APPENDIX C: HOUSE C - DALTON BROTHERS BUILDERS, INC.

Home built in Santa Rosa Beach, Florida

Selling price (with lot) Approximately:	$750,000
Building Value:	$475,000

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C.1 Case Study Status

This appendix contains the results and documentation on the Dalton wood frame house from Part I of this study. This house was not considered to be typical of wood frame construction in Florida, and since the number of builders participating in this program was limited, another wood frame building was sought for Part II of the study. A wood frame version of the Mercedes building was obtained and forms the basis of the wood frame results in the main body of the report.

The results of the Part I study on the Dalton house are retained here for information purposes only.

C.2 Construction Features and Documentation

The home built by Dalton Brothers in Santa Rosa Beach, Florida, is a three story single-family 4,854 Total Square Foot home. It is constructed of wood framing with wood roof trusses and plywood roof deck covered with standing seam metal decking. The location of the house in Walton County is shown in Figure C-1. It is less than 1500 feet from the coast.

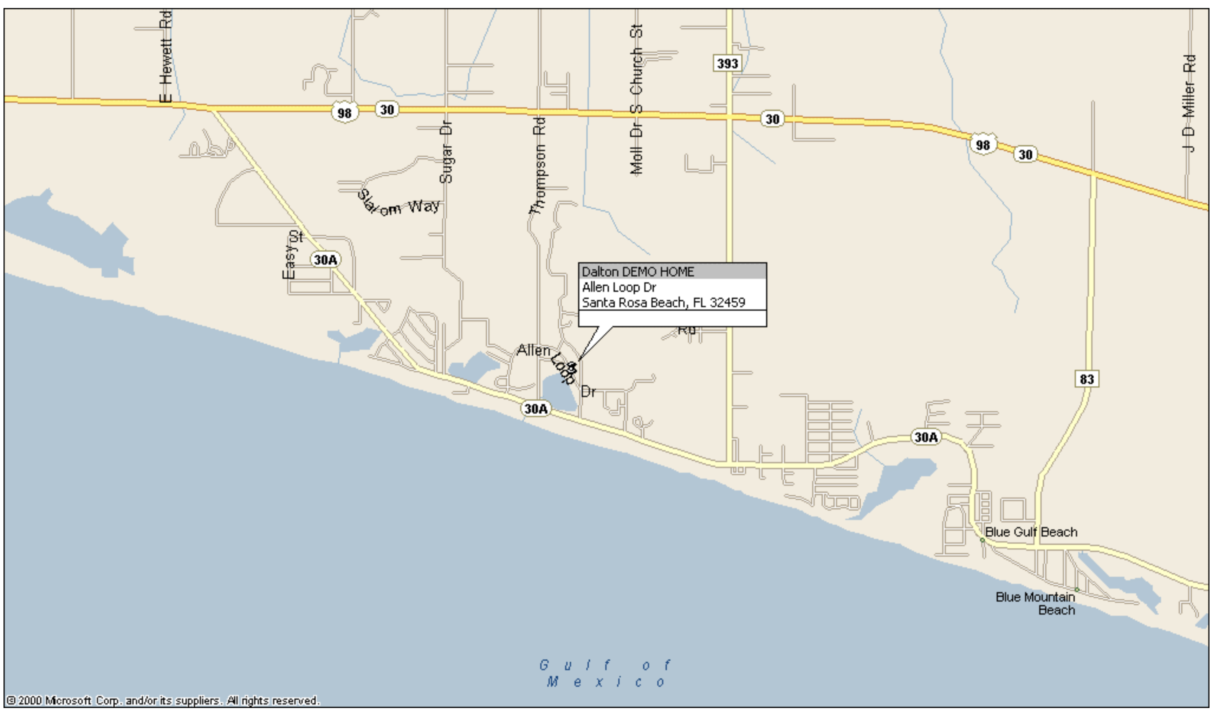


Figure C-1. Approximate Location of Dalton Homes construction site.

At floor-to-floor connections, the exterior sheathing spans from one floor to next in order to make a continuous load path for uplift forces. In addition, walls are wood framed and roof to wall connections are provided by tie-down straps with threaded rod connectors transferring the wind loads to the foundation as shown in Photos C.3, C.4, and C.5. This threaded rod system was not evaluated in terms of costs or risk reduction.

