to achieve their goals. The students though are rewarded for their hard work with generous daylighting and views towards the mountains.

Lecture Hall

Figure 72 - pg. 102

The lecture hall, purposely located in the historic building, are one of the places were this building can serve dual functions as a culinary school and community amenity. During the school day, these spaces can be used for culinary education, while at night these spaces can transform into a community amenity for cooking demonstrations and functions.



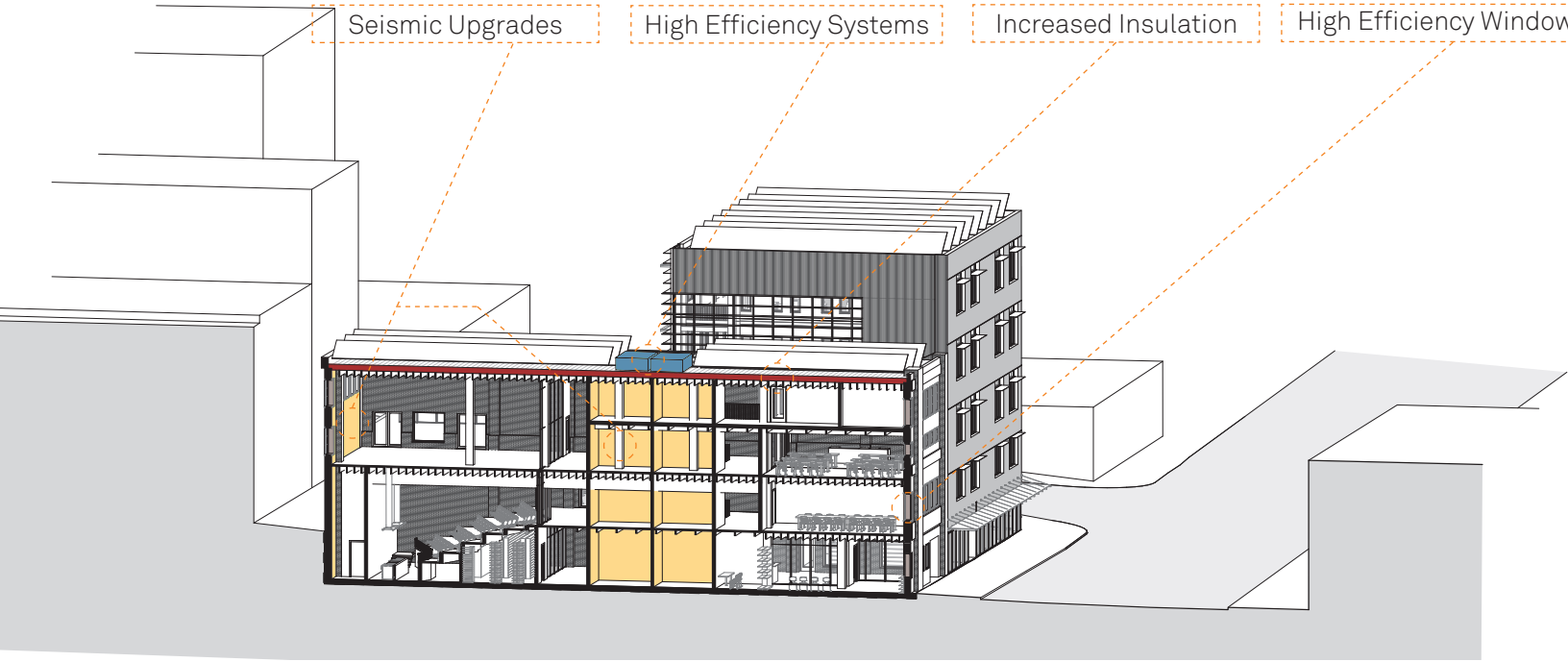


fig. 73 - Reduction Strategies - New High Performance Addition
fig. 74 - Reduction Strategies - Energy Efficient Retrofit

Baseline Culinary School

143 EUI

491,000 kg CO_2e/yr

Baseline

Energy Efficient Retrofit

89 EUI

294,600 kg CO_2e/yr

40% Reduction Target

High Performance Addition

43 EUI

147,300 kg CO_2e/yr

70% Reduction Target

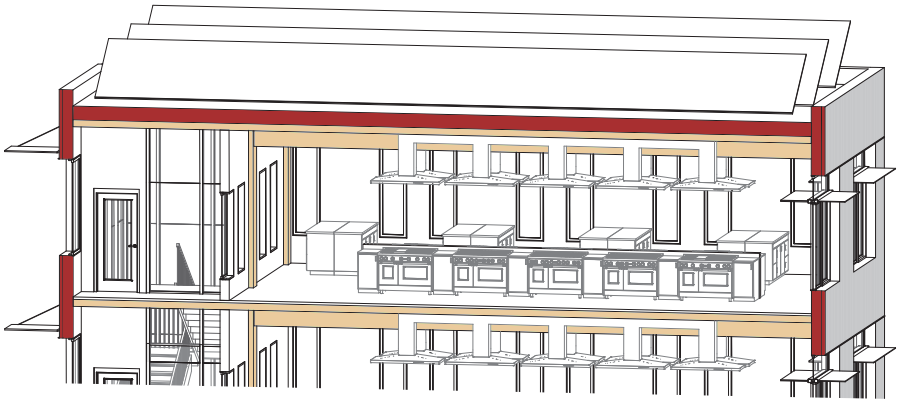
High Performance Addition

The Wenatchee Valley offers a lot of potential for geothermal energy production and is ideal for solar energy production because of almost year round clear sky conditions. Both of these strategies are used to lower the off-site energy needs for the building. Rainwater collection is also part of these reduction strategies as way to limit storm-water runoff. The water collected is reused on site to water plants as well as flush toilets.

