Chapter 4

Energy-Efficient Home Design

Recommendations	First Cost	% Estimated Savings		Other Benefits
		Cooling	Heating	
1. Have long axis east-west (long sides face north and south).	N	0-15	10-50	—
2. Eliminate unnecessary windows.	R	10-20	10	
3. Have few or no east or west windows.	R/N	5-15	—	Increased comfort
4. Provide porches or other structural shading.	S/M/H	5-25	—	Outdoor living areas
5. Have at least half of glass on south side (Central, North Florida); consider clerestory or dormer windows.	N	—	30-70	Improved light levels
6. Have overhangs on all sides (consider hip roofs instead of gable roofs).	S	5-10	—	Rain protection
7. Use simple building shapes.	R/N	0-5	0-20	Quicker construction
8. Cross-ventilate major rooms (kitchen, dining, family, master bedroom).	N/S	10-20	—	Improved air quality
9. Place morning rooms on west side, afternoon rooms on the east, living areas on north or south (time-of-day layout).	N	0-5	0-10	Greatly enhanced comfort
10. Locate air handler and ducts in conditioned space, laundry area and water heater in non-conditioned space.	N	0-10	0-15	—
11. Avoid fireplaces.	R	0-10	5-15	—
Maximum Combined Total	H	50	70	Increased comfort

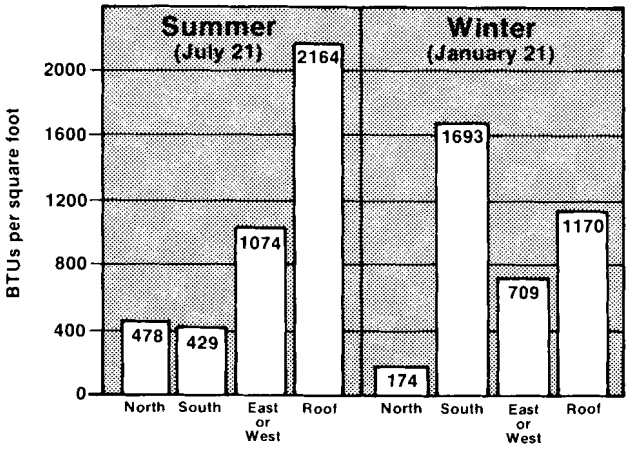
Cost Codes: R = reduced
N = negligible
S = small (<$0.25/ft² of floor area)
M = medium (>$0.25 and <$1.00/ft² of floor area)
H = high (>$1.00/ft² of floor area)

Marketing Energy-Efficient Home Design

Most home buyers are more concerned with the basic rooms a house contains than with its energy features. Nevertheless, you have an advantage over the competition by selling the potential buyer on the energy advantages of *your* home plans. Many energy features can be included at a negligible cost to you. Emphasize the comfort, convenience and savings they provide.

Orientation is a key energy and comfort feature. Chapter 3 on site planning illustrates the discomfort of eating an early-evening meal in a dining room with west-facing glass or a west-facing porch, because of the sun's strong rays at that time of day. Examples like that will help you market the time-of-day layout concept discussed in this chapter. The avoidance of west windows can be marketed first from a comfort viewpoint, then from an energy viewpoint.

Daily Solar Heat Gain for 1/8" Single Glass



Glass facing north or south is preferable to glass facing east, west or roofward (horizontal).

It is clear that north and south windows cause significantly fewer problems in summer than do east or west windows. Further, south windows are a benefit in winter. In North or Central Florida, you should promote the wintertime heating that the south-facing glass will provide — almost 2-1/2 times as much as the heating benefit of east or west windows. For this reason, south-facing glass should be clear, and shading should be provided by deciduous trees, overhangs (the calculation procedure in this chapter may be used to impress customers), and interior operable window treatments (shades or blinds). South-facing clerestory windows are an excellent means of providing light and winter heat to interior spaces — and in summer they receive only 20% of the heat of a horizontal skylight! Additionally, the dramatic effect of a clerestory, from inside and out, may actually sell the house.

The passive solar heating afforded by proper window orientation can be best utilized if it can be (1) distributed (via lots of openings between rooms) and (2) stored for use at night. The heat storage ability (capacity) or "thermal mass" of the house depends on the components it is made with. The following components have good heat storage ability and are referred to as being "massive":

- a quarry tile concrete slab floor
- a concrete block or brick interior partition wall
- a concrete block exterior wall insulated on the outside.

Ceramic or quarry tile flooring is the most marketable feature, particularly in a high-end home. See Chapters 5 and 6 for more details on marketing the thermal mass.

Natural ventilation is a key energy-saving strategy for Florida homes. Unfortunately, many stock house plans do not provide for cross-ventilation and will require modifications. If you have selected or modified plans that permit cross-ventilation, market them from the perspective of energy savings, "natural living" and fresh air. Combined with the effects of thermal mass and ceiling fans, the air-conditioning savings from natural ventilation can be 10-40%.

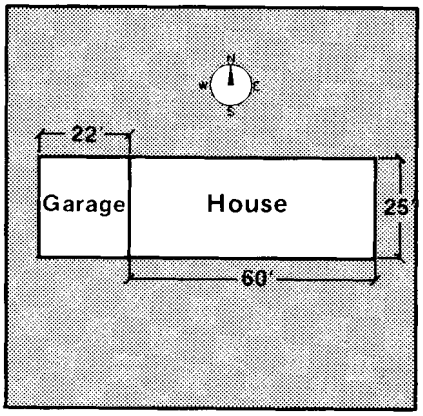
Porches are desirable to many home buyers, so why not incorporate one in your home plans from the start? This way, the porch roof can be continuous and there can be a radiant barrier and a vented attic above the porch (techniques described in Chapter 8). Point out that a porch on the east or south side provides a shaded, breezy haven during the heat of late summer afternoons and evenings. Consider more than one porch for larger homes. On starter or retirement homes, explore the market (and cost) trade-off of a porch vs. the extra bedroom — or make the porch an option. Since a porch is far better than a fireplace in terms of energy savings, encourage the choice of the porch by asking home buyers which they will use more.

Selecting and Modifying Home Plans for Energy Efficiency

The rest of this chapter describes energy-efficient features to look for in a home plan, and provides examples that will help you visualize "putting it all together."

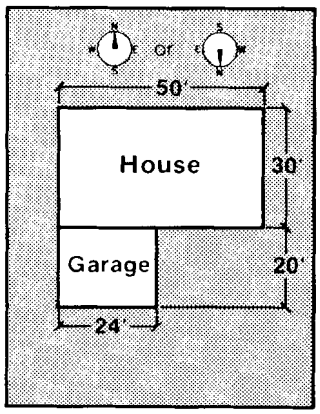
1. Have long axis east-west

The best time to start thinking of this is in the subdivision and site planning stage. However, most sites will accommodate a house oriented in this fashion — that is, with its long sides facing north and south. Suppose a 1500-square-foot house and a 500-square-foot garage were going on a site. If the site faces north or south and is a 100-foot by 100-foot lot, a conventional solution is:



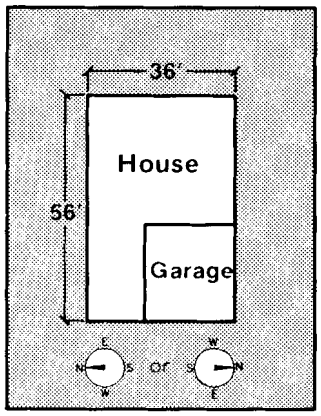
Ideal orientation of a Florida house.

Or on a 75-foot by 100-foot lot which can not have more than a 54-foot-wide footprint:



Orientation for standard size lots.

A house plan which has *a narrow front is best for a site which faces east or west.* Many zero lot line and other narrow front plans are now available.



Narrow house shape is best for east- or west-facing lots.

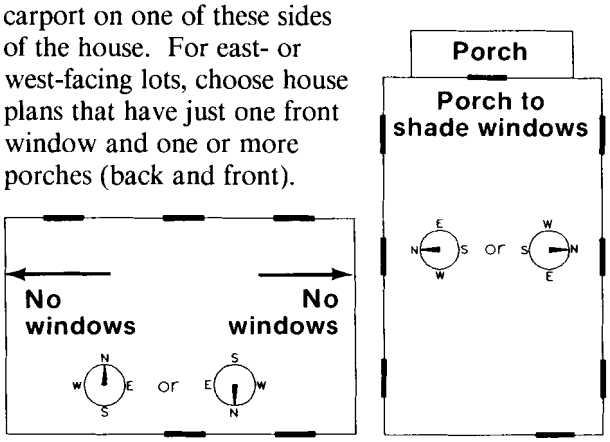
Side-entry garages can help relieve the impression of the garage dominating the street side elevation. Other specific solutions to west fronts and east fronts are covered in examples at the end of this chapter.

2. Eliminate unnecessary windows

Windows generally represent a source of significant heat gain in summer and significant heat loss in winter. Proper orientation of the windows and selection of appropriate glass (see Chapter 7) can partially alleviate the problem. However, excessive glass may not be adding much value to the home. As a general rule, 15% of the floor area given to well-spaced windows will provide a well-lit interior. But if you give that much or more percentage to windows, make sure the glass is well shaded and/or consider more elaborate window products (see Chapter 7). Homes can be attractive with 10% or less of floor area as window glass, and some builders are finding that the initial cost-savings of fewer windows can provide an edge on the competition. Choose plans that have a *few* well-placed windows in terms of view, appearance and energy considerations instead of many randomly placed windows.

3. Have few or no east or west windows

For a north- or south-facing lot, there are a number of plans which omit side windows that face east or west. An obvious alternative is to place a garage or carport on one of these sides of the house. For east- or west-facing lots, choose house plans that have just one front window and one or more porches (back and front).

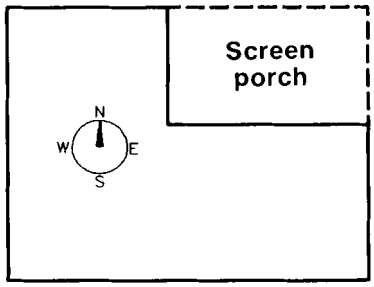


Avoid unshaded east- or west-facing windows.

