IPRO 359 Final Report

Development of the Michael Reese Continued Living Community

Executive Summary

The goal for the team this semester was to rehabilitate the 37 acre area of what remains of the Michal Reese Hospital Campus. Seeing as Chicago lost the bid for the 2016 Olympics, the site has fallen into disrepair and the city is frantically looking for a solution. Thus a solution was developed that would not only benefit the City of Chicago but also the community surrounding the site. The IPRO's work of the previous semester was used as the anchor that would be supplemented by other programmatic features that would contribute to the Bronzeville community. With this in mind, the development would be based on the idea of a continued living community that would interest those that are close to retirement or already retired. The continued living community would be based in two high rise buildings that would offer a variety of units including 800 sq ft studios, 1200 sq ft one bedrooms, as well as 1600 sq ft two bedrooms. These would provide the residents with all the amenities necessary to live comfortably with possibility of having assisted living as they progress in age. Assisted living would provide help for those who have difficulty completing everyday tasks. If necessary the investor has access to an onsite facility that would provide them well hospital-like amenities.

Purpose and Objectives

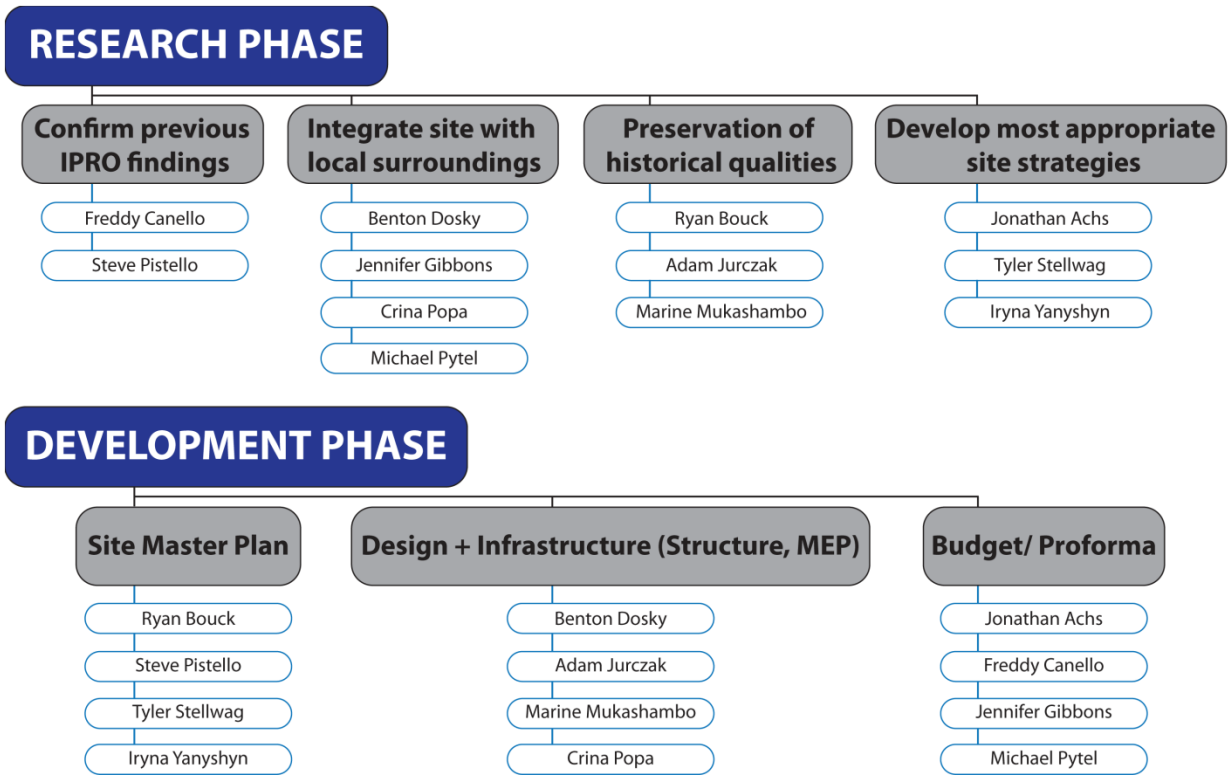
The objective of IPRO 359 was to use the Continued Living concept as an anchor to create a residential community within the site, which is integrated into the surrounding area through mixed-use spaces that will serve the exterior communities and the interior Continued Living Community.

Going into the semester, the team set the following goals for itself:

i. Confirm the findings of the previous IPRO
ii. Integrate site into the surrounding neighborhood to meet residents needs
iii. Maintain the historical preservation of the site
iv. Determine best combination of commercial/residential/other buildings

Team Organization and Approach

It would be best for the team to be broken down into subgroups to ease the research and create the best results. The first half of the semester consisted of a research phase which consisted of confirming the findings if the previous IPRO, integrating the site with local surroundings, preservation of historical qualities and developing the most appropriate site strategies. During the second part of the semester, the research was used in the design of the project which called for a master plan that would integrate the design and infrastructure that would ultimately be financially feasible as well as beneficial for not only the investors but the City of Chicago as well.



A table of the task chart we created can be seen in the Appendix. The focus of organizing our tasks was to ensure that all tasks were overlapping and that the groups didn't focus on only one area of the project at a time. This plan helped get more work done more efficiently while ensuring that each team member was able to contribute to the progress.

Analysis and Findings

The Master Plan was designed with an attitude to reintroduce the city grid and create a new major N/S artery in Cottage Grove Ave. To further subdivide the site, 26th Street, 29th Street, and 30th Street were extended through the site, creating 6 distinct city blocks within the site's boundaries. From there, single lane roads, alleyways, and pedestrian ways were added to provide desired building pads. The pedestrian ways are placed not along the high traffic roads, but tucked between the buildings creating a plaza that maximizes building frontage that helps to ensure its use. Green space along Cottage Grove is intended to pull the users either into the site or into the inner plazas. The site's interior plaza approach allows for the proper building density along Cottage Grove, while still creating an attractive building/green space relationship.

Program within the site was designed in a way to best integrate the new site with its existing surroundings. The 6 blocks help to divide the site's program as well. The block which shares no edge with the existing community is the location of the Continued Living Community. By placing the community in the center, the other 5 blocks create a buffer of office, residential, and retail program to be used both by the Continued Living Community and the surrounding neighborhoods alike. The site's program was also heavily influenced by major marketable attractions nearby. These include McCormick Place, the proposed Marina near 31st Street, the Prairie Shores Community, the 26th Street South Line Metra Stop, and the Lake Meadows new master plan.

In the Continued Living Community on the former Michael Reese Campus, we were able to save one of the last Walter Gropius' structures, the Singer Pavilion. The Singer Pavilion offers the ideal building layout for the programmatic requirements of a small intensive care unit while also offering its residents beautiful views of the streetlife and private courtyards. Two high-rise buildings were added for the independent and assisted living portions of the continued living community. Both high-rises are named after previous buildings that once stood there, Kaplan Pavilion to the east and Baumgarten Pavilion to the north. Both buildings offer a variety of living options: two bedroom at 1600 square feet; one bedroom at 1200 square feet; studio at 800 square feet. The buildings are designed to provide comfort, excitement, and enrich the lives of the residents. Abundant services welcome residents and visitors with spacious lobbies, food markets, and fine dining overlooking the outdoor gardens. The layout of the community is designed to offer flexibility for those who wish to be among others of similar age who wish to maintain their personal independence, while having assistance with the smaller tasks in life easily available. The configuration of the buildings creates premium lakefront and city views for the residents. The block for the community was not only planned for its views but also to coexist with the master plan which retains the Chicago grid. This creates a city high-rise streetscape along Cottage Grove and 29th while developing open recreational park space for the community's residences on the interior portion of the block. This solution also preserves the historic value of the site, which offers successful and enjoyable interior park space.

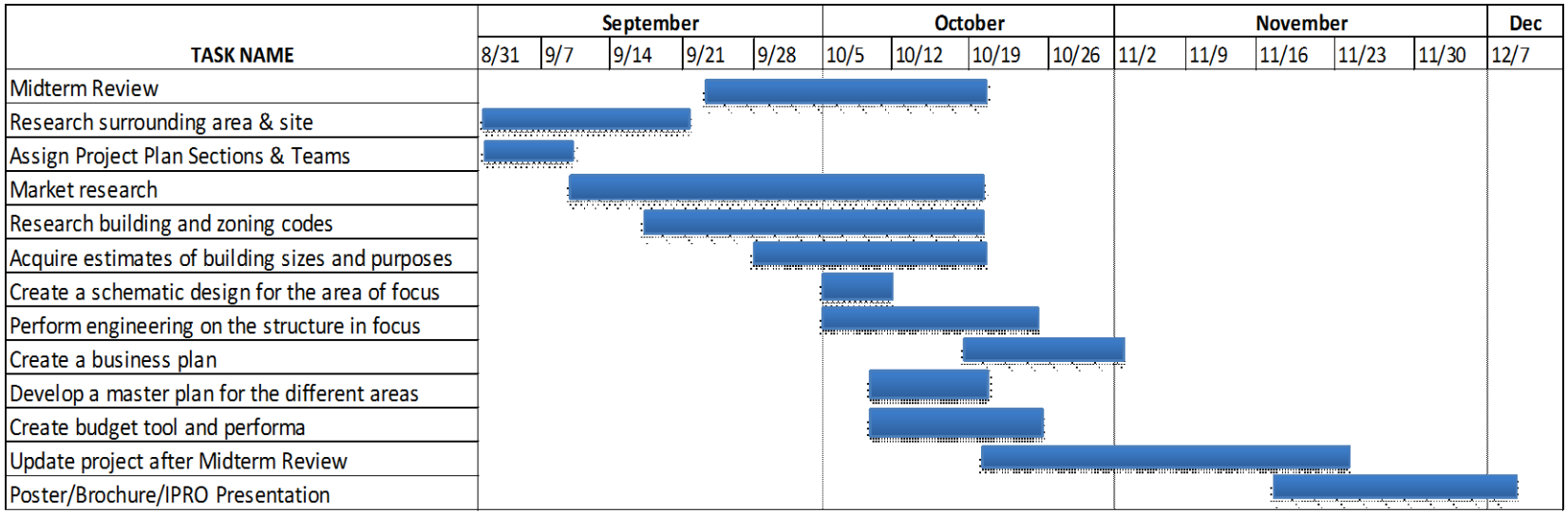
The project budget and proforma was based upon projected expenses and incomes around the date of completion. With current assumptions, the expected profits can pay off the bank loans and the interest on said loans within 8.5 years. We opted to create an amortization schedule for 15 years; with a 15 year loan payoff, excess profits may be used towards further maintenance or growth opportunities. The project may be phased easily as well, which would further aid in obtaining loans and profit may then be used as equity towards subsequent phases or developments on the site.