Roof framing is wood engineered trusses. Windows have laminated glass with design pressure ratings shown in Table C-1 for an enclosed building designed for 130 mph winds in exposure C.

C.3 Wind Load Design

The home was designed as an "enclosed structure" for 130 mph wind speed Exposure C, in the Wind Borne Debris Region with glazed opening protection provided by impact resistant (laminated glass) windows and doors.

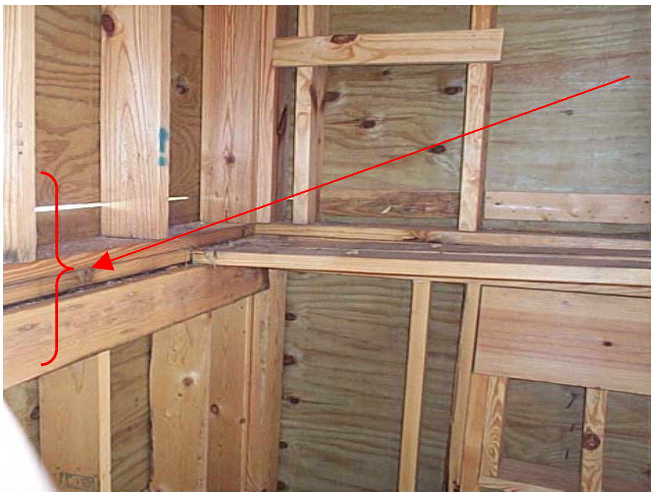


Photo C.1 shows: Exterior sheathing (plywood) spanning the wall framing at the floor/ceiling intersection. This creates a very strong joint and helps secure the upper floor framing to the lower floor framing. Additionally, the plywood is fastened to the bottom plate and covers all framing joints to provide superior uplift resistance.

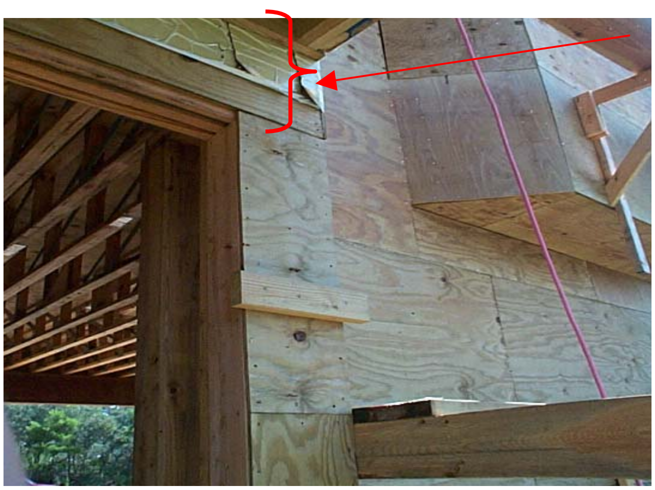


Photo C.2 shows: Exterior view of sheathing as described above.

Photo C.3 shows: Threaded rod anchor system used in house. Anchors are placed in the foundation and the rods extend through the structure to the top plate to provide the "load path" to transfer uplift loads from the roof to the ground. Rods are placed on 4-foot centers (nominal) and are connected to roof framing where loads are high.

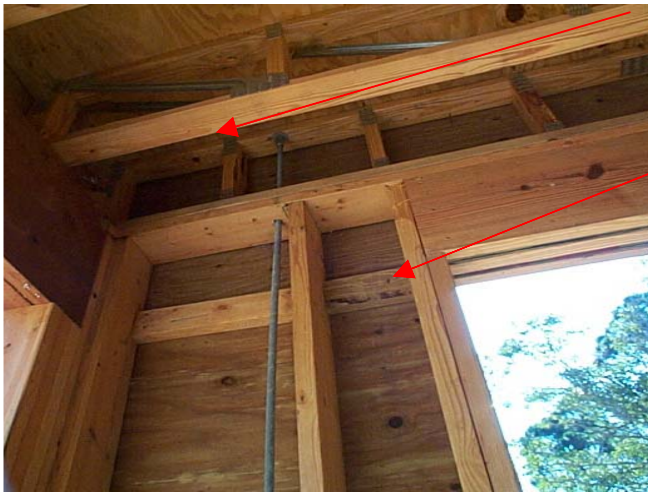


Photo C.4 shows: Additional picture of threaded rod connection passing through the top plate and floor above.

