The Cascades

Final Summary Book

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Architectural Engineering
Construction Management Disipline

Senior Thesis 2005
Advisor: David Riley, PhD

The Cascades – Cumberland, MD

General Contractor:
The Whiting-Turner Contracting Company
Architect, Landscape Architect:
Hord Coplan Macht, Inc.
Owners:
Cumberland Partners, LLC
Civil Engineers:
SPECS, Inc.
Mechanical & Electrical Engineers:
Century Engineering, Inc.
Structural Engineer:
Wolfman Associates, Inc.

Dates of Construction:
Start: March 15, 2004
Completion: January 14, 2005

Overall Project Cost: $5,706,460

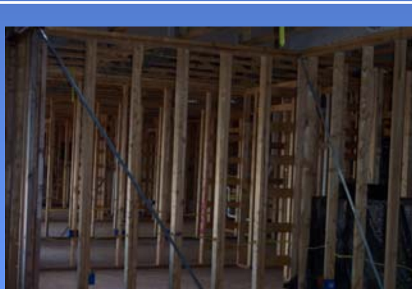
Size: 76,564 SF, 4 stories, 79 apartments

Function Type: Senior independent living apartment building

Project Type: Negotiated

Mechanical Systems
- Split system heating pumps (800-1800 CFM)
- Electric baseboards (100-910 CFM)
- Each apartment unit has an individual furnace and condenser situated on the roof of the building

Electrical Systems
- Individual circuit breakers in each apartment (120/208 volt – 1 phase – 3 wire, 125 AMP)
- Three common area circuit breakers (120/208 volt – 3 phase – 4 wire, 400 AMP; 120/208 volt – 3 phase – 4 wire, 225 AMP; 120/208 volt – 3 phase – 4 wire, 400 AMP)



Structural System
- Wood Frame Timbers columns, beams, trusses and studs
- Slab on Grade with column footings
- Gypsum concrete floors poured over plywood
- Masonry stairwells and elevator shaft

Elizabeth Felice – CM
www.arche.psu.edu/thesis/2005/eaf158

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Executive Summary

The following Architectural Engineering senior thesis is a study to improve the construction procedures of The Cascades in Cumberland, MD. There are three analyses that examine LEED™ criteria, IAQ (indoor air quality) during construction, and panelized structural systems.

The first analysis studies the feasibility of creating a LEED™ standard for senior citizen construction projects. A comprehensive study of the design elements of senior citizen apartment building was conducted and compared with the current LEED™ standard for *New Construction & Major Renovations (LEED-NC)*. From this, a LEED™ standard for senior citizen construction was created based on the LEED-NC called LEED-NCSC.

The second analysis studies the threat of the growth of mold during construction. Mold is more threatening to senior citizens. A thorough guide was created to aid the architect, engineers, contractor, and owner of a project to build a building with a reduced risk of mold. The guide begins with the initial design conceptions moves through the design phase and ends with the constructions phase; with guidelines each step of the way.

The third analysis studies panelized floor systems. A panelized floor system can reduce the schedule significantly. The study of the panelized floor system was applied to The Cascades to determine schedule reduction the system would achieve.

Acknowledgements

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- Structural Systems, Inc.
  - Gray Taylor

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Proposal

Analysis #1: LEED™ Standard for Senior Citizen Living Facilities

LEED™ certification is becoming a desirable achievement for new construction facilities. The U.S. Green Building Council (USGBC) has created standards for engineers, designers, and contractors to follow to achieve the desired LEED™ rating. The standards available now are general requirements that fit various types of buildings. For example, a building such as The Cascades that is for senior citizen where the owner wants to meet LEED™ requirements would follow the same requires as typical apartment buildings. I proposal to create a LEED™ standard that would be particular to an apartment building built for senior citizens. To do this I will use a combination of existing LEED™ standards and an analysis of the design and requirements for senior citizen apartment buildings. With the review of the design, the current LEED™ standards can be adapted to fit an apartment building for senior citizens. The steps I will take are as followed:

1. Review LEED-NC™.
2. Conduct a comprehensive review on senior citizen design by interview architects that design senior citizen buildings.
3. Combine this information into a new "LEED for Seniors Standard."
4. Use the new standard to analysis the impact to The Cascades project.

Analysis #2: Indoor Air Quality during Construction

During the planning stages of The Cascades, the contractor decided to hire a mold consultant to prevent mold growth becoming a problem in the later stages of the construction. Mold was especially an issue on this project because the users of the building are senior citizens who are more prone to develop health problems from mold. I prose to research and develop procedures can be used during construction to increase the indoor air quality and thus reduce the growth of mold. If these procedures are effective, they will reduce the total cost of the building because a mold specialist will not need to be contracted to the project. The procedure will include information such as the timing and level of quality of the enclosure of the façade and the use of gypsum concrete flooring system. The enclosure of the building can greatly affect the indoor air quality, if it's not done early enough the drywall and other finishes will easily grow mold. Also, the use of gypsum concrete adds a large amount of moisture to the air; I will look at solutions to reduce the amount of moisture in the air at this time. The end-result will be a comprehensive guide that the design team and contractor can use to help reduce the risk of mold in the building.

Analysis #3: Panelized Floor System

The Cascades is completely timber structure, therefore there is a large amount of wood piece in the building. Each piece has been individually installed, which is very time consuming. For example, the picture here shows the one wall with the studs, if this section was delivered to the site already assembled it would save much time. I propose to change the construction of the floor system a panelized floor system for The Cascades and analyze the schedule impact on this change. I will interview contractors that are currently using this system on single-family homes and use the information to apply it to The Cascades.

Project Information

Project Description

The Cascade building is an apartment building for senior citizens, as well as low-income households located in Cumberland, MD. There are income levels that are required in order to rent an apartment unit. There are both one bedroom and two-bedroom apartment unit in the building. There are a total of 71 apartment units included, 53 one bedroom and 18 two bedroom units. There are also features of the building that appeal to the older age group. For example, there is a beauty salon and consulting rooms that can be used for doctor visits. There are also eight handicap compliance units in the building, two being vision/hearing impaired units.

Architecturally, the building is L-shaped with the main entrance is at the middle of the building of the longer wing of the building. From the entrance of the building, there is a community room at the lobby, to promote interaction between the residences. From the lobby, the elevator next then there is a corridor straight through the middle of the building with apartments of either side. The façade of the building is a mix of red brick and tan siding, with the siding on the upper floors of the building. The roofline is mostly flat containing some pitched roofs and a raised arch at the main entrance. This roofline resembles that of row homes. The elevations created by the architect- Hord, Coplan, Macht, Inc. - can be found in *Appendix I.*

The construction of The Cascades was typical for the area. The structural system is a wood frame structure, which is readily available in the area. A negotiated delivery method between the owner, Cumberland Partners, LC, the contractor, and The Whiting-Turner Contracting Company was used. The project also meets some LEED™ credits but is not a certified LEED™ project.

Site Plan of Existing Conditions

Figure 1 shows the map location of the project site, courtesy of MapQuest. The project site is indicated by the red star. Just above the project site, the blue line represents the Pennsylvania-Maryland boarder. *Figure 2* shows the site plan for construction with the building foot highlighted in red. More detailed site plans can be found in *Appendix II*.

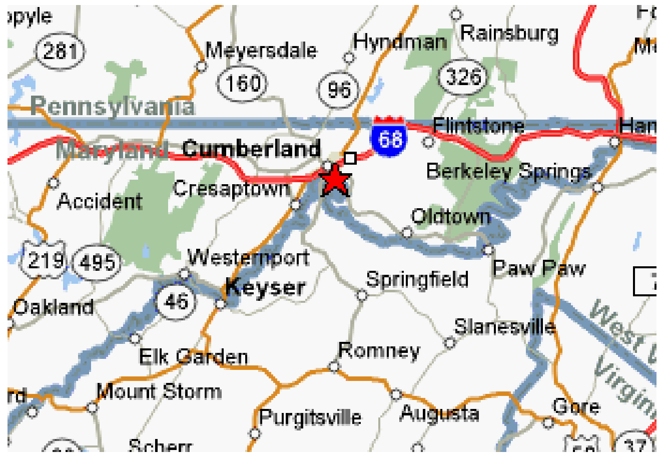

Figure 1

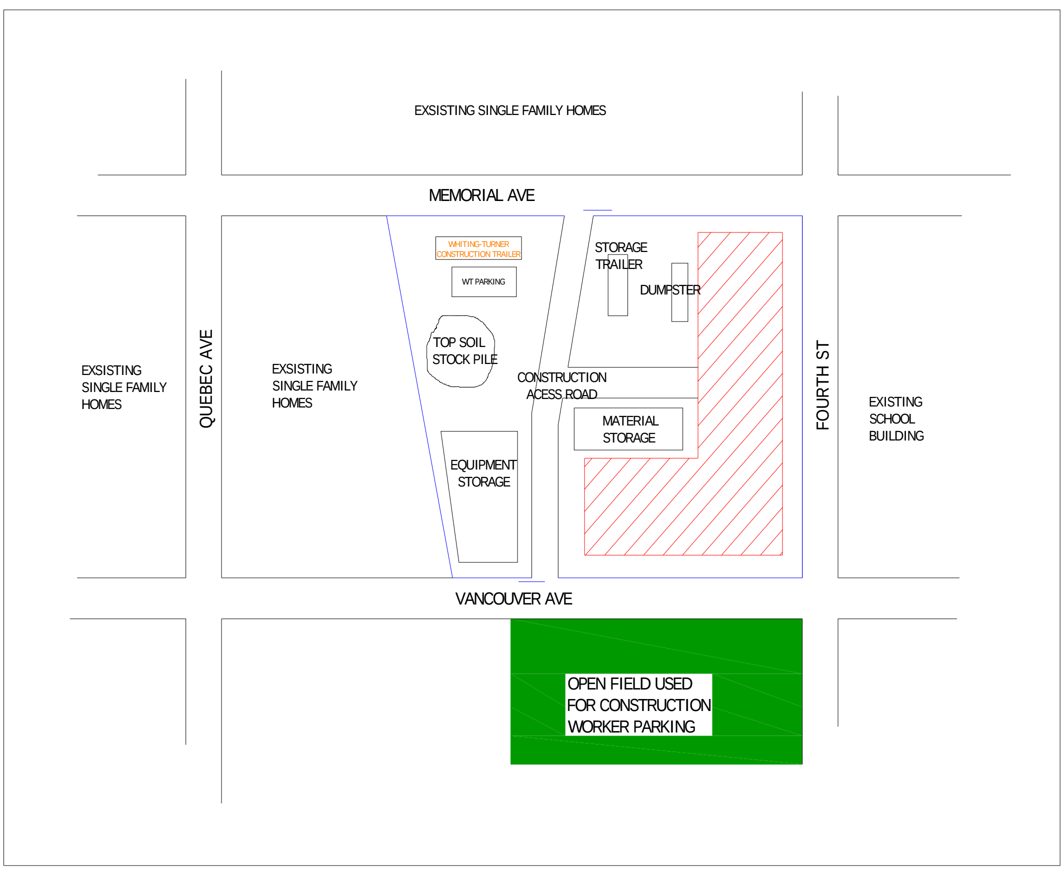

Figure 2

Local Conditions

Cumberland, MD is a small working class town close to the Pennsylvania-Maryland border. Problems such as city congestion that can cause problems during the course of a construction project are not issues for The Cascades Project. For example, parking for the construction workers on the project is on an open adjacent to the construction site.

When preliminary subsurface test were done it was found that there was subsurface water on the site, most likely from a natural spring. To address this, a 200-foot trench drain was installed under the parking area to handle the ground water issues. A trench drain was also installed under the northeast corner of the building, four feet below the footer. Under slab drains were installed under the long leg of the building, these were installed so that any water that comes up through the slab can be expelled.

Preferred method of construction in the Cumberland for a building that is four stories or less is wood construction because the project falls under the Residential Davis Bacon Wages. In addition, this benefit, wood is also widely available in the region.

Project Organization

The project delivery method for The Cascades was a negotiated GMP. The owner chose the contractor, The Whiting-Turner Contracting Company, and the architect, Hord Coplan Macht, Inc, based on reputation and past projects. This team has worked on a several similar projects in the past. The contract between the Cumberland Partners, LP and Whiting-Turner is a cost plus with negotiated GMP. The contracts between Whiting-Turner and the subcontractors is a Lump Sum Trade Contract developed by Whiting-Turner. All other contractors are lump sum contracts.

Figure 3 organizational chart represents the key project players for The Cascades project. The dotted line between the owner, Cumberland Partner, LP, and Taylor Architects, Inc. symbolizes a consulting agreement. All other solid lines represent contractual responsibility for design, contracting, or building. Lines connected with parties lower in the organizational chart represent that the higher party holds the contract. The owner holds the contracts with the architect and contractor. The architect holds the contracts for the civil, structural, mechanical and electrical engineers.

Key Contacts:

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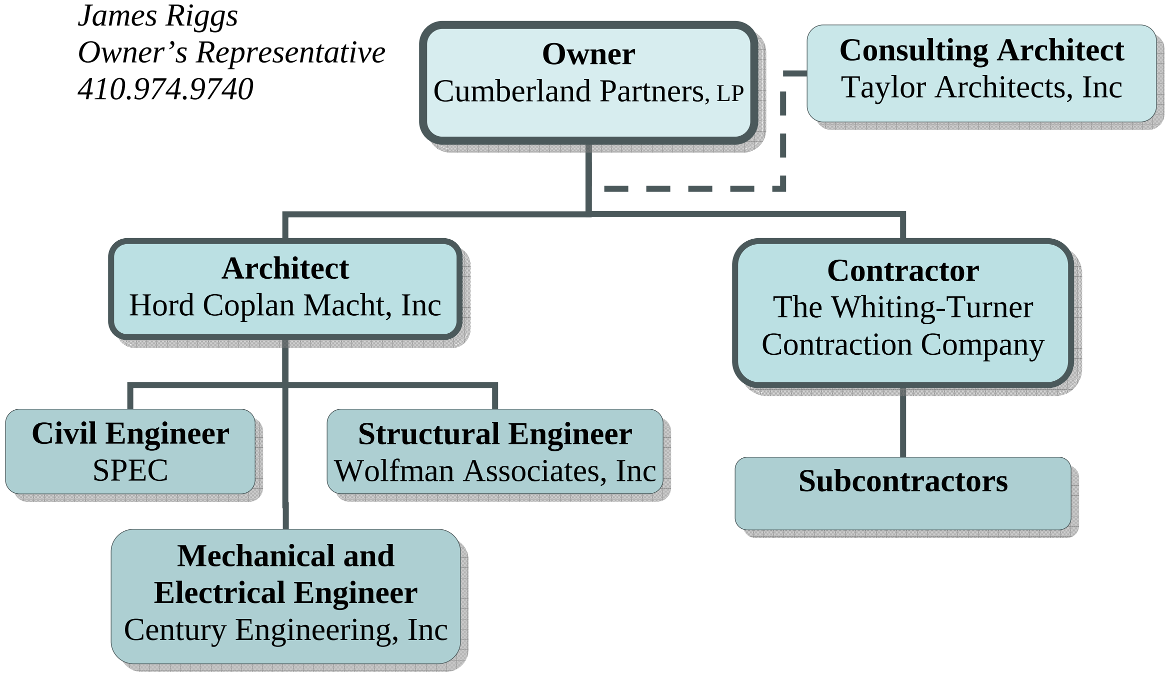


Note: Cumberland Partners, LP includes: Cumberland Partners, LLC and The Bell Group

Figure 3

The project team that built The Cascades has done several projects of similar uses and size; a subsidized apartment building with a minimum age of 60 years old. The success of these projects has led to different owners trusting this project team to build this specific type of building for them. The key project players remain very similar for each project; the contractor, architect, mechanical and electrical engineer, and even many of the subcontractors have all worked together on very similar projects for different owners in the past. Cumberland Partners, LP has sought out these project players because of past performance, thus the project was approach as a negotiated contract with Whiting-Turner. Whiting-Turner has signed an AIA A11-1997 contact with Cumberland Partners, LP where the basis of payment is cost plus with a negotiated GMP. Since the owner is looking to build a specific type of building that many of the project players have already been successful at building together, the scheme of the owner picking the project players and negotiated the terms of the contract is very reasonable. This approach communicates the trust the owner has in the project players. The contracts between Whiting-Turner and the subcontractors is a Lump Sum Trade Contract developed by Whiting-Turner. All other contractors are lump sum contracts.

