

**TECHNICAL NOTE SERIES  
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**Energy-Related Characteristics  
of  
New Home Construction in Florida  
(REVISED)**

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## BACKGROUND

In January 2001, the Shimberg Center for Affordable Housing entered into an agreement with the Florida Department of Community Affairs to serve as the receiving point for Florida Energy Efficiency Code for Building Construction (FEECBC) Compliance forms submitted by local building officials across the state. Through March 2002, a total of 95,106 forms had been received.

Upon receipt of the FEECBC Forms, the Shimberg Center draws a random sample of 1 out of 20 (5%) of the forms for entry into a database. If a jurisdiction submits less than 20 forms, one form is selected at random and entered in to the database. This procedure insures representation in the database of housing markets with low levels of construction activity. However, it also results in an over sampling of the low-activity areas and has resulted in a sample of 7.2 percent, rather the planned 5 percent. As of March 2002 a total of 6,924 forms had been drawn as the sample and are being entered into the database.

The following analyses are focused on the data captured on the compliance forms submitted for 1,612 single-family homes built between late 1999 and 2001. The summary tables present comparisons of the housing characteristics built in Florida's three Climatic Zones and, where possible, comparisons between homes built in 2000 and 2001. The sample size of homes built in 1999 was too small to provide meaningful results. The objective of this report is to provide the Department of Community Affairs and other interested organizations with a snapshot of the buildings constructed in Florida in the 2000-2001 time frame.

## CHARACTERISTICS OF THE SAMPLE

Of the 1,612 forms randomly chosen as the sample, 21.7 percent were from the South zone of Florida, 57.8 percent were from the Central zone, and 20.5 percent were in the North zone as shown in Table 1. All forms in the sample were for newly constructed single-family residential structures.

**Table 1: Characteristics of the sample**

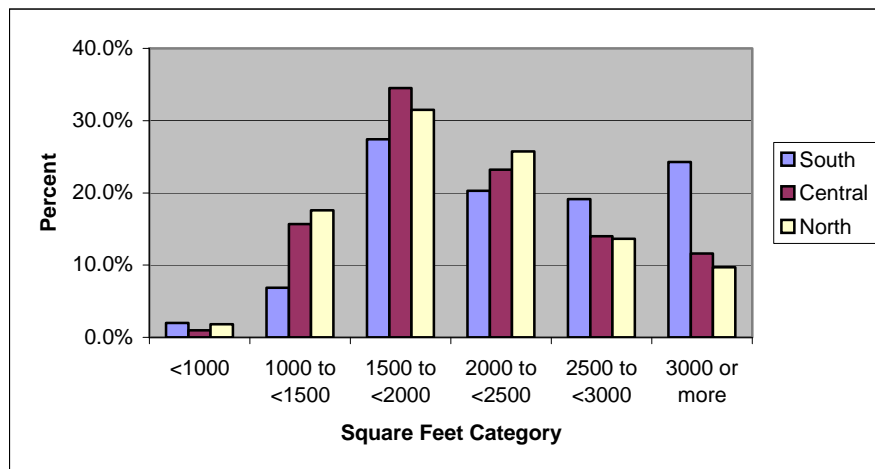
<b>Climatic zone</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>Total</b>
<b>South</b>	5	95	250	350
<b>Central</b>	34	241	657	932
<b>North</b>	4	43	283	330

Shown in Table 2 is a summary of the conditioned space in the single-family housing units included in the sample. As may be seen, the median values for each Climatic Zone in both 2000 and 2001 are less than the corresponding average values. This relationship indicates that in all cases there were some exceptionally large homes being built

producing a greater effect on the arithmetic average than on the median. The frequency distribution shown in Figure 1 illustrates this condition, particularly in the case of the South Climatic Zone.

**Table 2: Conditioned Floor Area in Square Feet**

Climatic zone	Total		2000		2001	
	Average	Median	Average	Median	Average	Median
South	2484	2299	2559	2235	2465	2324
Central	2116	1985	2207	2006	2087	1978
North	2120	1970	2578	2002	2058	1975



**Figure 1: Conditioned Floor Area by Climatic Zone**

## COOLING SYSTEMS

The characteristics of central air-conditioning systems installed in new single-family homes are shown in Table 3. The table presents average capacity and average energy efficiency rating (EER) for the first or primary central A/C system along with the number of housing units included in the sample. Also shown in Table 3 are the characteristics of the second (and third) A/C systems that were installed in some homes. As expected, the central A/C systems in the South had the highest average capacity and the highest EER in order to handle the higher cooling loads. The averages for the Central and North zones were similar to each other. Efficiencies were higher in the Central zone and capacities were higher in the North zone. It is interesting to note that overall 15 percent of the single-family homes reported having a second A/C system. In the South zone second A/C systems were reported in a quarter (24.9%) of the homes.

