

Tiny Homes

INSPECTION CERTIFICATION ASSOCIATES

Necessity for 3rd Party Professional Inspections

- ▶ At the moment, there is no governmental body or institution ensure quality or code compliance in the construction of tiny homes. Whether it is a factory builder, or a DIYer, there is no compliance.

Not Code Inspectors

As home inspectors, we are beyond any code and choose the highest standard based on the understanding of safety and function of the systems in the home.



Inspection Criteria

Along with normal single family residential inspection standards, because of the nature of tiny homes, special guidelines would include:

- ▶ Basic function of the essential functions of the systems
- ▶ Ensure that the systems are not installed in a way that will cause issues in the future
- ▶ Fire safety is met



Do It Yourself Tiny Homes

Inexperience can be problematic and can result in catastrophic problems in tiny homes.



What is a Tiny Home?

Any structure used for single family residence that meets the following requirements:

- ▶ Less than 400 square feet of living space
- ▶ Is built for permanent residence
- ▶ Is built to modern code compliance for residential construction



Tiny Homes Allowances

- ▶ Because of the decreased size of the dwelling, special considerations have been taken into account and both the International Residential Code and NFPA have made allowances for Tiny Homes.
- ▶ Local Authority Having Jurisdiction might not have adopted either and may not allow this type of construction.

Ceiling Heights

Habitable space and hallways in *tiny houses* shall have a ceiling height of not less than 6 feet 8 inches (2032 mm). Bathrooms, toilet rooms and kitchens shall have a ceiling height of not less than 6 feet 4 inches (1930 mm). Obstructions including, but not limited to, beams, girders, ducts and lighting, shall not extend below these minimum ceiling heights.

Exception: Ceiling heights in *lofts* are permitted to be less than 6 feet 8 inches (2032 mm).

IRC Appendix Q



Minimum Room Sizes

Sets a minimum horizontal dimension of 7 feet for both directions for habitable rooms with a total square footage of no less than 49.

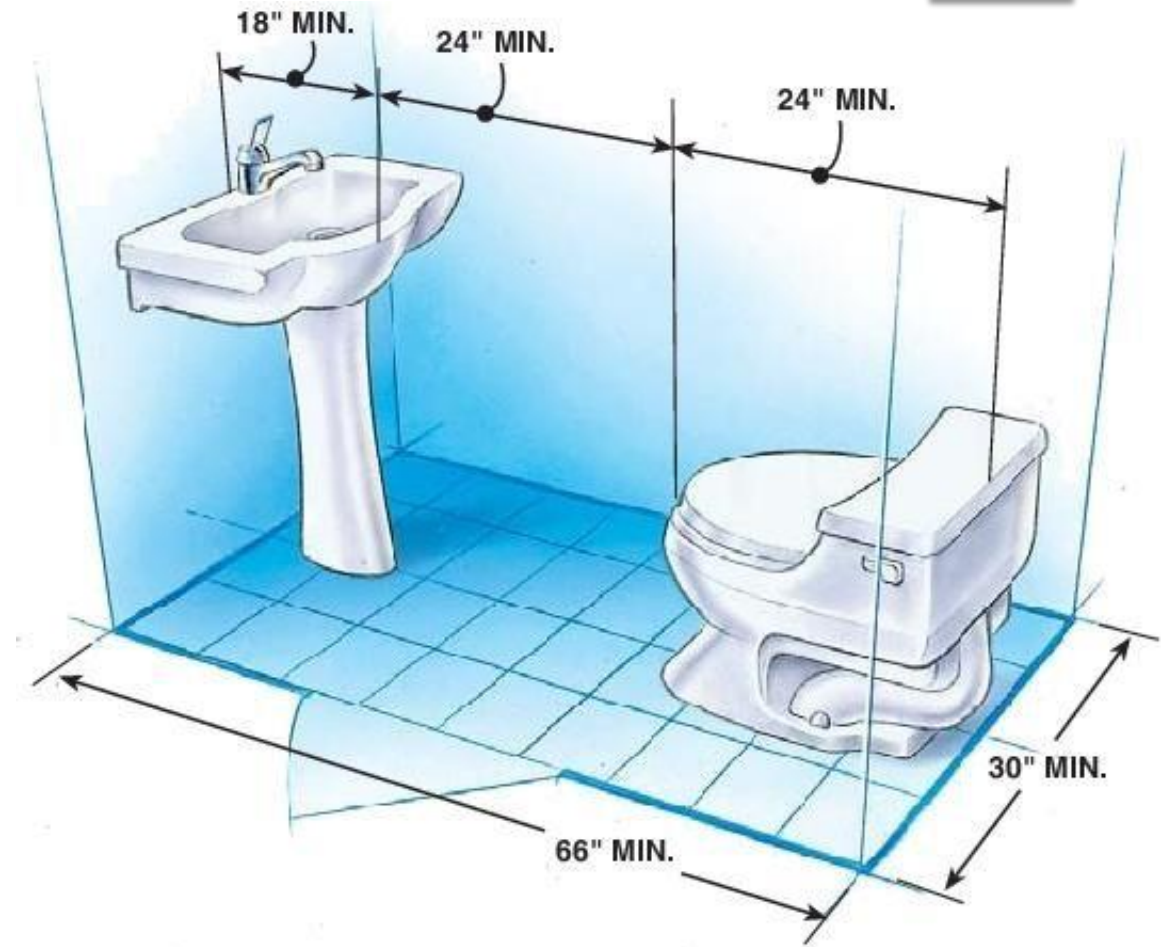
Exceptions:

- ▶ Bathrooms
- ▶ Closets
- ▶ Utility areas
- ▶ Lofts

Toilet Minimum Clearances

Minimum Clearances for Toilet

- ▶ 24" to the front
- ▶ 30" width or 15" from the center side to side



Lofts

LOFT. A floor level located more than 30 inches (762 mm) above the main floor, open to the main floor on one or more sides with a ceiling height of less than 6 feet 8 inches (2032 mm) and used as a living or sleeping space.



Loft Area

- ▶ No less than 5 feet in width in both directions
- ▶ No less than 35 square feet



Loft Head Room

Portions of a *loft* with a sloped ceiling measuring less than 3 feet (914 mm) from the finished floor to the finished ceiling shall not be considered as contributing to the minimum required area for the loft.

Exception: Under gable roofs with a minimum slope of 6 units vertical in 12 units horizontal (50-percent slope), portions of a *loft* with a sloped ceiling measuring less than 16 inches (406 mm) from the finished floor to the finished ceiling shall not be considered as contributing to the minimum required area for the *loft*.

Loft Guards

Loft guards shall be located along the open side of lofts. Loft guards shall be not less than 36 inches (914 mm) in height or one-half of the clear height to the ceiling, whichever is less.



Stairways to Lofts

Stairways accessing a *loft* shall not be less than 17 inches (432 mm) in clear width at or above the handrail. The width below the handrail shall be not less than 20 inches (508 mm).

The headroom in stairways accessing a *loft* shall be not less than 6 feet 2 inches (1880 mm), as measured vertically, from a sloped line connecting the tread or landing platform nosings in the middle of their width.



Ladders to Lofts

Ladders accessing *lofts* shall have a rung width of not less than 12 inches (305 mm), and 10-inch (254 mm) to 14-inch (356 mm) spacing between rungs. Ladders shall be capable of supporting a 200-pound (75 kg) load on any rung. Rung spacing shall be uniform within $\frac{3}{8}$ inch (9.5 mm).

Ladders shall be installed at 70 to 80 degrees from horizontal.

4-to-1 Rule

Make sure you can set up your ladder at the required angle, using the 4-to-1 Rule: For every 4 feet (1.2 metres) up, place the base of your ladder 1 foot (0.3 metres) from the wall or upper support that it rests against.



Fire Safety

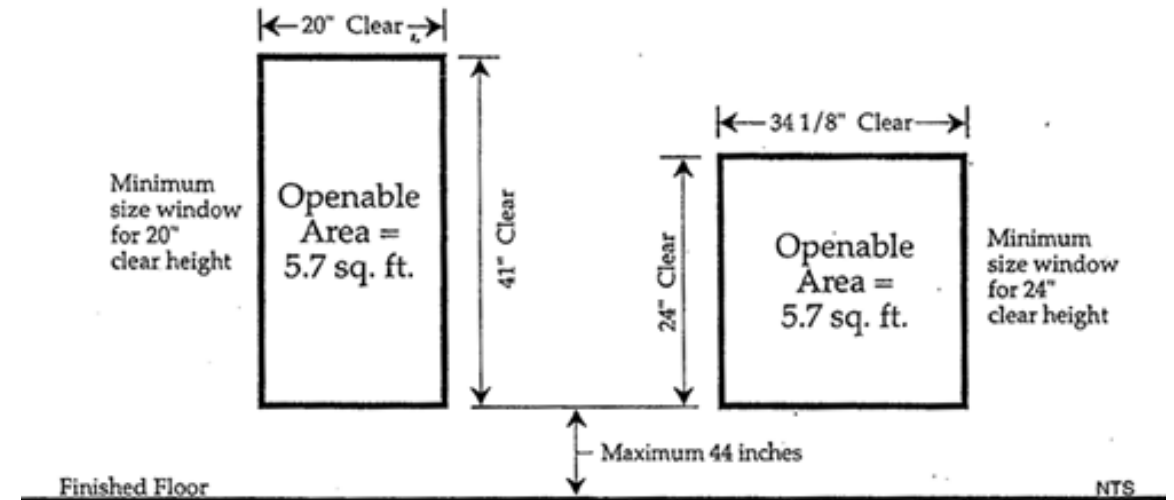
All dwellings should have the following:

- ▶ Secondary means of egress
- ▶ Smoke/carbon monoxide detectors
- ▶ Propane/natural gas detector if plumbed with that fuel



Sleeping Areas

All sleeping areas including lofts must have a secondary means of egress. Where that means is a window, it needs to meet the following requirements:

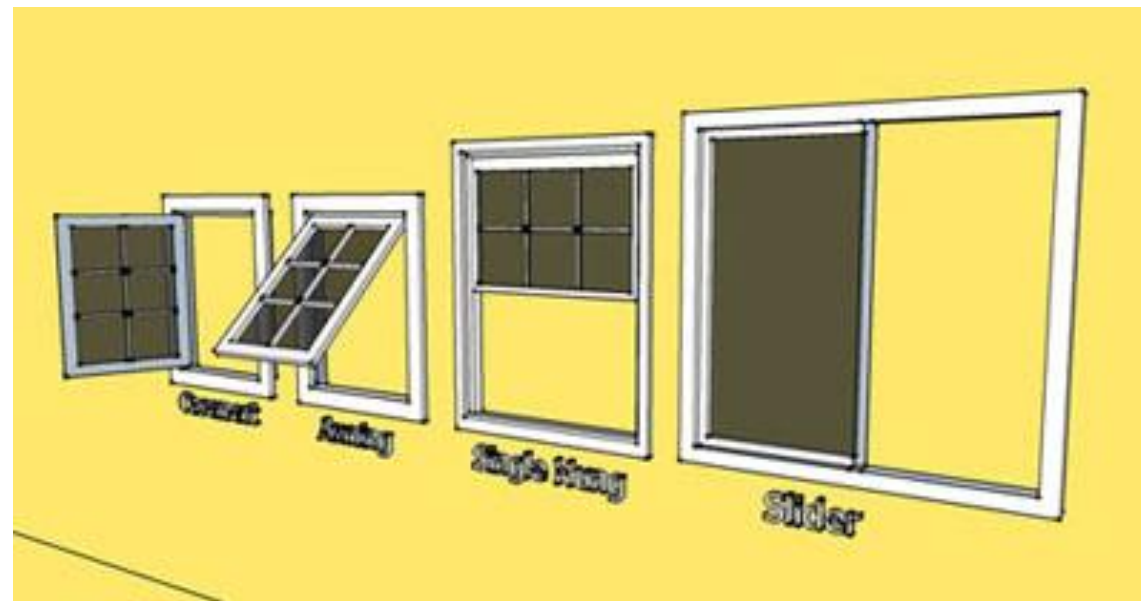


Loft Egress

- ▶ *Egress roof access windows in lofts used as sleeping rooms where installed such that the bottom of the opening is not more than 44 inches (1118 mm) above the *loft* floor, provided the egress roof access window complies with the minimum opening area 5.7 square feet with minimum width of 20'' and minimum height of 24''.*

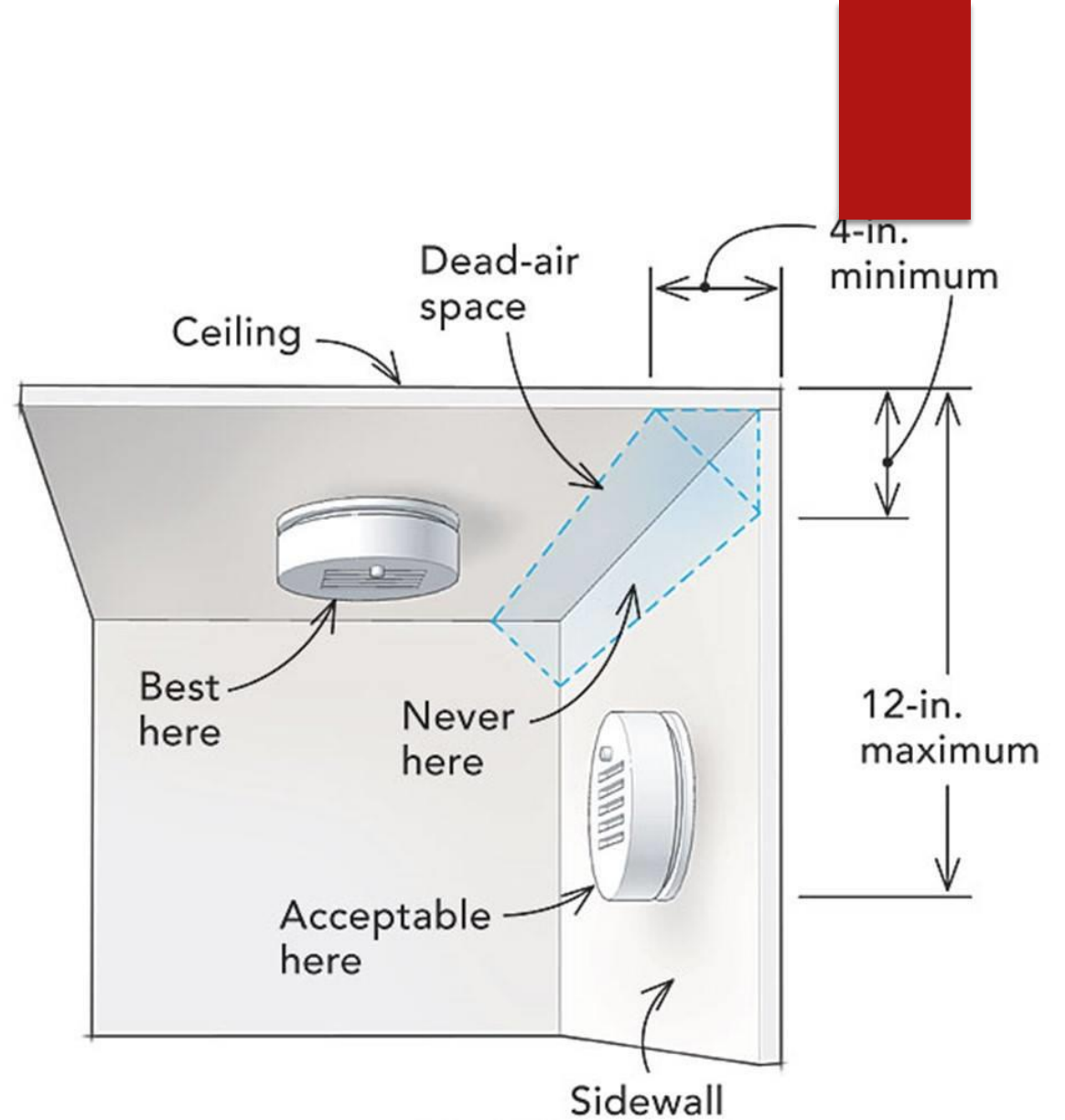
Egressable Windows

Emergency escape and rescue openings shall be operational from the inside of the room without the use of keys or tools.



Smoke Detectors

- ▶ Should be located in the kitchen and sleeping areas at a minimum.



Carbon Monoxide Detectors

- ▶ Carbon Monoxide Detectors should be placed in kitchens and any other location where fuel is being burned.



Propane/Natural Gas Detectors

- ▶ Propane and natural gas detectors should be placed in the room where the appliance is utilizing the fuel.



Tiny Homes on Wheels (THOW's)

These are tiny homes that are on trailers that have meet certain qualifications for DOT and engineering. These are not manufactured homes or recreational vehicles.



THOW's vs Manufactured Homes

Difference between manufactured homes and THOW's

- ▶ THOW's need to be built for the expectation of being relocated and being consistently re-located.
- ▶ THOW's should be built to IRC/NFPA standards with higher construction standards
- ▶ Are limited to maximum 400 square feet

THOW'S vs RV'S

Both have maximum square footage of 400 square feet according to (NFPA) 1192.