4. Provide porches or other structural shading

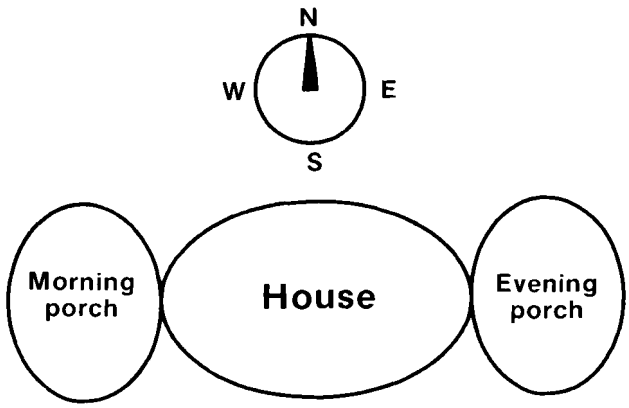
Since east and west windows have significantly more solar heat gain in summer than north or south windows, permanent window shading using porches or building shape is desired. Shading from the west sun is even more important than from the east sun, due to the time of day. Keep buffer spaces (closets, the garage, etc.) on the east and west sides.

A porch provides a place for the home's occupants to eat and even cook outdoors, assuming it is shady, breezy and insect-free. Since heat from food and bodies remains outside, a porch can be an important energy saver worth looking for in home designs. To encourage the use of the porch for outdoor dining, choose a home plan that incorporates the following design criteria.



This north-facing porch will be shaded from summer evening sun.

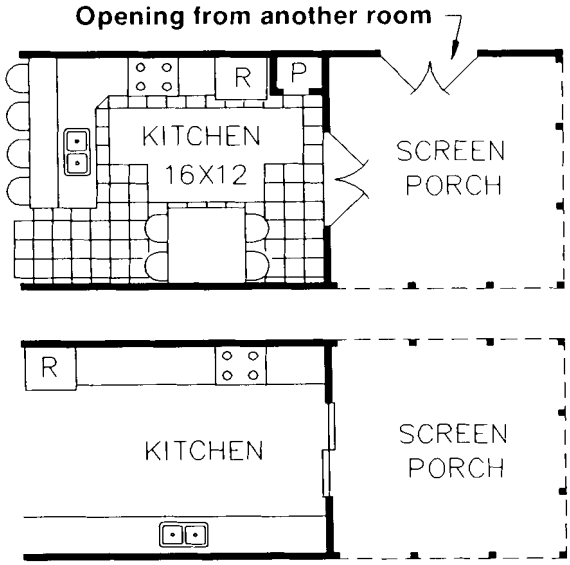
- Orient the porch so it is shaded in the evening in summer. The east and south sides are first choices. A north-facing porch will receive direct sun from the northwest, so an "L" to the west is required for shading (see drawing). A west-facing porch can provide nice shade for the house but



Place a porch on east and west sides.

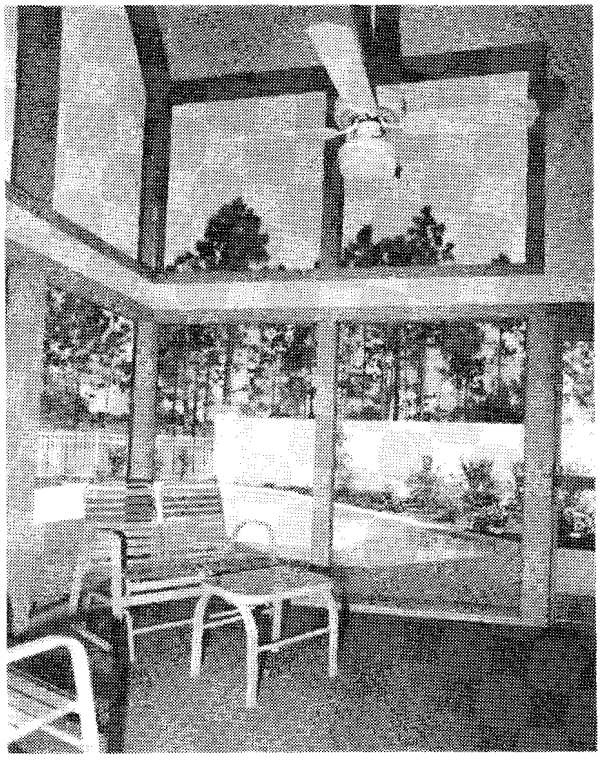
will probably not be used in the evening. Having two porches — one on the east side and one on the west side — assures a shady porch is available all day long.

- Have direct access from the kitchen to the porch. Having to carry dishes through a dining room or family room discourages the frequent use of a porch for dining. Atrium (French) or sliding glass doors directly to the porch will provide added convenience.



Convenient access from kitchen to porch is desirable.

- Make sure the porch will be cross-ventilated. Three open sides is best. In some cases, open house windows will permit cross-ventilation of a porch. A ceiling fan can help people feel cool.



Install ceiling fans on porches.

- Keep the roof of the porch cool. Use a ventilated attic space and a radiant barrier over the porch as described in Chapter 8.

Other structural shading techniques can be provided. Overhangs (described later in this chapter) are important. In two-story homes, use designs which provide overhangs or other shading for first-floor windows. North-facing windows are best shaded by adjacent projections, such as a garage that sticks out. Recessing the windows on the north side is another good shading method.

5. Have at least half of glass on south side

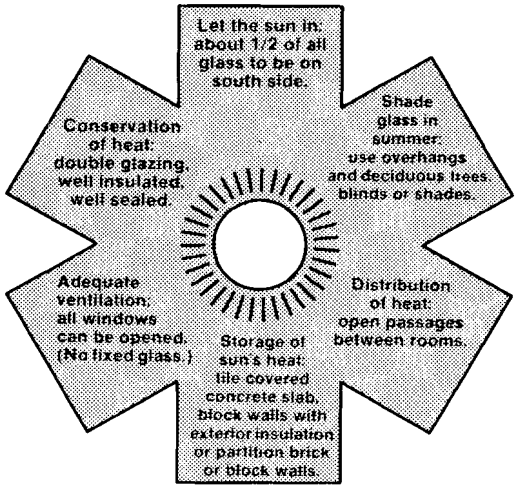
As illustrated by the chart in the marketing section, south-facing glass receives significant winter sun and much less summer sun. In North and Central Florida, use south-facing windows to provide heat in winter. Place the main living area on the south side. Provide heat storage in the house to prevent overheating. In frame houses on slabs, this can be done in two conventional ways. One is to use a good conducting material on the slab floor (tile or slate, for example) and the other is to use concrete block or brick partition walls. For every square foot of south glass, there should be 30 Btu (British Thermal Unit, a unit of energy) per °F of storage. A 4-inch slab floor has 8 Btu/°F per square foot. An 8-inch block wall has 30 Btu/°F per square foot of wall area. So, glass area (GA) = partition wall block area + (4/15 x tiled concrete slab floor area). Another way of putting that is: use 3.75 square feet of exposed slab for each square foot of south-facing glass.

For example, suppose you wanted to use a house design with 300 square feet of glass and you modified it so 200 square feet of glass was on the south side. You would then want one of the following:

- 200 square feet of 8-inch block partition wall (25 feet of 8-foot-high wall)
- 750 square feet of tiled floor (See Chapter 5 for other options)
- a combination such as 100 square feet of block wall and 375 square feet of tiled area.

Another alternative is to use containers of water as wall dividers. There are cylindrical containers designed for this purpose, and the water can be dyed for an aesthetic effect. Water provides 62 Btu per cubic foot (8 Btu/gallon = 1 Btu/pound).

Elements of successful passive solar heating for Florida



Combine all elements to use the sun's heat in winter.

With concrete block construction, use block walls with R-11 exterior insulation (see Chapter 6).

Heating Savings for a Well-Sealed Home with R11 Walls, Double Glass Windows and High Mass

	North Florida (R30 ceiling insulation)		Central Florida (R19 ceiling insulation)	
Percent Heating Savings	Required south glass as percentage of conditioned floor space	Required exposed slab floor area as percentage of conditioned floor space	Required south glass as percentage of conditioned floor space	Required exposed slab floor area as percentage of conditioned floor space
30	5.3	20	3.3	12
40	8.1	31	5.1	19
50	11.5	43	7.2	27
60	Not recommended	Not recommended	9.8	37
70	Not recommended	Not recommended	13.3	50

Also, use openable windows, not fixed glass, as a backup to prevent overheating. Position the house on the site so the south windows will not be shaded by adjacent buildings or evergreen trees.

How much energy can you save by doing this? That depends, of course, on the house itself and the number of people occupying it. For a family of four, the preceding table shows the percentage of heating saved for different fractions of glass area.

Starting in the design stage, the only extra cost of the passive solar heating is a floor finish that will permit the concrete slab to be exposed for use as a thermal mass. The energy conservation measures are the equivalent of the baseline house in the energy code (including at least Level 2 air-tightening and double-pane windows). And it is no more costly to situate glass on the south side. Trying to provide more than 50% heating savings may not be cost-effective due to the required window area.

There are also some initial cost savings in providing a passive solar heating design. You may be able to substitute electric strip heat for a heat pump. Heat will be required primarily during very cold nights (when a heat pump would rely mainly on electric resistance heat anyway) or cold overcast periods (infrequent in Florida).

In Florida, solar heating is secondary to cooling. Do not add window area for the sake of heating. Instead, shift window area from east and west sides to the south side.

Do not use attached "sunrooms" or greenhouses that have overhead glass. This glass receives too much sun in summer, is difficult to shade, and is not openable.

Clerestory or Dormer Windows. Look into designs which have north-facing or south-facing clerestory or dormer windows. These windows can provide daylight to interior spaces at a fraction of the heat gain of skylights (and with less chance of leaking rain). They can provide a dramatic effect inside and out which may help you sell the home. Clerestory windows should be operable (awning-type or hopper-type) to provide a secure ventilation outlet. If operable, they can be used to ventilate a room that otherwise would not have cross-ventilation. South-facing clerestory windows can be used to provide solar heating to rooms on the north side (see end-of-chapter examples). Moreover, because the direction of the slope of a shed roof is unlike that of a normal overhang, all south-facing clerestory windows can be used for winter heat gain and still be totally shaded in summer from the direct sun (as shown on next page).