Whiting-Turner is required by the owner in their contract to hold the builders risk insurance and liability insurance. They are also required to obtain a payment and performance bond. Whiting-Turner writes their own contractors for the subcontractors, Trade Contracts.

Whiting-Turner takes a team oriented approach to the construction process. Instead of having separate estimating, scheduling, field operations, close out, etc. departments, these task are all done within the same operating group, which is headed up by a Vice President. *Table 1* below shows approximate percentages of time each member of the project teams spends working on The Cascades.

Position	Time Spent on Project
Vice President (Group Manager)	10%
Senior Project Manager	20%
Assistant Project Manager	80%
Project Engineer	100%
Superintendent	100%

Table 1

The Vice President spends very little time on one individual project; his time is mostly spent on the management and organization of his operation group. The Senior Project Manager spends some time at the site but mainly for meeting and checking on progress. He spends most of his time in the office concentrating on the management of the project. The Assistant Project Manager, Superintendent, and Project Engineer represent the on site project team, working full time at The Cascades job site. The work is approach as a team between the three employees with the Project Engineer acting as an assistant to the Assistant Project Manager. The dotted line on the organizational chart in *Figure 4* between the Assistant Project Manager and the Superintendent represents that they work closely together as a team approach on site, along with the Project Engineer. The Superintendent is at the same level of seniority as the Senior Project Manager, however, the Superintendent spends 100% of his time working on The Cascades site while the Senior Project Manager only spends about 20% of his time working on The Cascades most of which is done from the head office.

The Cascades Staffing Plan

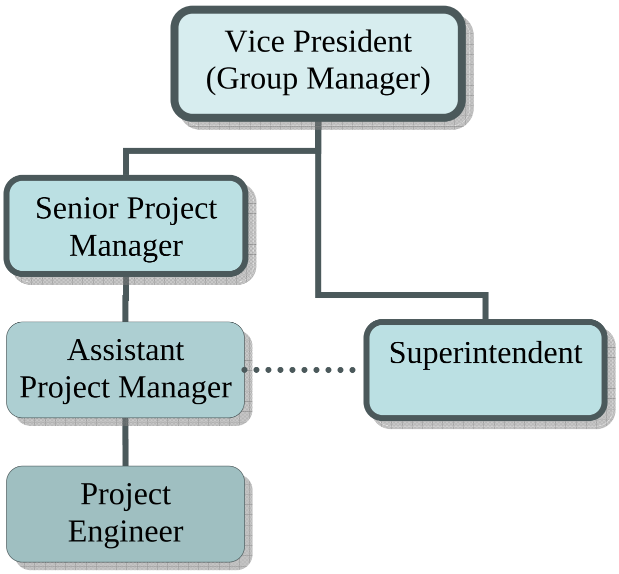


Figure 4

Owner Information

The owner of The Cascades is Cumberland Partners, LP, which is a partnership between Cumberland Partners, LLC and The Bell Group. The Cascades falls in the Federal Low Income Housing Tax Credit Program (LIHTC) of The Department of Housing and Community Development (DHCD) in Maryland. This program provides tax credits to developers who build housing targeted to households whose income is below the area median gross income. This owner is a Maryland developer with similar apartment complexes already in use that also fall into the LIHTC Program. The owner's motivation behind these projects is to improve the quality of life for people whose income is below the average, and also because it is a good investment. The owner determines area which low-income housing would be beneficial by doing market studies of particular areas.

Building Systems Summary

Table 2

Yes	No	Work Scope	If yes, address these questions / issues
X		Demolition Required	Previously to this project the site contained ten trailer homes, including decks, porches, etc. These were removed as well as existing utility poles, metal and wooden sheds.
X		Structural Steel Frame	Wood frame structural system with a structural steel frame to support the trash chute.
X		Cast in Place Concrete	Cast in place spread footings with plywood formwork and a form-releasing agent, placed using a concrete pump.
X		Precast Concrete	Precast concrete bands and lintels on the exterior façade. Cast off site and delivered to site. Connected to the exterior façade by masons, a lift is used to raise the cast on to the scaffolding at the elevation it is to be installed.
X		Mechanical System	One main mechanical room located on the first floor of the building. Individual furnaces and condensers for each apartment unit are located on the roof of the building. Each unit also has electrical base, wall, and unit heater. The fire protection system is a noncoded, addressable system with manual and automatic alarm initiation; and multiplexed signal transmission dedicated to fire alarm service only.
X		Electrical System	Individual residential panels 125 amp 120/208 volt - 1 phase – 3 wire Common area distribution panels 400 amp 120/208 volt – 3 phase – 4 wire
X		Masonry	Brick veneer using ties and anchors for the connection. Construction is bay sections using scaffolding.
	X	Curtain wall	N/A
	X	Support of Excavation	Foundation system is a slab on grade so there was minimal excavation needed.

Design Coordination

The Cascades is not a MEP extensive project, however, MEP coordination is required as is in any construction project. The coordination of the drawings was somewhat lapsed at times. The architect made changes to the drawings that were not communicated to the MEP engineers effectively. The architect added some new rooms and changed some of the room layouts; these changes were not picked up by the MEP engineers and caused confusion during construction. When the issue arouse, Whiting-Turned had to halt construction in order for the MEP engineers to make the needed changes.

Without information on the coordination required for MEP, a plan for coordination of the MEP construction could be met by requiring periodic meets with all project players during the design phase to insure the spaces are be used effectively and that there are no coordination issues to resolve. During construction, plans could be made to have the MEP engineers periodically walk through the building during periods when the work they designed is being construction. This will allow the engineer to see if the work is being constructed as planned and if not have changes made before the constructions goes much farther.

The greatest coordination challenge was the space needed for the ductwork interfering with the wood trusses. The common areas and corridors were the most effective because there is larger ductwork in those areas. The mechanical engineer had to reevaluate the design of the ductwork to come up with a solution so that the wood trusses were not disturbed. There were also coordination conflicts with the bathtub drains and the toilet drains. The connections that were designed were not possible. This could have been avoided with a 3D drawing or mock of the space prior to construction.

Temporary Facilities and Utilities

The Cascades property is 68,400 square feet of land. The building footprint takes up 21,000 square feet, leaving over 47,000 square feet of land for temporary facilities during the construction of the building. The temporary facilities present during the entire erection of the building include a general contractor's site office trailer, a storage trailer, a dumpster, multiple portable toilets, an equipment storage area, a topsoil storage area, and two parking areas for the site management team another for the construction workers. The topsoil in the storage area is from the excavation phase is stored on site to be used during the landscaping phase. The logistic of these facilities can be seen on the Site Layout Plans.

In addition to these temporary facilities, temporary utilities are needed in during the course of the construction. The following chart describes the requirement for each type of temporary utility. The general contractor is responsible for meeting and maintaining the requirements outlined. *Table 3* is a summary of the temporary utilities.

Table 3

Temporary Utility	Requirements
Electric	Provide temporary power outlets, branch wiring, distribution boxes, and flexible power cords
	Provide weather tight, grounded, temporary electrical service-entrance and distribution systems.
	Provide meters, transformers and over current protective devices at main distribution panel for power and light circuitry.
	Provide 20 amp, 4-gage receptacle outlets, equipped with ground fault circuit interrupters, reset button and pilot light, spaced that a 100-foot extension cord can reach each area of work.
Lighting	Provide and maintain temporary lighting for construction operations.
	Permanent building lighting may be utilized during construction.
Heating	Maintain a minimum ambient temperature of 50°F in areas where construction is in progress.
Ventilation	Ventilate enclosed areas to assist curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, and gases.
Telephone Service	Provide, maintain, and pay for telephone service to field office for use in emergencies.

Project Estimate Summary

Project Cost Evaluation

Table 4 shows the Construction Cost, CC/SF, Total Cost, TC/SF, the Building Systems Cost, and Building Systems Cost/SF based on the budget for The Cascades.

Table 4

Project Cost Evaluation Data	
Construction Cost	$3,608,099
CC/SF	$47.13
Total Cost	$5,326,003
TC/SF	$69.56
System Costs	
Plumbing System	$344,303
Cost/SF	$4.50
Fire Protection System	$111,018
Cost/SF	$1.45
HVAC System	$391,319
Cost/SF	$5.11
Electrical System	$590,399
Cost/SF	$7.71
Elevator	$52,500
Cost/SF	$0.69
Structural System	$998,343
Cost/SF	$13.04

The actual cost for The Cascades is $5,326,004. The cost determined using D4 Cost Estimator is $6,608,366, the D4 cost summary can be found in *Appendix III*. A comparison of the actually cost verses the D4 costs for each division is shown in *Table 4*. The likely reason D4 estimated a cost much high then the actual cost is that D4 did not take into consideration the type of structural system. The structural system in The Cascades is wood frame. Comparing the costs for division 5 shows, that D4 has estimated $709,402 over the actual. Mostly likely D4 is assuming the structural system to be steel. This large difference adds to the inaccuracy of the D4 Estimate.

Table 4

The Cascades Cost Summary				
Division		**Actual Cost**	**D4 Estimated Cost**	**Difference**
Division 1	General Requirements	$ 397,800	$ 342,827	$ (54,973)
Division 2	Site Work	$ 502,958	$ 363,335	$ (139,623)
Division 3	Concrete	$ 283,152	$ 443,329	$ 160,177
Division 4	Masonry	$ 392,000	$ 297,960	$ (94,040)
Division 5	Metals	$ 26,126	$ 735,528	$ 709,402
Division 6	Woods and Plastics	$ 1,053,194	$ 957,489	$ (95,705)
Division 7	Thermal and Moisture Protection	$ 248,335	$ 301,049	$ 52,714
Division 8	Doors and Windows	$ 176,892	$ 327,406	$ 150,514
Division 9	Finishes	$ 592,433	$ 757,334	$ 164,901
Division 10	Specialties	$ 55,859	$ 170,576	$ 114,717
Division 11	Equipment	$ 95,701	$ 159,604	$ 63,903
Division 12	Furnishings	$ 12,015	$ 50,128	$ 38,113
Division 13	Special Construction	$ 111,018	$ 91,278	$ (19,740)
Division 14	Conveying Systems	$ 52,500	$ 126,786	$ 74,286
Division 15	Mechanical	$ 735,622	$ 838,431	$ 102,809
Division 16	Electrical	$ 590,399	$ 645,306	$ 54,907
	Total	**$ 5,326,004**	**$ 6,608,366**	

Assemblies Estimate

Note: The following assemblies estimate is as close as possible to correct. Many of the member sizes used on The Cascades do not match the member sizes called out in R.S. Means. The estimates are to the best closest member.

Table 5 is the estimate for structural wood system in The Cascades project; from this estimate, it is predicted that the structural wood system will cost $93,923. The quantity take-offs for this estimate can be found in the appendix at the end of this report.

Table 5

Assembly Number	Description	Qty	Unit	Unit Cost	Total Cost	Cost per SF
Division B	**Shell**					
B10	**Superstructure**					
B1010-210-1250	Wood columns	39	EACH	$42.00	$1,638.00	
B1010-210-2050	Wood columns	16	EACH	$47.36	$757.76	
B1010-210-1600	Wood columns	16	EACH	$28.80	$460.80	
B1010-250-1050	Wood columns	47	EACH	$19.08	$896.76	
B1010-216-2350	Wood beams	6176	LF	$14.60	$90,169.60	
	Total for Division B10				**$93,922.92**	$1.23

General Conditions Estimate

Table 6 is an estimate of the general conditions cost for The Cascades, the total cost is $366,050.

Table 6

Description of Work	Cost per month	Duration of time		Total Cost
Management Team:				
Group Manager	$1,200	2	Months	**$2,400**
Project Manager	$7,984	5	Months	**$39,920**
Project Engineer	$8,500	10	Months	**$85,000**
Superintendent	$9,500	10	Months	**$95,000**
Asst. Superintendent	$2,500	10	Months	**$25,000**
Engineering and Layout	$800	10	Months	**$8,000**
Soil Testing	$650	10	Months	**$6,500**
Concrete Test	$250	10	Months	**$2,500**
Site set-up	$150	10	Months	**$1,500**
Field office cost:				
Office equipment rental	$850	10	Months	**$8,500**
PC support	$400	10	Months	**$4,000**
Office supplies	$300	10	Months	**$3,000**
Postage and shipping	$75	10	Months	**$750**
Drawings and specifications	$300	10	Months	**$3,000**
Progress photo's & as-built	$175	10	Months	**$1,750**
Trailer rental	$450	10	Months	**$4,500**
Site cost:				
Project Sign	$50	10	Months	**$500**
Safety signage	$50	10	Months	**$500**
Trash removal	$1,350	10	Months	**$13,500**
Rental equipment	$250	10	Months	**$2,500**
Storage trailer	$110	8	Months	**$880**

Utility cost:				
Temporary Electric	$2,500	10	Months	**$25,000**
Temporary Water	$100	10	Months	**$1,000**
Temporary Toilets	$225	10	Months	**$2,250**
Temporary Fences	$650	4	Months	**$2,600**
Temporary Walls and Barricades	$150	10	Months	**$1,500**
Close-out:				
Punch-out supplies:	$500	10	Months	**$5,000**
Rough clean-up:	$700	10	Months	**$7,000**
Final clean-up	$1,250	10	Months	**$12,500**
Total General Conditions Cost				**$366,050**

Detailed Systems Estimate

Table 7 is a detailed estimate of the structural system of The Cascades. The foundation system is slab on grade with cast-in-place square footings. The superstructure consists of mostly timber columns and a few steel columns, timber floor and roof Warren trusses, and some timber and steel beams generally in the corridors near the stairwells and elevator shafts. The few steel members used in the building are in areas where the dead loads are greater then typical dead loads in the rest of the building. The following is a cost summary for the structural system organized in the CSI Masterformat, the detailed cost estimate and take-offs can be found in the Appendix. The total cost for the entire structural system is $390,928.