Energy Efficient Retrofit

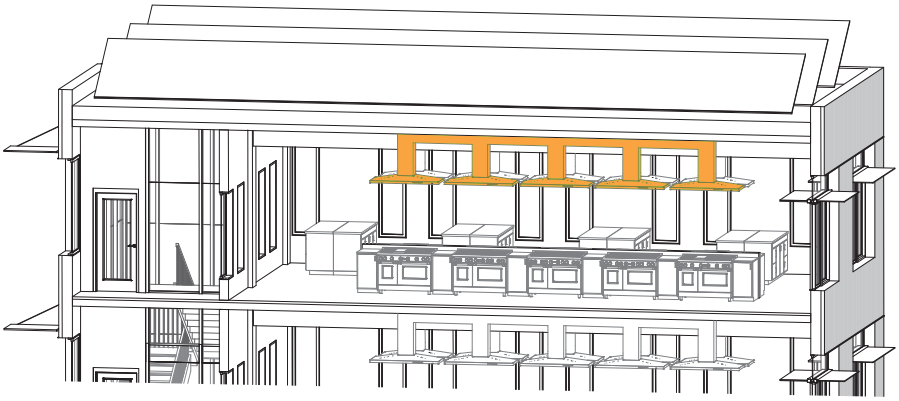
The current major issue with the existing building is the lack of seismic upgrades in the unreinforced masonry building. This problem makes a seismic upgrade critical. Along with the seismic upgrade, the use of new high efficiency systems, increased roof insulation and new high efficiency windows work towards the overall goal of a reduction in energy demands.

High Performance Addition - Design Strategies



Structure | Envelope

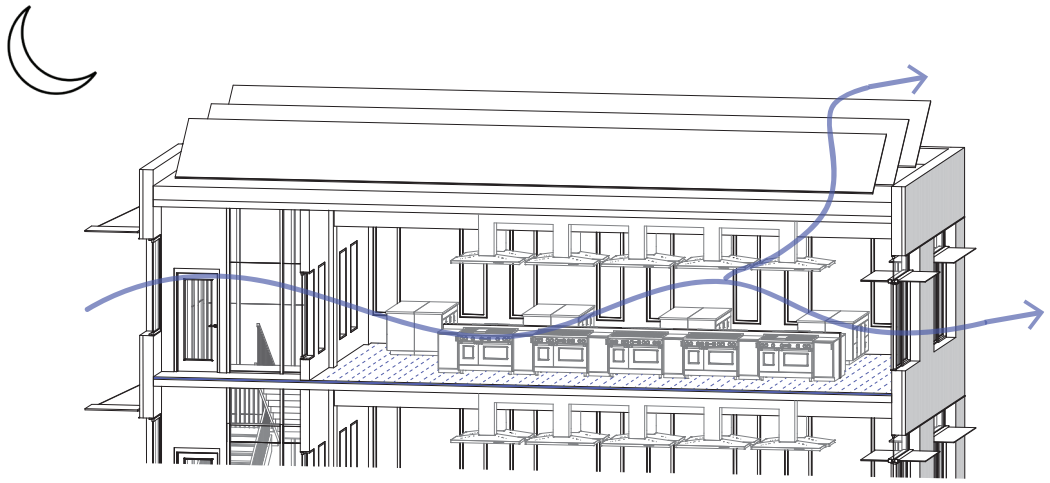
The structure of the new high performance addition utilized low carbon materials including glu-lam beam systems and cross-laminated timber (CLT) floors. The envelope utilized a passive-house roof and wall system (R-60) for an air tight envelope. A gray wood siding rain screen system is used for its aesthetics as well as its low carbon footprint.



High Efficiency Systems

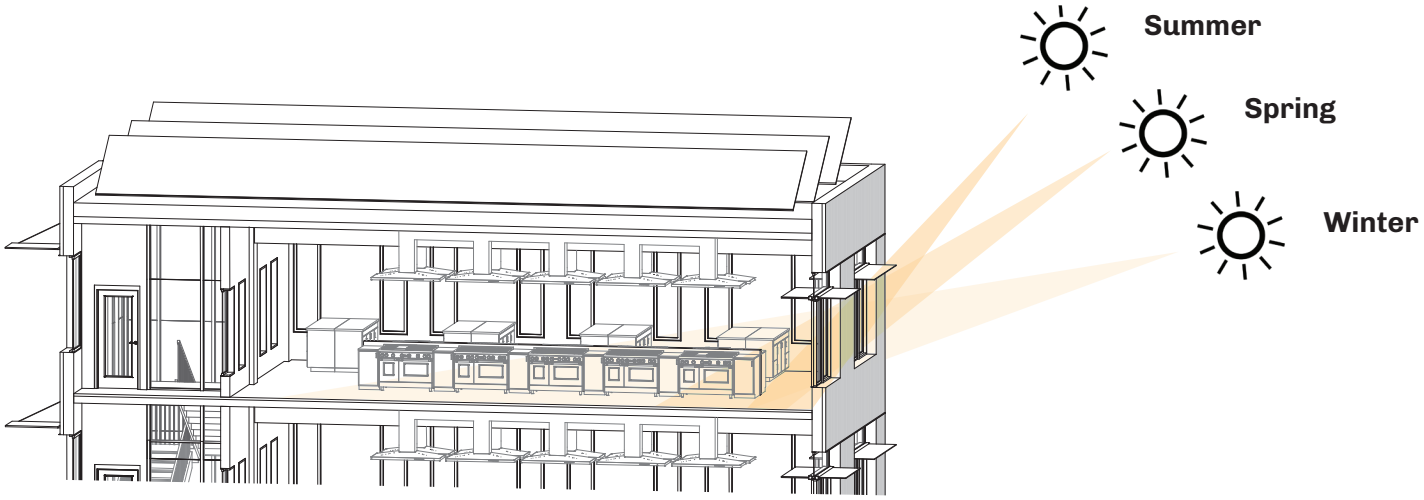
High efficiency systems are used throughout the project but are critical to the performance of the kitchen spaces as high energy consumption areas. Heat recovery ventilators precondition air with heat from the kitchen spaces for use else where in the building saving on heating costs in the winter.