Photo C.4 also shows exterior sheathing joints “Blocked” for strength.

Photo C.5 shows: Threaded rod coming from the level below.

Exterior sheathing joints “Blocked” for strength.

Table C-1 lists the parameters used in the HURLOSS simulation for the 4 design cases. The design parameters for the SBC case and the FBC cases were derived from our analysis of the wind load provisions of SBC and ASCE 7-98. The *Specific Builder’s Practice* details were taken from design drawings supplied by the builder.

Note that this builder uses a threaded rod system to tie the top plate of the top floor. This connection was not considered in the loss analysis results.

C.4 Cost Differential Documentation

Costs differences between other design options were not available for the Dalton Home. The home was designed only with impact resistant units as required for an enclosed building in Exposure C. The costs of items with identified code related cost differentials are shown in Table C-2.

The increased cost of construction for doors that meet the wind pressure requirements and impact resistant glazing protection is $10,665. Because the house will sell for approximately $475,000 the increase is approximately 2.3% of the building price or $2.20 per square foot.

Table C-1. Dalton Key Parameters for HURLOSS Simulations of Each Design Scenario

Design Parameter	SBC	Specific Builder's Practice*	FBC Enclosed	FBC Part Enclosed
Window/Door/Slider Design Pressure (PSF) Zone 5	+41.3 / -47.6	+45 / -50	+42.5 / -56.9	+55.9 / -70.3
Roof Deck Thickness	½" plywood	½" plywood	½" plywood	½" plywood
Nail Size	6d common	8d common	8d common	8d common
Nail Spacing in Field of Roof	6"/12"	4"/12"	6"/6"	6"/6"
Roof Straps (lbf)	658	1000	1091	1557
Roof Covering	Standing Seam Metal Panels	Standing Seam Metal Panels	Standing Seam Metal Panels	Standing Seam Metal Panels

Table C-2. Summary of Cost Differences for Design Scenarios on Dalton Demo House

ITEM (Only items with code related cost differentials are shown)	SBC97	Specific Builder's Practice	FBC Enclosed			
			Impact Resistant Glazed Units		Shutters with Standard Windows	
	Estimated Cost ($)	Actual Cost ($)	Actual Cost ($)	Additional Cost vs. SBC ($)	Actual Cost ($)	Additional Cost vs. SBC ($)
Windows & Glass Doors	11,700	-	22,365	10,665	11,700	0
Accordion Shutters					10,170	10,170
Total Cost	11,700	-	22,365		21,870	
Extra Costs above SBC97		-		10,665		10,170
% of Building Value				2.3%		2.1%

* This builder currently uses building techniques that exceed *SBC* for which incremental costs were not available.

If glazed opening protection (accordion shutters) was used in lieu of impact resistant windows and sliding glass doors, the cost was estimated to be $10,170. Therefore the increased cost of construction would be approximately 2.1% of the building price or $2.10 per square foot.

Comment: Several quotations for window and door options were reviewed for this house. The standard window used in this home is an aluminum single glazed unit. Prices shown in Table C-2 are for this type of window. The builder chose to upgrade to wooden frame (Anderson Corporation) windows and doors. The cost for these non-impact units was quoted at $28,764 with an up-charge for impact resistant units of $5,410, or 18.8% increase. It is interesting to note that the higher quality window price increase is less than 20% whereas the aluminum window prices double when they are impact rated.

C.5 Loss Reduction and Cost Benefit Analysis

C.5.1 Hurricane Risks

This house is located in the 130 mph wind speed zone on the FBC Figure 1606, design wind speed map. The HURLOSS hurricane simulation shows that the probability of the site being affected by a hurricane in the next 10 years is 56%. The likelihood that this building will be affected by a hurricane is very high.

Table C-3 shows the risk broken down by various categories of hurricanes that may affect this building. Note that this risk estimate is tailored to this location in Florida. Figure C-2 shows that the 124 mph wind speed has a return period of approximately 100 years.

