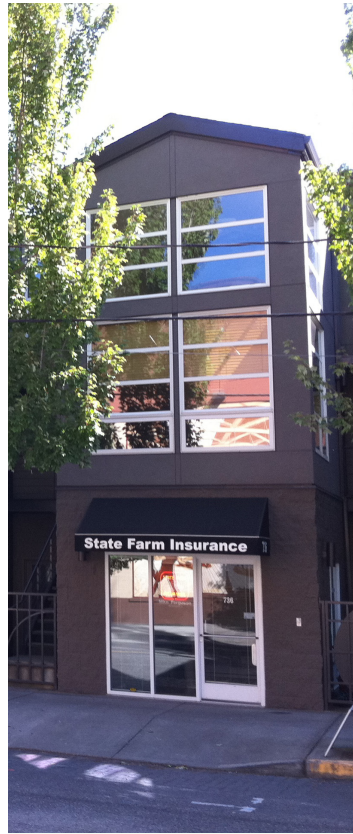
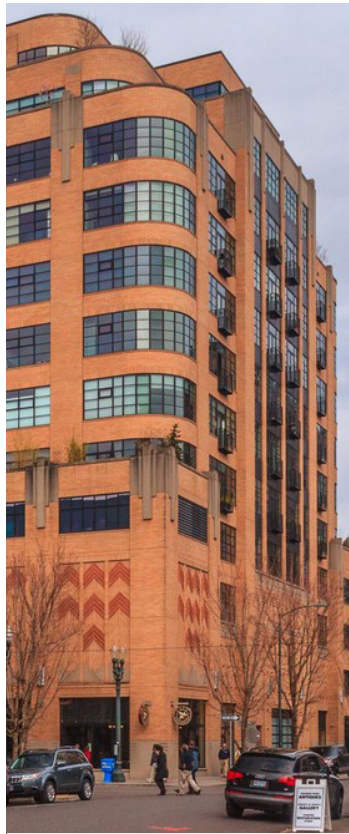




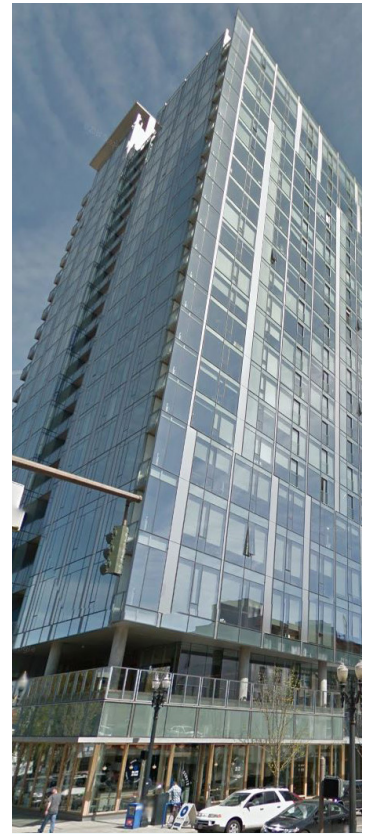
North Bank Depot Rowhouses



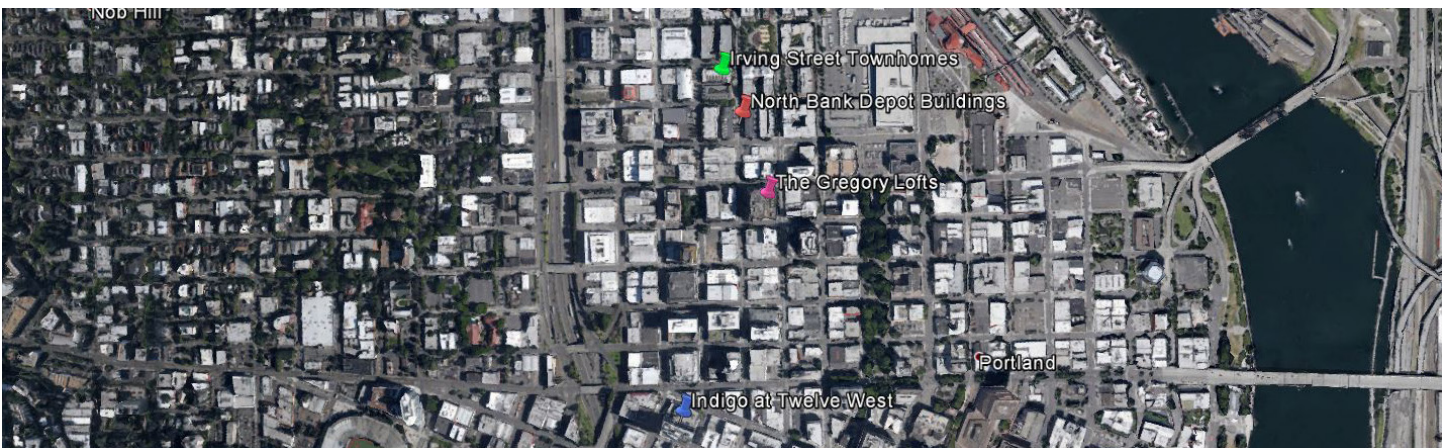
Irving St. Townhomes



The Gregory Condos



Indigo Apartments



Four Portland Housing Types

Project #1: Case Studies – Four Portland Housing Types
Housing Prototypes – ARCH 538

Prof: Michael Fifield, Professor of Architecture, University of Oregon

November 13, 2014

Case Study by: Richard H. Wilson - www.rhwdesigns.com



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Project Objectives

To document, analyze, and communicate the essential ideas associated with various housing projects that have addressed housing issues in a creative or innovative manner in the Portland metropolitan area.

This case study will investigate four types of housing that are of various sizes, from small to tall.

- Rowhouse: North Bank Depot Buildings, NW Hoyt St & NW 11th Ave, Portland, OR
- Townhome: Irving Street Townhomes, NW Irving St & NW 11th St, Portland, OR
- Mid-rise Condo: The Gregory Lofts, 420 NW 11th Avenue, Portland, OR
- High-rise Apartment: Indigo at Twelve West, 430 SW 13th Avenue, Portland, OR (ZGF Tower)

Now after the fact of suburbia in the United States, the general approach to housing design at the University of Oregon in Portland is to develop an understanding of compact urban development. What influenced the decision to research these housing types was a focus on understanding what may represent sustainable and resilient design. Each of these housing types will be evaluated on their sustainable characteristics and approach to housing.

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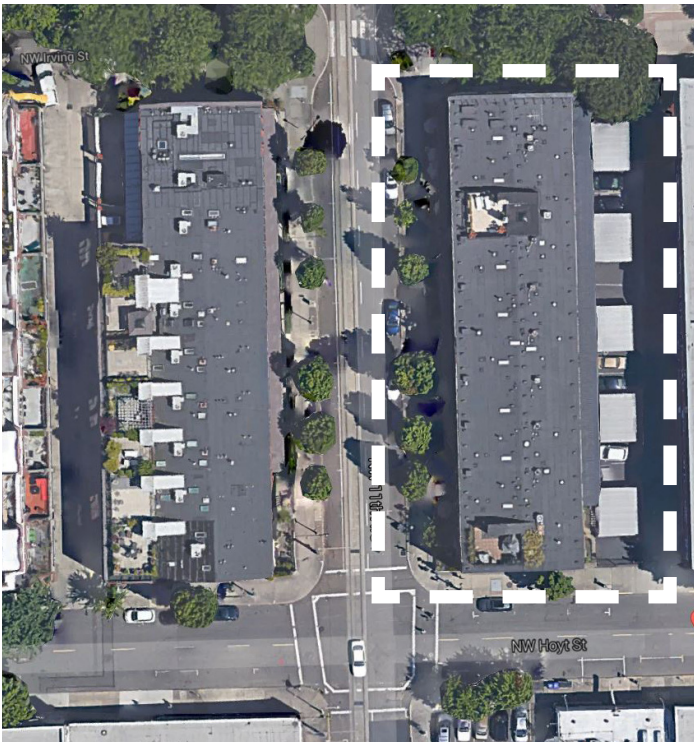
North Bank Depot - Rowhouses | Documentation



1908 NW Hoyt Street View²

History¹

- Constructed 1908 (top left²)
- Originally an operations, loading, and passenger station building for the Northern Pacific Rail Company.
- Passenger rail service ended in 1931.
- Freight service ended in the 1980's, and became mostly vacant until 1990, when a development company bought it, and abated the contaminated soils around the building. Investment in the area was spurred by the Portland Planning Commission (PDC) after rezoning the district.
- Claimed Oregon National Historic Registry on 1996 Feb 02³
- Units became available after completion in 1991.
- Rowhouses from aerial photo (bottom left⁴), and from sidewalk (right⁵).
- Note that this housing type will receive the greatest amount of attention, as the author is particularly interested in adaptive re-use architecture.



