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Comparing Occupant Self-Assessed Behaviour to Actual Metered Consumption

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COMPARING OCCUPANT SELF-ASSESSED BEHAVIOUR TO ACTUAL METERED CONSUMPTION

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Abstract

A post-occupancy evaluation (POE) is a comprehensive building performance review that includes occupant surveys and provides feedback on the overall success of a building design in addressing end-user requirements. In doing so, POE often identifies disparities between expected and actual energy usage patterns. Part of determining the source of these disparities is the evaluation of tenant responses. Since these are heavily dependent on the users' ability to accurately recall their usage patterns, their potential inaccuracy may misinform building retrofits and future projects. This study seeks to compare occupant self-assessed behaviour to actual metered consumption.

A recently retrofit multi-unit residential building (MURB) and Tower Renewal pilot project was selected for the evaluation, and access to the electricity consumption of the pilot was obtained from building management. The project has 146 units, each approximately 20.5m^2, whose electricity consumption is metered individually. These readings are done electronically, and the data goes back to October 2010. Individual unit electricity loading and a holistic building consumption parameters were analyzed based on metered utilities and were found to fall within the average consumption values for buildings of equivalent type and vintage in Ontario (78.59 kWh/m^2/year and 192 ekWh/m^2/year respectively). It was also determined that no other formal parameters affect electricity loading in the individual units.

A post-retrofit survey has been carried out, which amongst other factors attempted to collect information on small appliances and electronics and their use. 48 valid samples were obtained. The monthly electricity consumption of each unit has been calculated based on the tenant responses, and these values have been compared to actual consumption values from the electronic meters. The average estimated consumption was found to be 45% more than the average metered consumption, with 46% of the survey-based estimates exceeding their respective metered readings by more than 50%. As many as 86% of tenants whose consumption estimate exceeded 50% of the metered value incurred time overestimation, while 23% incurred statistical bias. It was also found that all tenants who incurred statistical bias also incurred time overestimation.

While individual estimates tend to disagree with metered data, large-sample assessments may still be possible. Mode-based assessments help to limit sources of discrepancy by eliminating tenant responses that occur infrequently, thus creating sample cases that resemble the contents of a 'typical unit'. However, great care must be taken to avoid introducing further bias. To this end, more rigorous statistical analysis is required. It is recommended that future surveys avoid overestimation by arranging time-related questions in a manner that allows quick revision, tightening the ranges for usage questions to minimize assumptions made, and including relevant custom-made questions that either clarify questions for the tenants or minimize ambiguity in the results.

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List of Abbreviations and Symbols

MURB	Multi-Unit Residential Building
TRP	Tower Renewal Project
POE	Post Occupancy Evaluation
CMHC	Canadian Mortgage and Housing Corporation
OEE	Office of Energy Efficiency
GP	"Green Project"
GPF	"Green Project" Foundation
AC	Air Conditioning
DWH	Domestic Hot Water

1. Introduction: Tower Renewal Project and Post Occupancy Evaluation

Energy performance has become an increasingly important parameter in building design, particularly in projects where construction and operational (consumption) costs are shouldered by the same entity. While the current crop of Multi-Unit Residential Buildings (MURB's) in Toronto does not follow this payment structure, the same cannot be said of the older building stock in the city, namely towers built between the 50's and 80's. There are more than 1,000 apartment towers that fit these criteria in Toronto, and the trend to construct high-density residential structures has only increased over time (City of Toronto, 2012). The problem is that the majority of towers built between the 50's and 80's were designed under the assumption that energy costs would remain relatively low, which resulted in the construction of a number of towers host to vast energy inefficiencies (City of Toronto, 2012). Many of these towers have since become rental properties, often subsidized by the city, making energy inefficiencies both an environmental and capital burden on the city (City of Toronto, 2012).

The Tower Renewal Project (TRP) was introduced in 2007 to provide solutions to this problem, resolving issues ranging from poor insulation values in towers, to improved mechanical systems, higher quality indoor environment and build new communities (City of Toronto, 2012). To this end, the TRP has set in motion a number of pilot projects to determine the proper course of action in retrofitting Toronto's towers, and assessing the cost efficiency of such a process (City of Toronto, 2012). This study will make use of the consumption parameters for one of these pilots, referred to as "Green Project" (GP).

2. State of the Art – Background

2.1. Importance of Post Occupancy Evaluation

Simulated building performance during the design stage often differs from actual building performance. This difference, referred to as the 'performance gap', has been the subject of a multitude of studies and has been generally attributed to the unrealistic input parameters pertaining to occupant behavior (Menezes, Cripps, Bouchlaghem, & Buswell, Predicted vs. actual energy performance of non-domestic buildings: Using post-occupancy evaluation data to reduce the performance gap, 2010). To minimize the gap, post occupancy evaluations (POE's) have been designed as a holistic building evaluation tool that includes, amongst other items, actual energy use data and operator/ manager and occupant surveys. The content of the surveys determines the occupant satisfaction in the designed spaces and is a powerful tool in determining design shortcomings, which in turn may be used to resolve problems in the existing design and to set the criteria for future projects (Zagreus, Huizenga, Arens, & Lehrer, 2004). However, the validity of the occupant surveys, and subsequently the opportunity for improvement based on these findings, depends entirely on the accuracy of responses given by occupants. The validity of these responses, specifically when it comes to energy consumption questions, has not been brought into question. Determining the difference between these responses and metered values is the subject of this study.

To establish the relationship between occupant responses and consumption, the building must be assessed holistically to ensure no externalities affect the consumption parameters, and individual units' plug loading must be evaluated to ensure it falls within range of an acceptable benchmark.

2.2. Total Energy Consumption Benchmarks

The literature suggests that, independently of individual tenant behavior, there are two major factors that determine a MURB's energy consumption: vintage and tenancy type (CMHC, 2000) (Office of Energy Efficiency, 2012) (RDH Group, 2011). The findings by CMHC through the HiSTAR database suggest that seniors consume the most energy (281ekWh/m^2/year), followed by singles (221ekWh/m^2/year), and family households (163ekWh/m^2/year). This is likely the effect of family apartments being larger (2+ bedrooms) than single and senior apartments (1 bedroom or bachelor) while maintaining relatively similar energy requirements.

In terms of vintage, results vary depending on the study being carried out.

HiSTAR: 40 MURB's across Canada, ≈ 12'000 units, total average 279ekWh/m^2/year
Buildings built between 1961 and 1980 - 212ekWh/m^2/year
Buildings built between 1981 and 1993 - 317ekWh/m^2/year

RDH: 60 MURB's in Vancouver, ≈ 18'000 units, total average 213ekWh/m^2/year
Buildings built between 1981 and 1990 – 184.17ekWh/m^2/year
Buildings built between 1991 and 2000 – 228.33ekWh/m^2/year
Buildings built between 2001 and 2002 – 270.00ekWh/m^2/year

OEE: All MURB's in Ontario, 1,417,600 units
Buildings built up to 1990 – 0.85GJ/m^2/year or 236.11ekWh/m^2/year
Buildings built up to 2000 – 0.78GJ/m^2/year or 216.67ekWh/m^2/year
Buildings built up to 2009 – 0.73GJ/m^2/year or 202.78ekWh/m^2/year

Source	HiSTAR	RDH	OEE
1960's	212.00		236.11
1970's			
1980's	317.00	184.17	
1990's		228.33	216.67
2000's		270.00	202.78
Sample Average		213.00	202.78
No. of Units in Sample	12'000	18'000	1,417,600

Table 1: Whole Building Consumption Benchmarks (ekWh/m^2)

Differences between the studies can be attributed to sample size, sample type and averaging method. Both the CMHC and RDH studies involved relatively small samples and grouped buildings by vintage. However, while the CHMC study selected apartment buildings at random throughout the country, RDH worked with buildings within the Vancouver region exclusively. Since neither study factored in the effect of weather, the data sets are difficult to compare. It is possible that the higher consumption values obtained by CMHC are the result of using only apartment buildings (rental properties, likely including utility fees in the rental agreement, thus discouraging energy saving strategies) and using samples from significantly colder locations in the country, which drive up consumption values. The OEE study is the most robust, but also the least specific. While the sample size is significantly larger than both CHMC and RDH, and is located in Ontario, the study groups buildings incrementally rather than isolating building samples by vintage. The consumption value is thus an aggregate and is not representative of any particular vintage but of the building stock at any given time.

The 3 studies provide a general idea of where the consumption of GP should be. OEE sets a general performance standard for the retrofit. Carried out in 2009, the GP retrofit should aim to meet or exceed the consumption average for the building stock at this time. The studies by RHD and CMHC supplement the findings of OEE by outlining project-specific tolerances, such as the impact of rental vs owned, and age group.

2.3. Electricity Consumption Benchmarks

The electricity consumption of individual units in MURB's is a function of both usage and individual loads, resulting in a wide data range. As such, establishing a comparable benchmark may be difficult given the variation, and only be approximated through statistical analysis. While this method may fail to provide a bias-free comparison, it is assumed that using a 'per-household' comparison should yield approximately equivalent results (CMHC, 2000) (Office of Energy Efficiency, 2012). Based on the total building stock in 2009, the OEE has assembled MURB energy consumption data into 5 separate categories: space heating, water heating, appliances, lighting, and space cooling (47, 30, 19, 2, and 2% respectively)(See Figure 1). These values include all energy usage, regardless of source type. Separately, the OEE groups MURB energy usage by energy type into 5 categories: electricity, natural gas, heating oil, other, and wood (31, 63, 2, 1, and 3% respectively)(See Figure 2). Finally, the OEE has determined the average annual energy consumption of MURB's to be 202.78ekWh/m^2 and 16,111.11ekWh/unit, suggesting the average unit size (including common areas distributed equally amongst the units) is 79.5m^2. These sets of data must be looked at simultaneously to determine a suitable set of benchmarks applicable to GP, namely total annual average-unit energy consumption as described above, and annual average-unit electricity consumption (63.67kWh/m^2 and 5,058.89kWh/unit) based on the whole building consumption. Obtaining benchmark parameters at the unit level using the OEE database is difficult, namely because consumption values do not specifically state if common elements, such as lighting and mechanical equipment, are included in the categories and averaged across all units, or if the values are exclusively in-unit parameters. Furthermore, it is difficult to adequately address certain parameters, particularly heating and cooling loads, since the system implemented at GP uses both gas consumption at the boilers (usually grouped into 'space heating') and electricity consumption at both the fan-coil units (usually grouped into 'appliance' or 'plug loading') and the geothermal setup (grouped into 'space heating').

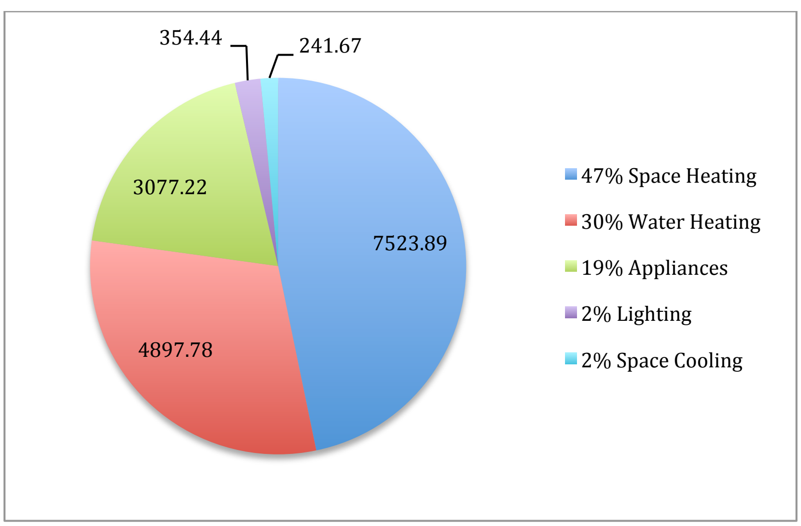

Figure 1: OEE – MURB Average Consumption by End Use (ekWh/unit/year)

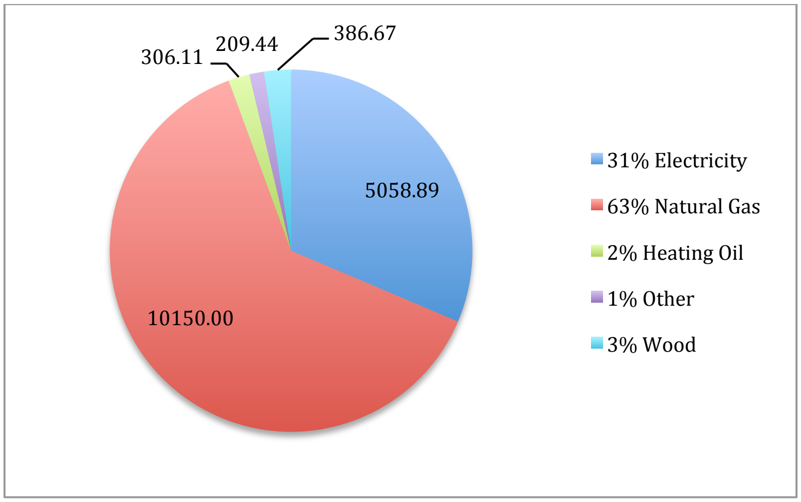

Figure 2: OEE – MURB Average Consumption by Energy Source (ekWh/unit/year)

The study by CMHC did not implicitly provide a study-wide 'total consumption per unit' parameter, but it did indicate the total consumption per unit averaged by building vintage. These values were 22,266ekWh/unit for the 26 buildings built between 1961 and 1980, and 21,437ekWh/unit for the 9 buildings sampled from 1980 to present. An equivalent building stock average, taking into account the number of buildings sampled and the respective vintage averages, yields approximately 22,052ekWh/unit. However, it is important to note that this average assumes an equal number of units in each building sampled, which is not necessarily correct, and therefore is only an approximation. Once again, the value obtained by CMHC is 37% higher than that of OEE. Further suggesting the studies are incomparable.

The study by RDH separated the total energy consumption (222ekWh/m^2/year) into 9 categories: ventilation and heating, DWH, lights (common), lights (unit), plug and appliances (unit), equipment and amenity (common), elevators, electric baseboard heating, and fireplaces (39, 9, 2, 7, 9, 9, 1, 8, and 16% respectively)(See Figure 3). From this study the following benchmarks can be derived: in-suit lighting consumption (15.54kWh/m^2) and in-unit plug+appliance consumption (19.98kWh/m^2). Once again there are issues separating the electricity loading resulting from the fans in the fan-coil units from the gas consumption at the boilers. Furthermore, since the study by RDH did not address a total consumption/unit parameter, it is difficult to assess how this study compares to GP or the findings by OEE and CMHC.

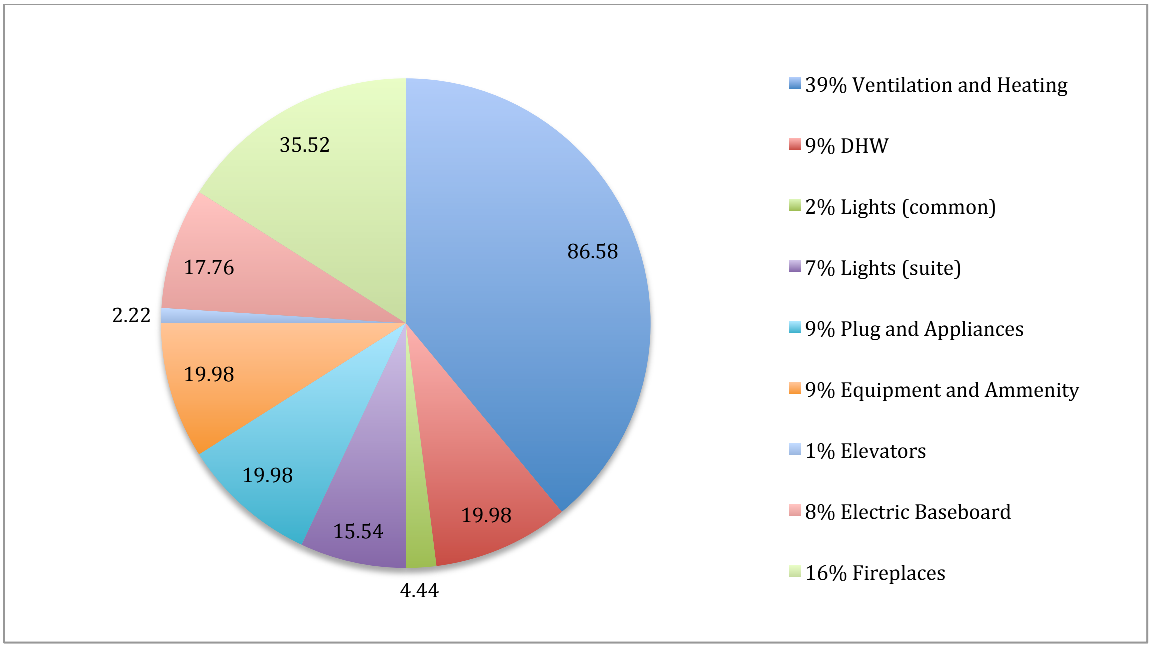

Figure 3: RDH – MURB Average Consumption by End Use (ekWh/m²/year)

3. Research Question and Scope

Thorough post occupancy evaluations seek to determine the effectiveness of measures implemented in these pilot projects, and are essential to the optimization and replication of favourable results. However, without more extensive monitoring, plug-loading analysis relies on tenants' ability to accurately recall their usage patterns. This study seeks to compare occupant self-assessed behaviour to actual metered consumption. As such, the scope of this study will be limited to the analysis of electricity consumption by tenants and the occupant survey carried out in the midrise pilot project (Roque, Straka, & Fung, 2012). Gas data will only be used to establish the consumption of the pilot project against the building stock as a whole. Other parameters, particularly those relating to socio-cultural aspects of the occupant survey, will be omitted from this study in an effort to limit the variables present in the system and provide a simpler benchmark for future studies to explore in greater detail.

4. Pilot Project

4.1. Building History

The pilot project under question is in fact not a single building but two buildings, a mid-rise tower built in 1976 and a low-rise housing development acquired in 2006 but of equivalent vintage. The tower houses 136 units, each approximately 20.5m^2, while the lower structure houses 10 apartments ranging from 27 to 57.5m^2. As of 2008, both structures are serviced by the same mechanical systems and are invoiced together, totaling 5,727m^2 of gross floor area. According to the "Green Project" Foundation (GPF) the idea to retrofit the facilities dates back to 2002, however the plan was not put into motion until the possibility of funding through the TRP was made available in early 2007. Further contributions in the forms of fundraising and investment by the owning corporation have been on-going from 2006 through to 2009, when the retrofit project was made possible (GPF, 2012). Table 2 describes the floor areas as calculated from the as-built drawings provided.

	Area (m^2)	Repetitions	Total Area (m^2)
Tower			
Basement	502.2	1	502.2
Main	474.86	1	474.86
Typical	407.82	10	4078.2
Roof	67.47	1	67.47
			5122.73
Low-rise Housing			
Basement	155.28	1	155.28
Main	148.62	1	148.62
2nd	154.07	1	154.07
3rd	146.12	1	146.12
			604.09
Gross Area			5726.82

Table 2: Floor Area of the "Green Project" Complex

4.2. Renovation and Consumption

Renovations to the property began in March 2009, and were carried through until June 2010, when the retrofit was deemed complete. The renovation included the upgrade of windows (U-value of 2W/m^2K), wall assemblies (RSI of 6.47m^2K/W) and mechanical upgrades from electric-baseboard heaters to hydronic fan-coil units (See Appendix A) in the tower and in-floor heating for the low-rise, both supplemented by geothermal and solar thermal DHWH (GPF, 2012). Ventilation was upgraded to include a 7000cfm air-handling unit with enthalpy recovery (See Appendix B). The system is designed to supply the hallways of the tower with fresh air, leak into the units and get ducted back, along with exhaust from bathrooms and kitchens, to the rooftop unit for enthalpy recovery before being exhausted out. The total cost of the project is approximately $7.5 Million (GPF, 2012). A summary of the retrofit condition can be seen on Appendix C.

Electricity consumption drives the fan-coil units and plug loads, while gas consumption drives the pre-heated boiler draw for all hot water supply to the units. During the summer, no natural gas is required to heat the showers and sinks, as 100% of this load is supplied by the solar-plate collectors (M, 2011-2012). The system has been designed to have no cooling other than whatever can be supplied through the geothermal setup, with an air supply ranging from 17^{0}C to 19^{0}C during the cooling season, which has been deemed insufficient by tenants and building management (M, 2011-2012).

Since then, there have been a number of rounds of commissioning ending as recent as early 2011 (GPF, 2012). The extended commissioning process was the result of inconsistencies between the modeled consumption estimates and the actual consumption values in the building. Many of these inconsistencies have since been addressed, however a few issues are still under investigation. Most notably, issues with the boiler valves and the untimely operation of the heat recovery system on the roof have caused dramatic spikes in the electricity and gas consumption, particularly in the summer of 2010, when gas consumption spiked due to a leaky valve. As a result, most of the post-retrofit consumption data available for analysis has been compromised, as it does not represent the design intent of the retrofit, or the capacity of the system under proper operation (M, 2011-2012). For this reason, the data samples to be used will limit pre-retrofit data to the data collected in 2008, as it is the only whole-year sample that includes both buildings before the retrofit. The data samples used to represent the post-retrofit condition will include data collected starting in 2011, as it reflects the retrofit capacity far more accurately than previous years. Even so, some minor details are currently under commissioning, namely issues with the lack of fresh air infiltration from the supply point at the hallways into the units (M, 2011-2012). As part of the ongoing review of GP's performance, Miles Roque carried out an occupant survey in early 2012. This survey, presented in '*Survey Of Household Energy Use In A Rental High-Rise Multi-Unit Residential Building (MURB)'* will be one of the primary sources used for this analysis (See Appendix D).

5. Methodology

5.1. Whole Building Analysis

First, it must be established that the building as a whole is not host to abnormal consumption patterns resulting from the building's characteristics rather than the occupants' behavior. To this end, the energy performance of the building has been evaluated and compared to a suitable set of benchmarks. Furthermore, unit consumption patterns have been evaluated to establish abnormalities resulting from formal bias such as orientation and vertical placement within the structure (impact of stack effect), as well as the thermal difference between external and internal walls.

5.1.1. Whole-Building Consumption

The holistic energy analysis is comprised of energy consumption bills for the years 2008, 2011 and 2012. This includes electricity invoices from Toronto Hydro (See Appendix E) natural gas invoices from Enbridge Inc. (See Appendix F). Based on these, the total energy intensity at GP has been established and compared to suitable benchmarks.

5.1.2. Consumption Distribution Assessment

Once the building benchmark was determined and compared to a suitable sample set, the actual consumption at the unit level was analyzed. This process served to determine the relationship between three parameters in relation to consumption levels: orientation, season, and floor elevation using the electronic monthly readings collected for each unit (See Appendix G). This whole-building analysis compared the total monthly consumption average of units facing East and units facing West to determine an overall trend. Monthly averages were then be grouped into seasonal averages in order to determine correlations between consumption, season and orientation. A floor-by-floor analysis was then be carried out in the same manner as the whole building analysis. Finally, the annual consumption averages per unit will be plotted on the building floor plans, and analyzed for consumption patterns.

5.2 Consumption Matrix

In order to objectively compare tenant survey responses to actual consumption readings, a matrix has been constructed using three primary parameters: tenant responses, plug-load consumption rates, and actual consumption values obtained from the electronic meters. Tenant responses from the survey provide up to 28 different loads types present in the units, from TV's to cell phone chargers to fans. The survey may also supply usage times for a number of these loads, such as stoves, or it may not, as is the case with toaster ovens, coffee makers, and other smaller equipment. These load types are then converted into consumption values using the particular appliance specification or a statistically derived consumption rate from a reliable database. For load types whose usage has been specified by the survey, this consumption rate takes the form of wattage, otherwise consumption values are statistical values in kWh/month. The matrix then takes these parameters and calculates the various consumption values for each load type and a total monthly consumption for each unit. These values are then compared to their respective metered values, and the whole-sample estimation average is compared to the whole-sample metered average, obtaining a relative summary of the matrix findings.

5.3 Matrix Assessment

The matrix is made up of a number of variables, some of which are specifically defined, such as the stove and fridge, and some that are not, such as fans and toasters. This ambiguity extends beyond load types to include usage times. Not only are some usage times undefined, but those specifically addressed by the survey take the form of ranges rather than single numbers. Further complicating the assessment are those assumptions required to provide the matrix with sufficient information to calculate consumption values, such as the size of the average TV and the usage time for personal heaters and fans. While it may be impossible to address the accuracy of the matrix without extensive monitoring and a superior inventory of loads, a few 'checks' have been built into the matrix in order to reduce the effect of ambiguity and explore the possible range of responses.

5.3.1 Matrix Range

Because load usage responses were given in the form of rages, the matrix has been constructed as three separate instances: the lower-bound, the average, and the upper-bound. As an example, if a tenant responded their TV usage is 1 to 3 hours, the lower-bound matrix uses 1h, the average matrix uses 2, and the upper-bound matrix uses 3. Results obtained from the lower-bound matrix determine the lowest possible outcome of the matrix in the assumption that all other parameters are consistent. Inversely, the upper-bound matrix provides the largest possible outcome. The average matrix provides results in the middle, and is arguably the most reliable given a large enough sample. However, it is worth noting that results can fall anywhere between the lower and upper bounds. The average is simply the point in the middle and is not necessarily the most accurate.

5.3.2 Case-based Assessment

Since this study seeks to determine the difference between survey based estimates and actual metered values, the assessment has been prepared to handle the possible outcomes: tenants are unable to estimate their consumption (over/underestimate) or tenants are able to predict their consumption within a certain tolerance. This assessment strategy has been organized into three separate cases, each designed to summarize the overall performance of tenants during the survey while attempting to limit the effect of possible sources of bias and estimation issues.

Case 1: Survey Mode

Case 1 is set up the same way as the individual unit assessments, having a set of load types and usage times, ultimately resulting in a total monthly consumption parameter. Both the load types and the usage times in case 1 have been selected based on the survey responses that appear most often either in the survey (when parameters were specifically addressed) or in the matrix (when parameters were determined through assumptions). For example, the most common response to the question "What type of TV do you own?" was LED/LCD, and the most common response to TV usage was 2h. Based on these two pieces of data, the matrix calculates the case 1 TV load on a monthly basis as it did with the individual units. In short, case 1 is the collection of modes for the questions present in the survey. Whenever a load type mode is '0' or 'no load', as is the case with stereo systems, any potential usage time associated with the load is disregarded, since technically there is no appliance to operate. It is worth noting that the selected values that make up case 1 are the modes for each question, not averages.

The value of case 1 lies in that it nulls the effect of unusually high or low usage time responses without the requirement for a larger sample group. Likewise, using the load type mode allows case 1 to null the effect of load types that are uncommon, such as game consoles and stereo systems. Ultimately, case 1 represents the 'basic unit', a collection of the most common loads and usage times. Because case 1 is ultimately the bare-bones scenario, it will always be at the lower end of all matrix instances.

Case 2: Load Mode + Usage Average

Case 2 is very similar to case 1, as it is comprised of a set of loads types and usage times, ultimately resulting in a total monthly consumption parameter. However, while case 2 uses modes to select the load types, it uses whole-sample averages to determine those loads' usage times. For example, the most common response to the question "What type of TV do you own?" was LED/LCD, and the average TV usage across the sample was 3.5h. The difference between cases 1 and 2 is subtle, but the result can be significant. Like case 1, case 2 constructs a summary of the loads most commonly found in a unit, but by using the average usage times rather than the modes, case 2 allows unusually high and low time usage estimates to affect the result. This is critical because the reality is that while most people use their appliances for a particular length of time (2h for TV sets), over-users and under-users affect the overall consumption that can be attributed to this load type, a fact that case 1 does not address. For this reason, case 2 creates a summary of monthly loads that will more closely resemble the sample average.

Case 3: Survey Average

Unlike cases 1 and 2, case 3 does not address load type or usage time responses. Case 3 is constructed from the averages for each load type across the matrix, for example: the average TV-related consumption across the matrix was 16kWh/month/unit. These load consumption averages are then added into a total average consumption/unit value, which is a summary of the matrix results. Because this case only looks at the consumption values calculated across the matrix, it accounts for all eccentricities present in the survey, both by load type and usage time, and therefore is a direct representation of the whole matrix, rather than any particular unit. As such, this case most clearly displays trends present in matrix, and when compared to the metered sample average, provides the clearest answer to the research question.

Important Note: Mode Bias

Earlier it was mentioned that there may be a significant difference between averages and modes. This difference is directly dependent on how often the mode repeats itself within the sample, with a low recurrence resulting in a higher difference between the sample average and the sample mode. This difference will be referred to as 'mode bias'. To illustrate this bias, consider the following example: 5 tenants are asked the question "On an average day, how many hours do you spend watching TV?" and their answers are 0h, 1h, 1h, 5h, and 10h. For this particular set of responses, the mode is 1h because it is the answer that came up most often, and the recurrence of this mode is 40%. However, the average for the same set is 3.4h. This difference can be rather substantial, and affect the assessment by large factors, resulting in a severe underestimation of the average consumption. Mode-based assessments can be strengthened by having larger sample sets (in which case averages also work well) or by ensuring the mode recurrence is high (reducing the possible responses). Because cases 1 and 2 are mode-based, they are susceptible to this form of bias, with the impact being directly depended on the mode recurrence for each survey question.

6. Results and Analysis

6.1 Whole Building Energy Assessment

The holistic energy analysis is comprised of a total of 43 readings, 27 electricity invoices (See Appendix E) and 16 natural gas invoices (See Appendix F). Figure 4 shows an electricity consumption spike during the heating season in 2008 that is absent in the post-retrofit condition. This is because the 2008 system utilizes baseboard heaters as the primary source of heat-generation, while the post-retrofit condition utilizes only as much electricity as is needed to run the fans in the fan-coil units. The increased electricity consumption during the cooling season for 2011 compared to 2008 is likely the result of the geothermal electricity consumption (pumps and fans) and the retrofit system's inability to generate sufficient cooling power, forcing tenants to install fans and window-mounted AC units despite management's best efforts to limit this kind of behavior (M, 2011-2012). Overall, the retrofit has resulted in an electricity loading reduction from 736,000kWh/year to 692,000kWh/year, a 6% reduction.

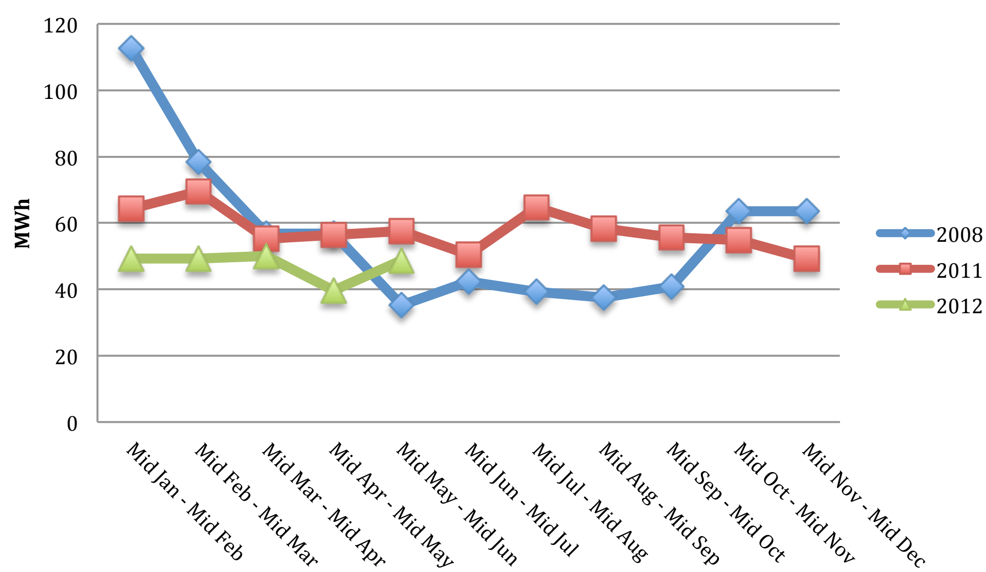

Figure 4: GP's Whole Building Electricity Consumption per Month

Gas consumption goes through highs and lows depending on climatic conditions. In 2008, natural gas loading is determined exclusively by the hot water supply to the rooftop unit and to the tanks supplying showers and sinks; so it is not surprising that Figure 5 shows consumption spikes during the heating season. Gas consumption is significantly lower during the cooling season, as it is only being used to supply hot water to sinks and showers (Cobalt Engineering, 2006). In the post-retrofit condition, gas consumption during the cooling season drops dramatically because gas is no longer required to supply the showers and sinks, since the solar thermal collectors are working to cover 100% of the demand (M, 2011-2012). Overall, the retrofit has resulted in a gas load reduction from 70,160m^3/year to 36,300m^3/year, a 49% reduction.

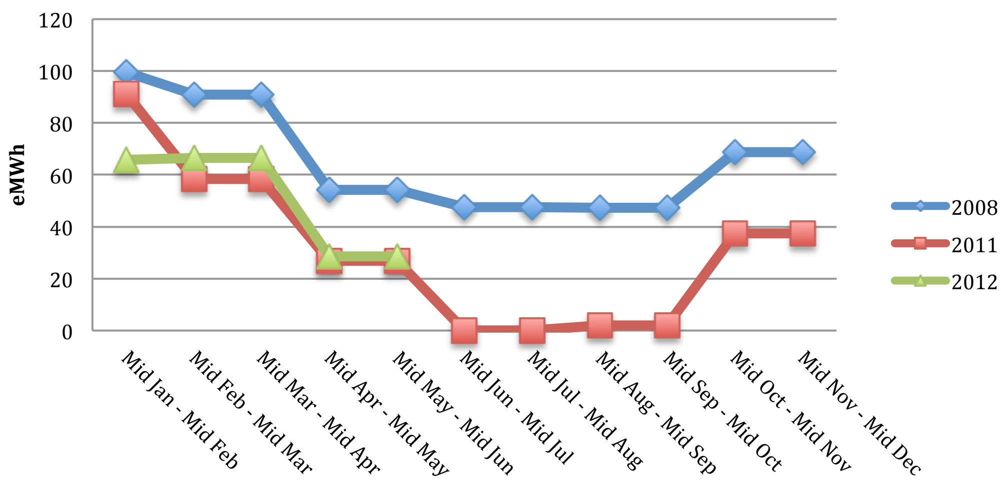

Figure 5: GP's Whole Building Natural Gas Consumption per Month

The combined gas and electricity consumption has been converted to equivalent kilowatt hours (ekWh) and divided by the total gross area of the design, thus establishing the energy intensity for GP of 268ekWh/m^2 before the retrofit and a 192ekWh/m^2 after. The total consumption reduction amounts to 431,000ekWh/year, 28% of the total load. The post-retrofit condition is 31% lower than CHMC's 281ekWh/m^2 for MURB's of the same tenancy, and 5% lower than the average building sampling by both OEE and RDH.

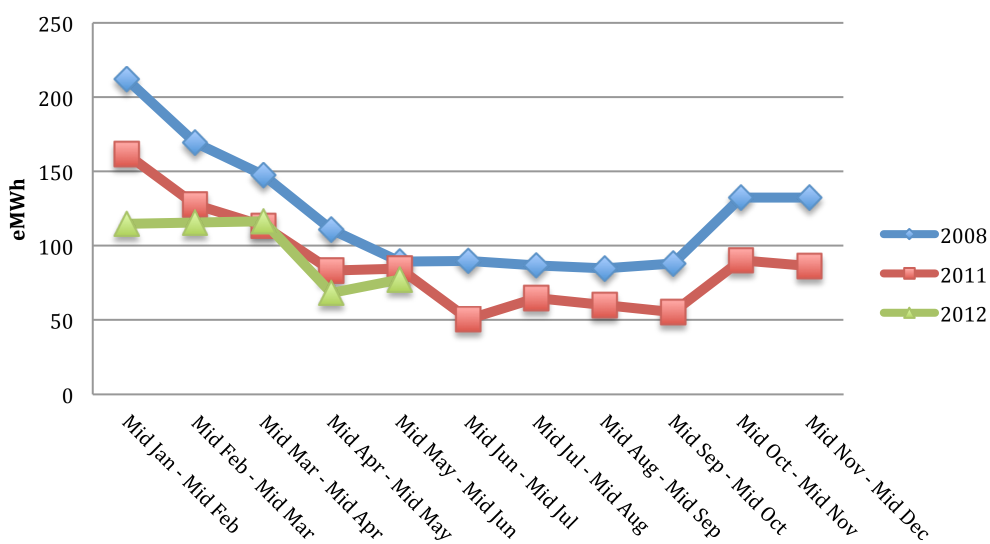

Figure 6: GP's Whole Building Total Energy Consumption per Month

The electricity consumption benchmark at GP has been established based on the total building gross area and the total electricity consumption. This value is 120.83kWh/m^2 annually, 63% higher than the 63.67kWh/m^2 determined by OEE. However, comparing the electricity consumption per unit in both samples yields a completely different result. Dividing the total electric consumption of GP by the 146 units yields a consumption of 4,739.73kWh/unit. Despite this number including the consumption of common elements (hallway lighting, lobby, etc), this value is 6% below findings by OEE, and 66% lower than the building sample in the CHMC study. The disagreement found when using kWh/m^2 as the comparison metric is the result of the difference in average unit size for each sample. Based on the consumption-per-unit and the consumption-per-m^2 averages in the OEE sample it is revealed that the OEE study sampled units whose average size is approximately 80m^2, whereas at GP this value is closer to 40m^2. This is not surprising, since in the absence of electric heating, the highest electrical load sinks in both cases are similar (stove, fridge, TV, etc) regardless of the size of the apartment.

Parameter	**Value**	
Total Gross Area	5726.82m^2	
Averaged Area per Unit (including common)	39.22m^2	
Actual Area per Unit	20.65m^2	
Total Consumption (gas and electricity)	1,104,459.12 ekWh/year	
Total Electricity Consumption	692,000 kWh/year	
Energy Intensity	192.86 ekWh/m^2/year	
Averaged Total Consumption per Unit	7,564.79 ekWh/unit/year	
Averaged Electricity Consumption per Unit	4,739.73kWh/unit/year; 63% of total.	
Floor 2 Metered Consumption Average	134.36	kWh/unit/month
Floor 3 Metered Consumption Average	116.93	
Floor 4 Metered Consumption Average	115.64	
Floor 5 Metered Consumption Average	147.90	
Floor 6 Metered Consumption Average	131.17	
Floor 7 Metered Consumption Average	129.68	
Floor 8 Metered Consumption Average	116.32	
Floor 9 Metered Consumption Average	141.61	
Floor 10 Metered Consumption Average	138.83	
Floor 11 Metered Consumption Average	185.85	
Whole-Building Metered Consumption Average	135.11	

Table 3: GP's Area and Consumption Parameters

In general, GP's performance for total energy use and electricity consumption is comparable to the building stock benchmark in Ontario.