Table 7

Detailed Structural Estimate Cost Summary		
Division		Total Cost
1	General Conditions	$0
2	Site Work	$8,939
3	Concrete	$72,465
4	Masonry	$0
5	Metals	$8,960
6	Woods and Plastics	$300,565
7	Thermal and Moisture Protection	$0
8	Doors and Windows	$0
9	Finishes	$0
10	Specialties	$0
11	Equipment	$0
12	Furnishings	$0
13	Special Construction	$0
14	Conveying Systems	$0
15	Mechanical	$0
16	Electrical	$0
	Total Structural Cost	**$390,928**

Project Schedule Summary

The schedule, in *Appendix IV*, shows a basic version of the construction schedule, including preconstruction activities. The project was delayed from the official kick off meeting on October 13, 2003 to March 15, 2004 to eliminate breaking ground and foundation work during the cold months of the winter when there is a chance that the ground may be frozen and poor weather. This was done to minimize delays during the early part of the schedule due to weather conditions. The foundation work occurred in the following order: the footings for the exterior walls, the foundation walls, and lastly the interior footings. The structural wood system was built starting west section of the building then moving to the east sections of the building. The walls were built first then the trusses and decking. Many of the activities occurred in phases, working by the top down approach, including mechanical and electrical rough in, drywall, gypsum concrete flooring, doors and trim, painting, VCT and tile flooring, mechanical and electrical trim out, cabinets, carpeting, cleaning, start up, testing, and inspections. These activities were scheduled in an order that is conducive to finishing the interior in the most productive time without interfering with other trades.

LEED™ for Senior Citizen Buildings

Introduction

Energy efficient buildings are becoming a desirable achievement for new construction facilities. The U.S. Green Building Council (USGBC) has created standards for engineers, designers, and contractors to follow to achieve this desired energy efficient building called the LEED™ (Leadership in Energy and Environmental Design). The standards available now are general, fitting various types of buildings. For example, a building such as The Cascades, that is a senior citizen apartment building, where the owner wants to meet LEED™ requirements would follow the *New Construction & Major Renovations (LEED-NC)* standard. This standard covers any type of construction from office buildings, museums, hospitals, to apartment buildings. Each of these different buildings have vastly different design elements and construction practices. Furthermore, a typical apartment buildings and a senior citizen apartment building have many different design elements. These design elements have a big impact on the quality of life for the residents.

With the baby-boomer generation getting older, there is a greater need for more senior citizen living communities. Senior citizens seek living communities for the social aspect as well as the safety of knowing the community is build with their aging conditions in mind. With senior living communities becoming more popular, the next logical trend would be the desire for an energy efficient building. This is a study of the specific design elements that make senior citizen communities unique in comparison with the existing LEED-NC™ to determine the practicality of creating a senior citizen specific standard.

Design Specifics to Senior Citizen Residential Buildings

Architecturally, there are many differences between a typical apartment building and one built for senior citizens. Many of these differences come from four simple goals to enrich the lives of the aging living in these buildings. These goals were developed by interviewing various architects who have been part of the design team that have design many senior citizen living communities. Theses goals are:

1.) To promote a safe living environment
2.) To create a community that is comforting and with homey feel
3.) To encourage interaction between tenants
4.) To keep seniors active as they age.

These simple goals tailor an apartment building for the use of senior citizens while maintaining the feel of a typical apartment. Also, they help to avoid building a hospital feeling building as many nursing homes are like. *Table 8*shows a list of common design elements and their relationship to the four main goals for senior citizen apartment buildings.

It is important that senior apartment buildings are safe for residents to live independently and have the confidence that they will be well looked after. As well as safety, it is important that the residences feel at home and not as if they are live in an old age home. From *Table 8*, 79% of the design elements help to make the residences feel like home.

Table 8

Design Elements	Goal 1	Goal 2	Goal 3	Goal 4
Community rooms			x	x
Places to watch people come and go		x	x	
Landscaped gardens		x	x	x
Walking paths		x	x	x
Raised garden planters		x	x	x
Horseshoe pits, Bocce ball courts, etc.		x	x	x
Patios		x	x	x
Traditional buildings style (neo-classical)		x		
Elevators – centrally located	x	x		
Beauty/barber shops		x		
Parking lots that are easy to navigate	x	x		
Corridors and common areas with bright lighting	x	x		
Brightly colored finishes		x		
Handrails along corridor and common spaces	x			
Mostly one bedroom apartments (most residents single)		x		
Wall cabinets in kitchen mounted lower	x	x		
Bedroom closet spaces at lower heights	x	x		
Both showers and bathes options		x		
Many seniors are smokers		x		
Common/shared laundry rooms			x	
Exercise rooms			x	x
Computer access		x	x	x
Consultant rooms for meeting with doctors, nurses, etc.	x	x		
Public mailboxes near entrance			x	
Live-in managers apartment	x	x		
Emergency call buttons/cords that call 911	x			
Larger kitchens	x	x		
Larger bathrooms	x	x		
Larger halls	x	x		
Handicap accessible but not look like it	x	x		
Wall materials for each floor slightly different /elevator lobbies	x	x		
Natural ventilation/lighting	x	x		
Soil resistant materials	x			

LEED™ Guideline for Senior Citizen Residential Buildings

Through studying the design criteria for senior citizen apartment buildings and the LEED™ standards, creating a LEED™ standard specifically for senior citizen construction is not productive. However, using a revised reversion of the existing standard for *New Construction & Major Renovations (LEED-NC)* is a viable option. Each LEED™ credit was carefully reviewed and selected based on the senior citizen design study conducted. The *LEED-NC Registered Project Checklist* can be found in *Appendix V*. Also in *Appendix VI*, a Registered Project Checklist can be found for senior citizen construction (LEED-NCSC). The checklist details all the point that can be applied to senior citizen construction. Many of the LEED™ points are based on the goals for senior citizen design and the design elements outlined in section *Design Specifics to Senior Citizen Residential Buildings* above.

For example in the Sustainable Sites section, the Development Density credit helps promote goal number four, to keep the elderly active as they age. This credit requires that the building be built near an existing developed area, a "two story downtown development." This encourages more walking to get around, rather then driving. The Alternative Transportation, Public Transportation Access credit also helps to promote more activity and walking by the residences by offering the use of public transportation to get around. A commuter rail, light rail, or subway station must be located within a half of a mile from the building or at least two public bus lines must be located with in a quarter of a mile. Also, the Alternative Transportation, Parking Capacity and Carpooling credit aids to promote goal number three, to encourage interaction between residences. As well as meeting the zoning requirements for parking capacity, this credit also provides preferred parking for carpools, encouraging the residences to organize carpools for common errands, such as grocery shopping, or for activities of leisure.

Also in the Sustainable Site section, there are two credits that help to achieve goals two, three, and four; promoting a homey feel, encourage interaction, and keep seniors active, respectfully. These credits are both Landscape & Exterior Design to Reduce Heat Islands, one being Non-Roof and the other Roof. Simply, these credits require gardens on both the landscape and the roof, respectively. From *Table 8* in the above section *Design Specifics to Senior Citizen*

Residential Buildings, walking paths and gardens are design elements that are important to senior citizen buildings and help to achieve three of the four goals set for these buildings.

In the Materials & Resources section, the credits Local/Regional Materials, Rapidly Renewable Materials, and the Certified Wood all can easily be achieved by designing a timber structural system. This is a practical option for these types of buildings because generally they are smaller structures. Having a smaller structure also helps to achieve the second goal of creating a homey environment. Using timber structures also introduces options of reducing the schedule. Panelizing sections of the structure reduces on site construction time. For example, panelized floor system can help to reduce the schedule by a few weeks. Details about advantages and disadvantages can be found in a later section entitled Floor Panelized Systems.

In the Indoor Environmental Quality section, almost all of the credits either promote the goals developed or design elements. Many of the credits helping to provide a safe living place for the residence. To start, this section requires that there is a Minimum IAQ (Indoor Air Quality) Performance. The benefit to this that is creates a healthier indoor air environment. Senior citizens are generally more sensitive to health problems that the general adult population are not. This requirement helps to promote a safer and healthier live environment to the occupants. The next requirement for the section, Environmental Tobacco Smoke (ETS) Controls, introduces a problem. From *Table 8* in the pervious section, smoking is a factor that is important to consider when designing senior citizen buildings. In order to meet this requirement, careful consideration of the design must be performed to allow residents to have the ability to smoke if they desire.

Another notable credit is the Construction IAQ Management Plan, During Construction. This is an important credit because, as already stated, senior citizens are more sensitive to sicknesses then the general adult population. This credit requires an IAQ plan be followed during construction, this helps to reduce pollutant that maybe in the building once the building is turned over to the owner. Molds fall into this category, as they can be cause illness in the elderly. A detailed Mold Management Plan can be found in the following section entitled Moisture and Mold Control.

Lastly, another important credit, still in the Indoor Environmental Quality, is the Daylight & Views, both Daylight 75% of Spaces and Views for 90% of Spaces. Both of these credits help introduce natural light into the building, which according the *Table 8* is a design element that is desirable to achieve. This abundance of light helps promote a health environment.

Conclusion

LEED™ has become very popular in the last couple of years. New standards are being developed constantly. Originally, the end result of this study was to create a new LEED™ standard that could be used for buildings specifically designed for senior citizens. A thorough study of the architecturally design of these facilities was conducted by interviewing architects that regularly design senior citizen apartment buildings. The specific design elements were then tabulated and used to create the four goals to achieve a well-designed senior citizen living facilities. From these goals and the current LEED™ standards available, it was determined that developing a LEED™ standard specifically written for senior citizen residential buildings would not differ much from the current LEED™ standard that would presently be used for this type of building, which is the new the *New Construction & Major Renovations (LEED-NC™)* standard. However, there are many LEED™ credits that do not apply to senior citizen design; therefore, a guideline for LEED™ rated senior citizen construction was created that is based on the current LEED-NC™, called New Construction & Major Renovation for Senior Citizen Construction (LEED-NCSC).

Moisture and Mold Control

Introduction

"The key to mold control is moisture control," according to the EPA (U.S. Environmental Protection Agency). Mold spores are all around us in the air, they float through the air until they find a suitable place to grow. Mold spores need fours main resources in order to survive: water, oxygen, a food source, and a safe place to grow. With these four necessities met, mold will begin to grow exponentially as long as the four resources are available. Often a safe place for mold will be behind and wall, thus out of sight and with exponential growth this can quickly become a very large problem.

The solution to moisture control is to have a watertight building. This all begins with the conception, design, and construction of the building. Every building should be watertight and mold should be prevented; however, there are certain types of buildings where the growth of mold is much more harmful to the users of the building and certain types of buildings where mold can become more easily an issue. There are also considerations that can be carefully planned to help reduce the possibility of developing a mold problem during and after construction. Lastly, there are procedures that can be taken during construction, the most critical time of the building in regards to mold growth, to keep the building free and mold growth. The solution to keeping mold under control has three steps:

1.) Evaluating the risk of mold with an initial design evaluation of the building

2.) Assessing the design criteria that could affect mold growth

3.) Having a list of procedures to following during the construction process.

A guide containing the most important consideration can direct you through the conception, design, and construction to help reduce the risk of mold growth.

Initial Design Conception Evaluation

There are three categories in which mold can quickly become an issue for the building to consider at the conception of the project: the type building, the major materials used, and specific room types. First, the type of building and the type of user are important factors that determine whether mold should closely be monitored. According to The Mold Litigation Task Force of the Associated General Contractors of America, Inc.:

> "In recent years, the media has begun to portray [molds] as something inherently dangerous. The scientific evidence does not, however, support hat proposition. Certainly, molds can trigger allergic reactions in sensitive individuals, and the country has seen an increase in the number of opportunistic infections amount people with compromised immune systems. At the same time, molds appear to have only minor effects on the healthy adult population."

Thus, over exposure to mold is most critical to the young, old, and the ill; therefore, mold in primary education, elderly, and healthcare facilities is most significant.

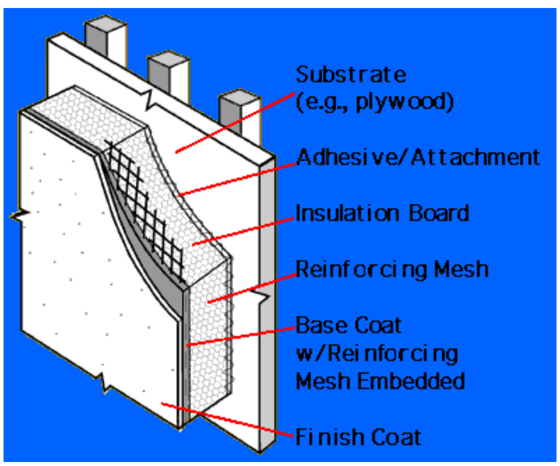


Figure 5

In addition, some commonly used materials can increase the likelihood of mold growth. All natural materials, such as wood and gypsum products, provide an abundant source of food and nourishment for mold. The last major building material that can cause mold is EIFS (exterior installation and finish systems); a section of EIFS can be seen in *Figure 5*. EIFS can be a breading ground for mold. The insulation board helps to drain moisture from with in the system; however, this also causes moisture to be trapped with in the system, which creates a perfect place for mold to grow.

Lastly, buildings whose design contains rooms that produce a large amount of moisture should raise concern about mold growth. Buildings that contain large laundry rooms, large shower facilities, and swimming pools are examples of these types of buildings. These rooms require at the minimum a good ventilation system to dissipate the excess moisture.

Design Criteria

There are eight major areas or systems of the building, which can increase the possibility of a mold problem if not addressed during the design phase of the project. The areas or systems are the building envelope, roofing system HVAC system, plumbing systems, elevator shafts, permanent drainage systems, foundation damp proofing, and interior materials. There are simple considerations that can be taken to reduce the risk of mold.

The building envelope, if not constructed correctly, can provide mold with the four necessities - water, food, oxygen, and a safe place - need for mold to survive. For example, using different materials for the façade creates joints between the materials, which can easily let water infiltrate the building envelope. Other important details to keep on top of are the flashing, window caulking, and door sweeps details. These are very important features that provide great protection against water infiltration if applied correctly, but can easily allow water to enter the building envelope if not.

The roofing system is another aspect of the building that is a great means of protecting the building from moisture. When selecting the brand of roofing system to use on the building it is important to choose one of high quality and one with an extensive warranty. Another possible cause of roof leakage could be skylights; the seals of the skylight could cause leaks if not properly sealed.

The HVAC system can be another common source of mold growth. It is also important to locate fresh air intakes away from standing water, bare soil, plant debris, or accumulated bird or animal droppings. The HVAC intake can draw these materials into the ductwork within in the building, supplying moisture or a food source for mold to grow. The ductwork itself provides a safe environment for mold growth as well so it best to take any measure to reduce the additions of any of the other requirements molds need to grow.