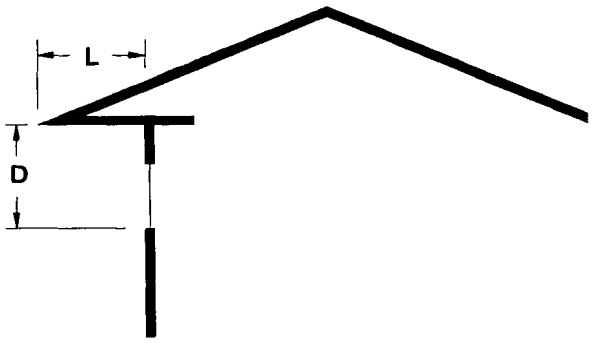
Clerestory windows can provide shaded daylight.

6. Have roof overhangs

Search for house plans that provide overhangs on all sides of the house (hip roof). Make certain that the roof is oriented along an east-west axis if the plan calls for a gable roof. The resultant overhang on the south side will shade all direct sun during the summer. The ideal length of an overhang on the south side of a house is dependent on three factors:

- the latitude of the location
- the time of year shade is desired
- the distance between the soffit and the bottom of the glass.

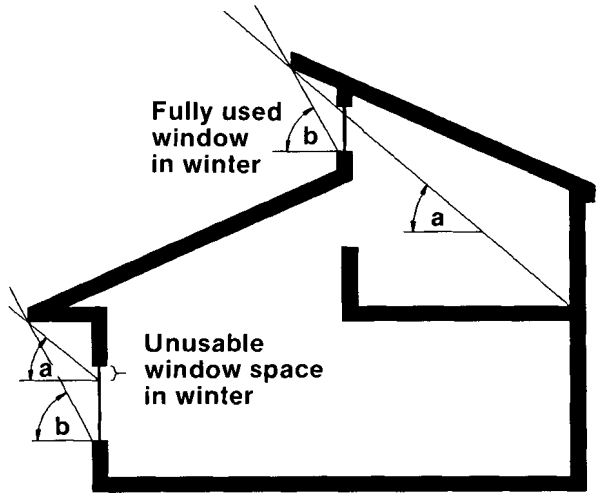
It is quite simple to calculate the ideal length of a horizontal south overhang using the table below.



The length (L) of a south-facing overhang can be determined by knowing the sill-to-soffit distance (D).

For south-facing clerestory windows, the roof which will shade the window is often rising and the multiplication factors are less appropriate. Therefore, sun angles a and b are also shown for each city. The point where a and b cross is the ideal location for the end of the roof as shown. Draw the roof line, window, and angles a and b to scale to determine this point.

Although all overhang factors are for south-facing surfaces only, overhangs can be effective in shading all sides from diffuse sunlight. However, unlike the south side, "direct beam" solar heat will fall on an east, west or north side under an overhang due to the low angle of the sun. Use overhangs as wide as practical on north, east and west sides.



Angle a is Dec. 21 sun, angle b is end of winter (see table below for dates).

Overhang Design for South-facing Windows

Latitude	Location	Sun Angles		Factor (F)	Time of Year Totally Shaded from Direct Sun	Length of Overhang (L= DxF) for Sill-to-Soffit Distance (D) of:				
		a	b			4'	5'	6'	7'	8'
25°	The Keys	41.5	52.5	.77	Feb 17 - Oct 24	3.1'	3.9'	4.6'	5.4'	6.2'
26°	Miami	40.5	54.0	.73	Feb 24 - Oct 16	2.9'	3.7'	4.4'	5.1'	5.8'
27°	Jupiter	39.5	53.5	.69	Mar 5 - Oct 7	2.8'	3.5'	4.1'	4.8'	5.5'
28°	Tampa	38.5	57.0	.65	Mar 7 - Oct 5	2.6'	3.3'	3.9'	4.6'	5.2'
29°	New Smyrna Beach	37.5	58.5	.61	Mar 16 - Sep 27	2.4'	3.1'	3.7'	4.3'	4.9'
30°	Panama City	36.5	60.0	.58	Mar 21 - Sep 21	2.3'	2.9'	3.5'	4.1'	4.6'
31°	Graceville	35.5	61.5	.54	Mar 30 - Sep 13	2.2'	2.7'	3.2'	3.8'	4.3'

7. Use simple building shapes

A rectangular-shaped home oriented on an east-west axis is the best design for energy efficiency. A square is better than a rectangle oriented north-south. Designs which have a large amount of exterior wall area should be avoided.

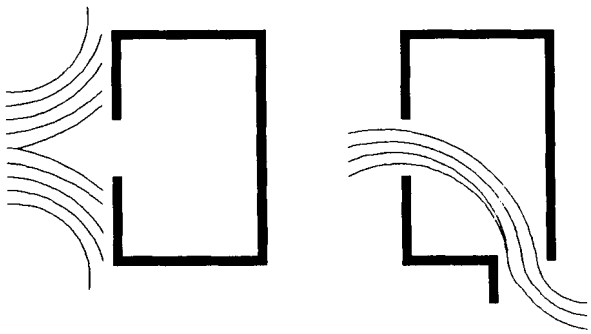
However, windows are more important than walls. An extra "jog" in the house shape to permit a window to face north or south instead of east or west will usually be a good trade-off and result in lower year-round energy use. Also, cross-ventilation of rooms lends itself nicely to spread-out, one-room-deep houses. If properly designed, the benefits of good cross-ventilation and orientation should outweigh the extra energy load imposed by slightly more wall area.

Two-story designs have more wall area and less floor and roof area than simple one-story designs. They are also more difficult to shade with landscaping. Therefore, consider using better-insulated walls on two-story designs. Two-story home designs frequently can be modified easily for adequate cross-ventilation.

8. Cross-ventilate rooms

Before vapor-compression air conditioning, natural ventilation kept homeowners cool. Florida houses were built with wide porches and large windows. The principles inherent in these older homes can be applied to contemporary ones. New homes can also be designed with massive materials to "store" the cooling provided by night-time ventilation and use it the next day to augment air conditioning.

The key to natural ventilation design is allowing openings for the air to enter and leave the home.

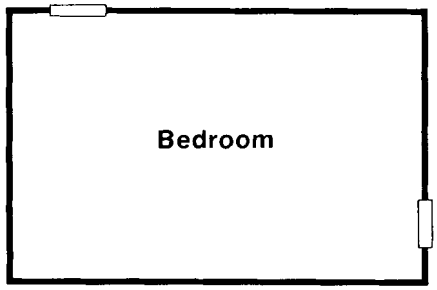


Allow openings for air to enter and leave the home.

Ideally, all rooms should be cross-ventilated. This includes bedrooms when their doors are shut. However, the major living, eating, sleeping and food preparation areas are most important. The kitchen is a source of much heat (from the refrigerator motor, dishwasher, oven, stove and microwave), so choose designs where the kitchen is well-vented.

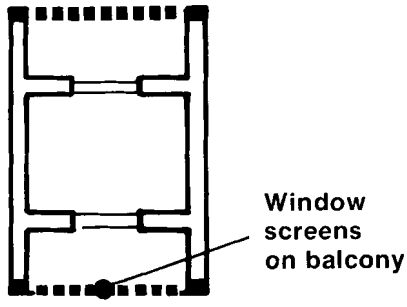
Keep the following general ventilation rules in mind when choosing or modifying plans:

- It is best to have equal inlet and outlet areas.
- Ideally, about 12% of the floor area should have screened openings. For second floors, 10% is adequate. If this is all met by sliding or single- or double-hung windows where 55-60% of the window is fixed, excessive window area would be required. To keep glass area to a minimum, use screen front doors, atrium-style doors to screened porches, and fully operable window types such as casements and awnings to provide the required openings.
- Openings on adjacent walls should be located as far away from one another as possible.

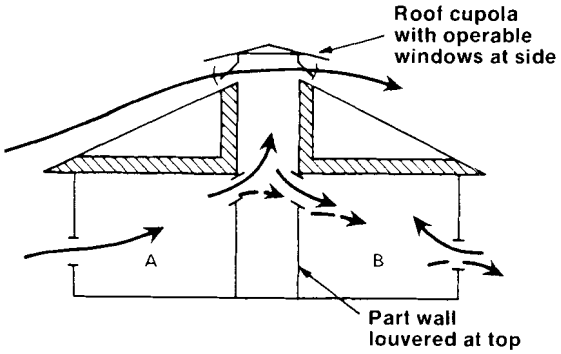


Adjacent wall openings should be at opposite ends.

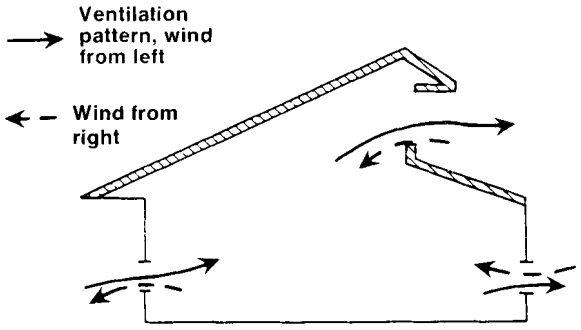
- Airflow is better with a screened balcony or porch than with window screens on the doors or windows.



Ventilation is improved by having screened porches or balconies instead of window screens.

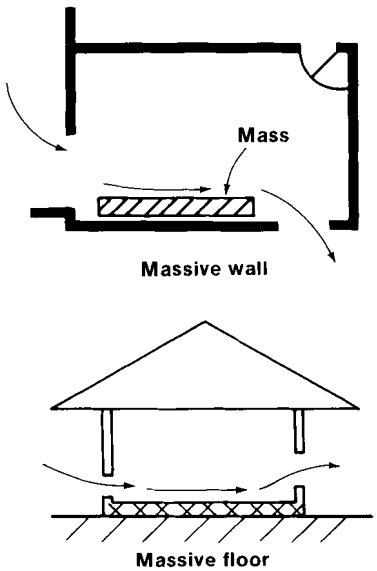


Roof cupolas can aid ventilation regardless of wind direction.