6.2 Consumption Distribution Assessment

The three parameters under observation (orientation, season, and floor elevation) were evaluated over a time period dating back to October 2010. The electronic readings included the appliance, lighting, and plug loading in each unit, along with the electricity consumption resulting from each fan-coil unit installed. Based on these, the average monthly consumption was calculated for each unit. Units were grouped into West and East facing units to determine an overall trend. Monthly averages were grouped into seasonal averages: Winter (December, January, and February), Spring (March, April, and, May), Summer (June, July, and, August), and Fall (September, October, and November) in order to determine correlations between consumption, season and orientation.

Figures 7 and 8 show and overall decline in electricity consumption per unit, likely the positive effect of the ongoing commissioning process at GP, particularly the optimization of operational temperatures for the boilers resulting in a decreased need to supplement them by electric means (heaters, stoves, etc) (M, 2011-2012). While figure 8 suggests an overall pattern (summer consumption spike on the East facing units, and a winter consumption spike for the West units).

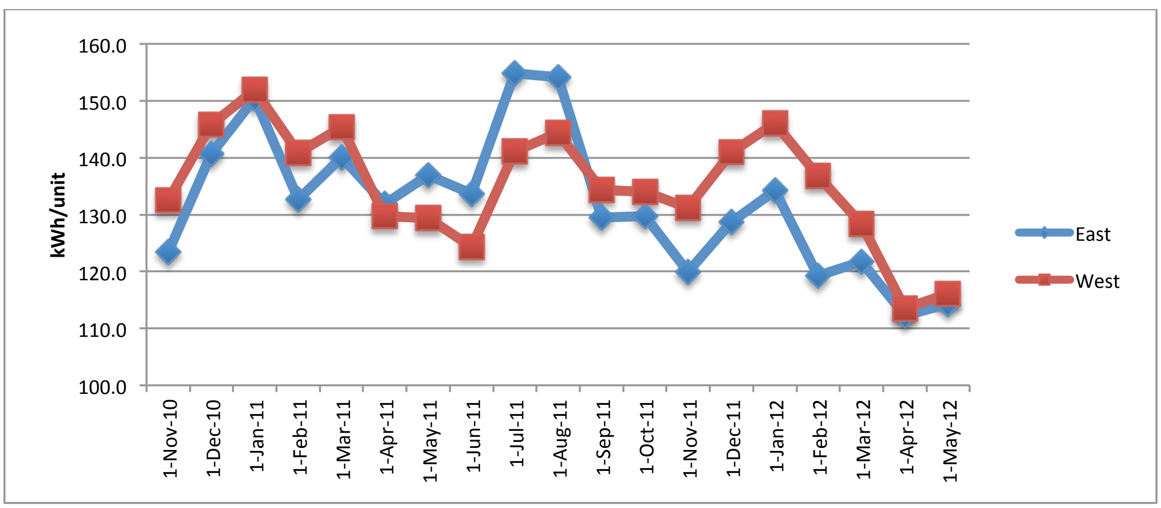

Figure 7: Total Monthly Electricity Consumption Average per Unit by Orientation

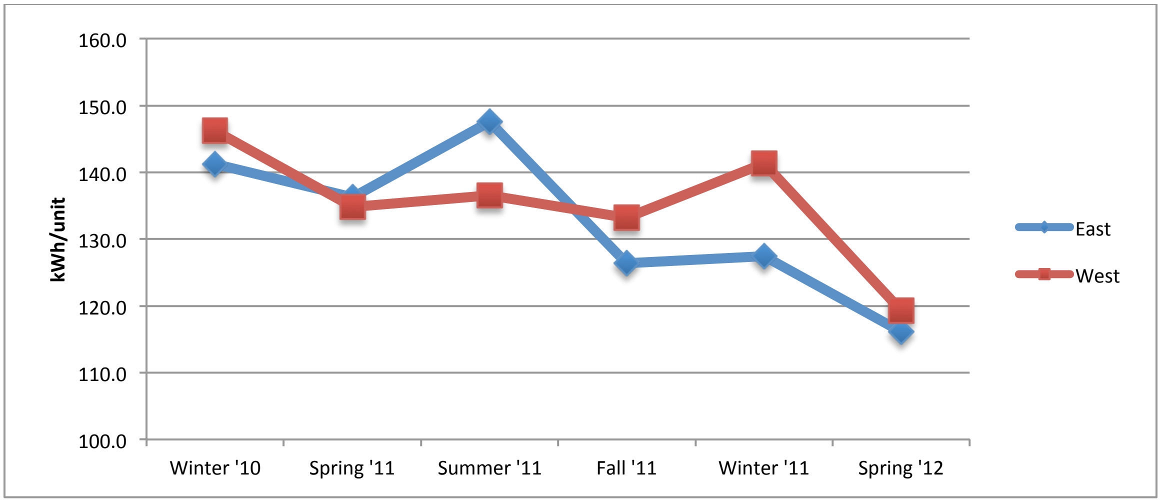

Figure 8: Total Seasonal Electricity Consumption Average per Unit by Orientation

The floor-by-floor analysis was carried out in the same manner as the whole building analysis, with averages obtained by floor and orientation, both monthly and seasonally. Looking at the consumption patterns for the individual floors (Figures 9-14 and Appendix H), the pattern established by Figure 8 is no longer discernible. Figures 9-14 describe, shown in cross-section, the East and West-facing consumption averages for each floor for the whole building during a particular season. The delta values located on the left side describe the consumption difference between orientations per floor. Darker values represent higher West-facing consumption, while the lighter values represent higher East-facing consumption. It becomes obvious looking at the individual figures that the alternating colours discredit the clear-cut pattern established by figure 8. In fact, whatever pattern may be discernible seasonally fails to repeat itself in the following year, further discouraging the chance of there being any relationship whatsoever. Given that the standard deviation for the unit consumption average is 77.05kWh/month, the peaks and valleys present in Figure 8 (range = 31.5kWh) seem rather insignificant.

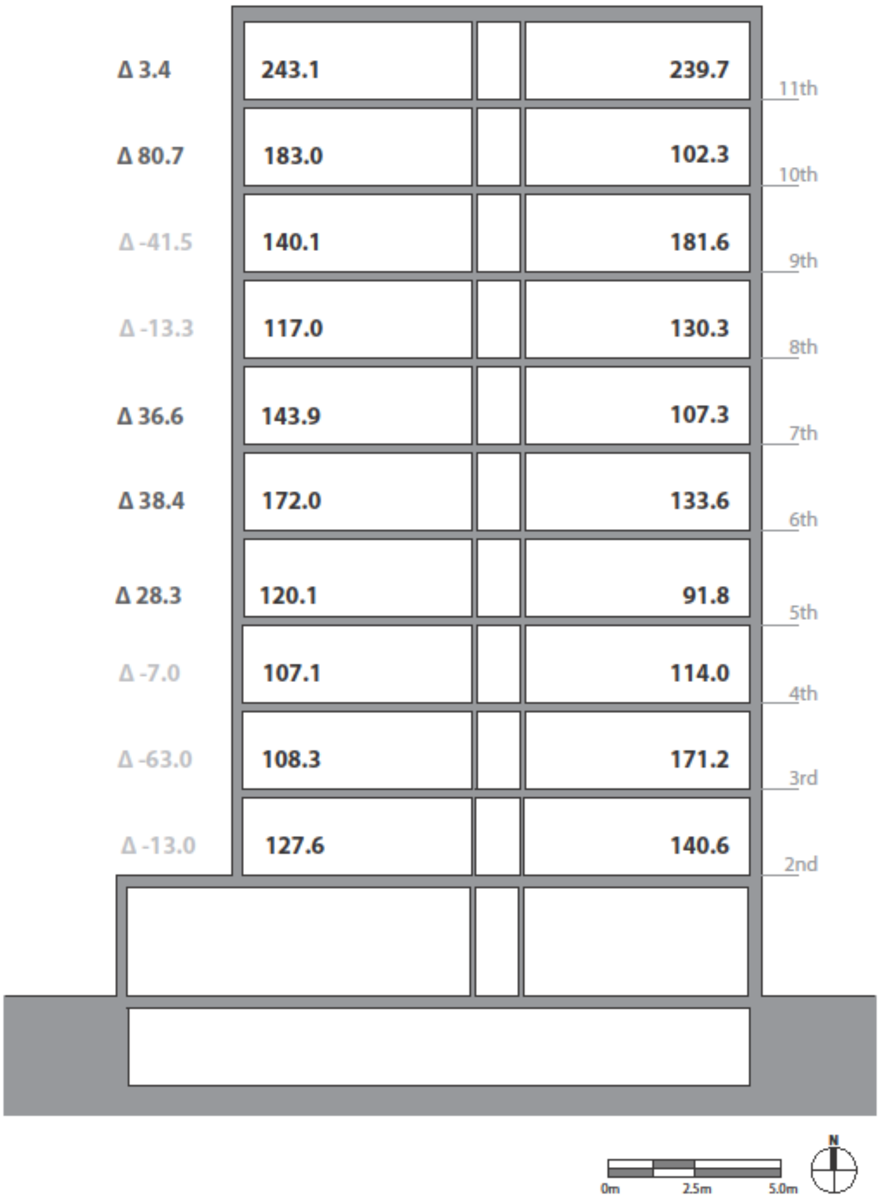

Figure 9: Effect of Height and Orientation in Seasonal Consumption - Winter '10 (kWh/month)

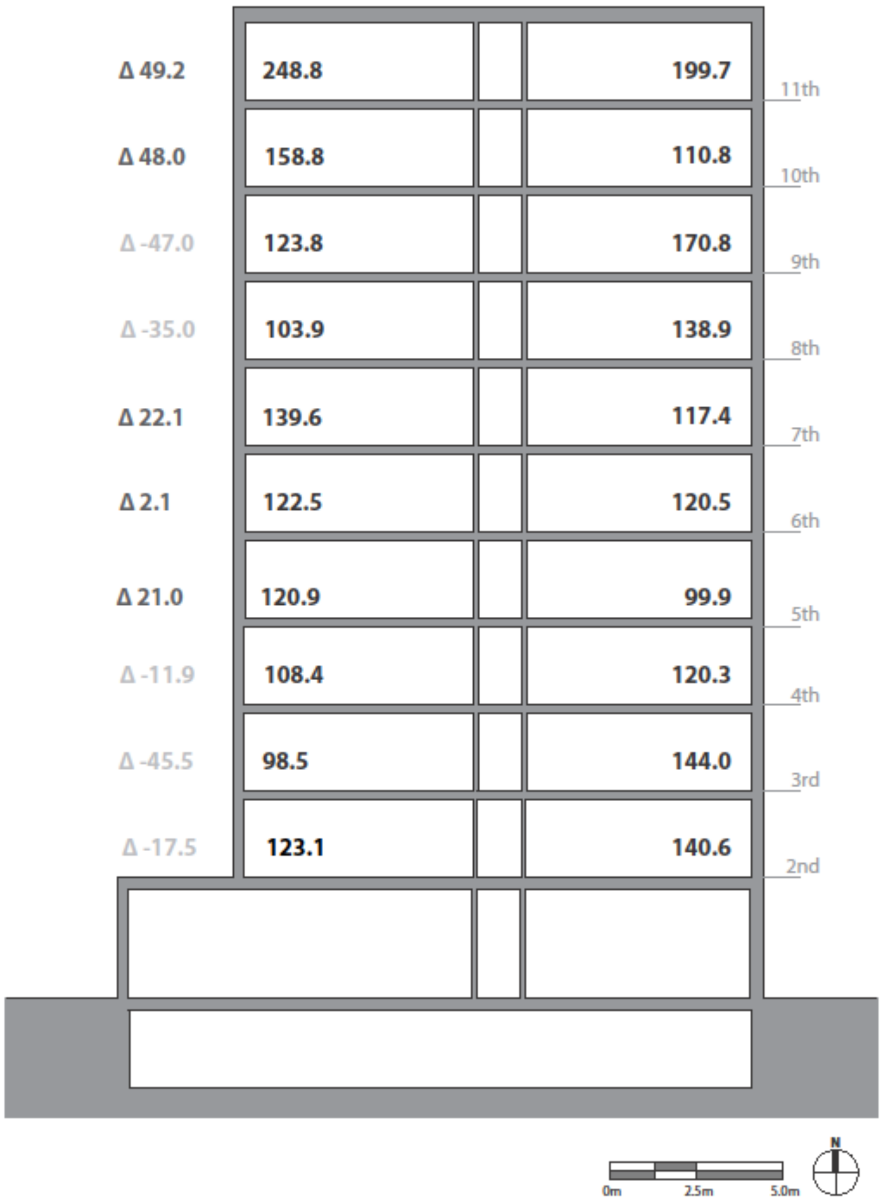

Figure 10: Effect of Height and Orientation in Seasonal Consumption - Spring '11 (kWh/month)

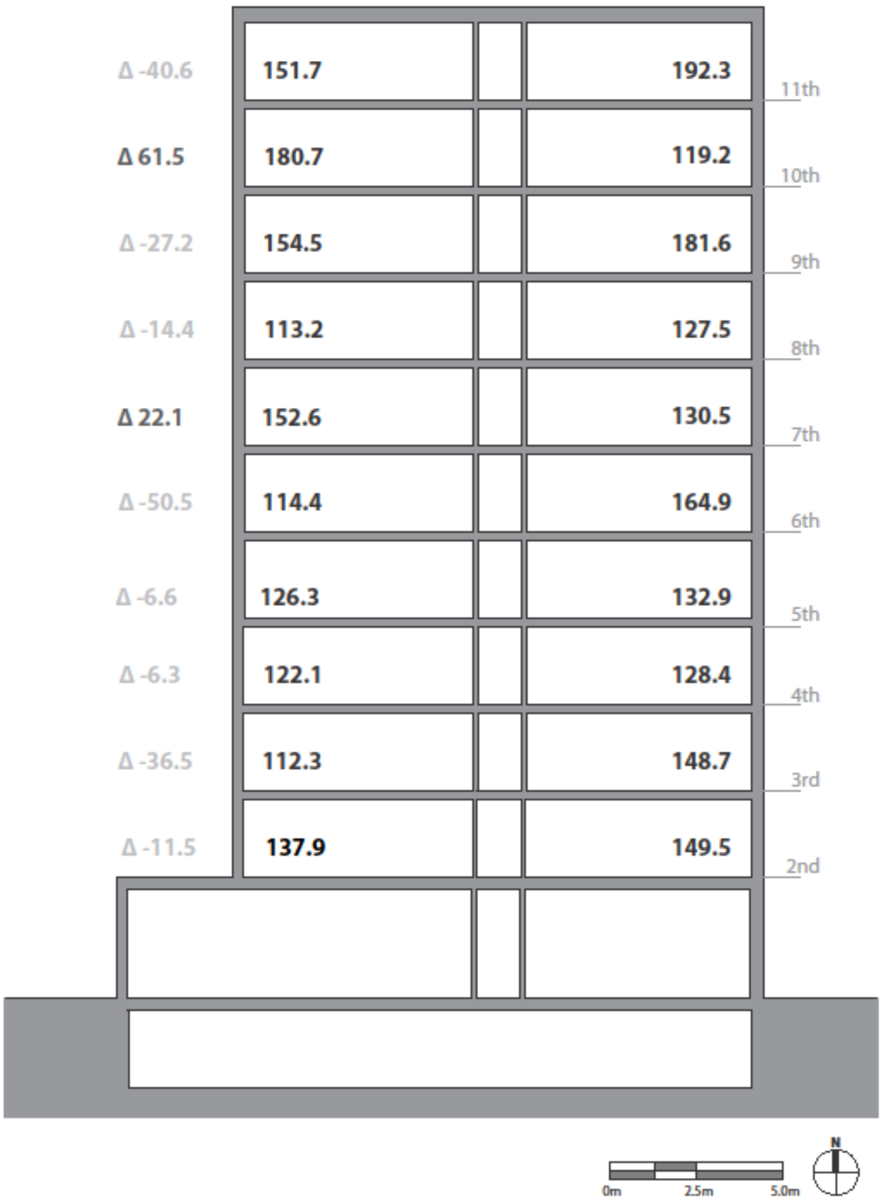

Figure 11: Effect of Height and Orientation in Seasonal Consumption - Summer '11 (kWh/month)

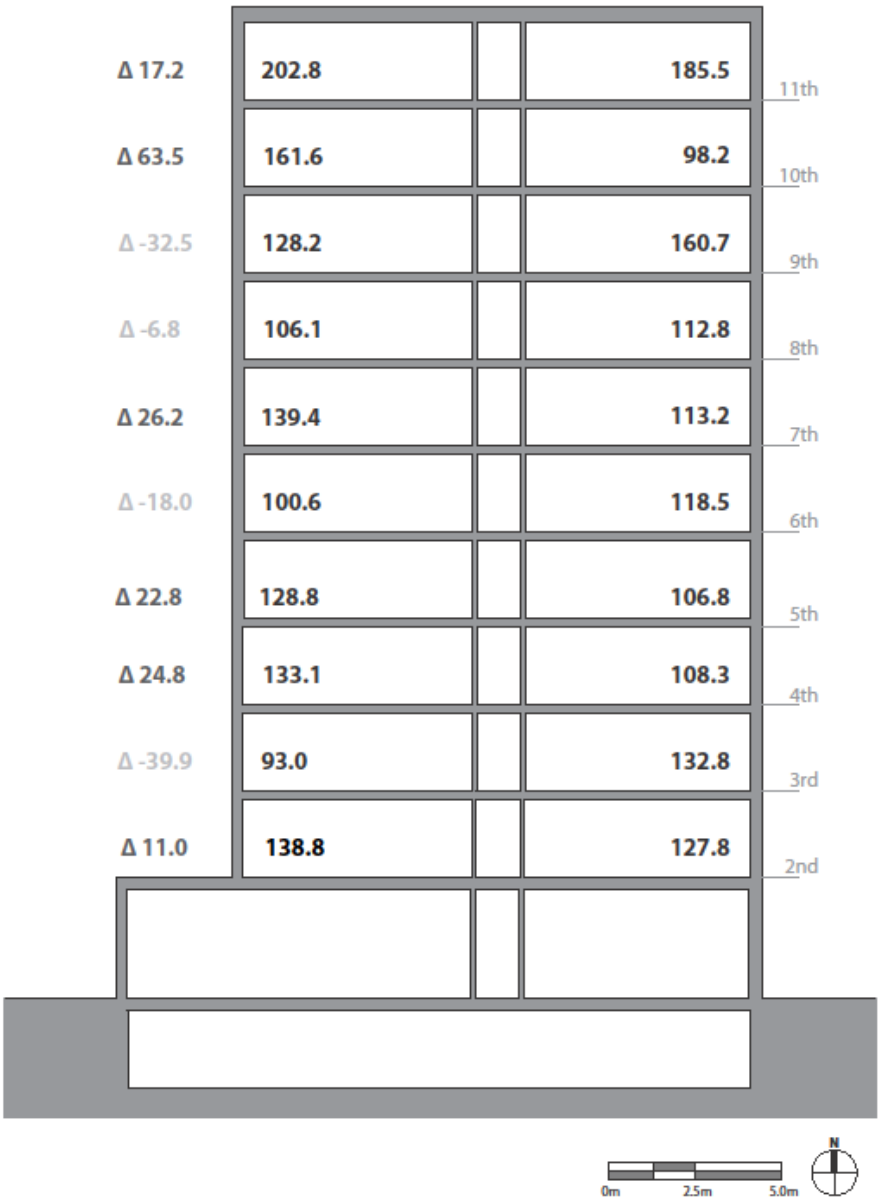

Figure 12: Effect of Height and Orientation in Seasonal Consumption - Fall '11 Orientation Ave. (kWh/month)

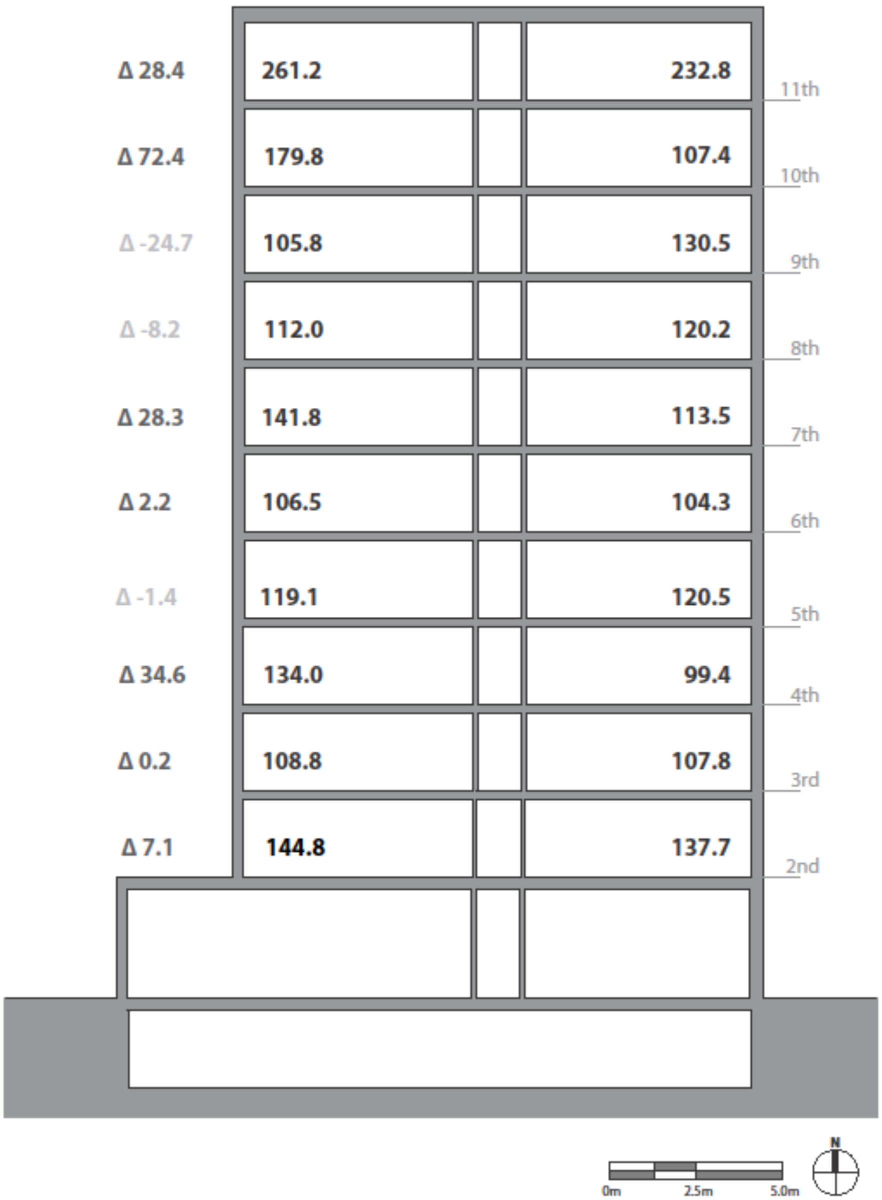

Figure 13: Effect of Height and Orientation in Seasonal Consumption - Winter '11 (kWh/month)

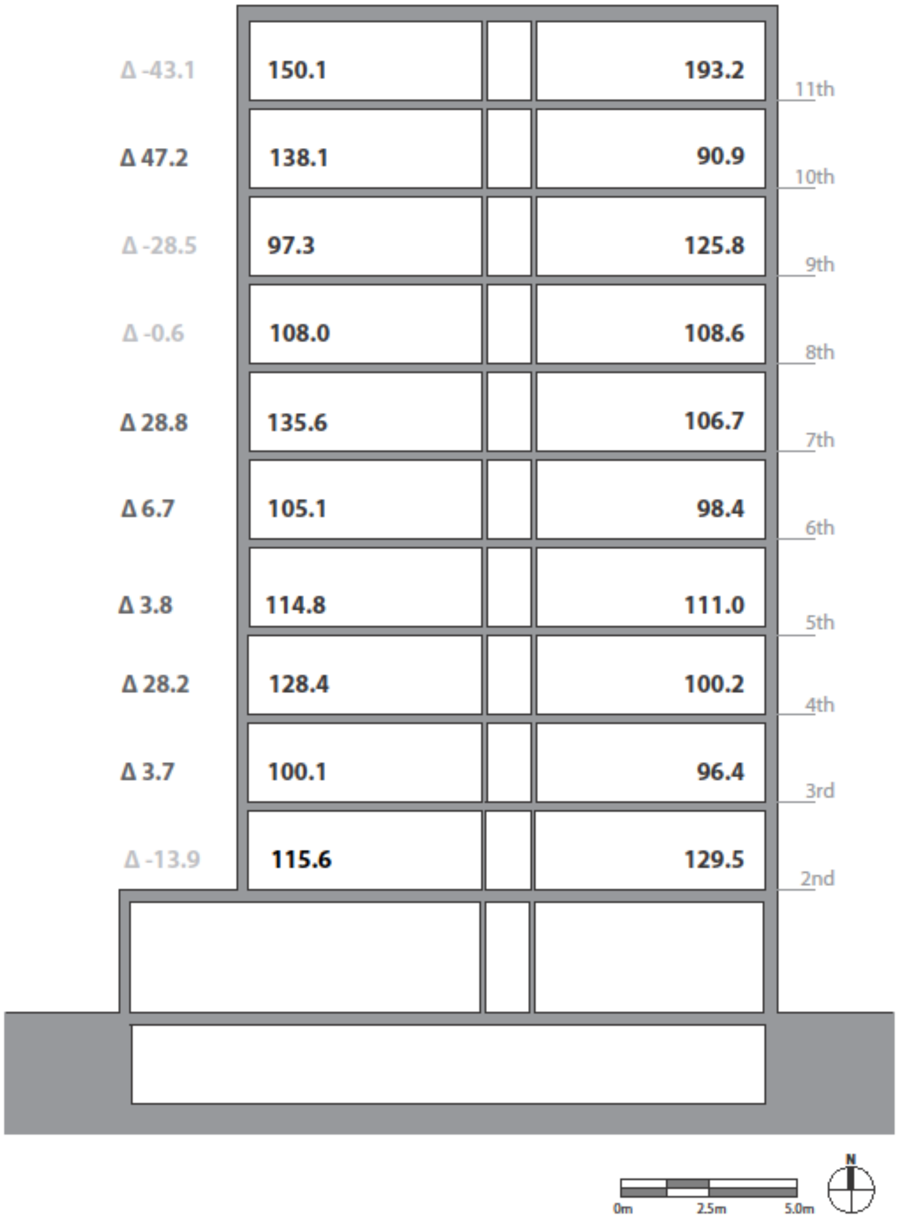

Figure 14: Effect of Height and Orientation in Seasonal Consumption - Spring'12 (kWh/month)

Finally, the annual electrical consumption averages per unit were plotted on the building floor plans, and analyzed for consumption patterns, such as interior vs. corner units, vertically reoccurring sinks, and differences between average unit consumption per floor. Appendix I provides a graphical analysis of the consumption averages for every unit at GP. Once again, there appears to be no pattern present. There is no clear relationship between units and their respective placement within the floor plan. Units with higher exposure areas (corner units) do not seem prone to high consumption rates any more than internal units, which benefit from having fewer exterior walls. Furthermore, there appears to be no vertical patterns established across the floors.

Overall, it is difficult to discern any particular pattern. Units with high consumption averages appear sporadically through the floor plans and show no particular relationship to their location within the structure (corners, floor, or orientation). Without further investigation, it may only be assumed that consumption variation is the direct result of tenant behavior.

6.3 Occupant Responses vs. Meter Readings

The matrix is comprised of tenant responses, plug-load consumption rates, and actual consumption values obtained from the electronic meters. The tenant responses selected are those related to the 28 different load types addressed by the survey. The particular questions selected are outlined in Appendix J. Note that usage-related responses, given as ranges, have been addressed by the three matrix instances: lower-bound, average, and upper-bound as described in the methodology. Further to this, a number of necessary usage parameters cannot be derived directly from the survey or the statistical databases, and must be estimated based on a combination of available data and assumptions. These parameters and their respective assumptions are summarized in Table 4.

Item	**Assumptions**
Cable box	- When 'Left on' is selected, usage will be set to 24h/day - Otherwise, time on TV = time on cable box
Internet	- Only available for tenants with computers - Time on computer = time on internet - Time not on computer incurs modem standby usage
Cell phone	- Assume a single 3h charge every other day
Speakers	- Available to tenants with TV sets and/or Computers. - Assume computer speakers when both TV and computer are present - Time on speakers = time on computer OR TV
Slow cooker	- Assume a 5h cycle twice per week.
Rice cooker	- Assume a 30min cycle every other day
Air conditioner	- Assume it runs full-time for 2 months/year, averaged over the year.
Heating Equipment	- Assume a 'typical day' averaged over the year based on daily average temperatures below 18^{0}C based on sample year 2011. - 254 days under 18^{0}C / 365 = 70%, 24h*70%=16.8h/day averaged over a year.
Cooling Equipment	- Assume a 'typical day' averaged over the year based on daily average temperatures above 24^{0}C based on sample year 2011. - 23 days over 24^{0}C / 365 = 6%, 24h*6%=2h/day averaged over a year.
Personal Heater	- Depends on daily average temperatures below 0^{0}C and time spent at home not including an 8h sleep cycle, based on sample year 2011. - 84 days under 0^{0}C / 365 = 23%, 24h*23%=5.5h/day averaged over a year. - Percentage of daily usage = (Time at home – 8)/24 - Total usage = 5.5h*Percent of daily usage.
Personal Fan	- Depends on daily average temperatures above 24^{0}C and time spent at home not including an 8h sleep cycle, based on sample year 2011.

	- 23 days over 24^{0}C / 365 = 6%, 24h*6%=2h/day averaged over a year. - Percentage of daily usage = (Time at home – 8)/24 - Total usage = 5.5h*Percent of daily usage.
Lights	- Ratings 5 (Never turn off) and 4 (Almost never turn off) will be given a 16h/day usage, so as to not include sleep. - Rating 3 (Sometimes turn off) will be given a 12h/day usage - Ratings 1 (Always turn off) and 2 (Almost always turn off) will be given usage as a function of Time at home – 8h sleep OR 3h (if they have made a selection under 'number of light bulbs left on over 3h'), whichever is higher.

Table 4: Usage Assumptions

The second set of parameters is the plug-load consumption rates. These are presented either as wattage + standby power, for appliances whose usage has been determined through the survey such as television sets and computers, or as monthly consumption values (kWh/month) for those items whose usage was not implicitly determined in the survey, such as radio or vacuum usage. Some of these values are common to all units, namely the stove wattage (Electrolux), the refrigerator monthly consumption (Moffat Appliances), and the electricity draw (W) of the fan-coil units (Johnson Controls), all of which were obtained directly from the manufacturer specifications. The values that had to be determined based on the limited data available were retrieved from various databases, namely the U.S. Energy Information Administration and the '*Energy Data Sourcebook for the U.S. Residential Sector'* by Wenzel, T. P., Koomey, J. G., Rosenquist, G. J., Sanchez, M., & Handford, J. W. Both of these sources built their databases from thousands of samples in the US, and are considered to be statistically reliable sources. The complete list of all loads, assumptions and sources is available in Appendix J. The last set of parameters is the actual consumption values from the electronic meters, which were used to determine discrepancies in the survey-based estimate.

6.3.1 Matrix Instances

Based on the range-style responses to usage time, 3 separate instances of the matrix have been created and results extracted. These instances are the lower-bound, average, and upper-bound conditions. As their names suggest, the lower and upper bound instances use the lower and upper bounds of each of the usage time ranged responses, with the average instance using the time in the middle of the range. The results are as follows:

Lower-Bound Matrix Instance

Overall Results	
73%	Of all estimates fall within 50% of the actual value
56%	Of all estimates are underestimates
44%	Of all estimates are overestimates
19%	Total of overestimates by more than 50%
8%	Total of underestimates by less than 50%
35%	Of tenants that allocated less than 6h sleep under the 'strict' estimate*
31%	Of tenants that allocated less than 6h sleep under the 'multitask' estimate*
6%	Of tenants that allocated less than 1h sleep
25%	Of tenants that allocated more than 2h of idle time, not including a 6h sleep cycle or any usage time responses.
13%	Incurred cooking overestimates
77%	Selected no cooking time in any appliance
Over-Estimations by More than 50%	
56%	Made time allocation overestimates*
67%	Made cooking time overestimates*
11%	Incurred statistical bias*
89%	Of these overshoots were the result of tenant-related discrepancies
Under-Estimations by Less than 50%	
25%	Of tenants that allocated more than 2h of idle time, not including a 6h sleep cycle or any usage time responses.
100%	Selected no cooking time in any appliance

Table 5: Lower-Bound Matrix Results

* These items are related to discrepancy sources that will be discussed in the following section.

Average Matrix Instance

Overall Results	
52%	Of all estimates fall within 50% of the actual value
25%	Of all estimates are underestimates
75%	Of all estimates are overestimates
46%	Total of overestimates by more than 50%
2%	Total of underestimates by less than 50%
40%	Of tenants that allocated less than 6h sleep under the 'strict' estimate*
33%	Of tenants that allocated less than 6h sleep under the 'multitask' estimate*
29%	Of tenants that allocated less than 6h sleep even after performing all other tasks simultaneously
8%	Of tenants that allocated less than 1h sleep
38%	Incurred cooking overestimates
Over-Estimations by More than 50%	
41%	Made time allocation overestimates*
77%	Made cooking time overestimates*
23%	Incurred statistical bias*
86%	Of these overshoots were the result of tenant-related discrepancies

Table 6: Average Matrix Results

Upper-Bound Matrix Instance

Overall Results	
33%	Of all estimates fall within 50% of the actual value
8%	Of all estimates are underestimates
92%	Of all estimates are overestimates
67%	Total of overestimates by more than 50%
0%	Total of underestimates by less than 50%
40%	Of tenants that allocated less than 6h sleep under the 'strict' estimate*
38%	Of tenants that allocated less than 6h sleep under the 'multitask' estimate*
13%	Of tenants that allocated less than 1h sleep
73%	Incurred cooking overestimates
Over-Estimations by More than 50%	
44%	Made time allocation overestimates*
94%	Made cooking time overestimates*
23%	Incurred statistical bias*
100%	Of these overshoots were the result of tenant-related discrepancies

Table 7: Upper-Bound Matrix Results

Not surprisingly, the results for the lower-bound instance tend toward under-estimation. This is primarily because the cooking-related loads are zero in 77% of the samples. Inversely, the results from the upper-bound instance tend toward over-estimation. This resulted from 73% of the tenants having excessive cooking times. Both of these outcomes are the result of the same problem: the consumption rates of cooking appliances, namely the stove and oven, are much higher than any other load type, and the usage range for these loads is too broad. With the typical tenant selecting the lowest allowable usage range, the lower-bound instance tends to zero, while the upper-bound instance (1h) is much higher than the tenant intended to select. As highlighted by the cooking-related consumption issues presented above, the upper and lower bound instances are generally unreliable, as they represent extremes and are not necessarily comparable to the individual units. In fact, their respective results support using the average matrix instance, as it is the closest approximation to the actual metered readings. For the complete unit-by-unit average matrix instance See Appendix L.

Overall, the ratio of overestimates to underestimates is high (3:1 in the average instance), indicating that while half of the respondents came relatively close to their actual metered consumption, the large majority of respondents tended toward overestimating their respective metered consumption. A closer look at the matrix results reveals two primary sources of discrepancy: time overestimates and statistical bias.

6.3.2 Discrepancy Sources

Time Overestimates

In order to establish a total monthly consumption for each unit, survey questions of two types were considered: those relating to appliance inventory and those related to usage, which were estimated by tenants. Not surprisingly, the most volatile parameter was also the one that was related to estimation rather than the more straight-forward appliance inventory. These overestimates take two forms, time allocation and cooking overestimates.

<u>Time Allocation:</u> Time allocation was verified based on each tenant's response to "how many hours do you spend in your apartment (includes sleeping)?" and the number of hours allocated to cooking, using the computer, and watching TV. Three sets of checks were set up. The first check (a more stringent check) assumed that cooking (the larger between oven and stove usage), using the computer, and watching TV were not be performed simultaneously. The sum of these estimates was subtracted from the 'time spent at home' and a value, presumably 'average sleeping time', was determined. 40% of tenants reported average sleeping times less than 6h. The second check (a more lenient check) assumed that using the computer and watching TV would always take place simultaneously. In this case 33% of tenants reported less than 6h sleep averages, with 8% of the total sample reporting less than 1h. Finally, allowing for all tasks to happen simultaneously (a rather synchronized effort), 29% of all samples reported less than the 6H sleep cycle. This suggests that a large portion of

the sample (approximately a third) were unable to accurately describe their typical daily schedule while answering the survey questions, resulting in inflated usage estimates. These time-management overestimates, in turn, resulted in higher consumption estimates.

Cooking Time: Figure 39 has a very obvious implication: usage estimates for cooking dominate the overall consumption estimate, as it amounts to almost half of the total consumption, and 55% of the total unknown load (the refrigerator load is assumed constant based on the product specification sheet). While time over-estimates anywhere in the matrix affect the final result, minimal estimation errors in this parameter, at a rate of 96.2kWh/h for the average month, dramatically affect the final result. For this reason, a cooking overestimate check has been built into the matrix. A monthly 'base consumption' parameter was determined based on the consumption of the basic appliances (Fridge, stove, microwave) and unit lighting. This number, which excludes all other electronic loads (and therefore avoids 'statistical error' as described in the following section), is then compared to each unit's respective average consumption. If the base consumption is higher than the metered average, error can be attributed to a cooking time overestimate, since it is the only significant variable in the equation. Of the units whose consumption estimate surpassed the metered consumption by more than half, 59% were found to incur cooking time over estimates.

Statistical Bias

Average monthly consumption values derived from statistical analysis are not necessarily reliable in combination, as they do not account for the effect of having various similar loads. This issue is illustrated by the example case where tenants have both a VCR and a DVD player. In this case, the statistical analysis has determined a consumption value for each appliance based on their average usage time across a large sample and the average consumption rate for each appliance. However, since both of these devices perform the same function (watch movies) the average usage time, or movie-watching time, should be shared. In this case the statistical consumption is not a simple addition of values, but a combination of both, a weighted average dependent of the ratio of VCR to DVD usage. Furthermore, this bias is cumulative, depending directly on the number of electronic devices selected by the tenant, and not just on how similar they are. Since there is only so much time in a day, a tenant with an excessive number of electronic gadgets would not be able to use each gadget as often as the statistical average would suggest, ultimately consuming less energy than the addition of all the individual statistical loads. This bias is present in 36% of the samples whose consumption exceeded 50%.

6.3.3 Cases Results

Further to this unit-by-unit analysis, 3 separate cases were constructed to evaluate the overall performance of tenants during the survey while attempting to limit the effect of the established sources of bias and over estimates. Note the following:

- All the values in the column 'Case 1' are the modes for the responses obtained in the survey. The mode recurrence percentages apply to these values only.
- A load type of '0.00' means the mode for that load type has been determined to be 'no appliance present'
- All usage time values in 'Case 2' are averages for the whole sample, and are not affected by the mode recurrence in that row.
- Mode recurrences of less than 50% are highly susceptible to mode bias.

