High Performance Building Design in Minnesota

For: Minnesota Office of Environmental Assistance

by The Weidt Group

June 30, 2005

Introduction

At the request of Laura Millberg at the Minnesota Office of Environmental Assistance, The Weidt Group developed an assessment of the air pollution savings results based on a sample of High Performance Building Design Projects in Minnesota.

The building performance data is based on a subset of over 170 building projects The Weidt Group has modeled from 1994 to 2005. The building performance results are based on energy simulations using DOE2.1E (Winkelman et. al. 1993) of the building during the design phase of a project. The computer models are simulated using the local DOE-2 TMY (Typical Meteorological Year) weather file. Many weather parameters are significant to the model, including outdoor dry and wet bulb temperature, wind velocity, cloud cover, solar radiation and incidence angle for each hour of the year. It should be noted that variations will exist between the TMY weather file (average year) and actual weather conditions in which the building will be operated.

This computer model is intended for comparison of relative differences in net energy use for various design alternatives, compared to a base condition; it is not intended for system design and/or equipment selection. In addition, the actual energy use of this building is likely to be different from the DOE-2.1E simulations because there will be differences in the weather, operating parameters, occupancy, and other circumstances not anticipated in the model. Given those qualifications, however, this model offers energy use estimations as good as any other means available for a building that has not yet been built.

The Code base model results are based on an energy model of the building designed to the minimum requirements of the Minnesota Energy Code. The design model is based on the strategies selected for implementation. In most cases the results have been adjusted to account for savings increases or decreases based on verified findings of the predominate strategies selected for implementation.

Summary Results

The Minnesota OEA and The Weidt Group reviewed the results and established a threshold of 30% annual energy dollar savings over code as a working definition for a High Performance building. Of the 170 building projects surveyed 41 building projects meet these criteria.

The 41 High Performance buildings surveyed contain over 7 million square feet of floor area, with combined annual savings of over:

- 58,000,000 KWh
- 15,000 Peak KW
- 290,000 Natural Gas MMBtu
- 5,250,000 dollars
- 118,000,000 lbs CO_2 emissions
- 205,000 lbs SO_2 emissions
- 225,000 lbs NO_x emissions
- 15,000 lbs Particulate emissions
- 1.9 lbs Mercury emissions

A partial list of buildings can be found in Appendix A.

Background

Items 1 and 2 below identify the type of data collected for each project

1. Data collected and summarized for each of the projects is listed below:

- Building Type
- Building square feet
- Electric energy savings as compared to the Minnesota Energy Code
- Natural gas energy savings as compared to the Minnesota Energy Code
- Total energy costs savings
- Annual Peak KW savings
- Incremental first cost*
- Simple payback*
- Design Year

* Incremental cost data for projects with incomplete incremental costs were left blank and simple payback was not identified.

2. Calculate pollution savings for each project for the following metrics:

- CO_2 savings
- SO_2 Savings
- NO_x Savings
- Particulate savings
- Mercury savings

The conversion of pollution savings from gas and electric energy generation is based on the current Xcel Energy aggregate generation blend of air emission for each pollutant source

3. Determine metric for defining “High Performance” Buildings.

We ranked the buildings results compiled by:

- Energy Cost % savings
- KW % savings
- Natural gas % savings
- Air emission types % savings

The data from this ranking was reviewed in a meeting on June 14, 2005 with Minnesota OEA to develop an appropriate threshold for use in defining “high performance” building projects.

The decision to use the threshold of 30% annual energy dollar savings over code was selected as the appropriate definition. This is consistent with the definition used in the new State B3 sustainable design guidelines recently adopted as a requirement for all new state building design projects.

4. Identify results for each High Performance Building in sample

Results metrics for each building include:

- Design Year
- Building Type
- Building Floor Area
- KWH savings
- KW peak savings
- Gas MMBTu savings
- Energy Dollar savings
- lbs CO_2 emission savings
- lbs SO_2 emission savings
- lbs NO_x emission savings
- lbs Particulate emission savings
- lbs of Mercury
- Incremental Costs
- Simple Payback

Modeled design results for each building are in appendix B.