Conclusions and Recommendations

In order to preserve one of the last Walter Gropius' structures, the Singer Pavilion, the Michael Reese Continued Living Community was designed to best suit the demands of the site and surrounding neighborhoods. The focus of our site plan was to create a community that incorporates the Chicago city design, attracts the surrounding neighborhoods, and creates an environment that benefits all types of ages and individuals. The continued living community shows a promising new potential market and the surrounding buildings (i.e. retail, apartments, hotel, etc.) provide a promising market that includes the surrounding neighborhood and city. A couple of key markets that we focused on outside of the directly surrounding neighborhoods were McCormick Place and the new 31st St. Marina. After market research, we were able to design the site plan to create a beneficial investment as well as a competitive continued living community. Our site plan shows a detailed description of the continued living community and surrounding structures. As a team, we were able to work together to produce a design that we believe would satisfy investors as well as city officials.

Future members of this IPRO will have the chance to perfect the business model and tweak the master plan, in response to feedback from city officials that are familiar with the site and have ideas about possible attractions and amenities that can be beneficial to the site and the surrounding community.

Appendix


TASK NAME
September
October
November
Dec
8/31
9/7
9/14
9/21
9/28
10/5
10/12
10/19
10/26
11/2
11/9
11/16
11/23
11/30
12/7
Midterm Review
Research surrounding area & site
Assign Project Plan Sections & Teams
Market research
Research building and zoning codes
Acquire estimates of building sizes and purposes
Create a schematic design for the area of focus
Perform engineering on the structure in focus
Create a business plan
Develop a master plan for the different areas
Create budget tool and performa
Update project after Midterm Review
Poster/Brochure/IPRO Presentation
Table Key
Team Task Progress

Faculty & Advisors: Steve Beck, Dr. Bill Pashcal, Dr. Mark Snyder

Student Members: Jonathan Achs, Ryan Bouck, Freddy Canello, Benton Dosky, Jennifer Gibbons, Adam Jurczak, Marine Mukashambo, Steve Pistello, Crina Popa, Michael Pytel, Tyler Stellwag, Iryna Yanyshyn

Illinois Institute of Technology

IPRO 359 - Redesign of the Michael Reese Campus: Capstone Report

Prepared by: Benton Dosky, Jennifer Gibbons, Freddy Canelo

December 6, 2010

Illinois Institute of Technology

Structural Design

Completed by Jennifer Gibbons

Approach

The proposed Independent Living Building is an L-shaped building of 26 stories; 4 floors of indoor garage parking and 22 floors of independent living condo-style units. First, a decision matrix was used to decide what type of structural system should be used. The two systems compared were A. a steel frame system with concrete decking, and B. reinforced concrete structure. The steel frame system was found to be more cost-effective and offered a shorter build time, among other things. Please see Appendix 1.1 for the Decision Matrix. Once the system was decided on, a column and beam layout was created. Once the layout was complete, the members could be designed based on loads calculated.

Methodology

Once the structural system was decided on, the column layout was created with spans between columns of 28'8", 35' and 36', depending on location in the building. Please see Appendix 1.3 for the column and beam layouts. The dead and live loads were calculated and applied to each respective column or beam member. Connections were assumed to be moment connections and the members were designed accordingly, using the AISC Steel Construction Manual. First the beams were designed, using the Table 3-6: Maximum Total Uniform Load (kips) and using the worst-case load combination. Once the beam members were sized, the columns were designed using the worst-case load combinations and the beam W section, but with different tributary areas (A.t). The beam weights were also taken into account in the column design. Using Table 4-1: Available Strength in Axial Compression (kips), a column section was assumed and then checked using section properties from Table 1-1: W Shapes to determine whether or not the assumed W section would be safe. Please see Appendix 1.2 for calculations and analysis.

Cost Analysis

A structural estimate was completed in order to determine up-front cost for the structural system, including: concrete needed for slab decks, steel columns, steel beams, welding services, and reinforcing bars. Please see Appendix 1.4 for the line-item estimate.

Conclusion

The beam section was calculated to be W12x210, but the weight could have been lessened if the beam spans had been shortened. The column section was calculated to be W12x40. The final line-item estimate for the structural system was $40,091,479.98.

Plumbing Design

Completed by Freddy Canelo

Approach

The focus of plumbing was to achieve a system that reduced water consumption, thereby lowering operational costs. The model used to achieve this was LEED-2009 Water Efficiency Prerequisite 1 and Credit 3.

Methodology

A reduction in water consumption is sought to (1) lower operational costs and (2) to possibly obtain LEED points. The decrease in operational costs was counteracted by an increase of initial costs. Two types of water reduction were taken into account, the use of reduced flow plumbing fixtures and the introduction of a gray water reuse system. The water reduction and changes in cost were determined with respect to the baseline as found in LEED – 2009. The baseline water consumption for each of the three types of residential units (studio, 1 bed, and 2 bed) were calculated individually and their results added together via a multipage excel spreadsheet. Reduced consumption values were obtained in a similar fashion.

Water Consumption calculations followed the model of [(FTE (Full Time Equivalent Occupancy)) × (consumption (gpm)) × (duration (min)) × (uses/day) × (365.25 Day/yr)]. Information on usage was obtained from the USGBC (United States Green Building Code).Please see Appendix 2.1 for Residential Default Fixture Uses and Residential FTE Assumptions.

Where reduced fixtures were introduced water consumption was calculated in exactly the same fashion, however the fixtures had lower gpm/gpf rates. Where the gray water reuse system was introduced, it was designed so as to collect shower gray water and use to supply water closets after going through a filtration system.

* All fixtures and the gray water reuse system are listed at the end of the plumbing section.

Cost Analysis

Operational costs (water supply and sewer costs) calculations were of the form [water consumption (kgal/yr) × (price of water + price of sewer)]. These calculations are included on the sheets that calculate water consumption. An example is shown in Appendix 2.2. Initial cost calculations were of the form [Σ(Qty. of a fixture/unit) × (# of units) × (price/fixture)]. Where the gray water reuse system was used its additional initial cost was obtained from [(wc consumption) / (capacity/unit) × (price/unit)]. Examples of each calculation are shown in Appendix 2.2. As is seen from the fixtures list in Appendix 2.1, all reduced fixtures, except lavatories, have no increased initial costs for using lower flow. As a result, only three major combinations were observed.

From the overview using low flow fixtures can only reach sufficient water use reduction to reach the 20% required when attempting LEED certification, but allowed for a sub 10 year breakeven point. The introduction of the gray water reuse system greatly improved water consumption. Where the lavatory reduction was not included, howev-

er, water reduction was not sufficient to earn WE Credit 3 points. A major tradeoff occurs when lavatory reduction is introduced and increases water consumption by over 7%, allowing for the system to earn 3 points, but increases breakeven point by almost 3 years, passing the 10 year mark.

Conclusion

The scope of this analysis was to observe different options for reducing operating costs, and their effects on the initial cost. Because of this, the gray water reuse system was included. It is important to note that currently the City of Chicago does not allow such systems to be used within residential buildings, therefore in the scope of the IPRO itself, which deals directly with the City of Chicago, only the first option could be used. In general, for someone who is looking for a relatively quick breakeven point and not so much obtaining LEED credits, the first option would be best suited. For someone who is attempting to obtain LEED Credits, the last option would be best suited.

HVAC Design

Completed by Freddy Canelo and Benton Dosky

Approach

The focus of HVAC was to establish the minimum level of energy efficiency for the building and its HVAC systems to reduce the environmental and economic impact associated with the HVAC systems. The model used to achieve this was LEED-2009 Energy and Atmosphere Prerequisite 2 and Credit 1.

Methodology

An increase in building efficiency due to improved HVAC system is sought to (1) lower operational cost and (2) to possibly obtain LEED points. Following LEED-2009, the building was modeled using a building load modeling software. eQuest 3-64 was chosen because of its simple user interface and considering that the building was not pending construction, thus it served as an estimation software more than a specific modeling software. The software had ASHRAE 90.1 preinstalled, thus all HVAC simulations were to be automatically modeled to the baseline. The Independent Living building was modeled within the software (a screenshot is shown in Appendix 3.1) with simple assumed rates, e.g. basic steel construction, board insulation, and generic windows. A combination direct expansion coil cooling and heat pump heating package (PTHP) system was used due to the abundance of systems available on the market, and relatively high efficiency. After modeling, systems of varying efficiencies were defined and modeled with respect to the baseline. The list of the PTHP systems defined and their energy load percent reduction is given in the form of an excel spreadsheet in Appendix 3.2.