The differences between the two are that:

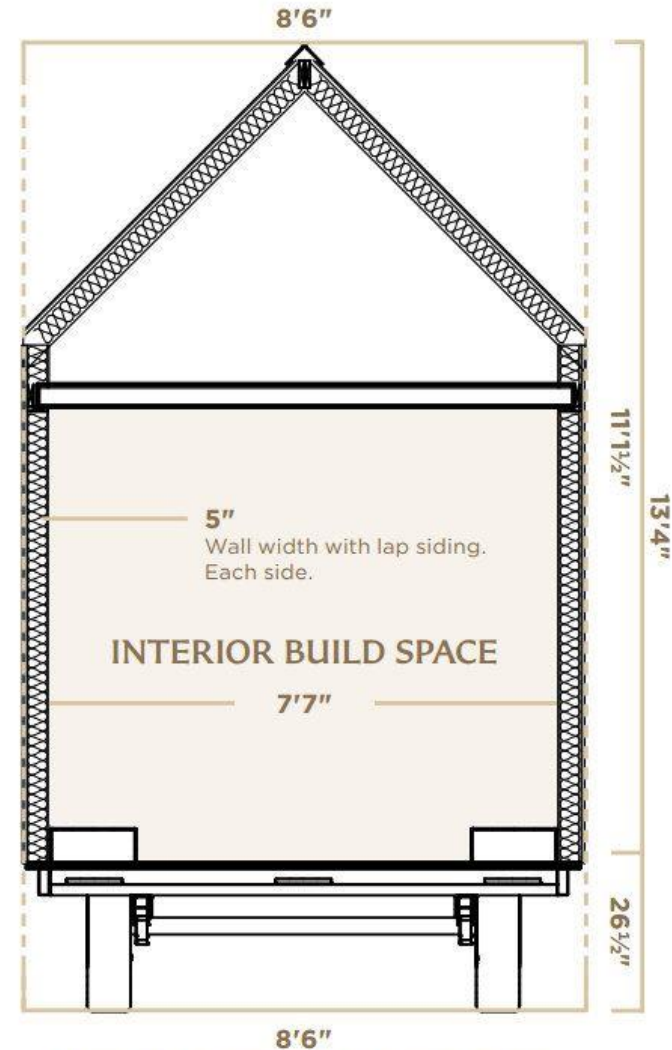
- ▶ An RV cannot be permanently affixed to the ground
- ▶ Is not built to residential construction standards



THOW's and DOT

To be drivable by anyone with a normal driver's license, THOW's:

- ▶ Maximum allowable height should be no more than 13'4"
- ▶ Maximum width of 8'6"



8'6" is the max width allowed by the Department of Transportation (DoT).
All measurements approximate. Low-Wider trailer only.

Trailers for THOW's

Weight is a concern for THOW's as building materials can overload the axles and suspension potentials causing issues in transit.

If the trailer does not have a total weight rating tag or a weight rating tag on the axles, here's a general guideline:

House length & required trailer capacities:

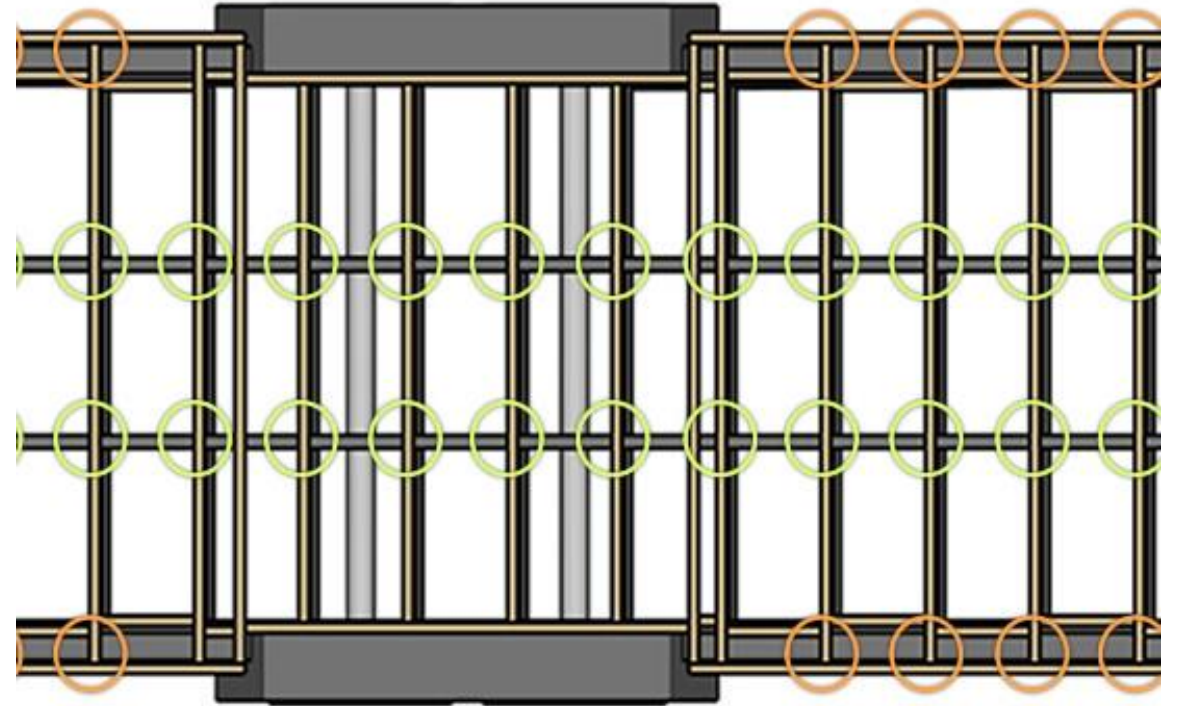
Length	Average finished weight
18'	7,000 - 9,000 lbs.
24'	9,000 - 12,000 lbs.
32'	12,000 - 16,000 lbs.

Typical Axle Diameters Based on Axle Capacity

3,500-lb axle:	2 3/8" diameter
6,000-lb - 7,200-lb axle:	3" diameter
8,000-lb axle:	3-1/2" diameter
9,000-lb axles:	4" diameter
10,000-lb or more axles:	5" diameter

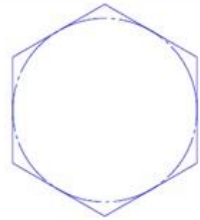
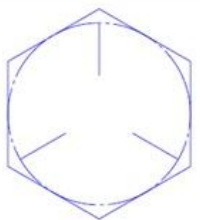
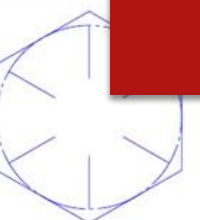
Attachment of Dwelling to Trailer

Minimum attachment for the bottom plate to the trailer is recommended $5/8''$ bolt every 6'. Every 24'' is always preferred to increase structural integrity.



Rating of Bolt

5/8" bolt attachment should be done using hot dipped galvanized SAE Grade 8³ bolts with washers on both sides for maximum strength.

Size						
	SAE Grade 2 ¹	SAE Grade 5 ²	SAE Grade 8 ³			
	Tightening Torque					
	Dry ⁵		Lubricated ⁶		Dry ⁵	
	lb-ft		lb-ft		lb-ft	
1/4-20	5.5	4	8	6.3	12	9
1/4-28	6.3	4.7	10	7.2	14	10
5/16-18	11	8	17	13	25	18
5/16-24	12	9	19	14	25	20
3/8-16	20	15	30	23	45	35
3/8-24	23	17	35	25	50	35
7/16-14	30	24	50	35	70	55
7/16-20	35	25	55	40	80	60
1/2-13	50	35	75	55	110	80
1/2-20	55	40	90	65	120	90
9/16-12	70	55	110	80	150	110
9/16-18	80	60	120	90	170	130
5/8-11	100	75	150	110	220	170
5/8-18	110	85	170	130	240	180
3/4-10	175	130	260	200	380	280
3/4-16	195	145	300	220	420	320

1. Minimum tensile strength for Grade 2 bolts up to 6" long is 74 ksi. Proof load is 55 ksi.
2. Minimum tensile strength for Grade 5 bolts is 120 ksi. Proof load is 85 ksi.
3. Minimum tensile strength for Grade 8 bolts is 150 ksi. Proof load is 120 ksi.
4. Tightening torque values are calculated using the industry standard formula $T = KDP$, where T = tightening torque (in-lb), K = friction coefficient, D = nominal bolt diameter (in), and P = bolt clamp load. Values are then converted to lb-ft.
5. Dry K value assumed to be $K=0.20$.
6. Lubricated K value assumed to be $K=0.15$.
7. Values presented in this chart are advisory reference values only and do not take individual design considerations into account. They should not be used in lieu of manufacturer specified torque values.
8. Ref: Fastening Reference, Machine Design, 1977.

www.floorjacked.com

Bottom Sill and the Trailer

If the bottom plate is a wood product, it should be either pressure treated wood or painted with an environmental protective paint.



Floor Insulation

The floor should be well insulated for the climate or climates it is intended to be used in.