2014 Aerial Photo⁴

1 Tess, J. M., & Mawson, R. (1995). National Register of Historic Places Inventory/Nomination: North Bank Depot Buildings. Portland: National Park Service. Retrieved Oct 25, 2014, from <http://pdfhost.focus.nps.gov/docs/NRHP/Text/96000124.pdf>

2 Harry, R. A. (n.d.). North Bank Station. Mayor (Archival) - Albee, Harry Russell - Photographs - A2000-003.74 : Survey # 46 - North Bank Freight Depot. Archives & Records, Division Auditor's Office, City of Portland, Portland. Retrieved Oct 25, 2014, from <http://efiles.portlandoregon.gov/webdrawer.dll/webdrawer/rec/2669390/>

3 Oregon Parks and Recreation Department. (2011). Oregon National Register List. Portland. Retrieved 10 25, 2014, from http://www.oregon.gov/OPRD/HCD/NATREG/docs/oregon_nr_list.pdf

4 Google, Inc. (2014). Google Maps Maker. Portland, Sanborn. Retrieved Oct 05, 2014, from <https://maps.google.com/>

5 Wilson, R. H. (1987-2014). Photographs, Sketches, Paintings and Architecture: A Collection. RHW Designs, Portland, OR, USA. Retrieved from www.rhwdesigns.com

North Bank Depot - Rowhouses | Documentation

Land Use¹

The project occupies two buildings facing each other across NW 11th Ave, one on the west side, and the other on the east. This case study will look primarily at the east building only.

The rowhouse lot occupies 1/2 of a typical Portland block (which is 200ft x 200ft). Meaning the lot size is 200ft x 100ft, or 20,000sf.

The building footprint occupies roughly 67% of the lot at 13,340sf, not including carports.

10 Rowhouse units. Each about 19ft x 67ft, with a main floor area of around 1,270sf. All two floor, adding to about 2,540sf each.

Two bed, two and one half baths.

Units range from \$745,000 to \$1,348,000, with an average of \$880,367. Or \$345/sf. The most valuable units are at the north and south corner.

An average 20-year mortgage would likely be around \$3300/mo. Which may require a total household income of \$90,000/yr.

Investigation of building completion and change of occupancy can often be a challenging aspect of case study research such as this. One cannot for example, just pull up the internet and type in a search for the history of all things construction related. Resources exist however to uncover the development and alterations of building use. 1) PortlandMaps.com, a metro-wide database of buildings, lots, and land-use². Although this recourse is also responsible for maintaining a certain level of respect and privacy to owners, and other sensitive data. It provides a large database for some relatively accurate information on each property, although deeper analysis of the data

1 City of Portland, Oregon. (2014). 5a. Regional Growth Projections. Retrieved from Portland Plan: <http://www.portlandonline.com/portlandplan/index.cfm?a=288097&c=52256>

2 City of Portland, Oregon. (2014, 10 20). PortlandMaps. Retrieved Oct 25, 2014, from PortlandMaps: <http://www.portlandmaps.com/>

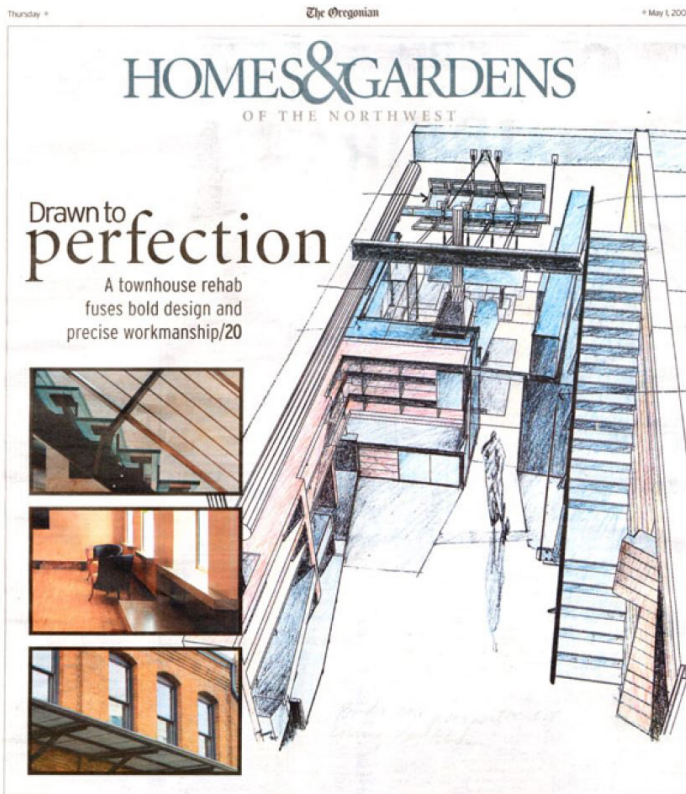


NW 11th Ave Street Elevation⁵



NW 11th Ave Street Perspective⁵

North Bank Depot - Rowhouses | Documentation

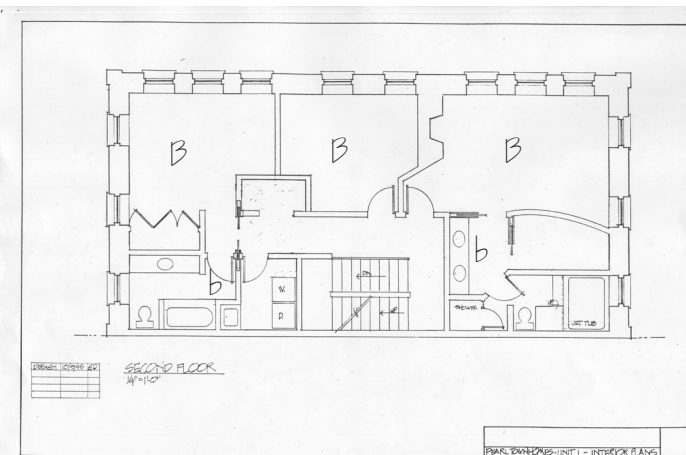
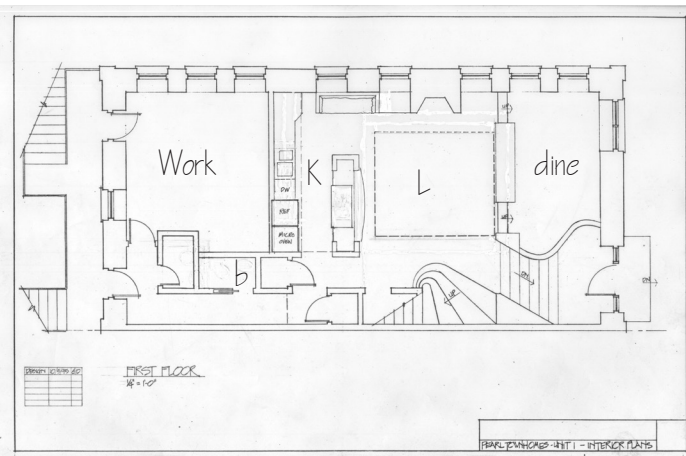


must be done. 2) Asking the City of Portland directly at the building and development department can sometimes be useful. However these results vary depending on the mood of the employees behind the counter, hour of day, whether it is busy and more. 3) The Oregonian, a local newspaper, can sometimes turn out to be a valuable resource. Here though a great amount of information must be absorbed and skimmed to find small bits of what may be considered valuable. In the case of this study, an article by Randy Gragg pointed the documentation into the right direction (top right)³.