			Case 1	Case 2	Case 3
Question #	Consumption type	Mode Recurrence	Appliance Mode+ Usage Mode	Appliance Mode+ Usage Average	Consumption Average
7	Time at home (h)	48%	11.00	11.90	
11	**TV type**	33%	LCD/LED	LCD/LED	
10	Daily Usage (h)	31%	2.00	3.40	
	Monthly Consumption		10.95	16.04	15.17
12	**Cable Box**	58%	0.00	0.00	
10	Daily Usage (h)	58%	0.00	5.15	
	Monthly Consumption		0.00	0.00	3.82
13	**Computer type**	54%	0.00	0.00	
14	Daily Usage (h)	56%	0.00	1.69	
	Monthly Consumption		0.00	0.00	6.34
16	**Internet Daily Usage (h)**	58%	0.00	1.52	
	Monthly Consumption	58%	0.00	0.00	3.01
17 a.	**Cellphone Charger**	73%	1.00	1.00	
	Monthly Consumption	73%	0.23	0.23	0.17
17 b.	**Home Phone**	60%	0.00	0.00	
	Monthly Consumption	60%	0.00	0.00	0.86
17 c.	**VCR**	88%	0.00	0.00	
	Monthly Consumption	88%	0.00	0.00	0.73
17 d.	**DVD Player**	50%	0.00	0.00	
	Monthly Consumption	50%	0.00	0.00	2.92
17 e.	**Game Console**	98%	0.00	0.00	
	Daily Usage (h)	98%	0.00	0.00	
	Monthly Consumption		0.00	0.00	0.12
17 f.	**Printer**	79%	0.00	0.00	
	Monthly Consumption (kWh/month)	79%	0.00	0.00	0.78
17 g.	**Speakers**	75%	0.00	0.00	
	Daily Usage (h)	75%	0.00	0.00	
	Monthly Consumption		0.00	0.00	1.43
17 h.	**Clock (alarm)**	65%	0.00	0.00	
	Monthly Consumption	65%	0.00	0.00	1.42
17 i.	**Stereo/Radio**	50%	1.00	1.00	
	Monthly Consumption	50%	1.58	1.58	0.79

17 j.	**Slow Cooker**	90%	0.00	0.00	
	Daily Usage (h)	90%	0.00	0.00	
	Monthly Consumption		0.00	0.00	2.24
17 k.	**Rice Cooker**	88%	0.00	0.00	
	Daily Usage (h)	88%	0.00	0.00	
	Monthly Consumption		0.00	0.00	0.47
17 l.	**Iron**	58%	0.00	0.00	
	Monthly Consumption	58%	0.00	0.00	0.35
17 m.	**Vacuum**	77%	0.00	0.00	
	Monthly Consumption	77%	0.00	0.00	1.15
17 n.	**Humidifier**	96%	0.00	0.00	
	Monthly Consumption	96%	0.00	0.00	1.39
17 o.	**Other**	88%	0.00	0.00	
	Daily Usage (h)	88%	0.00	0.03	
	Monthly Consumption		0.00	0.00	1.51
18	**Heating Equip Set Point**	35%	0.00	0.00	
Winter	Daily Usage (h)	100%	16.70	16.70	
	Monthly Consumption		0.00	0.00	15.46
19	**Cooling Equip Set Point**	46%	0.00	0.00	
Summer	Daily Usage (h)	100%	1.51	1.51	
	Monthly Consumption		0.00	0.00	0.98
20 d.	**Personal Heater**	94%	0.00	0.00	
Winter	Daily Usage (h)	94%	0.69	0.90	
	Monthly Consumption		0.00	0.00	1.58
20 e.	**Personal Fan**	73%	0.00	0.00	
Summer	Daily Usage (h)	73%	0.19	0.25	
	Monthly Consumption		0.00	0.00	0.39
	Unit Lights				
22, 23	CFL Light Bulbs	25%	3.00	3.00	
22, 23	Incandescent Light Bulbs	33%	0.00	0.00	
	Equivalent Wattage/Bulb (W)		18.00	18.00	
21a	... off when not at home	85%	1.00	1.00	
21b	... off when not in use	71%	1.00	1.00	
24	No. of lights on over 3h	81%	1.50	1.80	
	Daily Usage (h)	69%	3.00	5.10	
	Monthly Consumption		2.46	5.04	10.04
	Stove				
33	Daily Usage (h)	67%	0.50	0.85	
	Monthly Consumption	67%	27.76	47.42	47.42
	Oven				
34	Daily Usage (h)	48%	0.00	0.41	
	Monthly Consumption	48%	4.00	39.83	39.83
	Microwave				
35	Daily Usage (min)	58%	0.00	2.38	

	Monthly Consumption	58%	0.00	0.00	3.08
	Fridge				
	Monthly Consumption	100%	30.75	30.75	31.39
	Base Monthly Consumption		**64.97**	**123.04**	**131.76**
	Survey Monthly Consumption		**77.73**	**140.89**	**194.82**
	Actual Monthly Consumption		**133.91**	**133.91**	**133.91**
	% Difference		**-42%**	**5%**	**45%**

Table 8: Matrix Assessment for Cases 1 to 3

Case 1: Survey Mode

Both the load types and the usage times in case 1 have been selected based on the survey responses that appear most often either in the survey (when parameters were specifically addressed) or in the matrix (when parameters were determined by algorithms or assumptions) creating a 'basic unit', an inventory of the most common load types and usage times across the sample. This case falls at the lower end of the average (-42%) because it inherently reduces time overestimates and statistical bias by removing all eccentricities from the analysis, such as uncommon gadgetry or excessive cooking times. Unfortunately, by removing all eccentricities, this method also removes abnormal consumption patterns that are in fact present in the sample, causing the 'base unit' to consume less than the actual metered average (incurs mode bias). As a result of this bias, the consumption of case 1 does not include loads related to heating, cooling, or computers.

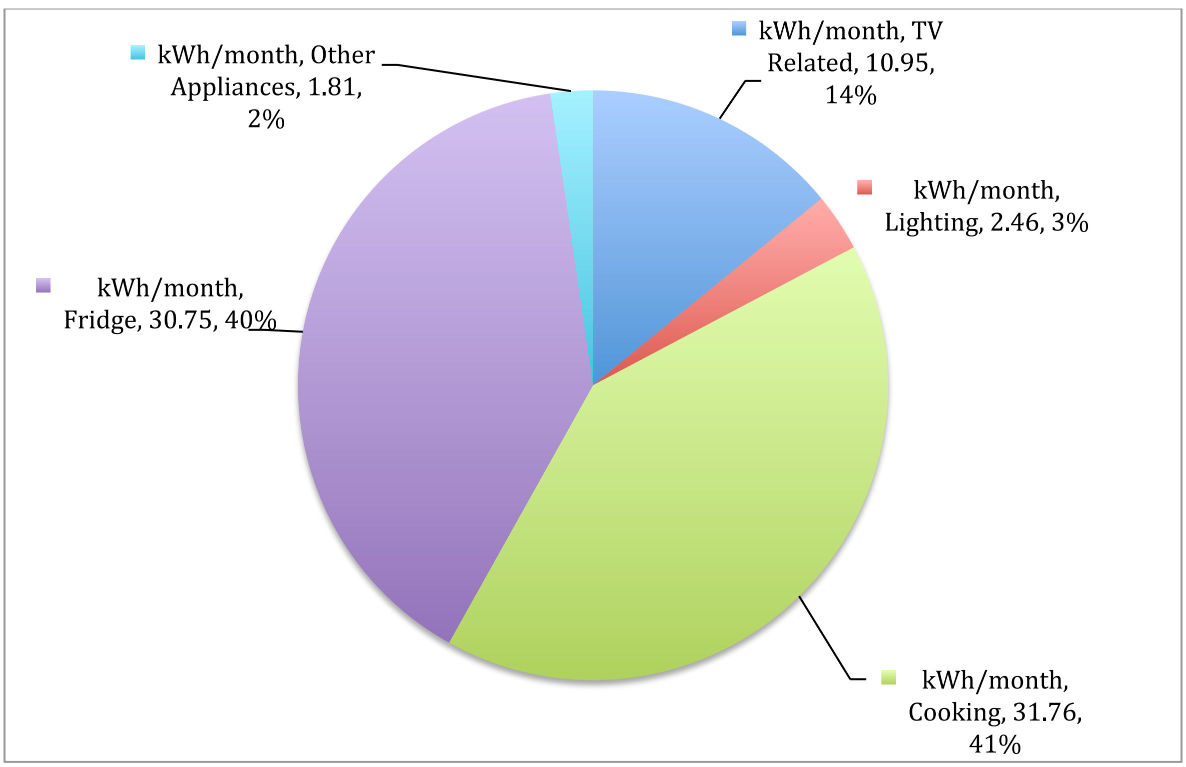

Figure 15: Case 1 Consumption (kWh/unit)

Case 2: Appliance Mode + Usage Average

Like case 1, case 2 provides an inventory of the most common loads present in units by using the mode of load type questions. However, unlike case 1, case 2 determines how long the loads are running based on a whole-sample average. In doing so, case 2 accommodates eccentricities present in usage patterns, such as abnormally long cooking times. The resulting 'basic unit' is one that more closely resembles the consumption average for the whole sample while still avoiding statistical bias.

This assessment case is particularly effective in this study because the units at GP, being relatively small, cannot accommodate many appliances. This means that load type modes (basic appliances found in the majority of units) have high a mode recurrence, making the case more accurate. This in turn places emphasis on usage time responses as the dominant variables in the matrix and obtaining their average serves to capture all the eccentricities present in the sample. As a result, the electricity consumption of case 2 (5%) most closely resembles the consumption average of the units at GP. However, it is worth noting that, like case 1, case 2 incurs mode bias and does not include loads related to heating, cooling, or computers.

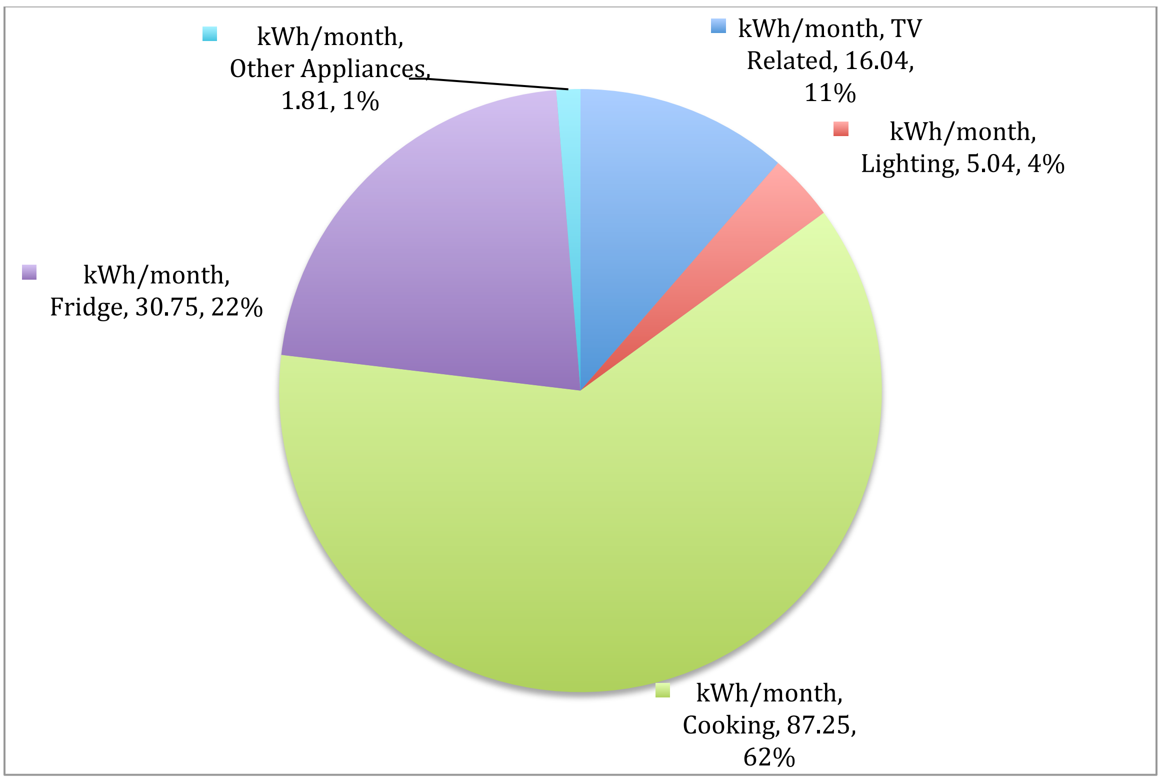

Figure 16: Case 2 Consumption (kWh/unit)

Case 3: Consumption Average

Case 3 calculates the load consumption averages for each load type and then adds them into a total average consumption/unit value, which is a summary of the matrix results. Because this case only looks at the consumption values calculated across the matrix, it accounts for all eccentricities present in the survey, both by load type and usage, and therefore incurs both time overestimates and statistical bias. As a result, this value (+45%) is the highest of the 3 cases because it is the most susceptible to overestimation by tenants. Figure 17 outlines the survey-based electricity consumption distribution amongst the load types.

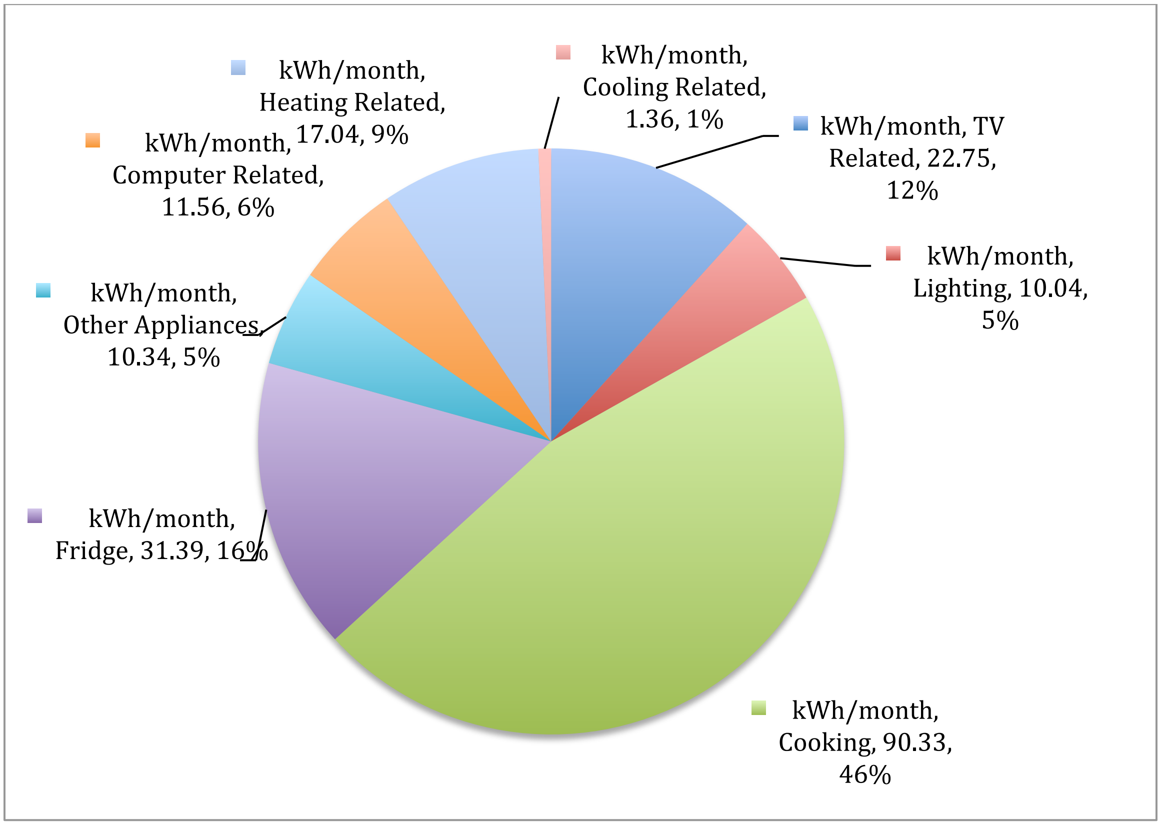

Figure 17: Case 3 Consumption (kWh/unit)

It is worth noting that the values obtained in case 3 are not representative of any particular unit, but rather represent the averaged outcome of the matrix. For this reason, comparison to this inflated average should exceed the established RDH benchmarks. However, comparing the in-unit lighting load (5.83kWh/m^2/year) and total plug load (97.8kWh/m^2/year) at GP to the benchmark set up by RDH yields interesting results. At GP, lighting consumption is only 38% of the expected load, while plug loading is almost 5 times that of RDH. Considering that the whole-building analysis declared the samples equivalent, these discrepancies can only be attributed to the effect of average unit size. RDH likely sampled units that are significantly larger than those at GP (after all, units at GP are a mere 20.7m^2). Larger units require more lighting due to larger surface areas and the introduction of partitions (GP units are bachelor-style), yet the basic plug loads are the same (fridge, stove, TV, etc) meaning that consumption in a per-m^2 basis would yield a lower value.

7. Conclusions

Comparing occupant self-assessed behaviour to actual metered consumption hinges on the assessment's ability to convert survey responses and statistical consumption values into a consumption/month value for each unit in the sample. This has proven to be quite difficult given the number of variables in the study and the quality of the responses obtained from the survey, particularly when it comes to missing usage times and response ranges that are too large. Assessing the upper and lower bound instance for the matrix makes it clear that usage time ranges can dramatically affect the matrix results if the load type is significant enough and the range it too large (stove/oven usage). As a whole, it is difficult to assess the accuracy of the study without making dramatic changes to the survey and/or the means of establishing the monthly consumption loads (individual metering per load type), coupled with more advanced statistical analysis.

Based on the results obtained from the average matrix instance, the individual unit estimates were found to be only approximately 50% reliable given a 50% tolerance; a considerable value given the standard is 10%. Furthermore, the ratio of overestimates to underestimates is 3:1. This tendency to overestimate results from discrepancies related to time management and cooking overestimates, which amounts to 40% and 38% of all samples respectively, affecting a total of 60% of all samples. Given a more accurate assessment strategy (including monitored plug loads), results like these could lead to the miss-allocation of resources during a retrofit (over-sizing of supply lines, downplaying the use of the fan-coil units, offsetting the perceived balance of unit-to-common loading, etc) and can easily mislead energy-saving strategies when it comes to appliance upgrades based on usage and overall efficiency.

The discrepancies found in the individual unit estimates may be filtered out through the use of mode-based cases. These are particularly effective when sample sizes are not large enough for averages to handle unusually high and low responses. However great care must be taken to avoid 'mode bias' as described in the methodology.

8. Recommendations

The most prevalent source of discrepancy in the study is time overestimates. These can be mediated by presenting all time-allocation questions in a manner that forces respondents to reconcile their numbers, such as having these questions presented in sequence and in the same page, where tenants can see their previous answers to inform their current estimates. Further to this, 'usage time' questions should have tighter answer ranges, particularly for items with very high consumption rates such as ovens. Allowing more stringent ranges and/or giving respondents the opportunity to fill their own responses minimizes assumptions during processing and strengthens the validity of average-based analysis while minimizing the chance of 'mode bias'.

Beyond these time-based considerations, it may be worth introducing custom-made questions into the survey where the tenancy type or building characteristics require it. In the case of GP, it would be helpful to determine whether tenants are aware of and can operate the technology present in their units, such as the air-tight window latches and fan-coil settings. Based on the responses given in the survey, it is likely that tenants answered seasonal set-point questions inaccurately because they did not understand the system or the question (most selected no heating during the winter). These context-sensitive questions could help to either clarify questions for the tenants or minimize ambiguity in processing the responses.

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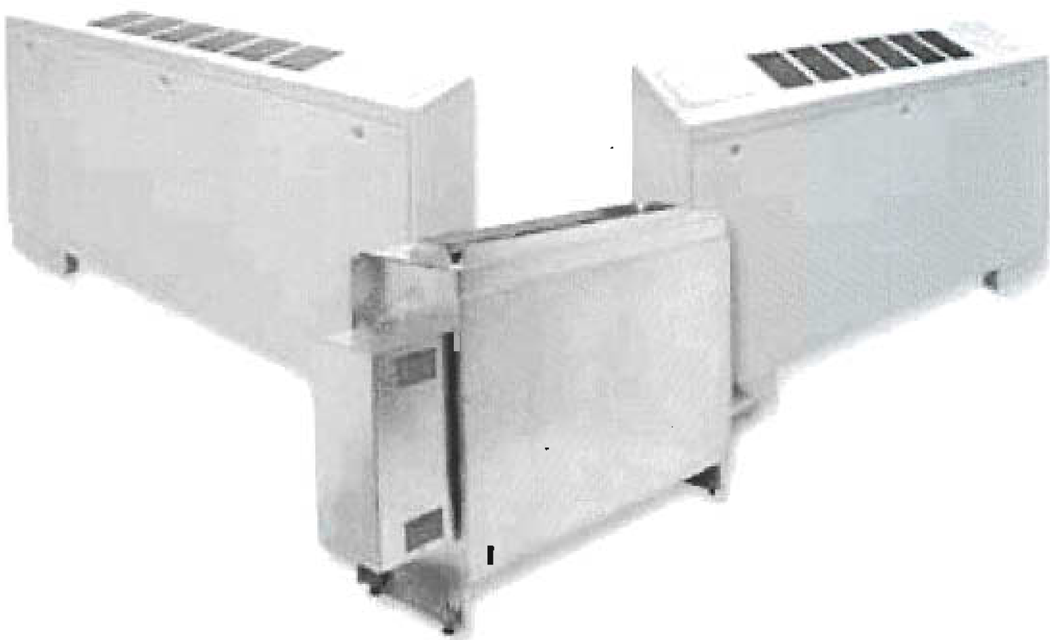
10 Appendices

Appendix A: Fan-Coil Unit Specification

ENVIRO-TEC® BY JOHNSON CONTROLS	SERIES B VERTICAL FLOOR FAN COIL UNIT	
INSTALLATION, OPERATION & MAINTENANCE	New Release	Form ET115.24-NOM9 (908)

MODEL VFC/VFE/VFS



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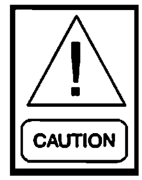
SAFETY SYMBOLS

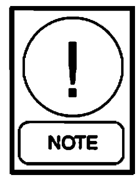
The following symbols are used in this document to alert the reader to areas of potential hazard:

***DANGER** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.*

***WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.*



***CAUTION** identifies a hazard which could lead to damage to the machine, damage to other equipment and/or environmental pollution. Usually an instruction will be given, together with a brief explanation.*



***NOTE** is used to highlight additional information which may be helpful to you.*

SAFETY CONSIDERATIONS

The equipment covered by this manual is designed for safe and reliable operation when installed and operated within its design specification limits. To avoid personal injury or damage to equipment or property while installing or operating this equipment, it is essential that qualified, experienced personnel perform these functions using good judgment and safe practices. *See the following cautionary statements.*

DANGER

ELECTRICAL SHOCK HAZARDS. All power must be disconnected prior to installation and serving this equipment. More than one source of power may be present. Disconnect all power sources to avoid electrocution or shock injuries.

DANGER

MOVING PARTS HAZARDS. Motor and Blower must be disconnected prior to opening access panels. Motors can start automatically, disconnect all power and control circuits prior to servicing to avoid serious crushing or dismemberment injuries.

DANGER

HOT PARTS HAZARDS. Electric Resistance heating elements must be disconnected prior to servicing. Electric Heaters may start automatically, disconnect all power and control circuits prior to servicing to avoid burns.

WARNING

Check that the unit assembly and component weights can be safely supported by rigging and lifting equipment.

WARNING

All assemblies must be adequately secured during lifting and rigging by temporary supports and restraints until equipment is permanently fastened and set in its final location.

WARNING

All unit temporary and permanent supports must be capable of safely supporting the equipment's weight and any additional live or dead loads that may be encountered. All supports must be designed to meet applicable local codes and ordinances.

WARNING

All fastening devices must be designed to mechanically lock the assembly in place without the capability of loosening or breaking away due to system operation and vibration.

CAUTION

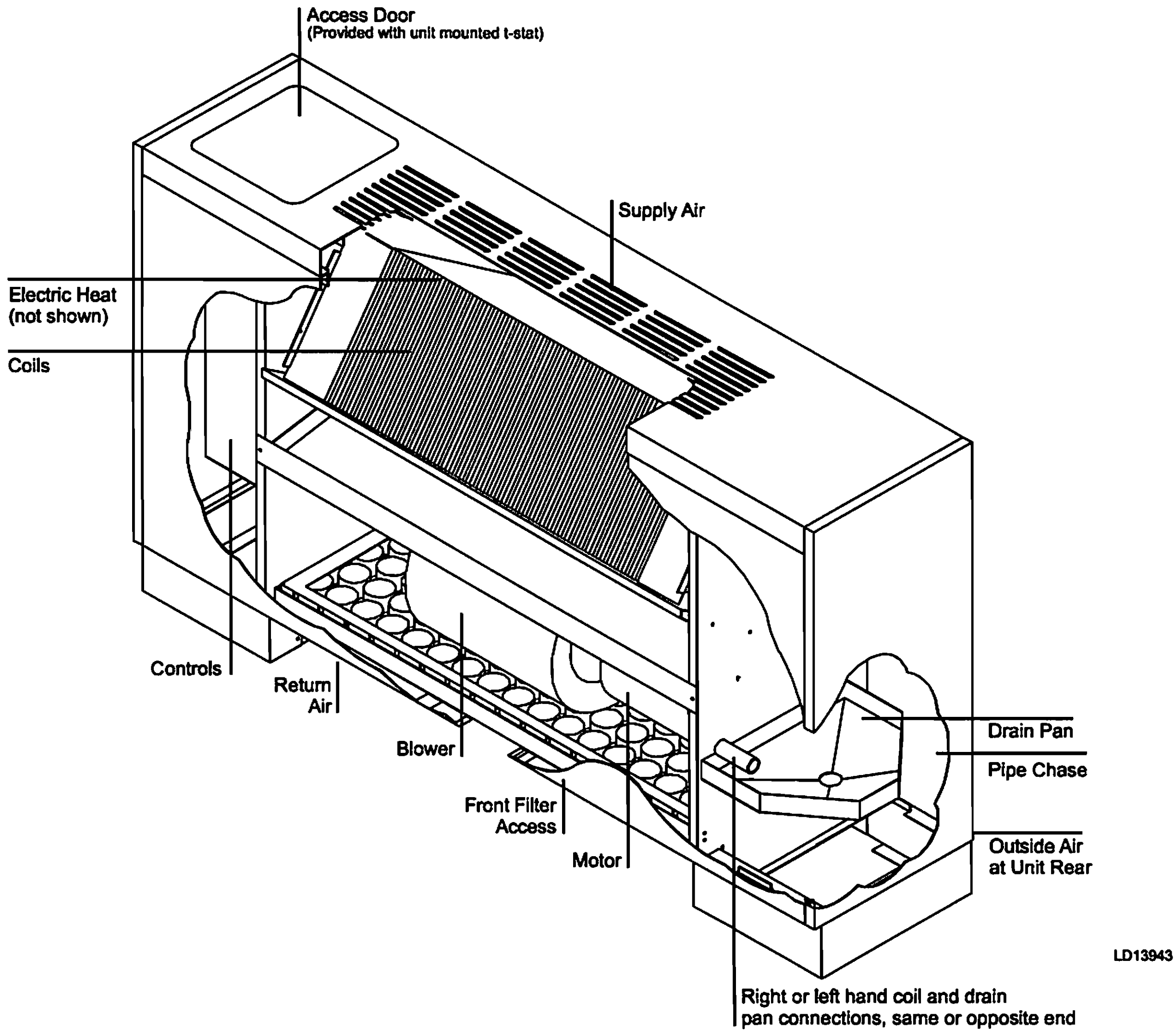
Secure all dampers when servicing damper, actuator or linkages. Dampers may activate automatically, disconnect control circuits or pneumatic control systems to avoid injury.

CAUTION

Protect adjacent flammable materials when brazing, Use flame and heat protection barriers where needed. Have fire extinguisher available and ready for immediate use.

SECTION 1 - RECEIPT & INITIAL INSTALLATION

VF SERIES B FEATURES



PREFACE

ENVIRO-TEC® fan coils represent a prudent investment which can, with proper installation, operation, and regular maintenance, give trouble-free operation and long service.

Your equipment is initially protected under the manufacturer's standard warranty; however, this warranty is provided under the condition that the steps outlined in this manual for initial inspection, proper installation, regular periodic maintenance, and everyday operation of the equipment be followed in detail. This manual should be fully reviewed in advance of any actual work being done on the equipment. Should any questions arise, please contact your local Sales Representative or the factory BEFORE proceeding.

The equipment covered by this manual is available with a vast variety of options and accessories. Consult the approved unit submittal, order acknowledgement, and other manuals for details on the options and accessories provided with the equipment on each project.

WARNING

No attempt should be made to handle, install, or service any unit without following safe practices regarding mechanical equipment.

WARNING

All power must be disconnected before any installation or service should be attempted. More than one power source may be supplied to a unit. Power to remote mounted control devices may not be supplied through the unit.

WARNING

Never wear bulky or loose fitting clothing when working on any mechanical equipment. Gloves should only be worn when required for proper protection from heat or other possible injury. Safety glasses or goggles should always be worn when drilling, cutting, or working with chemicals such as refrigerants or lubricants.

WARNING

Never pressurize any equipment beyond specified operating pressures. Always pressure test with some inert fluid or gas such as clear water or dry nitrogen to avoid possible damage or injury in the event of a leak or component failure during testing.

WARNING

Always protect adjacent flammable material when welding or soldering. Use suitable heat shield material to contain sparks or drops of solder. Have fire extinguisher available for use when welding or brazing.

The manufacturer assumes no responsibility for personal injury or property damage resulting from improper or unsafe practices during the handling, installation, service, or operation of any equipment.

UNPACKING & INSPECTION

All units are carefully inspected at the factory throughout the manufacturing process under a strict detailed quality assurance program, and where possible, all major components and subassemblies are carefully tested for proper operation and verified to be in full compliance with the factory manufacturing documents. Customer furnished components such as control valves, switches and DDC controls are not factory tested.

Each unit is carefully packaged for shipment to avoid damage during normal transport and handling. The equipment should always be stored in a dry place in the proper orientation as marked on the carton.

All shipments are made F.O.B. factory and it is the responsibility of the receiving party to inspect the equipment upon arrival. Any obvious damage to the carton and/or its contents should be recorded on the bill of lading and a claim should be filed with the freight carrier.

After determining the condition of the carton exterior, carefully remove each unit from the carton and inspect for hidden damage. At this time check to make sure that "furnished only" items such as switches, thermostats, etc. are accounted for. Any hidden damage should be recorded and immediately reported to the carrier and a claim filed as before. In the event a claim for shipping damage is filed, the unit, shipping carton, and all packing must be retained for physical inspection by the freight carrier.

All equipment should be stored in the factory-shipping carton with internal packing in place until installation.

At the time of receipt, the equipment type and arrangement should be verified against the order documents. Should any discrepancy be found, the local Sales Representative should be notified immediately so that the proper action may be instituted. Should any question arise concerning warranty repairs, the factory must be notified BEFORE any corrective action is taken. Where local repairs or alterations can be accomplished, the factory must be fully informed as to the extent and expected cost of those repairs before work is begun. Where factory operations are required, the factory must be contacted for authorization to return equipment and a Return Authorization Number will be issued. Unauthorized return shipments of equipment and shipments not marked with an authorization number will be refused. In addition, the manufacturer will not accept any claims for unauthorized expenses.

HANDLING & INSTALLATION

While all equipment is designed for durability and fabricated for sturdy construction and may present a rugged appearance, great care must be taken to assure that no force or pressure be applied to the coil, piping or drain stub-outs during handling. Also, depending on the options and accessories, some units could contain delicate components that may be damaged by improper handling. Wherever possible, all units should be maintained in an upright position and handled by the chassis as close as possible to the mounting point locations.

In the case of a full cabinet unit, the unit must obviously be handled by the exterior casing. This is acceptable providing the unit is again maintained in an upright position and no impact forces are applied that may damage internal components or painted surfaces. The equipment covered in this manual IS NOT suitable for outdoor installations. The equipment should never be stored or installed where it may be subjected to a hostile environment such as rain, snow, or extreme temperatures.

During and after installation, special care must be taken to prevent foreign material such as paint, plaster, and drywall dust from being deposited in the drain pan or on the motor or blower wheels. Failure to do so may have serious adverse effects on unit operation and in the case of the motor and blower assembly, may result in immediate or premature failure. All manufacturers' warranties are void if foreign material is deposited on the motor or blower wheels of any unit. Some units and/or job conditions may require some form of temporary covering during construction.

While the manufacturer does not become involved in the design and selection of support methods and components, it should be noted that unacceptable system operating characteristics and/or performance may result from improper or inadequate unit structural support. In addition, adequate clearance must be provided for service and removal of the equipment and its accessory components. Anchoring the equipment in place is accomplished by using the mounting points provided and positioning the unit to maintain the unit on a LEVEL plane. The drain pan is internally sloped toward the outlet connection. Care must be taken to insure that the unit drain pan does not slope away from the outlet connection.

NOTE

The unit's drain pan is factory sloped toward the drain connection when the unit is installed level and plumb.

Vertical units are designed to be floor mounted or otherwise supported from below and bolted to the wall structure through the mounting holes provide in the chassis. Vertical concealed units are designed to be floor mounted or otherwise supported from below and may be anchored directly through the cabinet back. Units with leveling legs must be anchored through the cabinet back.

If equipped with optional leveling legs, the legs can be adjusted with a wrench before anchoring the unit in place.

The type of mounting device is a matter of choice, however the mounting point should always be that provided in the chassis, or cabinet. *Refer to the unit product drawing for mounting hole location and sizes.*

If equipped with optional falseback spacers or subbases, these accessories must first be assembled and mounted to the unit before anchoring.

After mounting the unit, it is then ready for the various service connections such as water, drain and electrical. At this time it should be verified that the proper types of service are actually provided to the unit.

On those units requiring chilled water and/or hot water, the proper line size and water temperature should be available to the unit. In the case of refrigerant cooling, the proper line size and refrigerant type should be available at the unit. The auxiliary drain pan is shipped loose for field installation. *See the Auxiliary Drain Pan Installation Details for instructions (next page).* On units with steam heating coils, the proper line sizing and routing should be verified and the maximum steam pressure applied to the unit should never exceed 15 psig. The drain piping and steam trap should be sized and routed to allow for proper condensate flow. The electrical service to the unit should be compared to the unit nameplate to verify compatibility. The routing and sizing of all piping, and the type and sizing of all wiring and other electrical components such as circuit breakers, disconnect switches, etc. should be determined by the individual job requirements and should not be based on the size and/or type of connection provided on the equipment. All installations should be made in compliance with all governing codes and ordinances. Compliance with all codes is the responsibility of the installing contractor.

COOLING/HEATING MEDIUM CONNECTIONS

CAUTION

Toxic residues and loose particles resulting from manufacturing and field piping techniques such as joint compounds, soldering flux, and metal shavings may be present in the unit and the piping system. Special consideration must be given to system cleanliness when connecting to solar, domestic or potable water systems.

Submittals and Product Catalogs detailing unit operation, controls, and connections should be thoroughly reviewed BEFORE beginning the connection of the various cooling and/or heating mediums to the unit. All documentation may be found at www.enviro-tec.com.

All accessory valve packages should be installed as required, and all service valves should be checked for proper operation.

If coil and valve package connections are to be made with "sweat" or solder joint, care should be taken to assure that no components in the valve package are subjected to a high temperature which may damage seals or other materials. Many two-position electric control valves, depending on valve operation, are provided with a manual-opening lever. This lever should be placed in the "open" position during all soldering or brazing operations. Valve bodies should be wrapped with a wet rag to help dissipate heat encountered during brazing.

If the valve package connection at the coil is made with a union, the coil side of the union must be prevented from twisting ("backed up") during tightening to prevent damage to the coil tubing. Over-tightening must be avoided to prevent distorting the union seal surface and destroying the union.

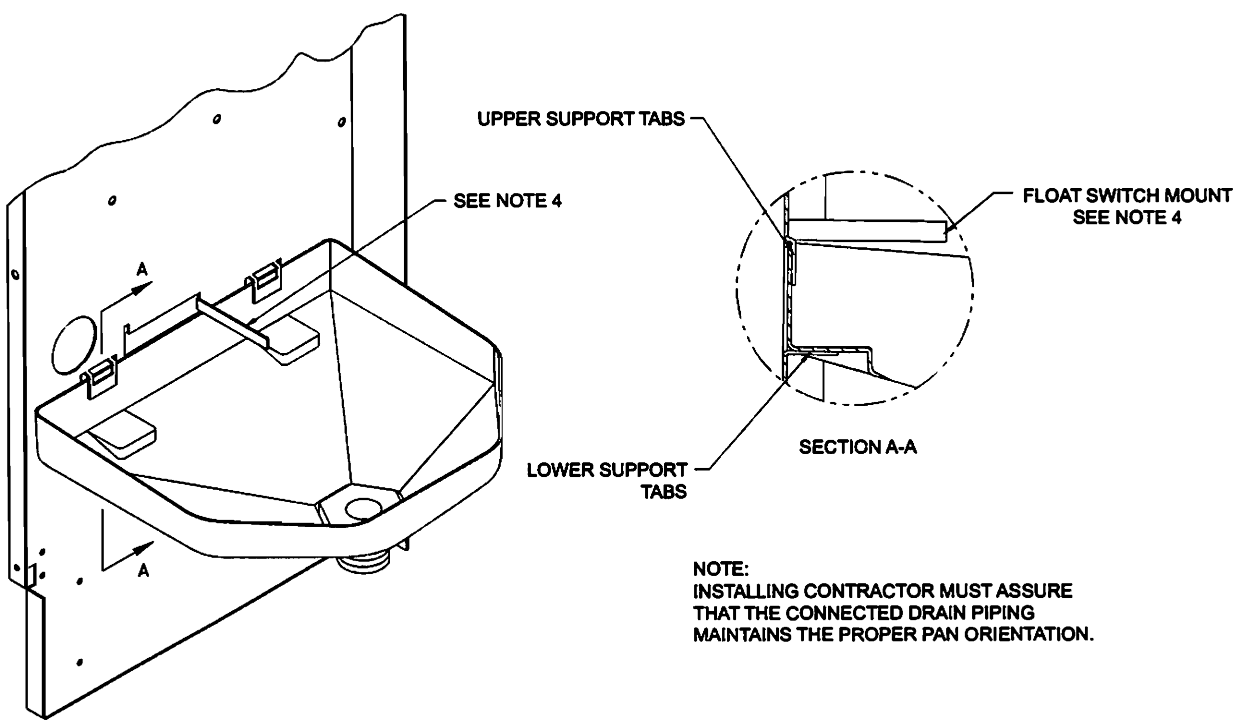
In the case of field installed valves and piping, the chilled water valve cluster (or expansion valve on DX units) should be installed in such a way that any dripping or sweating is contained in the auxiliary drain pan or other device.