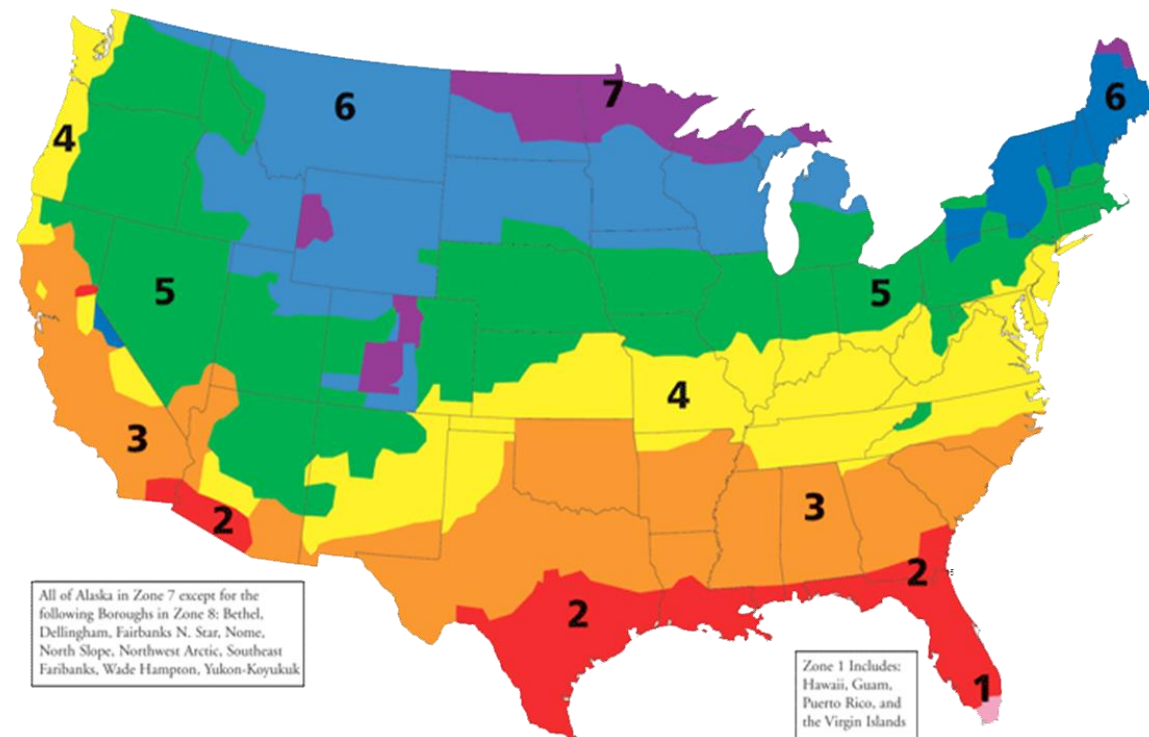
Floor Moisture Barrier

The sub floor should also have moisture/air barrier to prevent both water and air infiltration into the dwelling.



The Building Envelope

Recommendations for insulation, windows, and barriers are based off national model codes.



Insulation

Adequate insulation is hard to achieve, especially with THOW's where dimensional constraints limit the total thickness of walls allowing for insulation.

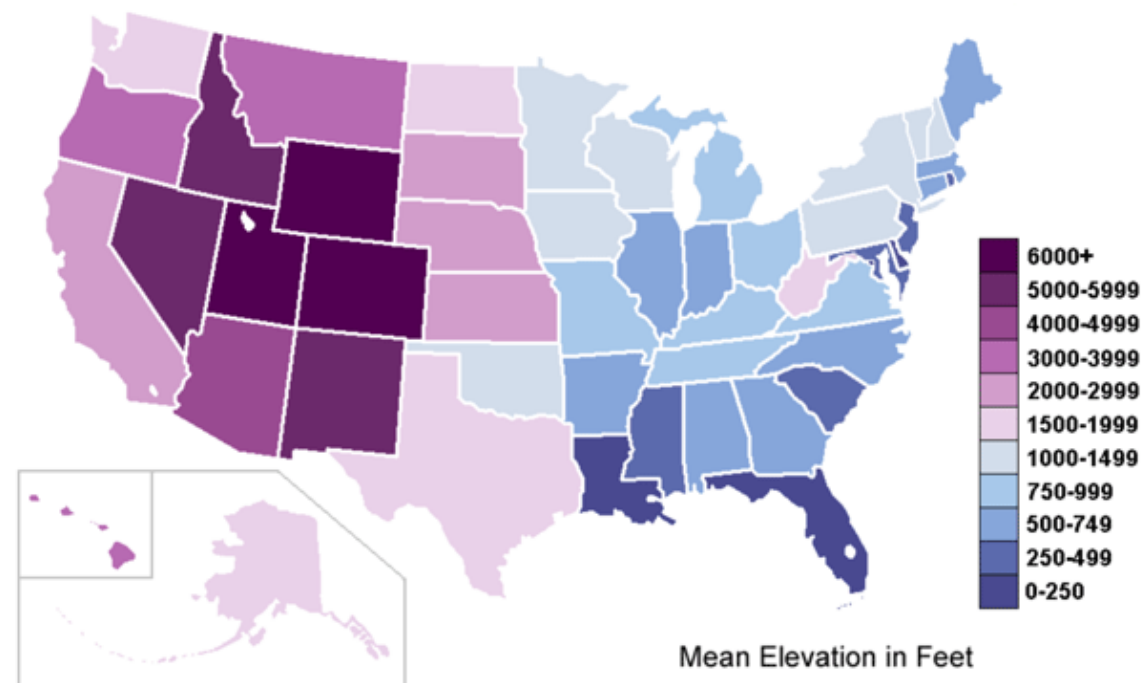
Zones	Walls	Roof	Floor
Zones 1-4	R-21	R-35	R-21
Zones 5-7	R-35	R-49	R-21

Glazed Openings

Zones	U Value	SHGC
Zones 1-4	≤ 30	≤ 25
Zones 5-7	≤ 28	≤ 32

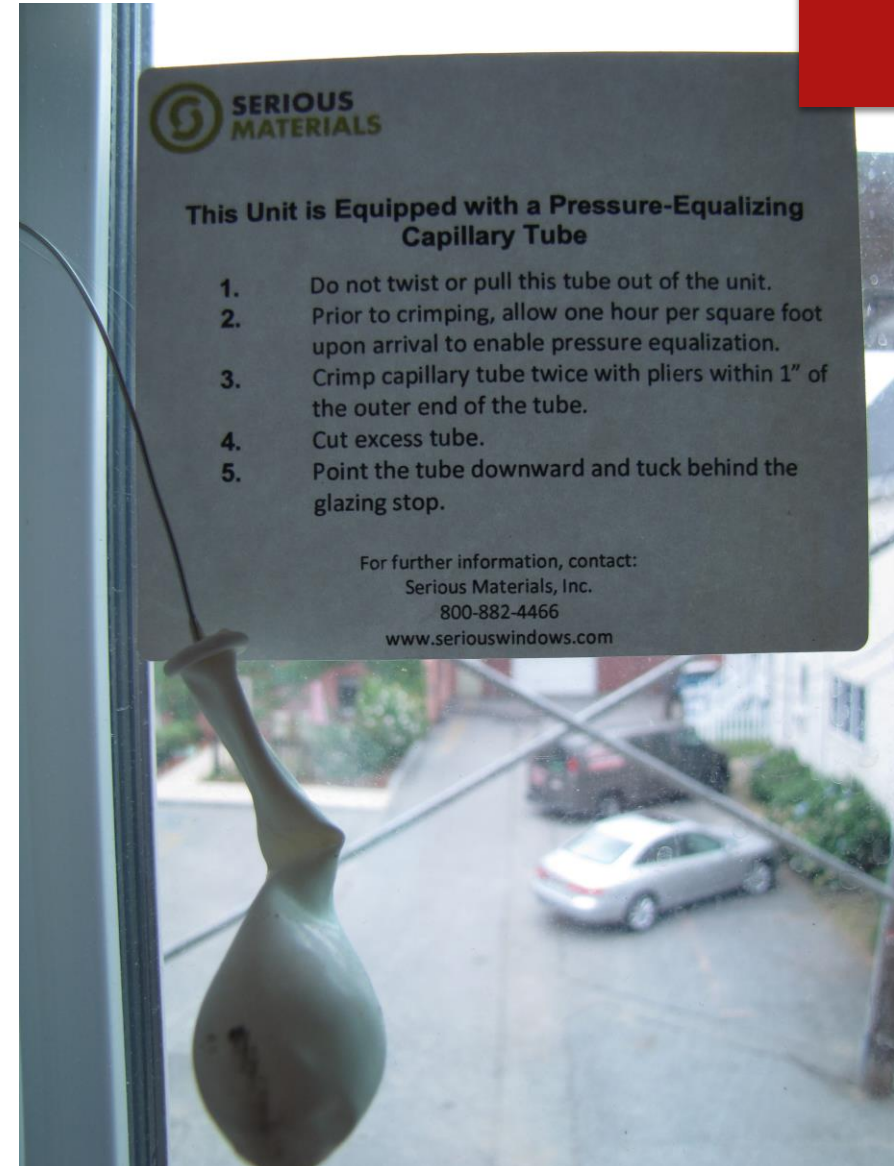
High Altitude Windows

Because Tiny Homes on Wheels are mobile, they have the capability of being relocated to high altitude. For the safety and performance, no tiny home may be taken into a high altitude area (greater than 5000 feet), high altitude windows will be required.



Caution

High altitude windows are double or triple pane hermetically sealed with capillary tubes that allow for the equalization of the changing pressures. At sea level, atmospheric pressure is 14.7 psi. At 5000 feet, the pressure is approximately 2.5 psi less. A standard window of 30'' x 40'' or 1,200 square inches will have 3,000 pounds or 1.5 tons exerted on both sides of it.