Cost Analysis

With the energy consumption rates obtained from eQuest, operational costs were defined in, and analyzed via, an excel spreadsheet annually for both the building and the individual types of residential units (studio, 1 bed, and 2 bed) based on a square foot energy consumption [(cost/energy × total energy) / total ventilated square feet]. Note that the median system (System 5) was used for no particular reason despite the fact that one needed to be selected so as to continue the calculations; any system could easily be selected if desired. Because of the relatively high operational costs, an option was included to allow for a monthly electrical utility fee based on residential unit type (these can be directly manipulated). The cost analysis spreadsheet is shown in Appendix 3.3. Initial cost data, despite having the exact units selected and defined, were not included because pricing information was not available.

Conclusion

The scope of this analysis was to model the buildings efficiency using different heating and cooling systems and types and to observe the affects each had, while trying to maximize the improvement from the baseline. All assumptions were held constant so that the changes solely reflected the change in HVAC systems in the simulation run. As is seen in Appendix 3.2, up to 18% reduction can be obtained from using a more efficient HVAC system alone, qualifying for up to 4 points in LEED A&E Credit 1 when put into that context. Also, as is seen in Appendix

3.3, by introducing monthly electrical utility fees to tenants, the operational cost to the owner can be greatly reduced.

Square-Foot Estimate

Completed by Jennifer Gibbons

Summary

A square-foot estimate was made in the RS Means CostWorks online software in order to develop a general idea of the total cost for the Independent Living Building. The total estimate was broken up in two sections: 4 floors of indoor parking garage and 22 floors of independent living. The RS Means CostWorks software does not have a built-in option for a independent living-type building, so the closest building type was used: a 4-28 story apartment building. Due to the general nature of the estimate itself, some special elements were not included and the resulting estimate is, therefore, slightly low. To account for these special elements and the fact that a different type of building was used for the independent living portion, a general percentage should be added to the total. The final square-foot estimate came to $149,046,500. After a 10% general percentage was added, the total becomes about $164,000,000. Please see Appendix 4.0 for more details on the estimate.

Appendix

APPENDIX 1.1: ***Structural System Decision Matrix***

	Steel Frame	Reinf. Concrete
Simplicity	9	8
Cost	9	9
Feasibility	10	9
Availability of local material	8	9
Time to build	8	6
Sustainability	7	9
Aesthetic	9	7
	60	57

*ranked 1-10, 10 being best

APPENDIX 1.2: *Column and Beam Sizing*

COLUMN	Beam L (ft)	Beam D (kips)	A.t (sf)	D (psf)	D (lbs)	L.o (psf)	L.r (lbs)	D (kips)	L.r (kips)	Total Load (kips)
1A	32.33	6.7893	258.4	90	23256	55	13275.48	30.05	13.28	57.30
1B	28.667	6.02007	516.8	90	46512	55	37523.59	52.53	37.52	123.08
1C	28.667	6.02007	516.8	90	46512	55	37523.59	52.53	37.52	123.08
1D	32.33	6.7893	258.4	90	23256	55	13275.48	30.05	13.28	57.30
2A	36	7.56	516.8	90	46512	55	18768.67	54.07	18.77	94.92
2B	28.667	6.02007	1033.5	90	93015	55	53058.11	99.04	53.06	203.74
2C	28.667	6.02007	1033.5	90	93015	55	53058.11	99.04	53.06	203.74
2D	36	7.56	516.8	90	46512	55	18768.67	54.07	18.77	94.92
3A	36	7.56	516.8	90	46512	55	18768.67	54.07	18.77	94.92
3B	28.667	6.02007	1033.5	90	93015	80	77175.43	99.04	77.18	242.32
3C	28.667	6.02007	1033.5	90	93015	80	77175.43	99.04	77.18	242.32
3D	36	7.56	516.8	90	46512	55	18768.67	54.07	18.77	94.92
4A	36	7.56	516.8	90	46512	55	18768.67	54.07	18.77	94.92
4B	28.667	6.02007	1033.5	90	93015	80	77175.43	99.04	77.18	242.32
4C	28.667	6.02007	1033.5	90	93015	80	77175.43	99.04	77.18	242.32
4D	36	7.56	516.8	90	46512	55	18768.67	54.07	18.77	94.92
5A	36	7.56	464.4	90	41796	55	17792.45	49.36	17.79	87.70
5B	28.667	6.02007	926.8	90	83412	80	73084.14	89.43	73.08	224.25
5C	28.667	6.02007	926.8	90	83412	80	73084.14	89.43	73.08	224.25
5D	64.167	13.47507	711.6	90	64044	55	22021.31	77.52	22.02	128.26
5E	49.33	10.3593	502.4	90	45216	55	18505.53	55.58	18.51	96.30
5F	49.33	10.3593	502.4	90	45216	55	18505.53	55.58	18.51	96.30
5G	49.33	10.3593	502.4	90	45216	55	18505.53	55.58	18.51	96.30
5H	31.83	6.6843	251.2	90	22608	55	13089.41	29.29	13.09	56.09
6A	43	9.03	411.2	90	37008	55	16743.16	46.04	16.74	82.03
6B	28.667	6.02007	820.6	90	73854	80	68770.68	79.87	68.77	205.88
6C	28.667	6.02007	820.6	90	73854	80	68770.68	79.87	68.77	205.88

6D	43	9.03	911.3	90	82017	80	72470.59	91.05	72.47	225.21
6E	28.667	6.02007	1002.6	90	90234	80	76013.26	96.25	76.01	237.13
6F	28.667	6.02007	1002.6	90	90234	80	76013.26	96.25	76.01	237.13
6G	28.667	6.02007	1002.6	90	90234	80	76013.26	96.25	76.01	237.13
6H	28.667	6.02007	501.3	90	45117	55	18485.28	51.14	18.49	90.94
7A	43	9.03	411.2	90	37008	55	16743.16	46.04	16.74	82.03
7B	28.667	6.02007	820.6	90	73854	80	68770.68	79.87	68.77	205.88
7C	28.667	6.02007	820.6	90	73854	80	68770.68	79.87	68.77	205.88
7D	43	9.03	911.3	90	82017	80	72470.59	91.05	72.47	225.21
7E	28.667	6.02007	1002.6	90	90234	80	76013.26	96.25	76.01	237.13
7F	28.667	6.02007	1002.6	90	90234	80	76013.26	96.25	76.01	237.13
7G	28.667	6.02007	1002.6	90	90234	80	76013.26	96.25	76.01	237.13
7H	28.667	6.02007	501.3	90	45117	55	18485.28	51.14	18.49	90.94
8A	28.667	6.02007	205.4	90	18486	55	11837.47	24.51	11.84	48.35
8B	28.667	6.02007	410	90	36900	55	16718.73	42.92	16.72	78.25
8C	28.667	6.02007	410	90	36900	55	16718.73	42.92	16.72	78.25
8D	46.167	9.69507	455.3	90	40977	55	17617.4	50.67	17.62	88.99
8E	35	7.35	1002.6	90	90234	55	26136.43	97.58	26.14	158.92
8F	35	7.35	1002.6	90	90234	55	26136.43	97.58	26.14	158.92
8G	35	7.35	1002.6	90	90234	55	26136.43	97.58	26.14	158.92
8H	31.83	6.6843	251.2	90	22608	55	13089.41	29.29	13.09	56.09

BEAM	Span (ft)	A.t (sf)	D (psf)	D (lbs)	L (psf)	L (lbs)	D (kips)	L (kips)	**Total Load (kips)**
Row 1:									
AB	28.667	387.6	90	34884	55	21318	34.884	21.318	75.9696
BC	28.667	516	90	46440	55	28380	46.44	28.38	101.136
CD	28.667	387.6	90	34884	55	21318	34.884	21.318	75.9696
Row 2:									
AB	28.667	774.8	90	69732	55	42614	69.732	42.614	151.8608
BC	28.667	1032	90	92880	80	82560	92.88	82.56	243.552
CD	28.667	774.8	90	69732	55	42614	69.732	42.614	151.8608
Row 3:									