After the connections are completed, the system should then be tested for leaks. Since some components are not designed to hold pressure with a gas, hydronic systems should be tested with water.

CAUTION

All water coils must be protected from freezing after initial filling with water. Even if the system is drained, unit coils may still hold enough water to cause damage when exposed to temperatures below freezing.

Refrigerant systems should be tested with dry nitrogen rather than air to prevent the introduction of moisture into the system. In the event that leaking or defective components are discovered, the Sales Representative must be notified BEFORE any repairs are attempted. All leaks should be repaired before proceeding with the installation.



NOTES:

1. BEND LOWER SUPPORT TABS DOWN 90°.
2. BEND UPPER SUPPORT TABS UP 90°.
3. POSITION DRAIN PAN IN PLACE AND THEN BEND UPPER SUPPORT TABS DOWN UNTIL PAN IS SECURE.
4. BEND FLOAT SWITCH MOUNT OUT 90° IF NEEDED.
5. STANDARD PAN SHOWN, TYPICAL FOR EXTENDED PAN.

LD13944

After system integrity has been established the piping should be insulated in accordance with the project specifications. ALL chilled water piping and valves or refrigerant suction piping not located over drain pans must be insulated to prevent damage from sweating. This includes factory and field piping inside the unit cabinet.

The drain should always be connected and piped to an acceptable disposal point. For proper moisture carry-off, the drain piping should be sloped away from the unit at least 1/8" per foot. A drain trap may be required by local codes and it is strongly recommended for odor containment.

DUCTWORK CONNECTIONS

All ductwork and/or supply and return grilles should be installed in accordance with the project plans and specifications. If not included on the unit or furnished from the factory, supply and return grilles should be provided as recommended in the product catalog.

All units must be installed in non-combustible areas.

Some models are designed to be connected to duct-work with a MINIMUM amount of external static pressure. These units may be damaged by operation without the proper ductwork connected. Consult the approved submittals and the product catalog for unit external static pressure limitations.

Units provided with outside air for ventilation should have some form of low temperature protection to prevent coil freeze-up.

It should be noted that none of these methods would adequately protect a coil in the event of power failure. The safest method of freeze protection is to use glycol in the proper percent solution for the coldest expected air temperature.

The manufacturer assumes no responsibility for undesirable system operation due to improper design, equipment or component selection, and/or installation of ductwork, grilles, and other field supplied components.

ELECTRICAL CONNECTIONS

The unit nameplate lists the unit electrical characteristics such as the required supply voltage, fan and heater amperage and required circuit ampacities. The unit-wiring diagram shows all unit and field wiring. Since each project is different and each unit on a project may be different, the installer must be familiar with the wiring diagram and nameplate on the unit BEFORE beginning any wiring. All components furnished for field installation, by either the factory or the controls contractor should be located and checked for proper function and compatibility. All internal components should be checked for shipping damage and all electrical connections should be tightened to minimize problems during start-up.

Any devices such as fan switches or thermostats that have been furnished from the factory for field installation must be wired in strict accordance with the applicable wiring diagrams. Failure to do so could result in personal injury or damage to components and will void all manufacturers' warranties.

The fan motor(s) should never be controlled by any wiring or device other than the factory furnished switch, thermostat/switch combination, without factory authorization.

All field wiring should be done in accordance with governing codes and ordinances. Any modification of the unit wiring without factory authorization will result in voiding of all factory warranties and will nullify any agency listings.

The manufacturer assumes no responsibility for any damages and/or injuries resulting from improperly field installed or wired components.

SECTION 2 - START-UP

GENERAL

Before beginning any start-up operation, the start-up personnel should familiarize themselves with the unit, options and accessories, and control sequence to understand the proper system operation. All personnel should have a good working knowledge of general start-up procedures and have the appropriate start-up and balancing guides available for consultation.

The initial step in any startup operation should be a final visual inspection. All equipment, plenums, duct-work, and piping should be inspected to verify that all systems are complete and properly installed and mounted, and that no debris or foreign articles such as paper or drink cans are left in the units or other areas. Each unit should be checked for loose wires, free blower wheel operation, and loose or missing access panels or doors. Except as required during start-up and balancing operations, no fan coil units should be operated without all the proper ductwork attached, supply and return grilles in place, and all access doors and panels in place and secure. A clean filter of the proper size and type must also be installed. Failure to do so could result in damage to the equipment or building and furnishings, and/or void all manufacturers' warranties.

COOLING/HEATING SYSTEM

Prior to the water system start-up and balancing, the chilled/hot water systems should be flushed to clean out dirt and debris, which may have collected in the piping during construction. During this procedure, all unit service valves must be in the closed position. This prevents foreign matter from entering the unit and clogging the valves and metering devices. Strainers should be installed in the piping mains to prevent this material from entering the units during normal operation.

During system filling, air venting from the unit is accomplished by the use of the standard, manual or optional automatic air vent fitting installed on the coil. In the case of the manual air vent fitting, the screw should be turned counterclockwise no more than 1-1/2 turns to operate the air vent. Automatic air vents may be unscrewed one turn counterclockwise to speed initial venting but should be screwed in for automatic venting after start-up operations.

CAUTION

The air vent provided on the unit is not intended to replace the main system air vents and may not release air trapped in other parts of the system. Inspect the entire system for potential air traps and vent those areas as required, independently. In addition, some systems may require repeated venting over a period of time to properly eliminate air from the system.

AIR SYSTEM BALANCING

All ductwork must be complete and connected, and all grilles, filters, access doors and panels must be properly installed to establish actual system operating conditions BEFORE beginning air balancing operations.

Each individual unit and attached ductwork is a unique system with its own operating characteristics. For this reason, balance specialists who are familiar with all procedures required to properly establish air distribution and fan system operating conditions normally do air balancing. Unqualified personnel should not attempt these procedures. Exposed units with no ductwork do not require air balancing other than selecting the desired fan speed.

After the proper system operation is established, the actual unit air delivery and the actual fan motor amperage draw for each unit should be recorded in a convenient place for future reference such as the inspection, installation, & start-up check sheet, a copy of which is provided at the back of this manual. Contact the Sales Representative or the factory for additional copies of this sheet.

WATER SYSTEM BALANCING

A complete knowledge of the hydronic system, its components, and controls is essential to proper water system balancing and this procedure should not be attempted by unqualified personnel. The system must be complete and all components must be in operating condition BEFORE beginning water system balancing operations.

Each hydronic system has different operating characteristics depending on the devices and controls in the system. The actual balancing technique may vary from one system to another.

After the proper system operation is established, the appropriate system operating conditions such as various water temperatures and flow rates should be recorded in a convenient place for future reference such as the inspection, installation, & start-up check sheet, a copy of which is provided on the back of this manual. Contact the Sales Representative or the factory for additional copies of this sheet.

Before and during water system balancing, conditions may exist which can result in noticeable water noise or undesired valve operation due to incorrect system pressures. After the entire system is balanced, these conditions will not exist on properly designed systems.

CONTROLS OPERATION

Before proper control operation can be verified all other systems must be in proper operation. The correct water and air temperatures must be present for the control function being tested. Some controls and features are designed to not operate under certain conditions.

A wide range of controls and electrical options and accessories may be used with the equipment covered in this manual. Consult the approved unit submittals, order acknowledgement, and other manuals for detailed information regarding each individual unit and its controls. Since controls and features may vary from one unit to another, care should be taken to identify the controls to be used on each unit and their proper control sequence. Information provided by component manufacturers regarding installation, operation, and maintenance of their individual controls is available upon request.

MOTOR AND FAN DATA

UNIT SIZE	FAN SPEED	MOTOR H.P. (QTY.)	# OF FANS	115VOLTS		208-230 VOLTS		277 VOLTS	
				AMPS	WATTS	AMPS	WATTS	AMPS	WATTS
20	High	(1) 1/30	1	0.8	57	0.6	77	0.3	71
	Medium	(1) 1/50		0.4	39	0.3	49	0.3	48
	Low	(1) 1/60		0.3	33	0.3	43	0.3	41
25	High	(1) 1/15	1	1.1	125	0.5	120	0.5	120
	Medium	(1) 1/30		0.9	90	0.3	80	0.3	80
	Low	(1) 1/60		0.5	60	0.2	60	0.2	60
30	High	(1) 1/10	2	1.9	165	0.8	158	0.8	162
	Medium	(1) 1/30		0.8	76	0.3	75	0.5	65
	Low	(1) 1/60		0.5	47	0.2	54	0.4	41
40	High	(1) 1/6	2	2.5	261	1.4	284	1.0	254
	Medium	(1) 1/12		1.5	162	0.5	171	0.5	152
	Low	(1) 1/40		0.8	75	0.4	79	0.3	74
50	High	(1) 1/8	3	1.7	215	0.9	216	0.8	214
		(1) 1/6		2.5	257	1.4	233	1.0	255
	Medium	(1) 1/15		1.3	145	0.6	109	0.5	132
		(1) 1/12		1.5	156	0.5	106	0.5	151
	Low	(1) 1/40		0.3	69	0.3	63	0.3	86
		(1) 1/40		0.6	75	0.3	62	0.3	84
60	High	(1) 1/6	4	5.0	522	2.8	568	2.0	508
	Medium	(1) 1/12		3.0	324	1.0	342	1.0	304
	Low	(1) 1/40		1.2	150	0.6	158	0.6	148

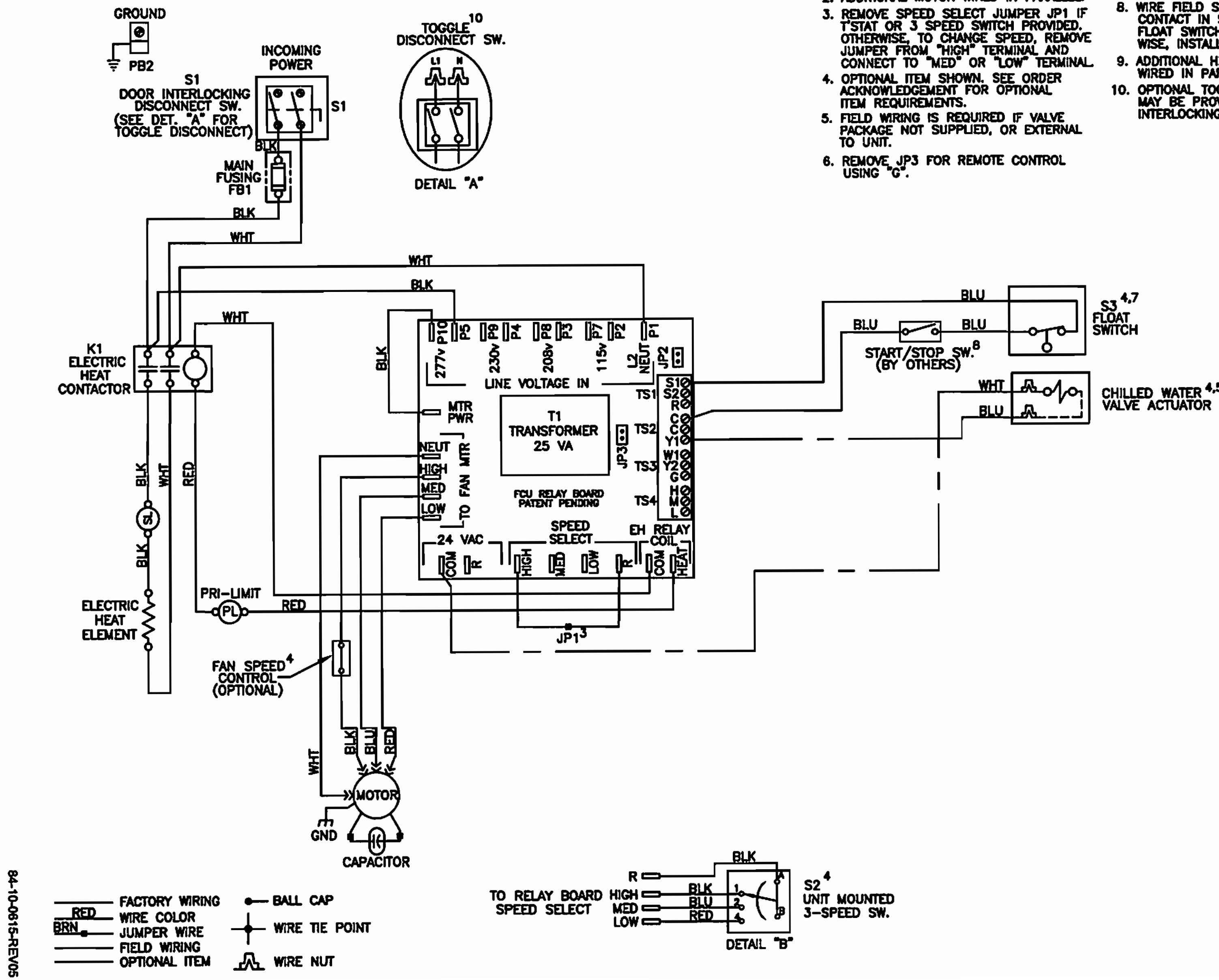
NOTES:

1. Motor electrical data is nameplated data. Actual data will vary with application.
2. 230 volt motor is nameplated for 208-230/1/60. Use 230 volt motor data for 208 volt applications.
3. Unit size 30, 208-230 and 277 volt motors are 1/12 HP at high tap.

EXAMPLE WIRING DIAGRAMS

FIELD NOTES:

1. FIELD WIRING MUST BE COPPER CONDUCTOR, RATED AT 75°C MINIMUM.
2. ADDITIONAL MOTOR WIRED IN PARALLEL.
3. REMOVE SPEED SELECT JUMPER JP1 IF T'STAT OR 3 SPEED SWITCH PROVIDED. OTHERWISE, TO CHANGE SPEED, REMOVE JUMPER FROM "HIGH" TERMINAL AND CONNECT TO "MED" OR "LOW" TERMINAL.
4. OPTIONAL ITEM SHOWN. SEE ORDER ACKNOWLEDGEMENT FOR OPTIONAL ITEM REQUIREMENTS.
5. FIELD WIRING IS REQUIRED IF VALVE PACKAGE NOT SUPPLIED, OR EXTERNAL TO UNIT.
6. REMOVE JP3 FOR REMOTE CONTROL USING "G".
7. IF FLOAT SWITCH PROVIDED, ATTACH JP2 TO ONE PIN ONLY; OTHERWISE ATTACH TO BOTH PINS.
8. WIRE FIELD SUPPLIED START/STOP CONTACT IN SERIES WITH OPTIONAL FLOAT SWITCH, IF PROVIDED. OTHERWISE, INSTALL JP2.
9. ADDITIONAL HEATER ELEMENT(S) WIRED IN PARALLEL.
10. OPTIONAL TOGGLE DISCONNECT MAY BE PROVIDED IN LIEU OF DOOR INTERLOCKING DISCONNECT.

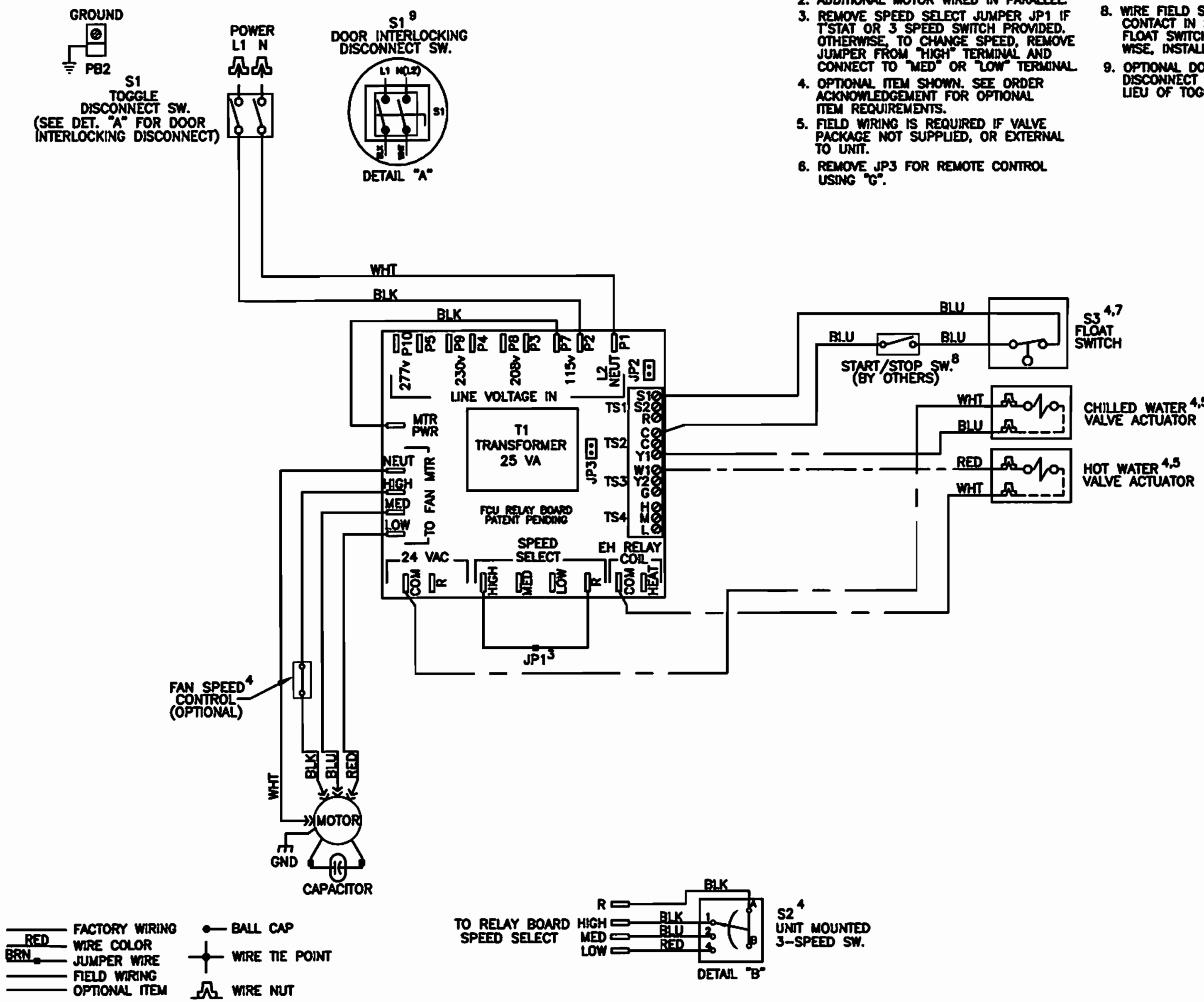


"Example Wiring Diagram - Typical 24 VAC Control Drawing (Refer to unit control enclosure for actual order-specific drawing)"

EXAMPLE WIRING DIAGRAMS (Continued)

FIELD NOTES:

1. FIELD WIRING MUST BE COPPER CONDUCTOR, RATED AT 75°C MINIMUM.
2. ADDITIONAL MOTOR WIRED IN PARALLEL.
3. REMOVE SPEED SELECT JUMPER JP1 IF T'STAT OR 3 SPEED SWITCH PROVIDED. OTHERWISE, TO CHANGE SPEED, REMOVE JUMPER FROM "HIGH" TERMINAL AND CONNECT TO "MED" OR "LOW" TERMINAL.
4. OPTIONAL ITEM SHOWN. SEE ORDER ACKNOWLEDGEMENT FOR OPTIONAL ITEM REQUIREMENTS.
5. FIELD WIRING IS REQUIRED IF VALVE PACKAGE NOT SUPPLIED, OR EXTERNAL TO UNIT.
6. REMOVE JP3 FOR REMOTE CONTROL USING "G".
7. IF FLOAT SWITCH PROVIDED, ATTACH JP2 TO ONE PIN ONLY; OTHERWISE ATTACH TO BOTH PINS.
8. WIRE FIELD SUPPLIED START/STOP CONTACT IN SERIES WITH OPTIONAL FLOAT SWITCH, IF PROVIDED. OTHERWISE, INSTALL JP2.
9. OPTIONAL DOOR INTERLOCKING DISCONNECT MAY BE PROVIDED IN LIEU OF TOGGLE DISCONNECT.



"Example Wiring Diagram - Typical 24 VAC Control Drawing (Refer to unit control enclosure for actual order-specific drawing)"

SECTION 3 - NORMAL OPERATION & PERIODIC MAINTENANCE

GENERAL

Each unit on a job will have its own unique operating environment and conditions that may dictate a maintenance schedule for that unit that is different from other equipment on the job. A formal schedule of regular maintenance and an individual unit log should be established and maintained. This will help to achieve the maximum performance and service life of each unit on the job.

NOTE

Information regarding safety precautions contained in the preface at the beginning of this manual should be followed during any service and maintenance operations.

For more detailed information concerning service operations, consult your Sales Representative or the Factory.

MOTOR/BLOWER ASSEMBLY

The type of fan operation is determined by the control components and their method of wiring, and may vary from unit to unit. *Refer to the wiring diagram for each unit for that unit's individual operating characteristics.* Motors are permanently lubricated, PSC type and do not require field lubrication.

Should the assembly require more extensive service, the motor/blower assembly may be removed from the unit to facilitate such operations as motor or blower wheel/housing replacement, etc. Dirt and dust should not be allowed to accumulate on the blower wheel or housing. This can result in an unbalanced blower wheel condition that can damage a blower wheel or motor. The wheel and housing may be cleaned periodically using a vacuum cleaner and a brush taking care not to dislodge the factory balancing weights on the blower wheel blades.

COIL

Coils may be cleaned in place by removing the motor/blower assemblies and brushing the entering air face between fins with a stiff brush. Cleaning with a vacuum cleaner should follow brushing. If a compressed air source is available, the coil may also be cleaned by blowing air through the coil fins from the leaving air face. Vacuuming should again follow this. Units provided with the proper type of air filters, replaced regularly, will require coil cleaning.

ELECTRIC RESISTANCE HEATER ASSEMBLY

Electric resistance heaters typically require no normal periodic maintenance when unit air filters are changed properly. Other conditions and equipment may affect the operation and service life in the system. The two most important operating conditions for an electric heater are proper airflow and proper supply voltage. High supply voltage and/or poorly distributed or insufficient airflow over the element will result in element overheating. This condition may result in the heater cycling on the high limit thermal cutout

Sheathed type heaters provided have an automatic reset switch with a back-up high limit thermal switch. Automatic reset switches are as the name implies; they reset automatically after the heater has cooled down. High limit thermal switches must be replaced once the circuit has been broken. The high limit thermal cutout device is a safety device only and is not intended for continuous operation. With proper unit application and during normal operation, the high limit thermal cutout will not operate. This device only operates when some problem exists and ANY condition that causes high limit cutout MUST be corrected immediately. High supply voltage also causes excessive amperage draw and may result in tripping of the circuit breaker or blowing of the fuses on the incoming power supply.

FAN DECK

The fan/drain pan assembly is easily removable for service access to motors and blowers at, or away from, the unit.

ELECTRICAL WIRING & CONTROLS

The electrical operation of each unit is determined by the components and wiring of the unit and may vary from unit to unit. Consult the wiring diagram for the actual type and number of controls provided on each unit. The integrity of all electrical connections should be verified at least twice during the first year of operation. Afterwards, all controls should be inspected regularly for proper operation. Some components may experience erratic operation or failure due to age. Wall thermostats may also become clogged with dust and lint and should be periodically inspected and cleaned to provide reliable operation.

When replacing any components such as fuses, contactors, or relays, use only the exact type, size, and voltage component as furnished from the factory. Any deviation without factory authorization could result in personnel injury or damage to the unit and will void all factory warranties. All repair work should be done in such a manner as to maintain the equipment in compliance with governing codes and ordinances or testing agency listings.

More specific information regarding the use and operating characteristics of the standard controls offered by this manufacturer is contained in other manuals.

VALVES & PIPING

No formal maintenance is required on the valve package components most commonly used with fan coil units other than a visual inspection for possible leaks in the course of other normal periodic maintenance. In the event that a valve should need replacement, the same precautions taken during the initial installation to protect the valve package from excessive heat should also be used during replacement.

FILTERS, THROWAWAY

The type of throwaway filter most commonly used on fan coil units should be replaced on a regular basis. The time interval between each replacement should be established based on regular inspection of the filter and should be recorded in the log for each unit. *Refer to the product catalog for the recommended filter size for each product type and size.* If the replacement filters are not purchased from the factory, the filters used should be the same type and size as that furnished from or recommended by the factory. Pleated media or extended surface filters should not be used since the high air pressure drops encountered with these types of filters is not compatible with the type of fan coil unit covered in this manual. Consult the factory for applications using filter types other than the factory standard or optional product.

DRAIN

The drain should be checked before initial start-up and at the beginning of each cooling season to assure that the lines are clear. If it is clogged, steps should be taken to clear the debris so that condensate will flow easily.

Periodic checks of the drain should be made during the cooling season to maintain a free flowing condensate. Should the growth of algae and/or bacteria be a concern, consult an air conditioning and refrigeration supply organization familiar with local conditions for chemicals available to control these agents.

REPLACEMENT PARTS

Factory replacement parts should be used wherever possible to maintain the unit performance and operating characteristics and the testing agency listings. Replacement parts may be purchased through the local Sales Representative.

Contact the local Sales Representative or the factory before attempting any unit modifications. Any modifications not authorized by the factory could result in personnel injury and damage to the unit and could void all factory warranties.

When ordering parts, the following information must be supplied to ensure proper part identification:

1. Complete unit model number.
2. Unit hand connection (right or left hand) while facing into the return air stream.
3. Complete part description including any numbers.

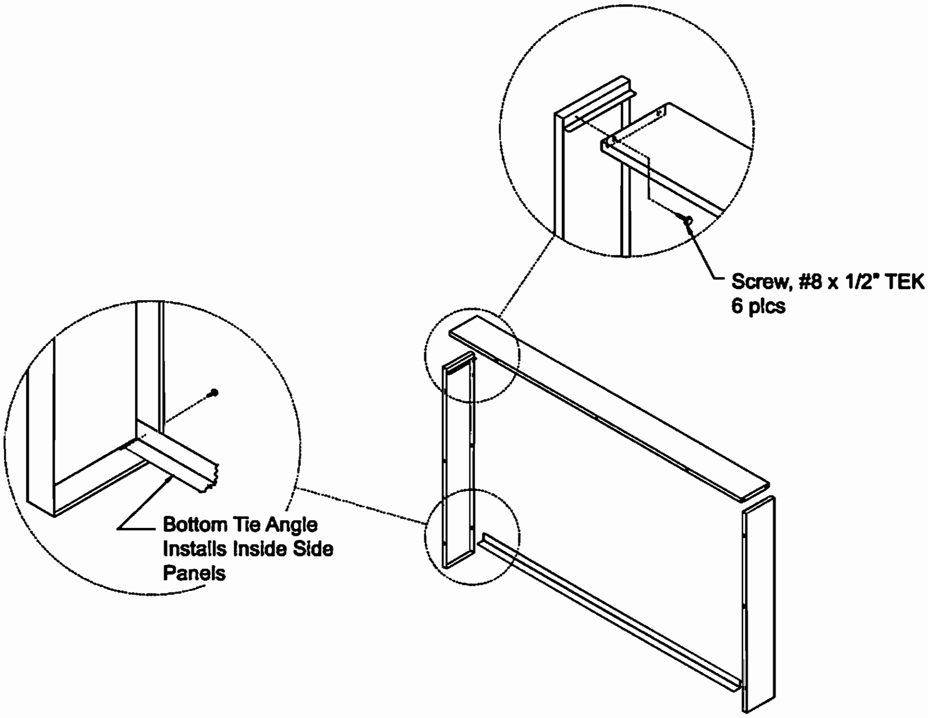
On warranty replacements, in addition to the information previously listed, the project CO # that appears on the unit nameplate, is required. Contact the factory for authorization to return any parts such as defective parts replaced in warranty. All shipments returned to the factory MUST be marked with a Return Authorization Number, which is provided by the factory.

All equipment and components sold through the Parts Department are warranted under the same conditions as the standard manufacturer's warranty with the exception that the warranty period is 12 months unless the component is furnished as warranty replacement. Parts furnished as warranty replacements are warranted for the remaining term of the original unit warranties.

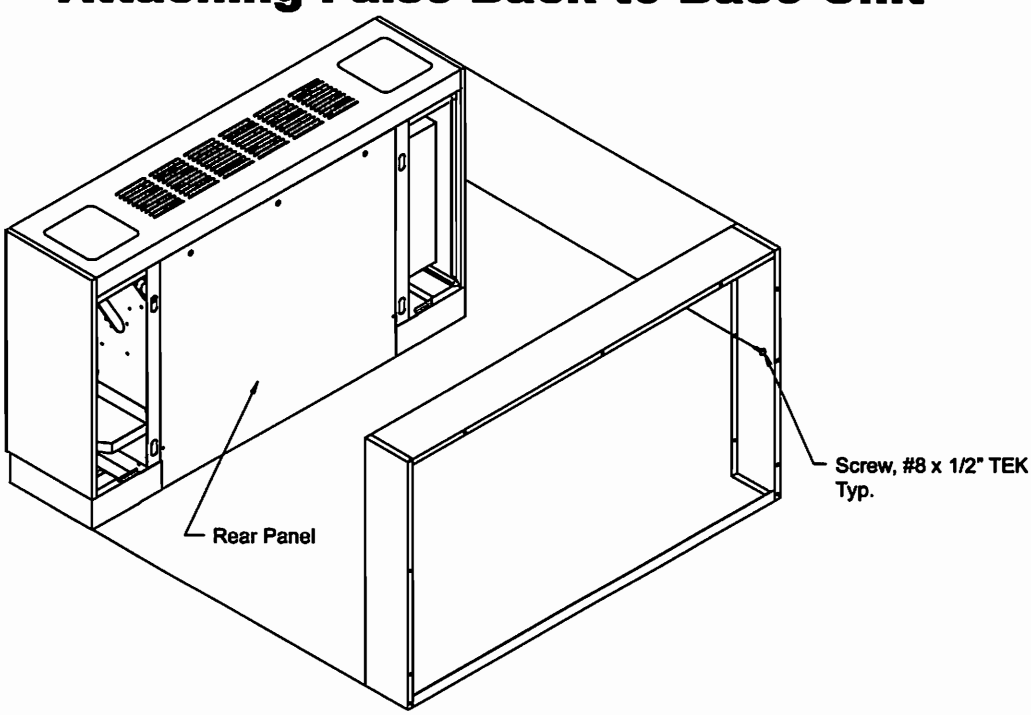
FALSE BACK ASSEMBLY

(Shipped loose and Dissassembled)

Drawings are subject to change without notice. Refer to www.enviro-tec.com for current IOM and submittal drawings.



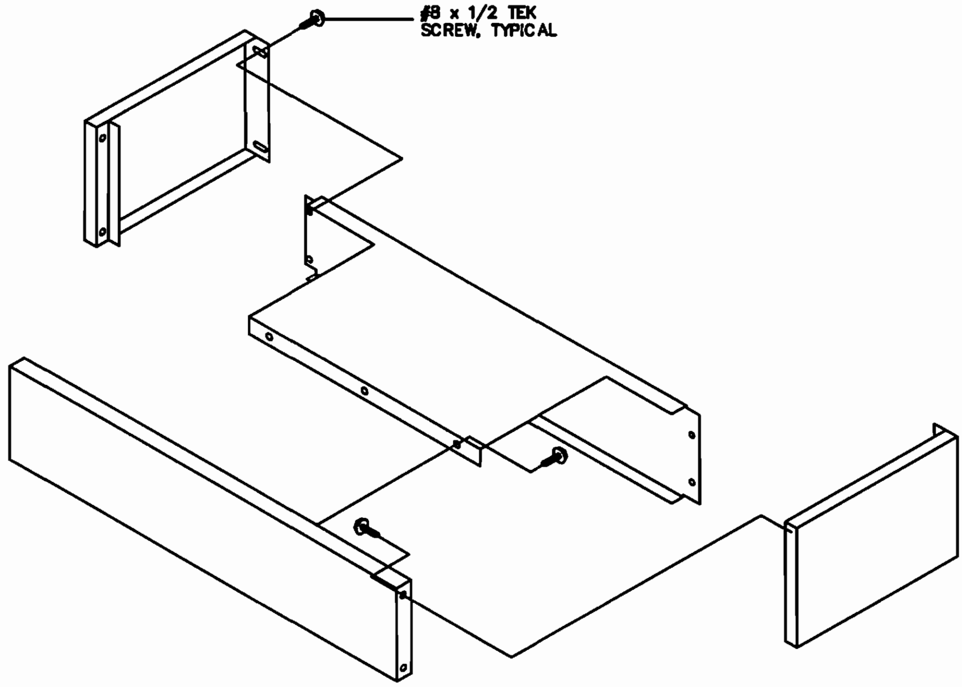
Attaching False Back to Base Unit



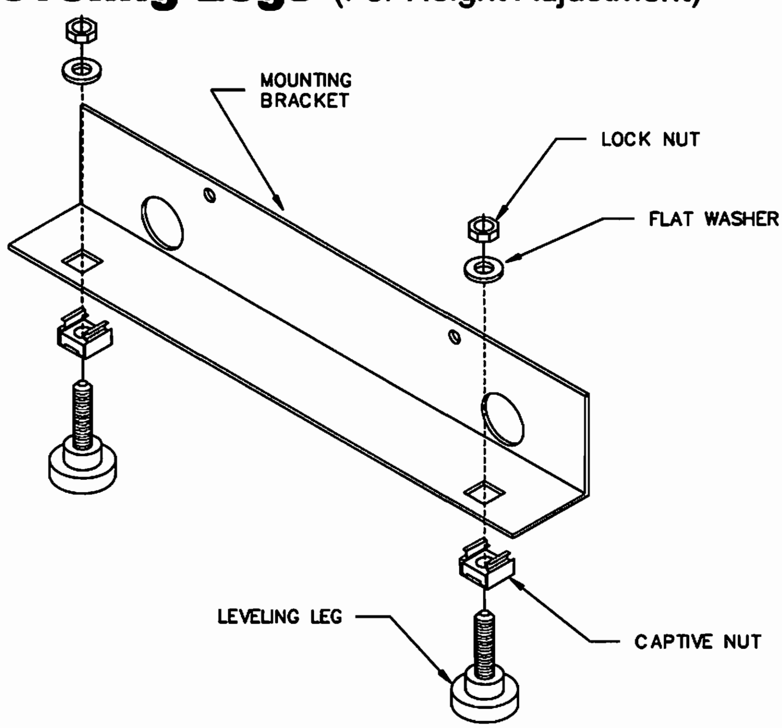
LD13945

SUB BASE ASSEMBLY AND LEVELING LEGS

Sub Base Assembly (Shipped Loose and Disassembled)



Leveling Legs (For Height Adjustment)



LD13946

SECTION 4 - INSPECTION, INSTALLATION & START-UP CHECKLIST

Receiving & Inspection

- ❑ Unit Received Undamaged
- ❑ Unit Arrangement/Hand Correct
- ❑ Unit Received Complete As Ordered
- ❑ Unit Structural Support Complete & Correct

Handling & Installation

- ❑ Unit Mounted Level & Square
- ❑ Proper Electrical Service Provided
- ❑ Proper Service Switch/Disconnect Provided
- ❑ Proper Access Provided For Unit & Accessories
- ❑ Proper Overcurrent Protection Provided

Handling & Installation (continued)

- ❑ Proper Chilled Water Line Size To Unit
- ❑ Proper Refrigerant Line Sizes To Unit
- ❑ Proper Steam Condensate Trap On Return Line
- ❑ All Services To Unit In Code Compliance
- ❑ Proper Hot Water Line To Unit
- ❑ Proper Steam Line Sizes To Unit
- ❑ Proper Steam Supply Pressure To Unit (15psi Max)
- ❑ All Shipping Screws & Braces Removed

Cooling/Heating Connections

- ❑ Protect Valve Package Components From Heat
- ❑ Connect Field Piping To Unit
- ❑ Install Drain Line & Traps As Required
- ❑ Install Condensate Pan Under Piping As Required
- ❑ Mount Valve Packages
- ❑ Pressure Test All Piping For Leaks
- ❑ Insulate All Piping As Required

Ductwork Connections

- ❑ Install Ductwork, Fittings & Grilles As Required
- ❑ Control Outside Air For Freeze Protection
- ❑ Proper Supply & Return Grille Type & Size Used
- ❑ Insulate All Ductwork As Required

Electrical Connections

- ❑ Refer To Unit Wiring Diagram
- ❑ All Field Wiring In Code Compliance
- ❑ Connect Incoming Power Service or Services

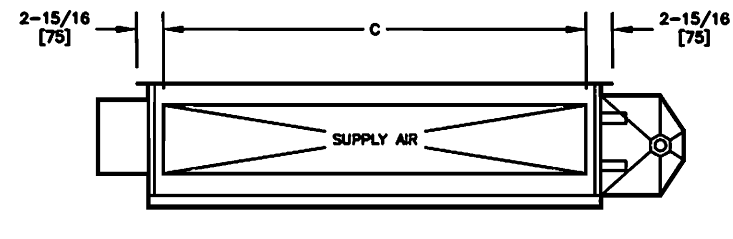
Unit Startup

- ❑ General Visual Unit & System Inspection
- ❑ Record Ambient Temperature
- ❑ Close All Unit Isolation Valves
- ❑ Fill Systems With Water/Refrigerant
- ❑ All Ductwork & Grilles In Place
- ❑ Start Fans, Etc.
- ❑ Check All Ductwork & Units For Air Leaks
- ❑ Record All Final Settings For Future Use
- ❑ Check All Dampers For Proper Operation
- ❑ Verify Proper Heating Operation
- ❑ Record Electrical Supply Voltage
- ❑ Check All Wiring For Secure Connections
- ❑ Flush Water Systems
- ❑ Vent Water Systems As Required
- ❑ All Unit Panels & Filters In Place
- ❑ Check For Overload Condition Of All Units
- ❑ Balance Air Systems As Required
- ❑ Check Piping & Ductwork For Vibration
- ❑ Verify Proper Cooling Operation
- ❑ Reinstall All Covers & Access Panels

LD13941

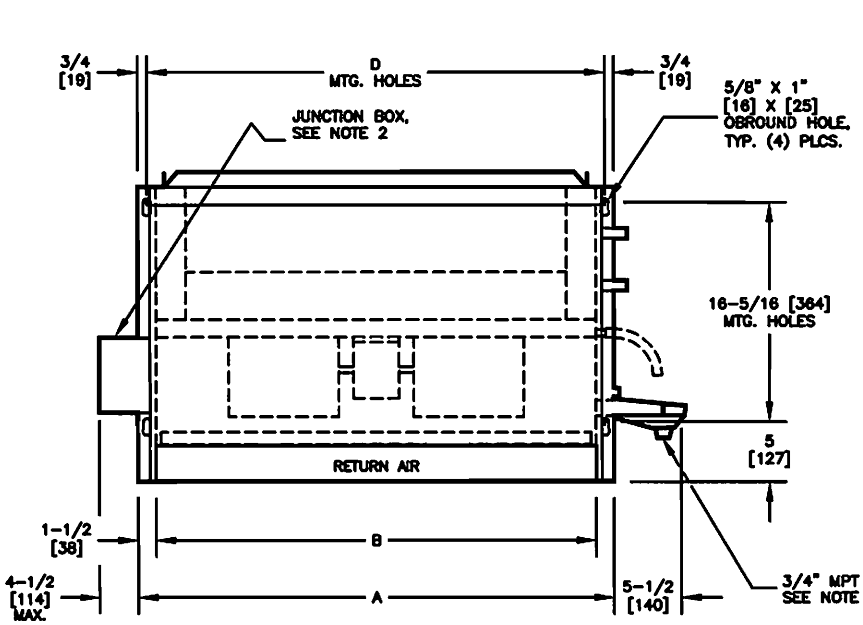
SECTION 5 - DIMENSIONAL DRAWINGS

MODEL VFC - CONCEALED FAN COIL UNIT

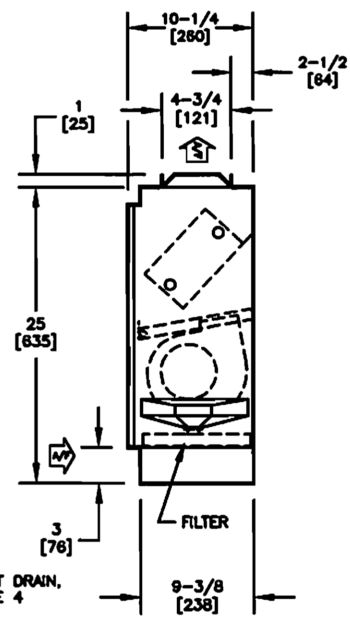


TOP VIEW

NOTES:
1. All dimensions are inches [millimeters]. All dimensions are ±1/4" [6mm]. Metric values are soft conversion.
2. Junction box size and location varies with unit features. Control options may be limited. Provide sufficient clearance to access electrical controls and comply with applicable codes and ordinances.
3. Right hand unit shown, left hand unit similar, but opposite.
4. Auxiliary drain pan ships loose for field installation.