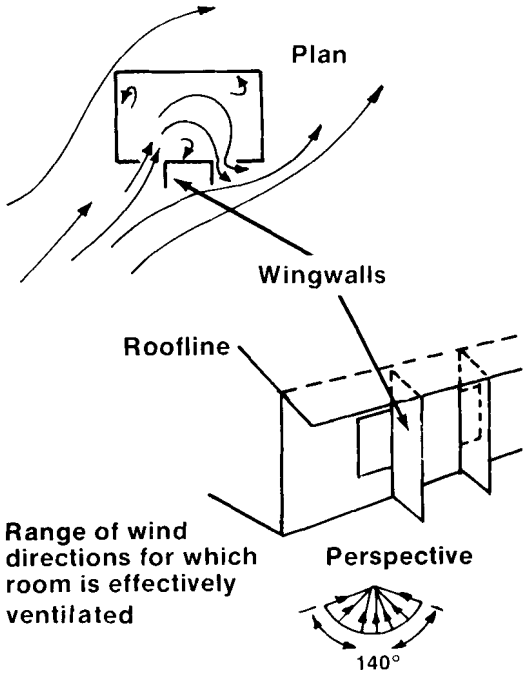


Clerestory windows can aid ventilation but may bring in hot air from the roof during the day (wind from right).

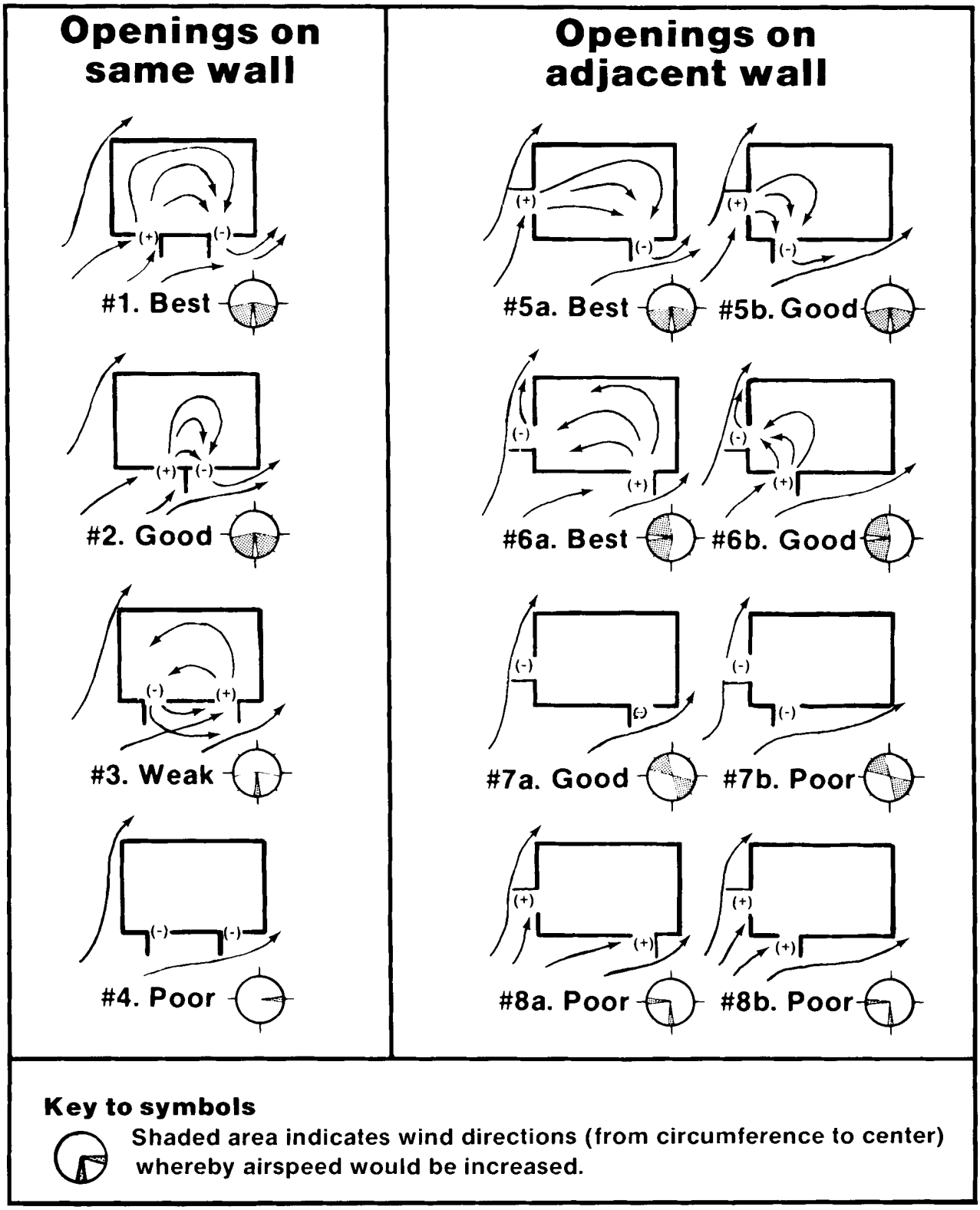
- Roof cupolas can aid ventilation, as can clerestory windows (however, clerestory windows open during the *day* may bring in hot air off the roof).
- Low inlets are preferred for occupant comfort. Therefore, screened doors and low windows are preferred from a ventilation viewpoint.
- In two- or three-story structures, there will be a slight benefit from high outlets if air is permitted to flow from the first floor up to the higher levels.
- Mass will provide daytime cooling from night venting. It is best to locate exposed (uncarpeted) floors and massive walls in living, dining and kitchen areas, leaving bedrooms with less mass so that they can be quickly cooled in the evening.
- For homes with massive walls or floors to store the heat (or coolness), inlets should be positioned close to the mass to create a wall or floor "jet."
- In rooms with one outside wall, two widely spaced windows are better than one large window.
- Wingwalls (walls that protrude out from the house, next to the window) can be used to improve ventilation. A wingwall should be as long as the window is wide. It can increase airflow, particularly in rooms with windows on only one wall. Appropriate uses of wingwalls are shown on the next page. In some instances, the space between the wingwalls can be used as indoor or outdoor closet space. Casement windows can act as wingwalls too (see Chapter 7).



Locate openings close to massive wall or floor.



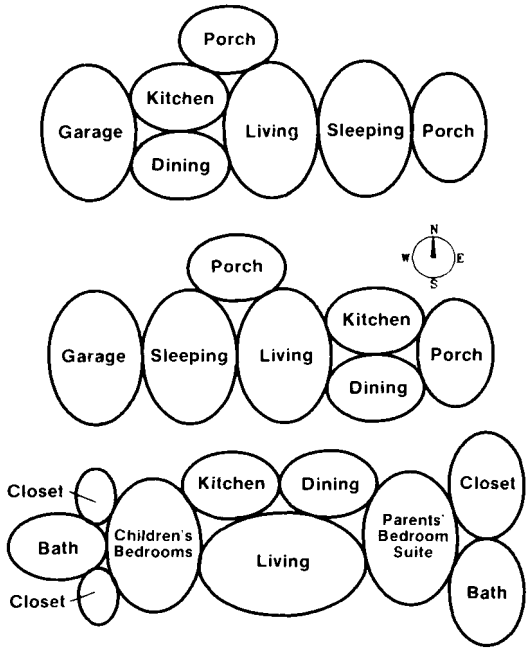
Wingwalls direct air into the house.



Wingwall examples

9. Time-of-day layout

Time-of-day layout refers to locating rooms where they will provide the most comfort when in use. Many Florida residents are hesitant about having a west-facing kitchen, dining room or porch because of the discomfort they experience while preparing and eating their evening meal. Time-of-day use can vary from one family to another, but the following table shows generally preferred locations for most rooms. Energy savings can be realized in summer, since residents will not be discomforted by hot wall surfaces or penetrating sun and therefore will not reset their air conditioner thermostat to compensate. Similarly, having the living area on the south or open to south-facing rooms will provide winter heating savings and comfort.



Room layouts designed for occupant comfort.

Time-of-Day Layout for Room Comfort						
	Preference					Comments
	1st	2nd	3rd	4th	Avoid	
Bedrooms	S	E	N	W		Base choice on direction of evening/night breezes. If late morning sleeping is anticipated, west may be better than east.
Family/Living	S	N			E,W	If family room and living room are provided, family room is more important; most living rooms are rarely used.
Kitchen	N	E	S		W	
Dining	S	E	N		W	
Garage	W	E	N	S		Provides a buffer to rest of house.
Covered porches	E	S	N	W		West should be avoided if evening meals are expected to be eaten on porch.
Baths	E	W	S	N		Provides a buffer to rest of house.
Closets	W	E	N	S		Provides a buffer to rest of house.

Clock Time-of-Day When Direct Sun Strikes Unshaded House
(July corrected for Daylight Saving Time)

	Eastern Florida (Jacksonville, Miami, Orlando)		Western Florida	
	January	July	Tallahassee	Pensacola (Central Time Zone)
North	Never	6:40-10:00 and 5:00-8:20	Add 15 minutes to all times at left	Subtract 30 minutes from all times at left
East	7:15-12:30	6:40-1:30		
South	7:15-5:45	10:00-5:00		
West	12:30-5:45	1:30-8:20		

10. Locate air handler and appliances properly

Look for designs which can contain the air handler for non-combustible furnaces, together with all ductwork, in the conditioned space. This is a big asset in reducing air infiltration and duct losses. Modify designs, if necessary, to put the air handler where a coat closet or basement stairs are shown, and think of potential layouts for the ductwork in the conditioned space.

Washers, dryers and water heaters can be a source of heat and/or moisture to the house. Since air conditioning is a greater concern than heating in Florida, enlarge garages, carports, or closets off of a porch to provide non-conditioned space for these appliances. Vent the dryer to the outdoors.

11. Avoid fireplaces

Fireplaces are a source of air leakage, whether or not they are being used. It would be best to omit fireplaces from plans. If they are to be installed, see Chapter 11 for how best to install them.

Summary

The choice of home design can greatly affect the energy use and comfort of the home owner. Proper orientation, fewer window areas, and structural shading can all help keep out some of the sun's heat. Glass should face north or south unless facing a porch. Overhangs should be correctly sized for shading direct sun from south-facing glass and should be used on all sides of the house. Simple building shapes are preferred but shading and ventilation may dictate an irregular shape. All major rooms should be cross-ventilated, and located where they will provide the most comfort to occupants. Choose plans which locate laundry appliances in the garage and air handlers for non-combustible furnaces in the conditioned space. Consider the energy disadvantages of a fireplace.