5. Description of Key Energy Savings Strategies

From the previous data set of High Performance Buildings, The Minnesota Office of Environmental Assistance selected 3 building types to identify key energy savings strategy categories and to quantify the energy dollar savings for each. The three building types selected are; Office, Retail, and Schools.

Ten energy savings categories were defined for all building types. Energy dollar savings for each strategy category was quantified for a sample of projects within each of the three building types. The table below identifies the average % energy dollar savings for each strategy category for the buildings sampled within each building type:

		Average % Savings Breakdown			
Strategy Categories		**Office**	**Retail**	**Schools**	**Comments**
1	Improved insulation levels	2%	1%	2%	Commercial buildings have high internal load requirements, reducing the energy required for heating. Improved insulation levels save less than residential projects and are not as cost effective.
2	Improved window glazing	4%	1%	4%	Similar comment as above. Retail savings opportunities are less due to low glass area-to-floor area ratios.
3	Calibrated Daylight controls	12%	12%	3%	Daylighting is a high performance strategy that has not reached market saturation. The future of improved savings for this category is high, once various market barriers are reduced including design and construction trade familiarity, and control technology improvements. (Vaidya et. al. 2005)
4	Lighting controls	8%	7%	15%	Due to the diverse operation of space occupancy and lighting design levels, school buildings have higher opportunities to reduce lighting energy consumption using occupancy sensors and dual-level lighting controls, as compared to offices and retail building types.
5	Improved lighting design	15%	33%	9%	High savings for retail in this category is the result of the type of retail projects in the sample set. Large "big box" retail buildings can easily meet the requirements of the current energy code, due to lower industry standard light level requirements.
6	Improved heating efficiency	3%	2%	4%	Based on energy costs, natural gas rates as compared to electric rates per unit of site energy have been much lower over the sample period reviewed, providing less opportunities for large dollar savings Technology improvements in high efficiency gas equipment range from 5 to 10% better than the code.
7	Improved cooling efficiency	14%	3%	6%	Improved cooling efficiencies are greatest for offices since they operate through out the summer months as compared to school buildings.
8	Load responsive HVAC design	35%	11%	15%	Use of variable frequency drives on air handler systems is significant. In the future for many buildings this will be a code requirement.
9	Conditioning of outside air	7%	21%	41%	New school IAQ criteria requires high ventilation loads providing larger opportunities for energy recovery strategies as compared to office and retail building types.
10	Refrigeration	0%	11%	0%	Retail with refrigerated case work provides many opportunities for improved savings.

Strategy Narratives:

1. Improved Insulation Strategy

Strategy Objective: Minimize heat loss through cost-effective insulation choices.

Strategy Descriptions: Envelope insulation strategies add insulation to the roof and walls of the building. For commercial construction the composite code R value is generally R-11 for walls and R-22 for roofs.

2. Window Glazing Strategies

Strategy Objectives: Manage heat gain, heat loss, and daylighting through appropriate glass and frame selection.

Strategy Description: Improved glazing strategies generally incorporate spectrally selective Low E glass types which have high visible light transmittance and relative, lower solar heat gain coefficients.

3. Calibrated Daylighting Control Strategies

Strategy Objectives: Reduce electric lighting in spaces with daylight, utilizing automated calibrated controls.

Strategy Description: Two types of daylight controls are typically considered for various spaces in the building.

Stepped Daylighting Control Systems turn off selected lamps/fixtures within the daylight control zone. This works best where the daylight level is above the design light level most of the day. Control device options include exterior or interior photo-sensors measuring the daylight source connected to a lighting relay able to switch lights on or off based on daylight availability or an astronomical time clock programmed to automatically switch lights off after sunrise and on before sunset, varying daily.