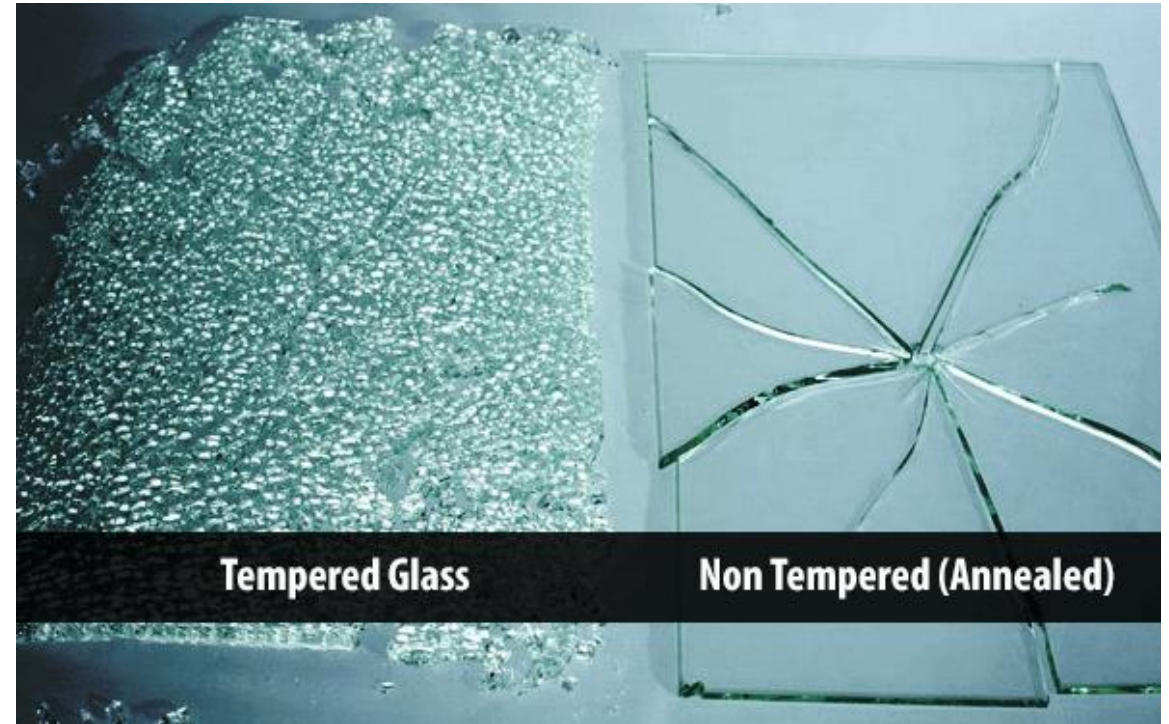


Tempered Glass Requirements

- ▶ Any Window or skylight within 24 inches horizontally of a door must be tempered.
- ▶ Any Window or Sash that is 9 square feet or more AND is 18 inches or less from a floor must be tempered.
- ▶ Any Window within a Tub or Shower area that is less than 60 inches from the floor of the tub must be tempered.
- ▶ Any Window on a Staircase Landing or within 60 inches a staircase tread must be tempered.
- ▶ Additionally, Custom Windows automatically tempers any window with 40 square feet or more of glass for safety and strength.

Tempered Glass for Transport

Because of the vibration of transported, tempered glass on all windows is recommended.



Structural

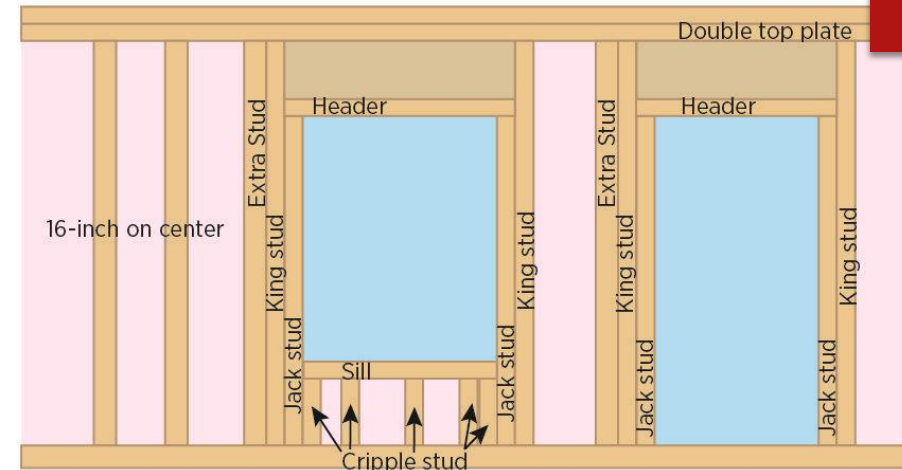
The two most common types of structural systems are:

- ▶ Traditional and Advanced Framing
- ▶ Structural Insulated Panels

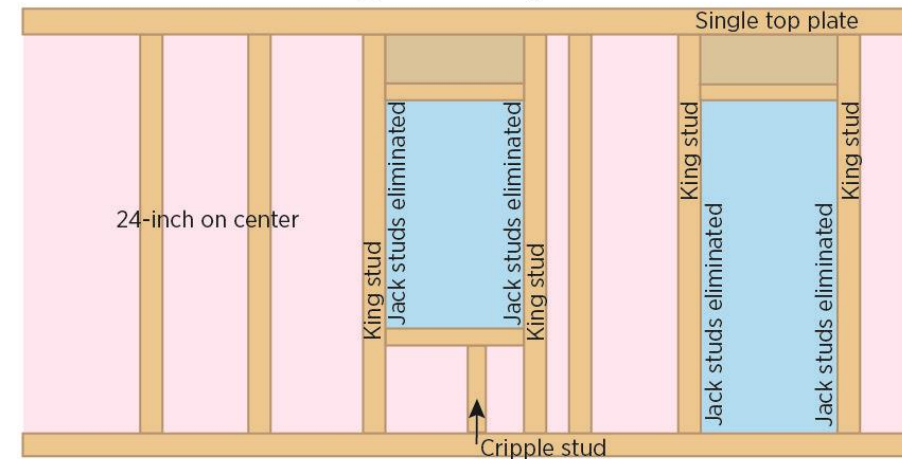
Traditional vs Advanced Framing

Advanced framing is heavier because it uses 2x6's vs 2x4's, but stud spacing is 24" on center. Wood studs act as thermal bridges. Having a larger wall cavity allows for more insulation increasing efficiency.

Traditional Framing



Advanced Framing Techniques



Framing Fasteners

Although it viewing fasteners might not be possible, because of the transport possibility, framing fasteners should either be 16D ring shanked nails or rated 3.5" framing screws. This is to prevent framing from becoming loose over time.



Structural Insulated Panels (SIP's)

SIP's offer the structural system, the exterior sheathing, and insulation.



Positive Attachment

To meet hurricane codes, resist winds and vibration during transport, and seismic requirements, positive attachment from the frame, to the wall, and then from the wall to the roof.

Recommended attachment is:

- ▶ Simpson Strong-Tie – HTT-4 at corners, before and after fenders
- ▶ Simpson Strong-Tie Hurricane Tie H2A - every stud top-plate/bottom plate; fill all holes



Materials Not Recommended

Some materials fair better than others. Because some materials are brittle or rigid, they should be avoided as vibrations during transport increase the chance of damage. Items may include:

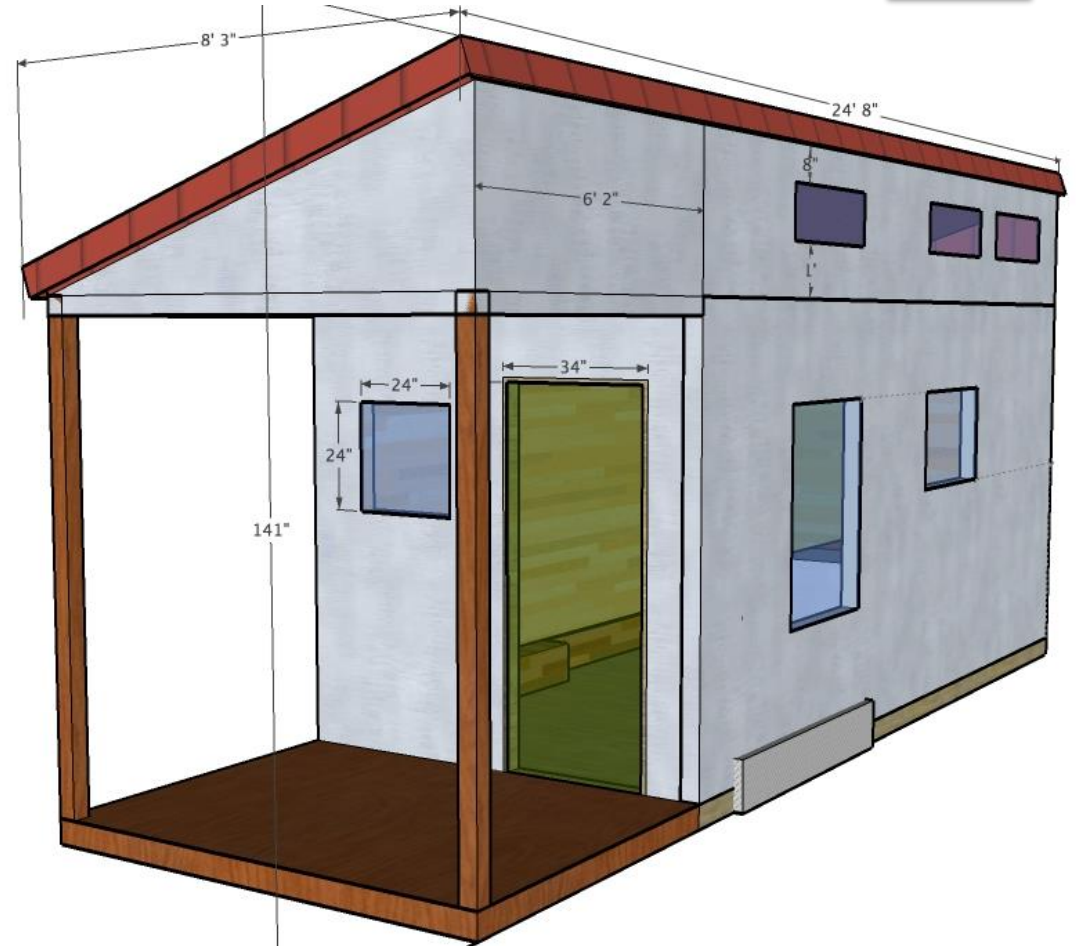
- ▶ Masonry products
- ▶ Large porcelain, ceramic, or clay tiles
- ▶ Cement board siding

These and others should be discouraged due to weight restrictions on the trailer.