House Plan Examples

Do not expect to readily find a home design that incorporates all of this chapter's recommendations and works well with the site you have selected. So that you can see how the preceding recommendations can be carried through into the house design, this section includes examples of homes for sites oriented to the north, south, east or west. If your site faces a different direction (northwest, for example), it would be best to orient the house so that the two sides with the most windows face within 15° of north or south. Two of the examples shown here, however, are site-independent — that is, most glass is well shaded regardless of orientation. Also, there are two multi-family examples, three zero-lot-line detached home examples, and eight orientation-dependent detached home designs.

Each example here is just that, an example; full plans are not available. If you would like to build one of the examples, take the drawing to an architect or residential designer. To maintain the energy aspects of the design, do not alter window or outside wall locations.

FSEC has other home designs available with full construction drawings. The designs are winners of state-wide competitions. Contact FSEC for more information.

Most single-family home designs shown here have a screened front door and a two-car garage. In most instances, a one-car garage or carport could be substituted. (A carport permits breezes to enter the home and is preferred.)

Four-inch walls are shown on most designs. Block walls could be substituted. All dimensions are rounded to the nearest foot.

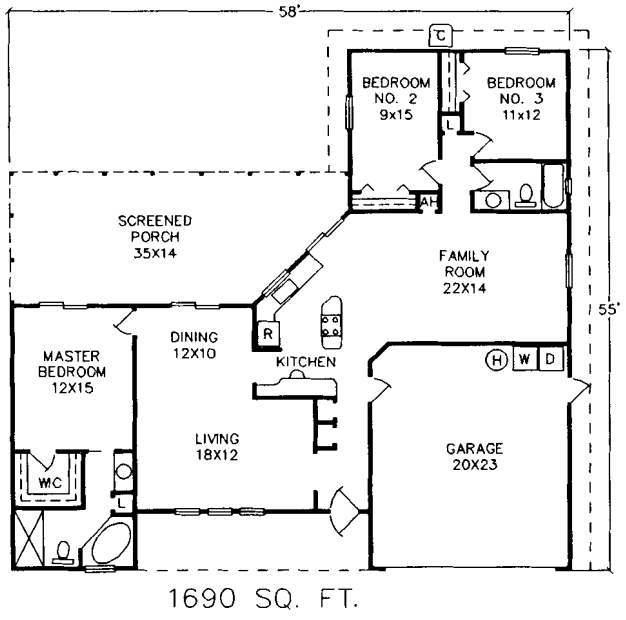
Less common abbreviations and symbols used in the examples are defined below:

Abbr./Symbol	Meaning
AH	Air handler for cooling/ heating system
C	Air conditioner compressor
L	Linen closet
P	Pantry closet
R	Refrigerator
WIC	Walk-in closet
WO	Wall oven
—	Roof overhang or screened porch wall
//////	Fence or railing

The plans are numbered with prefix abbreviations for quick identification. For example, SF is South-Facing.

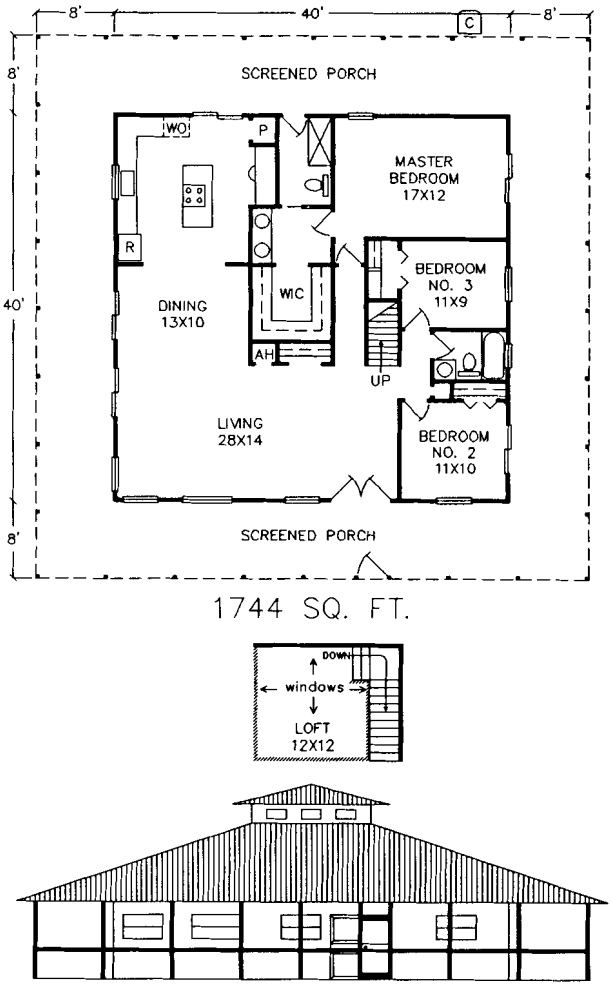
Orientation-independent plans

Home plans that are adaptable to many lots regardless of orientation should emphasize shading glass areas and avoid a disproportionate number of unshaded windows on any one side. Example OI-1 is a plan similar to many being built today, but with better shading provided. Front and back porches structurally shade most of the glass. A few unshaded windows remain — one in the front (master bath), two on one side (family room and second bath), one on the other side (bedroom 2) and one on the back (bedroom 1) — but overhangs and other shading devices (Chapter 7) can help protect them. Ventilation of the main living areas, kitchen and master bedroom is possible. Bedrooms 2 and 3 require additional openings for ventilation when the doors are closed.



Plan OI-1

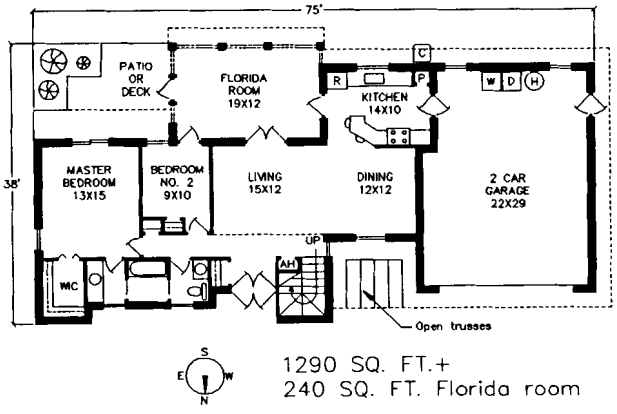
Example OI-2 is reminiscent of older Florida homes, with a porch or veranda on all sides. High, narrow loft windows provide light and good ventilation.



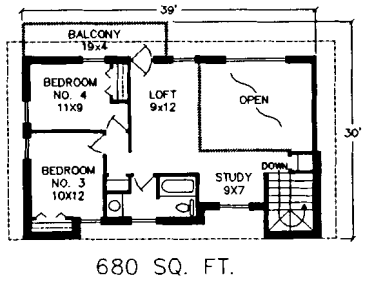
Plan OI-2

North-facing single family home plans

North-facing sites may be the best orientation for an energy-efficient, comfortable home. Example NF-1 shows a two-story plan with thick block walls indicating space for exterior insulation. Note that the overhanging second floor balcony shades the first-floor south-facing glass. There is no unshaded west glass. The Florida room should remain unconditioned and can serve as a screened porch in summer. North-facing glass is shaded from direct sun by the projections. Walls create wingwall effects for ventilation in bedrooms 2 and 3. All rooms have good ventilation potential.

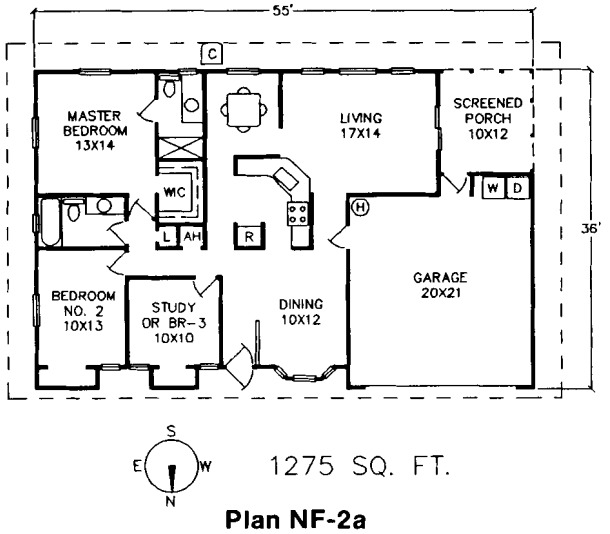


Plan NF-1, 1st floor



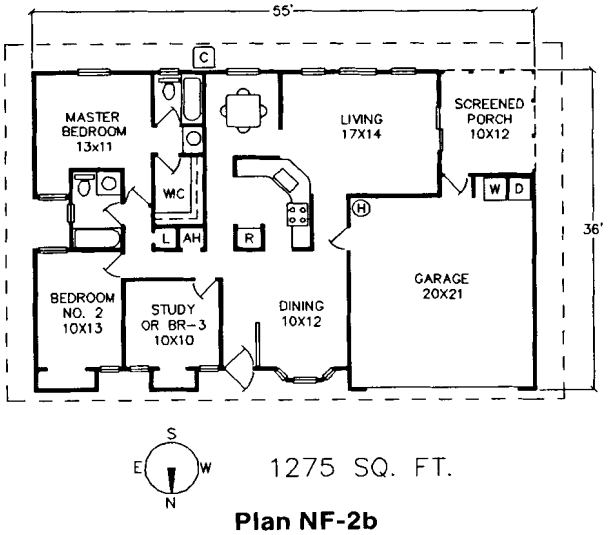
Plan NF-1, 2nd floor

Plan NF-2a is a simple, small rectangular plan with a hip roof and two-car garage that will fit on most lots. Shading on the west side is provided by the garage and a screened porch. Tinted glass or an alternate shading method should be used on the three small east windows. Closets in bedrooms 2 and 3 act as wingwalls. Cross-ventilation potential for each room is good.



Plan NF-2a

Plan NF-2b varies slightly from NF-2a. It adds wall area but reduces shading problems for the east windows, while maintaining reasonable cross-ventilation potential. A different interior layout is shown in the south-facing plan SF-2, which would also be effective on north-facing lots.