FRONT VIEW



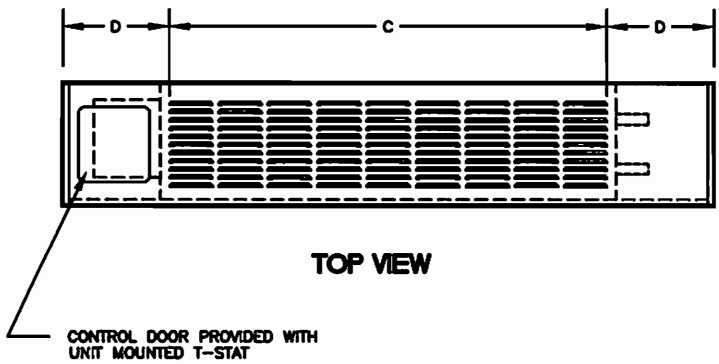
SIDE VIEW

DIMENSIONS - In [mm]

UNIT SIZE	A	B	C	D
20	30 [762]	27 [686]	24-1/8 [613]	28-1/2 [724]
25	36 [914]	33 [838]	30-1/8 [765]	34-1/2 [876]
30	40 [1016]	37 [940]	34-1/8 [867]	38-1/2 [978]
40	50 [1270]	47 [1194]	44-1/8 [1121]	48-1/2 [1232]
50	60 [1524]	57 [1448]	54-1/8 [1375]	58-1/2 [1486]
60	70 [1778]	67 [1702]	64-1/8 [1629]	68-1/2 [1740]

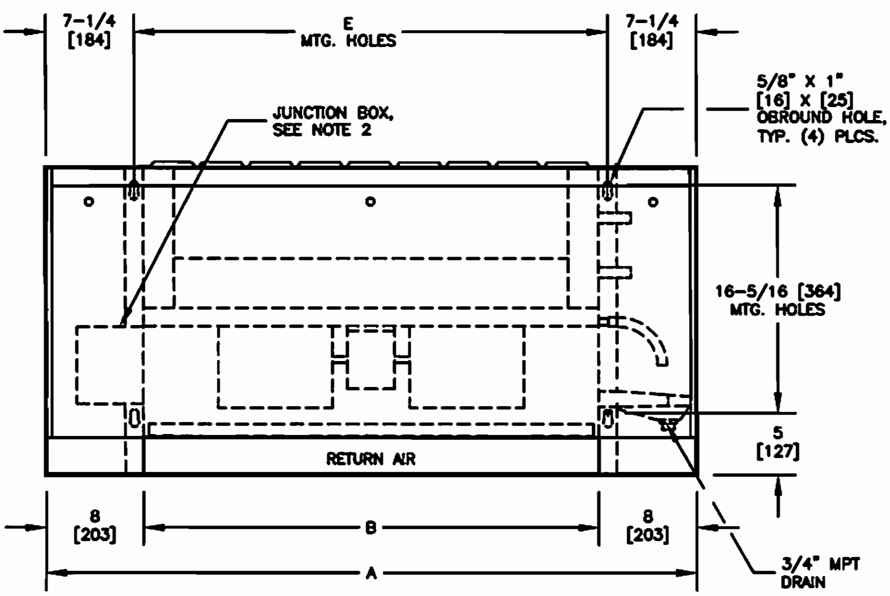
51-80004-REV01

MODEL VFE - EXPOSED FAN COIL UNIT W/ STAMPED SUPPLY GRILLE

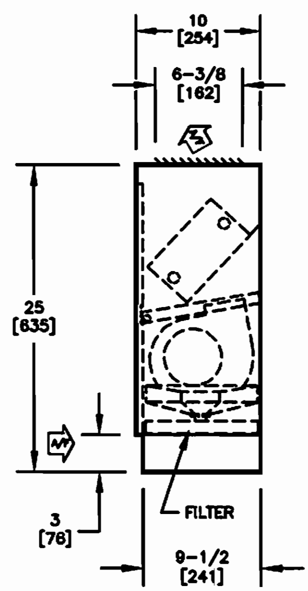


TOP VIEW

NOTES:
1. All dimensions are inches [millimeters]. All dimensions are ±1/4" [6mm]. Metric values are soft conversion.
2. Junction box size and location varies with unit features. Control options may be limited. Provide sufficient clearance to access electrical controls and comply with applicable codes and ordinances.
3. Standard cabinet finish is "Pearl White Satin".
4. Right hand unit shown, left hand unit similar, but opposite.



FRONT VIEW



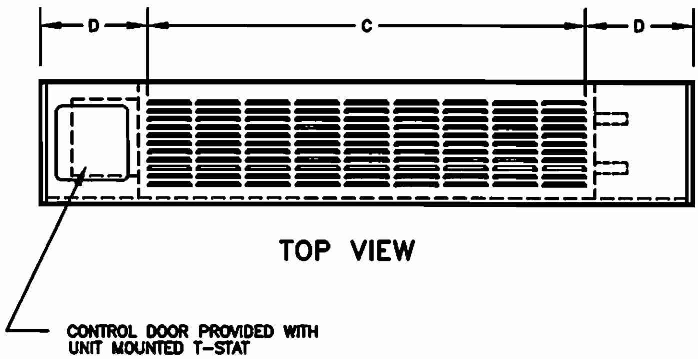
SIDE VIEW

DIMENSIONS - In [mm]

UNIT SIZE	A	B	C	D	E
20	43 [1092]	27 [686]	23-1/2 [597]	9-3/4 [248]	28-1/2 [724]
25	49 [1245]	33 [838]	27-1/2 [699]	10-3/4 [273]	34-1/2 [876]
30	53 [1346]	37 [940]	31-1/2 [800]	10-3/4 [273]	38-1/2 [978]
40	63 [1600]	47 [1194]	43-1/2 [1105]	9-3/4 [248]	48-1/2 [1232]
50	73 [1854]	57 [1448]	51-1/2 [1308]	10-3/4 [273]	58-1/2 [1486]
60	83 [2108]	67 [1702]	63-1/2 [1613]	9-3/4 [248]	68-1/2 [1740]

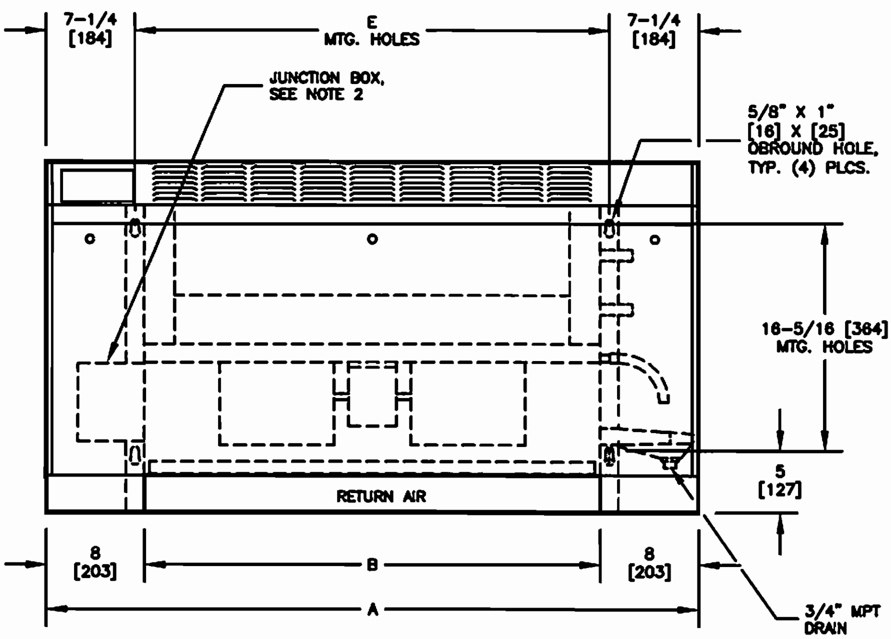
51-80003-REV03

MODEL VFS - EXPOSED SLOPE TOP FAN COIL UNIT W/ STAMPED SUPPLY AIR GRILLE

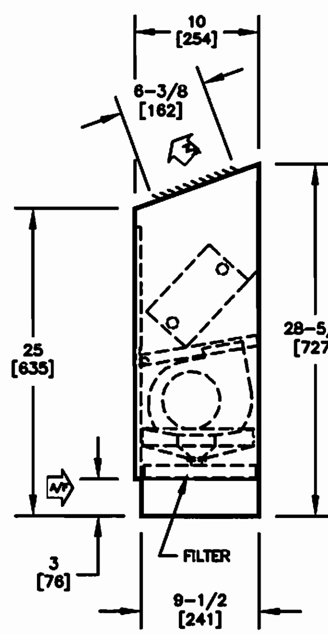


TOP VIEW

NOTES:
1. All dimensions are Inches [millimeters]. All dimensions are ±1/4" [6mm]. Metric values are soft conversion.
2. Junction box size and location varies with unit features. Control options may be limited. Provide sufficient clearance to access electrical controls and comply with applicable codes and ordinances.
3. Standard cabinet finish is "Pearl White Satin".
4. Right hand unit shown, left hand unit similar, but opposite.



FRONT VIEW



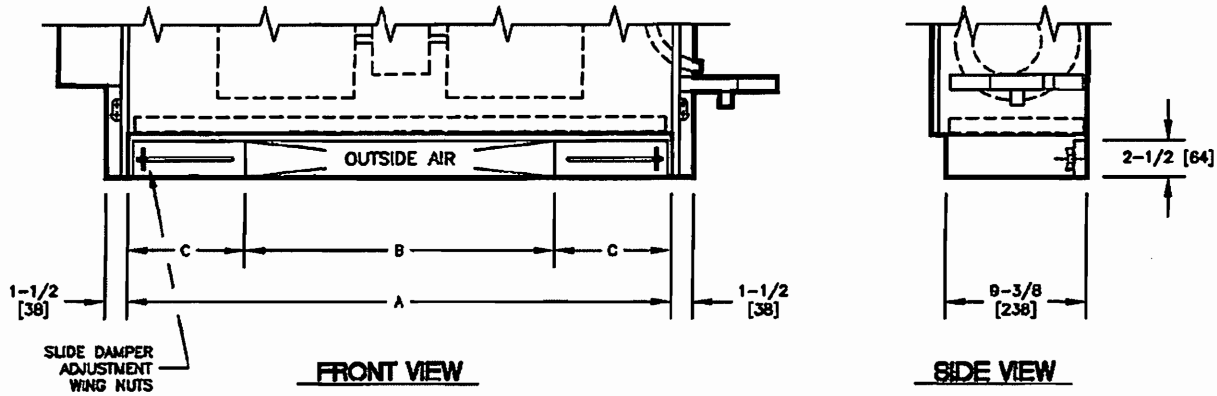
SIDE VIEW

DIMENSIONS - In [mm]

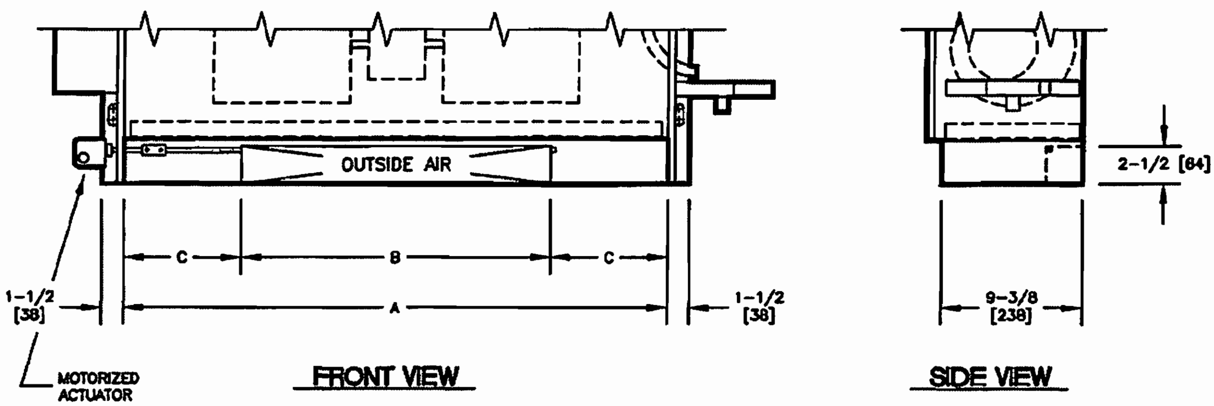
UNIT SIZE	A	B	C	D	E
20	43 [1092]	27 [686]	23-1/2 [597]	9-3/4 [248]	28-1/2 [724]
25	49 [1245]	33 [838]	27-1/2 [699]	10-3/4 [273]	34-1/2 [876]
30	53 [1346]	37 [940]	31-1/2 [800]	10-3/4 [273]	38-1/2 [978]
40	63 [1600]	47 [1194]	43-1/2 [1105]	9-3/4 [248]	48-1/2 [1232]
50	73 [1854]	57 [1448]	51-1/2 [1308]	10-3/4 [273]	58-1/2 [1486]
60	83 [2108]	67 [1702]	63-1/2 [1613]	9-3/4 [248]	68-1/2 [1740]

51-80025-REV02

MODEL VF - OUTSIDE AIR INLET LOCATION



☐ MANUAL DAMPER OPTION



☐ MOTORIZED DAMPER OPTION

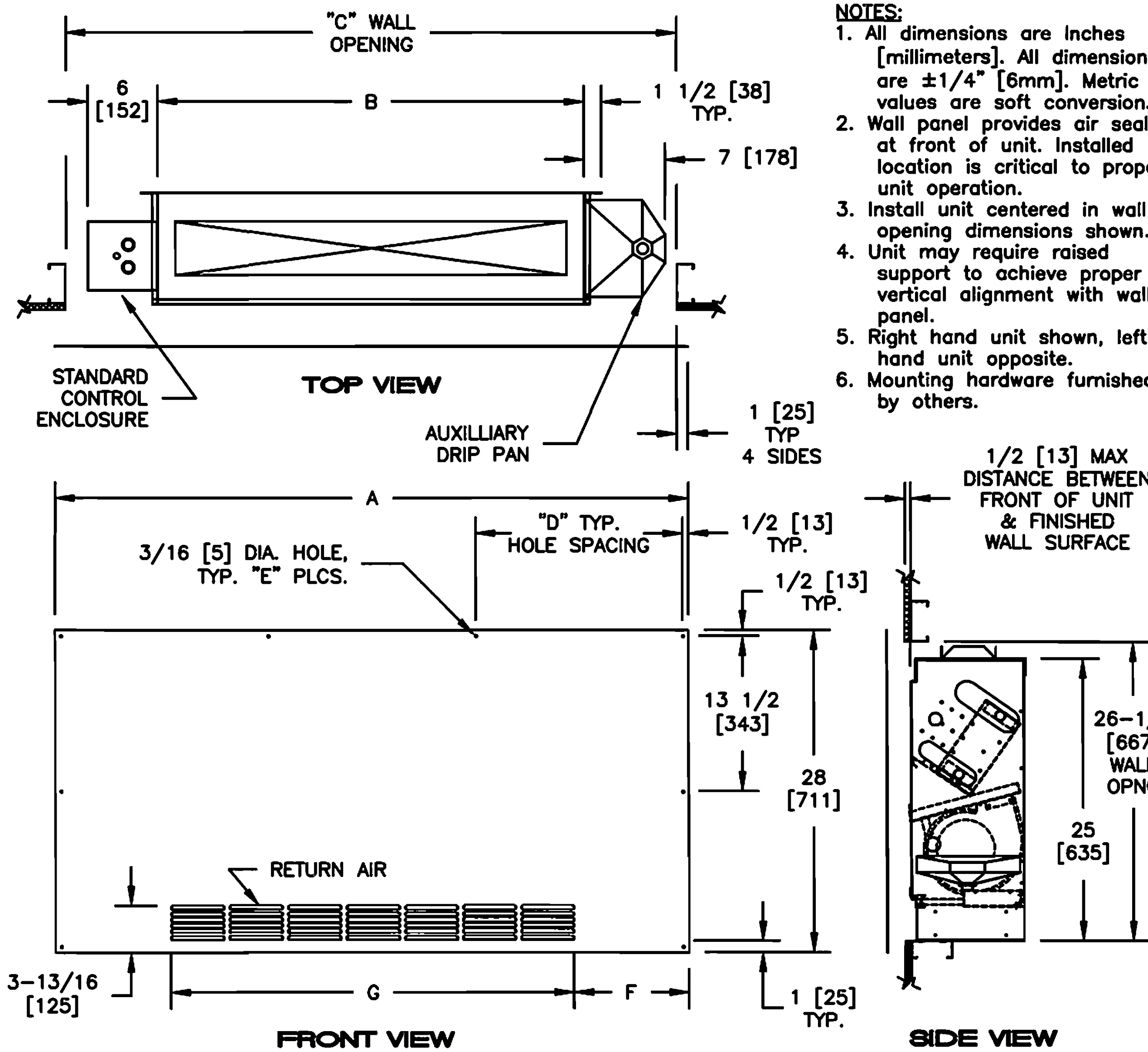
DIMENSIONS - In [mm]

UNIT SIZE	A	B	C
20	27 [686]	16 [406]	5-1/2 [140]
25	33 [838]	19 [483]	7 [178]
30	37 [940]	21 [533]	8 [203]
40	47 [1194]	27 [686]	10 [254]
50	57 [1448]	33 [838]	12 [305]
60	67 [1702]	39 [991]	14 [356]

NOTES:
1. All dimensions are inches [millimeters]. All dimensions are ±1/4" [6mm]. Metric values are soft conversion.
2. Model FWC unit shown, typical for models "FWX" and "FWI".
3. The standard damper options may not provide freeze protection under all conditions and applications. Other forms of freeze protection may be required.
4. Right hand unit shown, left hand unit is similar but opposite.

VFOA-001-REV02

MODEL VFC - STANDARD DECORATOR WALL PANEL W/ STAMPED RETURN AIR GRILLE



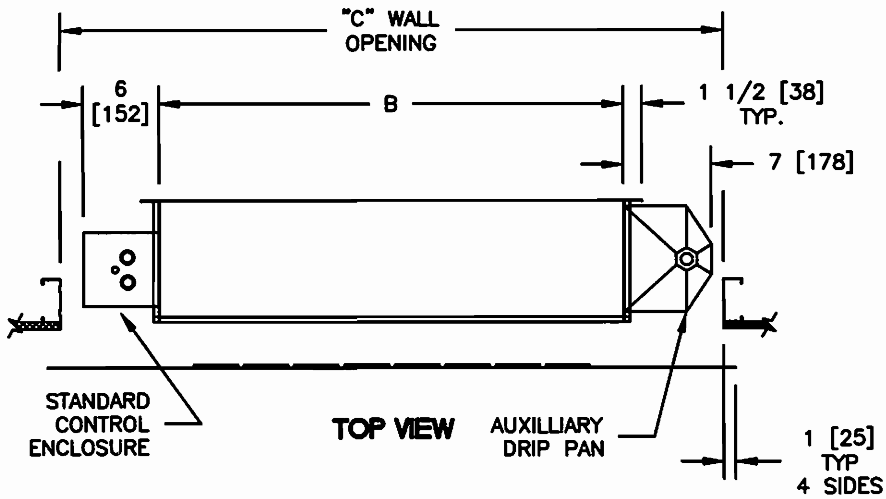
NOTES:
1. All dimensions are Inches [millimeters]. All dimensions are ±1/4" [6mm]. Metric values are soft conversion.
2. Wall panel provides air seal at front of unit. Installed location is critical to proper unit operation.
3. Install unit centered in wall opening dimensions shown.
4. Unit may require raised support to achieve proper vertical alignment with wall panel.
5. Right hand unit shown, left hand unit opposite.
6. Mounting hardware furnished by others.

DIMENSIONS - In [mm]

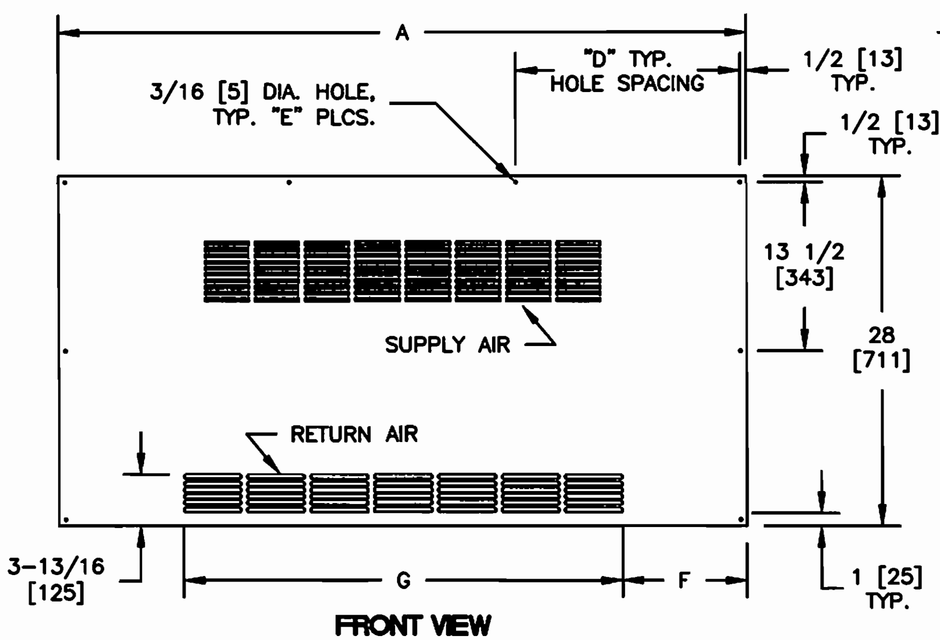
UNIT SIZE	A	B	C	D	E	F	G
20	45 [1143]	27 [686]	43 [1092]	22 [559]	8	10-1/16 [256]	24-7/8 [632]
25	51 [1295]	33 [838]	49 [1245]	16-5/8 [422]	10	10-1/2 [267]	30 [762]
30	55 [1397]	37 [940]	53 [1346]	18 [457]	10	10 [254]	35 [889]
40	65 [1651]	47 [1194]	63 [1600]	16 [406]	12	9-15/16 [252]	45-1/8 [1146]
50	75 [1905]	57 [1448]	73 [1854]	18 1/2 [470]	12	9-7/8 [251]	55-1/4 [1403]
60	85 [2159]	67 [1702]	83 [2108]	14 [356]	16	9-13/16 [249]	63-3/8 [1610]

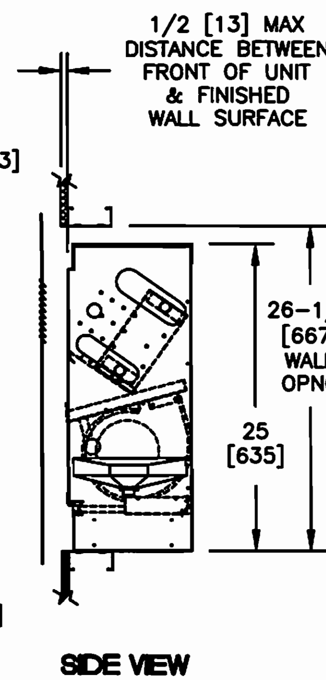
51-80007-REV01

MODEL VFC - STANDARD DECORATOR WALL PANEL W/ STAMPED SUPPLY & RETURN AIR GRILLE



NOTES:
1. All dimensions are Inches [millimeters]. All dimensions are ±1/4" [6mm]. Metric values are soft conversion.
2. Wall panel provides air seal at front of unit. Installed location is critical to proper unit operation.
3. Install unit centered in wall opening dimensions shown.
4. Unit may require raised support to achieve proper vertical alignment with wall panel.
5. Right hand unit shown, left hand unit opposite.
6. Mounting hardware furnished by others.



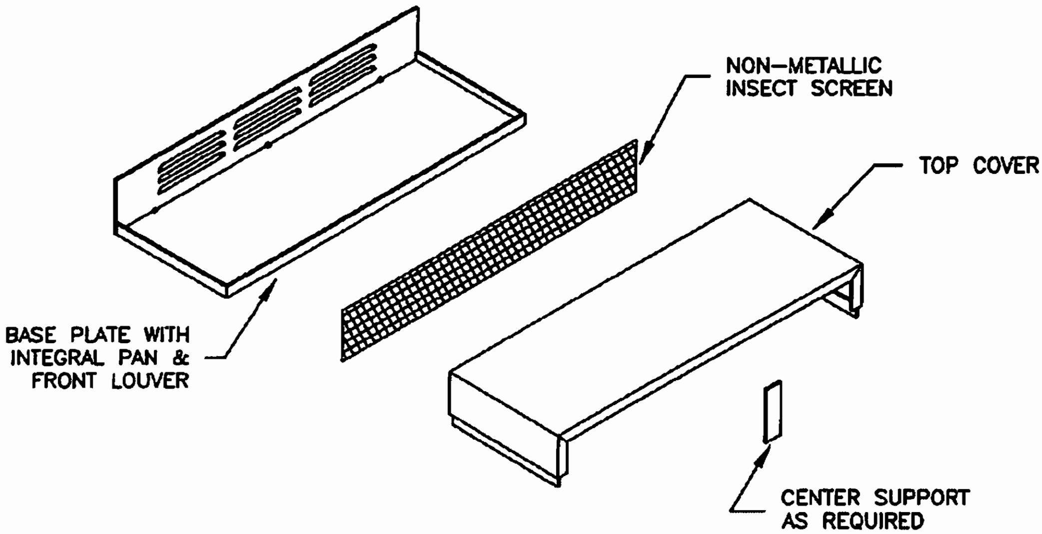


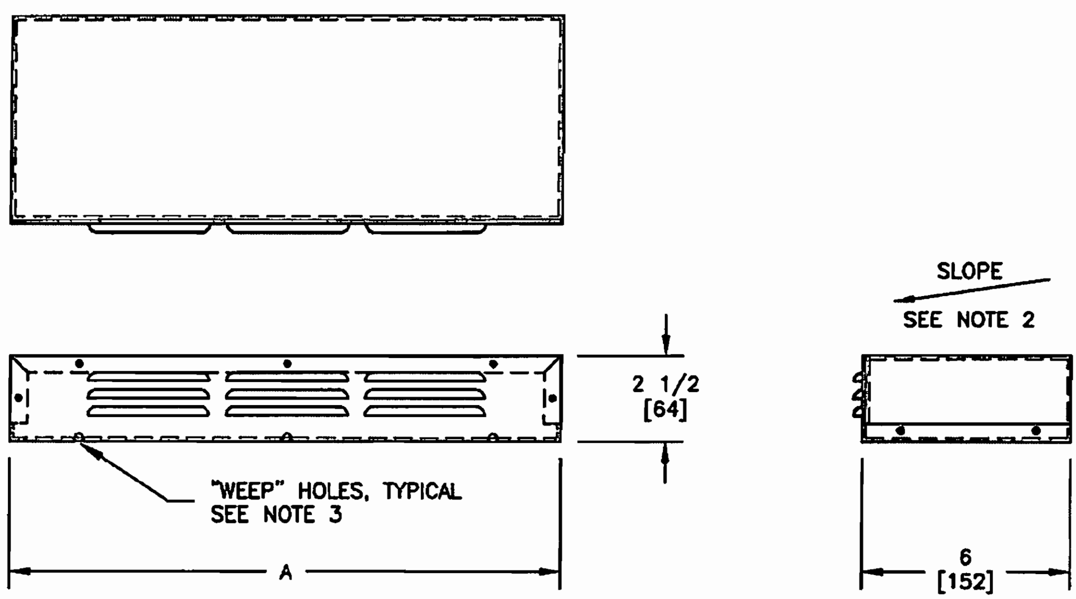
DIMENSIONS - In [mm]

UNIT SIZE	A	B	C	D	E	F	G
20	45 [1143]	27 [686]	43 [1092]	22 [559]	8	10-1/16 [256]	24-7/8 [632]
25	51 [1295]	33 [838]	49 [1245]	16-5/8 [422]	10	10-1/2 [267]	30 [762]
30	55 [1397]	37 [940]	53 [1346]	18 [457]	10	10 [254]	35 [889]
40	65 [1651]	47 [1194]	63 [1600]	16 [406]	12	9-15/16 [252]	45-1/8 [1146]
50	75 [1905]	57 [1448]	73 [1854]	18 1/2 [470]	12	9-7/8 [251]	55-1/4 [1403]
60	85 [2159]	67 [1702]	83 [2108]	14 [356]	16	9-13/16 [249]	63-3/8 [1610]

51-80008-REV01

MODEL VF - OUTSIDE AIR WALL BOX ASSEMBLY





DIMENSIONS - In [mm]

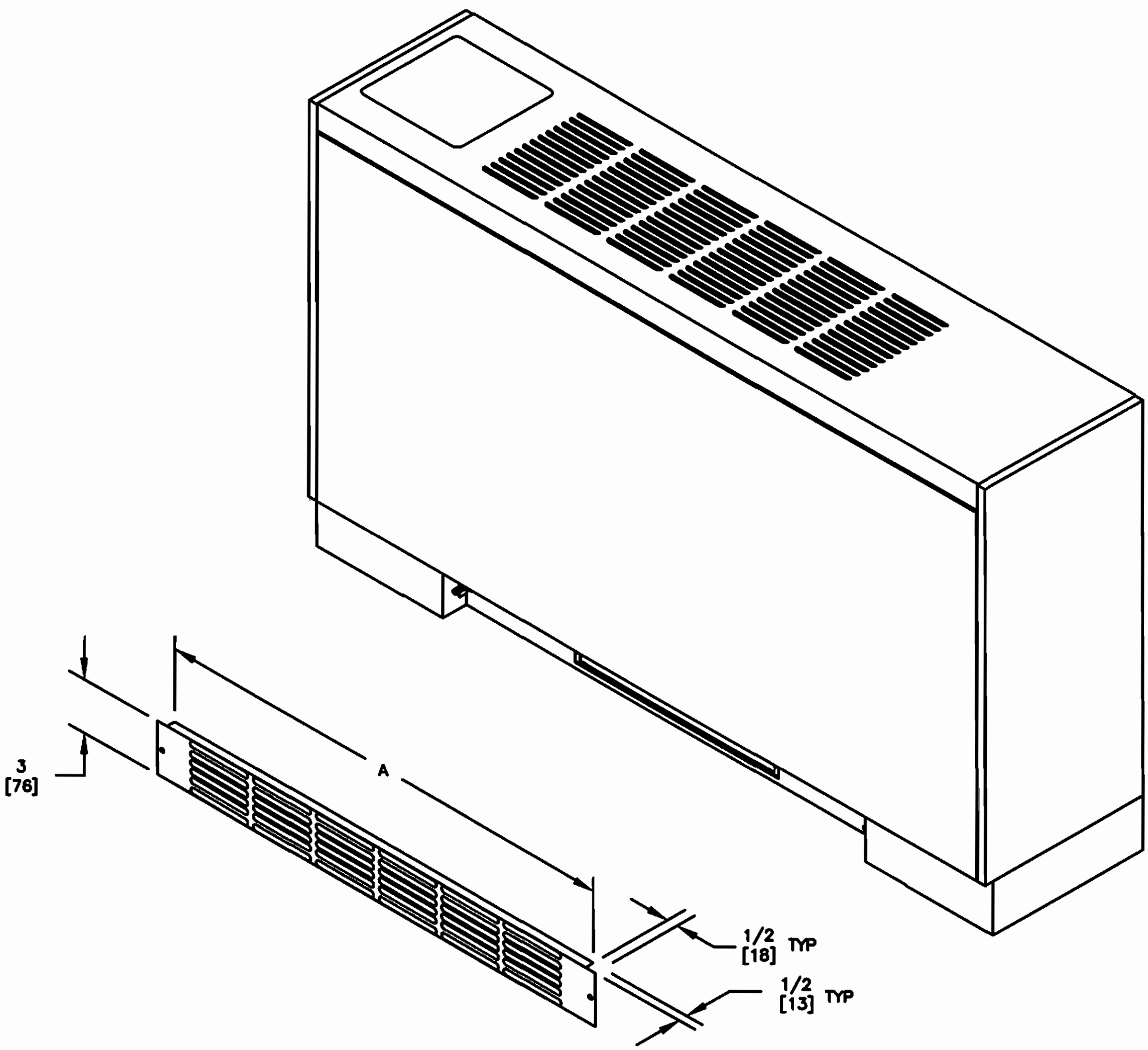
UNIT SIZE	A
20	16 [406]
25	19 [483]
30	21 [533]
40	27 [686]
50	33 [838]
60	39 [991]

NOTES:
1. Material is .050" thick aluminum.
2. Wall box should be installed pitched slightly toward exterior surface of wall.
3. "Weep" holes should not be obstructed when sealing box to wall.

VFWB-001-REV03

MODEL VFE/VFS - STAMPED LOUVER RETURN AIR GRILLE

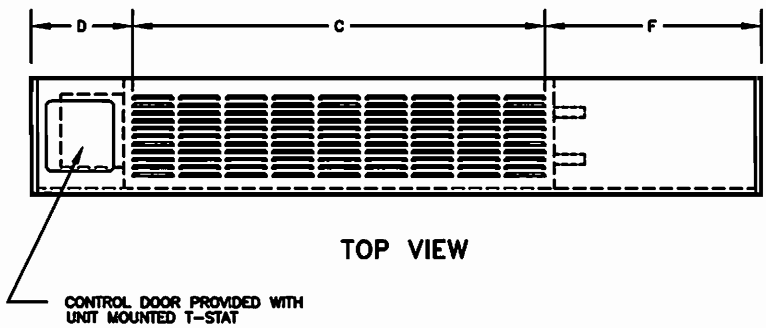
NOTES:
1. All dimensions are Inches [millimeters]. All dimensions are ±1/4" [6mm]. Metric values are soft conversion.
2. Standard cabinet finish is "Pearl White Satin".
3. Model FWX unit shown, typical for model FWI.
4. Return grille is held in place with sheet metal screws.



UNIT SIZE	A	# BANKS
20	26-11/16 [678]	5
25	32-11/16 [830]	6
30	36-11/16 [932]	7
40	46-11/16 [1186]	9
50	56-11/16 [1440]	11
60	66-11/16 [1694]	13

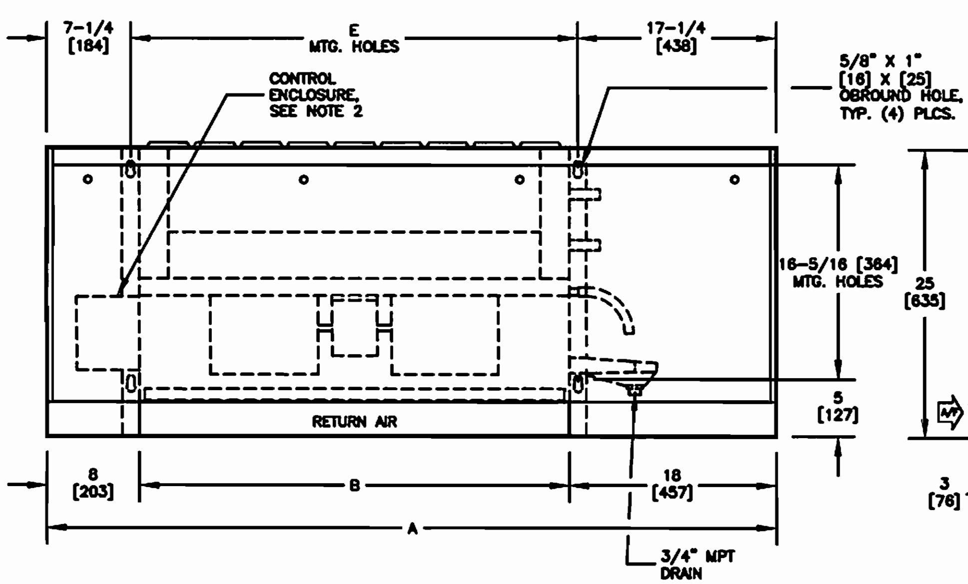
51-80031-REV01

MODEL VFE - EXPOSED FAN COIL UNIT W/ STAMPED SUPPLY GRILLE & 10" END POCKET EXTENSION

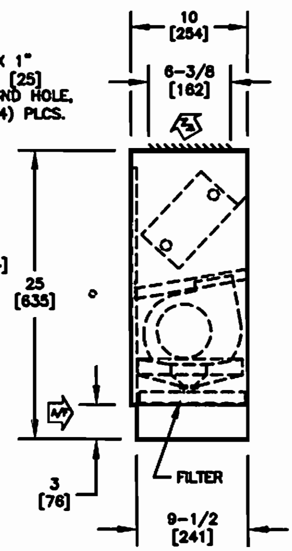


TOP VIEW

NOTES:
1. All dimensions are inches [millimeters]. All dimensions are ±1/4" [6mm]. Metric values are soft conversion.
2. Control enclosure size and location varies with unit features. Provide sufficient clearance to access electrical controls and comply with applicable codes and ordinances.
3. End pocket extension shown on piping side of unit, but may be specified on piping or control enclosure side.
4. Some control option combinations may require extended end pocket on control enclosure side.
5. Standard cabinet finish is "Pearl White Satin".
6. Right hand unit shown, left hand unit similar, but opposite.