Roofing

Roof Sheathing

Recommendations and guidelines for the roofing system are based on the restrictions on height of structure which in turn minimizes the pitch of the roof to low sloped of 2:12. Materials recommended are based on their waterproofing vs water shedding capabilities.



Roof Sheathing



Zones	Plywood CDX	OSB/Hybrid	Minimum Pitch
Zones 1-4	15/32 inch	7/16 inch	¼/12-2/12
Zones 5-7	¾ inch	9/16 inch	6/12-7/12

Heavy Snow Loads

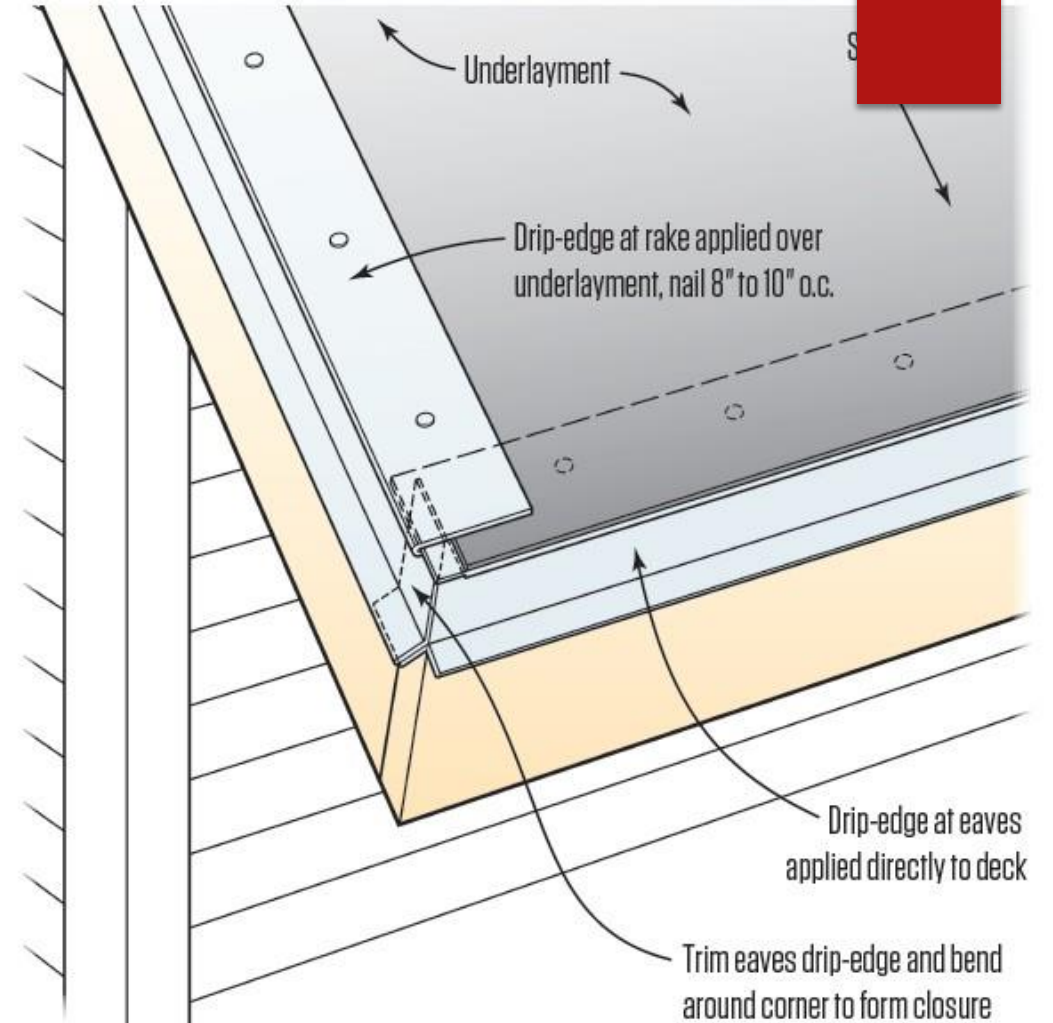
In areas where heavy snow loads are more prone, steeper pitches may be required to minimize the potential damage.

To increase longevity and decrease possibility of degradation, all ends of lumber to include sheathing shall be painted to inhibit absorption and deterioration.



Drip Edge

If the roof is constructed with zero overhang, the peel and stick underlayment shall extend over the edge of the roof to the siding. The drip edge shall also extend further over the underlayment and over 1 inch over the siding.



Drip-Edge Installation

Electrical Service

If the Tiny Home is not considered an RV, and has the ability to be strapped or directly connected to the ground, the unit should have the ability to have metered service.



Electrical Disconnect

With metered service, the Tiny Home should have a main disconnect on the exterior. It is recommended that this disconnect is located on the opposite side of all sleeping areas for safety.



Grounding

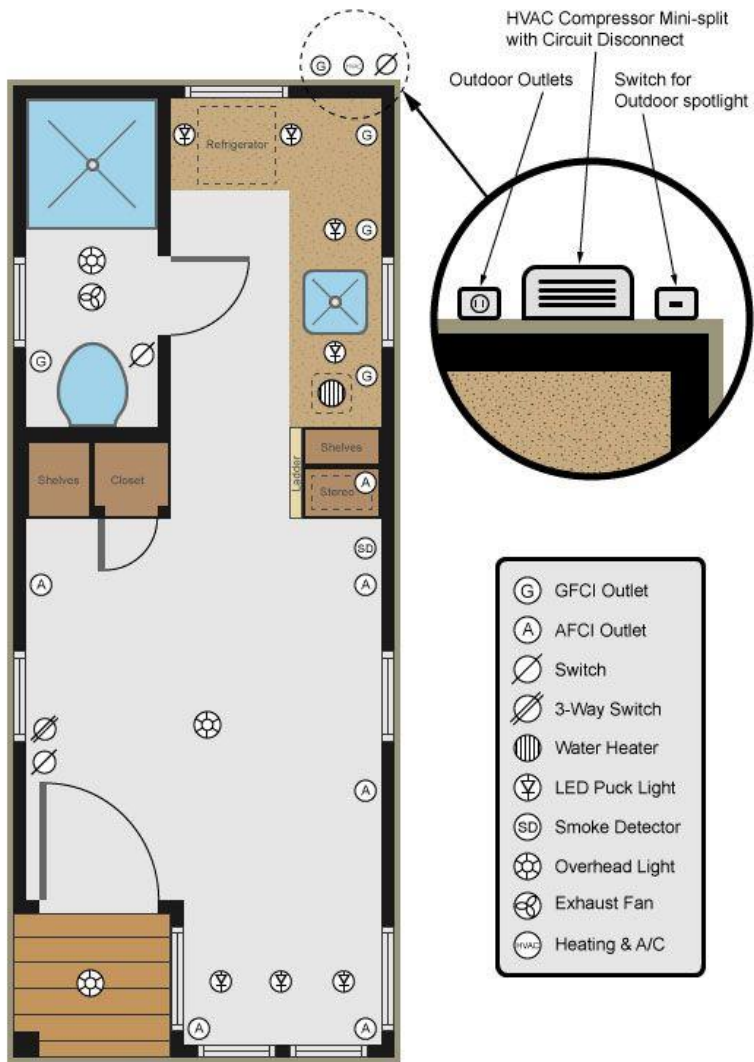
The Tiny Home should have a dedicated grounding system within 6' of the main disconnect with minimum #6 copper solid wire and minimum 6' copper or copper coated UL listed ground rod which can be laid horizontally a minimum of 18'' below the ground. 2 ground rods are recommended as this will meet or exceed all AHJ.