The plumbing system can be another source of excess moisture in the building if it is not constructed correctly. It is important that cold water pipes have proper installation; there should be drawings in the construction documents that show the details of the installation. If the pipes are left with insufficient installation, condensation can form which if left alone can begin to drip, leaving standing water in the building. It is also important to thoroughly review the plumbing plans to ensure that no drainage pipes are left unconnected. Another area where water can easily enter the building is the elevator pit because it is the low point of the building. a solution to this is to install a sump pump to dispose of any excess water. It is also advisable to review the civil plans and compare them with the actually conditions to be sure that water will property drain away from the building. It is also important to be sure that foundation damp proofing is properly leveled and covered during construction.

Some interior materials can provide a source of food for mold if there is excess moisture. Natural materials, such as gypsum products or woodwork, are sources of food for mold to grow on. If these interior materials are installed in the building prior to activities that produce very high amounts of moisture, such as fireproofing and placing concrete, it creates an environment where mold will grow quickly.

Construction Procedures

The most important practice to adapt in the prevention of mold would be to perform daily inspections for water infiltration and mold growth. If standing water is found it should be removed within 24 to 48 hours to prevent mold growth in that area. If mold is found it should be cleaned or removed immediately to prevent the spread of the mold growth. It is also advisable to use dehumidifiers during activities such as fireproofing or placing concrete, which produces high amounts of moisture in the air.

Also, HVAC filters and ductwork can cause a problem. The nature of the ductwork provide and ideal place for mold to growth. If the filters are not cleaned regularly, the dirt trapped in the filter is another source of nourishment for mold. The mold will begin to grow in the filter and the nature of the circulation of air will blow the mold into rooms. The insulation used with the ductwork can also cause a problem. Lined ducts can become breading grounds for mold if they become wet.

Recommendation

There are simple practices that can be adopted that can greatly reduce the risk of mold growth in a building whose user would be sensitive to mold spores. The design team, contractor, and the owner should adopt these practices in order to help reduce the risk of mold in the building. Using the issues previously discussed, a simple guide can be created to help the design team and contractor through these issues easily. The following is a guide that if followed will help reduce the possibility of mold. The guide first determines, in Section I, whether mold will be an issue based on the user of the building and other design element of the building. Next, in Section II, the guide introduces considerations that should be taken during the design phase, if mold will be an issue to the building. Lastly, Section III is a checklist of actions that should be taken during the construction phase to keep the growth of mold under control. This Threat of Mold Evaluation is a simple way to prevent a very serious issue.

Threat of Mold Evaluation

Section I: Types of Buildings

1. Is the building any of the following types?

   Healthcare facility
   Primary school facility
   Elderly facility
   Renovation of an abandoned building

   ☐ YES ☐ NO

   If YES continue Section II, if NO continue to item 2.

2. Are any of the following building materials major components of the design?

   Wood frames
   Gypsum products
   EIFS
   Plywood sheathing
   HVAC filters and ductwork

   ☐ YES ☐ NO

   If YES continue to Section II, if NO continue to item 3.

3. Does the building design contain any of the following?

   Large laundry rooms
   Large shower facilities
   Swimming pools

   ☐ YES ☐ NO

   If YES continue to Section II, <u>if NO there is no elevated risk of mold</u>.

Section II: Design Considerations

The following are items for different systems of the building that should be considered during the design process to reduce the growth of molds during construction.

1. **Building Envelope**
   - ☐ Multiple materials building envelopes can lead to leaks between joints.
   - ☐ Flashing details should be included in the contracted documents.
   - ☐ Window caulking and door sweeps should have detailed specifications.

2. **Roofing System**
   - ☐ The roofing system should have a substantial warranty.
   - ☐ Skylights can cause leaks if not seal adequately.

3. **HVAC System**
   - ☐ Lined ducts can become breeding grounds for mold if they become wet.
   - ☐ Locate fresh intakes away from standing water, bare soil, plant debris, or accumulated bird or animal droppings.

4. **Plumbing System**
   - ☐ Having insufficient insulation on cold water pipes can cause mold to grow.
   - ☐ Be sure drain pipes are not left unconnected.

5. **Elevator Shafts**
   - ☐ Elevator lowest point of building, a sump pump will help to rid of standing water.

6. **Permanent Drainage Systems**
   - ☐ Review civil plans and actual conditions to ensure moisture will drain away from building after construction is complete.

7. **Foundation Damp Proofing**
   - ☐ Property leveling and covering with gravel can help prevent mold growth.

8. **Interior Materials**
   - ☐ Natural materials, such as gypsum products or woodwork, are a source of food for mold if they grow on these products.
   - ☐ Placing concrete or fireproofing after gypsum and wood products creates a lot of moisture in the building. The gypsum and wood products are excellent sources for mold to grow.

After these items have been carefully considered during construction, continue to Section III for a list of considerations during construction.

Section III: Construction Procedures

When the construction is underway, simple procedures can be taken to keep mold under control. The following is a checklist of items that should be checked everyday to ensure the building is free of water infiltration.

- ☐ Inspection of roofing system and flashing.
- ☐ Check integrity of sealant at all penetrations.
- ☐ Close and secure all doors and windows daily.
- ☐ Insure positive drainage at perimeters of building.
- ☐ Immediately remove any water due to building or plumbing leaks.
- ☐ Use dehumidifiers during process that generate large amounts of water in the air (i.e. concrete or fireproofing).
- ☐ Test the moisture contain and humidity of the air inside the building and take appropriate measures to reduce if necessary.
- ☐ Check all installed materials and systems for excess water or condensation.

Floor Panelized Systems

Introduction

In construction, an easier and faster way of completing a job is always top priority. Using wood as a construction material allows for an easily obtainable and replenished building material. It is also a very versatile material; a dimensional piece of lumber could be used in various applications. For example, a 2x4 can be used as part of a post, girder, or joist. This same 2x4 can also be cut as needed on site as the use of the board is determined. However, having many of the same pieces that are used for various applications can become tedious.

Precast concrete has been used successfully for some time now. The benefit of this is that the structural element is cast and cured off site in a controlled environment. When the project is ready for the piece it is shipped to site and installed. This eliminates the on site construction of the structural element which ultimately saves time. This same idea can be used in timber construction as well. Panelized wall systems are already being used but panelized floor systems are a new innovation. This floor system is constructed the same way as it would be on site but in a controlled environment. Both on site assembled and panelized floor systems are effective. This is a study of the implication of using a panelized floor system on The Cascades project in Cumberland, MD.

Structure Construction in The Cascades

Process description

A traditional timber framed building is built one piece of wood at a time. Each board, plank, and board are used as posts, girders, joists, and sheathing. These posts, girders, joists, and sheathing are assembled into various combinations to the structure. The material is stock piled on site and the pieces are pulled from the pile when they needed for construction.

Cost, Time, and Labor

Table 9 shows the cost per square foot for the material needed and the cost per hour for the labor to install the system. It also shows the square footage that can be installed in an hour with a crew of sixteen. The numbers used to find this information is based on The Cascades project.

Table 9

Cost		
Material	$3.03	cost/SF
Labor	$47.00	cost/hour
Time		
Installation	300	SF/hour

Advantages

With on site construction of the flooring system, the process becomes more flexible. The materials needed, can be stored on site as long until they are ready to use with minimal demand on site space as they are sufficiently protected from the weather. In addition, the flooring system is built when the project is ready for it, so if there are any major changes to the floor plan design they can easily be adapted during construction. The only consequence to a major change would be an increase or decrease in the material needed, which would not be a major problem if the materials are ordered as they are needed.

Another advantage to a stick build systems would be the familiarity to the system. This is the same type of construction that was used when timber first began to be used as a building material. The process has been refined over the years and is very customary to installers.

Disadvantages

The entire construction of the flooring system is constructed on site. This on site construction takes a long time. All other construction activities depend on the structure to finish before they can start. In addition, the material needed must be delivered to site prior to installation. This material must be stored on site, which, if the site is tight for space, takes up a lot of valuable space.

Panelized Floor System

Description

Panelized floor systems take the assembly of the floor system off the construction site and bring it into a controlled environment of a manufacturing plant. It is the same idea as precast concrete but using a different building material. The floor panel is constructed from specific dimensions, shipped to site, and installed. It is structurally identical to a floor system built of site with individually delivered materials but the process creates possibilities that are not feasible with on site construction.

Process description

The first and most important step is to collaborate. The design team, manufacturing team, builder, and owner work closely together to achieve the desired product most effectively. The structural system is then completely designed, the entire framing design, including layout and engineering of roof, walls, and the floor systems, must be completed in order to begin creating the floor panel sections. The design is then sent to the manufacturing plant to be cut and prepared to delivery. Finally, it is delivered to site and installed.

Software and Manufacturing Plant

In order for the manufacturing plant to be able to use the design plan, the design must be completed using a program called TJ-XPERT. This is a propitiatory design program developed by Trus Joist, a Weyerhaeuser Business. The design files created in TJ-XPERT are then sent to PANEL-MATE. The program PANEL-MATE takes the designed floor plan and creates the panel sections dimensions and shapes. Finally, the panel sections created in PANEL-MATE are sent to OPT-FAB. OPT-FAB is used in the manufacturing plant, it allows the saw to cut the panel sections to the size and dimensions desired. The program is accurate up to a 1/16” and uses the dimensions from PANEL-MATE to cut the panel to the specific unique size. The panels are now ready to be stacked on the delivery truck and shipped to site.

Delivery

The program PANEL-MATE also creates a stacking plan for the delivery truck from the layout, which takes into consideration the order in which each piece will be installed. The panels are stacked in a very particular order on the truck so that the panels can be picked directly off the truck and installed when they are delivered to site. See *Appendix VII* for a detailed drawing on the stacking and shipping details and *Figure 6* for a photo of the delivery truck ready for delivery.

Installation

The installation of the panels is the fastest part of the process. Each piece is clearly marked for the location in the building. The builder follows a script for the location and the pieces are craned into place. The panels should fit together easily and all that is needed is for the panel to be connected. See *Figure 8* and *Figure 9* for photos of the panels being installed.

There are five typical connections that are used: panel to wall connection, panel-to-panel connection, panel to beam connection, panel to interior bearing wall, and strap to panel. See *Appendix VIII* for a detailed connection plan. The panel to wall connection uses toenails of 12d at 16" on center. The panel-to-panel connection requires the panels edge has to be cut in a tough and grove method, called a flying edge to split edge. The connection then requires glue and edge nails of 10d at 6" on center. In the panel to beam connection, the beam can be installed prior to or during the installation of the panels. The panel to interior bearing wall requires blocking to be fastened to the bearing wall with 12d nails staggered at 12" on center. Lastly, for the straps to panel connection, the straps must be installed prior to the installation of the panel.

Cost, Time, and Labor

One of the biggest appeals of these panelized floor systems is the reduced time that is required compared to the conventional stick-built system. The panelized floor system can reduce the time by almost five times. With efficient layout, delivery, and a crew of five, up to 3400 square feet can be installed in four hours. With a typical panel 304 square feet, approximately 2.8 panels can be installed per hour and 22 panels can be installed in a day.

Table 10 shows the cost per square foot for the material needed and the cost per hour for the labor to install the system. It also shows the square footage that can be installed in an hour with a crew of five. The numbers used to find this information is based on projects were the Trus Joist panelized floor system was used.

Table 10

Installation Rate	
850	SF/hour
2.8	panels/hour
22	panels/day

Equipment needed

The most important piece of equipment needed to install the floor panels is a crane. The crane used to lift the roof trusses is sufficient. The crane should be able to lift a maximum load of 40 tons. However, the most important aspect of the crane should be the reach. A crane with a reach of 75 feet would be ideal. See *Figure 7* for a photo of the crane placing a panel.

Site storage/staging

The most desired situation is that the panels are delivered on the day they are needed and the crane picks them directly off the truck, eliminating the need for a site storage or staging area. If the panels must be delivered prior to installation, a large area is needed. A typical panel can range from 8'x32' to 8'x44' and needs a large enough area that they can be layout in order for them to be installed with easy.

Sequencing/Impact on other trades

The floor panel system is one of the first components to be completed in the building. After the foundation is poured, the first floor panels are installed, then the wall panels followed by the second floor panels. This process continues through the roof truss. The building is then closed in more quickly than with a conventional stick-built system and the interior trades can begin working. The floor panels are conveniently precut, according to the design, for the mechanical, electrical, and plumbing work.

Figure 6: Delivery truck stacked with panels at the manufacturing plant ready to delivery.

Figure 7: Panel being picked with a crane.

Figure 8: A first floor panels being swung into place.

Figure 9: A first floor panel being installed.

Advantages

The three major advantages of a panelized floor system over a stick-built system are decreased time, increased quality, and a safer installation process. These three advantages are a result of the pre-fabrication of the floor panels. The panels are built in a controlled environment, this controlled environment allow for more control over the process.

Decreasing schedule time helps to move the project along more quickly. Constructing the floor panels indoors eliminates the risks of encountering inclement weather; the panels can be built regardless of the weather. In addition, the use of the manufacturing plant increases the productive of the construction of the panels. As the process becomes more familiar, the process becomes easier and is completed more quickly. Along with decreased time, the quality also increases with more familiarity. The panels are built in a controlled environment, which allows the fabrications to be more controlled then on site construction. Lastly, the manufacturing plant brings the construction inside and controls it, which helps to decrease on site accidents.

Disadvantages

The two major disadvantages to a panelized floor system are the decreased flexibility to make changes and the space needed if on site storage is required. Since the panels are cut to such precision in the plant, if a panel shows up to site and is drastically miss-sized, the only way to rectify the situation is to order a replacement panel. Ordering a new panel will completely halt all construction until the new panel arrives. This new panel could take up to a week to arrive to site. However, small alteration can be done to the panels on site if needed. If a panel does not fit perfectly it is completely safe to make small cut to the panel so that it fits. The other major disadvantage of the panelized floor system is that it takes up large amount of space if the panel needs to be stored on site. Ideally, the panels would be scheduled to be delivered the day they are needed, however that is not always possible. The panels take up four times more space then the material needed to construct the panels. These two major disadvantages, however, can be avoided if the process is well planned.

Implication on The Cascades

Schedule impact

One of the leading reasons to use a panelized floor system would be to reduce schedule time. The Cascades is a four-story building with the first floor as slab on grade, leaving three floors that would be panelized floors. Using the square footage of each floor and the square footage rate of installation for the panelized floor system, the total time of installation would be 8.5 days. Using the rate of number of panels per day the installation time would 10 days. Moreover, using the rate of number of panels per days the installation time would be 10.2 days.