Dimming Daylighting Control Systems use interior photo-sensors to control electronic dimming ballasts that gradually dim or brighten lamps within the daylight zone. This system can be transparent to the building occupant since the dimming system continuously maintains the designed light levels without switching lamps on or off.

4. Lighting Control Strategies

Strategy Objectives: Reduce electric lighting energy by turning lights off (or down) when they are not needed.

Strategy Descriptions:
Occupancy sensor control is appropriate for most space types where it is common for lights to be on when no one is present for periods throughout the day. To reduce “False-On’s” the sensor should not view out a door or into adjacent spaces. A wall switch is still required to allow occupants to turn lights off when space is occupied. See Appendix C for typical installation diagrams.

Dual level switching is applicable for rooms with variable light level requirements. Manual switches provide for two or more levels of light output. These strategies provide greatest savings opportunities when switch design follows an inboard–outboard (“b” lamp “a” lamp) scheme per fixture.

Time-clock sweep system controls large areas of the building lights at once. Lights in a particular area are scheduled with a central controlled relay system, typically switching off after normal occupied hours. Before the lights are automatically switched off, the lights blink, warning that the lights are about to be switched off. If the space is occupied, the occupant can press a switch that informs the controller to keep the lights on for a specified period of time.

Manual dimming is applicable for rooms with concentrated Audio/Visual requirements. Electronic dimming ballasts are used with manual dimming controls in place of wall switches.

5. Lighting Design Strategies

Strategy Objectives: Reduce electric lighting energy through appropriate lighting equipment selection and layout.

Strategy Descriptions:
Lamp Type is a significant variable for reducing lighting power density. Super T8 lamps along with low ballast factor ballasts provides the same lumen output as Standard T8 lamps, but they use 15% less energy.

Fixture Type also influences lighting power density because some types are more efficient than others, considering both quality and quantity of light. For example, indirect or direct/indirect fixtures can provide a better quality of light with less glare, so that light levels and watts/sq. ft. may be reduced.

6. Improved Heating Efficiency

Strategy Objectives: Reduce energy use by selecting higher efficiency heating systems.

Strategy Description: Increase heating equipment efficiency above code levels by 5 to 10% with high efficiency or condensing boilers.

7. Improved Cooling Efficiency

Strategy Objectives: Reduce energy use by selecting higher efficiency cooling systems.

Strategy Description: Increase cooling equipment efficiency above code levels by 10 to 20% for DX, air cooled and water cooled systems.

8. Load Responsive HVAC operation

Strategy Objectives: Reduce energy use by providing improved efficiency and control systems that reduce both the power required and the level of power needed in response to the building load.

Strategy Description:

Premium efficiency motors: Replace code level motors with Premium Efficiency motors as defined by the NEMA PremiumTM Efficient Motor Program. NEMA specifications for Premium Efficiency motors are tabulated at the end of this section of the report.

Variable Frequency Drives (VFDs) on Supply/Return Air Fans – with constant static pressure control: Install VFD control rather than inlet-vane control for these conventional VAV system(s).

This strategy assumes system static pressure is held constant with sensor located two thirds of the way down the supply air duct.

Variable Frequency Drives on heating pump: Install VFD control rather than constant speed drives on the secondary loop pump motors for the heating water distribution system. This strategy assumes two-way valves on applicable heating coils, in order to reduce hydronic flow (modeled to minimum 30% flow) during periods of low heating load.

Variable Frequency Drives on chilled water pump: Install VFD control rather than constant speed drives on the secondary loop pump motors for the chilled water distribution system. This strategy assumes two-way valves on applicable chilled water coils, in order to reduce hydronic flow (modeled to minimum 30% flow) during periods of low cooling load.

9. Conditioning of Outside Air

Strategy Objectives: Reduce energy use by adjusting the volume of outside air which needs conditioning, according to the actual building load or by recovering heat/cool from return air or equipment.