fig. 75 - Reduction Strategies - Structure | Envelope
fig. 76 - Reduction Strategies - High Efficiency Systems



Cooling | Ventilation

Radiant floor slabs as well as night flush cooling allow for the building to use thermal mass throughout the day to regulate the need for mechanical ventilation. Natural ventilation strategies also decrease need for mechanical ventilation.



Daylighting | Solar Shading

Access to daylighting allows for a decreased use of artificial lighting and energy consumption. A sensible daylight strategy allows for access to winter sun and some spring sun but solar shading devices filter out the harsh summer sun, decreasing the cooling needs during the summer.

fig. 77 - Reduction Strategies - Cooling | Ventilation
fig. 78 - Reduction Strategies - Daylighting | Solar Shading

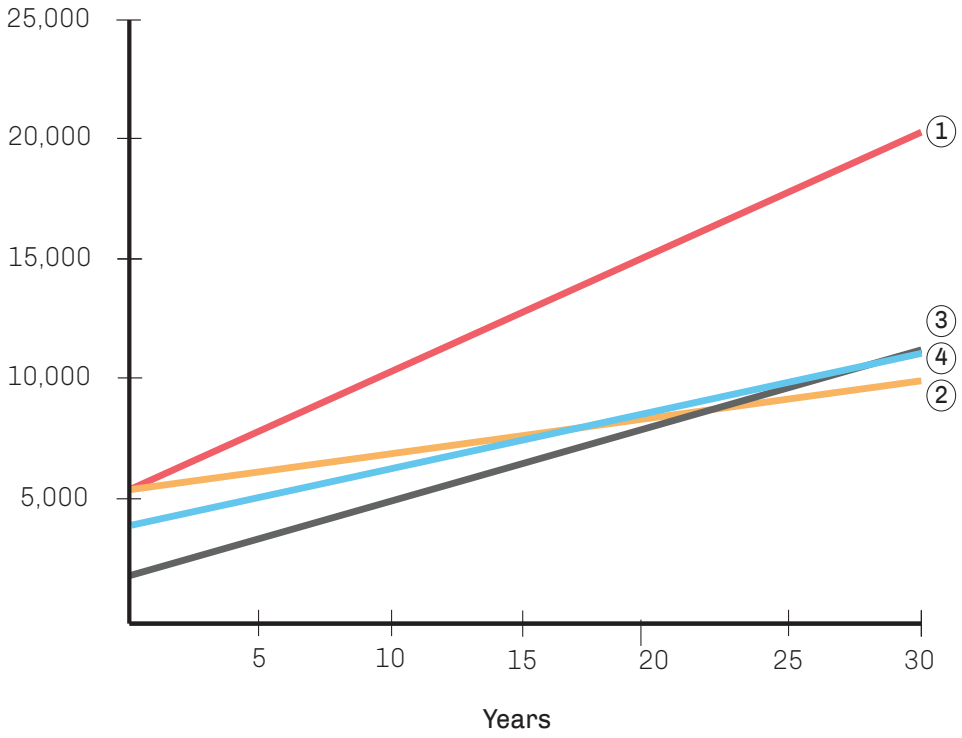
11

Assessment - Total Carbon Design

Comparison

Similar to high performance design, total carbon design will only be accepted as a valid design approach with the support of quantifiable data. As outline in Chapter 9, this exploration of total carbon design used life cycle assessment data along with operational use targets to quantity approximate carbon impacts for the design proposal. This section uses these data points to compare the design proposal against common building strategies today with the goal of identifying the carbon impacts for each scenario.

The four scenarios explored were: 1) new construction with baseline culinary school energy performance, 2) new construction with high performance energy targets, 3) total retrofit with the retrofit energy performance targets, 4) design proposal, hybrid strategy of new construction and retrofit for both initial and operational carbon.