Table 11

Installation Rate			Units per Floor			Installation Time per Floor			Number of Floors		Total Time of Installation	
850	SF/hour		19205	SF		22.6	hours		3		8.5	days
2.8	panels/hour		75	panels		26.8	hours		3		10.0	days
22	panels/day		75	panels		3.4	days		3		10.2	days

Finding the installation times this way is accurate, except it does not take into consideration the layout of the building. For instant, if a floor is finished with half a day left it is not possible to start the next floor that day, because obviously the walls need to be constructed before the next floor is started. Therefore, the most accurate calculation to find the number of days for installation to use the layout of the building to find the layout of the panels to determine the number of days it will take. *Figure 10* is the plan of The Cascades showing a break down of the floor panels. Each color represents the amount that can be completed in one day. The blue, red, and green areas are all a full day of work; the yellow area is a half day of work. As each area is completed, work can begin on framing the walls, which on The Cascades are also panelized. According to the layout, it will take four days to complete the flooring system on one floor. Therefore, it will take a total of 12 days to complete the flooring system for The Cascades using a panelized floor system, compared the original stick-built system, which took 32 days. This is a reduction in the schedule by 62.5%, seen in *Table 12*.

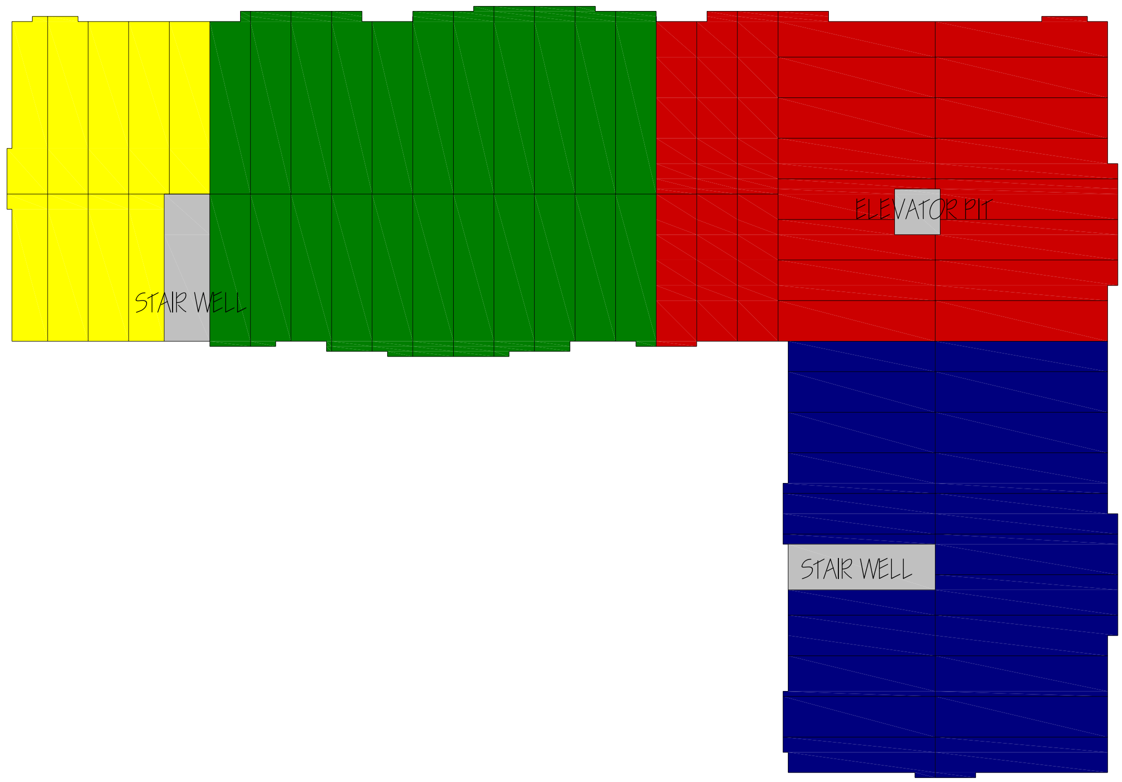


Figure 10

Table 12

The Cascades Schedule Time Comparison	
Original System	Panelized System
32 Days	12 Days
6.4 Weeks	2.4 Weeks
Total reduction of 62.5%	

Recommendation

Using a panelized floor system is an excellent means of reducing schedule time. In The Cascades, it reduced the schedule by four weeks. A reduction of this amount of time could help to enclose a building sooner when building during colder months. In addition, the panelized floor system can be used when other aspects of the project are time consuming to be able to apply the saved time to the more time consuming areas. Lastly, it can lead to an early turnover, saving a month's worth of rents, salaries, and time spent on the project. Using a panelized floor system is recommended when time is of an essence on the project.

Summary & Conclusion

Though a relatively simple building, The Cascades has provided an excellent basis of study for the analyses examined in this thesis. The study of the architectural design elements in senior citizen facilities became useful in developing a new LEED™ standard that could be used specifically for senior citizen apartment buildings, LEED-NCSC. The residence's health conditions proved a needed to develop a guide to reduce the risk of mold, which will help improve the well-being of the residences. Lastly, the panelized floor systems proved effective to reduce the schedule significantly. Allowing for an earlier turnover to the owner. In conclusion, the three analyses proved to be effective and should be implemented with similar projects.

References

AE 401 Class Notes.

Andalora, Will. Personal Interview. 18 February 2005.

Ching, Francis D.K. Building Construction Illustrated. New York: John Wiley & Sons, Inc., 2001.

Frameworks Building System. North by Northwest Productions. DVD. Trus Joist, 2004.

Kupfer, Kenneth. Personal Interview. 12 February 2005.

LEED: Leadership in Energy and Environmental Design. 2005. http://www.usgbc.org/LEED.

LEED-NC Version 2.1 Reference Guide.

Money, Nicholas P. Carpet Monsters and Killer Spores: A Natural History of Toxic Mold. New York: Oxford University Press, 2004

Olin, Harold B. and Simmons, H. Leslie. Construction Principles, Materials, and Methods. New York: John Wiley & Sons, Inc., 2001.

RS Means Building Construction Cost Data. Massachusetts: R.S. Means Co. 2004.

Sander, George. Personal Interview. 16 February 2005.

Taylor, Gray. Personal Interview. 28 February 2005.

Thomas, William H. The Eden Alternative: Nature, Hope, and Nursing Homes. New York: Eden Alternative Foundation, 1994.

Thomas, William H. What Are Old People Good For? How Elders Will Save the World. Action: VanderWyk & Burnham, 2004

USGBC: U.S. Green Building Council. 2005. http://www.usgbc.org.

Appendix I: Elevations

FOURTH STREET ELEVATION

SOUTH WEST ELEVATION

VANCOUVER STREET ELEVATION

THE CASCADES

CUMBERLAND, MARYLAND

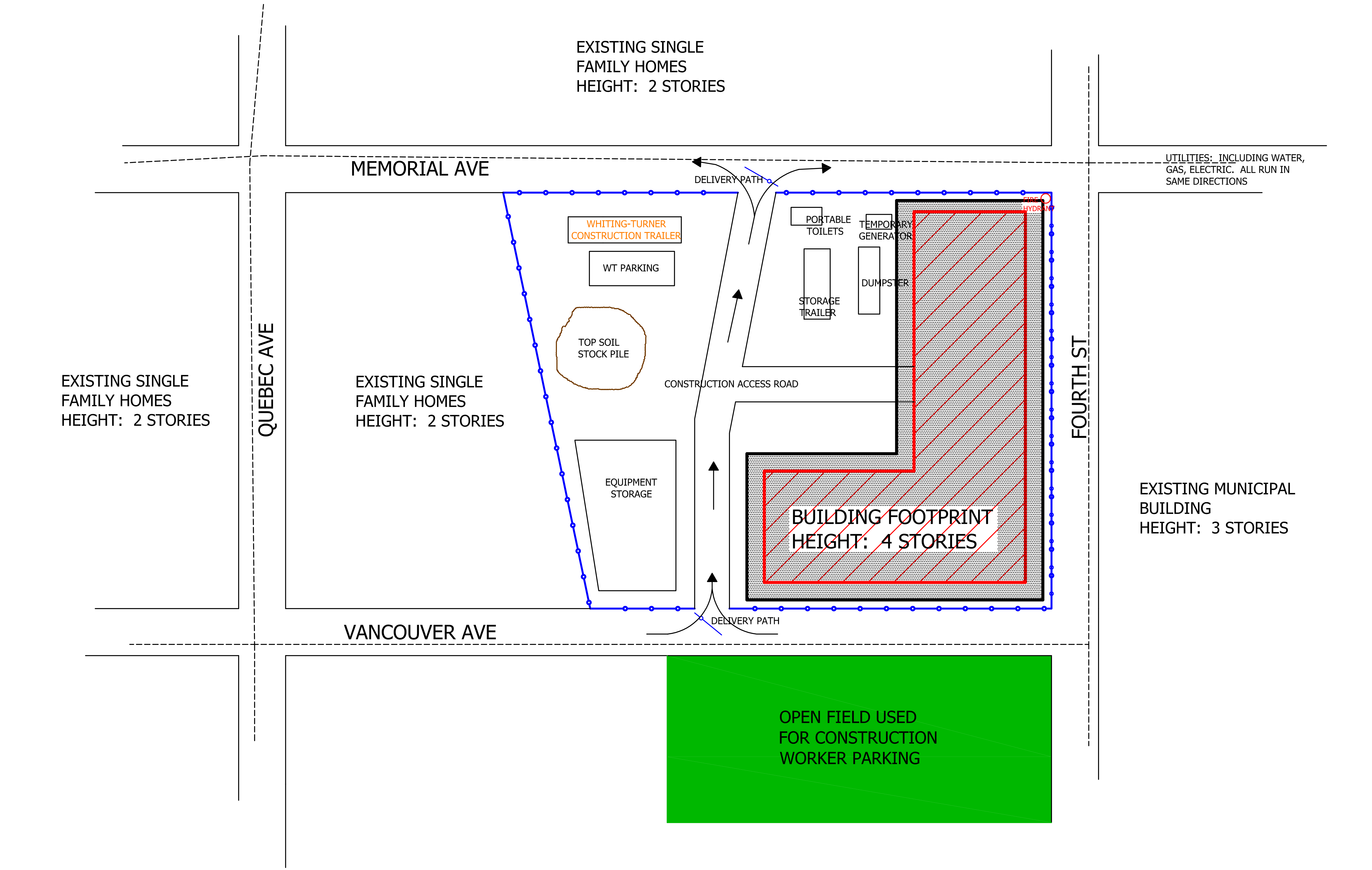
ELEVATIONS

CUMBERLAND PARTNERS, LP

hcm

01.14.2003

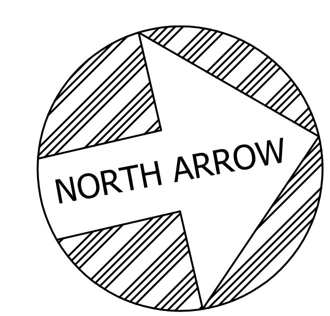
Appendix II: Detailed Site Plans

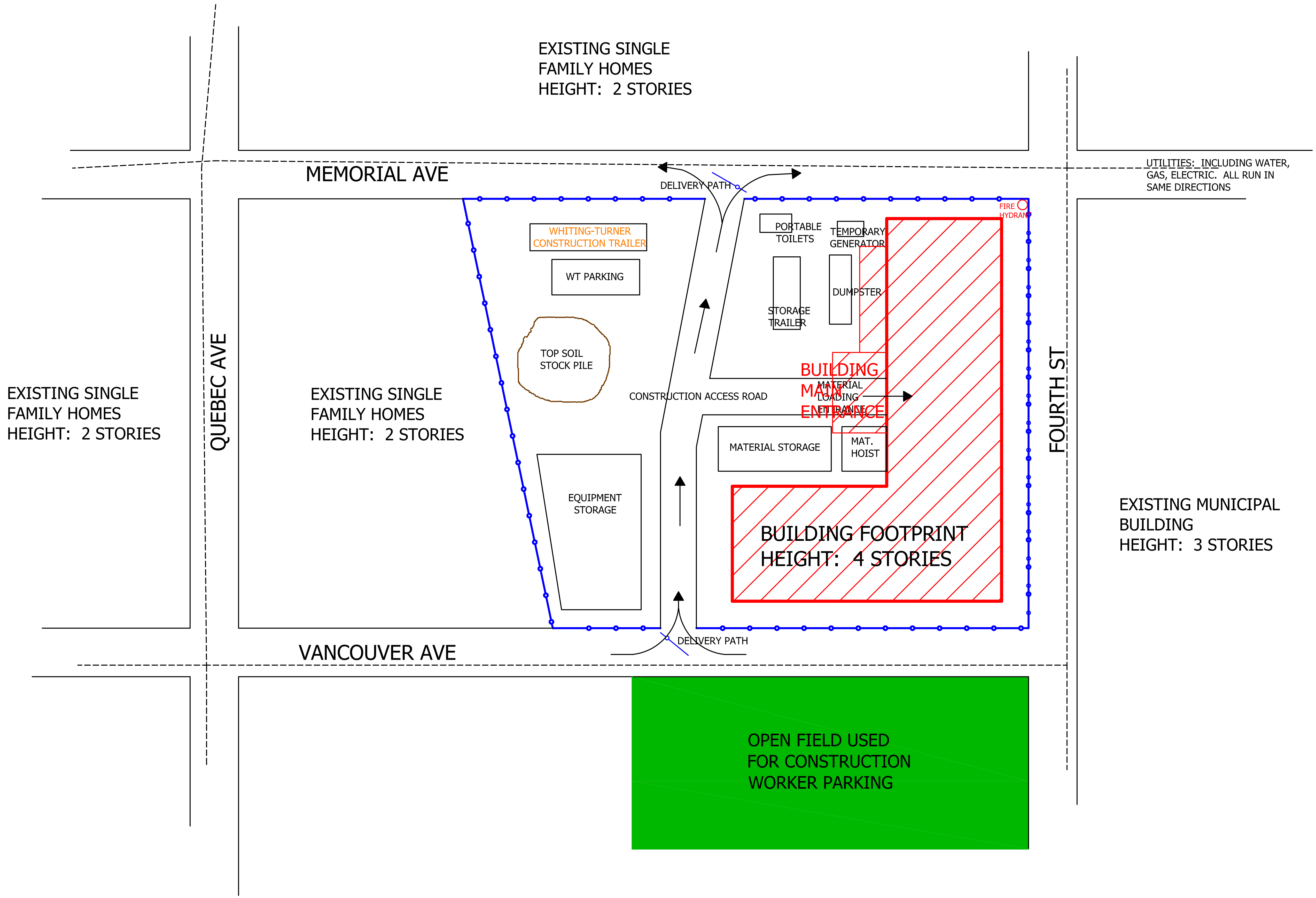


EXCAVATION SITE PLAN

ELIZABETH FELICE
THESIS SITE PLANS
FOR TECHNICAL
ASSIGNMENT 3

NOTE: NO EXCAVATION IS REQUIRED BECAUSE THERE ARE NO BASEMENT LEVEL, THE FOUNDATION SYSTEM IS SLAB ON GRA. HOWEVER, SOIL RESURFACING IS REQUIRED IN THE BLACK SHADED AREA.