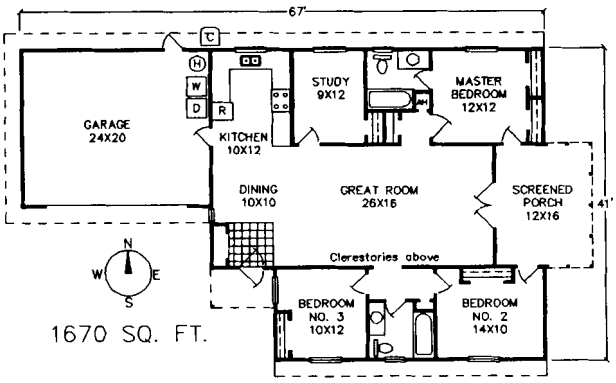


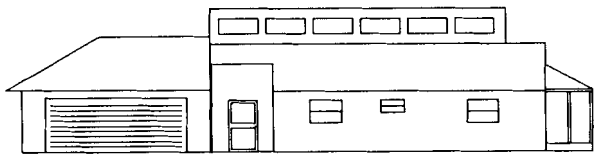
Plan NF-2b

South-facing single family home plans

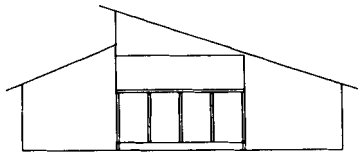
Energy-efficient designs are easily adapted to south-facing home sites. A front overhang is recommended with few or no side windows. Example SF-1 shows east and west windows, but they are shaded by long overhangs on the west and a screened porch on the east. All rooms have good ventilation potential. The south-facing clerestory windows provide light, winter heat and ventilation to the main living area.

Plan SF-2 is the same as NF-2b except that an alternate room arrangement is shown. There is direct access from the kitchen to the porch. The mirror image of this plan would also be effective for south-facing lots.



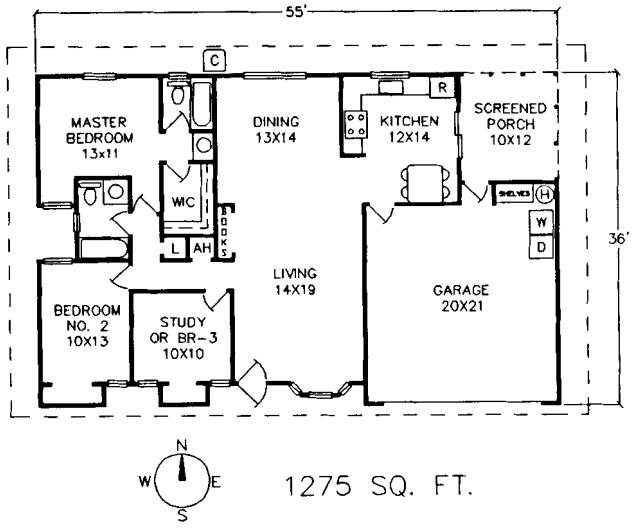


SOUTH ELEVATION



EAST ELEVATION

Plan SF-1

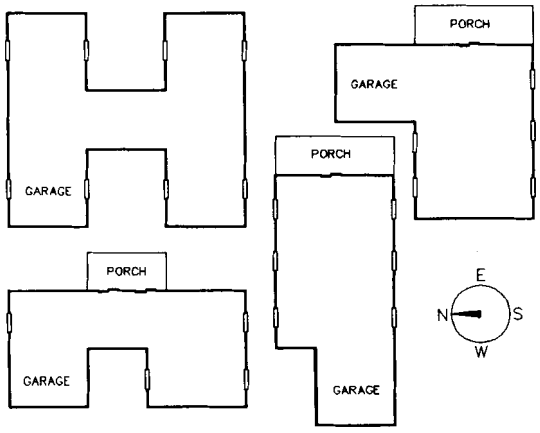


Plan SF-2

West-facing home plans

As previously discussed, the west is the worst side for glass. Choose designs which have one or no front windows, and which have a long porch on the back to shade the house from the morning sun. Finding an energy-efficient west-facing plan is a challenge, but many design options are available — although they may require modifications to an existing plan.

- Keep house oriented on east-west axis. Put design emphasis on roof elevation and consider side-entry garages.
- Consider a house shape other than a simple rectangle to permit north- and south-facing glass and adequate ventilation. Examples: a 7-shape, U-shape, H-shape.

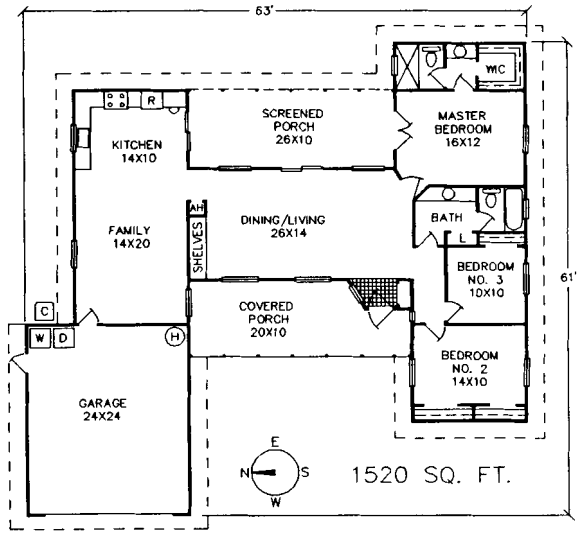


Choose shapes with most windows on side.

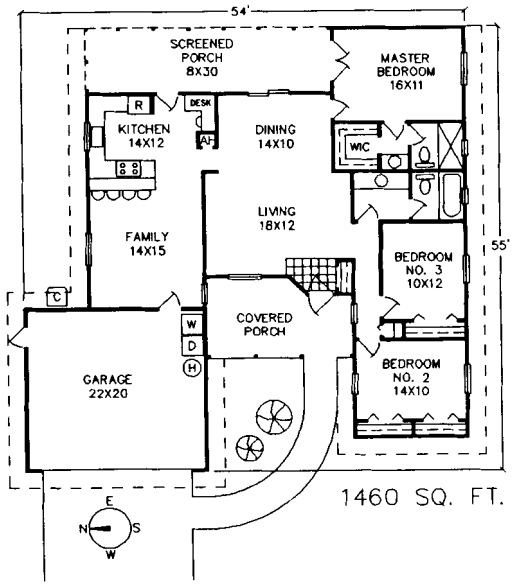
- Use a large, covered front porch to shade windows. Consider a Victorian or country design to make the front porch a marketing feature.

Plan WF-1a is a U-shaped plan that uses the garage and front porch to shade the house from the sun. The shape permits cross-ventilation for every room. If a longer front elevation is desired, a larger front and back porch can provide the needed shade, as shown in plan WF-1b.

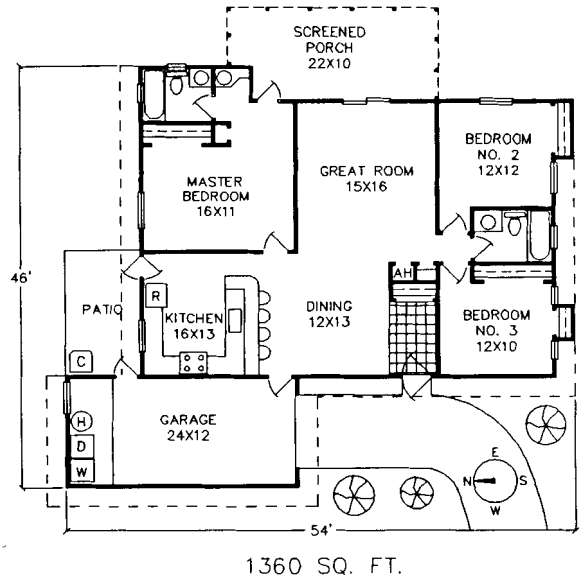
Plan WF-2 has no front windows and will provide excellent cross-ventilation to each room with southeast winds (a predominant wind direction in many parts of the state).



Plan WF-1b



Plan WF-1a

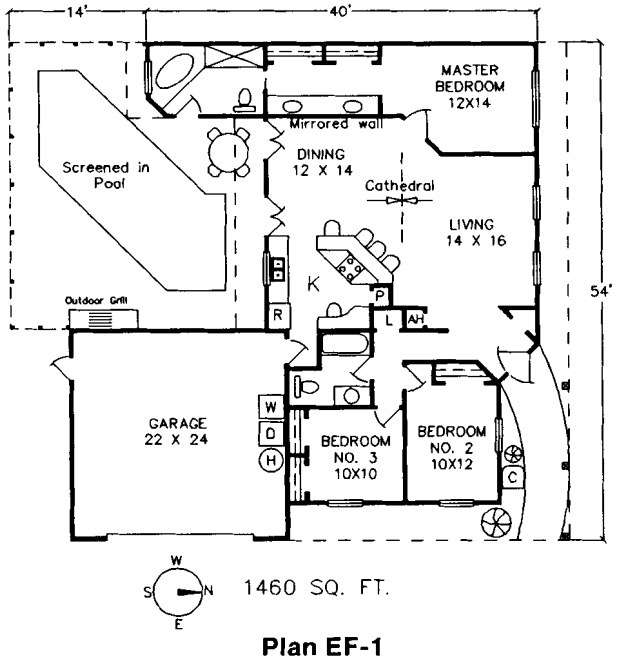


Plan WF-2

East-facing home plans

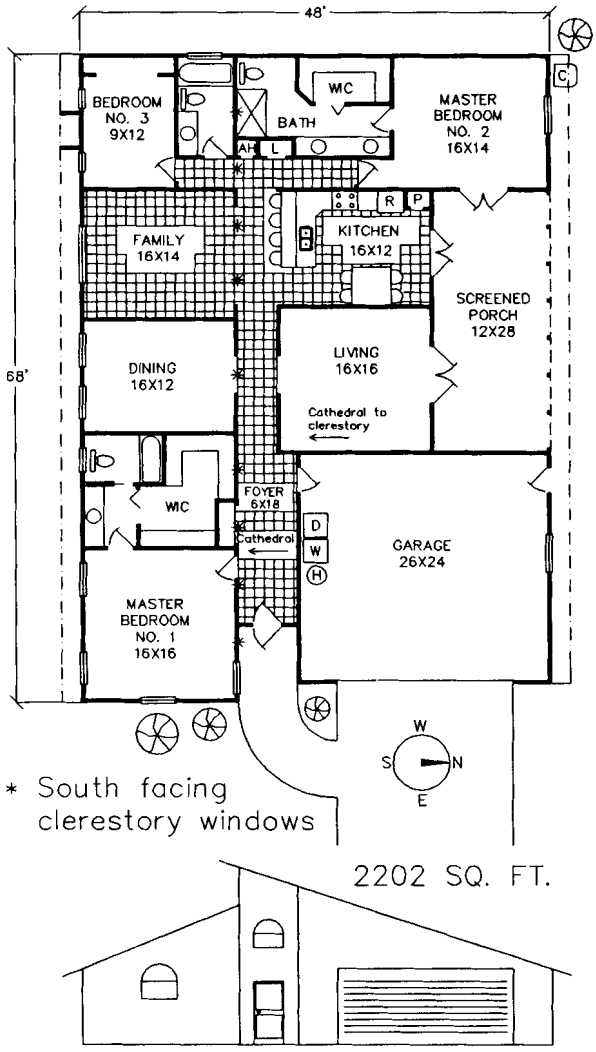
The design criteria listed for west-facing plans will be energy-efficient on east plans also. However, east-facing lots present the most difficult challenge in selecting comfortable and energy-efficient floor plans. Not only does the back of the house have to be shaded, but the ideal focal point of the property should be shifted from the traditional back yard to a side yard to avoid the afternoon heat. A C-shape (or reverse C-shape) house with most glass on its sides, but not in front or back, will create a pleasant outdoor area, as shown in examples EF-1 and EF-2.