**Table 3: Central Air-conditioning System Characteristics**

Climatic zone	Average first system			Average second system			Average third system		
	Sample	EER	kBtu	Sample	EER	kBtu	Sample	EER	kBtu
South	349	11.0	45.2	87	11.1	33.8	7	11.7	38.3
Central	921	10.3	39.5	97	10.3	31.9	20	10.3	33.6
North	330	10.6	38.4	57	10.7	30.8	4	10.5	32.0

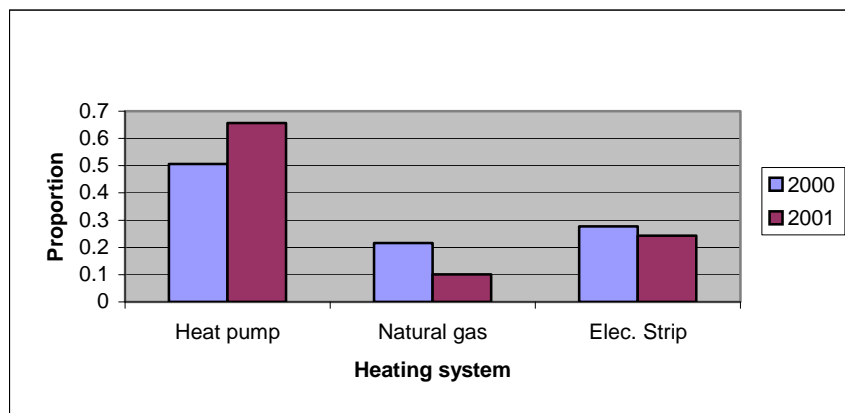
## HEATING SYSTEMS

In the South zone electric strip heat is the predominant heating system whereas in the Central and North zones the heat pump is the predominant heating system (see Table 4). As expected, natural gas heating systems are not present in the South.

**Table 4: Heating System Characteristics**

Climatic zone	Heat pump			Natural gas			Electric strip		
	Sample	HSP	kBtu	Sample	AFUE	kBtu	Sample	COP	kBtu
South	5	8.3	33.4	-	-	-	344	1.0	38.4
Central	703	7.1	39.4	170	0.8	53.7	43	1.0	27.5
North	272	7.2	37.6	48	0.8	44.6	8	1.0	38.4

Presented in Figure 2 is a histogram showing the change in heating system choice from year to year. It is clear that the heat pump system displayed a gain in market share at the expense of both natural gas and electric strip heating systems.



**Figure 2: Heating System Choice by Year**

## DUCTS AND AIR-HANDLERS

The location, length, and R-value of the ducts in the heating and cooling system as well as the location of the air-handling units play an important role in the overall efficiency of the heating, ventilating, and air-conditioning (HVAC) system in a home.

Shown in Table 5 is a summary of the location of the supply and return ducts in the three Climatic Zones. It is clear the supply ducts are most commonly installed in unconditioned space (e.g., attic areas). However, up to 30 percent of return ducts (see South Climatic Zone) are being installed in conditioned space.

**Table 5: HVAC Duct Location**

Climatic zone	Supply ducts				Return ducts			
	Unconditioned		Conditioned		Unconditioned		Conditioned	
South	324	93.4%	23	6.6%	240	69.6%	105	30.4%
Central	828	97.6%	20	2.4%	743	87.6%	105	12.4%
North	324	98.8%	4	1.2%	249	76.6%	76	23.4%

Presented in Table 6 is a summary of the average R-values for the duct system as well as the average total duct length.