Electrical Outlets

- ▶ All branch circuits for living room and bedroom receptacles and lighting will be AFCI protected
- ▶ Bathrooms shall have a minimum of one dedicated 20 amp GFCI receptacle
- ▶ Kitchens shall have a minimum of two dedicated 20 amp GFCI receptacles
- ▶ The exterior shall have a minimum of two outlets on one 20 amp GFCI protected circuit, one placed with 6' of the front entrance, and one adjacent side





GFCI and AFCI Locations

Electrical Lighting

- ▶ All exterior doors shall have a light fixture within 6' from the entrance on the outside on a switch located on the interior within 2' of the entrance
- ▶ All rooms shall have a light fixture controlled by a switch located at all entrances to the room



Humidity Control

Humidity in Tiny Homes can be fatal. Constant dehumidification in moderate and hot humid climates is essential. Recommended relative humidity is between 40 – 50 %. Any higher, effects of excess moisture will start to be seen. Dew points will be reached on solid surfaces where the moisture can condense.



HVAC Recommendations

- ▶ Ductless mini split
- ▶ Variable speed compressor, air handler, condenser fan
- ▶ Heat pump capability
- ▶ Condensate drain from air handler plumbed to the exterior
- ▶ Climate zones 4-7 shall be hyper heat pumps for improved heating efficiency in the winter



HVAC Size

The currently lowest BTU size for ductless mini splits is 9000 BTU. This is still oversized for at most a 350 square foot Tiny Home. With the variable speed technology of these units, they will have the capability to lower their speed to actively dehumidify the home.



Hyper Heat Pumps

Hyper Heat Pump Differences

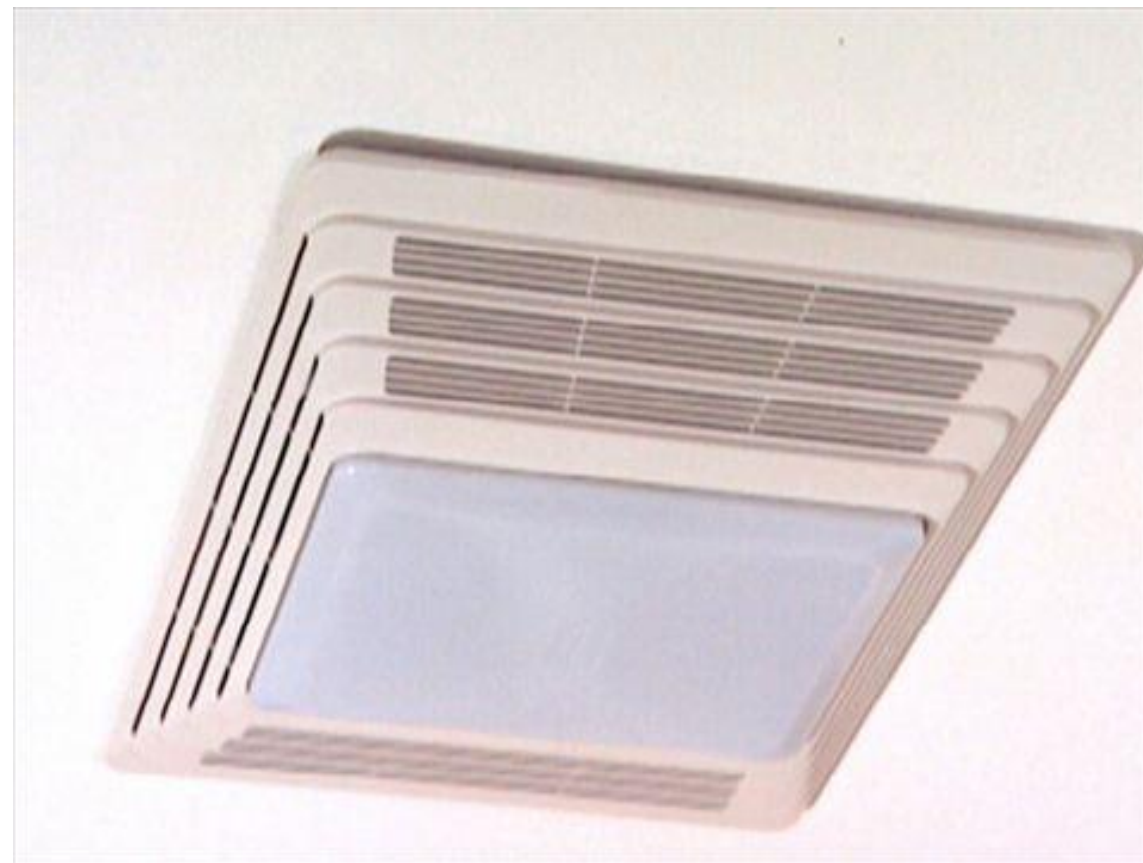
- ▶ Uses Inverter DC Compressor/Variable speed
- ▶ EVI- vapor injection in the compressor

This allows the heat pump to maintain efficiency down to -20 F making it an ideal candidate for climate zones 4-7.



Ventilation

- ▶ All bathrooms shall have humidity activated vent fans with automatic dampers vented to the exterior wall
- ▶ All kitchens shall have a vented hood with proper CFM rating matching the stove which will also have automatic damper vented to the exterior wall



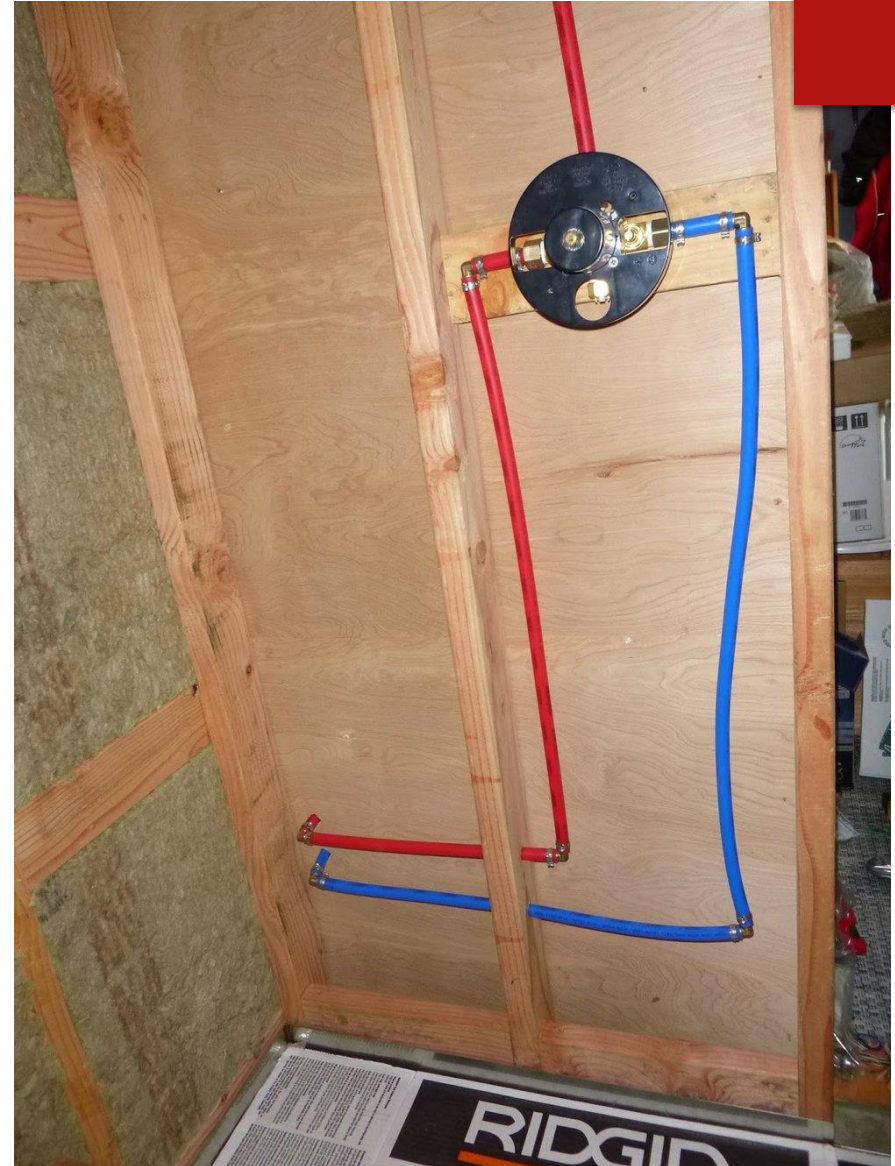
Fuel Storage and Delivery

- ▶ All propane tanks shall be located on the adjacent side of the sleeping areas and a minimum of 6' away from all egresses
- ▶ All fuel delivery pipe shall have a gas rated ¼ turn shut off exterior service entrance near the propane tank and at all appliances utilizing the fuel



Plumbing Supply Recommendations

- ▶ Due to the flexibility and resistance to bursting in freezing weather, PEX is the recommended material for supply piping.



Plumbing

- ▶ A minimum of one ¾" rated plumbing supply line shall be plumbed to the inside of the home
- ▶ A minimum of one sink and one means for bathing shall be installed
- ▶ A minimum of one toilet plumbed to the exterior shall be installed
- ▶ Composting and incinerating toilets are acceptable, and when present, must be installed according to the manufacturer's specifications. AHJ compliance may supersede.