FRONT VIEW



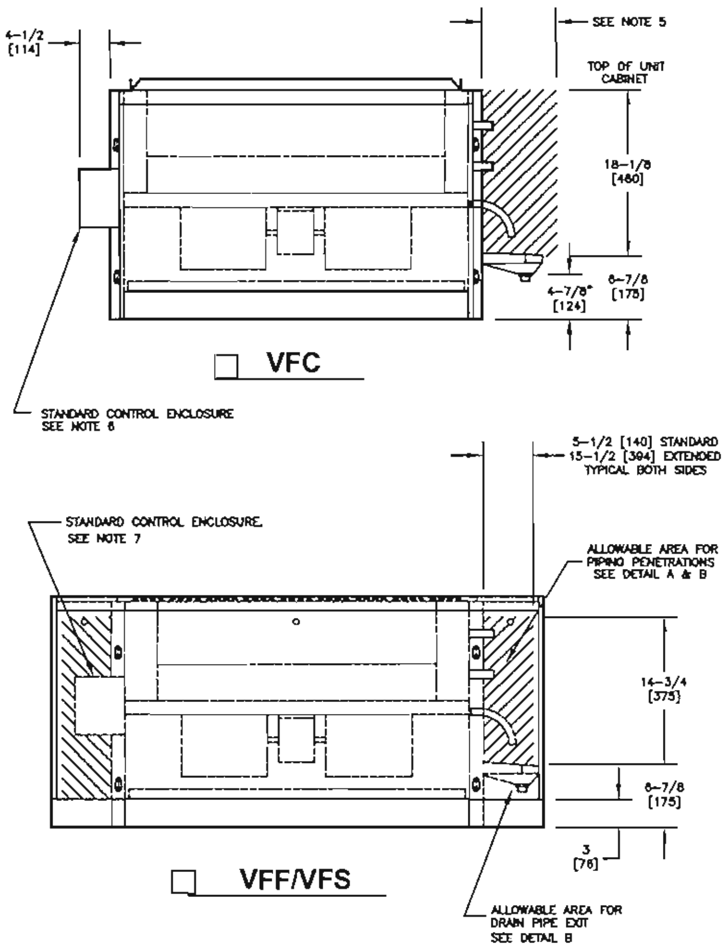
SIDE VIEW

DIMENSIONS – In [mm]

UNIT SIZE	A	B	C	D	E	F
20	53 [1346]	27 [686]	23-1/2 [597]	9-3/4 [248]	28-1/2 [724]	19-3/4 [502]
25	59 [1499]	33 [838]	27-1/2 [699]	10-3/4 [273]	34-1/2 [876]	20-3/4 [527]
30	63 [1600]	37 [940]	31-1/2 [800]	10-3/4 [273]	38-1/2 [978]	20-3/4 [527]
40	73 [1854]	47 [1194]	43-1/2 [1105]	9-3/4 [248]	48-1/2 [1232]	19-3/4 [502]
50	83 [2108]	57 [1448]	51-1/2 [1308]	10-3/4 [273]	58-1/2 [1486]	20-3/4 [527]
60	93 [2362]	67 [1702]	63-1/2 [1613]	9-3/4 [248]	68-1/2 [1740]	19-3/4 [502]

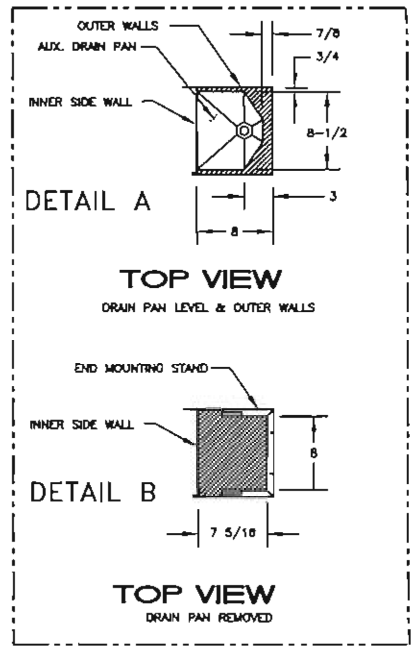
51-80010-REV03

MODEL VF - ELECTRIC ENTRY & PIPING WALL PENETRATION LOCATIONS

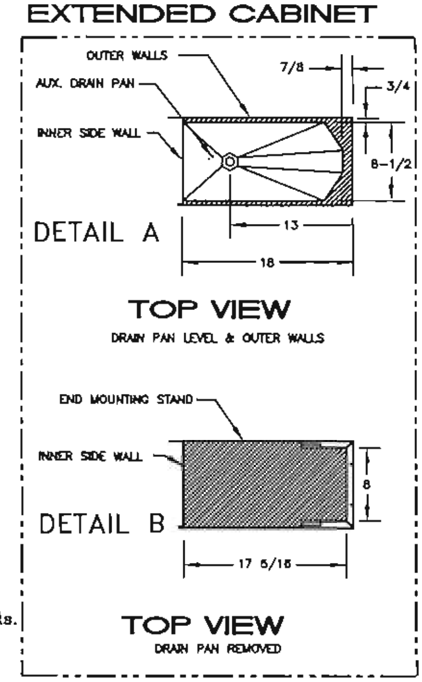


UNIT FRONT VIEWS

STANDARD CABINET



EXTENDED CABINET



NOTES;

1. All dimensions are inches [millimeters]. All dimensions are ±1/4" [6mm]. Metric values are soft conversion.
2. All drawings are subject to change without prior notice.
3. Control enclosure size and location may vary with unit features.
4. All chilled water piping that projects beyond the auxiliary drain pan must be field insulated by others.
5. Available space for piping wall penetrations and valve packages on model VFC units is determined by individual installation conditions. Consult actual job floor plans and other documents to verify clearances. Factory valve packages will not exceed 6-1/2" [165mm].
6. Provide sufficient clearance to access electrical components and comply with all applicable codes and ordinances. Control enclosure may extend an additional 10" [254mm] to accomodate some optional electrical components.
7. Electrical entry should be routed above or below the control enclosure.
8. 10" [254mm] cabinet extension may be specified on control enclosure end to accomodate an extended electrical enclosure.

51-80032-REV01

Johnson Controls

P.O. Box 423, Milwaukee, WI 53203 www.johnson-controls.com

Printed in USA ET115.24-NOM9 (908)
New Release

Jan 29/09

Appendix B: Ventilation Unit Specification

SEMCO INCORPORATED

Green Phoenix
Toronto, Canada

SEMCO order #: 00000 revision #: 01

SCOPE OF WORK FOR UNIT TAGGED: HRU-1

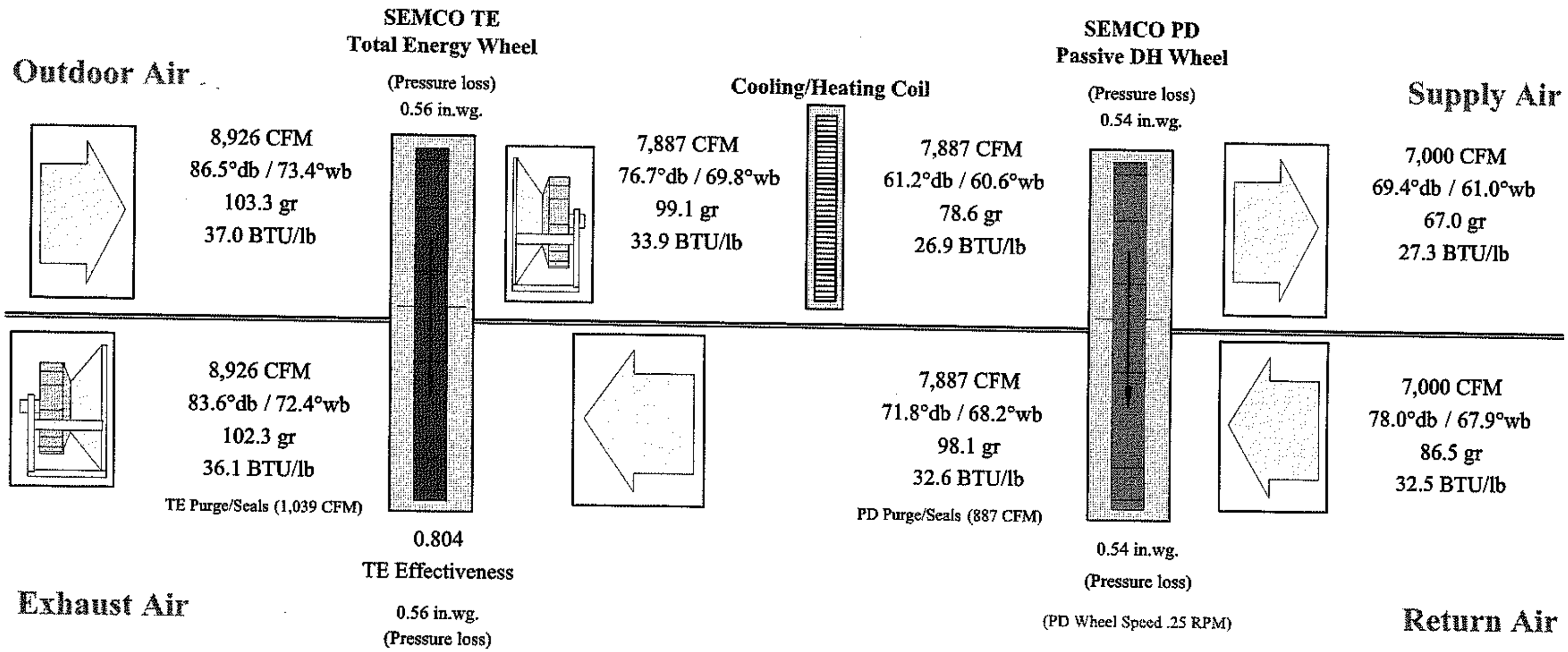
UNIT CONSTRUCTION	Model	**PVS-13 *PINNACLE*® Primary Ventilation System**				
	Hand	**RIGHT**				
	Installed	**Outdoors - Self flashing for curb mounting (curb by others)**				
	Enclosure Construction	**Standard, unpainted, galvanized.**				
FANS	Supply Air	**7000**	CFM			
	Outside Air	**8926**	CFM	includes wheel purge		
	Outside / Supply Side Pressure	**1.5**	in. wg. ESP,		**4.6**	in. wg. TSP
	Supply Fan Motor	**10**	HP, Prem. Eff. ODP			
	Return Air	**7000**	CFM			
	Exhaust Air	**8926**	CFM	includes wheel purge		
	Return / Exhaust Side Pressure	**1.5**	in. wg. ESP,		**3.5**	in. wg. TSP
	Exhaust Fan Motor	**15**	HP, Prem. Eff. ODP			
WHEEL	Enthalpy Wheel Speed Control	**Variable**				
	Passive DH Wheel Speed	**Variable.**				
FILTERS	**ASHRAE test std. 52-96**					
	OA filter bank	**MERV 8 (30%) 2" deep, qty of 6 @ 24x24**				
	Also Mounted in OA filter bank	**MERV 14 (95%) 12" deep, qty of 6 @ 24x24**				
	RA filter bank	**MERV 8 (30%) 2" deep, qty of 3 @ 24x24 & 3 @ 12x24**				
	Filter Gauges @ ea. filter bank	**Dwyer Magnehelic - std. model 2001LT**				
DAMPERS	Outside Air	**Galvanized Steel w/ 24 volt, modulating actuator**				
	Exhaust Air	**Aluminum, counter-balanced, back-draft**				
	Recirculation Air	**Galvanized Steel w/ 24 volt, modulating actuator**				
AUX COOLING/ HEATING	Fluid	**Chilled Water Cooling/Hot Water Heating Combo Coil** **Each coil bank is two coils high and each coil has one supply and one return connection.**				
ELECTRICAL	**FIELD POWER CONNECTIONS ARE REQUIRED AT THE FOLLOWING:**					
	208/3/60	at the main unit electrical panel.				
UNIT CONTROL	**Provided by SEMCO. See the submitted Sequence of Operation for additional information.**					
SPECIAL						

FIELD UNIT START-UP:

- **SEMCO's factory trained personnel will provide unit start-up service at the job site.**
- **An appointment should be made with the SEMCO DWP Service Dept. a minimum of five weeks prior to the required start-up date. Contact the DWP Service Dept. at 573-443-3636 ext. 7118**

Project: Green Phoenix
Location: Toronto, Canada
Model: PVS-13

Operating Mode:
Peak Space Latent Load
Unit #: HRU-1

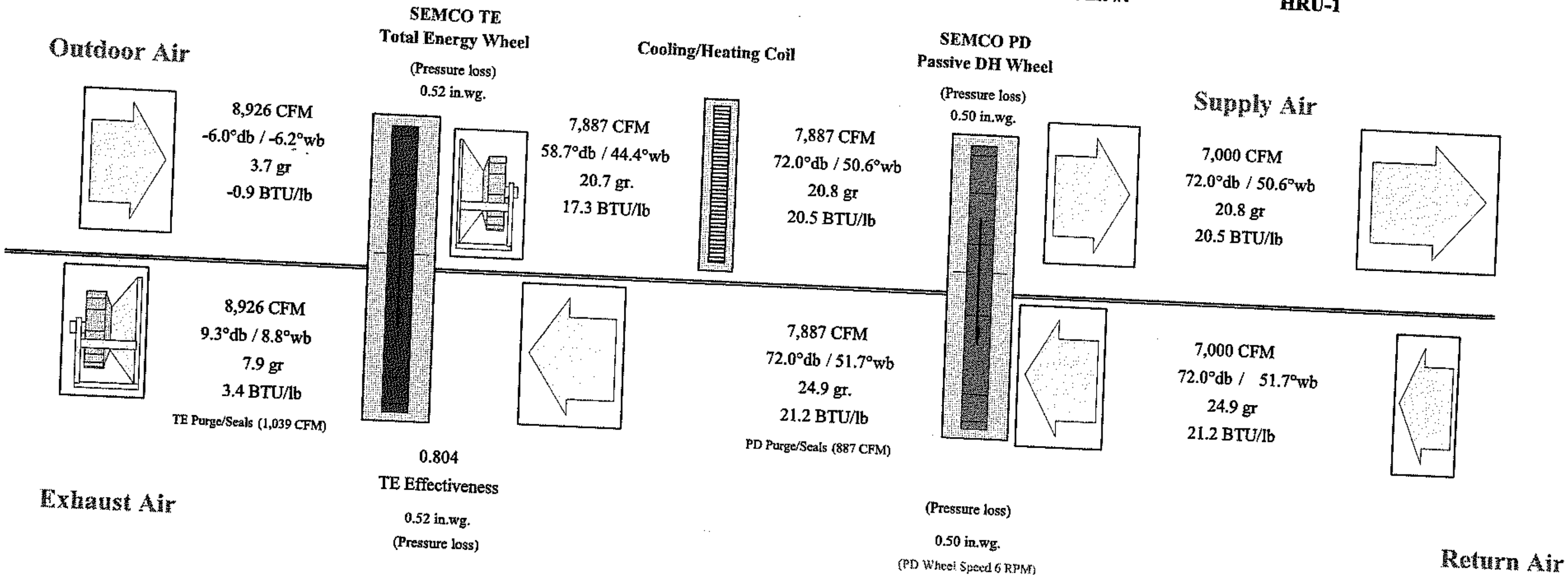


10/30/2008 11:44 AM

1800 East Pointe Drive, Columbia, Missouri 65201-3508

Project: Green Phoenix
Location: Toronto, Canada
Model: PVS-13

Operating Mode:
Peak Heating Load
Unit #: HRU-1



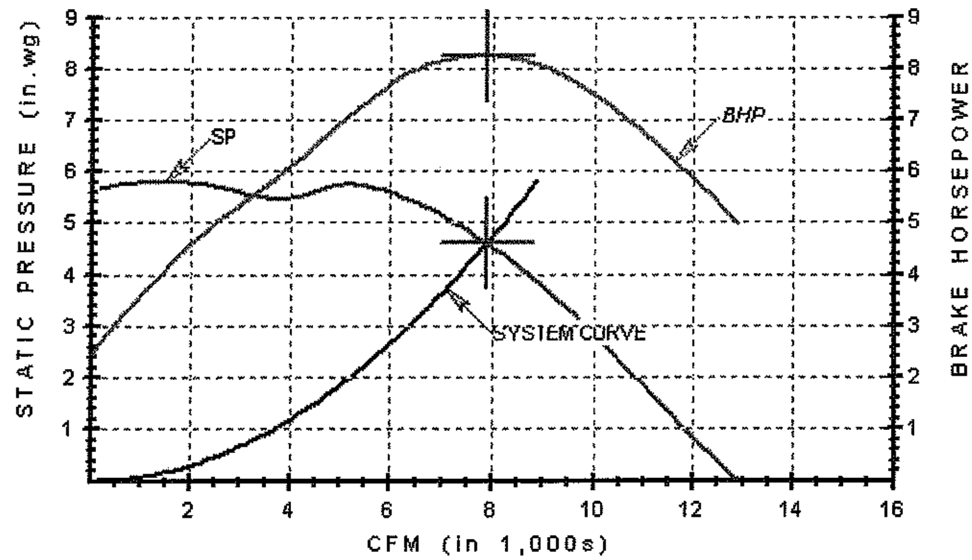
10/30/20081:16 PM

SEMCO INCORPORATED **Green Phoenix** **SEMCO order #: 00000 revision #: 01**

FAN CURVE FOR UNIT TAGGED: HRU-1

Customer: Green Phoenix	Fan Tag: Supply
Job ID:	Model: 222 EPF

01
TWIN CITY FAN AND BLOWER PERFORMANCE CURVE



CFM:	7,887
SP:	4.6 in.wg
RPM:	1894
BHP:	8.24
Outlet Velocity:	N/A
Density:	0.075

Sound Power Level

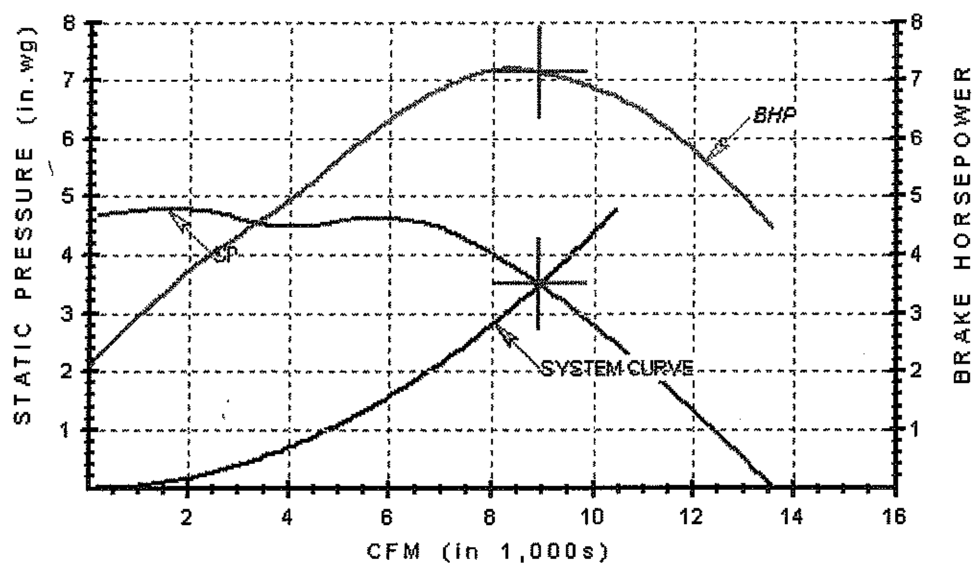
Octave	In/Out
1	86 / 89
2	89 / 91
3	96 / 95
4	90 / 92
5	81 / 88
6	78 / 82
7	73 / 78
8	70 / 75

in db re 10^{-12} watts

1/20/2009 14:05

Customer: Green Phoenix	Fan Tag: Exhaust
Job ID: HRU-1	Model: 245 EPF
Represented By: Twin City Fan Companies, Ltd. (763) 551-7600	

01
TWIN CITY FAN AND BLOWER PERFORMANCE CURVE



CFM:	8,926
SP:	3.5 in.wg
RPM:	1555
BHP:	7.13
Outlet Velocity:	N/A
Density:	0.075

Sound Power Level

Octave	In/Out
1	84 / 90
2	92 / 94
3	97 / 96
4	85 / 91
5	80 / 87
6	78 / 83
7	74 / 80
8	69 / 75

in db re 10^{-12} watts

10/30/2008 15:36

Appendix C: "Green Project" Design Features

Retrofit Building Shell	
Wall Assembly[1]	EIFS over cladding
Wall RSI[1]	6.47 $(m^2K)/W$
Roof RSI[1]	2.36 $(m^2K)/W$
Window Type[1]	Fiberglass frame, Double glazed, argon filled, low-e coating
Window[1]	USI 2 $W/(m^2K)$
Mechanical System	
Space Heating[1]	Geothermal, efficient boiler
Cooling[1]	Geothermal
Distribution	Hydronic Fan coil[2]
Water Heating[1]	Efficient Modulating Hydrotherm multi-pulse Boiler
Alternative HWS[1]	Solar Thermal DHWH
Ventilation	7000cfm Air Handling Unit + Enthalpy Recovery[2]
Lighting[1]	Energy Efficient Lighting Retrofit
Other	
	Building Automation System[1]
	Rainwater collection and irrigation[1]
[1] (GPF, 2012), [2] (M, 2011-2012)	

Dear "Green Project" tenant,

Ryerson University team supported by the sponsors listed on the cover page is launching a project to look at tenant's energy/water usage and their attitude towards energy/ water use. How can tenants save energy and water? Do tenant engagement strategies really work? The purpose of this study is to see whether tenant engagement strategies will conserve energy and water in Toronto's "Green Project" building. Tenants will have the opportunity to participate and be exposed to various tenant engagement strategies such as informational tools (e.g. poster and brochures), workshops, and energy-water--saving commitments. For more details, please see the posters throughout the building.

Confidentiality will be maintained and only general non-identifying data will be disclosed in any report and research publication. Further details regarding the protection of your privacy are in the "***Ryerson University Consent Agreement***" included with the survey.

Ryerson University Team has Research Ethics Approval for this project.

If you have any questions about the research study, please contact Miles Roque - miles1.roque@ryerson.ca

Please take the time to complete the survey and SUBMIT it to:

DROP BOX is located in the MAIN LOBBY, near the Front Entrance Door

Remember:

- As a token of appreciation, $5.00 will be given to you for taking part in the survey. Please enter your apartment unit number in Question 1 of the survey so that we know which mailbox to put the $5.00 in.

We hope you enjoy participating in our research. We truly appreciate your time to complete the survey!

THANK YOU FOR YOUR COOPERATION!

Instructions

Please complete all questions below. **CHECK OFF ☑** the appropriate option.

Part 1: General Information

1. What is your apartment unit #?

____

You will receive **$5.00** in your mailbox when entering your apartment unit #.

2. Are you male or female?
   - ❑ Male
   - ❑ Female

3. What is your age?
   - ❑ 18-30 years old
   - ❑ 31-45 years old
   - ❑ 46-60 years old
   - ❑ Over 60 years old

4. What part of the world did you grow up in?
   - ❑ Canada
   - ❑ USA
   - ❑ Europe
   - ❑ South or Central America or Caribbean
   - ❑ South Asia (e.g. India, Pakistan, Sri Lanka)
   - ❑ East Asia (e.g. China, Japan, Korea)
   - ❑ Southeast Asia (e.g. Vietnam, Philippines, Malaysia)
   - ❑ West Asia & Middle East (e.g. Lebanon, Iran)
   - ❑ Africa (e.g. Ethiopia)
   - ❑ Austrailia, New Zealand or the South Pacific
   - ❑ Other, please specify.___________________
   - ❑ Prefer not to answer.

5. How many years have you been living in the "Green Project"?
   - ❑ 0 to 1 year
   - ❑ 2 to 4 years
   - ❑ 5 to 7 years

- ❑ More than 7 years

6. How many people live in your household?
- ❑ 1 person
- ❑ 2 persons
- ❑ 3 or more persons

7. On an average day, how many hours do you spend in your apartment (includes sleeping)?
- ❑ 8 hours or less
- ❑ 9 to 13 hours
- ❑ 14 to 18 hours
- ❑ more than 18 hours

8. What is your total household residency?
- ❑ $0 to 14,999
- ❑ $15,000 to 29,999
- ❑ $30,000 to 49,999
- ❑ over $50,000
- ❑ Prefer not to answer.

Part 2: Electrical Devices

TELEVISION

9. How OLD is your TELEVISION?
- ❑ I DO NOT HAVE A TELEVISION.
- ❑ 5 years or less
- ❑ 6 to 10 years
- ❑ 11 to 15 years
- ❑ 16 years or more

10. How many hours a day do you leave your TELEVISION turned ON?
- ❑ 1 hour or less
- ❑ 1 to 3 hours
- ❑ 4 to 8 hours
- ❑ 9 to 13 hours
- ❑ 14 hours or more

11. What TYPE of TELEVISION do you have?

- ❑ Regular (tube)
- ❑ Plasma
- ❑ Liquid Crystal Display (LCD/LED)
- ❑ Other

CABLE BOX (DIGITAL ANALOG BOX)

12. Do you turn off the cable box when you are done watching TV?

- ❑ I DO NOT HAVE CABLE - NO CABLE BOX.
- ❑ Always turn off my digital analog box after using the TV
- ❑ Sometimes turn it off
- ❑ Leave it ON all the time

COMPUTERS - DESKTOP AND/OR LAPTOP

13. Do you have a laptop, desktop, or both? (Check all that apply.)

- ❑ I DO NOT HAVE A COMPUTER.
- ❑ Laptop
- ❑ Desktop (regular computer)

14. How many hours a day do you use your computer?

- ❑ 1 hour or less
- ❑ 1 to 3 hours
- ❑ 4 to 8 hours
- ❑ 9 hours or more

15. How OLD is your COMPUTER?

- ❑ 5 years or less
- ❑ 6 to 10 years
- ❑ 10 years or more

INTERNET CONNECTION

16. On an average day, how long do you spend on the Internet?

- ❑ I DO NOT HAVE AN INTERNET CONNECTION.
- ❑ 1 hour or less
- ❑ 1 to 3 hours
- ❑ 4 to 8 hours
- ❑ 9 to 13 hours
- ❑ 14 hours or more

OTHER ELECTRICAL DEVICES

17. What appliances do you have at home?

Please **CHECK OFF ☑** all electrical devices that you have at home.
(Check off all devices that you have at home.)

- ❑ Cell phone charger
- ❑ Home phone
- ❑ VHS player
- ❑ DVD player
- ❑ Game console (e.g. Nintendo, Xbox, Play Station)
- ❑ Printer
- ❑ Speakers
- ❑ Clock
- ❑ Radio/stereo
- ❑ Slow cooker
- ❑ Rice Cooker
- ❑ Iron
- ❑ Vacuum cleaner

- ❑ Humidifier/dehumidifier
- ❑ Other? Please specify: ____________________________

Part 3: Heating and Cooling

18. **During the winter**, what temperature do you set your heating/cooling equipment at?

- ❑ Temperature setting during the winter. ________(specify)

19. **During the summer**, what temperature do you set your heating/cooling equipment at?

- ❑ Temperature setting during the summer. ________ (specify)

20. Which of the following do you use to adjust you thermal comfort?
(Check all that apply)

- ❑ Open/close windows
- ❑ Open/close doors
- ❑ Close blinds/drapes
- ❑ Adjust the thermostat
- ❑ Turn on personal heater
- ❑ Turn on personal fan
- ❑ Put on/remove clothing

Other? Specify:________________

Part 4: Energy Behaviour

21.

For each item listed below, circle the number on HOW LIKELY YOU ARE TO DO the following. Use the scale shown on top to select the behavioural scale from **1 (Always) to 5 (Never).**

Item	Scale				
Do you... ⇩	**Always**		**I don't know**		**Never**
1. ...turn off the lights when you are not at home	**1**	**2**	**3**	**4**	**5**
2. …turn off the lights when not in use	**1**	**2**	**3**	**4**	**5**
3. ...turn off electronics when you are not at home	**1**	**2**	**3**	**4**	**5**
4. …turn off electronics when not in use	**1**	**2**	**3**	**4**	**5**
5. ...use timer controls to control your electrical devices/electronics	**1**	**2**	**3**	**4**	**5**
6. …turn off (shut down) computer when not in use	**1**	**2**	**3**	**4**	**5**
7. …turn off (shut down) computer when you are not at home	**1**	**2**	**3**	**4**	**5**
8. ...buy green appliances/devices (e.g. energy saving light bulbs, EnergyStar)	**1**	**2**	**3**	**4**	**5**

Part 5: Lighting

22. How **many COMPACT FLUORESCENT** (CFL) (Energy Saving) light bulbs do you use in your apartment?

- ❑ Please write down how many CFL light bulbs you use. ________(NUMBER)

23. How **many INCANDESCENT (regular)** light bulbs do you use in your apartment?

- ❑ Please write down how many INCADESCENT light bulbs you use. ________(NUMBER)

24. On an average day, how many light bulbs are turned on longer than 3 hours or more?

- ❑ 1 to 2 bulbs
- ❑ 3 to 5 bulbs
- ❑ 6 to 10 bulbs
- ❑ More than 10 bulbs

25. How many hours are the light bulbs turned on **during the winter**?

- ❑ Less than 3 hours
- ❑ 3 to 5 hours
- ❑ 6 to 9 hours
- ❑ More than 9 hours

26. How many hours are the light bulbs turned on **during the summer**?

- ❑ Less than 3 hours
- ❑ 3 to 5 hours
- ❑ 6 to 9 hours
- ❑ More than 9 hours

27. How many lamps, floor lamps, or any other light fixtures do you have?

- ❑ Please write down how many lamps or any other light fixture you have.______(NUMBER)

Part 6: Water Usage

28. Do you run the tap (faucet) while brushing your teeth, shaving, etc.?

- ❑ Yes
- ❑ No

29. Do you leave the sink/tap running while washing the dishes?
- ❑ Yes
- ❑ No

30. How many times do you flush your toilet in a day? __________(Number)

31. Do you prefer taking a shower/bath? (Please choose one)
- ❑ Shower
- ❑ Bath

32. In a week, how many times do you shower/bathe?
- ❑ 1+ per day (More than once a day)
- ❑ Once a day
- ❑ Every other day
- ❑ Once a week
- ❑ Other? Specify. _________

Part 7: Household Activities

Cooking

33. On an average day, for how long do you use your **stove**?
- ❑ I do not use the stove at home
- ❑ 1 hour or less
- ❑ 1 to 3 hours
- ❑ more than 3 hours

34. On an average day, for how long do you use your **oven**?
- ❑ I do not use the oven at home
- ❑ 1 hour or less
- ❑ 1 to 3 hours
- ❑ more than 3 hours

35. On an average day, what is the total time spent using your **microwave**?
- ❑ I do not have a microwave
- ❑ Less than 3 minutes
- ❑ 3 to 9 minutes
- ❑ 9 to 15 minutes
- ❑ 15 minutes or more

Part 8: Indoor Environment Satisfaction and Thermal Comfort

36.
For each item listed below, circle the number on HOW SATISFIED YOU ARE ABOUT THE FOLLOWING, listed below. Use the scale shown on top to select the satisfaction level from **1 (Very satisfied) to 7 (Very dissatisfied).**

Item	Scale						
How satisfied are you with...	**Very Satisfied**			**Neutral**			**Very Dissatisfied**
A. The amount of space available for individual daily activities	**1**	**2**	**3**	**4**	**5**	**6**	**7**
B. The apartment unit layout	**1**	**2**	**3**	**4**	**5**	**6**	**7**
C. The quality of water in your apartment	**1**	**2**	**3**	**4**	**5**	**6**	**7**
D. The appliances in your apartment (i.e. stove, refrigerator, etc.)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
E. The cleanliness of the building	**1**	**2**	**3**	**4**	**5**	**6**	**7**
F. The maintenance of the building	**1**	**2**	**3**	**4**	**5**	**6**	**7**
G. The air quality in your apartment (e.g. stuffy/stale air, odours, cleanliness, etc.)	**1**	**2**	**3**	**4**	**5**	**6**	**7**
H. The sound privacy between apartments?	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Part 8: Indoor Environment Satisfaction and Thermal Comfort cont'd…

Circle the appropriate number according to your level of satisfaction/thermal comfort.

37. On a scale from 1 to 7, 7 being very dissatisfied and 1 being very satisfied, how satisfied are you with...

The temperature of your apartment unit during the **SUMMER** (Very satisfied) 1 2 3 4 5 6 7 (Very dissatisfied)

38. On a scale from 1 to 7, **7 being interferes and 1 being enhances**…

Overall, does your thermal comfort in the apartment **<u>during summer</u>** enhances or interfere with your comfort?

(Enhances) 1 2 3 4 5 6 7 (Interferes)

39. How satisfied are you with...

The temperature of your apartment unit during the **WINTER**

(Very satisfied) 1 2 3 4 5 6 7 (Very dissatisfied)

40. Overall, does your thermal comfort in the apartment **<u>during winter</u>** enhances or interfere with your comfort?

(Enhances) 1 2 3 4 5 6 7 (Interferes)

41. How satisfied are you with...

The temperature of your apartment unit during **SPRING/FALL**

(Very satisfied) 1 2 3 4 5 6 7 (Very dissatisfied)

42. Overall, does your thermal comfort in the apartment **<u>during spring/fall</u>** enhances or interfere with your comfort?

(Enhances) 1 2 3 4 5 6 7 (Interferes)

43. How satisfied are you with...

The air quality in your apartment (e.g. stuffy/stale air, odours, cleanliness, etc.)

(Very satisfied) 1 2 3 4 5 6 7 (Very dissatisfied)

44. Overall, does your **air quality** in the apartment enhances or interfere with your comfort?

(Enhances) 1 2 3 4 5 6 7 (Interferes)

45. How satisfied are you with...

The sound privacy between apartments?

(Very satisfied) 1 2 3 4 5 6 7 (Very dissatisfied)

46. Overall, does the **acoustic quality** in the apartment enhances or interfere with your comfort?

(Enhances) 1 2 3 4 5 6 7 (Interferes)

Please answer Question 46 ONLY if you have lived in the building for longer than 3 years.

47. How satisfied are you with the building upgrade? (i.e. individual apartment thermostat, new windows, draft proofing, etc.)

(Very satisfied) 1 2 3 4 5 6 7 (Very dissatisfied)

48. Do you have other comments, concerns, or questions about your indoor environment satisfaction, thermal comfort, or energy behaviour?

Part 9: Your Neighbourhood

49. How would you describe your sense of belonging to your local neighbourhood? Would you say it is...

- ❑ Outstanding
- ❑ Very strong
- ❑ Somewhat strong
- ❑ Somewhat weak
- ❑ Very weak
- ❑ I don't know

50. In general, how do you feel about living in the "Green Project"?

51. In what ways has living in the "Green Project" changed your life (financial, sense of security, well-being, etc.)?

Thank you for your time to complete this survey!
For more information, please contact: miles1.roque@ryerson.ca

Roque, M., Straka, V., & Fung, A. (2012). *Survey of Household Energy Use in a Toronto Rental High-rise Multi-unit Residential Building (MURB).* Ryerson University, Toronto.