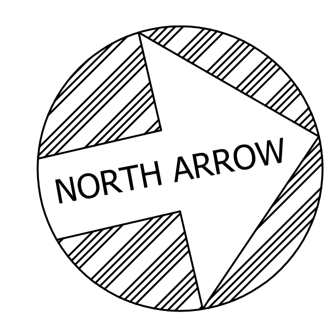


SUPERSTRUCTURE PLAN

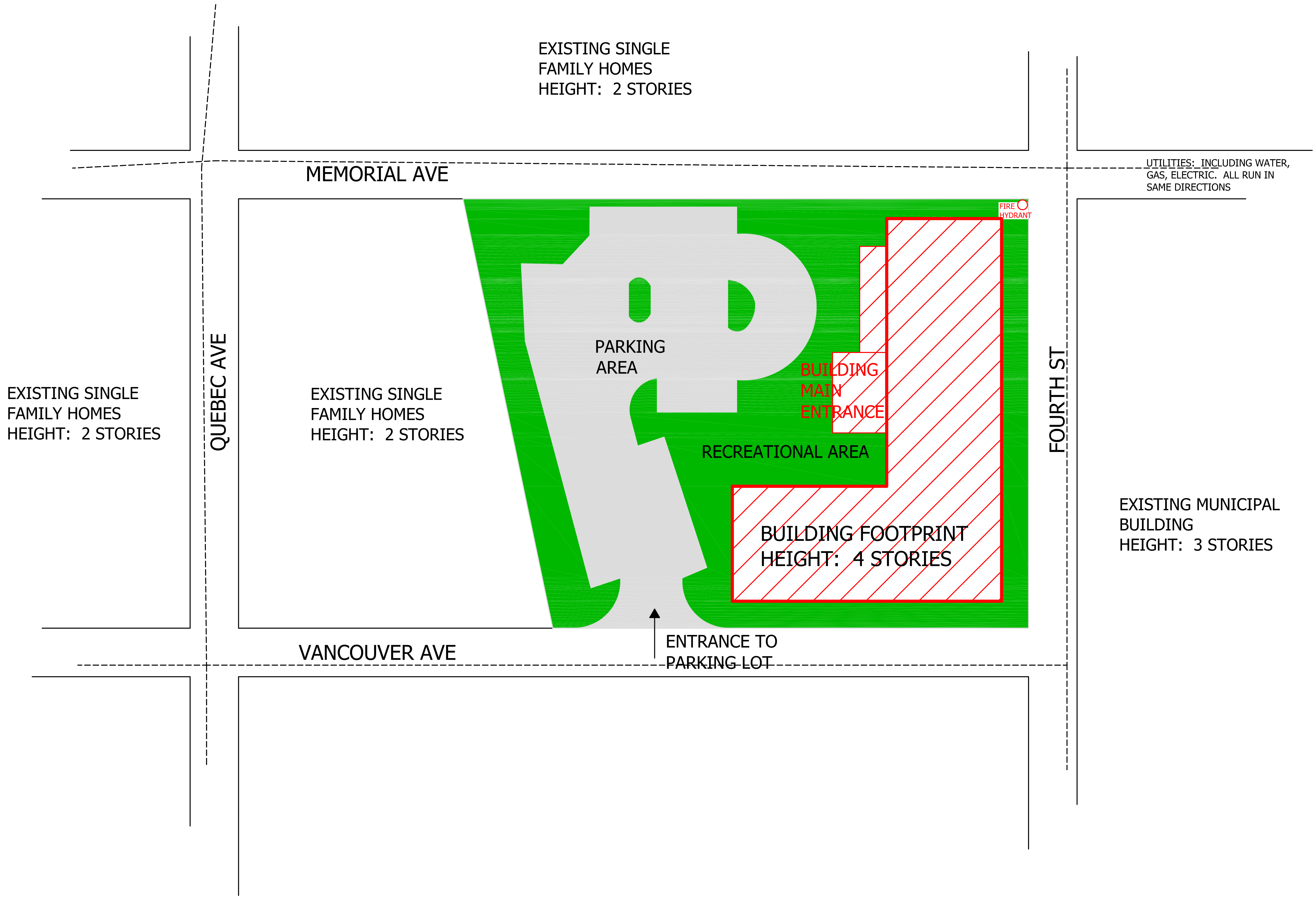
ELIZABETH FELICE
THESIS SITE PLANS
FOR TECHNICAL
ASSIGNMENT 3

NOTE: THERE IS NO CRANE USED ON SITE.

NOTE: NO TEMPORARY ELEVATOR OR PERSONNEL HOIST. STAIR WELL AND TEMPORARY STAIRS USED TO ACCESS UPPER FLOORS.

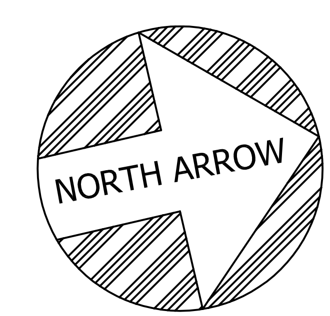


FINISHED PLAN



ELIZABETH FELICE THESIS SITE PLANS FOR TECHNICAL ASSIGNMENT 3

NO NOTES



Appendix III: D4 Cost Estimate

Estimate of Probable Cost

The Cascades - Jan 2005 - MD - Cumberland

Prepared By:

Fax:

Prepared For:

Fax:

Building Sq. Size: **76000**
Bid Date:
No. of floors: **4**
No. of buildings:
Project Height:
1st Floor Height:
1st Floor Size:

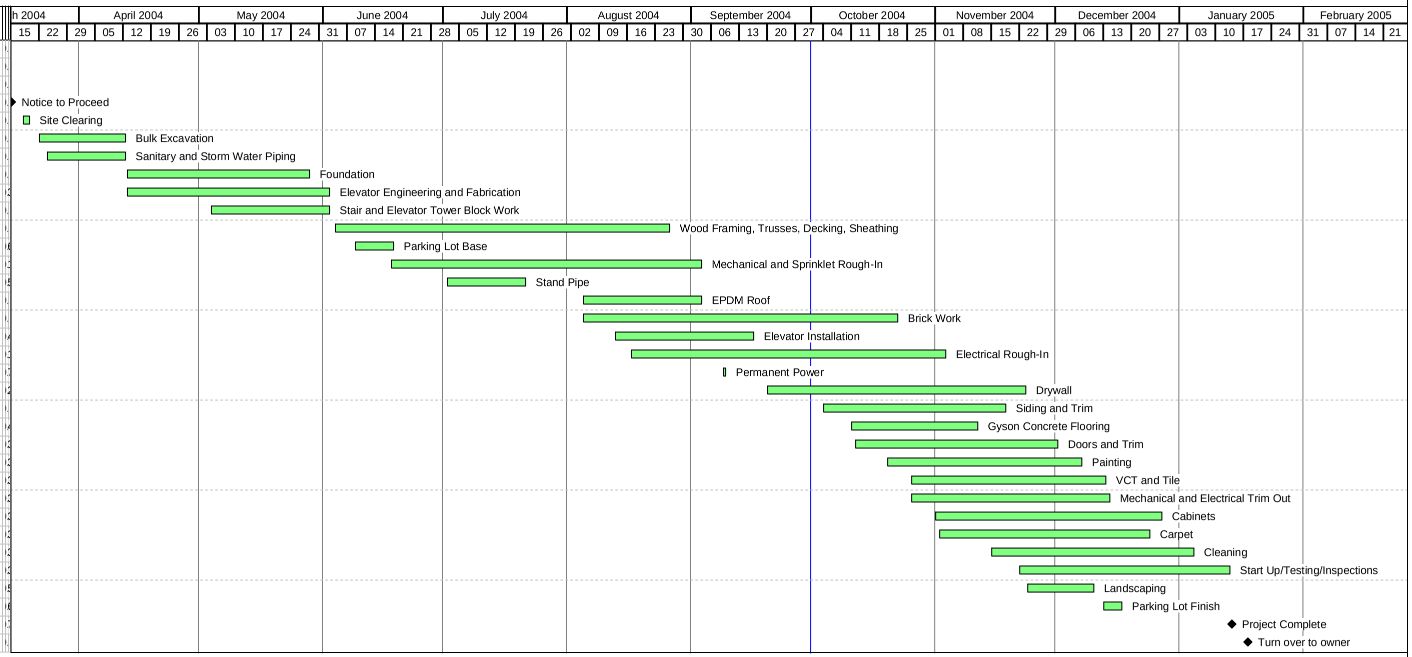
Site Sq. Size: **77305**
Building use: **Residential**
Foundation: **Concrete Slab**
Exterior Walls: **Masonry/Brick/Bloc**
Interior Walls: **Drywal/Gypsum Sheathing**
Roof Type: **EPDM**
Floor Type: **Carpet**
Project Type: **NEW**

Division		Percent	Sq. Cost	Amount
00	**Bidding Requirements**	**3.28**	**2.95**	**224,029**
	Bidding Requirements	3.28	2.95	224,029
	Untitled	0.00	0.00	0
01	**General Requirements**	**5.02**	**4.51**	**342,827**
	General Requirements	5.02	4.51	342,827
02	**Site Work**	**5.32**	**4.78**	**363,335**
	Site Work	5.32	4.78	363,335
03	**Concrete**	**6.49**	**5.83**	**443,329**
	Concrete	6.49	5.83	443,329
04	**Masonry**	**4.36**	**3.92**	**297,960**
	Masonry	4.36	3.92	297,960
05	**Metals**	**10.77**	**9.68**	**735,528**
	Metals	10.77	9.68	735,528
06	**Wood & Plastics**	**14.01**	**12.60**	**957,489**
	Wood & Plastics	14.01	12.60	957,489
07	**Thermal & Moisture Protection**	**4.41**	**3.96**	**301,049**
	Thermal & Moisture Protection	4.41	3.96	301,049
08	**Doors & Windows**	**4.79**	**4.31**	**327,406**
	Doors & Windows	4.79	4.31	327,406
09	**Finishes**	**11.08**	**9.96**	**757,334**
	Finishes	11.08	9.96	757,334
10	**Specialties**	**2.50**	**2.24**	**170,576**
	Specialties	2.50	2.24	170,576
11	**Equipment**	**2.34**	**2.10**	**159,604**
	Equipment	2.34	2.10	159,604
12	**Furnishings**	**0.73**	**0.66**	**50,128**
	Furnishings	0.73	0.66	50,128
13	**Special Construction**	**1.34**	**1.20**	**91,278**
	Special Construction	1.34	1.20	91,278
14	**Conveying Systems**	**1.86**	**1.67**	**126,786**
	Conveying Systems	1.86	1.67	126,786
15	**Mechanical**	**12.27**	**11.03**	**838,431**
	Mechanical	12.27	11.03	838,431
16	**Electrical**	**9.44**	**8.49**	**645,306**
	Electrical	9.44	8.49	645,306

Appendix IV: Schedule

The Cascades | Classic Schedule Layout | 06-Apr-05 13:32

Activity ID	Activity Name	Original Duration	Start	Finish
A1000	Perlimary Design/Budget concept	86	14-Jan-02	13-May-02
A1010	Design Development	371	13-May-02	13-Oct-03
A1020	Offical Kick Off Meeting	0	13-Oct-03	
A1030	Notice to Proceed	0	15-Mar-04	
A1040	Site Clearing	2	18-Mar-04	19-Mar-04
A1050	Bulk Excavation	16	22-Mar-04	12-Apr-04
A1060	Sanitary and Storm Water Piping	14	24-Mar-04	12-Apr-04
A1070	Foundation	34	13-Apr-04	28-May-04
A1130	Elevator Engineering and Fabrication	37	13-Apr-04	02-Jun-04
A1080	Stair and Elevator Tower Block Work	22	04-May-04	02-Jun-04
A1090	Wood Framing, Trusses, Decking, S...	60	04-Jun-04	26-Aug-04
A1210	Parking Lot Base	8	09-Jun-04	18-Jun-04
A1150	Mechanical and Sprinklet Rough-In	56	18-Jun-04	03-Sep-04
A1160	Stand Pipe	14	02-Jul-04	21-Jul-04
A1100	EPDM Roof	22	05-Aug-04	03-Sep-04
A1110	Brick Work	57	05-Aug-04	22-Oct-04
A1140	Elevator Installation	25	13-Aug-04	16-Sep-04
A1170	Electrical Rough-In	57	17-Aug-04	03-Nov-04
A1180	Permanent Power	1	09-Sep-04	09-Sep-04
A1190	Drywall	47	20-Sep-04	23-Nov-04
A1120	Siding and Trim	34	04-Oct-04*	18-Nov-04
A1230	Gyson Concrete Flooring	24	11-Oct-04	11-Nov-04
A1240	Doors and Trim	37	12-Oct-04	01-Dec-04
A1250	Painting	35	20-Oct-04	07-Dec-04
A1260	VCT and Tile	35	26-Oct-04	13-Dec-04
A1280	Mechanical and Electrical Trim Out	36	26-Oct-04	14-Dec-04
A1270	Cabinets	41	01-Nov-04	27-Dec-04
A1290	Carpet	39	02-Nov-04	24-Dec-04
A1300	Cleaning	37	15-Nov-04	04-Jan-05
A1310	Start Up/Testing/Inspections	39	22-Nov-04	13-Jan-05
A1200	Landscaping	13	24-Nov-04	10-Dec-04
A1220	Parking Lot Finish	5	13-Dec-04	17-Dec-04
A1320	Project Complete	0		14-Jan-05
A1330	Turn over to owner	0	18-Jan-05	



Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

TASK filter: All Activities

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Appendix V: LEED-NC™ Registered Project Checklist

LEED-NC Version 2.1 Registered Project Checklist

<< enter project name >>
<< enter city, state, other details >>

Yes	?	No	Sustainable Sites		14 Points
Y			Prereq 1	**Erosion & Sedimentation Control**	Required
			Credit 1	**Site Selection**	1
			Credit 2	**Development Density**	1
			Credit 3	**Brownfield Redevelopment**	1
			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
			Credit 4.3	**Alternative Transportation**, Alternative Fuel Vehicles	1
			Credit 4.4	**Alternative Transportation**, Parking Capacity and Carpooling	1
			Credit 5.1	**Reduced Site Disturbance**, Protect or Restore Open Space	1
			Credit 5.2	**Reduced Site Disturbance**, Development Footprint	1
			Credit 6.1	**Stormwater Management**, Rate and Quantity	1
			Credit 6.2	**Stormwater Management**, Treatment	1
			Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands**, Non-Roof	1
			Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands**, Roof	1
			Credit 8	**Light Pollution Reduction**	1

Yes	?	No	Water Efficiency		5 Points
			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
			Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
			Credit 2	**Innovative Wastewater Technologies**	1
			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
			Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Yes	?	No	Energy & Atmosphere		17 Points
Y			Prereq 1	**Fundamental Building Systems Commissioning**	Required
Y			Prereq 2	**Minimum Energy Performance**	Required
Y			Prereq 3	**CFC Reduction in HVAC&R Equipment**	Required
			Credit 1	**Optimize Energy Performance**	1 to 10
			Credit 2.1	**Renewable Energy**, 5%	1
			Credit 2.2	**Renewable Energy**, 10%	1
			Credit 2.3	**Renewable Energy**, 20%	1
			Credit 3	**Additional Commissioning**	1
			Credit 4	**Ozone Depletion**	1
			Credit 5	**Measurement & Verification**	1
			Credit 6	**Green Power**	1

continued...