By contacting a resident of one of the units, Gordon E. Davis⁴, seeing the interior and generously receiving plans and documentation of the typical units was possible (next page)⁵. Mr. Davis also provided his designs of his unit which he resides in at the North Bank Blocks (left and bottom left). His unit is unique since upon purchase was just the shell. As an architect at the time, he designed the floor plan, and created a magnificent interior custom designed home and business. Notice the wall thickness, which delineates the resulting adaptive reuse and seismic upgrade wall thickness. The wall, as reported by Davis, starting from the exterior:

- Brick
- Seismically reinforced with 8" of concrete and rebar
- Metal 2x3 studs
- Foam insulation
- Gypsum wall board at the interior.

He did leave a few accent walls exposed as the original brick as well, which added to the beauty of the interior space.

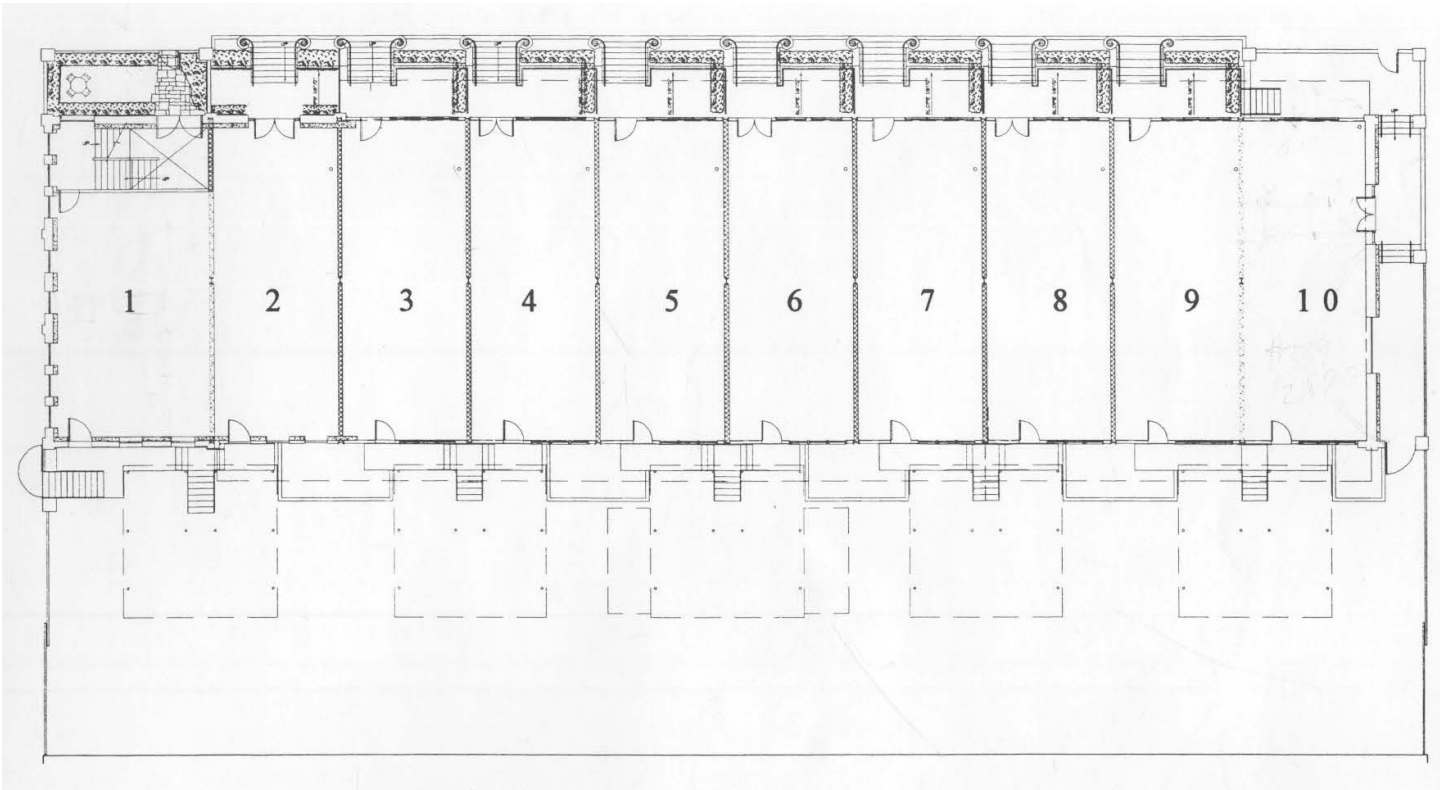


³ Gragg, R. (2003, May 27). Drawn to Perfection: A townhouse rehab fuses bold design and precise workmanship. The Oregonian, pp. 1, 20-29. Retrieved Oct 25, 2014, from <http://www.fhzal.com/works/010402/gragg-030501.asp>

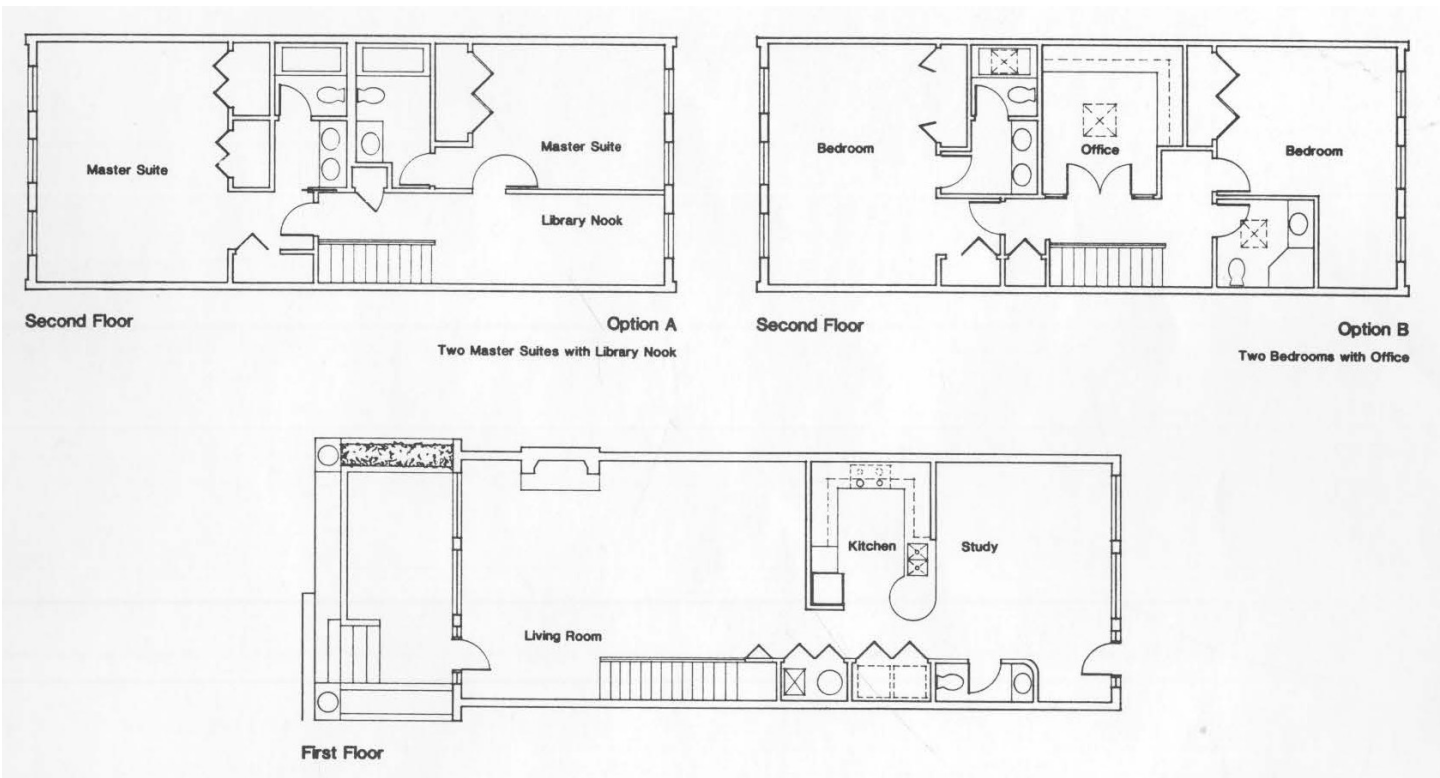
⁴ Davis, G. (2014). Retrieved from Sculpture - Gordon Davis: <http://www.gordondavis.net/>

⁵ Urban Homes, Inc. (1992). Pearl Townhomes Urban Residential Elegance. Portland: Realty Trust Associates, Inc.