Strategy Description:

CO2 sensor reset of minimum outside air: CO2 sensors, located in the return air ducts (or the space), are used to reduce ventilation in proportion to the number of occupants served by a system. To implement this strategy, CO2 sensors are added to the return air ducts (or to the space) as needed to ensure that concentrations in the building do not exceed threshold values. The CO2 concentration threshold of roughly 1000 ppm provides ventilation of human and non-human source contaminants (e.g. VOCs, cleaning compounds, etc.). This strategy was modeled on both air handlers.

Occupancy sensor control of VAV boxes: Supply air is controlled based on signals from occupancy sensors. If a space is unoccupied, the VAV box goes to a “space vacant” minimum and supply air quantity is reduced in proportion. In spaces where occupancy control of lighting is also used, a single occupancy sensor controls two relays: a lighting relay and a VAV box relay. This strategy includes private office and conference room space (see the drawings in the lighting control section for details of affected areas).

Sensible Energy Recovery: Sensible heat from the exhaust air streams to the unconditioned ventilation air is used to reduce heating energy. This strategy is uses a run-around loop, flat plate heat exchanger, heat wheel, or heat pipe heat exchanger.

Total Energy Recovery: Recovery of both sensible and latent heat from the exhaust air streams to the unconditioned ventilation air is used to reduce both heating and cooling energy by pre-conditioning outside air. This is typically accomplished using an enthalpy wheel or permeable membrane cross-flow heat exchanger.

10. Improved Refrigeration

Strategy Objectives: Reduce overall energy use for refrigeration systems, configuration, or controls.

Strategy Description:

There is a wide range of refrigeration-related equipment that is configured differently from store-to-store, based on current technology and practice. Each supermarket owner has different approaches and different standards for current practice, and the Energy Code does not specifically address most of the components or configurations. The following paragraphs provide detail on the upgrade potential for this equipment.

High efficiency compressors with mechanical subcooling on low temperature refrigeration rack: Change from conventional level of compressor efficiency to higher efficiencies. Also, change from ambient subcooling to mechanical subcooling on the low temperature refrigeration rack. The mechanical subcooling is provided by the medium temperature refrigeration rack.

High performance T/C Coil refrigerated cases: Change medium temperature cases from standard units to high performance T/C Coil units.

Variable frequency drives in refrigeration condenser fans: change from cycling control of condenser fans to variable frequency drive control. MRF04 – Evaporative condensers: Change from air cooled condensers on refrigeration system to evaporative condensers.

Heat reclaim for domestic hot water use: Install heat exchangers to reclaim heat from the refrigeration condensers and transfer that heat to the domestic hot water system.

Heat reclaim for radiant floor heat in dairy: Install heat exchangers to reclaim heat from the refrigeration condensers and transfer that heat to the radiant floor heating system in the dairy area.

Heat reclaim for sales floor air handler reheat: Install heat exchangers to reclaim heat from the refrigeration condensers and transfer that heat to the reheat coil in the sales floor air handler.

High-Efficiency Evaporator Fan Motors: Upgrade evaporator fans in the refrigerated cases to meet or exceed efficiency standards as listed below. This requires the use of permanent split capacitor (PSC) or electronically commutated (ECM) motors.

Gas defrost on freezers: Change from electric defrost to hot refrigerant gas defrost on freezer cases and walk-in freezers.

Centralized case door defrost / humidity control (PMAC): Central control system that measures the store humidity and varies the case door defrost cycles accordingly, rather than running case door defrost continuously. This strategy reduces the run-time of the anti-sweat heaters during low-humidity winter periods.

Centralized case door defrost / humidity control (Door Miser): Central control system that measures the case humidity and varies the case door defrost cycles accordingly, rather than running case door defrost continuously. This strategy reduces the run-time of the anti-sweat heaters during low-humidity winter periods.