Table C-3. Probability in Next 10 Years of the Nearest Coast Experiencing Various Intensities of Hurricanes

Category	Sustained Speed	Probability
I	74-95 mph	34%
II	95-110 mph	15%
III	110-130 mph	5.0%
IV	130-155 mph	1.2%
V	155+ mph	0.1%
ALL Hurricanes		56%

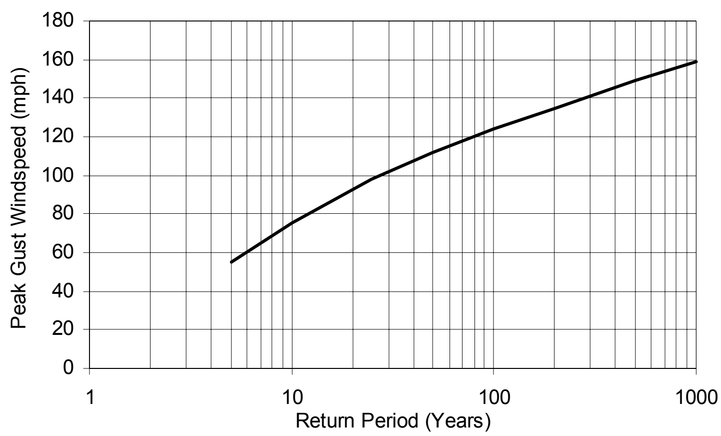


Figure C-2. Peak Gust Wind Speeds for Various Return Periods for this Site

C.5.2 Analysis of Loss Reduction

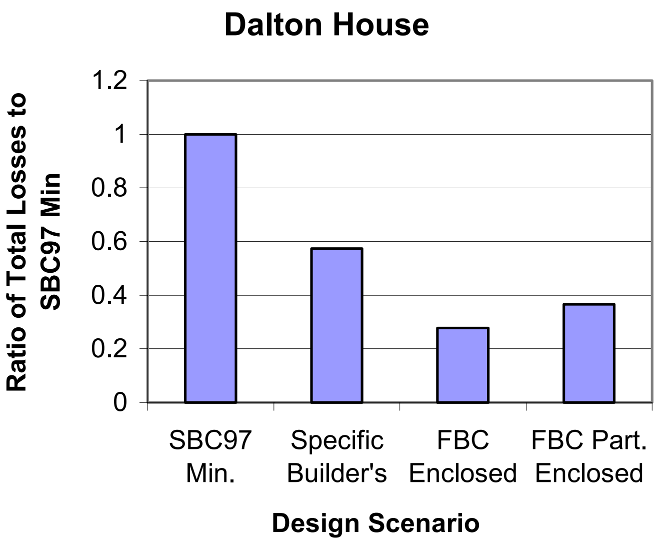
The results of the loss analysis from HURLOSS are given in Table C-4 for the 4 design cases. The table presents loss cost values, and the ratios of the loss cost to the SBC design case. The ratios are also shown in the chart in Figure C-3. Loss Costs are the expected losses per $1,000 of value of the building. The computed losses include the building (without land cost), the contents, and any additional living expenses. These results demonstrate that many of the changes in wind load design in FBC produce large reductions in losses. Also note that this builder already exceeds the SBC standards and is already achieving a loss reduction of approximately 43%.

An analysis of the damage estimates from HURLOSS (not shown here) showed the following items:

Table C-4. Summary of Loss Analysis

Loss Costs*	SBC	Specific Builder's Practice	FBC Enclosed	FBC Partially-Enclosed
Total	$10.54	$6.05	$2.93	$3.85
Ratio to SBC	1.0	0.57	0.28	0.37
Loss Costs (after 2% deductible)	$9.34	$4.85	$2.23	$3.12
Ratio to SBC	1.0	0.52	0.24	0.33

* Loss cost is average dollars lost per $1000 of building coverage



Dalton: Chart shows FBC vs SBC97

- 72% reduction in projected losses for enclosed structure
- 63% reduction in projected losses for partially-enclosed structure
- 43% reduction in projected losses for the way Dalton builds today

Figure C-3. Ratio of Loss Costs for Various Design Cases

- The savings for the FBC enclosed case are largely attributed to the use of shutters or impact windows, the use of a larger nail size (8d nail instead of 6d nail), and stronger shingles on the roof.
- The savings for the FBC partially-enclosed case can be attributed to the increased nail size, closer nailing spacing, increased size of roof strap, and stronger shingles on the roof.
- The savings that result from the Specific Builder's practice design case are caused by an increase in roof truss strap size, and a tighter nailing pattern on the roof deck with larger nail size (8d).