% of Total Carbon - Initial Carbon

① **26%** ② **54%** ③ **20%** ④ **37%**

	Initial Carbon Emissions	Operational Carbon Emissions
Scenario 1	**New Construction** 5,307,200 kg CO_2e	**143 EUI** 491,000 kg CO_2e/yr
Scenario 2	**New Construction** 5,307,200 kg CO_2e	**43 EUI** 147,300 kg CO_2e/yr
Scenario 3	**Retrofit** 2,150,000 kg CO_2e	**89 EUI** 294,600 kg CO_2e/yr
Scenario 4	**Retrofit** 525,000 kg CO_2e + **New Construction** 3,711,495 kg CO_2e	**43 EUI** 147,300 kg CO_2e/yr + **89 EUI** 294,600 kg CO_2e/yr

fig. 79 - Total Carbon Analysis

Conclusion

Two main points are illustrated by the graph of carbon impacts from the four scenarios. Initial impacts can be very high when compared with operational impacts especially in new construction with high performance energy targets, these operational reductions can take many years become important. New construction with high performance targets when compared to the design proposal will take almost sixteen years to lower the overall impact of the building. The carbon data as well shows, a solution that can reuse buildings in a meaningful can dramatically lower the initial impacts of building. At this critical period of time, 15 - 30 years, to limit the impacts of climate change, any meaningful reductions in initial carbon emissions are important.

The history of Wenatchee is ingrained into the Fruit Growers Service Building. Constructed in 1926, the building is from an era long gone in Wenatchee. As historic buildings like the Fruit Growers Service Building near one hundred years of service, a solution that can preserve them in a sustainable way will be the most lasting solution. The hybrid solution that this thesis explored can be that lasting solution. The combination of the new high performance addition and the retrofit of the existing building creates the most architecturally reward experience in terms of form and function. The hybrid scheme offers the benefits of high performance design with material and character preservation. For too long architects have viewed historic buildings as an energy inefficient, cost burden that must be overcome, commonly through demolition. This thesis demonstrations those assumptions do not have to be the standard.

The connection between high performance design and preservation is not always clear but this project serves as the link between preservation and high performance design which is only possible with a new outlook geared towards a total carbon design approach.

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Bibliography

"2017 Population Trends" Office of Financial Management, State of Washington. 2017.

"2030 Challenge". *The 2030 Challenege*. www.architecture2030.org/2030_challenges/2030-challenge.

"About Us". Inspiration Kitchens. http://inspirationkitchens.org/about-us/

"About Wenatchee." Wenatchee Chamber of Commerce. http://visitwenatchee.org/discover/about-wenatchee/

Advisory Council on Historic Preservation. "Sustainability and Historic Federal Buildings". ACHP, 2011.

Athena Institute. "A Life Cycle Assessment Study of Embodied Effects for Existing Historic Buildings". Parks Canada, 2009.

Avrami, Erica. "Making historic preservation sustainable." *Journal Of The American Planning Association* 82, no. 2 (2016): 104-112.

Brown, Jeffrey. "A Brief History of Culinary Arts Education in America." *Journal of Hospitality & Tourism Education* 17, no. 4 (2005): 47-54.

Campagna, Barbara, and Patrice Frey. "The impact of evolving LEED standards on historic preservation projects." *Journal Of Green Building* 3, no. 4 (Fall 2008): 21-31.

The Carbon Leadership Forum. "Embodied Carbon Benchmark Study". University of Washington, 2017.

Carroon, Jean. *Sustainable Preservation: Greening Existing Buildings*. Hoboken, N.J.: Wiley, 2010.

"Cascade Culinary Institute Program Options." Cascade Culinary Institute. www.cascadeculinary.com/certificates-and-degrees/.

"Central Oregon CC Jungers Culinary Center." Yost Grube Hall Architecture. http://ygh.com/projects/education/central-oregon-community-college-jungers-culinary-center/.

"Chelan and Douglas Counties Profile". Employment Security Department, State of Washington, 2017. https://fortress.wa.gov/esd/employmentdata/reports-publications/regional-reports/county-profiles/chelan-and-douglas-counties-profile.

City of Wenatchee Zoning. 10.24.005. Central Business District Purpose.

City of Wenatchee Zoning. 10.40.015. Historic/Entertainment Overlay (HEO).

City of Wenatchee Zoning. 10.40.020. Columbia Street Overlay (CSO).

"Climate Summary – Wenatchee, Washington, 1931 - 2005". Western Regional Climate Center. https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?wawena

"Community and Economic Development". City of Wenatchee. http://www.wenatcheewa.gov/government/community-and-economic-development

"Creating a positive street edge." Guidance for Mixed Use Development, Auckland Design Manuel, 2018. http://www.aucklanddesignmanual.co.nz/project-type/buildings-and-sites/mixed-use/MixedUse/guidance/streettofrontdoor/createapositivestreetedge

Delgado, Lisa. "Yard work: sustainability is key while expanding the Brooklyn Navy Yard industrial park - and the tenants wouldn't have it any other way." *Oculus* 75, no. 3 (Fall 2013): 42-45.

Ecological Building Network, et al. *The Total Carbon Study: Case Study of DPR Construction San Francisco Office Building*. 2015.

"Economic Development". City of Wenatchee. http://www.wenatcheewa.gov/government/community-and-economic-development/economic-development.

"Farm-to-Table Training". Seattle Culinary Academy, Seattle Central College. https://culinary.seattlecentral.edu/farm-to-table-training

Felton, Daniel, Robert Fuller, and Robert H. Crawford. "The potential for renewable materials to reduce the embodied energy and associated greenhouse gas emissions of medium-rise buildings." *Architectural Science Review* 57, no. 1 (February 2014): 31-38. *Avery Index to Architectural Periodicals*, EBSCO*host* (accessed November 27, 2017).