Plan EF-1 succeeds in having no windows on the back of the house and an outdoor focal point on the south side. Due to the projection of the master bath wing, occupants can eat in the shade in the screened area during late afternoon and early evening in summer. The south side is also the best location for a pool. The south glass will help heat the home in winter. Every room except bedroom 3 has cross-ventilation potential, although the garage may block southeast breezes.



Plan EF-1

Plan EF-2 maximizes cross-ventilation potential and the use of south glass, for an energy-efficient plan. There is one front-facing east window and one small (4 square-foot) west window. The south-facing clerestory windows provide light and winter heat for the kitchen, living room, foyer and one bath. A north porch allows outdoor living/eating off the kitchen and living room, and either the north or south side can serve as an outdoor focal point. Tile flooring provides thermal mass for ventilation and passive solar heating.

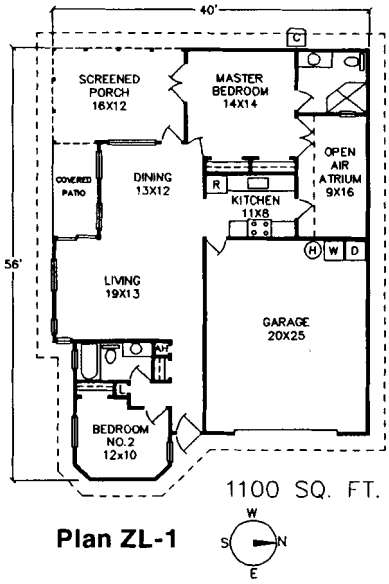


Plan EF-2

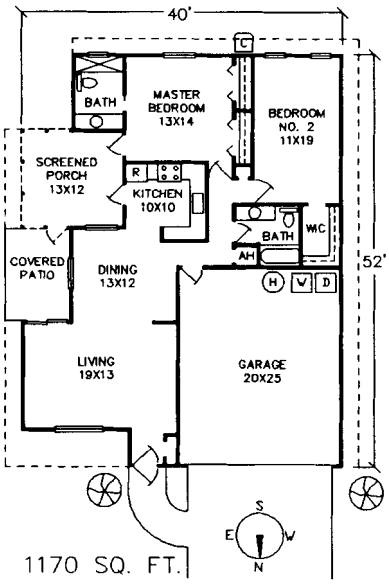
Zero lot line plans

In areas where land costs are high, many builders use high-density detached house zoning. A typical lot size is 50 by 100 foot. Usually one side of the house is built on the lot line and is without windows. Glass is provided on the other three sides.

Plan ZL-1 is best for east- or west-facing lots. Most of the glass is concentrated on the south side. Cross-ventilation potential is excellent. The open-air atrium (screened roof) helps provide ventilation and light to the kitchen and master bath, and the screened porch and covered patio help shade other glass.

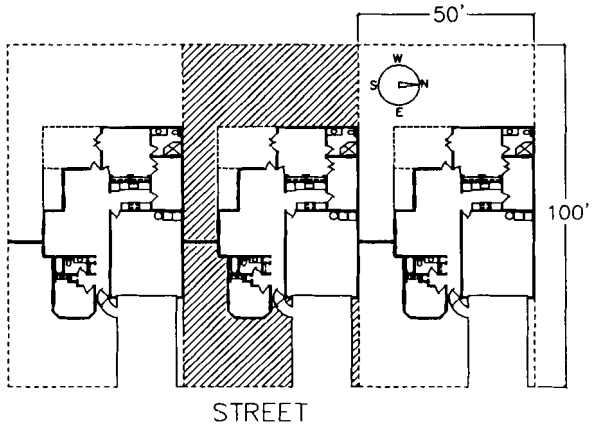


Plan ZL-1

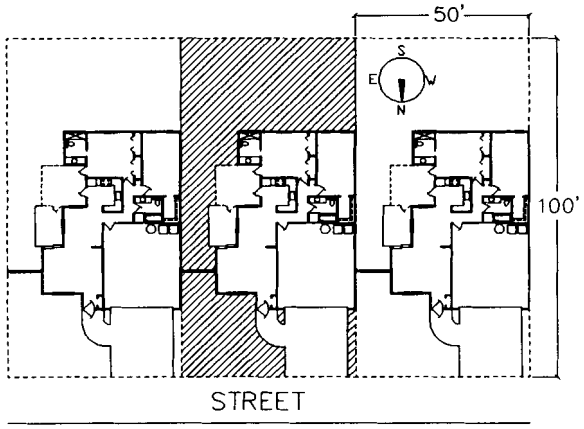


Plan ZL-2

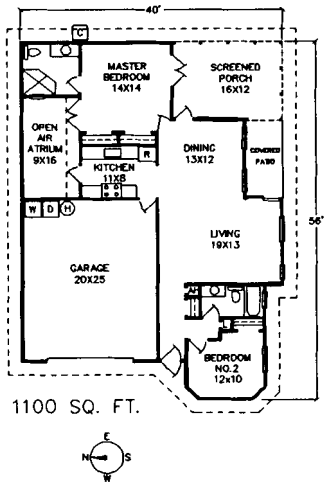
Plan ZL-2 is better than ZL-1 if the lot faces north or south. The west side should always be the side without windows. Cross-ventilation potential is available to all rooms except bedroom 2. East windows are shaded by the porch and patio.



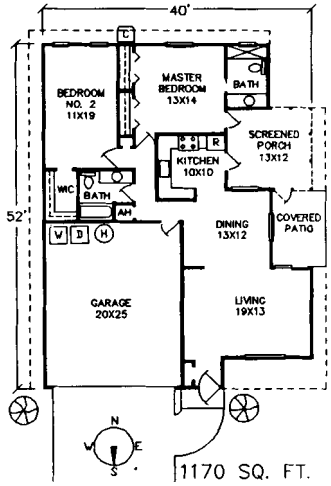
Plan ZL-1 site layout



Plan ZL-2 site layout

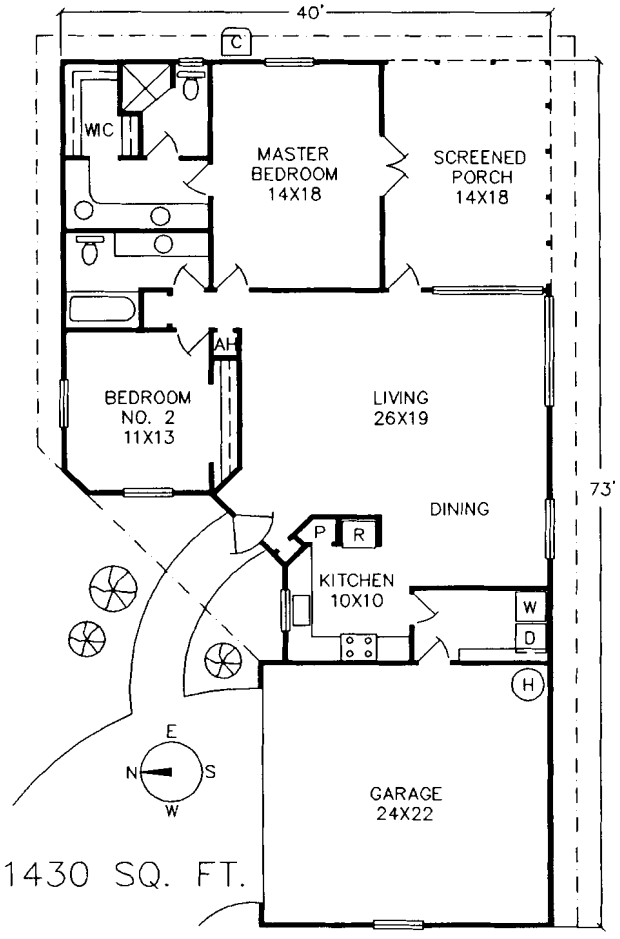


Mirror image of ZL-1 would be effective on west-facing lots.

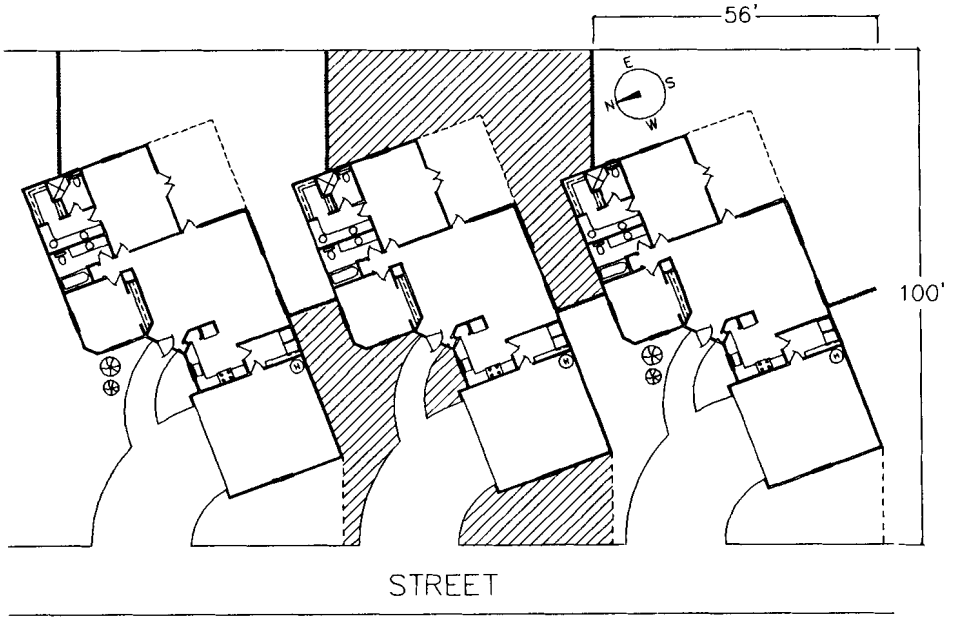


Mirror image of ZL-2 would be effective on south-facing lots.