C.5.3 All Stakeholders (Total) Cost-Benefit Analysis

The total "All Stakeholders" cost-benefit perspective includes all costs and benefits, regardless of the stakeholder (owner, government, insurer) that receives the benefits. For this purpose, consider the extra cost of construction required as a result of these design changes and compare them to the value of the reduced losses that are created as a result of the changes. Note that we have not attempted to quantify benefits such as improved safety and protection of irreplaceable homeowner possessions, or government differential costs of evacuation, shelters, clean-up, etc. that results from damaged houses.

For this house, Table C-5 shows the Present Value analysis of the four design scenarios for a 30-year building life. Thirty years is selected since most buildings have a useful life of at least 30 years. Present Value analysis is a method of converting a series of cash flows into a number in today's dollars such that a comparison of the costs and benefits can be made for each design scenario. Three components were considered in the Present Value analysis; the cost of construction, the salvage value of the differential costs of the code improvements, and the savings resulting from reduced losses (Average Annual Losses) estimated by HURLOSS. More details of the Present Value Analysis technique appear in Section 2.2.4.

Table C-5. Dalton House - Net Present Value Analysis with Respect to SBC Design for a 30 Year Time Period

Cost-Benefit Parameter	SBC	Specific Builder's Practice	FBC Enclosed		FBC Partially-Enclosed
			Impact Resistant	Shutters	
Increase in Cost of Construction ($)	0	-	10,665	10,170	-
Future Salvage Value of FBC Cost Differentials ($)	0	-	19,318	18,422	-
AAL ($)	5,005	-	1,392	1,392	-
Savings in AAL (annually) ($)	0	-	3,613	3,613	-
Net Present Value (analyzed over 30 years)					
Increase in Cost of Construction ($)	0	-	-10,665	10,170	-
Present Salvage Value of FBC Cost Differentials ($)*	0	-	4,470	4,262	-
Present Value of AAL Reductions ($)*	0	-	69,968	69,968	-
Total($)	***0***	***-***	***63,773***	***64,061***	***-***

* Assumes that construction costs increase at 2% per year with a discount factor of 5% per year.

C.5.4 Cost Benefit Analysis from Homeowner's Perspective

From the homeowner's perspective, the four factors in Section 2.2.4 are considered to be: the increased cost of construction, and the savings resulting for possible reductions in insurance premiums, deductible savings, and the increase in the value of the house due to FBC improvements.

Table C-6 compares the effect that the extra construction costs of each design case would have on a typical mortgage payment for this house with the savings resulting from reductions of insurance premiums. Negative numbers in the Net Change in Monthly Costs row indicate that the homeowner is saving money as a result of the design case.

Notice that the two FBC cases show a net gain on behalf of the homeowner for this house. The increased costs of construction are more than offset by the insurance savings.

Table C-6. Dalton House - Financial Analysis from the Homeowner's Perspective for 30 Year Holding Period

	SBC	Specific Builder's Practice	FBC Enclosed		FBC Partially-Enclosed
			Impact Resistant	Shutters	
Basic Data					
Increase in Cost of Construction ($)	0	-	10,665	10,170	-
Estimated Reduction in Insurance Premium (annual) ($)*	0	-	-3,042	-3,042	-
Reduction in Owner portion of AAL (annual) ($)	0	-	233	233	-
Salvage Value after 30 yrs** ($)	0	-	19,318	18,422	-
Monthly Changes					
Change in Loan Payment (monthly) ($)**	0	-	+78.26	+74.62	-
Change in Insurance Premium (monthly) ($)	0	-	-316.23	-316.23	-
Net Out-of-Pocket Monthly Cost Differential ($)	***0***	***-***	***-237.97***	***-241.61***	***-***
Other Monthly Benefits					
Change in owners' AAL portion	0	-	-24.24	-24.24	-
Monthly Equivalent of Salvage Value after 30 yrs***	0	-	-23.21	-22.13	-
Total Monthly Cost Differential ($)	***0***	***-***	***-285.42***	***-287.98***	***-***

* Computed at 90% of AAL reduction net of deductible.

** Principal and interest cost mortgage payments are based on a 8% interest rate on an ordinary 30 year loan.

*** Assuming that the code cost differential increase on average by 2% per year. All future benefits are discounted using an interest rate of 5% and converted to a monthly benefit.