Appendix E: Electricity Consumption Bills From Toronto Hydro

Year	Elec. Billing Period	Elec. Consumption (kWh)
8	Jan 14 - Feb 13	112800
8	Feb 14 - Mar 13	78400
8	Mar 14 - May 13	113600
8	May 14 - Jun 11	35200
8	Jun 12 - Jul 15	42400
8	Jul 16 - Aug 14	39200
8	Aug 15 - Sep 15	37600
8	Sep 16 - Oct 15	40800
8	Oct 16 - Dec 11	127200
8	Dec 12 - Jan 15	108800
11	Jan 13 - Feb 10	64400
11	Feb 11 - Mar 14	69600
11	Mar 15 - Apr 11	55200
11	Apr 12 - Mat 15	56400
11	May 16 - Jun 16	57600
11	Jun 17 - Jul 14	50400
11	Jul 15 - Aug 16	64800
11	Aug 17 - Sep 15	58400
11	Sep 16 - Oct 17	55615
11	Oct 18 - Nov 15	54785
11	Nov 16 - Dec 14	49200
11	Dec 15 - Jan 16	59600
12	Jan 17 - Feb 13	49200
12	Feb 14 - Mar 14	49200
12	Mar 15 - Apr 15	50000
12	Apr 16 - May 13	39600
12	May 14 - Jun 13	48800

Appendix F: Gas Bills from Enbridge

Year	Gas Billing Date	Consumption (m^3)
7	Dec 12 - Feb 12	17534
8	Feb 13 - April 14	16014
8	Apr 14 - Jun 11	9535
8	Jun 12 - Aug 12	8348
8	Aug 13 - Oct 09	8319
8	Oct 10 - Dec 10	12110
8	Dec 11 - Feb 11	14133
9	Dec 09 - Feb 10	16029
11	Feb 11 - Apr 10	10272
11	Apr 11 - Jun 12	4737
11	Jun 13 - Aug 10	12
11	Aug 11 - Oct 11	336
11	Oct 12 - Dec 08	6574
11	Dec 09 - Feb 07	11580
12	Feb 08 – Apr 10	11687
12	Apr 11 – Jun 11	5018

Floors 2 and 3

Meter	Suite	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Average
1	304	108.8	113.3	290.7	402.4	275	123.8	78	52	57.8	76.3	75.2	41.7	52.7	46.8	42.9	52	45	49.8	44.4	46.9	104
2	305	92.1	95.1	98.8	95	84.9	92.1	87.2	76.2	70.6	83.2	77.3	68.4	76.4	87.2	84.1	82.1	76.9	77.3	80.5	77.6	83
3	302	106.7	97.1	95.8	103.1	96.1	115.6	125.8	101.5	132.7	122.3	98	85	79.1	69.3	70.6	71.3	68.9	80	74.7	81.1	94
4	303	75.8	84.7	91.8	94	82.8	87.3	96.2	130.9	100.5	141	130.2	125.5	112.7	87	102.4	91.4	72.8	81.5	90.5	80.3	98
5	306	244.2	294.7	399.6	447.8	359.2	437.4	361.9	375.1	284.7	298.7	416.5	428.6	447.9	323.8	289.9	211.1	176.5	180.1	206.8	172	318
6	301	110	112.8	158.3	182	161.1	175.1	109.1	102.6	107.7	120.1	137.2	96	110.2	97.2	146.9	194.7	179.9	135.8	140.9	94.2	134
7	308	69.5	24.2	22.7	25.5	24.8	108.9	29.2	65.9	69.9	85.5	76.4	69.8	26.8	24.5	25.2	24.3	23.3	25.4	43.9	73.6	47
8	313	102.1	90.4	98.8	110.6	92.5	103	82.9	94.7	89.5	103.7	106.2	75.7	81.4	85.2	104.5	85.1	94.6	100.2	62.2	92	93
9	310	85.9	100.2	130	135.5	108.4	117.4	120.2	127.9	148.3	203.6	186	152.8	141.2	141.7	162.4	158.8	130.2	102.1	42.7	83.3	129
10	311	80.3	97.2	82.1	101.6	100.6	85	93.3	99.1	105.9	127.2	140.6	85.1	106.8	61.9	103.9	102.2	183.4	142.8	139	145.2	109
11	312	79.9	70.7	74.8	91.5	80.6	89.5	82.1	73.4	75.1	113.8	93	85.7	73.4	83.7	89.2	82.6	80.9	85	78.9	72.8	83
12	309	75.8	56.4	61	100.8	69.8	81.3	57	56.4	76.1	81.7	86.7	61.3	61.3	44.9	50.9	38.9	44.7	45.9	51.5	47.4	62
13	314	114.1	77.2	127.9	161.7	142.6	127.9	138	172.1	159	169.9	180.9	148.7	151.6	115	152.2	132.4	173.8	197.3	124.9	158.7	146
14	307	115.6	124	132.4	135.3	139.4	109.3	116.2	134.1	128.7	174	169.6	140.7	136.2	151.5	146	146.6	135	146	137.4	133.5	138
15	212	74.2	78.9	96.9	120	85	81.7	87.3	87.2	68.7	70.1	61.2	66	94.3	83.8	111.5	84.1	73.9	64	64.8	74	81
16	207	102.2	102.4	95.6	101.2	96.1	122.4	114.2	85.8	98.6	118.8	119.8	99	75.5	65.6	81.9	85.2	81.4	74.6	94.5	76.1	95
17	210	83.5	82	71.6	70.6	83.4	125.8	124.8	136.7	143.3	179.5	177.4	127.4	120.8	137.6	143.7	137.3	124	142.3	139.4	130.7	124
18	211	154.1	137.2	139.8	146.7	132.6	152.7	149.4	148.8	151.2	177.4	201.7	163.8	159	149.5	159.1	156.8	142.9	167.5	148.9	56.1	150
19	208	208.1	182.4	196.8	194.7	193.2	199.4	188.3	188.8	190.5	229	222.6	184.9	184.9	178.3	186.1	195.1	182.5	177.1	174	181.6	192
20	201	211.3	208.3	208.9	233.3	215.9	250.9	213.7	218	219.5	255.2	247.8	316.1	304.6	269.7	326.2	343.3	320	258.3	235.2	206	253
21	204	153.1	146.2	150.8	166.5	137.3	138.7	140.2	143.5	133.9	142.2	127.7	93	81.1	66.5	106.4	91.1	76.4	79.5	71.8	70.5	116
22	214	143.5	144.7	131	149.3	123.2	137.6	124.6	128.2	124.9	135.8	133.8	139.3	140.3	126.7	159.5	172.8	145.5	148.3	144.3	132.7	139
23	206	173.3	164	167	193.5	172.5	177.5	167.6	158.5	150	148.9	148.8	139.4	140.3	129.7	126.4	166.2	145.7	132.4	164.8	117.3	154
24	209	86	84.3	98.9	115.4	91.5	76.7	29.4	65.5	68.8	73.9	78.9	85.8	92.4	82.5	55.3	58.1	43.7	32.9	31.3	57.8	70
25	202	181.8	142.1	153.2	148.6	148	154.9	124.1	137.6	155.6	179.4	215.4	174.5	120.7	154.4	144.3	170.1	148.3	151	162.4	196.7	158
26	213	3.4	42.1	82.7	75.4	80.4	83.6	72.6	63	79.8	89.8	87.9	52.1	60	106.4	94.6	120.9	102.6	108.6	83.5	102.5	80

Floors 4 and 5

Meter #	Suite #	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Average
1	501	98.7	110.9	140	129.3	97.1	111.5	113	149.6	141.5	114.3	135.1	139.8	137	155.5	114.6	120.9	120.7	127.8	102.5	109	123
2	503	109.7	104.7	90.4	89.6	82.5	81.1	75.8	73.3	76.3	100	90.7	76.5	79.3	72.9	70.4	68.5	73.9	77.1	84	96.6	84
3	502	97.7	98.2	99.1	101.9	89.5	91.4	83.3	84.9	83.9	86	84.4	80.1	89.1	82.7	100	96.1	90.2	83.7	82.9	79.1	89
4	509	132.3	123.4	169.8	147.3	131.6	128.1	141.4	127.8	133.6	129.3	152.8	172.8	159.7	137.6	165.7	144.9	108.5	99.6	113.9	172.2	140
5	506	80.1	38.4	34.7	34.9	28.6	31.9	30.1	64.4	163.3	186.8	209	172.7	155.1	150.7	150.8	147.8	117.5	138	35.2	107.3	104
6	513	141.9	132.3	127.3	153	132.9	130.4	124.2	121	101.4	157.7	206.2	130.6	137.5	117.8	127.4	104.2	75.8	84.5	84	82.5	124
7	508	74.7	83.4	79.1	89.9	85.4	94.1	111.8	119	110.5	108.4	108.8	94.3	96.5	90.8	98.7	97.4	92.2	100.9	96.1	95.7	96
8	504	114.5	140.7	153.7	73.4	26.3	32.5	132.2	117.4	106.3	160.9	118.7	93.1	81.3	38.9	36	68.6	117	101.8	111.6	90.1	96
9	510	206.9	189	176.9	208.3	198.4	215.7	206.3	216.7	198.9	206.3	200.7	102.6	133.5	189.2	249	248.1	237.6	262.9	213.1	174.5	202
10	511	158.3	143.1	158.7	183.3	152.8	181.1	174.8	216.9	196.3	186	230.2	236.3	249.1	193.7	225.9	228.8	206.8	199.5	198.1	181.4	195
11	514	47.6	44.1	54.5	61.5	57	59	49.8	57.7	63.3	81.5	114.1	108.6	86	63.4	75.7	82.8	63.6	77	67.8	81	70
12	507	75.6	71.2	65.4	45.4	30.7	82.3	74.6	85.7	82.4	82.2	89	74	94.8	90.7	97.8	100.9	93.5	87.2	96.6	118.9	82
13	512	329.3	235.1	257	1107	1003.7	1000	547.5	747.4	283.8	255.2	267.1	624.5	331.8	342.6	829.8	977	495.9	179	195	1,302	566
14	505	115.5	118.1	152.1	134.4	109	111.1	122.1	114.1	79.6	89.7	78.1	72.7	81.5	95.1	81.3	84.4	86.3	119.1	99.4	76.9	101
15	414	75.2	70	66	76.7	66.4	73.9	78.3	79.2	75.4	80.1	85	78.2	78.7	79.5	70.9	84.3	70.4	77.4	69.8	73	75
16	411	121.3	120.9	129.3	127.6	123.4	134.3	129	139.1	172.8	193.4	170.8	176.1	150.5	174.1	148.1	160.3	138.3	153.4	145.9	159.5	148
17	412	82	102.7	68.9	57.5	73.1	54.9	85.6	55.1	73	109.9	136.6	110.1	118.5	89.6	79.6	60.5	58.9	58.4	41.2	34.7	78
18	405	124.5	123	115.9	117.6	104.4	120.5	120.5	121	138.2	153.5	152.7	128.4	122	119.9	128.9	118	109.5	120.5	119.8	116.9	124
19	410	57	52.4	56.9	76.4	89	81	68.4	71.7	86.1	51.2	75.6	70.7	75.6	72.9	82.1	88	86.4	87.4	79.8	83.3	75
20	409	54	65.8	65.5	70	65.9	69.1	57.1	49	46.5	71.2	80.5	63.8	58.9	69.4	48.8	41.5	63.5	67.8	48.7	55.4	61
21	408	161.5	189	189.4	193.5	176.9	196.1	180.8	162.3	129.4	160.1	164.2	131.4	141	136.3	138.6	127.5	126.6	134.5	117.7	76.6	152
22	413	101.7	87.1	97.7	102.6	105	104	65.3	43.7	40.4	42.3	47.5	126	152.8	109.4	110.1	121.5	131.1	129.1	179.9	245.9	107
23	402	111.6	131.3	118.6	129.3	138.2	157.7	151.9	153	150.7	180.4	201.1	171	148.6	120.6	133.2	141.1	141.4	154.6	156.2	138.3	146
24	407	92.3	93.2	50.9	50.8	46.9	82.7	82.9	89.6	83.9	100.8	108.6	94.7	80.4	77.3	92.8	101	100.1	103.7	43.5	71.3	82
25	401	99.6	109.5	101.1	127.8	109.5	116.9	106	131.3	124.9	103.3	91.2	123.2	125	108.1	101.5	113.7	103.6	109.5	96	125.5	111
26	406	116.8	103.3	85.8	135.1	137.1	145.6	140.1	142.5	147.7	189.1	215.3	127	129	107.5	96.9	74.4	82.3	113.7	117.3	104.3	126
27	404	152.7	137.2	159.2	161.7	139	160.5	147.2	139.7	136.7	122.7	126.6	100.4	103	84.8	98	125.3	121	127.2	137	121.6	137
28	403	188.3	196.1	210.8	192.7	132.8	178.5	162.8	173.1	220.4	190.6	231.3	215.1	263.4	256	274.9	327.9	279.1	211.5	196.6	195.8	197

Floors 6 and 7

Meter #	Suite #	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Average
1	702	124.7	110.1	113.9	89.8	81.9	82.1	83.4	126.7	160.1	182.7	198.5	171.8	116.9	111.5	138.1	113.8	90.2	88.5	83.3	137.1	126
2	701	72.9	86.6	105.8	108.9	118.6	165.6	79.9	95.8	79.9	107.7	93.2	81.1	174.2	89.6	98.7	109.2	100.4	93	85.4	79.5	105
3	704	122.1	112.1	126.5	145.7	127	139.4	155.8	149.9	135.6	156.3	159.9	129.6	154.5	145.3	167.6	160	152.4	145.6	128.7	103.6	140
4	703	111.3	99.4	102	108.4	99.4	107.7	102	103.5	115.5	134.2	136.5	122.2	134.9	121.8	129.7	123.9	131.4	128.6	117	131.2	114
5	706	93.3	94.9	91.4	95.8	83.2	79.3	82.7	89.9	117.1	115.9	126.3	85.2	93.1	85.9	80.1	63.1	70.6	88.7	86.8	94.6	96
6	705	112.1	69.8	79.3	123.9	75	78.3	88.9	60.8	94.1	93.5	165.8	110.5	78.9	78.2	76.1	75.6	152.2	149	42.3	58.2	95
7	708	67.3	73.1	72.4	77.7	78	85.9	83.6	89.3	76.4	78.1	75	76.9	85.9	86.7	86.5	86.4	92.5	94.1	78.9	79.4	78
8	707	97.3	106.9	109.9	111.8	93.1	117.8	94.7	89.8	89.2	121.2	123.8	63	40.5	67.4	96.1	97	77.5	84.4	73	70.4	97
9	710	154.7	147.5	161.6	174.7	149.3	151.1	119.7	134.9	130.5	155.5	170.4	145.5	124.8	136	176.8	182.5	147.6	176.4	188.1	151.9	148
10	709	51.6	60.5	71.8	91.2	79.6	54.3	49.8	85.2	35.6	31.2	30.4	26.2	76.3	92.5	73.6	67	48.6	55.3	57.6	67.4	57
11	712	75.9	80.7	88.2	98.4	93	78.5	103.9	92.8	118.2	123.6	132	124.6	100.8	94.8	90.4	118.7	83	86.8	94.2	87.9	101
12	711	276.1	257.5	272.2	285.8	259.3	271	262.4	263.5	248.1	248.9	250.6	239.8	272.9	234.7	249.7	242.7	239.5	262.3	235.5	250.6	262
13	714	75.5	81	95.7	124.1	85.2	124	187.9	225.2	155.5	82.6	90.6	105.4	124.7	76.5	96.9	101.4	84.1	91.8	78.4	76.7	120
14	713	330.5	215.4	210.1	330.3	185.8	236.1	246.4	277.4	304.9	352.5	347.1	282.3	281.4	258.2	253.3	274.1	260.9	293.3	252.6	260.1	277
15	614	94.4	88.6	39	70.7	77	71.3	47	30.8	93.4	145.7	139.8	107.2	82.4	82.4	75.5	82.9	85.4	98.3	88	91.6	84
16	613	85.1	111.3	114.7	119.3	135.4	105.2	94	87.5	72.9	106.3	123.1	100.4	83.7	118	124.7	129.6	115.8	100.9	108.7	101.7	103
17	612	138.3	140.1	168.3	115.3	77.4	77.6	75.4	106.8	114.7	149.1	148.8	115.2	82.1	92.5	86.5	75.2	76.5	76.4	75.7	86.5	116
18	611	98.8	111.3	91.5	95.7	106.4	126	79	86.9	109.9	108.9	121.3	128.4	84.2	89.3	81.4	87.5	84	69	71.8	82.7	104
19	610	248.8	209.4	220.5	230.8	212.6	230.4	207.6	226.1	422.5	476.6	468.7	418.4	292.3	205.5	209.3	210.3	194.9	203.5	194.7	226.1	297
20	609	85.6	137.4	316.5	382.7	520.4	322.8	151.2	124	146.4	134.9	117.1	117.8	72.9	66.3	62.4	61.2	51.3	74.9	62.5	74.9	202
21	608	81.8	86.7	71	87.6	85.7	76.5	70.4	69.7	83.2	95.5	102.4	78.7	82.6	79.8	79.5	93.4	74	83.3	68.7	70.4	82
22	607	97.4	89.9	113.6	130.4	131.5	138.1	128.6	127.3	114.8	115.5	137.4	101.7	106.5	101.3	121.8	128	118	117.3	119.7	114.1	118
23	606	107.7	111.6	119.9	115.6	114.9	106.9	116.7	119.3	115.9	153.1	151.4	126.8	116.1	113.4	115	117.5	98.1	100.6	105.7	106	121
24	605	80.9	74.8	88.2	109.8	104.2	80.5	76.5	77.1	79.4	96.7	97.3	85.3	84.7	80.4	83.1	85.1	80.7	88.4	94	110.7	87
25	604	158.1	169.3	183.7	196.8	154.2	173.9	183	165.7	135.1	56.9	83.2	73.4	67.1	60.2	66.2	73.2	75.3	70.6	71.4	68.2	138
26	603	90.3	71.9	97.8	101	95.4	80.8	73.6	73.3	74.8	101.8	91.6	71.1	93.9	117.8	113.8	150.4	156.7	170.9	169.2	161.2	86
27	602	108.1	132.6	150.6	159.4	154.8	143.9	115.9	115.1	116	127.6	84	63.2	67.5	82.4	94.7	122.7	84.3	61.2	60	58.9	118
28	601	125.7	149.8	186.3	335.9	235.9	190	156.8	194.1	173.4	156.8	122.1	168.6	126.9	112.7	124.5	168.1	107.9	135.2	94.6	85	179

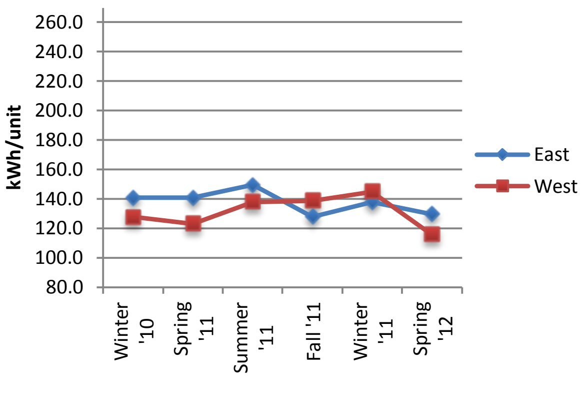
Floors 8 and 9

Meter #	Suite #	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Average
1	902	166.6	80.7	56.3	78.7	80.5	81.3	87.4	101.2	87.7	87.6	88.3	89.1	108.6	91.2	81.1	82.5	85	87.4	90.2	83.7	90
2	901	46	59.6	42.3	50.9	47.6	50.4	50.8	54.9	54.8	81.6	90	57.2	75.7	76.5	69.9	56	46.7	66	54.8	65.1	60
3	904	201	256	346.9	334.1	238.3	213.5	177.5	196.4	204.2	257.4	273.9	277	248.6	248.7	196.9	166.4	158.5	168.7	151.6	147.6	223
4	903	58.7	60	55.1	53.1	47.5	60	61.3	67	75.5	84.8	83	69.1	71.8	62.5	62.3	39.4	42.8	65	60.8	62.9	62
5	906	72.8	89.2	296.3	127.6	171.2	147.4	68.9	86	68.6	80	85.5	74.6	97.4	68.8	69.8	72.5	69.9	72.5	68.9	68.2	98
6	905	184.1	186	175.8	129.3	191.4	29.8	122.2	162.3	175.9	186.8	186.2	165.3	118.2	88	84.8	102	92.8	89.2	105.3	115.7	135
7	908	261.2	268.8	328.6	305.6	278.9	372.7	334	356.9	324.5	360.2	329.8	315.9	301.4	260.5	286.1	278.1	255.6	179.3	255.8	249.3	295
8	907	96.3	79.5	74.7	96.1	170.6	180.1	95.4	75	165.7	190.5	183.4	168.7	192	183.3	177.4	178.5	153.7	165.5	127.6	122.5	144
9	910	42.1	42.6	54.3	55.2	55.2	54.8	47.2	40.6	48.3	88.8	85.9	55.1	50.7	58.2	59	29.5	55.6	77.6	100	98.6	60
10	909	158.6	167.8	176.3	156.6	148.8	154.5	128.7	125.5	123.4	185.7	209.8	171.3	191.4	194.4	170.1	170.2	147.2	138.7	148.9	135.4	160
11	912	159.6	154.3	146.2	158.6	139.3	159.8	172.8	224.9	234.8	281.1	296.9	231.3	272.7	58	43.1	43.7	68.8	81.9	75	88.3	155
12	911	98.7	142.2	150	153.4	140.4	145.7	58.5	115.9	121	142.3	127.2	120.5	80.7	135	101.8	85.1	75.7	76.8	69.7	84	111
13	914	123.4	125.5	205.6	203.4	152.7	229.7	189.6	243.5	172.2	174.1	184.4	128	178.7	159.5	196.6	230.6	210.7	189.1	166.3	142.5	180
14	913	274.6	280.2	294.2	303.4	284.7	301.9	258.8	301.2	276	265.1	234.8	275.7	76.5	118.3	135.1	112.1	118.3	151.1	68.7	70.3	210
15	814	68.4	90.2	78.7	114.2	96.3	96.3	86.1	107	161	127	131.3	87	85.5	145.8	157.2	115.3	124.1	120.9	132.7	139.1	113
16	813	123.9	130	130.4	98.3	127.2	101.8	47.1	66.9	79.4	131.3	137.9	105	117	108.5	112.5	110.8	115	98.4	109.2	95.7	107
17	812	134.8	130.3	150.4	163.7	169.9	184.6	126.7	154.1	140.6	140.2	155.3	161.5	141.2	127.3	152.3	146.8	146.4	141	121.4	126.4	146
18	811	45.3	43.5	40.8	56.2	30.6	39.7	43.4	46.8	48.8	66.9	75	49.5	50.1	44.6	44	42.6	57.4	46.3	38.8	42.3	48
19	810	132.1	132.9	135.6	179.4	145.9	185.4	169.1	151.5	52.3	75.5	86.7	53	73.3	63.9	76.3	69	68.2	76.5	55.3	74.8	103
20	809	129.3	137.6	150.4	130.8	97.6	97.1	90.8	95.9	95.1	118.3	131.5	109.5	141.5	130.7	120.1	151.3	111.7	83.5	96.1	90.7	115
21	808	140.5	174.3	190.2	202.4	163.3	136.3	169.4	182.1	191.8	206	198.6	188.7	165.1	169	145.5	162.3	187.8	181	183.9	155	175
22	807	100.1	138.9	177.2	162.6	129.2	111.1	117.6	93.7	99.8	123.5	121.5	104.9	83.6	87.3	100.8	87.8	125.2	132.2	156.4	169.7	121
23	806	70.8	69.8	59.4	78	79.2	80.1	80.7	81	83.8	94.6	84.4	65.6	67.7	68.9	73.9	73.1	51.8	60.5	70	76.1	73
24	805	81	87	85	82.4	90.5	113.1	81.7	66.5	66.6	88.1	120.3	103.8	105.9	110.2	114.4	171.3	127.3	113	132	103.1	102
25	804	120.6	112.2	120.3	129.2	113.8	126.3	131.9	132.4	121.5	137	126.2	103.6	108.8	97.3	101.1	93.9	96.9	94	93.9	92.4	113
26	803	207.3	218.8	218.6	209	194.4	213.7	234.9	287.6	223.1	228.6	187.2	206	195.5	163	171.7	173.1	164.2	173.5	167.3	214	203
27	802	121	114.2	125.8	122	118.8	170.4	182.4	183.4	116.9	112.7	134.7	110.9	134.3	151.4	173.3	177.6	131.2	100	86.7	99.4	133
28	801	71.5	73.4	82.8	84.5	78.5	84.4	79.2	68.5	71.2	86.5	75.7	67	69.4	74.7	84.6	85.9	80.3	74.9	66.4	64.7	76

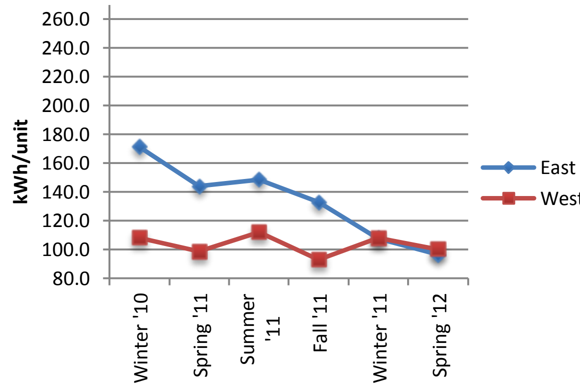
Floors 10 and 11

Meter #	Suite #	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Average
1	1104	97.2	89.2	99.7	90.1	62	94.3	80.8	91.7	80.7	106.8	99.9	94.5	86.2	79.2	82.4	81.7	107.7	87	99.5	88.4	90
2	1103	0.7	2.7	1.2	1.7	14	0	2.1	4.4	1.4	5.8	5.8	7.4	6.9	3.7	2.7	8.3	7.4	15.7	13.8	8.5	4
3	1106	180.8	182.3	204.3	217.7	202.4	211.3	194.2	158	24.4	92.7	92.1	121.3	194.1	183.1	217.2	209.9	169.8	147.8	144.6	109.8	160
4	1102	107.5	87.6	113.8	102.8	96.6	108.5	94.7	107.5	117.4	138.8	131	119.3	93.3	93.5	91.4	96.9	92	95.3	80.2	106.8	109
5	1108	238.8	319.5	329.6	294.8	262.2	341.1	267.9	304.4	484	889.2	654.4	376	415.1	391.8	368.4	371.9	349.3	416.9	364.5	611.8	398
6	1107	91.6	82.8	70.1	102.2	109	138.2	106	121.7	118.9	149.3	156	138	132	123.4	127.7	125	122.5	137.9	109.7	128.6	117
7	1110	207.6	301.9	400.1	589	470.3	456.9	406.9	306.8	191.4	197.9	184.8	213.7	312.9	266.1	289.2	324	295.8	310.2	221.9	176.6	326
8	1109	153.3	144.5	139.6	159.4	188.4	223.6	237	196.8	175	156.3	174.5	167.6	148.4	102.2	106.7	134.7	160.4	125.7	121.2	136.9	174
9	1112	78.3	67.8	178.3	241.8	227.5	47.2	29.6	64.5	87.7	110.2	87.4	122	142.1	146.5	186	178.5	118.4	141.8	111.2	85.4	114
10	1111	129.6	306.9	126.1	41.4	23.8	269.3	339.3	202.2	141.7	150.8	182.5	252.6	195.1	217	400.2	405.6	400.8	295.2	125	116.2	182
11	1114	135.8	289	273.1	296.1	280.8	284.5	276.3	265.8	109.2	81.5	76.7	66.3	120.5	258.9	306.3	714.4	237.2	232.2	224.1	201.2	197
12	1113	258.5	354	648.4	639.2	669.1	507.9	370.4	273.6	128.3	141.5	145.4	192.5	343	421.6	416.3	385	349.6	183.3	163.7	158.2	359
13	1014	98.5	98.5	108.7	103.3	91.9	96.4	119.7	85.9	81.3	98.9	100.7	77.9	111.5	88.4	82.2	92.3	93	79.8	80.1	85	98
14	1001	316.3	305.7	332.4	380.5	272	304.4	322.7	365.4	333.3	337.3	335.3	334.6	351.1	381.1	497.7	613.7	491.5	328.9	327.8	329.7	330
15	1012	60.4	70.9	90	85.6	69.9	72.1	65.3	77	78.6	109.9	115.2	94.3	82.1	83.6	110.8	107.9	103.8	90.8	82.9	95.6	82
16	1013	199.8	185.7	160.2	147.7	77.4	59.2	91.3	124.1	171.6	189.5	158.7	86.4	87.1	95	114.2	99.4	84.7	99.4	90	91.7	134
17	1010	31	37.8	77.1	114.6	91.9	116.3	93.7	131.4	101.4	120.9	144.3	141	87.7	52.1	104.1	126.4	95.9	84.6	90.1	89.6	99
18	1011	267.1	331.7	492.8	378.7	373.2	331.7	290.6	357.8	319.2	393.1	332.5	281.9	272.1	235.3	231.8	221.8	177.7	192.9	175.5	225.8	340
19	1008	82.5	81.5	65.8	56.6	74	82.3	66.1	88.3	90	112.4	119.5	80.4	74.4	72.9	82.7	78	69.5	80.2	74.6	35.2	83
20	1009	120.1	117.4	127	155.4	150.7	132.9	120.1	60.6	57.5	188.9	148	158	148	144	139	172.9	151.5	142.5	147.8	84.6	130
21	1006	109.1	71.3	66.5	90.9	128.4	131.4	91.2	89	93.3	99.6	121.4	89.8	87.2	127.5	147.9	130.2	137.8	144.8	128.4	116.7	98
22	1007	36.7	35.5	34.1	40.2	37.1	42.7	44.3	42	37.1	50.5	54.5	51.5	53.6	53.1	51.6	54	47.9	52.3	45.9	50	43
23	1004	121.6	135.3	152.1	160.1	102.7	142.8	200.8	184	201.4	243.4	186.4	125.4	141.5	133.4	126.4	125.9	135.7	139.6	37.5	59	161
24	1005	55.3	63.2	51.9	59.6	49	76.8	69.9	67	69.3	83.1	81.2	67.1	66.1	70.5	57.5	60.6	76.6	145.4	46.3	64.8	66
25	1002	113.3	131	138.4	146.1	134.1	141.7	127.8	124.2	92.1	98.1	94	94.7	110.1	105.6	99.7	101.7	103.4	111.5	99	104.6	119
26	1003	202.6	176.8	202	191	130.7	154.6	143.1	133.5	128.6	148.4	176.1	155.8	147.4	154.7	169.3	151.7	110.2	107.9	72.1	79.1	161

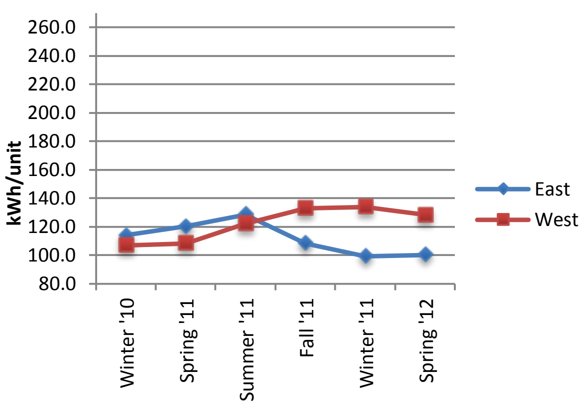
Appendix J: Seasonal Averages by Floor and Orientation



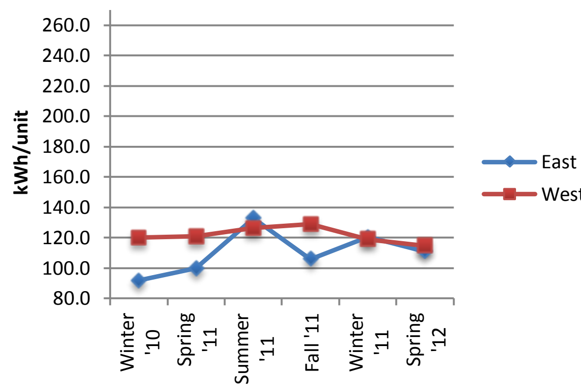
2nd Floor



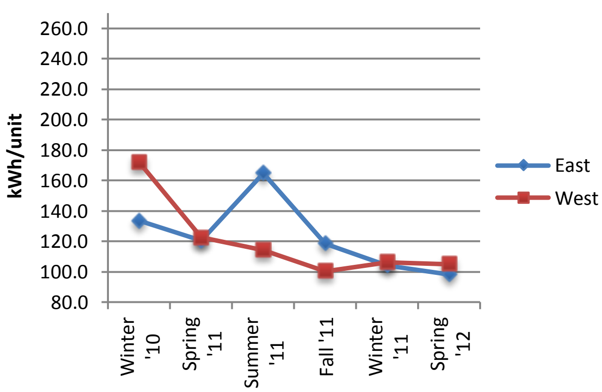
3rd Floor



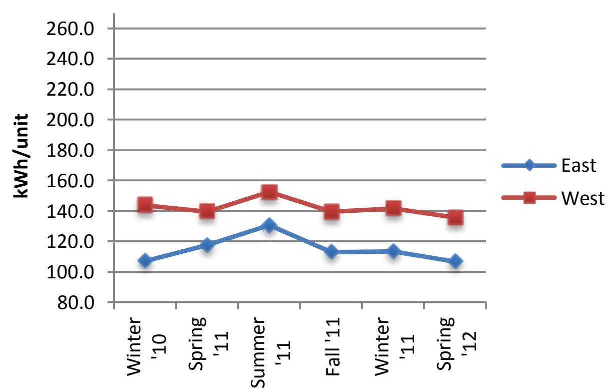
4th Floor



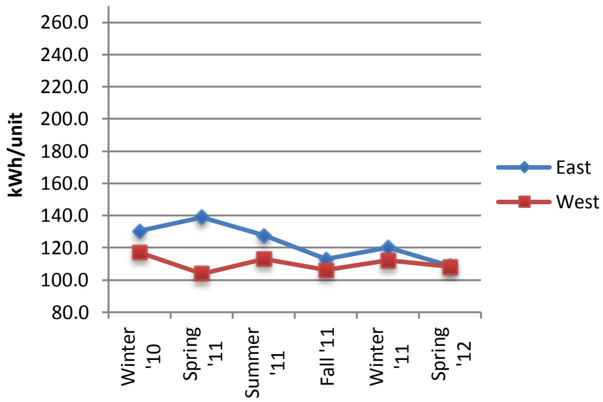
5th Floor



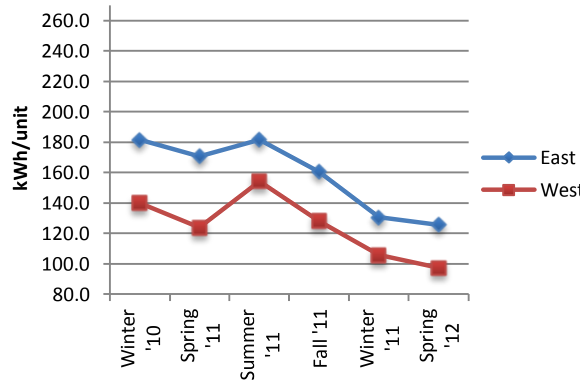
6th Floor



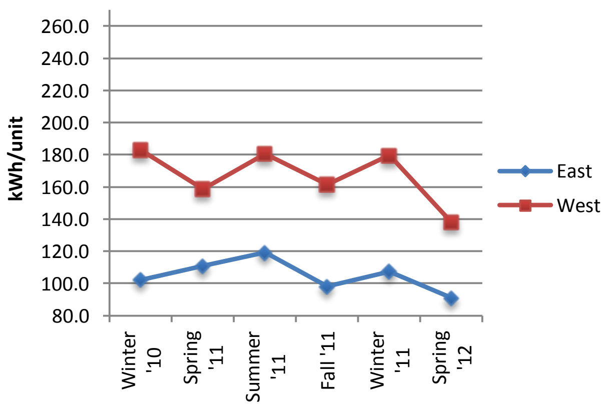
7th Floor



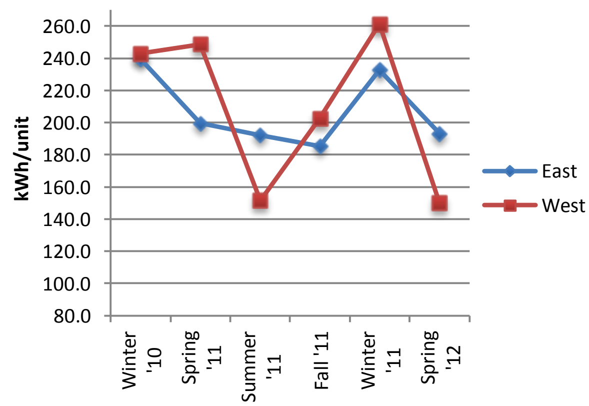
8th Floor



9th Floor



10th Floor



11th Floor

Appendix I: Unit Average Consumption Distribution in Plan

Colour									
Range (kWh)	0-50	50-100	100-150	150-200	200-250	250-300	300-350	350-400	400-450

Consumption Distribution Analysis Legend

Figure 1: Metered Electricity Consumption, Floor 2

Figure 2: Metered Electricity Consumption, Floor 3

Figure 3: Metered Electricity Consumption, Floor 4

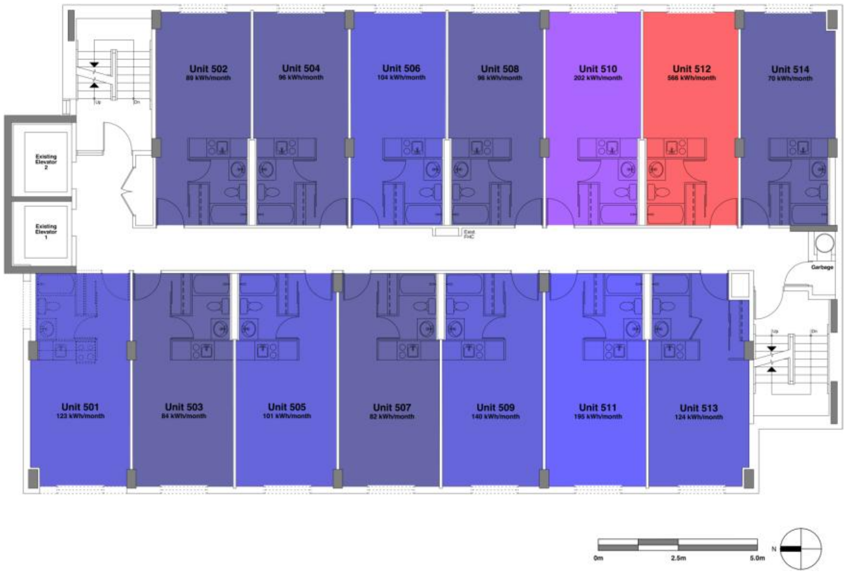


Figure 4: Metered Electricity Consumption, Floor 5

Figure 5: Metered Electricity Consumption, Floor 6

Figure 6: Metered Electricity Consumption, Floor 7

Figure 7: Metered Electricity Consumption, Floor 8

Figure 8: Metered Electricity Consumption, Floor 9

Figure 9: Metered Electricity Consumption, Floor 10

Figure 10: Metered Electricity Consumption, Floor 11

Appendix J: Set of Questions Used in the Consumption Matrix

Question #	Question
7	On an average day, how many hours do you spend in your apartment (includes sleeping)?
10	How many hours a day do you leave your television turned on?
11	What type of television do you have?
12	Do you turn off the cable box when you are done watching TV?
13	Do you have a laptop, desktop, or both? (check all that apply.)
14	How many hours a day do you use your computer?
16	On an average day, how long do you spend on the internet?
17	What appliances do you have at home? Cell phone charger Home phone VHS player DVD player Game console (e.g. Nintendo, xbox, play station) Printer Speakers Clock Radio/stereo Slow cooker Rice cooker Iron Vacuum cleaner Humidifier/dehumidifier Other? Please specify
18	During the winter, what temperature do you set your heating/cooling equipment at?
19	During the summer, what temperature do you set your heating/cooling equipment at?
20	Which of the following do you use to adjust you thermal comfort? (check all that apply) d. Turn on personal heater e. Turn on personal fan
21	For each item listed below, circle the number on how likely you are to do the following. Use the scale shown on top to select the behavioural scale from 1 (always) to 5 (never).

	a. …turn off the lights when you are not at home b. …turn off the lights when not in use
22	How many compact fluorescent (cfl) (energy saving) light bulbs do you use in your apartment?
23	How many incandescent (regular) light bulbs do you use in your apartment?
24	On an average day, how many light bulbs are turned on longer than 3 hours or more?
33	On an average day, for how long do you use your stove?
34	On an average day, for how long do you use your oven?
35	On an average day, what is the total time spent using your microwave?