References

Winkelman F.C. , Birdsall B. E., Buhl W. F., Ellington K.L., Erdem A.E., Hirsch J.J.,Gates S. 1993 DOE2 Supplement, Version 2.1E, LBL-34947. Lawrence Berkeley National Laboratory. Springfield, Virginia: National Technical Information Services.

Vaidya, P, McDougall, T, Steinbock, T, Douglas J, Eijadi, D. 2005. Making Daylighting Work - Learning from failures to improve the design and implementation process. In Proceedings of ECEEE 2005 Summer Study.

Appendix A Partial List of Buildings

Dittmann Center
1520 St. Olaf Avenue
Northfield, MN 55057

Winona State Science Bldg.
400 Winona St.
Winona, MN 55987

Burroughs Community School
1601 West 50th St.
Minneapolis, MN 55419

WMEP Interdistrict Downtown School
10 South 10th Street
Minneapolis, MN 55403

Jordan Park Community School
1501- 30th Ave. N.
Minneapolis, MN 55411

Nellie Stone Johnson Community School
807 27th Ave. N.
Minneapolis, MN 55411

Monticello High School
5225 School Blvd.
Monticello, MN 55362

Hopkins West Junior High School
3830 Baker Road
Minnetonka, Minnesota 55305

Karges-Faulconbridge, Inc.
670 W. County Road B
St. Paul, MN 55113-4527

General Mills JFB Technical Center
9000 Plymouth Ave North
Golden Valley, MN 55427