North Bank Depot - Rowhouses | Analysis



East Building Overall Floor Plan



Typical Unit Floor Plan - w/ Option A and B Upper Floor

North Bank Depot - Rowhouses | Analysis

By looking at the typical plans on the previous page, there are two bedrooms, and a study. Although the study for this demographic would more likely be used as a study, in some cases it may be used as a bedroom. This means the average units contains 2.5 bedrooms. Or two adults sleeping in the same room, with 1.5 other potential people in the residence. It may be likely then to assume each unit has 3.5 people, times 10 is about 35. Indicating that this one building of rowhouses may contain 35 people. This results in 571sf per capita for this lot.

This type of housing is typical in the US, and in other countries as well. Many may be found in European countries for example. They offer a level of ownership that spans a gap between single-family housing and condos or apartments. Although similar to Townhomes, Rowhouses usually only have access to daylight on the two short sides of the unit, and lack a garage. They are usually two to three stories tall, varying in their unit placement (either one on top of the other, or side-by-side).

North Bank Depot was an adaptive re-use of a historic building, and units are side-by-side. For a sustainable community to be successful, there must be a wide range of income levels¹. Preserving old buildings allows for cheaper rents/costs to new tenants. As Jane Jacobs discussed in her book, *The Death and Life of Great American Cities*, these old buildings provide value to a city that needs a mixed variety of incomes². The older buildings may be valued at a lower cost to tenants. So the adaptively reused buildings are the perfect opportunity to provide this mixed income value.

That was the logic at least. Unfortunately, as was found on [PortlandMaps.com](http://www.portlandmaps.com), these average unit cost about \$880,000 each. Which may be an unfortunate result of unforeseen factors that Jacobs could not fathom. Sound logic indeed that an old building should be less valuable than a newly constructed building. However here may be some reasons for the unexpectedly high cost:

1. Recent attract-ability of urban professionals to rugged, nostalgic, aesthetic living.
2. Most masonry buildings built before 1950 were unreinforced³. With a change of occupancy, or any upgrade to a building where construction costs are \$236,000 or more, a seismic evaluation is required. This means that in order to meet safety codes, they must be seismically upgraded to a minimum level of safety. At a lecture on seismic upgrades at the AIA in Portland, it was discussed that the cost of a seismic upgrade may range from \$15-\$50 per square foot⁴. Considering the square-footage in the North Bank Depot east building, at 13,340sf multiplied by roughly \$32/sf, would cost a developer about \$427,000. This figure is on top of purchasing the land and building, plus soil abatement, plus interior renovation for residential use, and design fees for consultants and architects – all before they may be sold. Unfortunately the numbers for each of these were not available for documentation. However it is easy to see how this may drive the cost of the units up past what is affordable.
3. The “Complete Neighborhood” score of this particular building is listed as 61/100⁵, although the author would put it much higher for proximity to amenities, downtown central location, leisure activities, and nearby accesses to mass transit.

1 Mirviss, L. (2014). *In-Demand Cities: Portland*. Portland: Architectural Record. doi:116

2 Jacobs, J. (1992). *The Death and Life of Great American Cities*. New York: Vintage Books.

3 Mehta, M., Scarborough, W., & Armpriest, D. (2010). *Building Construction: Principles, Materials, and Systems*. New Jersey: Pearson Education, Inc.

4 Dean, E. T. (2014, 04 16). *Seismic Upgrades of Existing Buildings*. Retrieved from Nishkian: Consulting and Structural Engineering: <http://www.nishkian.com/seismic-upgrades-of-existing-buildings/>

5 City of Portland, Oregon. (2014, 10 20). *PortlandMaps*. Retrieved Oct 25, 2014, from [PortlandMaps](http://www.portlandmaps.com/): <http://www.portlandmaps.com/>

North Bank Depot - Rowhouses | Analysis

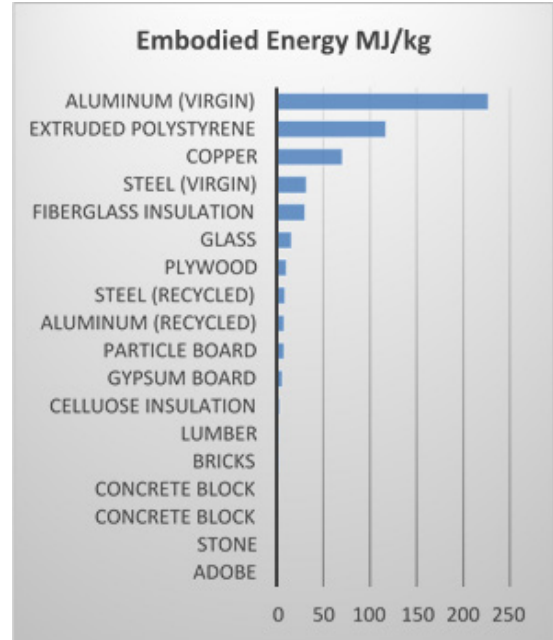
Sustainability

Re-use of existing buildings holds potential for retaining the embodied energy of the structure and materials¹.

New construction demands new energy consumption, compared to re-use of existing buildings that have already spent energy to be built.

Although refurbishing an existing building still requires energy, the offset of new vs. re-used can be substantial.

The materials used for renovations likely included steel brace frames, and some interior framing for sound, separations between units for fire safety, and privacy. Maintaining the exterior envelope of brick masonry was a good choice.



Embodied Energy of Materials¹



¹ Mehta, M., Scarborough, W., & Armpriest, D. (2010). Building Construction: Principles, Materials, and Systems. New Jersey: Pearson Education, Inc.

Irving St. Townhomes - Documentation



1994 Aerial Photo¹



2004 Aerial Photo³

History

- This property shares the same history as the North Bank Blocks rowhouses. However the difference here was that the buildings that were once on the lot for the new Irving Street Townhomes were demolished. As may be seen in the 1994 aerial image on the left, in comparison to the 2014 aerial image¹.
- Part of Urban Renewal Portland, and built in built 1996².

Land Use

- 14 properties
- Zoned as "Live/Work"
- Allows flexible business space on base level. Owners may convert street-level garage into retail or business space.
- Lot = 22,200sqft
- Building footprint = 18,046sqft
- Building occupies 81% of site.
- Seven units have a private exterior courtyard.
- North side of lot is a pedestrian-only street, tree-lined, with intermittent benches accessible to the public.

Units

- (7) Possible Street Retail: 600sf (ea)
- (4) Two-Bed: 845sf; \$1,800/mo (ea)
- (3) Two-Bed: 1,200sf; \$2,300/mo (ea)
- (7) Two-Bed: 1,500sf; \$3,100/mo (ea) w/ garage and courtyard

Irving St. Townhomes - Analysis

This townhouse building characterizes an ideal housing type. While the car still dominates the transportation of humans from place to place, tenants may choose to store their car in the garage provided, rather than on the street, which is a relatively high-value bit of land.

As America has begun to recognize the potential detriment of the suburban housing construction method, there have been some general shifts in culture toward compact development. With this shift has also been the gradual infrastructure

1 (1994). Photograph: Aerial NW Downtown Portland. BP514-23. Bergman Photographic Services Inc., Portland.