AB	28.667	774.8	90	69732	55	42614	69.732	42.614	151.8608
BC	28.667	1032	90	92880	80	82560	92.88	82.56	243.552
CD	28.667	774.8	90	69732	55	42614	69.732	42.614	151.8608
Row 4:									
AB	28.667	774.8	90	69732	55	42614	69.732	42.614	151.8608
BC	28.667	1032	90	92880	80	82560	92.88	82.56	243.552
CD	28.667	774.8	90	69732	55	42614	69.732	42.614	151.8608
Row 5:									
AB	28.667	696	90	62640	55	38280	62.64	38.28	136.416
BC	28.667	924.1	90	83169	80	73928	83.169	73.928	218.0876
CD	28.667	696	90	62640	55	38280	62.64	38.28	136.416
DE	35	251.2	90	22608	55	13816	22.608	13.816	49.2352
EF	35	251.2	90	22608	55	13816	22.608	13.816	49.2352
FG	35	251.2	90	22608	55	13816	22.608	13.816	49.2352
GH	35	251.2	90	22608	55	13816	22.608	13.816	49.2352
Row 6:									
AB	28.667	619	90	55710	55	34045	55.71	34.045	121.324
BC	28.667	823.6	90	74124	80	65888	74.124	65.888	194.3696
CD	28.667	619	90	55710	55	34045	55.71	34.045	121.324
Row 7:									
AB	28.667	619	90	55710	55	34045	55.71	34.045	121.324
BC	28.667	823.6	90	74124	80	65888	74.124	65.888	194.3696
CD	28.667	619	90	55710	55	34045	55.71	34.045	121.324
Row 8:									
AB	28.667	308.2	90	27738	55	16951	27.738	16.951	60.4072
BC	28.667	410.3	90	36927	55	22566.5	36.927	22.5665	80.4188
CD	28.667	308.2	90	27738	55	16951	27.738	16.951	60.4072
DE	35	251.2	90	22608	55	13816	22.608	13.816	49.2352
EF	35	251.2	90	22608	55	13816	22.608	13.816	49.2352
FG	35	251.2	90	22608	55	13816	22.608	13.816	49.2352
GH	35	251.2	90	22608	55	13816	22.608	13.816	49.2352
Column A:									
1-2	36	258.4	90	23256	55	14212	23.256	14.212	50.6464
2-3	36	258.4	90	23256	55	14212	23.256	14.212	50.6464

3-4	36	258.4	90	23256	55	14212	23.256	14.212	50.6464
4-5	36	258.4	90	23256	55	14212	23.256	14.212	50.6464
5-6	28.667	206	90	18540	55	11330	18.54	11.33	40.376
6-7	28.667	206	90	18540	55	11330	18.54	11.33	40.376
7-8	28.667	206	90	18540	55	11330	18.54	11.33	40.376
Column D:									
1-2	36	258.4	90	23256	55	14212	23.256	14.212	50.6464
2-3	36	258.4	90	23256	55	14212	23.256	14.212	50.6464
3-4	36	258.4	90	23256	55	14212	23.256	14.212	50.6464
4-5	36	258.4	90	23256	55	14212	23.256	14.212	50.6464
5-6	28.667	582.6	90	52434	55	32043	52.434	32.043	114.1896
6-7	28.667	706.8	90	63612	80	56544	63.612	56.544	166.8048
7-8	28.667	582.6	90	52434	55	32043	52.434	32.043	114.1896
Column E:									
5-6	28.667	753.6	90	67824	55	41448	67.824	41.448	147.7056
6-7	28.667	1003.3	90	90297	80	80264	90.297	80.264	236.7788
7-8	28.667	753.6	90	67824	55	41448	67.824	41.448	147.7056
Column F:									
5-6	28.667	753.6	90	67824	55	41448	67.824	41.448	147.7056
6-7	28.667	1003.3	90	90297	80	80264	90.297	80.264	236.7788
7-8	28.667	753.6	90	67824	55	41448	67.824	41.448	147.7056
Column G:									
5-6	28.667	753.6	90	67824	55	41448	67.824	41.448	147.7056
6-7	28.667	1003.3	90	90297	80	80264	90.297	80.264	236.7788
7-8	28.667	753.6	90	67824	55	41448	67.824	41.448	147.7056
Column H:									
5-6	28.667	376.8	90	33912	55	20724	33.912	20.724	73.8528
6-7	28.667	501.7	90	45153	55	27593.5	45.153	27.5935	98.3332
7-8	28.667	376.8	90	33912	55	20724	33.912	20.724	73.8528

Beam Design:

Load assumptions -

Live load: hallways = 80 psf

apartments = .75 (40psf) + .25 (100psf) = 55 psf } from ASCE 7 Table 4-1

(40psf: private rooms; 100psf: public rooms)

Dead load: 150 lb/ft³ for slab (6" slab) = 75 psf + 15 psf (floor finishing, partitions)

= 90 psf

Max. load, A_{490} combination:

243.5 k	28'8"	span
49.2 k	35'	span
50.6 k	36'	span

Dividing by $\phi = .90$ (LRFD) gives:

270.6 k	28'8"	span
54.7 k	35'	span
56.3 k	36'	span

Table 3-6: Max. Uniform Load (kips) in AISC Manual

28'8" span: W12 x 170

35' span: W12 x 170

36' span: W12 x 210

for simplicity, all beams will be **W12 x 210**

See Excel calculations for more detail

Column Design:

Try W12x40: $r_x = 5.13$ in $r_y = 1.94$ in $A_g = 11.7$ in²

$$\lambda = \left(\frac{KL}{r}\right)_x = \left(\frac{.5 \times 13' \times 12}{5.13}\right) = 15.2$$

$$\left(\frac{KL}{r}\right)_y = \left(\frac{.5 \times 13' \times 12}{1.94}\right) = 40.2 \text{ (controls)} < 4.71\sqrt{\frac{E}{F_y}} = 4.71\sqrt{\frac{29 \times 10^3}{50}} = 113.43$$

$40.2 < 113.43$ ✓

$$F_e = \frac{\pi^2 E}{\lambda^2} = \frac{\pi^2 (29 \times 10^3)}{40.2^2} = 177.1 \text{ ksi}$$

$$F_{cr} = \left(.658^{F_y/F_e}\right) F_y = \left(.658^{50/177.1}\right) 50 = 44.4 \text{ ksi}$$

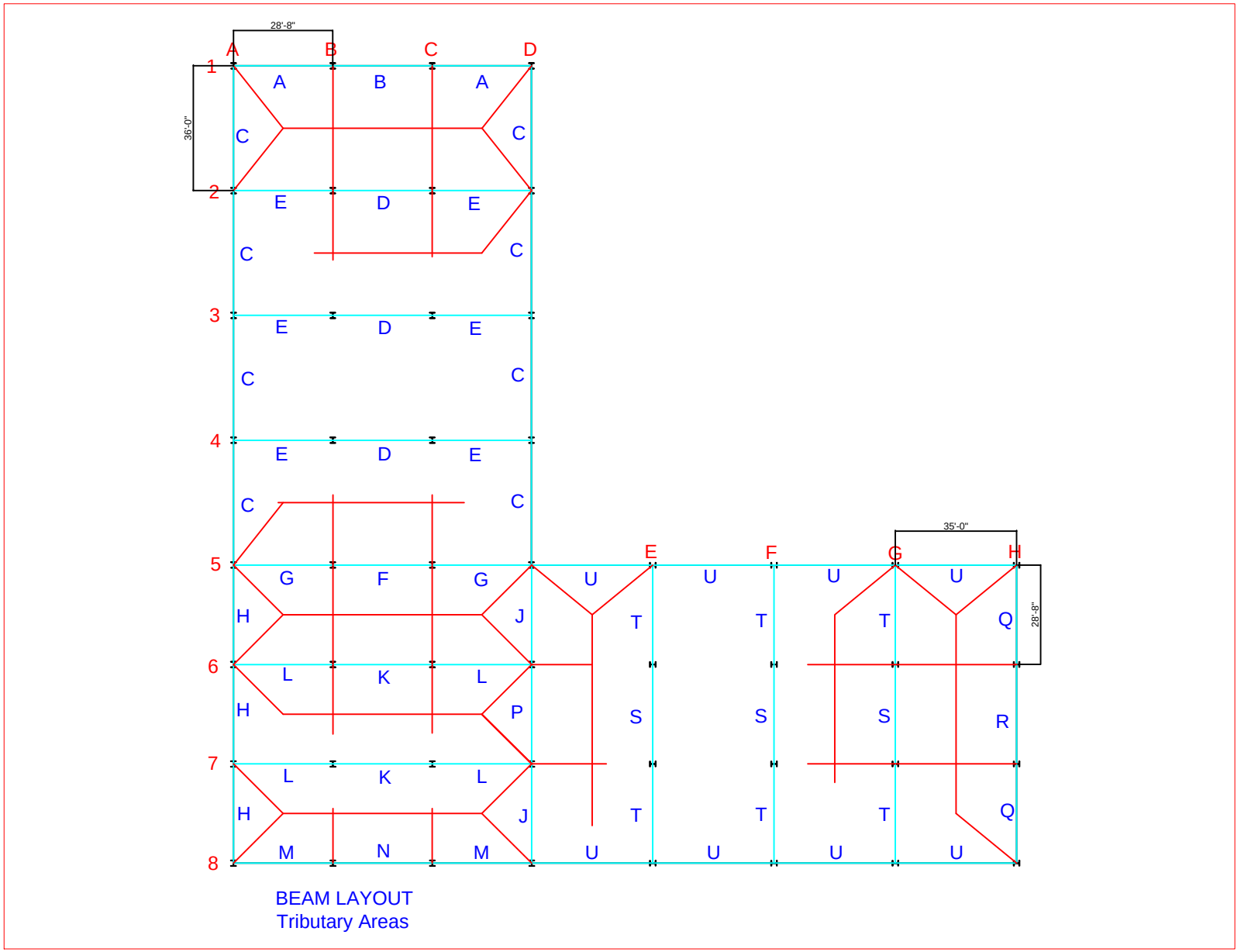
$$P_n = F_{cr} A_g = (44.4 \text{ ksi})(11.7 \text{ in}^2) = 519.8^k$$