Eagan Community Center
1501 Central Parkway
Eagan, MN 55121

College of St. Catherine
St. Paul Library
2004 Randolph Ave.
St. Paul MN 55105

Fairview Red Wing Medical Center
701 Fairview Blvd
PO Box 95
Red Wing, MN 55066

Hassan Elementary School
14055 Orchid Avenue
Rogers, MN

Providence Academy
15100 Schmidt Lake Road
Plymouth, MN

Crosswinds Arts and Science Middle School
600 Weir Drive
Woodbury, MN

Arlington High School
1495 Rice St.
St. Paul, MN

Crossroads Elementary
543 Front Street
St. Paul, MN

Lakeview School
875 Barstad Road
Cottonwood, MN

Appendix B – Building Data

2	Design Date	EPMS Building Type	Building Area SF	KWH Savings	KWH % Savings	Peak KW Savings	Peak KW % Savings	Gas MMBTu Savings	Gas MMBTu % Savings	Energy Cost Savings	Energy Cost % Savings	Total CO2 Savings (lbs)	Total CO2 % Savings	Total SO2 Savings (lbs)	Total SO2 % Savings	Total NOX Savings (Lbs)	Total NOX % Savings	Total Particulate Savings (lbs)	Total Particulate % Savings	Total Hg Savings (lbs)	Total Hg % Savings	Incremental First Costs	Simple Payback
4	1994	College Classroom	229,395	1,129,090	35%	308	31%	6,329	62%	126,917	44%	2,415,492	41%	3,991	35%	4,568	39%	300	37%	0.03749	35%		
5	1997	College Classroom	98,775	704,979	46%	169	39%	(5)	0%	34,137	38%	988,796	42%	2,481	46%	2,157	43%	164	45%	0.02340	46%	43,051	1.3
6	2000	College Classroom	77,459	753,128	38%	160	32%	10,140	37%	58,393	37%	2,388,024	38%	2,680	38%	4,087	38%	235	38%	0.02501	38%		
Total			405,629	2,587,198		637		16,463		219,447		5,792,312		9,152		10,812		700		0.08590			
Mean	1997		135,210	862,399	40%	212	34%	5,488	33%	73,149	40%	1,930,771	40%	3,051	40%	3,604	40%	233	40%	0.02863	40%	43,051	1.3
Median	1997		98,775	753,128	38%	169	32%	6,329	37%	58,393	38%	2,388,024	41%	2,680	38%	4,087	39%	235	38%	0.02501	38%	43,051	1.3
7	2003	College Lab	160,205	2,469,805	33%	237	18%	41,589	63%	785,315	56%	8,925,630	47%	8,812	33%	14,870	43%	819	38%	0.08203	33%	435,053	0.6
8	2001	College Lab	149,000	1,607,210	40%	538	37%	7,241	40%	146,805	39%	3,206,337	40%	5,676	40%	6,192	40%	417	40%	0.05336	40%		
Total			309,205	4,077,015		775		48,831		932,120		12,131,967		14,489		21,061		1,236		0.13539			
Mean	2002		154,603	2,038,508	36%	388	28%	24,415	52%	466,060	47%	6,065,984	43%	7,244	36%	10,531	41%	618	39%	0.06770	36%	435,053	0.6
Median	2002		154,603	2,038,508	36%	388	28%	24,415	52%	466,060	47%	6,065,984	43%	7,244	36%	10,531	41%	618	39%	0.06770	36%	435,053	0.6
9	1994	Lab	118,570	1,424,968	36%	475	41%	30,605	59%	127,157	44%	6,017,256	48%	5,104	36%	9,741	46%	511	41%	0.04733	36%		
10	1999	Lab	243,347	3,502,827	24%	855	21%	33,258	53%	574,155	40%	9,282,009	33%	12,423	24%	16,566	30%	1,011	27%	0.11632	24%		
11	1999	Lab	225,000	2,005,227	35%	596	32%	26,850	36%	172,799	35%	6,338,910	36%	7,134	35%	10,857	36%	625	36%	0.06659	35%		
Total			586,916	6,933,022		1,926		90,713		874,111		21,638,176		24,660		37,164		2,148		0.23025			
Mean	1997.33		195,639	2,311,007	32%	642	31%	30,238	49%	291,370	39%	7,212,725	39%	8,220	32%	12,388	37%	716	35%	0.07675	32%		
Median	1999		225,000	2,005,227	35%	596	32%	30,605	53%	172,799	40%	6,338,910	36%	7,134	35%	10,857	36%	625	36%	0.06659	35%		