Gellatly, John Arthur. *A History of Wenatchee : The Apple Capital of the World*. Wenatchee, Wash.], 1963.

“History and Culture”. City of Wenatchee. www.wenatcheewa.gov/visitor-info/history-and-culture.

Hedrick, Roger, et al. “Restaurant Energy Use Benchmarking Guideline.” *National Renewable Energy Laboratory*, July 2011.

“Inspiration Kitchens”. Wheeler Kearns Architects. http://wkarch.com/project/inspirationkitchens/

Jackson, Mike. "Embodied energy and historic preservation: a needed reassessment." *APT Bulletin* 36, no. 4, 2005.

Larsen, Knut Einar, and Marstein, Nils. *Conservation of Historic Timber Structures: An Ecological Approach*. Butterworth-Heinemann Series in Conservation and Museology. Oxford [England]; Boston: Butterworth Heinemann, 2000.

Longstreth, Richard W., and National Forum on Historic Preservation Practice. *Sustainability & Historic Preservation: Toward a Holistic View*. Newark [Del.] : Lanham, Md.: University of Delaware Press ; Co-published with Rowman & Littlefield, 2011.

Loussos, Paressa, et al. "Integrating life cycle energy into the design of façade refurbishment for a post-war residential building in the Netherlands." *Buildings: An Open Access Journal For The Built Environment* 5, no. 2 (June 2015): 622-649. *Avery Index to Architectural Periodicals*, EBSCO*host* (accessed November 27, 2017).

Maxwell, Ingval. "Sustainability and historic preservation: toward a holistic view, edited by Richard Longstreth." *Journal Of Architectural Conservation* 18, no. 3 (November 2012): 112-113.

McDonald, Martha. "Uniting preservation and sustainability: Jean Carroon's efforts to connect the restoration and environmental communities have won her the fourth annual Clem Labine Award." *Clem Labine's Traditional Building* 25, no. 4 (August 2012): 10-13.

Moe, Richard, and Dwight Young. "Building on what we've built: Richard Moe addresses preservation and sustainability." *Preservation: The Magazine Of The National Trust For Historic Preservation* 60, no. 1 (January 2008): 6-7. *Avery Index to Architectural Periodicals*, EBSCO*host* (accessed November 26, 2017).

Mudie, S., et al. “Electricity Use in the Commercial Kitchen.” *International Journal of Low-Carbon Technologies*, vol. 11, no. 1, 2016, pp. 66–74.

Muldrow, Ralph C. "Preservation and sustainability: the restoration of historic buildings in Charleston, SC, shows how sustainability and preservation issues can be solved." *Clem Labine's Traditional Building* 25, no. 2 (April 2012): 14-16.

“Opioid- Related Deaths in Washington State, 2006-2016.” *Washington Department of Health*, 2017.

“Outdoor Recreation.” Wenatchee Valley Chamber of Commerce. http://visitwenatchee.org/listings/category/outdoor-recreation/

Preservation Green Lab: National Historic Trust for Historic Preservation. *The Greenest Building: Quantifying the Environmental Value of Building Reuse,* 2011.

Pyburn, Jack. "Architectural Programming and the Adaptation of Historic Modern Era Buildings for New Uses." *Journal of Architectural Conservation* 23, no. 1-2 (2017): 12-26.

Rabun, J. Stanley., and Kelso, Richard Miles. *Building Evaluation for Adaptive Reuse and Preservation*. Hoboken, N.J.: Wiley, 2009.

“Regional Population Trends”. Puget Sound Regional Council. 2017.

“River Cottage Headquaters”. Satellite Architects. http://www.satellitearchitects.com/#/river-cottage-headquarters-/

Simonen, Kathrina. *Life Cycle Assessment*. First ed. PocketArchitecture, Technical Design Series. London ; New York: Routledge, 2014.

Skolnik, Lisa. "Wright restoration: a preservation architect's quest for authenticity and sustainability." *Preservation: The Magazine Of The National Trust For Historic Preservation* 64, no. 2 (Spring 2012): 42-46.

Spencer Lewin, Susan, and Craig Goodman. "Transformative renewal and urban sustainability." *Journal Of Green Building* 8, no. 4 (Fall 2013): 17-38.

Steicek, Gary, and Petr Vancura. "Reinventing Woolworth: adaptive reuse of a historic skyscraper." *CTBUH Journal: Tall Buildings, Design, Construction & Operation* no. 4 (2015): 40-45.

Stein, Carl J. *Greening Modernism: Preservation, Sustainability, and the Modern Movement*. 1st ed. New York: W.W. Norton &, 2010.

Strain, Larry FAIA. *Time Value of Carbon: When you save matters, what you build matters, what you don't build matters more*. 2017.

United States Department of Defense. "Demonstrating the Environmental & Economic Cost-Benefits of Reusing DoD's Pre-World War II Buildings". ESTCP, 2013.

United States Department of the Interior. National Parks Service. *National Register of Historic Places Registration Form: Downtown Wenatchee Historic District, 2008*.

"U.S. Energy Use Intensity by Property Type." Energy Star Portfolio Manager. 2016.

"Washington – Chelan County – Historic Districts". National Register of Historic Places. http://www.nationalregisterofhistoricplaces.com/wa/chelan/districts.html

"WA Cloud Cover". Office of the Washington State Climatologist. http://www.climate.washington.edu/cloudcover/#wenatchee

"WA County Summary Highlights: 2012". National Agricultural Statistics Services, USDA. 2012.