**Table 6: Duct Length and Insulation**

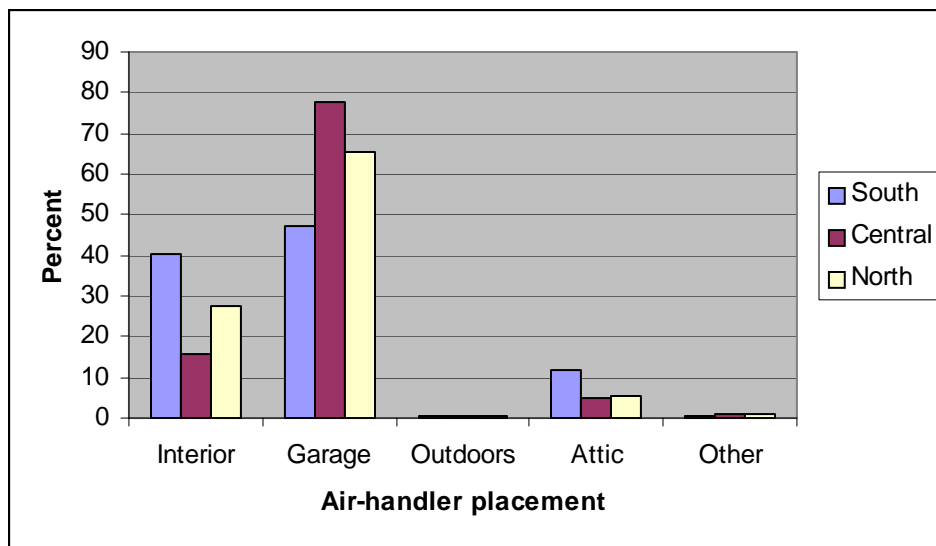
Climatic zone	Average duct length in feet	Average duct insulation R-value
South	122.1	5.9
Central	134.4	6.0
North	97.9	7.0

The air-handler component of the HVAC system can be installed in a variety of locations. Presented in Table 7 is a summary of the air-handler location choices in the three Climatic Zones.

**Table 7: Air-Handler Location**

Climatic zone	Interior		Garage		Outdoors		Attic		Other		Total #
	#	%	#	%	#	%	#	%	#	%	
South	138	40.1	162	47.1	2	0.6	41	11.9	1	0.3	344
Central	131	15.6	653	77.9	5	0.6	41	4.9	8	1.0	838
North	89	27.4	213	65.5	2	0.6	17	5.2	4	1.2	325
Totals	358	23.8	1028	68.2	9	0.6	99	6.6	13	0.9	1507

The histogram shown in Figure 3 is a graphic representation of the relative frequency by Climatic Zone of placement of the air-handler.



**Figure 3: Air-handler Placement Choice by Climatic Zone**

## WATER HEATING SYSTEMS

Electric water heaters dominated all Climatic zones as shown in Table 8. Between 1.0 percent and 2.0 percent of the homes in all three Climatic Zones reported the use of LP Gas for water heating. The average capacity of the water heating systems ranged from 45.9 to 52.1 gallons. Between 1 and 4 percent of the homes reported installation of a second water heating system. In the Central and North Climatic Zone these second water heating system were either electric or natural gas. In the South Climatic Zone the second systems were all electric.



**Table 8: Domestic Water Heating Systems**

Climatic zone	First DWH System					Second DWH System				
	Sample size	Avg. Gallons	Elec	Nat Gas	LP Gas	Sample size	Avg Gallons	Elec	Nat Gas	LP Gas
			%	%	%			%	%	%
South	347	52.1	96.8	2.0	1.2	13	51.2	100.0	-	-
Central	901	45.9	80.6	18.4	1.0	11	46.9	54.5	45.5	-
North	326	52.0	85.9	12.9	1.2	6	46.7	83.3	16.7	-

The changes in water heating capacity and water heating efficiency between 2000 and 2001 followed no particular pattern. In the South, average capacity declined while average efficiency remained relatively unchanged. Both average capacity and average efficiency remained relatively unchanged in the Central zone. And in the North, both average capacity and average efficiency increased. (See Table 9)

**Table 9: Domestic Water Heating System Capacity and Efficiency**

Climatic zone	Capacity in gallons		System Efficiency	
	2000	2001	2000	2001
South	57.8	50.1	0.87	0.88
Central	46.9	45.6	0.82	0.85
North	46.5	52.9	0.74	0.87

Heat recovery units were reported as installed in 51 (14.7%) of the 347 single-family homes built in the South Climatic Zone in 2000-2001. One percent of the 901 homes built in the Central Climatic Zone and 1.8 percent of the 326 homes built in the North also reported the inclusion of heat recovery units in the same time frame. (See Table 10)

**Table 10: Heat Recovery Units Installed with Domestic Water Heaters\***

Climatic zone	2000		2001	
	Dedicated heat pump	Heat recovery (Air conditioner)	Dedicated heat pump	Heat recovery (Air conditioner)
South	0	24	7	18
Central	3	0	5	1
North	0	0	1	5

\*Footnote: Waste heat recovery units (HRUs) include dedicated heat pump and air conditioners or tankless add-on heat pumps coupled to water heater.