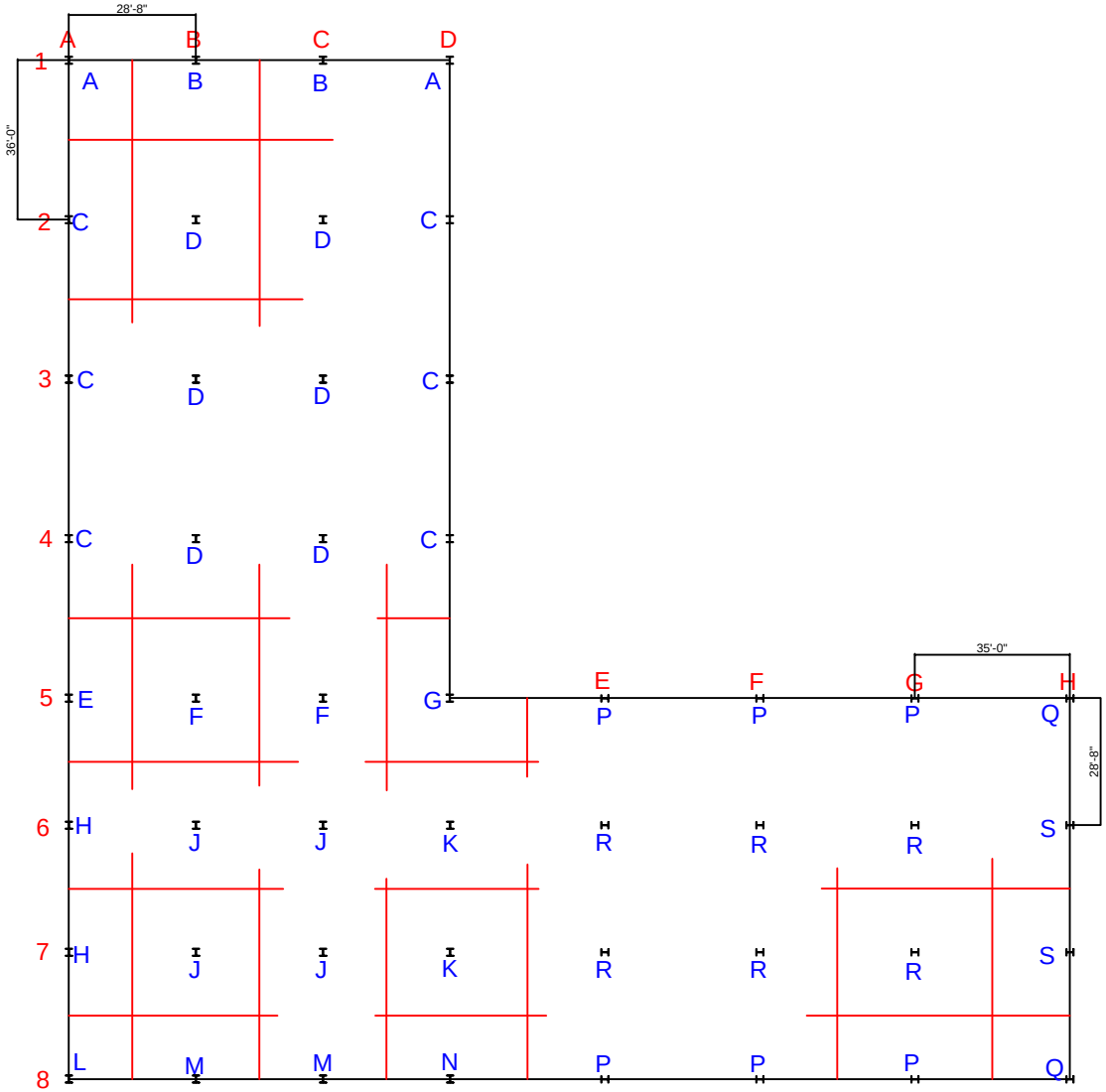
$$\phi P_n = .9(519.8^k) = 467.8^k > 242.32^k \quad \underline{\text{WORKS}}$$

Columns will be **W12 × 40**

↑ worst-case load

See Excel calculations for more detail





COLUMN LAYOUT
Tributary Areas

APPENDIX 1.4 ***Cost Analysis: Structural System Line Item Estimate***

Data Release : Year 2010 Quarte **Unit Cost Estimate**

Quantity	LineNumber	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor
45962.2	033053402950	Structural concrete, in place, elevated slab (4000 psi), two way beam and slab, 125 psf superimposed load, 25' span, includes forms(4 uses), reinforcing steel, concrete, placing and finishing	C14B	35.87	5.799	C.Y.	$ 229.47	$ 365.42
624	051223177150	Column, structural, 2-tier, W12x50, A992 steel, incl shop primer, splice plates, bolts	E2	1032	0.054	L.F.	$ 56.33	$ 3.40
2600	050521904010	Welding structural steel in field, cleaning & welding plates/bars/rods to existing beams/columns/trusses	E14	12	0.667	L.F.	$ 1.14	$ 44.79
1508	051223751740	Structural steel member, 100-ton project, 1 to 2 story building, W12x87, A992 steel, shop fabricated, incl shop primer, bolted connections	E2	640	0.088	L.F.	$ 97.76	$ 5.49
330928	032110700350	Reinforcing bars, glass fiber reinforced polymer, #8 bar, 0.497 lbs/ ft.	4 Rodm	7400	0.004	L.F.	$ 2.18	$ 0.33

Total

Equipment	Total	Ext. Mat.	Ext. Labor	Ext. Equip.	Ext. Total	Mat. O&P
$ 20.53	$ 615.42	$ 10,546,946.03	$ 16,795,507.12	$ 943,603.97	$ 28,286,057.12	$ 252.19
$ 1.49	$ 61.22	$ 35,149.92	$ 2,121.60	$ 929.76	$ 38,201.28	$ 61.91
$ 11.60	$ 57.53	$ 2,964.00	$ 116,454.00	$ 30,160.00	$ 149,578.00	$ 1.26
$ 2.40	$ 105.65	$ 147,422.08	$ 8,278.92	$ 3,619.20	$ 159,320.20	$ 108.00
$ -	$ 2.51	$ 721,423.04	$ 109,206.24	$ -	$ 830,629.28	$ 2.41
		$11453905.07	**$17031567.88**	**$978312.93**	**$29463785.88**	

Labor O&P	Equip. O&P	Total O&P	Ext. Mat. O&P	Ext. Labor O&P	Ext. Equip. O&P	Ext. Total O&P
$ 566.25	$ 22.44	$ 840.88	$ 11,591,207.22	$ 26,026,095.75	$ 1,031,391.77	$ 38,648,694.74
$ 5.76	$ 1.63	$ 69.30	$ 38,631.84	$ 3,594.24	$ 1,017.12	$ 43,243.20
$ 79.24	$ 12.75	$ 93.25	$ 3,276.00	$ 206,024.00	$ 33,150.00	$ 242,450.00
$ 9.29	$ 2.64	$ 119.93	$ 162,864.00	$ 14,009.32	$ 3,981.12	$ 180,854.44
$ 0.54	$ -	$ 2.95	$ 797,536.48	$ 178,701.12	$ -	$ 976,237.60
			$12593515.54	**$26428424.43**	**$1069540.01**	**$40,091,479.98**

APPENDIX 2.1: ***Plumbing Calculations and Analysis***

Residential Default Fixture Uses

Fixture Type	Duration (sec)	Uses / day
Water Closet (Female)	n/a	5
Water Closet (Male)	n/a	5
Lavatory Faucet	60	5
Shower	480	1
Kitchen Faucet	60	4

Information on FTE was assumed.

Residential FTE

Type	FTE
Studio	1.25
1 Bedroom	1.5
2 Bedroom	2.5
3 Bedroom	3.5

Rationale: It is likely that two people may occupy a single room

Reduced Consumption Fixtures				
	Baseline	Reduced - V1	Difference	% Change
Consumption (kgal / Year)	11,182.5	8,585.7	2,596.8	-23.2%
Initial Cost ($)	$ 750,288.00	$ 820,050.00	$ 69,762.00	9.3%
Annual Operation Cost ($)	$ 41,806.74	$ 32,098.48	$ 9,708.26	-23.2%
Break Even Point	7.2	Years		
Savings After Break Even Point	$ 9,708.26	per Year		
Financial Position After 10 Years	$ 27,320.59	Savings		

Reduced Consumption Fixtures (Minus Lavatories) With Graywater Reuse				
	Baseline	Reduced - V2	Difference	% Change
Consumption (kgal / Year)	11,182.5	7,907.3	3,275.2	-29.3%
Initial Cost ($)	$ 750,288.00	$ 849,128.00	$ 98,840.00	13.2%
Annual Operation Cost ($)	$ 41,806.74	$ 29,562.08	$ 12,244.65	-29.3%
Break Even Point	8.1	Years		
Savings After Break Even Point	$ 12,244.65	per Year		
Financial Position After 10 Years	$ 23,606.51	Savings		

Reduced Consumption Fixtures With Graywater Reuse				
	Baseline	Reduced - V3	Difference	% Change
Consumption (kgal / Year)	11,182.5	7,088.5	4,094.0	-36.6%
Initial Cost ($)	$ 750,288.00	$ 918,890.00	$ 168,602.00	22.5%
Annual Operation Cost ($)	$ 41,806.74	$ 26,500.92	$ 15,305.81	-36.6%
Break Even Point	11.0	Years		
Savings After Break Even Point	$ 15,305.81	per Year		
Financial Position After 10 Years	$ -	Savings		

* Leed Criteria for WE Credit 3: Water Use Reduction

% Reduction	Points
20%	Required
30%	2
35%	3
40%	4

* Up to three points of the LEED Credit can be obtained by implementing reduced fixtures and graywater reuse.

