FLORIDA SOLAR ENERGY CENTER®
Creating Energy Independence

Comparison of ASHRAE Standard 90.1-2004, ASHRAE Standard 90.1-2007 and the 2008 Florida Energy Code (2009 Supplement)

FSEC-CR-1822-09

Letter Report
September 25, 2009
Revised September 28, 2009

Submitted to

Department of Community Affairs
2555 Shumard Oak Blvd
Tallahassee, FL 32399-2100
DCA Contract No. 10-BC-28-12-00-22-004

Authors

Mangesh Basarkar
Lixing Gu
Muthusamy Swami

1679 Clearlake Road
Cocoa, Florida 32922, USA
(321) 638-1000
www.floridaenergycenter.org

A Research Institute of the University of Central Florida

Disclaimer

The Florida Solar Energy Center/University of Central Florida nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the Florida Solar Energy Center/University of Central Florida or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the Florida Solar Energy Center/University of Central Florida or any agency thereof.

COMPARISON OF ASHRAE STANDARD 90.1 2004, ASHRAE STANDARD 90.1 2007 AND THE 2008 FLORIDA ENERGY CODE (2009 SUPPLEMENT)

Mangesh Basarkar (mbasarkar@fsec.ucf.edu), Lixing Gu (gu@fsec.ucf.edu), Muthusamy Swami (swami@fsec.ucf.edu)

Florida Solar Energy Center, 1679 Clearlake Road, Cocoa, FL 32922.
September 25, 2009. Revised September 28, 2009

INTRODUCTION

Typical models for three building types including a strip mall, a small office and a medium sized office were simulated using the EnergyGauge® software. These models were built to three different baseline standards, the ASHRAE 90.1 2004, ASHRAE 90.1-2007 and the 2008 Florida Building code respectively. The following describes the setup and results for these simulation runs.

BUILDING MODELS

The strip mall and the medium office building models were obtained from the DOE commercial building benchmark (Torcellini et al., 2008) database developed jointly by NREL, PNNL and LBNL. The strip mall is a 22,500 sq. ft. building with 8 small and 2 large zones served by packaged single zone units. The strip mall has 26% (WWR – window to wall ratio) south facing glass. Further building model details are specified in Appendix A. The medium office is a 53,626 sq. ft. three storey building with 48% (WWR) of evenly distributed glass for the ASHRAE 90.1 2004 model and 40% (WWR) of evenly distributed glass for the ASHRAE 90.1 2007 model. Further details for the medium sized office building are specified in Appendix B. The small office is a 10,000 sq. ft. single storey building with 50% (WWR) glass for the ASHRAE 90.1 2004 run and 40% (WWR) for the ASHRAE 90.1 2007 run.

Appendix C compares the difference between the prescriptive minimum requirements for major building components per the ASHRAE 90.1 2004 and the ASHRAE 90.1 2007 standards.

Each of the building models is simulated in three climate locations, viz. Jacksonville, Orlando and Miami.

RESULTS

The results for the runs are summarized in the tables below.

Small Office

City	Annual Energy Use (MBtu)			Savings wrt ASHRAE 90.1-2004 (%)	
	ASHRAE 90.1 2004	ASHRAE 90.1 2007	2008 FL Code (2009 Suppl).	ASHRAE 2007	2008 Florida Code
Jacksonville	846	777	719	8%	15%
Orlando	852	800	724	6%	15%
Miami	920	884	782	4%	15%

Medium Office

City	Annual Energy Use (MBtu)			Savings wrt ASHRAE 90.1-2004 (%)	
	ASHRAE 90.1 2004	ASHRAE 90.1 2007	2008 FL Code (2009 Suppl).	ASHRAE 2007	2008 Florida Code
Jacksonville	3847	3579	3270	7%	15%
Orlando	3687	3485	3134	6%	15%
Miami	3670	3526	3119	4%	15%

Strip Mall

City	Annual Energy Use (MBtu)			Savings wrt ASHRAE 90.1-2004 (%)	
	ASHRAE 90.1 2004	ASHRAE 90.1 2007	2008 FL Code (2009 Suppl).	ASHRAE 2007	2008 Florida Code
Jacksonville	2634	2492	2239	6%	15%
Orlando	2745	2624	2333	5%	15%
Miami	2908	2798	2472	4%	15%

CONCLUSION

The simulation runs comparing ASHRAE 90.1-2004 to ASHRAE 90.1-2007 and 2008 Florida Building code show that 90.1-2007 is anywhere from 4% to 8% more efficient than 90.1-2004. The 2008 Florida code is 15% better than ASHRAE 90.1-2004, since it is a requirement of the Florida Building Code. In effect, the current 2008 Florida Building Energy Code for commercial buildings is better than the ASHRAE 90.1-2007 baseline by a margin of 7% to 11% subject to building type and size.