## EXTERIOR WALLS

Exterior walls are categorized by the structural elements of the wall system, by the R-value of the insulation installed, and by the area of the wall of that configuration. Shown in the following three tables is a summary of the exterior wall characteristics by Climatic Zone of the housing units built in 2000 and 2001. The percentage of homes with a given wall type may not add up to 100% since one unit may report different wall configurations in the same home. It is clear from Table 11 that 63.7 percent of the homes in the South zone were built with concrete wall systems. Wood frame walls were included in 39.7 percent of the homes. Concrete and wood frame construction were also reported by 90 percent or more of the homes in the Central and North zones. In the North zone, brick veneer on a wood-frame structure was reported by 14.8 percent of the homes.

**Table 11: Exterior Wall Configuration – Percent of Units**

Climatic zone	Face brick		Concrete		Lt Wt Conc		Poly bead aggregate	Wood frame	Steel frame	Log	Other
	Wood frame	Conc block	Int insul	Ext insul	Int insul	Ext insul					
South (350 units)	0.5%	0.5%	62.0%	1.7%	3.4%	1.1%	-	39.7%	-	0.2%	-
Central (932 units)	-	-	42.8%	1.7%	1.6%	0.1%	0.5%	53.2%	0.2%	-	-
North (330 units)	14.8%	0.6%	9.1%	0.3%	0.6%	-	0.9%	79.4%	-	-	-

Presented in Table 12 is the average R-value installed in the exterior wall of the various wall configurations. A dash (-) indicates no data reported for the configuration.

**Table 12: Exterior Wall Configuration – Insulation R-value**

Climatic zone	Face brick		Concrete		Lt Wt Conc		Poly bead aggregate	Wood frame	Steel frame	Log	Other
	Wood frame	Conc block	Int insul	Ext insul	Int insul	Ext insul					
South (350 units)	11.0	3.0	4.3	3.9	3.8	4.2	-	12.5	-	-	-
Central (932 units)	-	-	4.5	5.1	5.6	4.0	11.3	11.4	24.0	-	-
North (330 units)	11.4	22.0	3.7	4.2	4.2	-	16.3	11.8	-	-	-

Presented in Table 13 is the average square feet per housing unit of each exterior wall configuration.

**Table 13: Exterior Wall Configuration – Wall Area in Square Feet**

Climatic zone	Face brick		Concrete		Lt Wt Conc		Poly bead aggregate	Wood frame	Steel frame	Log	Other
	Wood frame	Conc block	Int insul	Ext insul	Int insul	Ext insul					
South (350 units)	126.0	1952.0	744.1	1014.0	695.5	1283.3	-	530.3	-	-	-
Central (932 units)	-	-	1409.4	3131.2	1224.3	-	1117.2	664.2	2185.0	-	-
North (330 units)	1710.8	1352.0	1315.1	1014.0	1264.0	-	3342.0	1457.3	-	-	-

## CEILING INSULATION

Ceiling insulation is installed either on the floor of the attic area or in the space between the ceiling finish and the roof sheathing in the case of a vaulted or cathedral ceiling. The latter location is shown in Table 14 in the columns headed Single Assembly Ceiling/Roof. In a home with multiple ceiling configurations, two or more entries describing the ceiling insulation may be required. These multiple entries of individual homes produce the increased numbers shown under the column heading Sample Size.

**Table 14: Ceiling Insulation R-value and Area by Year**

Climatic zone	Ceiling Under Attic					Single Assembly Ceiling/Roof				
	Sample size	Insulation R-value		Avg. area (sq. ft.)		Sample size	Insul R-value		Avg. area (sq. ft.)	
		2000	2001	2000	2001		2000	2001	2000	2001
South	405	22.8	23.9	2063.3	1790.6	2	25.2	-	3280.0	-
Central	989	24.6	23.2	1845.5	1773.0	2	-	21.8	-	1102.0
North	326	25.2	25.9	1475.4	1162.7	-	-	-	-	-

## WINDOW GLAZING

The ratio of total glass area to conditioned floor area in the three Climatic Zones for homes built in 2000 and 2001 ranged between 0.14 and 0.17 as shown in Table 15. The total glass area include single- and double-pane clear glass as well as single- and double-pane glass that was tinted, had reflective film, or had solar screen. The values shown in Table 15 indicate a great deal of similarity among the three Climatic Zones with little or no change from 2000 to 2001.

**Table 15: Ratio of Glass Area to Floor Area**

Climatic zone	Sample size	Glass/Floor Ratio	
		2000	2001
South	350	0.17	0.17
Central	932	0.15	0.15
North	330	0.15	0.14

Based on the data summarized in Table 16, clear glass has been the predominant choice for new single-family homes in all three Climatic Zones. However, glazing with tinting, solar film, or solar screen has been installed in 44.2 percent of the homes in the South zone in 2000 and in 37.6 percent of the homes in 2001. Note that the percentages may not add up to 100 percent because one home can be reported as having both clear glazing and tinted glazing.