Loads and Their Respective Assumptions and Sources

Q. No.	Consumption Type	Options Considered						Time Frame	Stat Value (kWh)	Source and Assumptions
11	**TV type**	No TV	LCD/LED	Plasma	Tube	Standby				Assumed at 32" average
	Load (W)	0	125	156	110	5				U.S. EIA
12	**Cable Box**	No Box	Always off	Sometimes off	Never off					
	Load (W)	0			24.4					U.S. EIA
13	**Computer type**	No Comp	Laptop	New Desktop	Old Desktop	Standby	Both			
	Load (W)	0	45	130	200	10	122.5			U.S. EIA
16	**Internet**	No Internet	In Use	Modem Stan-by						
	Modem Load (W)	0	12	10						U.S. EIA
17 a.	**Cellphone charger**	No Charger	Yes							Assume 1, 3h charge every other day
	Load (W)	0	5					Monthly	0.2	U.S. EIA
17 b.	**Home phone**	No Phone	Yes							Based on a daily average
	Load (W)	0	0.4					Annual	26	U.S. EIA
17 c.	**VHS**	No VHS	Yes							
	Load (W)	0	40					Annual	70.0	U.S. EIA
17 d.	**DVD player**	No DVD	Yes							
	Load (W)	0	40					Annual	70.0	U.S. EIA
17 e.	**Game console**	No Console	Yes							For latest generation console
	Load (W)	0	190							U.S. EIA
17 f.	**Printer**	No Printer	Yes							On standby
	Load (W)	0	4					Annual	45	U.S. EIA
17 g.	**Speakers**	No Speakers	Max	Reasonable	Home Theatre	Average				
	Load (W)	0	70	25	1000	357				U.S. EIA
17 h.	**Clock (alarm)**	No Clock	Yes							
	Load (W)	0	5					Monthly	4	U.S. EIA
17 i.	**Stereo/Radio**	Neither	Yes							
	Load (W)	0	30					Annual	19	U.S. EIA
17 j.	**Slow cooker**	No Cooker	Yes							Assume same as rice cooker
	Load (W)	0	495							
17 k.	**Rice cooker**	No Cooker	Yes							
	Load (W)	0	495							U.S. EIA
17 l.	**Iron**	No Iron	Yes							
	Load (W)	0	1000					Annual	10	U.S. EIA
17 m.	**Vacuum**	No Vacuum	Yes							
	Load (W)	0	800					Annual	60	U.S. EIA
17 n.	**Humidifier**	No Humidifyer	Yes							
	Load (W)	0	350					Annual	400	U.S. EIA
17 o.	**Other**	No Other	Fans	AC	Boiler	Toaster	Coffee Maker			

	Load (W)	0	115	750	900	1440	900			U.S. EIA
	Annual (kWh)			580						U.S. EIA
18	**Heating equip set point**	Off	>10	10 to 20	20+					Estimates based on product literature
	Load (W)	0	33	39	57					Assume low-med-high fan speed
19	**Cooling equip set point**	Off	>10	10 to 20	20+					Estimates based on product literature
	Load (W)	0	57	39	33					Assume high-med-low fan speed
20 d.	**Personal Heater**	No Heater	Yes							
	Load (W)	0	1200					Annual	503	U.S. EIA
20 e.	**Personal Fan**	No Fan	Yes							
	Load (W)	0	115							U.S. EIA
22, 23	**Lightbulbs**	CFL	Incandescent							
	Load (W)	18	60							U.S. EIA, based on equivalent brightness
	Stove (Element)	Small	Large	Average						
	Load (W)	1250	2400	1825						Estimates based on product literature
	Oven	Min	Max	Average					Standby	
	Load (W)	2400	3400	2900				Monthly	4	Estimates based on product literature
	Microwave								Standby	
	Load (W)	1300						Monthly	5	U.S. EIA
	Fridge									
	Load (W)							Annual	369	Estimates based on product literature

Q. No.	Consumption type	1	2	3	4	5	6	7	8	9	10
Suite		401	208	404	804	312	809	502	606	803	702
7	Time at home (h)	18+	18+	9 to 13	9 to 13	<8	<8	9 to 13	14 to 18	14 to 18	9 to 13
	Average time (h)	18	18	11	11	8	8	11	16	16	11
11	TV type	Tube	LCD/LED	Plasma	0	Tube	Tube	LCD/LED	LCD/LED	LCD/LED	Plasma
10	Daily Usage (h)	6	6	2	0	1	1	2	1	6	2
	Consumption (kWh/month)	22.81	25.55	12.84	0.00	6.84	6.84	10.95	7.30	25.55	12.84
12	Cable Box	Turn off	Leave on	Leave on	0	0	Turn off	Turn off	Turn off	Turn off	Leave on
10	Daily Usage (h)	6	24	24	0	0	1	2	1	6	24
	Consumption (kWh/month)	4.45	17.81	17.81	0.00	0.00	0.74	1.48	0.74	4.45	17.81
13	Computer type	0	Desktop	Laptop	Laptop	0	0	Desktop	Laptop	0	Laptop
14	Daily Usage (h)	0	1	2	2	0	0	2	2	0	11
	Consumption (kWh/month)	0.00	10.95	9.43	9.43	0.00	0.00	14.60	9.43	0.00	19.01
16	Internet Daily Usage (h)	0	1	2	2	0	0	2	2	0	6
	Consumption (kWh/month)	0.00	7.36	7.42	7.42	0.00	0.00	7.42	7.42	0.00	7.67
17 a.	Cellphone charger	0	0	1	1	1	1	1	1	1	1
	Consumption (kWh/month)	0.00	0.00	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
17 b.	Home phone	1	0	1	1	1	0	1	1	0	0
	Consumption (kWh/month)	2.17	0.00	2.17	2.17	2.17	0.00	2.17	2.17	0.00	0.00
17 c.	VCR	0	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 d.	DVD player	0	1	0	0	0	1	1	1	1	1
	Consumption (kWh/month)	0.00	5.83	0.00	0.00	0.00	5.83	5.83	5.83	5.83	5.83
17 e.	Game console	0	0	1	0	0	0	0	0	0	0
	Daily Usage (h)	0	0	1	0	0	0	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	5.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 f.	Printer	0	0	1	0	0	0	1	0	0	0
	Consumption (kWh/month)	0.00	0.00	3.75	0.00	0.00	0.00	3.75	0.00	0.00	0.00
17 g.	Speakers	0	1	0	0	0	0	1	1	0	0
	Daily Usage (h)	0	1	0	0	0	0	2	2	0	0
	Consumption (kWh/month)	0.00	0.76	0.00	0.00	0.00	0.00	1.52	1.52	0.00	0.00
17 h.	Clock (alarm)	0	1	1	1	0	0	1	1	0	0
	Consumption (kWh/month)	0.00	4.00	4.00	4.00	0.00	0.00	4.00	4.00	0.00	0.00
17 i.	Stereo/Radio	1	0	0	0	0	1	1	1	1	0
	Consumption (kWh/month)	1.58	0.00	0.00	0.00	0.00	1.58	1.58	1.58	1.58	0.00
17 j.	Slow cooker	0	0	0	0	0	1	1	0	0	0
	Daily Usage (h)	0	0	0	0	0	1	1	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	21.51	21.51	0.00	0.00	0.00
17 k.	Rice cooker	0	0	0	0	0	0	1	0	0	0
	Daily Usage (h)	0	0	0	0	0	0	0.25	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	3.76	0.00	0.00	0.00
17 l.	Iron	0	0	0	1	0	0	0	1	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.83	0.00	0.00
17 m.	Vacuum	1	0	0	1	0	0	0	0	1	0
	Consumption (kWh/month)	5.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	5.00	0.00
17 n.	Humidifier	0	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 o.	Other	0	0	0	0	0	0	0	0	0	0
	Daily Usage (h)	0	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	0	0	0	0	0	0	0	0	0	0
18	Heating equip set point	High	0	High	0	0	Medium	High	High	High	Medium
(Winter)	Daily Usage (h)	17	17	17	17	17	17	17	17	17	17
	Consumption (kWh/month)	28.96	0.00	28.96	0.00	0.00	19.81	28.96	28.96	28.96	19.81
19	Cooling equip set point	Medium	0	0	Medium	0	0	Medium	Low	Medium	Medium
(Summer)	Daily Usage (h)	2	2	2	2	2	2	2	2	2	2
	Consumption (kWh/month)	1.79	0.00	0.00	1.79	0.00	0.00	1.79	1.52	1.79	1.79
20 d.	Personal Heater	0	0	0	0	0	0	0	0	0	0
(Winter)	Daily Usage (h)	2.30	2.30	0.69	0.69	0.00	0.00	0.69	1.84	1.84	0.69
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20 e.	Personal Fan	0	1	0	0	0	0	1	0	1	0
(Summer)	Daily Usage (h)	0.63	0.63	0.19	0.19	0.00	0.00	0.19	0.50	0.50	0.19
	Consumption (kWh/month)	0.00	2.20	0.00	0.00	0.00	0.00	0.66	0.00	1.76	0.00
22, 23	No. of CFL Lightbulbs	3	2	0	4	4	1	3	2	5	0
22, 23	No. of Incandescent Lightbulbs	1	1	3	0	1	2	0	1	0	3
	Equivalent Wattage per bulb (W)	29	32	60	18	26	46	18	32	18	60
21a	Lights off when not at home	1	1	2	1	1	1	1	5	1	1
21b	Lights off when not in use	1	1	3	1	1	1	1	1	1	1
24	No. of lights on over 3h	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	Daily Usage (h)	10	10	3	3	3	3	3	24	8	3
	Consumption (kWh/month)	13.00	14.60	8.21	2.46	3.61	6.30	2.46	35.04	6.57	8.21
33	Stove Daily Usage (h)	0.5	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Consumption (kWh/month)	27.76	27.76	111.02	27.76	27.76	27.76	27.76	27.76	27.76	27.76
34	Oven Daily Usage (h)	0	0.5	2	0.5	0	0	0.5	0.5	0	0.5
	Consumption (kWh/month)	4.00	48.10	180.42	48.10	4.00	4.00	48.10	48.10	4.00	48.10
35	Microwave Daily Usage (min)	3	6	0	0	0	0	6	3	0	0
	Consumption (kWh/month)	5.62	7.59	0.00	0.00	0.00	0.00	7.59	5.62	0.00	0.00
	Fridge Consumption (kWh/month)	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75
	Base Consumption (kWh/month)	81.13	128.80	330.40	109.07	66.12	68.80	116.66	147.27	69.08	114.82
	Total Consumption (kWh/month)	147.89	203.27	422.78	139.95	75.36	125.35	226.88	218.80	144.24	199.81
	Metered Consumption (kWh/month)	111.36	191.92	137.43	112.67	82.83	115.48	89.21	121.22	202.58	126.35
	% Difference	33%	6%	208%	24%	-9%	9%	154%	80%	-29%	58%
	Strict Time Estimate Validity	11.5	10.5	5	8.5	6.5	6.5	6.5	12.5	9.5	-2.5
	Multi-task Time Estimate Validity	11.5	11.5	7	8.5	6.5	6.5	8.5	13.5	9.5	-0.5
Issues	Time assessment										1
(>50%)	Cooking over-estimate			1					1		1
	Electronic over-estimate							1	1		1

Q. No.	Consumption type	12	13	14	15	16	17	18	19	20	21
Suite		1112	204	210	904	1007	414	504	409	813	513
7	Time at home (h)	9 to 13	9 to 13	<8	18+	9 to 13	9 to 13	9 to 13	9 to 13	9 to 13	9 to 13
	Average time (h)	11	11	8	18	11	11	11	11	11	11
11	TV type	0	LCD/LED	Tube	Plasma	0	LCD/LED	Tube	0	0	0
10	Daily Usage (h)	0	6	2	1	0	2	1	0	0	0
	Consumption (kWh/month)	0.00	25.55	10.04	8.24	0.00	10.95	6.84	0.00	0.00	0.00
12	Cable Box	0	Turn off	0	0	0	0	0	0	0	0
10	Daily Usage (h)	0	6	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	0.00	4.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	Computer type	0	Laptop	0	0	Laptop	0	Laptop	0	Laptop	Laptop
14	Daily Usage (h)	0	6	0	0	6	0	2	0	2	6
	Consumption (kWh/month)	0.00	13.69	0.00	0.00	13.69	0.00	9.43	0.00	9.43	13.69
16	Internet Daily Usage (h)	0	6	0	0	6	0	2	0	1	6
	Consumption (kWh/month)	0.00	7.67	0.00	0.00	7.67	0.00	7.42	0.00	7.36	7.67
17 a.	Cellphone charger	1	1	0	1	1	0	1	0	1	1
	Consumption (kWh/month)	0.23	0.23	0.00	0.23	0.23	0.00	0.23	0.00	0.23	0.23
17 b.	Home phone	0	0	0	0	0	1	1	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	2.17	2.17	0.00	0.00	0.00
17 c.	VCR	0	0	1	0	1	0	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	5.83	0.00	5.83	0.00	0.00	0.00	0.00	0.00
17 d.	DVD player	1	0	1	1	0	1	1	0	0	0
	Consumption (kWh/month)	5.83	0.00	5.83	5.83	0.00	5.83	5.83	0.00	0.00	0.00
17 e.	Game console	0	0	0	0	0	0	0	0	0	0
	Daily Usage (h)	0	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 f.	Printer	0	0	0	0	1	0	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	3.75	0.00	0.00	0.00	0.00	0.00
17 g.	Speakers	1	0	1	0	1	0	0	0	0	0
	Daily Usage (h)	0	0	2	0	6	0	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	21.73	0.00	4.56	0.00	0.00	0.00	0.00	0.00
17 h.	Clock (alarm)	0	0	1	0	0	1	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	4.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00
17 i.	Stereo/Radio	1	0	1	1	1	1	0	0	0	0
	Consumption (kWh/month)	1.58	0.00	1.58	1.58	1.58	1.58	0.00	0.00	0.00	0.00
17 j.	Slow cooker	0	0	0	0	1	0	0	0	0	0
	Daily Usage (h)	0	0	0	0	1	0	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	21.51	0.00	0.00	0.00	0.00	0.00
17 k.	Rice cooker	0	1	0	0	1	0	0	0	1	0
	Daily Usage (h)	0	0.25	0	0	0.25	0	0	0	0.25	0
	Consumption (kWh/month)	0.00	3.76	0.00	0.00	3.76	0.00	0.00	0.00	3.76	0.00
17 l.	Iron	1	0	0	1	0	1	1	1	1	1
	Consumption (kWh/month)	0.83	0.00	0.00	0.83	0.00	0.83	0.83	0.83	0.83	0.83
17 m.	Vacuum	0	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 n.	Humidifier	0	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 o.	Other	Toaster	0	0	0	Toaster, coffee maker	Broiler, toaster	0	0	0	0
	Daily Usage (h)	0.17	0	0	0	0.25	0.25	0	0	0	0
	Consumption (kWh/month)	7.3	0	0	0	17.79	17.79	0	0	0	0
18	Heating equip set point	0	Medium	Medium	Medium	0	0	0	Medium	0	0
(Winter)	Daily Usage (h)	16.70	16.70	16.70	16.70	16.70	16.70	16.70	16.70	16.70	16.70
	Consumption (kWh/month)	0.00	19.81	19.81	19.81	0.00	0.00	0.00	19.81	0.00	0.00
19	Cooling equip set point	Medium	Medium	Medium	0	0	0	Medium	Low	0	0
(Summer)	Daily Usage (h)	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51
	Consumption (kWh/month)	1.79	1.79	1.79	0.00	0.00	0.00	1.79	1.52	0.00	0.00
20 d.	Personal Heater	1	1	0	0	0	0	0	0	0	0
(Winter)	Daily Usage (h)	0.69	0.69	0.00	2.30	0.69	0.69	0.69	0.69	0.69	0.69
	Consumption (kWh/month)	25.20	25.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20 e.	Personal Fan	0	0	0	1	0	1	0	0	0	0
(Summer)	Daily Usage (h)	0.19	0.19	0.00	0.63	0.19	0.19	0.19	0.19	0.19	0.19
	Consumption (kWh/month)	0.00	0.00	0.00	2.20	0.00	0.66	0.00	0.00	0.00	0.00
22, 23	No. of CFL Lightbulbs	0	2	3	0	1	3	3	4	1	3
22, 23	No. of Incandescent Lightbulbs	3	3	2	4	3	1	1	0	1	0
	Equivalent Wattage per bulb (W)	60	43	35	60	50	29	29	18	39	18
21a	Lights off when not at home	1	1	2	1	3	1	1	1	1	1
21b	Lights off when not in use	1	3	2	2	1	1	1	1	1	3
24	No. of lights on over 3h	1.5	1.5	1.5	1.5	0	4	1.5	1.5	1.5	1.5
	Daily Usage (h)	3	3	3	10	12	3	3	3	3	3
	Consumption (kWh/month)	8.21	5.91	4.76	27.38	0.00	10.40	3.90	2.46	5.34	2.46
33	Stove Daily Usage (h)	0.5	0.5	2	3	0.5	3	2	0	0.5	0
	Consumption (kWh/month)	27.76	27.76	111.02	166.53	27.76	166.53	111.02	0.00	27.76	0.00
34	Oven Daily Usage (h)	0	0	2	0	0.5	0	0	0	0	0.5
	Consumption (kWh/month)	4.00	4.00	180.42	4.00	48.10	4.00	4.00	4.00	4.00	48.10
35	Microwave Daily Usage (min)	0	6	0	0	0	6	0	0	3	0
	Consumption (kWh/month)	0.00	7.59	0.00	0.00	0.00	7.59	0.00	0.00	5.62	0.00
	Fridge Consumption (kWh/month)	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75
	Base Consumption (kWh/month)	70.72	76.01	326.95	228.66	106.61	219.27	149.67	37.21	73.46	81.32
	Total Consumption (kWh/month)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Metered Consumption (kWh/month)	114.18	115.82	124.09	223.16	43.06	75.42	95.75	60.62	107.32	123.63
	% Difference	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Strict Time Estimate Validity	10.5	-1.5	4	14	4.5	6	6	11	8.5	4.5
	Multi-task Time Estimate Validity	10.5	4.5	4	14	4.5	6	7	11	8.5	4.5
Issues	Time assessment		1	1		1					
(>50%)	Cooking over-estimate			1			1	1			
	Electronic over-estimate										

Q. No.	Consumption type	22	23	24	25	26	27	28	29	30	31
Suite		714	305	906	512	514	601	510	213	713	314

7	**Time at home (h)**	14 to 18	<8	9 to 13	18+	9 to 13	14 to 18	<8	<8	18+	9 to 13
	Average time (h)	16	8	11	18	11	16	8	8	18	11
11	**TV type**	LCD/LED	0	Tube	Tube	Tube	0	Tube	Plasma	LCD/LED	LCD/LED
10	**Daily Usage (h)**	6	0	2	14	2	0	6	2	11	2
	Consumption (kWh/month)	**25.55**	**0.00**	**10.04**	**48.36**	**10.04**	**0.00**	**22.81**	**12.84**	**43.80**	**10.95**
12	**Cable Box**	0	0	0	Sometimes turn it off	0	0	0	Leave on	0	0
10	**Daily Usage (h)**	0	0	0	19	0	0	0	24	0	0
	Consumption (kWh/month)	**0.00**	**0.00**	**0.00**	**14.10**	**0.00**	**0.00**	**0.00**	**17.81**	**0.00**	**0.00**
13	**Computer type**	0	Laptop	0	0	0	0	0	Laptop	Desktop	Both (old)
14	**Daily Usage (h)**	0	1	0	0	0	0	0	6	6	2
	Consumption (kWh/month)	**0.00**	**8.36**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**13.69**	**29.20**	**14.14**
16	**Internet Daily Usage (h)**	0	0	0	0	0	0	0	6	6	2
	Consumption (kWh/month)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**7.67**	**7.67**	**7.42**
17 a.	**Cellphone charger**	1	0	0	0	1	0	0	1	1	1
	Consumption (kWh/month)	**0.23**	**0.00**	**0.00**	**0.00**	**0.23**	**0.00**	**0.00**	**0.23**	**0.23**	**0.23**
17 b.	**Home phone**	1	0	1	1	0	0	0	0	1	0
	Consumption (kWh/month)	**2.17**	**0.00**	**2.17**	**2.17**	**0.00**	**0.00**	**0.00**	**0.00**	**2.17**	**0.00**
17 c.	**VCR**	0	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
17 d.	**DVD player**	1	0	1	0	1	0	0	1	1	1
	Consumption (kWh/month)	**5.83**	**0.00**	**5.83**	**0.00**	**5.83**	**0.00**	**0.00**	**5.83**	**5.83**	**5.83**
17 e.	**Game console**	0	0	0	0	0	0	0	0	0	0
	Daily Usage (h)	0	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
17 f.	**Printer**	0	0	0	0	0	0	0	1	1	1
	Consumption (kWh/month)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.75**	**3.75**	**3.75**
17 g.	**Speakers**	0	0	0	0	1	0	0	1	0	0
	Daily Usage (h)	0	0	0	0	2	0	0	6	0	0
	Consumption (kWh/month)	**0.00**	**0.00**	**0.00**	**0.00**	**21.73**	**0.00**	**0.00**	**4.56**	**0.00**	**0.00**
17 h.	**Clock (alarm)**	1	0	1	0	1	1	1	1	1	0
	Consumption (kWh/month)	**4.00**	**0.00**	**4.00**	**0.00**	**4.00**	**4.00**	**4.00**	**4.00**	**4.00**	**0.00**
17 i.	**Stereo/Radio**	1	1	1	1	1	1	0	0	1	0
	Consumption (kWh/month)	**1.58**	**1.58**	**1.58**	**1.58**	**1.58**	**1.58**	**0.00**	**0.00**	**1.58**	**0.00**
17 j.	**Slow cooker**	0	0	0	0	0	0	0	0	0	0
	Daily Usage (h)	0	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
17 k.	**Rice cooker**	0	0	0	0	0	0	0	0	0	0
	Daily Usage (h)	0	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
17 l.	**Iron**	0	0	0	0	0	0	0	1	0	1
	Consumption (kWh/month)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.83**	**0.00**	**0.83**
17 m.	**Vacuum**	1	0	0	1	0	0	0	0	1	1
	Consumption (kWh/month)	**5.00**	**0.00**	**0.00**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**	**5.00**
17 n.	**Humidifier**	0	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
17 o.	**Other**	0	0	0	Toaster, boiler	0	0	0	0	0	0
	Daily Usage (h)	0	0	0	0.25	0	0	0	0	0	0
	Consumption (kWh/month)	**0**	**0**	**0**	**17.79**	**0**	**0**	**0**	**0**	**0**	**0**
18	**Heating equip set point**	High	Medium	High	High	Medium	Medium	0	High	Medium	High
(Winter)	**Daily Usage (h)**	16.70	16.70	16.70	16.70	16.70	16.70	16.70	16.70	16.70	16.70
	Consumption (kWh/month)	**28.96**	**19.81**	**28.96**	**28.96**	**19.81**	**19.81**	**0.00**	**28.96**	**19.81**	**28.96**
19	**Cooling equip set point**	Low	0	Low	Medium	Medium	Medium	0	Medium	Medium	0
(Summer)	**Daily Usage (h)**	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51
	Consumption (kWh/month)	**1.52**	**0.00**	**1.52**	**1.79**	**1.79**	**1.79**	**0.00**	**1.79**	**1.79**	**0.00**
20 d.	**Personal Heater**	0	0	1	0	0	0	0	0	0	0
(Winter)	**Daily Usage (h)**	1.84	0.00	0.69	2.30	0.69	1.84	0.00	0.00	2.30	0.69
	Consumption (kWh/month)	**0.00**	**0.00**	**25.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
20 e.	**Personal Fan**	1	0	0	1	0	1	0	0	1	0
(Summer)	**Daily Usage (h)**	0.50	0.00	0.19	0.63	0.19	0.50	0.00	0.00	0.63	0.19
	Consumption (kWh/month)	**1.76**	**0.00**	**0.00**	**2.20**	**0.00**	**1.76**	**0.00**	**0.00**	**2.20**	**0.00**
22, 23	**No. of CFL Lightbulbs**	5	2	5	3	3	5	2	3	0	1
22, 23	**No. of Incandescent Lightbulbs**	0	2	0	0	2	1	2	3	6	3
	Equivalent Wattage per bulb (W)	18	39	18	18	35	25	39	39	60	50
21a	**Lights off when not at home**	1	1	1	1	1	1	1	1	1	1
21b	**Lights off when not in use**	1	1	1	1	1	1	1	2	2	2
24	**No. of lights on over 3h**	4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	Daily Usage (h)	8	3	3	10	3	8	3	3	10	3
	Consumption (kWh/month)	**17.52**	**5.34**	**2.46**	**8.21**	**4.76**	**9.13**	**5.34**	**5.34**	**27.38**	**6.78**
33	**Stove Daily Usage (h)**	2	0.5	0.5	0.5	0.5	0.5	3	0	0.5	0.5
	Consumption (kWh/month)	**111.02**	**27.76**	**27.76**	**27.76**	**27.76**	**27.76**	**166.53**	**0.00**	**27.76**	**27.76**
34	**Oven Daily Usage (h)**	0.5	0.5	0	0.5	0	0	3	0.5	0.5	0.5
	Consumption (kWh/month)	**48.10**	**48.10**	**4.00**	**48.10**	**4.00**	**4.00**	**268.63**	**48.10**	**48.10**	**48.10**
35	**Microwave Daily Usage (min)**	0	0	3	3	0	0	0	12	6	3
	Consumption (kWh/month)	**0.00**	**0.00**	**5.62**	**5.62**	**0.00**	**0.00**	**0.00**	**11.53**	**7.59**	**5.62**
	Fridge Consumption (kWh/month)	**30.75**	**30.75**	**30.75**	**30.75**	**30.75**	**30.75**	**30.75**	**30.75**	**30.75**	**30.75**
	Base Consumption (kWh/month)	207.40	111.95	70.59	120.44	67.27	71.63	471.24	95.72	141.57	119.00
	Total Consumption (kWh/month)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Metered Consumption (kWh/month)	119.80	83.15	97.81	565.54	69.80	178.64	201.73	79.60	276.94	146.30
	% Difference	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Strict Time Estimate Validity	8	6.5	8.5	3.5	8.5	15.5	-1	-0.5	0.5	6.5
	Multi-task Time Estimate Validity	8	6.5	8.5	3.5	8.5	15.5	-1	1.5	6.5	8.5
Issues	**Time assessment**				**1**			**1**	**1**		
(>50%)	**Cooking over-estimate**	**1**	**1**					**1**			
	Electronic over-estimate								**1**		

Q. No.	Consumption type	32	33	34	35	36	37	38	39	40	41
Suite		**1102**	**701**	**1106**	**604**	**608**	**509**	**802**	**912**	**901**	**814**
7	**Time at home (h)**	<8	<8	9 to 13	9 to 13	9 to 13	9 to 13	<8	<8	<8	9 to 13
	Average time (h)	8	8	11	11	11	11	8	8	8	11

11	TV type	Plasma	Plasma	Plasma	LCD/LED	Tube	Tube	Tube	LCD/LED	0	LCD/LED
10	Daily Usage (h)	2	1	6	2	2	11	8	2	0	6
	Consumption (kWh/month)	12.84	8.24	31.21	10.95	10.04	38.78	29.20	10.95	0.00	25.55
12	Cable Box	Turn off	Turn off	0	0	0	Leave on	Turn off	0	0	Sometimes off
10	Daily Usage (h)	2	1	0	0	0	24	8	0	0	15
	Consumption (kWh/month)	1.48	0.74	0.00	0.00	0.00	17.81	5.94	0.00	0.00	11.13
13	Computer type	Laptop	0	0	Laptop	Laptop	0	Desktop	Laptop	0	Laptop
14	Daily Usage (h)	2	0	0	2	0	0	6	6	0	2
	Consumption (kWh/month)	9.43	0.00	0.00	9.43	7.30	0.00	29.20	13.69	0.00	9.43
16	Internet Daily Usage (h)	1	0	0	2	0	0	6	6	0	2
	Consumption (kWh/month)	7.36	0.00	0.00	7.42	0.00	0.00	7.67	7.67	0.00	7.42
17 a.	Cellphone charger	1	1	1	1	1	0	1	1	1	1
	Consumption (kWh/month)	0.23	0.23	0.23	0.23	0.23	0.00	0.23	0.23	0.23	0.23
17 b.	Home phone	0	1	0	0	0	1	1	0	0	0
	Consumption (kWh/month)	0.00	2.17	0.00	0.00	0.00	2.17	2.17	0.00	0.00	0.00
17 c.	VCR	0	1	0	0	0	0	1	0	0	0
	Consumption (kWh/month)	0.00	5.83	0.00	0.00	0.00	0.00	5.83	0.00	0.00	0.00
17 d.	DVD player	0	0	0	1	1	0	1	0	0	1
	Consumption (kWh/month)	0.00	0.00	0.00	5.83	5.83	0.00	5.83	0.00	0.00	5.83
17 e.	Game console	0	0	0	0	0	0	0	0	0	0
	Daily Usage (h)	0	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 f.	Printer	1	0	0	0	0	0	1	1	0	0
	Consumption (kWh/month)	3.75	0.00	0.00	0.00	0.00	0.00	3.75	3.75	0.00	0.00
17 g.	Speakers	1	0	0	1	0	0	1	0	0	0
	Daily Usage (h)	2	0	0	2	0	0	6	0	0	0
	Consumption (kWh/month)	1.52	0.00	0.00	1.52	0.00	0.00	4.56	0.00	0.00	0.00
17 h.	Clock (alarm)	0	0	0	0	1	1	1	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	4.00	4.00	4.00	0.00	0.00	0.00
17 i.	Stereo/Radio	0	0	1	0	1	0	1	0	0	0
	Consumption (kWh/month)	0.00	0.00	1.58	0.00	1.58	0.00	1.58	0.00	0.00	0.00
17 j.	Slow cooker	0	0	0	0	0	0	1	0	0	0
	Daily Usage (h)	0	0	0	0	0	0	1	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	21.51	0.00	0.00	0.00
17 k.	Rice cooker	0	0	0	0	0	0	0	0	0	1
	Daily Usage (h)	0	0	0	0	0	0	0	0	0	0.25
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.76
17 l.	Iron	0	1	1	0	1	1	1	0	0	1
	Consumption (kWh/month)	0.00	0.83	0.83	0.00	0.83	0.83	0.83	0.00	0.00	0.83
17 m.	Vacuum	0	1	0	0	0	0	1	0	0	0
	Consumption (kWh/month)	0.00	5.00	0.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00
17 n.	Humidifier	1	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	33.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 o.	Other	0	0	0	0	0	0	0	0	0	0
	Daily Usage (h)	0	0	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	0	0	0	0	0	0	0	0	0	0
18	Heating equip set point	0	Low	Medium	0	Medium	0	Low	Medium	0	0
(Winter)	Daily Usage (h)	16.70	16.70	16.70	16.70	16.70	16.70	16.70	16.70	16.70	16.70
	Consumption (kWh/month)	0.00	16.76	19.81	0.00	19.81	0.00	16.76	19.81	0.00	0.00
19	Cooling equip set point	0	0	Medium	Medium	Medium	0	0	0	0	0
(Summer)	Daily Usage (h)	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51
	Consumption (kWh/month)	0.00	0.00	1.79	1.79	1.79	0.00	0.00	0.00	0.00	0.00
20 d.	Personal Heater	0	0	0	0	0	0	0	0	0	0
(Winter)	Daily Usage (h)	0.00	0.00	0.69	0.69	0.69	0.69	0.00	0.00	0.00	0.69
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20 e.	Personal Fan	0	1	0	0	1	1	0	0	0	0
(Summer)	Daily Usage (h)	0.00	0.00	0.19	0.19	0.19	0.19	0.00	0.00	0.00	0.19
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.66	0.66	0.00	0.00	0.00	0.00
22, 23	No. of CFL Lightbulbs	3	2	3	0	4	5	6	4	0	0
22, 23	No. of Incandescent Lightbulbs	0	2	0	3	0	0	4	0	0	2
	Equivalent Wattage per bulb (W)	18	39	18	60	18	18	35	18	0	60
21a	Lights off when not at home	1	0	1	1	1	1	2	1	1	1
21b	Lights off when not in use	1	2	1	1	1	2	2	1	1	1
24	No. of lights on over 3h	1.5	1.5	1.5	1.5	4	4	4	1.5	0	1.5
	Daily Usage (h)	3	3	3	3	3	3	3	3	0	3
	Consumption (kWh/month)	2.46	5.34	2.46	8.21	6.57	6.57	12.70	2.46	0.00	8.21
33	Stove Daily Usage (h)	0.5	0.5	0.5	0.5	0	2	2	0.5	0	0.5
	Consumption (kWh/month)	27.76	27.76	27.76	27.76	0.00	111.02	111.02	27.76	0.00	27.76
34	Oven Daily Usage (h)	0	0	0.5	0	0	0	2	0	0	0.5
	Consumption (kWh/month)	4.00	4.00	48.10	4.00	4.00	4.00	180.42	4.00	4.00	48.10
35	Microwave Daily Usage (min)	0	6	0	0	6	0	15	0	0	3
	Consumption (kWh/month)	0.00	7.59	0.00	0.00	7.59	0.00	13.50	0.00	0.00	5.62
	Fridge Consumption (kWh/month)	30.75	30.75	30.75	30.75	30.75	61.5	30.75	30.75	30.75	30.75
	Base Consumption (kWh/month)	64.97	75.43	109.07	70.72	48.91	183.09	348.39	64.97	34.75	120.44
	Total Consumption (kWh/month)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Metered Consumption (kWh/month)	109.14	105.40	159.66	138.49	82.45	139.62	133.36	154.56	59.84	113.21
	% Difference	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Strict Time Estimate Validity	3.5	6.5	4.5	6.5	9	-2	-8	-0.5	8	2.5
	Multi-task Time Estimate Validity	5.5	6.5	4.5	8.5	9	-2	-2	1.5	8	4.5
Issues	Time assessment						1	1			1
(>50%)	Cooking over-estimate						1	1			
	Electronic over-estimate						1				1

Q. No.	Consumption type	42	43	44	45	46	47	48	50
Suite		405	905	408	607	808	806	1012	914
7	Time at home (h)	18+	9 to 13	14 to 18	14 to 18	<8	9 to 13	9 to 13	18+
	Average time (h)	18	11	16	16	8	11	11	18
11	TV type	Tube	Tube	LCD/LED	0	LCD/LED	LCD/LED	LCD/LED	Plasma
10	Daily Usage (h)	6	6	6	0	6	2	2	11
	Consumption (kWh/month)	22.81	22.81	25.55	0.00	25.55	10.95	10.95	54.17
12	Cable Box	0	0	Turn off	0	Turn off	0	Leave on	Leave on
10	Daily Usage (h)	0	0	6	0	6	0	24	24
	Consumption (kWh/month)	0.00	0.00	4.45	0.00	4.45	0.00	17.81	17.81
13	Computer type	0	0	0	0	0	0	0	Both (old)
14	Daily Usage (h)	0	0	0	0	0	0	0	6
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.83
16	Internet Daily Usage (h)	0	0	0	0	0	0	0	6
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.67
17 a.	Cellphone charger	1	1	0	0	1	1	1	1
	Consumption (kWh/month)	0.23	0.23	0.00	0.00	0.23	0.23	0.23	0.23
17 b.	Home phone	1	0	1	1	1	0	0	0
	Consumption (kWh/month)	2.17	0.00	2.17	2.17	2.17	0.00	0.00	0.00
17 c.	VCR	1	0	0	0	1	0	0	0
	Consumption (kWh/month)	5.83	0.00	0.00	0.00	5.83	0.00	0.00	0.00
17 d.	DVD player	0	0	0	0	1	1	0	1
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	5.83	5.83	0.00	5.83
17 e.	Game console	0	0	0	0	0	0	0	0
	Daily Usage (h)	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 f.	Printer	0	1	0	0	0	0	0	0
	Consumption (kWh/month)	0.00	3.75	0.00	0.00	0.00	0.00	0.00	0.00
17 g.	Speakers	0	0	0	0	0	0	0	1
	Daily Usage (h)	0	0	0	0	0	0	0	6.00
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.56
17 h.	Clock (alarm)	0	0	0	0	0	0	0	0
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 i.	Stereo/Radio	1	1	0	1	0	1	0	0
	Consumption (kWh/month)	1.58	1.58	0.00	1.58	0.00	1.58	0.00	0.00
17 j.	Slow cooker	1	0	0	0	0	0	0	0
	Daily Usage (h)	1	0	0	0	0	0	0	0
	Consumption (kWh/month)	21.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 k.	Rice cooker	1	0	0	0	0	0	0	0
	Daily Usage (h)	0.25	0	0	0	0	0	0	0
	Consumption (kWh/month)	3.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 l.	Iron	1	0	0	0	0	0	1	1
	Consumption (kWh/month)	0.83	0.00	0.00	0.00	0.00	0.00	0.83	0.83
17 m.	Vacuum	1	0	1	0	0	0	0	0
	Consumption (kWh/month)	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00
17 n.	Humidifier	0	0	0	0	0	0	0	1
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33
17 o.	Other	0	Toaster	0	0	0	0	Boiler	0
	Daily Usage (h)	0	0.17	0	0	0	0	0.17	0
	Consumption (kWh/month)	0	7.30	0	0	0	0	4.56	0
18	Heating equip set point	0	High	High	High	Low	0	High	High
(Winter)	Daily Usage (h)	16.70	16.70	16.70	16.70	16.70	16.70	16.70	16.70
	Consumption (kWh/month)	0.00	28.96	28.96	28.96	16.76	0.00	28.96	28.96
19	Cooling equip set point	0	High	Medium	Medium	High	0	Low	0
(Summer)	Daily Usage (h)	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51
	Consumption (kWh/month)	0.00	2.62	1.79	1.79	2.62	0.00	1.52	0.00
20 d.	Personal Heater	0	0	0	0	0	0	0	0
(Winter)	Daily Usage (h)	2.30	0.69	1.84	1.84	0.00	0.69	0.69	2.30
	Consumption (kWh/month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20 e.	Personal Fan	0	0	1	0	0	0	0	0
(Summer)	Daily Usage (h)	0.63	0.19	0.50	0.50	0.00	0.19	0.19	0.63
	Consumption (kWh/month)	0.00	0.00	1.76	0.00	0.00	0.00	0.00	0.00
22, 23	No. of CFL Lightbulbs	0	1	4	3	4	4	2	0
22, 23	No. of Incandescent Lightbulbs	5	2	1	3	0	0	1	4
	Equivalent Wattage per bulb (W)	60	46	26	39	18	18	32	60
21a	Lights off when not at home	1	1	1	1	1	1	1	2
21b	Lights off when not in use	1	2	1	2	1	1	1	4
24	No. of lights on over 3h	4	1.5	1.5	4	1.5	1.5	1.5	1.5
	Daily Usage (h)	10	3	8	8	3	3	3	10
	Consumption (kWh/month)	73.00	6.30	9.64	37.96	2.46	2.46	4.38	27.38
33	Stove Daily Usage (h)	0.5	0.5	0.5	2	0.5	0.5	2	0.5
	Consumption (kWh/month)	27.76	27.76	27.76	111.02	27.76	27.76	111.02	27.76
34	Oven Daily Usage (h)	0	0.5	0.5	0.5	0.5	0	0.5	0.5
	Consumption (kWh/month)	4.00	48.10	48.10	48.10	48.10	4.00	48.10	48.10
35	Microwave Daily Usage (min)	0	6	0	6	6	6	0	0
	Consumption (kWh/month)	0.00	7.59	0.00	7.59	7.59	7.59	0.00	0.00
	Fridge Consumption (kWh/month)	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75
	Base Consumption (kWh/month)	135.51	120.49	116.25	235.42	116.66	72.56	194.26	133.98
	Total Consumption (kWh/month)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Metered Consumption (kWh/month)	123.79	134.56	151.67	117.90	174.66	73.47	82.41	180.31
	% Difference	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Strict Time Estimate Validity	11.5	4.5	9.5	14	1.5	8.5	7	0.5
	Multi-task Time Estimate Validity	11.5	4.5	9.5	14	1.5	8.5	7	6.5
Issues	Time assessment								1
(>50%)	Cooking over-estimate				1			1	
	Electronic over-estimate	1							1