APPENDIX 2.2: *Plumbing Cost Analysis*

Baseline Water Supply and Sewage Load Cost

Unit Type:	Residential				*Water & Sewer Prices Obtained from					
Type:	Studio				city of chicago .org					
FTE	1.25				"Common Questions on Water Services"					
# of Units:	42									
Total FTE:	52.5									
			Consumption			Consumption		Price of Water	Price of Sewer	Total Yearly Cost
Fixture	Use/Day	Duration (sec)	Rate	Unit	Total FTE	(kgal/day)	(kgal / yr)	($/kgal)	($/kgal)	($)
WC	5	-	1.6	gpf	52.5	0.4	153.4	2.01	1.73	573.52
Lavatory Faucet	5	60	2.2	gpm	52.5	0.6	210.9	2.01	1.73	788.59
Showerhead	1	480	2.5	gpm	52.5	1.1	383.5	2.01	1.73	1,433.80
Kitchen Faucet	4	60	2.2	gpm	52.5	0.5	168.7	2.01	1.73	630.87
					Total	2.5	916.6			$ 3,426.78

Figure 1: Baseline Consumption and Operating Cost – Studio Unit

*Graywater recycling system will be used to supply the water closets

Consumption (kgal/day)	
WC (1.28 gpf)	4.1

Capacity (gal)	Price	Name	# of Units Necessary			Total Cost
39	$ 1,890	Brac Systems RGW-150	105.1	*->	106	$ 200,340
66	$ 2,190	Brac Systems RGW-250	62.1	*->	63	$ 137,970
92.5	$ 2,574	Brac Systems RGW-350	44.3	*->	45	$ 115,830
119	$ 2,824	Brac Systems RGW-450	34.4	*->	35	$ 98,840

* Brac Systems RGW-450 is chosen for minimal cost

* Product information obtained from greenbuildingsupply.com

Figure 2: Gray Water Reuse Cost

Unit Type:	Residential						
Type:	2 Bedroom						
# of Units:	84						
				Consumption			
Fixture	Qty./Unit	Qty. Total	Brand	Rate	Unit	Price/Fixture	Total Price
WC	2	168	Toto	1.28	gpf	$ 524.00	$ 88,032.00
Lavatory Faucet	2	168	Toto	1.5	gpm	$ 487.00	$ 81,816.00
Showerhead	2	168	Toto	1.75	gpm	$ 480.00	$ 80,640.00
Kitchen Faucet	2	168	American Std.	2.2	gpm	$ 284.00	$ 47,712.00
					Total	$ 1,775.00	$298,200.00
Water Reuse System	Total Price						
Graywater System	$ 98,840						
			Total Initial Cost				
			$ 918,890.00				
* Total Initial cost = [Σ Total Cost (Studio + 1 Bed + 2 Bed)] + Total Cost Water Reuse							

Figure 3: Initial Cost – Including Water Reuse System

APPENDIX 2.3: ***Miscellaneous Plumbing Data Used***

Potential Water Closets	Flow Rate (gpf)	Price	Name
Baseline	1.6	$ 524	Toto - Promenade® Toilet, Elongated Bowl - 1.6 GPF
Reduced	1.28	$ 524	Toto - Eco Promenade® Toilet, Elongated Bowl - 1.28 GPF

* WCs are chosen for comparison via similar type descriptions:
manufacturer, series/suite (where applicable), traditional style, elongated bowl, minor features, and two piece make up.

Potential Lavatory Faucets	Flow Rate (gpm)	Price	Name
Baseline	2.2	$ 336	Toto - Clayton® Widespread Lavatory Faucet
Reduced	1.5	$ 487	Toto - Clayton® Widespread Lavatory Faucet, 1.5 GPM

* Lav Faucets are chosen for comparison via similar type descriptions:
manufacturer, series/suite, traditional style

Potential Showerheads	Flow Rate (gpm)	Price	Name
Baseline	2.5	$ 480	Toto - Guinevere® Showerhead
Reduced	1.75	$ 480	Toto - Guinevere® High-Efficiency Showerhead, 1.75 gpm

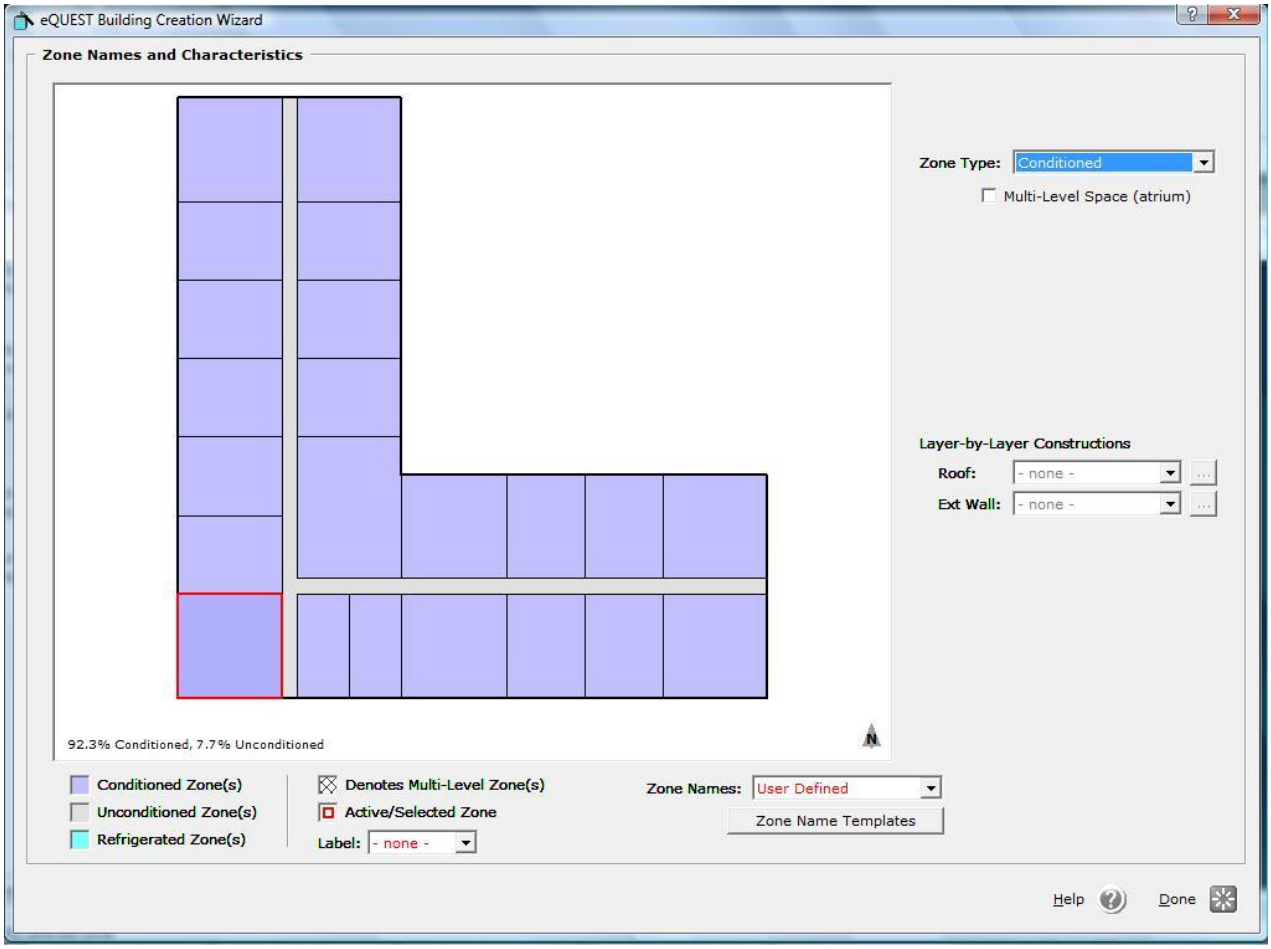
* Showerheads are chosen for comparison via similar type descriptions:
manufacturer, series/suite, traditional style

Potential Kitchen Faucets	Flow Rate (gpm)	Price	Name
Baseline/Reduced	2.2	$ 284	American Std. Reliant +® Pull-Out Kitchen Faucet

*Toto does not carry kitchen faucets.
American Std. only carries 2.2 gpm kitchen faucets
Comparison cannot be done for gpm w/ respect to price

* Product information obtained from totousa.com and americanstandard-us.com

APPENDIX 3.1: *eQuest Example*



APPENDIX 3.2: *Plumbing Calculations and Analysis*

	Unit	Specifications		% Reduction	Description
Baseline	DX Cooling Heat Pump	8.88 2.72	EER COP	0%	
System 1	DX Cooling Heat Pump	9.30 3.00	EER COP	2%	BQ036 to 060 Sunline Packaged Heat Pump
System 2	DX Cooling Heat Pump	11.00 7.70	EER HSPF	8%	50 EZ Comfort™ Series Packaged Heat Pump
System 3	DX Cooling Heat Pump	12.00 8.00	EER HSPF	10%	50 XT Infinity® Series Packaged Heat Pump
System 4	DX Cooling Heat Pump	12.00 8.00	EER HSPF	10%	50 VT Performance™ Series Packaged Heat Pump
System 5	DX Cooling Heat Pump	12.00 3.30	EER COP	10%	BHQ024-060 Affinity® Packaged Heat Pump
System 6	DX Cooling Heat Pump	12.00 3.50	EER COP	10%	BHX024 to 060 Affinity® Package Heat Pump
System 7	DX Cooling Heat Pump	12.20 3.70	EER COP	11%	UQ024 to 060 Latitude R-410A Packaged Heat Pump
System 8	DX Cooling Heat Pump	13.00 9.00	EER HSPF	13%	Trane XL15i Heat Pump
System 9	DX Cooling Heat Pump	16.00 9.00	EER HSPF	18%	Trane XL20i Heat Pump