2 City of Portland, Oregon. (2014). 5a. Regional Growth Projections. Retrieved from Portland Plan: <http://www.portlandonline.com/portlandplan/index.cfm?a=288097&c=52256>

Irving St. Townhomes - Analysis

improvement for bicycle traffic around Portland. And since mayor Charlie Hales has been in office, he has reintroduces the light-rail directly in the downtown, which is apparent on the street adjacent to this townhome. All of this change may result in residents living within the downtown having options for transportation other than single-occupancy vehicles (SOVs).

With lower dependence on the need for a vehicle some residents may opt to sell their car, and rely on a bicycle or mass transportation. This leaves the garage space open for either bike parking, or renting for a single room.

The garage may also be converted into a work space or micro-enterprise. 'Maker-space' is a popular term used in the architecture studio around the University of Oregon in Portland. Which describes the use of small leasable space for small-business to be performed. Whether the "maker" is producing hand-made goods, technical expertise, or other talents. Some of the businesses that currently occupy the convertible rooms are:

1. Smart Real Estate, real estate office
2. Botanicus, flower shop
3. Pearl District Properties, real estate office
4. State Farm Insurance
5. Recycled Chic Boutique, clothing
6. Solo architect practice

Notice in the image (top right)³ how the units share one front street entry. One tenant chose to convert their garage into a shop, whereas the other did not. While the design forces the vehicle to be placed at the street front, the design of the building did not pronounce the presence of the garage more than the living space above. Although perhaps the shop on the left is more inviting, both options are completely acceptable. Notice too the alley on the left of the image, which provides garage access to other units that have live-work options on the opposite side south-facing the pedestrian-only street.



NW 12th Ave Street View

Inner Private Courtyards



SW Aerial Image³

³ Google, Inc. (2014). Google Maps Maker. Portland, Sanborn. Retrieved Oct 05, 2014, from <https://maps.google.com/>

The Gregory Condos - Documentation



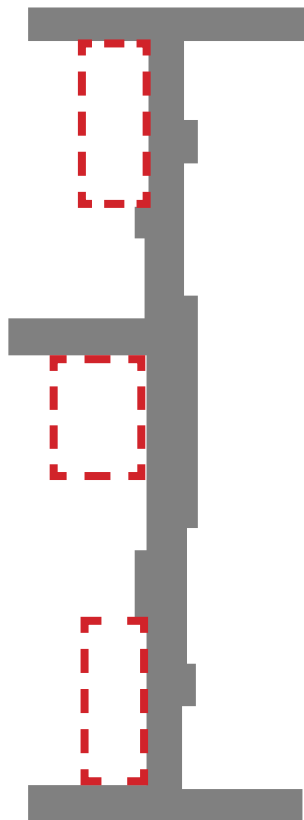
Project Information

- Occupied in 2000
- 12-story
- 340,000 gross square feet
- 21 Office Units
- 17 Retail Units
- 133 residential units
- Units range from 1,000sf – 3,000sf
- One Bed, 857sf; \$391,500
- Base-level retail and restaurants/cafés
- Parking garage: 205 stalls
- Fifth-floor residential roof deck
- Developer: Carroll Aspen
- Architect: Ankrom Moisan
- Builder: Howard S. Wright
- Budget: \$27,000,000

The 1994 picture on the top left, shows in reference to the North Bank Depot, the location of The Gregory, just south¹. Notice that it replaced an existing building. What it replaced could not be uncovered.

The illustration on the bottom left shows only the double-loaded corridor which is typical for the fifth through tenth floors. Notice the locations of egress stairs, and elevators as the middle red box.

This 12-story mid-rise condominium came as bare unit shells. Residents were able to purchase the units, then install their own plumbing fixtures, cabinetry, kitchen and appliances. The floor plans, seen on the right from Obsidian Architecture² shows the arrangement of spaces. The typical floor plans do not have balconies however, but only on the floor plans that are shown here. The rest of the units have doors that open to the exterior, which are immediately faced with a guardrail. The style of architecture is a mix of Traditional and Art Deco.

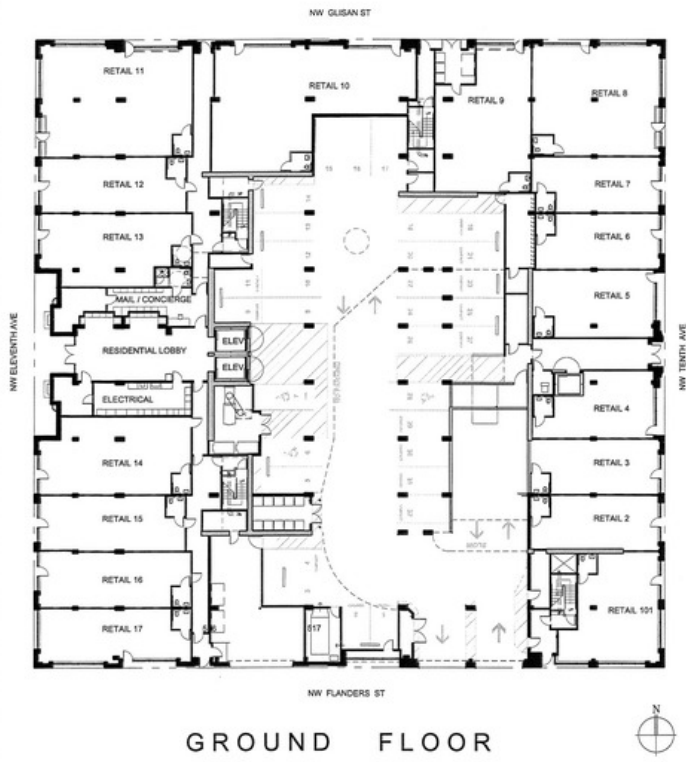


Typical Double-Loaded Corridor

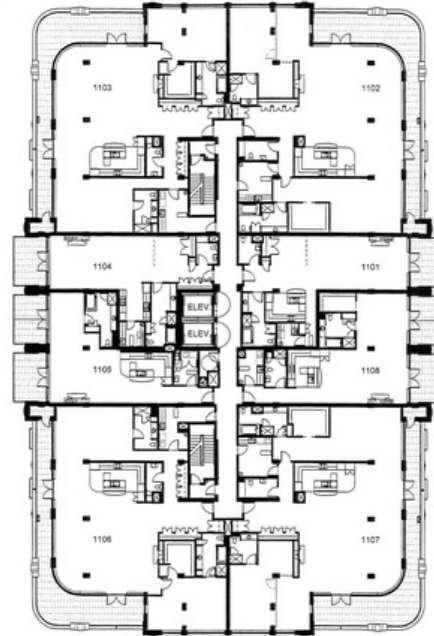
¹ (1994). Photograph: Aerial NW Downtown Portland. BP514-23. Bergman Photographic Services Inc., Portland.