**Table 16: Clear Versus Tinted Glazing in Percent of Homes**

Climatic zone	Sample size	Clear glass		Tinted, Film, Solar screen	
		2000	2001	2000	2001
South	350	68.4	62.4	44.2	37.6
Central	932	87.4	81.6	11.6	4.4
North	330	76.7	95.0	7.0	0.7

## **SPECIAL ENERGY-RELATED FEATURES**

Compliance with the Florida Energy Efficiency Code for Building Construction includes a number of special actions that will enhance the building's thermal efficiency. Presented in the follow tables is a summary of the frequency of use of each of the energy conserving techniques.

**Table 17: Ceiling Fan Frequency**

Climatic zone	2000			2001		
	Sample size	Ceiling fan	Percent	Sample size	Ceiling fan	Percent
South	95	7	7.3	250	29	11.6
Central	241	19	7.8	657	70	10.7
North	43	10	23.2	283	47	16.6

**Table 18: Cross Venting Frequency**

Climatic zone	2000			2001		
	Sample size	Cross ventilation	Percent	Sample size	Cross Ventilation	Percent
South	95	-	-	250	-	-
Central	241	1	0.4	657	2	0.3
North	43	-	-	283	-	-

**Table 19: Whole House Fan Frequency**

Climatic zone	2000			2001		
	Sample size	Whole house fan	Percent	Sample size	Whole house fan	Percent
South	95	-	-	250	-	-
Central	241	1	0.4	657	-	-
North	43	-	-	283	-	-

**Table 19: Radiant Barrier Under Roof Frequency**

Climatic zone	2000			2001		
	Sample size	Radiant barrier	Percent	Sample size	Radiant barrier	Percent
South	95	-	-	250	-	-
Central	241	-	-	657	-	-
North	43	-	-	283	-	-

**Table 20: Programmable Thermostat Frequency**

Climatic zone	2000			2001		
	Sample size	Program thermostat	Percent	Sample size	Program thermostat	Percent
South	95	3	3.2	250	20	8.0
Central	241	1	0.4	657	11	1.7
North	43	-	-	283	3	1.1

**Table 21: Heat Pump Programmable Thermostat (Cooling) Frequency**

Climatic zone	2000			2001		
	Sample size	Prog Thermo for HP cooling	Percent	Sample size	Prog thermo for HP cooling	Percent
South	95	3	3.2	250	11	4.4
Central	241	8	3.3	657	19	2.9
North	43	1	2.3	283	8	2.8

**Table 22: Heat Pump Programmable Thermostat (Heating) Frequency**

Climatic zone	2000			2001		
	Sample size	Prog thermo for HP Heating	Percent	Sample size	Prog Thermo for HP heating	Percent
South	95	3	3.2	250	9	3.6
Central	241	8	3.3	657	19	2.9
North	43	1	2.3	283	8	2.8

**Table 23: Multizone Cooling Frequency**

Climatic zone	2000			2001		
	Sample size	Multizone cooling	Percent	Sample size	Multizone cooling	Percent
South	95	4	4.2	250	27	10.8
Central	241	11	4.6	657	14	2.1
North	43	3	6.9	283	13	4.6

**Table 24: Multizone Heating Frequency**

Climatic zone	2000			2001		
	Sample size	Multizone heating	Percent	Sample size	Multizone heating	Percent
South	95	2	2.1	250	27	10.8
Central	241	11	4.6	657	14	2.1
North	43	3	6.9	283	13	4.6

**Table 25 White Roof Surface Frequency**

Climatic zone	2000			2001		
	Sample size	White roof	Percent	Sample size	White roof	Percent
South	95	-	-	250	-	-
Central	241	-	-	657	-	-
North	43	-	-	283	-	-

**Table 26 Airtight Ducts Frequency**

Climatic zone	2000			2001		
	Sample size	Air tight ducts	Percent	Sample size	Air tight ducts	Percent
South	95	-	-	250	-	-
Central	241	-	-	657	-	-
North	43	-	-	283	-	-

**Table 27 Factory Sealed Air Handling Unit Frequency**

Climatic zone	2000			2001		
	Sample size	Sealed AHU	Percent	Sample size	Sealed AHU	Percent
South	95	-	-	250	-	-
Central	241	-	-	657	-	-
North	43	-	-	283	-	-