*Pricing was not unavailable online
*% Reduction obtained from eQuest simulation

System information was obtained from:
http://www.yorkupg.com/NewCatalog.asp?t=c&id=8
http://www.residential.carrier.com

APPENDIX 3.3: *Annual System Cost Analysis*

System	Energy Consumption (kWh)	Chicago Electricity Rate ($/kWh)	Total Electrical Cost ($)	Cost/SF ($/SF)
Baseline	3,085,243	$0.16	$487,468.39	$1.04
System 1	3,028,494	$0.16	$478,502.05	$1.02
System 2	2,837,071	$0.16	$448,257.22	$0.95
System 3	2,766,714	$0.16	$437,140.81	$0.93
System 4	2,766,714	$0.16	$437,140.81	$0.93
System 5	2,767,129	$0.16	$437,206.38	$0.93
System 6	2,765,973	$0.16	$437,023.73	$0.93
System 7	2,750,326	$0.16	$434,551.51	$0.92
System 8	2,696,503	$0.16	$426,047.47	$0.91
System 9	2,542,249	$0.16	$401,675.34	$0.85

Unit	Area (SF)	System 5 (Median) (Cost/Unit)	Possible Tenant Fee ($/Unit/Month)	Remaining Cost ($/Unit)	Remaining Cost ($)
Studio	800	$743.55	$30.00	$383.55	$16,109.03
1 Bedroom	1200	$1,114.86	$40.00	$634.86	$159,983.83
2 bedroom	1600	$1,478.07	$50.00	$878.07	$73,757.57
				Total	$249,850.43
				Savings From Tenant Fee	$187,355.95
				% Savings	43%

* Possible Tenant Fee can be modified

Utility Rate Obtained From - http://www.bls.gov/ro5/aepchi.htm

Independent Living Building: Square-Foot Estimate

CostWorks® RSMeans

Estimate Name:	**IPRO Parking SF**	**Square Foot Cost Estimate Report**
Building Type:	**Garage, Parking with Precast Concrete / Steel Frame**	

Location:	CHICAGO, IL
Stories:	4
Story Height (L.F.):	10
Floor Area	127280
Labor Type:	Union
Basement Included:	No
Data Release:	Year 2010 Quarter 4
Cost Per Square Foot:	$70.05
Building Cost:	$8,915,500

Costs are derived from a building model with basic components. Scope differences and market conditions can cause costs to vary significantly.

		% of Total	Cost Per S.F.	Cost
A Substructure		10.60%	$6.37	$811,000
A1010	Standard Foundations		$1.78	$227,000
	Strip footing, concrete, reinforced, load 11.1 KLF, soil bearing capacity 6 KSF, 12" deep x 24" wide			
	Spread footings, 3000 PSI concrete, load 600K, soil bearing capacity 6 KSF, 10' - 6" square x 33" deep			
	Spread footings, 3000 PSI concrete, load 1000K, soil bearing capacity 6 KSF, 13' - 6" square x 41" deep			
A1030	Slab on Grade		$1.96	$249,500

	Slab on grade, 6" thick, light industrial, non reinforced			
A2010	Basement Excavation		$0.06	$8,000
	Excavate and fill, 30,000 SF, 4' deep, sand, gravel, or common earth, on site storage			
A2020	Basement Walls		$2.57	$326,500
	Foundation wall, CIP, 4' wall height, direct chute, .099 CY/LF, 4.8 PLF, 8" thick			
B Shell		60.00%	$36.03	$4,586,500
B1010	Floor Construction		$29.99	$3,817,000
	Steel column, W14, 500 KIPS, 10' unsupported height, 99 PLF			
	Floor, composite concrete slab on fireproofed W beam, 4" slab, 35'x40' bay, 31" total depth, 125 PSF superimposed load, 186 PSF total			
B2010	Exterior Walls		$6.05	$769,500
	Exterior wall, precast concrete, flat, 8" thick, 4' x 8', white face, low rise			
C Interiors		4.70%	$2.80	$356,500
C1010	Partitions		$1.67	$212,500
	Concrere block (CMU) partition, light weight, hollow, 8" thick, no finish 8" concrete block partition			
C1020	Interior Doors		$0.18	$22,500
	Door, single leaf, kd steel frame, hollow metal, commercial quality, flush, 3'-0" x 7'-0" x 1-3/8"			
C2010	Stair Construction		$0.75	$95,500
	Stairs, steel, cement filled metal pan & picket rail, 12 risers, with landing			
C3010	Wall Finishes		$0.20	$26,000
	Painting, masonry or concrete, latex, brushwork, primer & 2 coats			
D Services		22.60%	$13.56	$1,726,500
D1010	Elevators and Lifts		$2.60	$331,000

	Hydraulic passenger elevator, 3500 lb., five floors, 10' story height, 125 FPM		
D2010	Plumbing Fixtures	$0.04	$5,500
	Water closet, vitreous china, bowl only with flush valve, floor mount Lavatory w/trim, wall hung, PE on CI, 19" x 17"		
D2020	Domestic Water Distribution	$0.08	$10,000
	Electric water heater, commercial, 100< F rise, 50 gallon tank, 9 KW 37 GPH		
D2040	Rain Water Drainage	$1.96	$249,000
	Roof drain, steel galv sch 40 threaded, 3" diam piping, 10' high		
	Roof drain, steel galv sch 40 threaded, 3" diam piping, for each additional foot add		
	Roof drain, steel galv sch 40 threaded, 4" diam piping, 10' high		
	Roof drain, steel galv sch 40 threaded, 4" diam piping, for each additional foot add		
D4010	Sprinklers	$4.60	$585,000
	Dry pipe sprinkler systems, steel, ordinary hazard, 1 floor, 10,000 SF		
	Dry pipe sprinkler systems, steel, ordinary hazard, each additional floor, 10,000 SF		
D4020	Standpipes	$0.11	$14,000
	Dry standpipe risers, class III, steel, black, sch 40, 4" diam pipe, 1 floor		
	Dry standpipe risers, class III, steel, black, sch 40, 4" diam pipe, additional floors		
D5010	Electrical Service/Distribution	$0.31	$39,500
	Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 400 A		
	Feeder installation 600 V, including RGS conduit and XHHW wire, 400 A		

	Switchgear installation, incl switchboard, panels & circuit breaker, 400 A			
D5020	Lighting and Branch Wiring		$3.67	$467,500
	Receptacles incl plate, box, conduit, wire, 2.5 per 1000 SF, .3 watts per SF			
	Miscellaneous power, to .5 watts			
	Motor installation, three phase, 200 V, 15 HP motor size			
	Motor feeder systems, three phase, feed to 200 V 15 HP, 230 V 15 HP, 460 V 40 HP, 575 V 50 HP			
	Fluorescent fixtures recess mounted in ceiling, 0.8 watt per SF, 20 FC, 5 fixtures @32 watt per 1000 SF			
D5030	Communications and Security		$0.13	$17,000
	Communication and alarm systems, fire detection, addressable, 12 detectors, includes outlets, boxes, conduit and wire			
	Fire alarm command center, addressable without voice, excl. wire & conduit			
D5090	Other Electrical Systems		$0.06	$8,000
	Generator sets, w/battery, charger, muffler and transfer switch, gas/gasoline operated, 3 phase, 4 wire, 277/480 V, 7.5 kW			
E Equipment & Furnishings		2.20%	$1.30	$166,000
E1030	Vehicular Equipment		$1.30	$166,000
	Architectural equipment, parking equipment, automatic gates, 8 FT arm, 1 way			
	Architectural equipment, parking equipment, booth for attendant, deluxe			
	Architectural equipment, parking equipment, ticket printer/dispenser, rate computing			
E1090	Other Equipment		$0.00	$0
F Special Construction		0.00%	$0.00	$0
G Building Sitework		0.00%	$0.00	$0

SubTotal	100%	$60.08	$7,646,500
Contractor Fees (GC,Overhead,Profit)	10.00%	$6.01	$764,500
Architectural Fees	6.00%	$3.96	$504,500
User Fees	0.00%	$0.00	$0
Total Building Cost (Indoor Parking Portion)		$70.05	$8,915,500

CostWorks® RSMeans

Estimate Name:	**IPRO Ind Living SF**
Building Type:	**Apartment, 8-24 Story with Ribbed Precast Concrete Panel / Steel Frame**

Square Foot Cost Estimate Report

Location:	CHICAGO, IL
Stories:	22
Story Height (L.F.):	12
Floor Area (S.F.):	700040
Labor Type:	Union
Basement	No
	Year 2010
Data Release:	Quarter 4
Cost Per Building Cost:	$200.18
	$140,131,000

Costs are derived from a building model with basic components. Scope differences and market conditions can cause costs to vary significantly.