² Darby, M. (2000). 2000: The Gregory, The Pearl District, Portland, Oregon. Retrieved Nov 01, 2014, from Obsidian Architecture LLC: <http://obsidianarchitecture.com/1999-gregory-lofts-portland-oregon>

The Gregory Condos - Documentation



GROUND FLOOR



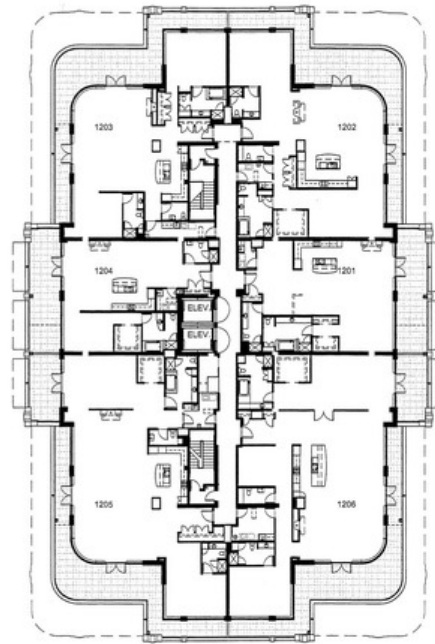
11th FLOOR

10 Different floor plans from floors 5 to 10; 21 units per floor.

- | | | | |
|---|--|--|--|
| Four | Two | One | Two |
| Four | One | Two | |
| Two | One | Two | |



5th FLOOR



12th FLOOR

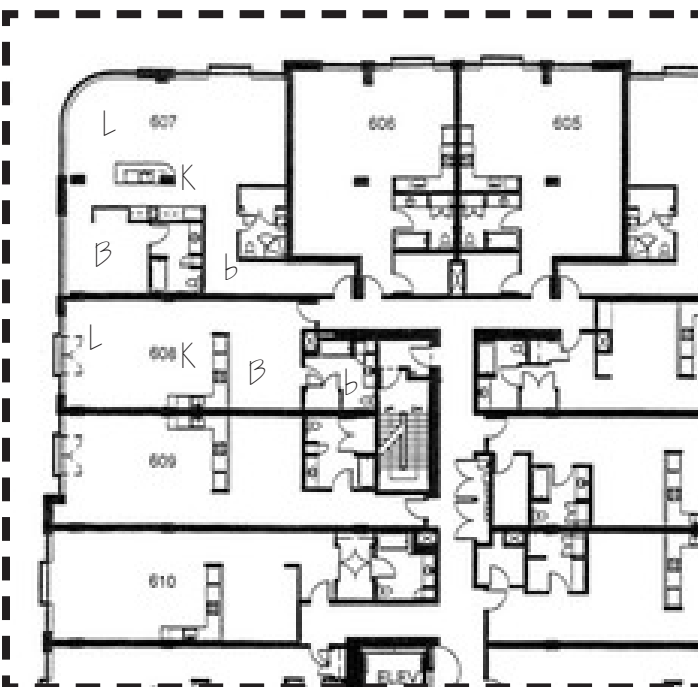
The Gregory Condos - Analysis



Corner Unit Penthouse



Typical Studio



Sixth Floor Enlarged Area

The images on the left¹ show units that were recently for sale. The Gregory is a good example of Art Deco architecture, and spotlights one of the last significant attempts in Portland to engage in high-quality traditional design. The space on the base floor fit a large amount of retail units into the surrounding facade. This ground-floor retail approach enlivens the neighborhood with some commerce, and puts people on the street. In order to create the highly ordered expression for the entire massive 2/3 Portland block building, the base had to take a form devoid of openings at the facade. Such as the base of a column, for example, that must appear strong. From there up, the facade becomes articulated with unit glazing.

The design is also of high quality since the developer was able to put money in what would have normally gone toward the cost of fixtures and appliances, into the building. With efficient floor plans, space was conserved and leaseable. And with a few clever step-backs, additional floors were able to be added to the top. This is apparent, because upon analyzing the Portland Code², the zoning for this site, as of now, has a Floor Area Ratio (FAR) of 3:1. This was possible as well, since the building only occupies 2/3 of the Portland block it sits within.

Units such as these, in a downtown, may only serve a specific audience however, which may or may not be a good thing (depending on who one wishes to attract). The high quality materials, open floor plans, and lack of additional bed rooms, indicates one of two things:

1. Attract young singles, and/or couples who share a room.
2. Attract retired individuals, or parents who's children have left home.

By reading the home owner's association website³ for The Gregory however, it is clear that the

1 Darby, M. (2000). 2000: The Gregory, The Pearl District, Portland, Oregon. Retrieved Nov 01, 2014, from Obsidian Architecture LLC: <http://obsidianarchitecture.com/1999-gregory-lofts-portland-oregon>

2 City of Portland. (2010). Title 33, Planning and Zoning . Portland: City of Portland. Retrieved Nov 11, 2014, from <http://www.portlandoregon.gov/bps/index.cfm?c=34560&a=53298>. Zone EXd

3 Home Owner's Association. (2014). Information for New & Prospective Owners. Retrieved Nov 11, 2014, from The Gregory: http://www.thegregory.com/visitors/house_rules/index.html

The Gregory Condos - Analysis

community wishes to maintain a quiet and orderly complex. Although not all young urban professionals tend to be rowdy, the assumption here may tend to indicate that the target audience of the condo should be the second group. This is apparent as well, due to the high unit cost to square footage ratio. One typical One-Bed unit has 809sqft, and costs \$374,000, or \$462/sqft. This is a high cost for a typical young professional just starting out. This number is not so unreasonable however for retirees looking to sell their home in the suburbs, and move to a place such as Downtown Portland, that has a walk score of 97/100 (portlandmaps.com). One resident posted a video on YouTube showing just about every inch of their unit 702⁴.

This type of housing, able to contain a high-density of residents, at 133 units x 1.5 residents/unit, of about 200 potential tenants. Compared to the previous two properties, this type of housing may be better suited to overcome the expected increased housing demand in Portland.

The sustainability aspects of this project are significant. Mainly due to the high quality of materials, and design. This building is likely to stand for at least 50 years without significant issues, if not 75, or more. This is valuable in terms of embodied material energy. Since brick, as a rainscreen, has a low embodied energy contrasted with other rainscreen systems. It benefits for both lasting material choice, and for its lower demand on the earth.

4 Bjorge, E. (2010, 07 19). Pearl District Loft for sale - Portland Oregon. Retrieved from YouTube: <https://www.youtube.com/watch?v=rBG-MgU5ESZw>



The Gregory - From SW Street

Indigo 12-West Apartments - Documentation

Project Information



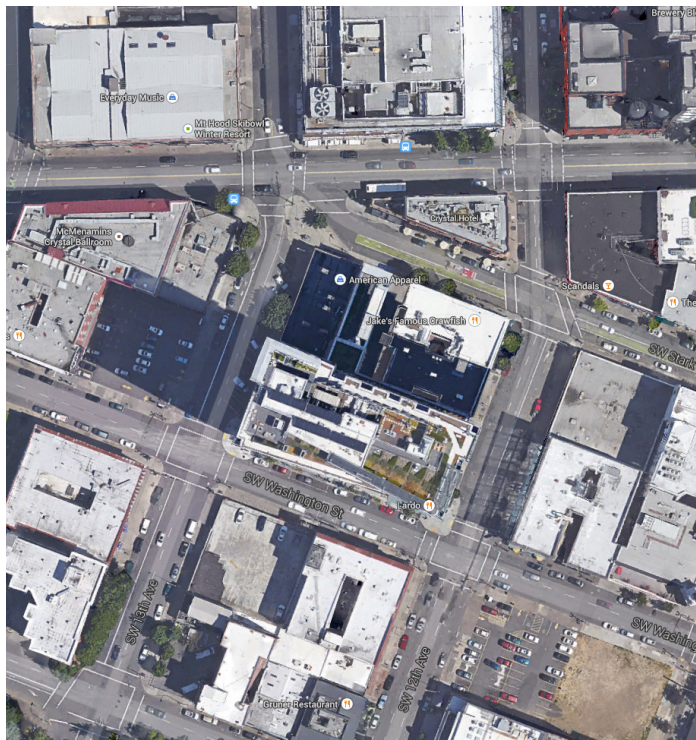
1994 Aerial Photo

- 1/2 Portland Block
- 22 Floor
- Mixed-Use
- Apartments - 18 units per 13 typical floors (234 units from floor seven to 21).
- Offices at Base
- Cost \$137,000,000
- Studios: 700sf; \$1,375
- Penthouse (Three-Bed): 2,040sf; \$4,050
- 1994 Aerial Photo¹ top left. Aerial photo 2014 bottom left².
- Site Zoned as RXd, with FAR of 4:1 and min density of 1 unit per 500sf of site area. Meaning this site only required about 40 units.
- The Architecture firm that designed the building, ZGF, occupies floors two through five³.

Sustainability Features

- Graywater Recycling in Toilets and Irrigation.
- Reclaimed wood.
- Urban Rooftop Wind Turbines - power the elevators.
- Composting in Portland
- LEED Platinum

High glazing ratio, seen in the image at the top right⁴.