"W Galen Weston Centre for Food". Gow Hastings Architects. www.gowhastings.com/projects/durham-galen-weston-centre-for-food.

"Why the Building Sector." *The 2030 Challenge*. www.architecture2030.org/buildings_problems_why/.

Young, Robert A., Elefante, Carl, and SpringerLink Content Provider. *Stewardship of the Built Environment Sustainability, Preservation, and Reuse*. Metropolitan Planning Design. Washington, DC: Island Press/Center for Resource Economics: Imprint: Island Press, 2015.

End Notes

1 Larry Strain, “Time Value of Carbon: When you save matters, what you build matters, what you don’t build matters more”, (Carbon Leadership Forum, 2017): 1.

2 2030 Challenge, “Why the Building Sector”, architecture2030.org/buildings_problem_why/.

3 2030 Challenge, “The 2030 Challenge”, www.architecture2030.org/2030_challenges/2030-challenge.

4 2030 Challenge, “Why the Building Sector”.

5 Strain, “Time Value of Carbon”: 1.

6 Advisory Council on Historic Preservation, “Sustainability and Historic Federal Buildings” (ACHP, 2011): 11.

7 Ibid.

8 Ibid.

9 Strain, “Time Value of Carbon”: 10.

10 Mike Jackson, “Embodied energy and historic preservation: a needed reassessment,” (APT Bulletin 36, no. 4, 2005): 47.

11 Ibid, 51.

12 Ibid, 50.

13 The Carbon Leadership Forum, “Embodied Carbon Benchmark Study”, (University of Washington, 2017): 2.

14 United States Department of Defense, “Demonstrating the Environmental & Economic Cost-Benefits of Reusing DoD’s Pre-World War II Buildings”, (ESTCP, 2013): ES-viii.

15 Ibid, ES-ix.

16 Ibid, ES-viii

17 Ibid, ES-iv.

18 Ibid.

19 Preservation Green Lab: National Historic Trust for Historic Preservation, “The Greenest Building: Quantifying the Environmental Value of Building Reuse” (2011): VI.

20 Ibid, 86.

21 Ibid, X.

22 Ibid, 86.

23 Athena Institute, “A Life Cycle Assessment Study of Embodied Effects for Existing Historic Buildings” (Parks Canada, 2009): 1.

24 Ibid, 22.

25 Ibid, 1.

26 Ecological Building Network, et al, “The Total Carbon Study: Case Study of DPR Construction San Francisco Office Building”, (2015): 8.

27 Ibid, 12.

28 Ibid, 13.

29 Athena Institute, “A Life Cycle Assessment Study…” (Parks Canada, 2009): 1.

30 “Regional Population Trends”, (Puget Sound Regional Council, 2017): 1.

31 Ibid.

32 United States Department of Defense, “Demonstrating the Environmental & Economic Cost-Benefits…”, (ESTCP, 2013): ES-iv.

33 Preservation Green Lab, “The Greenest Building” (2011): 19.

34 “2017 Population Trends”, Office of Financial Management, (State of Washington, 2017): 20-25.

35 Ibid, 11.

36 United States Department of the Interior, “National Register of Historic Places Registration Form: Downtown Wenatchee Historic District”, (National Parks Service, 2008): 62.

37 Ibid, 63.

38 Ibid, 62.

39 Ibid.

40 Ibid.

41 Ibid, 63.

42 Ibid, 62.

43 Ibid, 63.

44 Ibid.

45 Ibid.

46 City of Wenatchee, “History and Culture”, www.wenatcheewa.gov/visitor-info/history-and-culture.

47 Ibid.

48 Ibid.

49 Ibid.

50 United States Department of the Interior, “National Register of Historic Places…” (National Parks Service, 2008): 65.

51 Ibid.

52 John Arthur Gellatly, *A History of Wenatchee : The Apple Capital of the World*, (Wenatchee, Wash., 1963): 49.

53 Ibid, 42.

54 City of Wenatchee, "History and Culture", www.wenatcheewa.gov/visitor-info/history-and-culture.

55 Gellatly, *A History of Wenatchee,* (1963): 48.

56 Ibid, 42.

57 City of Wenatchee, "History and Culture", www.wenatcheewa.gov/visitor-info/history-and-culture.

58 Gellatly, *A History of Wenatchee,* (1963): 42.

59 Ibid, 50.

60 United States Department of the Interior, "National Register of Historic Places..." (National Parks Service, 2008): 22.

61 Ibid, 68.

62 Ibid, 69.

63 Gellatly, *A History of Wenatchee,* (1963): 49

64 Ibid.

65 Ibid.

67 United States Department of the Interior, "National Register of Historic Places..." (National Parks Service, 2008): 69.

68 Ibid.

69 City of Wenatchee, "History and Culture", www.wenatcheewa.gov/visitor-info/history-and-culture.

70 Ibid.

71 United States Department of the Interior, "National Register of Historic Places..." (National Parks Service, 2008): 70.

72 Ibid.

73 City of Wenatchee, "History and Culture", www.wenatcheewa.gov/visitor-info/history-and-culture.

74 Ibid.

75 Wenatchee Valley Chamber of Commerce, "About Wenatchee", http://visitwenatchee.org/discover/about-wenatchee/.

76 Ibid.

77 "Washington – Chelan County – Historic Districts", National Register of Historic Places, http://www.nationalregisterofhistoricplaces.com/wa/chelan/districts.html
"Chelan and Douglas Counties Profile", Employment Security Department, (State of Washington, 2017), https://fortress.wa.gov/esd/employmentdata/reports-publications/regional-reports/county-profiles/chelan-and-douglas-counties-profile.