	% of Total	Cost Per S.F.	Cost
A Substructure	9.70%	$16.65	$11,657,000

A1010	Standard Foundations	$0.72	$501,500
	Pile caps, 6 piles, 8' - 6" x 5' - 6" x 37", 40 ton capacity, 14" column size, 458 K column		
	Pile caps, 12 piles, 11' - 6" x 8' - 6" x 49", 40 ton capacity, 19" column size, 900 K column		
A1020	Special Foundations	$15.47	$10,831,000
	Steel H piles, 100' long, 400K load, end bearing, 6 pile cluster		
	Steel H piles, 100' long, 800K load, end bearing, 12 pile cluster		
	Grade beam, 30' span, 52" deep, 14" wide, 12 KLF load		
A1030	Slab on Grade	$0.28	$195,500
	Slab on grade, 4" thick, non industrial, reinforced		
A2010	Basement Excavation	$0.02	$12,500
	Excavate and fill, 100,000 SF, 4' deep, sand, gravel, or common earth, on site storage		
A2020	Basement Walls	$0.17	$116,500
	Foundation wall, CIP, 4' wall height, direct chute, .099 CY/LF, 4.8 PLF, 8" thick		
	Foundation wall, CIP, 4' wall height, direct chute, .148 CY/LF, 7.2 PLF, 12" thick		
B Shell	23.10%	$39.58	$27,709,000
B1010	Floor Construction	$20.96	$14,669,500
	Steel column, W12, 400 KIPS, 10' unsupported height, 79 PLF		
	Floor, concrete, slab form, open web bar joist @ 2' OC, on W beam and column, 20'x25' bay, 26" deep, 65 PSF superimposed load, 110 PSF total load		
	Fireproofing, gypsum board, fire rated, 1 layer, 1/2" thick, 14" steel column, 2 hour rating, 18 PLF		
B1020	Roof Construction	$0.28	$198,500
	Floor, steel joists, beams, 1.5" 22 ga metal deck, on columns, 20'x25' bay, 20" deep, 40 PSF superimposed load, 60 PSF total load		
B2010	Exterior Walls	$13.69	$9,582,500
	Exterior wall, precast concrete, ribbed, 4" thick, 10' x 10', aggregate finish, high rise		
B2020	Exterior Windows	$1.67	$1,170,500
	Windows, aluminum, sliding, standard glass, 5' x 3'		
B2030	Exterior Doors	$2.69	$1,880,000

	Door, aluminum & glass, without transom, wide stile, hardware, 3'-0" x 7'-0" opening			
	Door, aluminum & glass, without transom, non-standard, double door, hardware, 6'-0" x 7'-0" opening			
	Door, aluminum & glass, sliding patio, tempered glass, premium, 6'-0" x 7'-0" opening			
B3010	Roof Coverings		$0.30	$208,000
	Roofing, asphalt flood coat, gravel, base sheet, 3 plies 15# asphalt felt, mopped			
	Insulation, rigid, roof deck, composite with 2" EPS, 1" perlite			
	Roof edges, aluminum, duranodic, .050" thick, 6" face			
	Flashing, aluminum, no backing sides, .019"			
C Interiors		28.50%	$48.89	$34,227,500
C1010	Partitions		$17.22	$12,051,500
	Concrere block (CMU) partition, light weight, hollow, 8" thick, no finish			
	Metal partition, 5/8"fire rated gypsum board face, no base layer, 3-5/8" @ 24" OC framing ,nothing opposite face, no insulation			
	Metal partition, 5/8"fire rated gypsum board face, 1/4" sound deadening gypsum board, 2-1/2" @ 24", same opposite face, no insulation			
	Furring 1 side only, steel channels, 3/4", 16" OC			
	Gypsum board, 1 face only, exterior sheathing, fire resistant, 1/2"			
	Add for the following: fiberglass insulation, 3-1/2"			
	Add for the following: taping and finishing			
	1/2" fire ratedgypsum board, taped & finished, painted on metal furring			
C1020	Interior Doors		$9.59	$6,715,000
	Door, single leaf, wood frame, 3'-0" x 7'-0" x 1-3/8", birch, solid core			
	Door, single leaf, wood frame, 3'-0" x 7'-0" x 1-3/8", birch, hollow core			
	Locksets, heavy duty cylindrical, non-keyed, passage			
	Locksets, heavy duty cylindrical, keyed, single cylinder function			
C1030	Fittings		$3.74	$2,620,500
	Cabinets, residential, wall, two doors x 48" wide			
C2010	Stair Construction		$3.22	$2,253,500
	Stairs, steel, cement filled metal pan & picket rail, 12 risers, with landing			
C3010	Wall Finishes		$3.86	$2,701,000

	Painting, interior on plaster and drywall, walls & ceilings, roller work, primer & 2 coats			
	Painting, interior on plaster and drywall, walls & ceilings, roller work, primer & 2 coats			
	Vinyl wall covering, fabric back, medium weight			
	Ceramic tile, thin set, 4-1/4" x 4-1/4"			
C3020	Floor Finishes		$5.79	$4,054,000
	Carpet tile, nylon, fusion bonded, 18" x 18" or 24" x 24", 24 oz			
	Carpet tile, nylon, fusion bonded, 18" x 18" or 24" x 24", 35 oz			
	Carpet, padding, add to above, minimum			
	Carpet, padding, add to above, maximum			
	Vinyl, composition tile, minimum			
	Vinyl, composition tile, maximum			
	Tile, ceramic natural clay			
C3030	Ceiling Finishes		$5.47	$3,832,000
	Gypsum board ceilings, 1/2" fire rated gypsum board, painted and textured finish, 7/8"resilient channel furring, 24" OC support			
D Services		38.80%	$66.55	$46,587,500
D1010	Elevators and Lifts		$15.27	$10,692,000
	Traction, geared passenger, 3500 lb,15 floors, 10' story height, 2 car group, 350 FPM			
D2010	Plumbing Fixtures		$15.61	$10,930,500
	Kitchen sink w/trim, countertop, PE on CI, 24" x 21", single bowl			
	Laundry sink w/trim, PE on CI, black iron frame, 24" x 20", single compt			
	Service sink w/trim, PE on CI, corner floor, 28" x 28", w/rim guard			
	Bathroom, lavatory & water closet, 2 wall plumbing, stand alone			
	Bathroom, three fixture, 2 wall plumbing, lavatory, water closet & bathtub, stand alone			
D2020	Domestic Water Distribution		$1.08	$755,500
	Gas fired water heater, residential, 100< F rise, 30 gal tank, 32 GPH			
D2040	Rain Water Drainage		$0.05	$32,000
	Roof drain, DWV PVC, 4" diam, diam, 10' high			
	Roof drain, DWV PVC, 4" diam, for each additional foot add			
D3010	Energy Supply		$8.29	$5,806,000

	Apartment building heating system, fin tube radiation, forced hot water, 30,000 SF area,300,000 CF vol		
D3030	Cooling Generating Systems	$9.49	$6,641,000
	Packaged chiller, air cooled, with fan coil unit, medical centers, 40,000 SF, 93.33 ton		
D4010	Sprinklers	$3.25	$2,272,500
	Wet pipe sprinkler systems, steel, light hazard, 1 floor, 10,000 SF		
	Wet pipe sprinkler systems, steel, light hazard, each additional floor, 10,000 SF		
D4020	Standpipes	$0.30	$210,500
	Wet standpipe risers, class III, steel, black, sch 40, 6" diam pipe, 1 floor		
D5010	Electrical Service/Distribution	$0.49	$340,500
	Service installation, includes breakers, metering, 20' conduit & wire, 3 phase, 4 wire, 120/208 V, 2000 A		
	Feeder installation 600 V, including RGS conduit and XHHW wire, 2000 A		
	Switchgear installation, incl switchboard, panels & circuit breaker, 2000 A		
D5020	Lighting and Branch Wiring	$9.07	$6,351,000
	Receptacles incl plate, box, conduit, wire, 10 per 1000 SF, 1.2 W per SF, with transformer		
	Wall switches, 2.5 per 1000 SF		
	Miscellaneous power, 2 watts		
	Central air conditioning power, 3 watts		
	Motor installation, three phase, 460 V, 15 HP motor size		
	Motor feeder systems, three phase, feed to 200 V 5 HP, 230 V 7.5 HP, 460 V 15 HP, 575 V 20 HP		
	Incandescent fixtures recess mounted, type A, 1 watt per SF, 8 FC, 6 fixtures per 1000 SF		
D5030	Communications and Security	$3.45	$2,416,500
	Communication and alarm systems, fire detection, non-addressable, 100 detectors, includes outlets, boxes, conduit and wire		
	Communication and alarm systems, includes outlets, boxes, conduit and wire, intercom systems, 100 stations		
	Communication and alarm systems, includes outlets, boxes, conduit and wire, master TV antenna systems, 30 outlets		
	Internet wiring, 2 data/voice outlets per 1000 S.F.		

D5090	Other Electrical Systems		$0.20	$139,500
	Generator sets, w/battery, charger, muffler and transfer switch, gas/gasoline operated, 3 phase, 4 wire, 277/480 V, 80 kW			
E Equipment & Furnishings		0.00%	$0.00	$0
E1090	Other Equipment		$0.00	$0
F Special Construction		0.00%	$0.00	$0
G Building Sitework		0.00%	$0.00	$0

SubTotal	100%	$171.68	$120,181,000
Contractor Fees (GC,Overhead,Profit)	10.00%	$17.17	$12,018,000
Architectural Fees	6.00%	$11.33	$7,932,000
User Fees	0.00%	$0.00	$0
Total Building Cost (Independent Living Portion)		$200.18	$140,131,000

Total Building Cost (BOTH PORTIONS)			$149,046,500