2004 Aerial Photo

1 (1994). Photograph: Aerial NW Downtown Portland. BP514-23. Bergman Photographic Services Inc., Portland.

2 Google, Inc. (2014). Google Maps Maker. Portland, Sanborn. Retrieved Oct 05, 2014, from <https://maps.google.com/>

3 GerdingEdlen. (2013). Indigo @ Twelve West. Retrieved Oct 05, 2014, from <http://indigo12west.com/>

4 ZGF Architects. (2007). Twelve|West. Portland: ZGF Architects. Retrieved Nov 11, 2014, from <http://issuu.com/zgfarchitectsllp/docs/twelve-west?e=5145747/2621878>

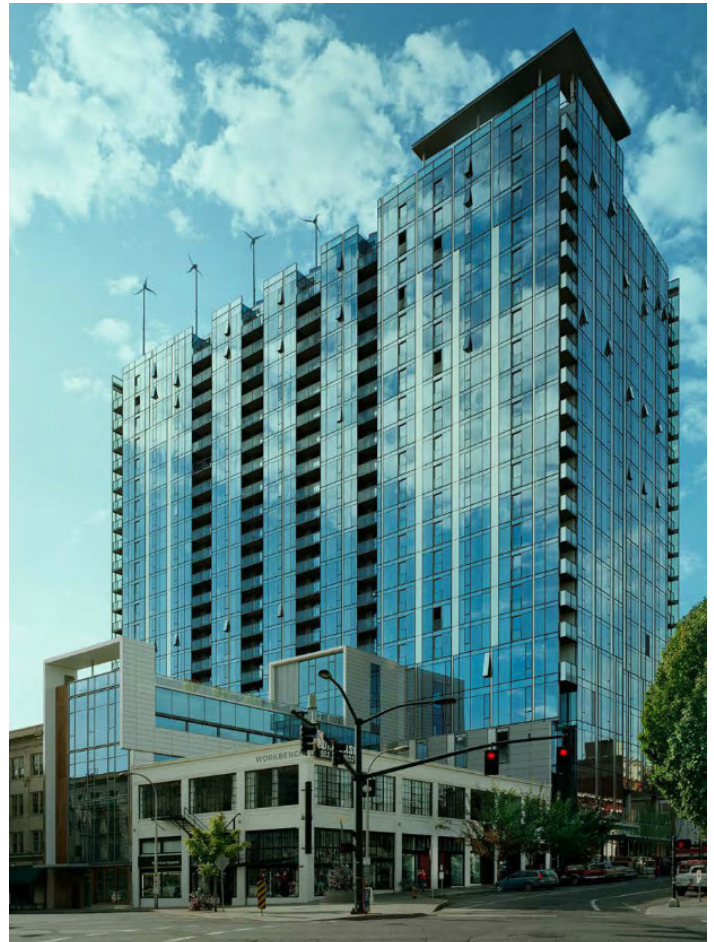
Indigo 12-West Apartments - Analysis

One advantageous move that 12-West made was to place two-bedroom units at the corners. Typically a challenging unit type to be placed otherwise, due to demand for daylight. The corner allows a more successful utilization of floor efficiency. Although, these corner units appear to contain a significant amount of circulation space, they do have two bedrooms and two bathrooms, which may be attractive to the types of clientele intended. In this case, the developer was likely attracting not just single young urban professionals, but professionals of age age-groups, as well as retirees. The space may be just as suitable for a small family as well.

The mixed-use of the building generates a valuable type of housing within the city. The offices bring workers to the surrounding streets during the morning and afternoon. The other hours of the day are invigorated still because people live here as well. With retail on the ground floor, the street becomes a lively place regardless of workers/renters. This type of housing, although expensive to build, provides a high level of activity and commerce in cities.

There is a trade-off however. That being noise, traffic of all kinds, reduced open green space as refuge, and potentially unclean streets. So although the liveliness indicated above allows a city to be competitive as a community, the tenants must weigh the benefits for themselves.

There are benefits to living in such a compact development, which comes in the form of closer amenities. The first two case study projects mentioned are low-density, which if viewed on a large scale may not produce the needed amenities for all residents within a reasonable distance. This means that individuals must rely on vehicles. Additionally, low-density housing, although quite lovely in terms of human scale, must rely on the vitality produced by housing types such as 12-West, if they wish to be successful within compact development. This is the equation balancing act of local businesses receiving enough customers, offset by distance, and availability of parking. And in the city, land is too valuable to devote to parking.

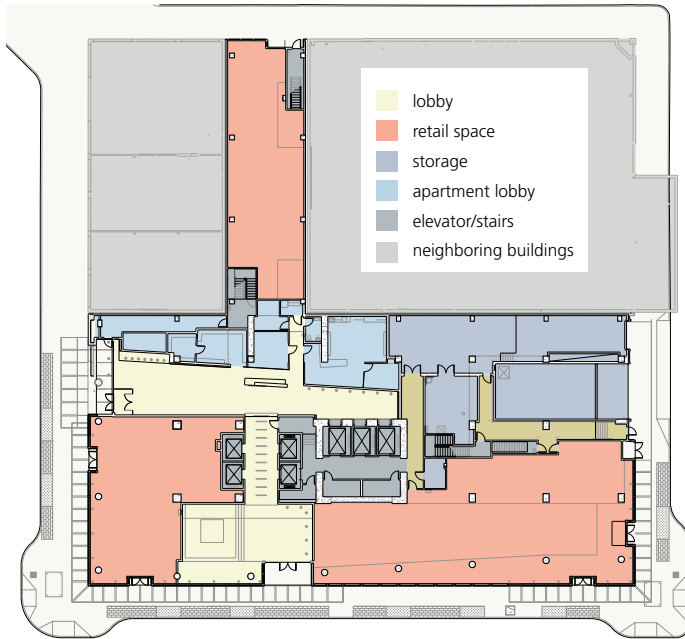


Street View



Enlarged SE Unit

Indigo 12-West Apartments - Analysis



Base Floor Plan

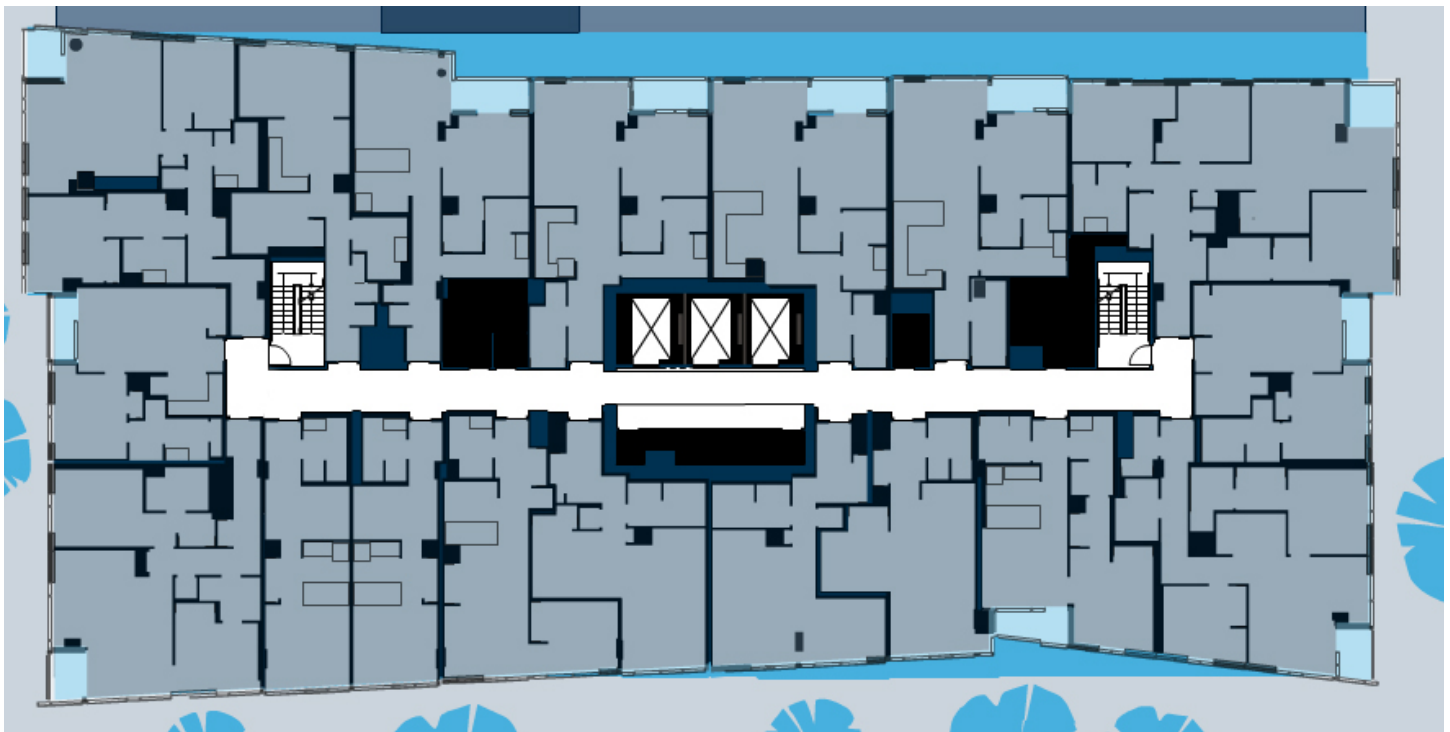
Seen on the next page, a beautifully simplified diagram showing just how sustainable the Indigo 12|West attempts to be¹. The design overall is revolutionary in terms of the most sustainable housing type in this case study selection of four. To the top left is a floor plan of the base level. Upon personal visit, the entrances were intentionally subtle, especially with the posted guard at the doors.