Plan ZL-3 is for double-zero lot line sites. There are windows in the front part of one side and the back part of the other side. The house is usually tilted on the lot, creating a wider elevation when viewed from the street. Since the garage has to occupy a fair portion of the front of the house, and the narrow width almost dictates that a porch go on the back of the house, east- or west-facing sites are preferred. Plan ZL-3 is an example of such a case. A solid fence (shown in the site layout) may act like a partial wingwall and aid in cross-ventilating the dining room and kitchen. A screened front door is essential for cross-ventilation of the living room.



Plan ZL-3



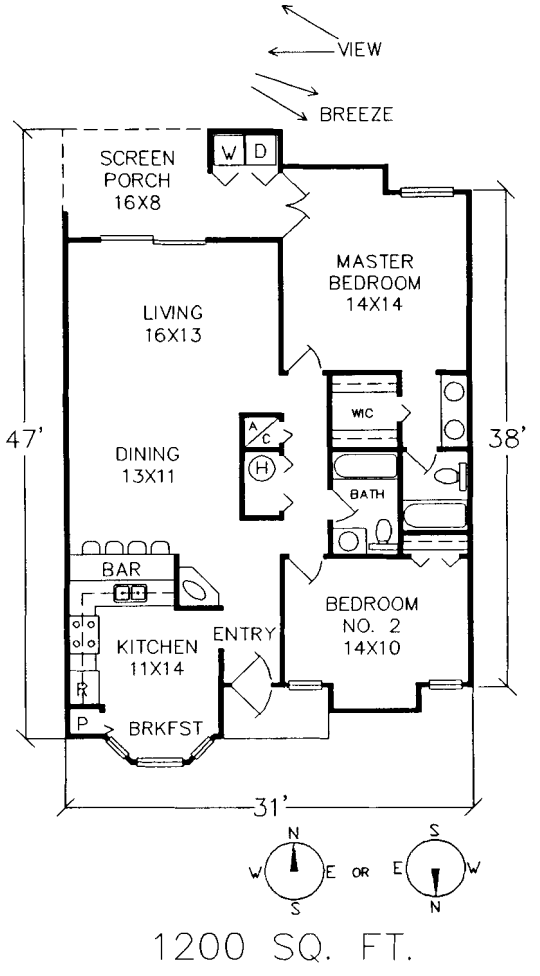
Plan ZL-3 site layout

Multifamily plans

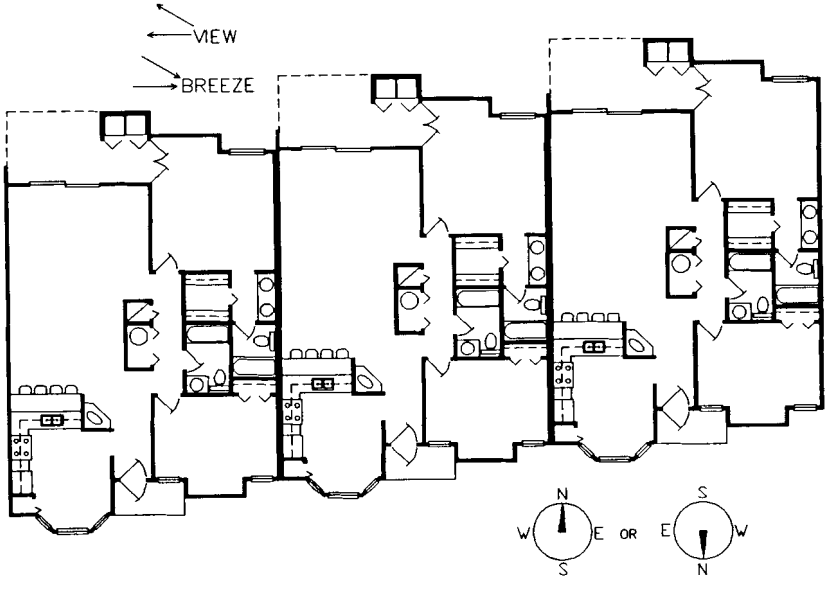
Multifamily buildings frequently contain identical units side by side and, sometimes, above and below. In many multifamily buildings, windows are limited to front and back. Due to staircases, most units in a multistory, multifamily building have some shading of front glass. A porch on the back can provide further shading. North- or south-facing sites are preferred.

Two-story units are best if situated side by side with openings front and back — for cross-ventilation and so that all windows can be facing north or south.

Plan MF-1 demonstrates an open floor plan that permits cross-ventilation of the kitchen/dining/living areas. A sitting area in the master bedroom protrudes to act as a wingwall for better cross-ventilation in that bedroom. The ventilation potential of a multifamily building will depend on the site, the spacing between buildings, and the way the units are connected. Shown is a method for connecting the units to allow angled breezes to each. Additionally, each unit could have a view of a special feature of the site (river, lake, ocean, golf course, etc.). Note that the washer and dryer are located on the porch and the dryer can easily be vented to the outdoors.

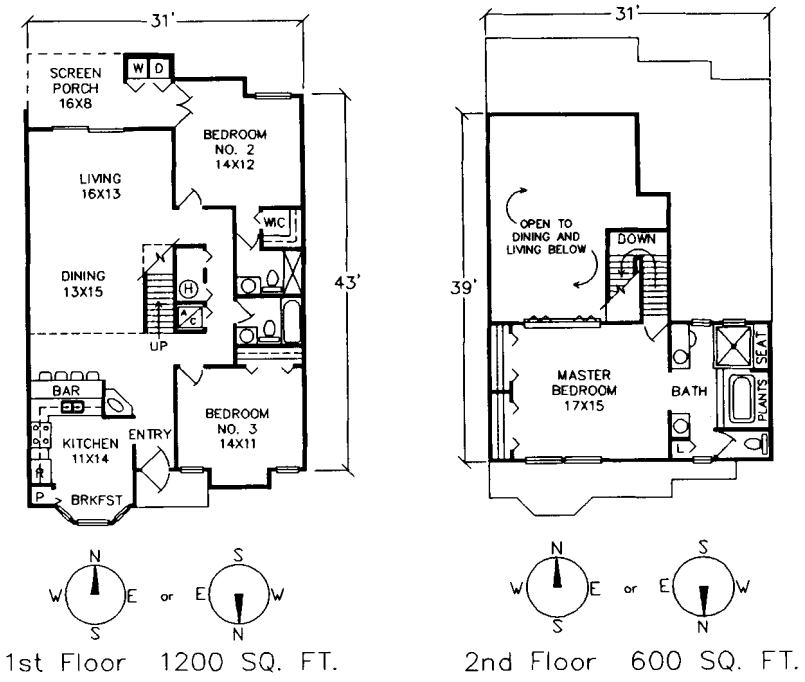


Plan MF-1

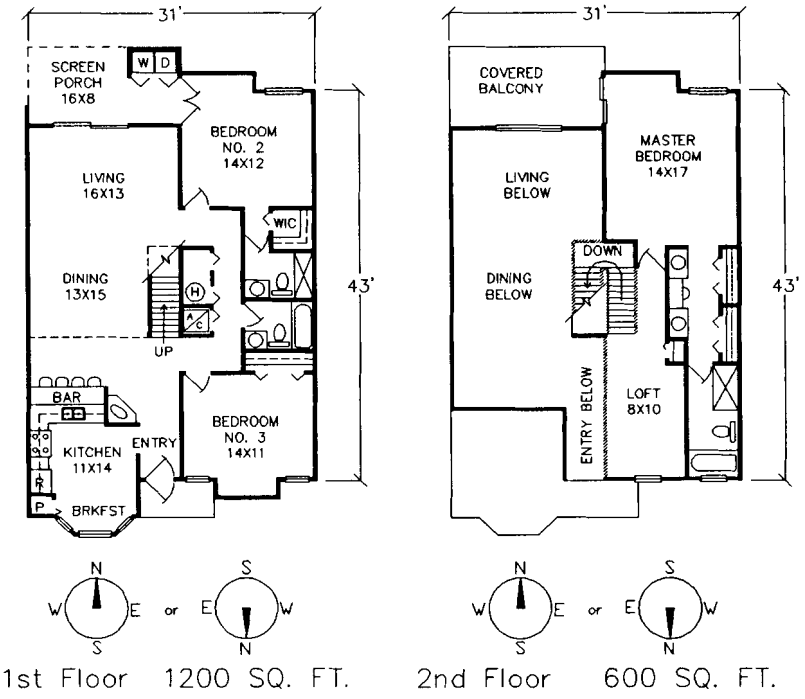


Connect units so that breezes reach each one.

Plan MF-2a is a two-story plan. Cross-ventilation of the second floor is possible by the opening from the first-floor dining room to the second-floor master bedroom. Plan MF-2b shows an alternative cross-ventilation design where the windows in the loft and master bath are at the opposite end of the master bedroom windows.



Plan MF-2a



Plan MF-2b

For further information

"A Passive Solar Home Program for Florida," T. Wayne Waldron, *Concrete Masonry Solar Architecture,* Vol. 6, No. 3, August 1986.

"Guidelines for Energy-Efficient Multi-Family Housing Design," Mike Nicklas, *Concrete Masonry Solar Architecture*, Vol. 6, No. 3, August 1986.

"Solar Homes Design Portfolio," Tennessee Valley Authority (TVA), 1985.

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Cooling with Ventilation, Subrato Chandra, Philip W. Fairey III, Michael M. Houston, Solar Energy Research Institute — Sp-273-2966, Golden, Colorado, 1986.

Climate Design, Donald Watson, Kenneth Labs, McGraw-Hill, Inc., New York, 1983.