78 Ibid.

79 Ibid.

80 "Community and Economic Development", City of Wenatchee, http://www.wenatcheewa.gov/government/community-and-economic-development

81 "Economic Development", City of Wenatchee, http://www.wenatcheewa.gov/government/community-and-economic-development/economic-development.

82 Ibid.

83 "Chelan and Douglas Counties Profile", Employment Security Department, (State of Washington, 2017), https://fortress.wa.gov/esd/employmentdata/reports-publications/regional-reports/county-profiles/chelan-and-douglas-counties-profile.

84 "WA Cloud Cover", Office of the Washington State Climatologist, http://www.climate.washington.edu/cloudcover/#wenatchee

85 "Climate Summary – Wenatchee, Washington, 1931 - 2005", Western Regional Climate Center, https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?wawena.

86 Ibid.

87 Ibid.

88 Jack Pyburn, "Architectural Programming and the Adaptation of Historic Modern Era Buildings for New Uses", *Journal of Architectural Conservation* 23, no. 1-2 (2017): 16.

89 Ibid, 15.

90 "Chelan and Douglas Counties Profile", Employment Security Department, (State of Washington, 2017), https://fortress.wa.gov/esd/employmentdata/reports-publications/regional-reports/county-profiles/chelan-and-douglas-counties-profile.

91 Ibid.

92 "WA County Summary Highlights: 2012", National Agricultural Statistics Services, (USDA, 2012):1.

93 "Farm-to-Table Training", Seattle Culinary Academy, Seattle Central College,

https://culinary.seattlecentral.edu/farm-to-table-training

94 Ibid.

95 "Outdoor Recreation," Wenatchee Valley Chamber of Commerce, http://visitwenatchee.org/listings/category/outdoor-recreation/

96 Jeffrey Brown, "A Brief History of Culinary Arts Education in America." *Journal of Hospitality & Tourism Education* 17, no. 4 (2005): 47.

97 Ibid, 49.

98 Ibid, 52.

99 Ibid.

100 Ibid.

101 S. Mudie, et al., "Electricity Use in the Commercial Kitchen," *International Journal of Low-Carbon Technologies,* vol. 11, no. 1, (2016), 66.

102 "U.S. Energy Use Intensity by Property Type", Energy Star Portfolio Manager, (2016):3-4.

103 "Central Oregon CC Jungers Culinary Center," Yost Grube Hall Architecture, http://ygh.com/projects/education/central-oregon-community-college-jungers-culinary-center/

104 "Cascade Culinary Institute Program Options," Cascade Culinary Institute, www.cascadeculinary.com/certificates-and-degrees/

105 "W Galen Weston Centre for Food", Gow Hastings Architects, www.gowhastings.com/projects/durham-galen-weston-centre-for-food.

106 Ibid.

107 "River Cottage Headquaters," Satellite Architects, http://www.satellitearchitects.com/#/river-cottage-headquarters-/.

108 Ibid.

109 "Inspiration Kitchens", Wheeler Kearns Architects, http://wkarch.com/project/inspirationkitchens/.

110 "About Us", Inspiration Kitchens, http://inspirationkitchens.org/about-us/.

111 United States Department of the Interior, "National Register of Historic Places..." (National Parks Service, 2008): 12-61.

112 "Creating a positive street edge," Guidance for Mixed Use Development, (Auckland Design Manuel, 2018) http://www.aucklanddesignmanual.co.nz/project-type/buildings-and-sites/mixed-use/MixedUse/guidance/streettofrontdoor/createapositivestreetedge

113 Ibid.

114 United States Department of the Interior, “National Register of Historic Places...” (National Parks Service, 2008): 22.

115 Documents provided by City of Wenatchee

116 United States Department of the Interior, “National Register of Historic Places...” (National Parks Service, 2008): 22.

117 Ibid.

118 City of Wenatchee Zoning, 10.24.005, Central Business District Purpose.

119 City of Wenatchee Zoning, 10.40.015, Historic/Entertainment Overlay (HEO).

120 City of Wenatchee Zoning, 10.40.020, Columbia Street Overlay (CSO).

121 City of Wenatchee Zoning, 10.40.015, Historic/Entertainment Overlay (HEO).

122 Kathrina Simonen, *Life Cycle Assessment*, First ed, PocketArchitecture, Technical Design Series. (London; New York: Routledge, 2014): 1.