Plumbing

- ▶ All wet areas shall be waterproofed using appropriate materials and methods
- ▶ Any joints or gaps in wet areas will only be sealed using 100% silicone sealant
- ▶ All drains will have a p-trap within 2 feet of the drain
- ▶ All drains shall have a minimum of a 2" vent or AAV located within 6'

HepVo Vents

- ▶ These traps/vents have been tested and accepted under the IRC.
- ▶ Ensure that they are properly installed.



Composting/Incinerating Toilets

- ▶ Most states and AHJ allow and even encourage composting toilets. These toilets do have installation and maintenance guidelines that must be adhered to for proper function.



Heating

- ▶ If ancillary heaters are utilized, they should be UL listed and proper clearances should be maintained. Heating via ancillary heaters, especially wood burning stoves, is discouraged as they present an increased fire risk. Proper clearance of these devices will be difficult to be maintained.



Utilities Disconnect

- ▶ All utilities that are provided by the site should have a proper way for disconnect for the ability of relocation of the tiny home.



Site Guidelines

- ▶ Site should be generally level with adequate site drainage of at least 1" per foot for a minimum of 6' away from the THOW



Tiny Home on Wheels Ground Attachment

Very much like manufactured homes, tiny homes should have the ability to be attached to ground. The most popular method will be the same method employed by manufactured homes using straps and anchors.

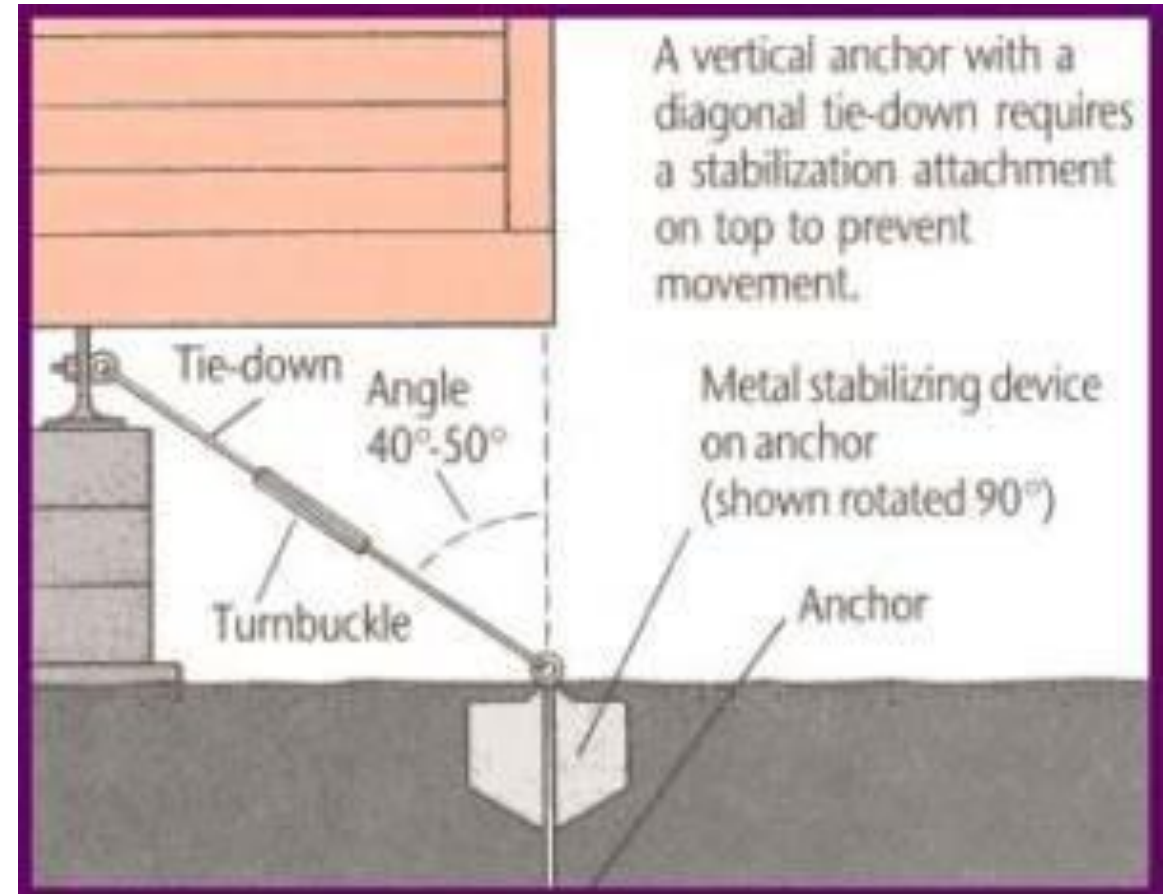


Strap Guidelines

- ▶ The same guidelines should apply for tiny homes on wheels that are for manufactured homes where a minimum of 2 diagonal and 3 vertical straps are required for up to a 40 ft dwelling. It would be strongly recommended that this guideline be applied for all THOW's no matter the length.

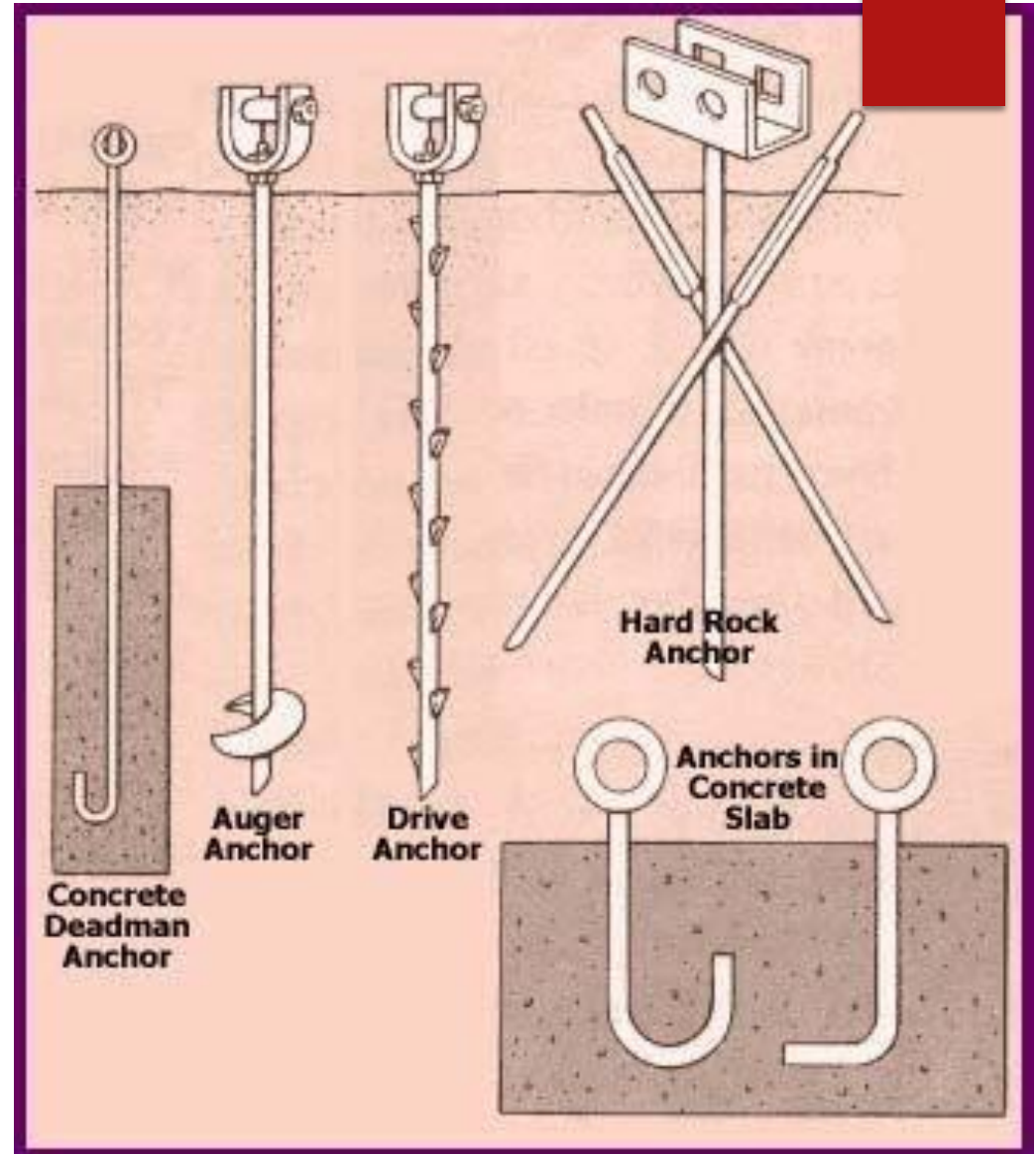
Diagonal Strap Installation

- ▶ Diagonal straps should be installed between 40 – 50 degrees



Anchors

- ▶ Your soil type will determine the type of anchor.
- ▶ Some types of anchors need to be installed five feet deep. If you will be attaching your tie-downs to a concrete foundation, make sure it is at least 4 inches thick.



Soil Types Dictating Anchor Types

- ▶ rock/hard pan
- ▶ heavy
- ▶ sandy gravel
- ▶ heavy sand
- ▶ silty gravel
- ▶ clay-gravel
- ▶ silty clay
- ▶ clayey silt
- ▶ uncommitted fill or peat/organic clay