Yes	?	No	Materials & Resources		13 Points
Y			Prereq 1	**Storage & Collection of Recyclables**	Required
			Credit 1.1	**Building Reuse**, Maintain 75% of Existing Shell	1
			Credit 1.2	**Building Reuse**, Maintain 100% of Shell	1
			Credit 1.3	**Building Reuse**, Maintain 100% Shell & 50% Non-Shell	1
			Credit 2.1	**Construction Waste Management**, Divert 50%	1
			Credit 2.2	**Construction Waste Management**, Divert 75%	1
			Credit 3.1	**Resource Reuse**, Specify 5%	1
			Credit 3.2	**Resource Reuse**, Specify 10%	1
			Credit 4.1	**Recycled Content**, Specify 5% (post-consumer + ½ post-industrial)	1
			Credit 4.2	**Recycled Content**, Specify 10% (post-consumer + ½ post-industrial)	1
			Credit 5.1	**Local/Regional Materials**, 20% Manufactured Locally	1
			Credit 5.2	**Local/Regional Materials**, of 20% Above, 50% Harvested Locally	1
			Credit 6	**Rapidly Renewable Materials**	1
			Credit 7	**Certified Wood**	1

Yes	?	No	Indoor Environmental Quality		15 Points
Y			Prereq 1	**Minimum IAQ Performance**	Required
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required
			Credit 1	**Carbon Dioxide** (CO_2) **Monitoring**	1
			Credit 2	**Ventilation Effectiveness**	1
			Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
			Credit 4.2	**Low-Emitting Materials**, Paints	1
			Credit 4.3	**Low-Emitting Materials**, Carpet	1
			Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber	1
			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
			Credit 6.1	**Controllability of Systems**, Perimeter	1
			Credit 6.2	**Controllability of Systems**, Non-Perimeter	1
			Credit 7.1	**Thermal Comfort**, Comply with ASHRAE 55-1992	1
			Credit 7.2	**Thermal Comfort**, Permanent Monitoring System	1
			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
			Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Yes	?	No	Innovation & Design Process		5 Points
			Credit 1.1	**Innovation in Design**: Provide Specific Title	1
			Credit 1.2	**Innovation in Design**: Provide Specific Title	1
			Credit 1.3	**Innovation in Design**: Provide Specific Title	1
			Credit 1.4	**Innovation in Design**: Provide Specific Title	1
			Credit 2	**LEED™ Accredited Professional**	1

Yes	?	No	Project Totals (pre-certification estimates)	69 Points

Certified 26-32 points **Silver** 33-38 points **Gold** 39-51 points **Platinum** 52-69 points

Appendix VI: LEED-NCSC Registered Project Checklist

LEED-NCSC Version 2.1 Registered Project Checklist

<< enter project name >>
<< enter city, state, other details >>

Yes	?	No		Sustainable Sites	7 Points
Y			Prereq 1	**Erosion & Sedimentation Control**	Required
			Credit 1	**Site Selection**	1
			Credit 2	**Development Density**	1
			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
			Credit 4.4	**Alternative Transportation**, Parking Capacity and Carpooling	1
			Credit 5.1	**Reduced Site Disturbance**, Protect or Restore Open Space	1
			Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands**, Non-Roof	1
			Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands**, Roof	1

Yes	?	No		Water Efficiency	2 Points
			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
			Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Yes	?	No		Energy & Atmosphere	6 Points
Y			Prereq 1	**Fundamental Building Systems Commissioning**	Required
Y			Prereq 2	**Minimum Energy Performance**	Required
Y			Prereq 3	**CFC Reduction in HVAC&R Equipment**	Required
			Credit 1	**Optimize Energy Performance**	1
			Credit 2.1	**Renewable Energy**, 5%	1
			Credit 2.2	**Renewable Energy**, 10%	1
			Credit 2.3	**Renewable Energy**, 20%	1
			Credit 3	**Additional Commissioning**	1
			Credit 5	**Measurement & Verification**	1

Yes	?	No		Materials & Resources	6 Points
Y			Prereq 1	**Storage & Collection of Recyclables**	Required
			Credit 3.1	**Resource Reuse**, Specify 5%	1
			Credit 3.2	**Resource Reuse**, Specify 10%	1
			Credit 5.1	**Local/Regional Materials**, 20% Manufactured Locally	1
			Credit 5.2	**Local/Regional Materials**, of 20% Above, 50% Harvested Locally	1
			Credit 6	**Rapidly Renewable Materials**	1
			Credit 7	**Certified Wood**	1

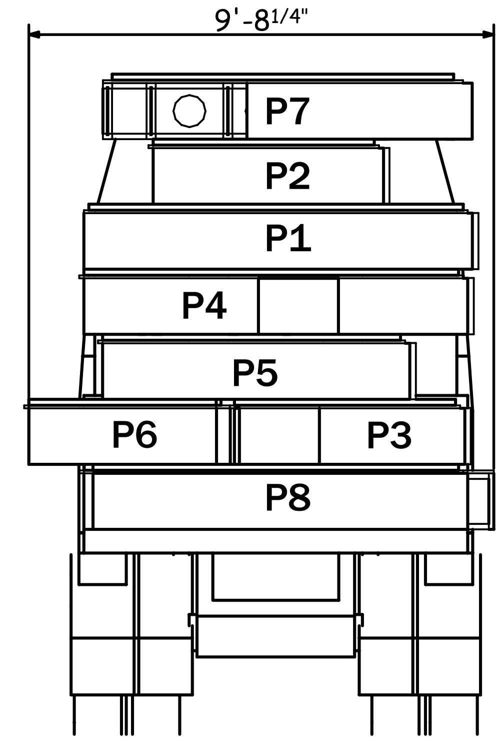
continued…

			Indoor Environmental Quality		**14** Points
Y			Prereq 1	**Minimum IAQ Performance**	Required
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required
			Credit 1	**Carbon Dioxide** (CO_2) **Monitoring**	1
			Credit 2	**Ventilation Effectiveness**	1
			Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
			Credit 4.2	**Low-Emitting Materials**, Paints	1
			Credit 4.3	**Low-Emitting Materials**, Carpet	1
			Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber	1
			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
			Credit 6.1	**Controllability of Systems**, Perimeter	1
			Credit 6.2	**Controllability of Systems**, Non-Perimeter	1
			Credit 7.1	**Thermal Comfort**, Comply with ASHRAE 55-1992	1
			Credit 7.2	**Thermal Comfort**, Permanent Monitoring System	1
			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
			Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1
Yes	?	No			
			Innovation & Design Process		**5** Points
			Credit 2	**LEED™ Accredited Professional**	1
Yes	?	No			
			Project Totals **(pre-certification estimates)**		**36** Points

Must meet all of the above points to obtain certification.

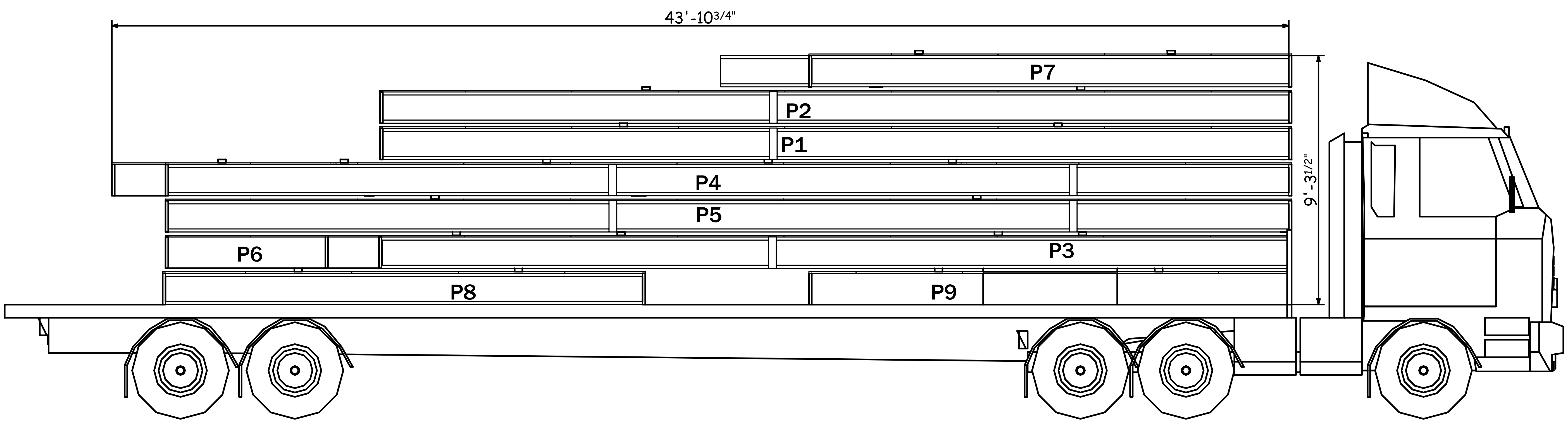
Appendix VII: Panelized Floor System Truck Stacking Plan

Note: Truck stacking is shown assuming just-in-time delivery of truck where installation will occur directly from the truck.
If delivery is NOT just-in-time, the jobsite stack should approximately match the stacking on this sheet.



NOTE:
THESE PANELS MUST E RE-STACKED BEFORE CRANE INSTALLATION.

1R Rear view (Model)
1/4" = 1'-0"



1S Side view (Model)
1/4" = 1'-0"

Saved: nugentt 2/15/2005

PREPARED BY
TrusJoist
A Weyerhaeuser Business
FRAMEWORKS EPS
2910 E. AMITY RD. BOISE, ID. 83687
PHONE: 800-338-0515 FAX: 208-364-3652
www.trusjoist.com

This layout and associated material list has been prepared based on project plans and/or information provided to Weyerhaeuser Company. It remains the responsibilty of lumber dealer, builder, architect, designer or other responsible person to review this information to assure that it is appropriate, accurate and complete.

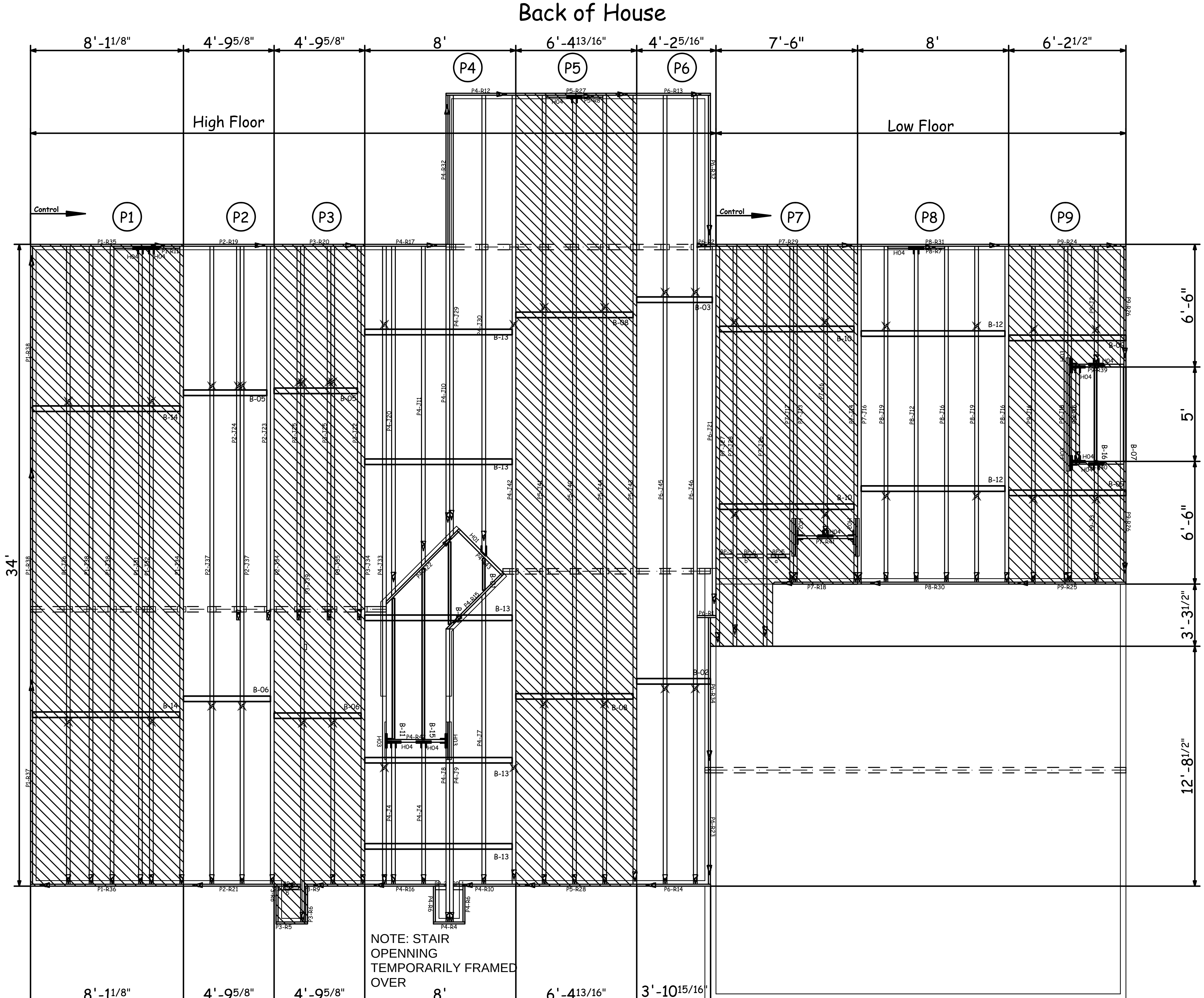
PREPARED BY:
DATE:
LATEST REVISION:
DRAWINGS APPROVED:

Stanley Martin Compnaies
Lot 41 Moncure Woods (1st Floor)
Panel Stacking Plan

DRAWN BY	CHECKED BY	STRUCTURAL REVIEW BY	RELEASE DATE	JOB NUMBER
TJN		---	2-15-05	198361-1

REV	BY	DATE	COMMENTS
1			
2			
3			
4			
5			

SHEET
EPS01



Step	Build	Offload	Push
1	High Floor	High Floor	High Floor
2	P1 & P2		
3		P1	P2
4	P3		
5		P2	P3
6	P4		
7		P3	P4
8	P5 & P6		
9		P4, P5 & P6	
10	Low Floor	Low Floor	Low Floor
11	P7 & P8		
12		P7	P8
13	P9		
14		P8 & P9	

Panel Break Plan

3/16"= 1'-0"

NOTE: THIS DRAWING ALSO REPRESENTS THE FIRST FLOOR JOIST FRAMING PLAN

Saved: nugentt 2/15/2005

PREPARED BY
TrusJoist A Weyerhaeuser Business
FRAMEWORKS EPS
2910 E. AMITY RD. BOISE, ID. 83687
PHONE: 800-338-0515 FAX: 208-364-3652
www.trusjoist.com

This layout and associated material list has been prepared based on project plans and/or information provided to Weyerhaeuser Company. It remains the responsibilty of lumber dealer, builder, architect, designer or other responsible person to review this information to assure that it is appropriate, accurate and complete.