123 Ibid, 2.

124 Ibid.

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fig. 18 - Annual average temperature data for Wenatchee with design targets (adapted from data collected by Office of the Washington State Climatologist, http://www.climate.washington.edu/cloudcover/#wenatchee)

fig. 19 - Sky cover and precipitation days for Wenatchee (adapted from data collected by Office of the Washington State Climatologist, http://www.climate.washington.edu/cloudcover/#wenatchee)

fig. 20 (left top) - Seattle Culinary Academy (Schacht Aslani Architects)

fig. 21 (right top) - Il Sogno Restaurant (Lake Flato Architects)

fig. 22 (left bottom) - Charles Smith Winery (Olson Kundig Architects)

fig. 23 (right bottom) - Seattle Culinary Academy (Schacht Aslani Architects)

fig. 24 - The agricultural impact of the five county area (adapted from data collected by National Agricultural Statistics Services, USDA, 2012)

fig. 25 - Major recreational opportunities near Wenatchee with travel times

fig. 26 - Culinary schools of Washington

fig. 27 - Experience of Dining through time

Appendix

The simplified LCA used in this project was based on background research conducted by the Carbon Leadership Forum for "Prototype Mass Timber Office Building Models: Material Quantities and Preliminary Life Cycle Assessment". While this data provided an approximation for the carbon impacts of production of materials and construction processes, other metrics could have been used to gain a more exact level of carbon impacts. The simplified LCA was used as a benchmark of all scenarios outline and provide an important metric for comparison.

Below is the data and assumption used to calculate the initial carbon impacts for each scenario.

	Initial Carbon Emissions	Operational Carbon Emissions
Scenario 1	**New Construction** 5,307,200 kg CO_2e	**143 EUI** 491,000 kg CO_2e/yr

Methods and Estimates

Building Width	73 feet	**Foundation**	30 kg CO_2 e/sf
Building Length	120 feet	**Structure**	75 kg CO_2 e/sf
Floor Area	8,760 square feet	**Enclosure**	15.33 kg CO_2 e/sf
Number of Floors	5 floors		
Facade Area	13,510 square feet		
Total Floor Area	43,800 square feet		

	Initial Carbon Emissions	Operational Carbon Emissions
Scenario 2	**New Construction** 5,307,200 kg CO_2e	**43 EUI** 147,300 kg CO_2e/yr

Methods and Estimates

Building Width	73 feet	**Foundation**	30 kg CO_2 e/sf
Building Length	120 feet	**Structure**	75 kg CO_2 e/sf
Floor Area	8,760 square feet	**Enclosure**	15.33 kg CO_2 e/sf
Number of Floors	5 floors		
Facade Area	13,510 square feet		
Total Floor Area	43,800 square feet		

Scenario 3	**Retrofit** 2,150,000 kg CO_2e	**89 EUI** 294,600 kg CO_2e/yr

Methods and Estimates

Building Width	73 feet	**Carbon Impacts**	40 kg CO_2 e/sf
Building Length	120 feet		
Floor Area	8,760 square feet		
Number of Floors	5 floors		
Facade Area	13,510 square feet		
Total Floor Area	43,800 square feet		

Scenario 4	Retrofit	+	New Construction	43 EUI	+	89 EUI
	525,000 kg CO_2e		3,711,495 kg CO_2e	147,300 kg CO_2e/yr		294,600 kg CO_2e/yr

Methods and Estimates

Lower Floor

Building Width	65 feet	**Foundation**	30 kg CO_2 e/sf
Building Length	73 feet	**Structure**	75 kg CO_2 e/sf
Floor Area	4,745 square feet	**Enclosure**	22.21 kg CO_2 e/sf
Number of Floors	1 floors		
Facade Area	1,932 square feet		
Total Floor Area	4,745 square feet		

East Building

Building Width	56 feet	**Foundation**	30 kg CO_2 e/sf
Building Length	72 feet	**Structure**	75 kg CO_2 e/sf
Floor Area	4,032 square feet	**Enclosure**	22.21 kg CO_2 e/sf
Number of Floors	5 floors		
Facade Area	8,960 square feet		
Total Floor Area	20,160 square feet		

West Building

Building Width	32 feet	**Foundation**	30 kg CO_2 e/sf
Building Length	59 feet	**Structure**	75 kg CO_2 e/sf
Floor Area	1,888 square feet	**Enclosure**	30.24 kg CO_2 e/sf
Number of Floors	1 floors		
Facade Area	1,274 square feet		
Total Floor Area	1,888 square feet		

Operational impacts used in this project were based on information provided by Architecture 2030's Zero Tool. By inputting location, program types and sizes, the Zero Tool produced baseline energy performance in terms of EUI, GHG emissions and energy consumption. This tool provides an approximation for the performance and consumption levels for each scenario.

6/4/2018

2030 Baseline

ABOUT YOUR BUILDING

Building Name: Fruit Growers Service Building

Country: United States *

City | State/Prov.: Wenatchee * | Washington *

Postal Code: 98801 *

Degree Days: HDD 6273 * CDD 459 *

○ New construction ○ Existing Building

BUILDING USE DETAILS

In order to provide you with an appropriate comparison for your building, we need to know how spaces in this building will be used. If your building has multiple uses, add them below.

○ Commercial ○ Residential

Add Another Use

Selected Use Type(s):

- Adult Education
- Food Service
- Restaurant

RESULTS

Target EUI is 43 based on a 70% reduction

BUILDING SUMMARY

LOCATION	Wenatchee, WA	98801
USES	Adult Education	26,500 sq.ft (61.6%)
	Food Service	12,100 sq.ft (28.1%)
	Restaurant	4,400 sq.ft (10.2%)

RESULTS	BASELINE	TARGET	YOUR BUILDING
EUI % Reduction from Baseline	0%	70%	N/A
Zero Score	100	30	N/A
Site EUI (kBtu/ft²/yr)	143	43	N/A
Source EUI (kBtu/ft²/yr)	285	86	N/A
Total GHG Emissions (metric tons CO_2e/yr)	491	148	N/A

○ imperial ○ metric print