12	2004	Elementary School	98,700	576,226	51%	364	50%	2,981	51%	64,189	51%	1,200,026	51%	2,036	51%	2,287	51%	152	51%	0.01913	51%		
13	2002	Elementary School	95,362	431,024	32%	233	29%	3,614	64%	42,258	38%	1,079,379	41%	1,527	32%	1,954	38%	122	35%	0.01431	32%		
Total			194,062	1,007,250		597		6,595		106,447		2,279,406		3,563		4,242		273		0.03344			
Mean	2003		97,031	503,625	41%	299	39%	3,297	57%	53,224	45%	1,139,703	46%	1,782	41%	2,121	44%	137	43%	0.01672	41%		
Median	2003		97,031	503,625	41%	299	39%	3,297	57%	53,224	45%	1,139,703	46%	1,782	41%	2,121	44%	137	43%	0.01672	41%		
14	1999	Hospital	165,451	1,367,228	34%	316	28%	13,719	43%	102,064	33%	3,719,830	38%	4,851	34%	6,596	37%	399	36%	0.04540	34%	97,641	1.0
15	1995	Library	72,108	656,919	40%	133	36%	3,234	66%	62,094	49%	1,346,540	45%	2,321	40%	2,579	43%	172	41%	0.02181	40%	135,738	2.2
16	1999	Library	124,496	701,611	49%	289	44%	(308)	-7%	38,371	37%	944,296	37%	2,468	49%	2,093	41%	162	46%	0.02329	49%	75,425	2.0
17	2001	Library	212,458	1,609,905	46%	477	40%	149	1%	83,832	34%	2,279,115	35%	5,665	46%	4,953	39%	376	43%	0.05344	46%		
Total			409,062	2,968,435		899		3,075		184,297		4,569,951		10,454		9,625		710		0.09855			
Mean	1998.33		136,354	989,478	45%	300	40%	1,025	20%	61,432	40%	1,523,317	39%	3,485	45%	3,208	41%	237	43%	0.03285	45%	105,582	2.1
Median	1999		124,496	701,611	46%	289	40%	149	1%	62,094	37%	1,346,540	37%	2,468	46%	2,579	41%	172	43%	0.02329	46%	105,582	2.1
18	2000	Middle/High School	317,399	2,175,534	46%	744	37%	32,230	58%	312,143	58%	7,284,074	52%	7,749	46%	12,324	51%	696	49%	0.07225	46%		
19	1997	Middle/High School	88,778	595,642	47%	225	42%	1,473	33%	68,728	45%	1,029,431	44%	2,100	47%	2,082	45%	147	46%	0.01978	47%		
20	1999	Middle/High School	114,603	763,730	49%	494	63%	1,861	22%	57,620	44%	1,316,258	40%	2,693	49%	2,664	42%	189	45%	0.02536	49%	348,594	6.0
21	1998	Middle/High School	116,266	765,515	47%	142	35%	(146)	-2%	47,283	44%	1,055,270	34%	2,693	47%	2,317	38%	178	43%	0.02541	47%		
22	2001	Middle/High School	125,000	344,919	29%	290	37%	1,950	22%	63,715	41%	740,076	26%	1,219	29%	1,398	27%	92	28%	0.01145	29%		
23	1997	Middle/High School	164,024	530,045	36%	412	47%	5,265	49%	48,240	40%	1,435,087	41%	1,880	36%	2,548	40%	154	38%	0.01760	36%		
24	1999	Middle/High School	116,068	567,152	37%	367	36%	4,918	57%	54,541	40%	1,441,581	44%	2,010	37%	2,600	42%	161	40%	0.01883	37%		
25	1994	Middle/High School	151,702	889,256	52%	270	38%	1,067	15%	48,443	39%	1,388,179	42%	3,132	52%	2,909	45%	214	49%	0.02952	52%		
26	1997	Middle/High School	271,335	1,006,084	37%	495	36%	5,808	41%	75,291	37%	2,174,494	38%	3,557	37%	4,100	38%	269	37%	0.03340	37%	201,570	2.7
27	1994	Middle/High School	16,882	91,143	43%	28	21%	564	45%	7,031	36%	201,982	44%	322	43%	378	43%	25	43%	0.00303	43%		
28	2000	Middle/High School	109,488	241,446	30%	160	28%	2,111	35%	25,782	34%	615,940	32%	856	30%	1,110	32%	69	31%	0.00802	30%	7,500	0.3
29	1998	Middle/High School	125,534	435,974	32%	173	24%	2,548	47%	32,241	31%	946,313	36%	1,541	32%	1,782	35%	117	33%	0.01448	32%	46,000	1.4