The below floor plan, and previous page, was from the apartment management website². This had to be pieced together one unit at a time, because floor plans were not available, and the owners were not comfortable sharing floor plans, as was the case with the personnel from the ZGF office. Although the shape of each unit on this floor plan differs, and no two are alike, each floor plate is alike. Sometimes it can be economically valuable to create identical units for an entire floor plan. However for a level of added uniqueness, each unit may be different, while each floor be the same for economy and efficiency.







1 ZGF Architects. (2007). Twelve|West. Portland: ZGF Architects. Retrieved Nov 11, 2014, from <http://issuu.com/zgfarchitectsllp/docs/twelve-west?e=5145747/2621878>

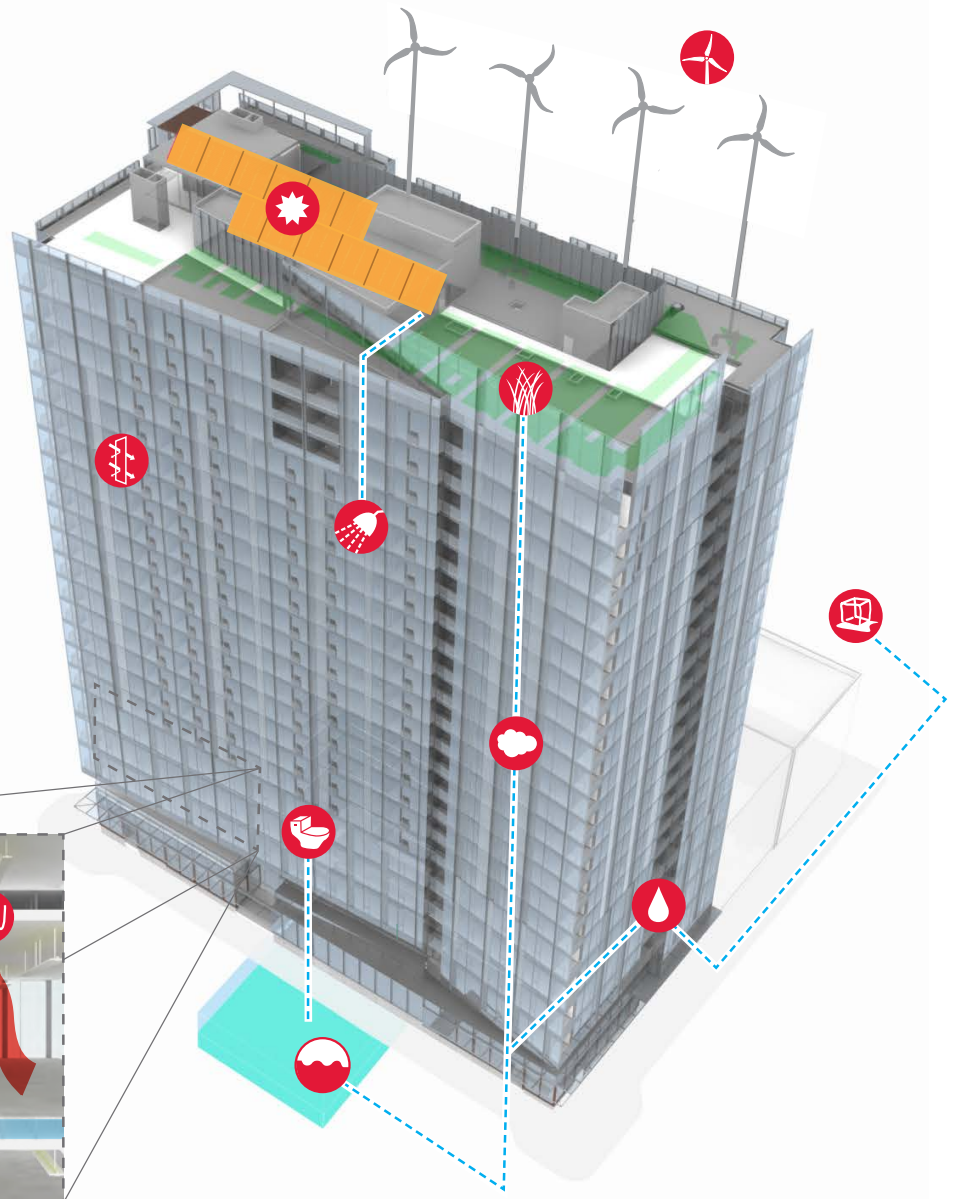
2 GerdingEdlen. (2013). Indigo @ Twelve West. Retrieved Oct 05, 2014, from <http://indigo12west.com/>










Typical Floor Plan from Floors 7-21



Indigo 12-West Apartments - Analysis

-  **Four Wind Turbines** produce 10–12,000 kWh of electricity per year. Monitoring of wind conditions and turbine performance will improve knowledge for future projects.
-  **Solar Thermal** panels heat 24% of hot water used in the building, offsetting natural gas use.
-  **Roof Gardens** clean, detain and filter rainwater and significantly reduce roof temperatures in warmer months.
-  **Low-e Glass** admits 35% of visible sunlight but reflects 74% of the associated heat, reducing energy use for lighting and space cooling.
-  **Rainwater Re-use** in toilet flushing on the office floors, and to irrigate the green roofs, reduces use of city water by 286,000 gallons per year.
-  **Water-efficient Plumbing Fixtures** help reduce water use by more than 44%.



-  **Operable Windows** provide occupants fresh air, cooling, and a connection to the outdoors.
-  **Daylight Sensors** switch off electric lights when there is ample daylight, reducing lighting energy use by 60%.
-  **Exposed Concrete** moderates indoor air temperatures. Mass is cooled with cool night air in the summer months and absorbs excess heat throughout the day.
-  **Passive / Chilled Beams** provide energy-efficient cooling on the hottest days.
-  **Under-Floor Air Distribution** efficiently delivers moderate-temperature air directly to occupants. Personal adjustable floor vents provide control over ventilation.
-  **Water Storage Tank** temporarily stores up to 23,000 gallons of rainwater and condensation for re-use.
-  **Efficient Central Cooling** plant in the nearby Brewery Blocks provides chilled water for space cooling.
-  **Rain Water Harvesting** piping gathers 273,000 gallons of rainwater from the roofs.
-  **Condensation** of 13,000 gallons of water from the air handler system will collect during summer months.

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