PREPARED BY:
DATE:
DRAWINGS APPROVED:
LATEST REVISION:

Stanley Martin Compnaies
Lot 41 Moncure Woods (1st Floor)
Panel Break Plan (First Floor)

DRAWN BY	CHECKED BY	STRUCTURAL REVIEW BY	RELEASE DATE	JOB NUMBER
TJN		---	2-15-05	198361-1

REV	BY	DATE	COMMENTS
1			
2			
3			
4			
5			

SHEET
2.0A

Ship to: **Stanley Martin Compnaies**
Lot: Lot 41 Moncure Woods (1st Floor)
Date Written: ______

Order Number: 198361-1
Ship date: ______
Driver: ______

Thank you for using Structural Systems Inc. floor panels! We appreciate your business.

House Type: ______
Elevation #: ______
Options: ______

Floor panels included in this truck: **2/15/2005** 1:25:50 PM

Panel	Total Weight	Max Length	Max Width	Max Depth	Total Area	Loaded	Delivered
1	1545 lbs.	34'	8'-1 3/16"	19 1/4"	275 sq ft	[ ]	[ ]
2	879 lbs.	34'	4'-9 5/8"	19 1/4"	163 sq ft	[ ]	[ ]
3	986 lbs.	36'	4'-9 5/8"	19 1/4"	166 sq ft	[ ]	[ ]
4	1735 lbs.	44'	8'	19 1/4"	305 sq ft	[ ]	[ ]
5	1238 lbs.	42'	6'-4 13/16"	19 1/4"	269 sq ft	[ ]	[ ]
6	890 lbs.	42'	4'-2 3/8"	19 1/4"	170 sq ft	[ ]	[ ]
7	893 lbs.	21'-3 1/2"	7'-9 1/2"	19 1/4"	145 sq ft	[ ]	[ ]
8	713 lbs.	18'-1/8"	8'	19 1/4"	144 sq ft	[ ]	[ ]
9	634 lbs.	18'	6'-2 1/2"	19 1/4"	486 sq ft	[ ]	[ ]

Loose Material included on this truck: **2/15/2005** 1:25:49 PM

MARK	QTY	LENGTH	PRODUCT	Loaded	Delivered
				[ ]	[ ]
				[ ]	[ ]
				[ ]	[ ]
Product: 14" TJI 230					
J5	1	8'-0"	14" TJI 230	[ ]	[ ]
Product: 1 1/4" x 14" TJ-Strand Rim Board					
R33	1	8'-0"	1 1/4" x 14" TJ-Strand Rim Board	[ ]	[ ]
Product: 1 3/4" x 14" TimberStrand 1.7E					
R45	1	7'-1 1/16"	1 3/4" x 14" TimberStrand 1.7E	[ ]	[ ]
R44	1	7'-1 1/16"	1 3/4" x 14" TimberStrand 1.7E	[ ]	[ ]
R46	1	8'-0"	1 3/4" x 14" TimberStrand 1.7E	[ ]	[ ]

Sheathing List **2/15/2005**

Qty	Mark	Sheet type
23/32" Structurwood Edge Gold (24" Span Rating)		
1	Sht.1	Rect:0 3/4" x 39 1/2" x 39 1/2"

Installation Drawings:

PRODUCT	Loaded	Delivered
Installation Drawings	[ ]	[ ]

By accepting delivery of the above products, the builder accepts the terms and conditions of the proposal for this project.
The above products have been placed in a location selected by the builder [ ] Yes [ ] No
The Installation and Product Placement drawings have been included with this delivery [ ] Yes [ ]No
Structural Systems Inc. will not be responsible for any discrepancy which has been reported to the sales person within 48 hours following receipt of materials.
Call (800) 800-7414 Fax (301)271-3733

Material recieved by: Date: SSI Driver:

PREPARED BY
TrusJoist® A Weyerhaeuser Business
FRAMEWORKS EPS
2910 E. AMITY RD. BOISE, ID. 83687
PHONE: 800-338-0515 FAX: 208-364-3652
www.trusjoist.com

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PREPARED BY:
DATE: LATEST REVISION:
DRAWINGS APPROVED:

Stanley Martin Compnaies
Lot 41 Moncure Woods (1st Floor)
Shipping Confirmation

DRAWN BY	CHECKED BY	STRUCTURAL REVIEW BY	RELEASE DATE	JOB NUMBER
TJN		---	2-15-05	198361-1

REV	BY	DATE	COMMENTS
1			
2			
3			
4			
5			

SHEET
SCS1

Appendix VIII: Panelized Floor Connection Detail

SAFETY FIRST !

Hooks

Do not exceed rated capacity.
Manufacturer's identification shall be forged, cast, or die stamped on a low stress & nonwearing area of the hook.
Approved rigging hooks shall be made from a material which has sufficient ductility to permanently deform.
Hook latches required except on grab and sorting hooks.
Hook capacities apply when pulled staight in line.
Consult manufacturer before angle loading hooks.
Avoid shockloading.
Do not back-load, side-load or tip-load hooks. Only sorting hooks may be tip-loaded.
Place load or sling(s) centered in the base of the hook to prevent point loading.
Do not place small sling eyes on large hooks.
Do not allow any throat closing device to carry the load.
Hands, fingers, & body shall be kept from between hook & load.

Remove if:

- Bending or twisting exceeding 10° from the plane of an unbent hook
- Increase in throat opening exceeding 15%
- Wear exceeds 10% of the original cross sectional dimension
- Hook latch is inoperative or missing if provided
- Cracks, nicks, gouges
- Damaged hook attachment or securing means
- Manufacturer's identification is missing or not legible
- Heat damaged or weld splattered

Other visible damage that causes doubt as to the integrity of the hook

Web Slings

Do not exceed rated capacity.
Do not use knots to form eyes.
Manufacturers stitching is the only acceptable method to attach end fittings and form eyes.
Fittings shall be of minimum breaking strength equal to that of the sling.
Slings shall be permanently marked with manufacturers name, code number, rated load for type of hitches and type of synthetic material.
Use softeners/padding between sharp edges and sling.
Do not drag slings. Do not pull slings from under loads.
Place sling(s) in center bowl of hook.
Calculate additional tension due to angles
Do not shorten or lengthen slings using knots.
Store slings by hanging in a cool dry location.

Remove if:

- Evidence of heat damage
- Acid or caustic burns
- Snags ◆ Punctures
- Tears or cuts ◆ Crushing
- Abrasion/wear
- Distortion of fittings
- Broken or worn stitches
- No tag or illegible tag
- Damaged end attachments
- Knots in any part of sling
- UV/sunlight degradation
- Excessive pitting or corrosion, cracked, distorted or broken fittings
- Other visible damage that causes doubt as to strength of sling
- Sling eye has opened up

Fabrication

Reference Framer's Pocket Guide and drawings for fabrication details
Reference Panel Detail Sheets (P1-P_) for layout, member schedules.

Installation Sequence

Install field set beams prior to installing floor panels.
Install straps to top of wall or beam prior to installing floor panels.
Reference Panel Stacking Plan (EPS01) for installation order

Panel Lifting

Do not use reach lifts for installing panels. Crane only.
Check straps, slings and hooks for damage prior to lifting. Replace if worn.
Never stand below panels during installation.
Keep equipment and personnel clear of crane swing.
Recycle straps and hooks or bridles from installed panel to next in sequence.

Typical Connections

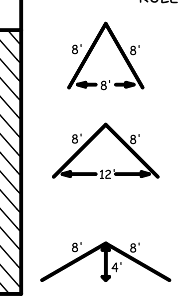
1. Panel to wall
   Toe nails 12d @ 16" o.c., UON
2. Panel to panel
   Flying Edge to Split Edge
   -Glue & Edge Nail 10d @ 6" o.c., UON
3. Panel to beam
   Beams may be field installed prior to or during panel installation, per TJ PanelMate drawings
4. Panel to interior bearing
   Fasten TJI blocking/joists to bearing wall w/ 12d staggered @ 12"o.c.,UON
5. Straps to panel, as noted in permit drawings
   CS, ST, LST, MST

Load Angle Factors - Sling Stress

SLING ANGLE	L.A.F. PER LEG	SLING ANGLE	L.A.F. PER LEG
90	1.000	45	1.414
85	1.004	40	1.555
80	1.015	35	1.742
75	1.035	30	2.000
70	1.064	25	2.364
65	1.104	20	2.924
60	1.155	15	3.861
55	1.221	10	5.747
50	1.305	05	11.49

DANGER

RULES



When the distance between the slings is equal to the sling length, sling angle is 60

CAUTION:
When the slings are 1 1/2 times as far apart as the sling length, sling angle is 45.

DANGER:
When the slings are twice as long as the hook height, sling angle is 30.

Field Installation

PANEL SUPPORTS
Supporting walls and dropped beams shall be correctly located, level, plumb, square, and flat prior to floor installation.

TJI JOISTS
Each TJI® joist in a floor panel shall be fastened to the supporting bearing wall or drop beam with one 10d (3 inch) box or 12d (3 ¼ inch) box nail each side of joist spaced 1-1/2 inches minimum from end to minimize splitting, unless noted otherwise on the Panel Fabrication Plans.
Where hangers support TJI® joists, follow hanger manufacturer recommendations.

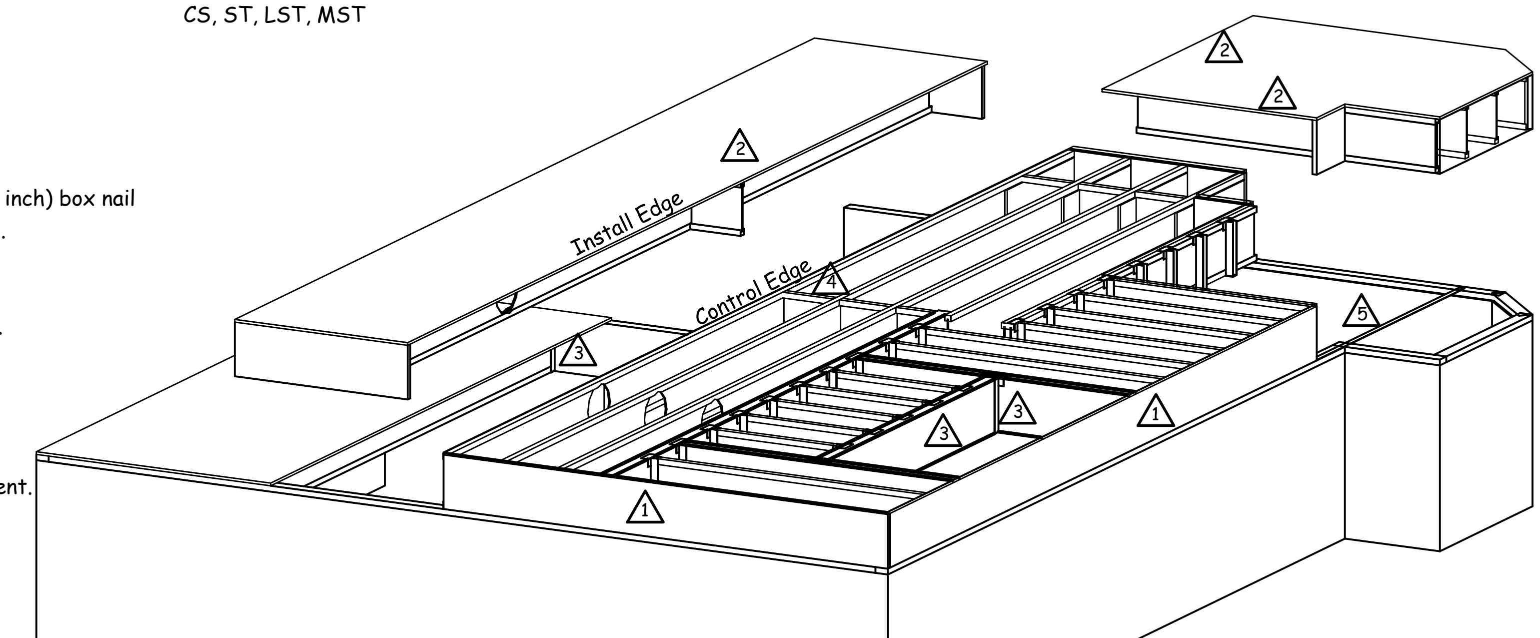
TIMBERSTRAND OR TJ-STRAND RIM BOARDS
The rim boards of a floor panel shall be fastened to the wall plates and/or dropped beam as specified in the Panel Fabrication Plans.
If there is no specified requirement, then the rim board shall be fastened with toenails to the top plate of the supporting wall with 12d (min) box nails at 16 inches on center or per local code requirements, which ever is more stringent.

WOOD PLATES
Wood plate connections shall be per Panel Fabrication Plans. If no detail is present on the plans, then fasten to the supporting wall or dropped beam with 16d box nails at 16 inches on center or per local code requirements, which ever is more stringent.

BEAMS
Beam connections shall be per the Panel Fabrication Plans. If no detail is present on the plans then refer to the TJ Pocket Guide and permit drawings.

FLOOR PANELS
The floor sheathing of a floor panel shall be glued and nailed to the top of the adjacent panel's joist and/or beam. The nail/screw pattern shall be per the Installation drawing or 6 inches on center; which ever is more stringent. Nail/screw size shall match those used to fabricate the panels. (Consult fabricator)

PANEL OPENINGS
Edge of floor panels shall have a barrier to prevent falling after floor is complete. Barriers include, but are not limited to walls (bearing or partitions), pony walls, temporary guard rails, and a temporary cover over the opening capable of carrying a live load of 40 pounds per square foot or 250 pounds, which ever is greater. If a cover is used, the cover shall be marked to highlight any potential trip hazards.



Saved: nugentt 2/15/2005

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PREPARED BY:
DATE:
LATEST REVISION:
DRAWINGS APPROVED:

Stanley Martin Compnaies
Lot 41 Moncure Woods (1st Floor)
Panel Fabrication Plans

DRAWN BY	CHECKED BY	STRUCTURAL REVIEW BY	RELEASE DATE	JOB NUMBER
TJN		---	2-15-05	198361-1

REV	BY	DATE	COMMENTS
1			
2			
3			
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5			

SHEET
CVR

Appendix IX: Senior Citizen Design Interview

Senior Citizen Design Interview

Interviewee: ___________________________

Date: ____________________

1. What is the design process of an elderly facility?

2. What are typical sizes of buildings?

3. What are the different types of senior facilities?

4. What are design elements specific to the different facilities?

5. What are the design features that differ from a typical apartment building?

Appendix X: Panelized Floor System Interview

Panelized Floor System Interview

Interviewee: ___________________________

Date: ____________________

1. How is the process sequenced?

2. How are trades sequenced?

3. Are the panels cut for MEP work?

4. What are the type sizes of the panels?

5. What size crane is needed?

6. How long is fabrication?

7. How much can one truck hold?

8. What are some advantages?

9. What are some disadvantages?