Total			1,717,079	8,406,441		3,799		59,650		841,058		19,628,684		29,754		36,213		2,309		0.27913			
Mean	1997.33		143,090	700,537	40%	317	37%	4,971	35%	70,088	41%	1,635,724	39%	2,479	40%	3,018	40%	192	40%	0.02326	40%	150,916	2.6
Median	1998		120,633	581,397	40%	280	37%	2,030	38%	51,492	40%	1,185,764	40%	2,055	40%	2,432	41%	158	41%	0.01930	40%	123,785	2.1
30	1999	Mixed Use	326,784	2,556,125	42%	561	36%	11,071	48%	248,557	43%	5,040,852	43%	9,026	42%	9,769	43%	661	42%	0.08487	42%		
32	2003	Office	34,787	502,789	55%	128	55%	1,127	74%	27,616	54%	853,639	57%	1,772	55%	1,737	56%	124	55%	0.01669	55%	32,819	1.2
33	1999	Office	76,470	651,330	44%	127	37%	1,971	38%	40,599	40%	1,172,911	42%	2,298	44%	2,340	43%	163	43%	0.02162	44%		
34	1999	Office	1,219,421	7,224,758	34%	1,822	31%	8,061	29%	636,955	40%	11,198,443	33%	25,445	34%	23,527	33%	1,731	34%	0.23985	34%	959,675	1.5
35	1996	Office	121,600	1,007,695	44%	233	35%	1	0%	56,140	39%	1,414,455	38%	3,546	43%	3,084	40%	235	42%	0.03345	44%		
36	1998	Office	431,655	4,504,125	38%	920	30%	18,143	43%	294,460	37%	8,703,244	39%	15,901	38%	16,973	38%	1,156	38%	0.14954	38%		
37	2000	Office	129,125	846,497	45%	251	40%	33	1%	49,549	36%	1,192,412	39%	2,979	45%	2,596	41%	198	43%	0.02810	45%		
38	2003	Office	210,123	2,432,854	38%	464	29%	883	16%	114,428	32%	3,530,491	36%	8,563	38%	7,600	37%	572	38%	0.08076	38%	392,287	3.4
Total			2,223,181	17,170,048		3,945		30,218		1,219,747		28,065,595		60,503		57,858		4,179		0.57003			
Mean	2000.33		317,597	2,452,864	42%	564	37%	4,317	29%	174,250	40%	4,009,371	41%	8,643	42%	8,265	41%	597	42%	0.08143	42%	461,594	2.0
Median	2000		129,125	1,007,695	44%	251	35%	1,127	29%	56,140	39%	1,414,455	39%	3,546	43%	3,084	40%	235	42%	0.03345	44%	392,287	1.5
40	2003	Police/Fire Station	39,510	372,127	47%	91	34%	1,189	33%	24,572	39%	678,406	43%	1,313	46%	1,348	44%	94	45%	0.01235	47%	64,166	2.6
41	2001	Recreation Center	67,917	438,815	36%	248	41%	5,978	69%	76,018	52%	1,400,590	49%	1,562	36%	2,394	45%	137	41%	0.01457	36%	98,029	1.3
42	1997	Retail	148,180	2,524,465	49%	345	33%	(148)	-3%	104,351	41%	3,523,857	44%	8,882	49%	7,700	46%	588	47%	0.08381	49%	109,000	1.0
43	1994	Retail	115,290	881,734	43%	267	40%	1,938	29%	47,117	37%	1,491,991	39%	3,108	43%	3,039	40%	217	42%	0.02927	43%		
44	2004	Retail	117,057	999,419	43%	227	35%	1,030	19%	54,684	34%	1,537,956	39%	3,520	43%	3,240	40%	239	42%	0.03318	43%	115,902	2.1
45	2004	Retail	171,611	2,980,362	45%	538	42%	(69)	-1%	131,349	33%	4,174,097	39%	10,487	45%	9,109	41%	694	43%	0.09894	45%		
46	2005	Retail	183,500	2,999,628	44%	578	43%	(110)	-1%	132,799	33%	4,195,697	38%	10,554	44%	9,160	40%	699	43%	0.09958	44%		
Total			735,638	10,385,608		1,954		2,642		470,300		14,923,597		36,551		32,248		2,436		0.34478			
Mean	2004		147,128	2,077,122	45%	391	39%	528	9%	94,060	36%	2,984,719	40%	7,310	45%	6,450	42%	487	43%	0.06896	45%	112,451	1.6
Median	2004		148,180	2,524,465	44%	345	40%	(69)	-1%	104,351	34%	3,523,857	39%	8,882	44%	7,700	40%	588	43%	0.08381	44%	112,451	1.6
Complete Total			7,180,433	58,269,312		15,748		290,144		5,298,737		119,869,366		205,878		229,328		15,282		1.93			