APPENDIX A

Building Summary Medium Office new construction version 1.1_3.1	Value	Data Source
Program		
Building Name	Benchmark Medium Office	
Available Fuel Types	gas, electricity	
Principal Building Activity	Office	
Form		
Total Floor Area (m^2)	4,982	2003 CBECS
Building Shape	Rectangle	
Aspect Ratio	1.5	
Number of Floors	3	
Window Fraction (Window to Wall Ratio)		
South	0.33	
East	0.33	
North	0.33	
West	0.33	
Total	0.33	
Skylight/TDD Percentage	0.0	
Shading Geometry	None	
Azimuth	0.0	
Thermal Zoning	core zone with four perimeter zones on each floor	
Floor to Ceiling Height (m)	2.7	
Floor to Floor Height (m)	4.0	
Roof type	Insulation entirely above deck	2003 CBECS
Fabric		
Exterior walls		
Construction Type	Steel frame	2003 CBECS
Gross Dimensions - Total Area (m^2)	1,978	
Net Dimensions - Total Area (m^2)	1,325	
Wall to Skin Ratio	0.54	
Roof		
Construction Type	Insulation entirely above deck	2003 CBECS
Gross Dimensions - Total Area (m^2)	1,661	
Net Dimensions - Total Area (m^2)	1,661	
Roof to Skin Ratio	0.46	
Window Dimensions (m^2)		
South	195.9	
East	130.6	
North	195.9	
West	130.6	
Total Area (m^2)	652.8	
Operable area (m^2)	0	
Skylights/TDD		
Dimensions - Total Area (m^2)	0	
Operable area (m^2)	0	

APPENDIX B

Building Summary Strip Mall new construction version 1.1_3.1	Value	Data Source
Program		
Building Name	Benchmark Strip Mall	
Available Fuel Types	gas, electricity	
Principal Building Activity	Strip Mall	
Form		
Total Floor Area (ft^2)	22,500	2003 CBECS
Building Shape	Rectangle	
Aspect Ratio	4.0	
Number of Floors	1	
Window Fraction (Window to Wall Ratio)	South: 0.26 East: 0.00 North: 0.00 West: 0.00 Total: 0.105	
Skylight/TDD Percentage	0.00%	
Shading Geometry	None	
Azimuth	0	
Thermal Zoning	10 stores	
Floor to Ceiling Height (ft)	5.182	
Roof type	Insulation entirely above deck	2003 CBECS
Fabric		
Exterior walls		
Construction Type	Steel-frame	2003 CBECS
Gross Dimensions - Total Area (ft^2)	12,746	
Net Dimensions - Total Area (ft^2)	10,907	
Wall to Skin Ratio	0.36	
Roof		
Construction Type	Insulation entirely above deck	2003 CBECS
Gross Dimensions - Total Area (ft^2)	22,500	
Net Dimensions - Total Area (ft^2)	22,500	
Roof to Skin Ratio	0.64	
Window		
Dimensions - Total Area (ft^2)	South: 1,338 East: 0.00 North: 0.00 West: 0.00 Total: 1,338	
Operable area (ft^2)	0	
Skylights/TDD		
Dimensions - Total Area (ft^2)	0	
Operable area (ft^2)	0	
Foundation		
Foundation Type	Mass Floor	
Construction	4 in slab-on-grade	
Dimensions - Total Area (ft^2)	22,500	

APPENDIX C

ASHRAE Climate Zone 2 Parameters

Component	Parameter	Value	
		90.1-2004 Baseline	90.1-2007 Baseline
Roof	Roof Insulation Small Office	R-30	R-38
	Roof Insulation - Medium Office & Strip Mall	R-15	R-20
	Surface Absorp/Emm.	0.7/0.9	0.7/0.9
Vertical Glazing	WWR	50%	40%
	U-Value	1.27	0.75
	SHGC	0.19	0.25
	Overhang	None	None
Skylights	Max Area (% of Roof)	5%	5%
Lighting	LPD (W/SF)	1.1	1.1
HVAC	EER	9.3	9.3
	Fan Power (W/cfm)	1.12	1.12

ASHRAE Climate Zone 1 Parameters

Component	Parameter	Value	
		90.1-2004 Baseline	90.1-2007 Baseline
Roof	Roof Insulation Small Office	R-30	R-30
	Roof Insulation - Medium Office & Strip Mall	R-15	R-15
	Surface Absorp/Emm.	0.7/0.9	0.7/0.9
Vertical Glazing	WWR	50%	40%
	U-Value	1.27	1.2
	SHGC	0.19	0.25
	Overhang	None	None
Skylights	Max Area (% of Roof)	5%	5%
Lighting	LPD (W/SF)	1.1	1.1
HVAC	EER	9.3	9.3
	Fan Power (W/cfm)	1.12	1.12