

# Andrew Morrison's Straw Bale Special Reports

## *Installing Toe Ups*



**Structural, interior toe up ready for installation**

**T**oe ups are the wood members that hold the bales off of the floor, and I strongly recommend that toe-ups be constructed from 4x4 material. This dimension provides adequate height off of the concrete floor for the protection of the bales against potential water leaks, ample nailing surface for the wire mesh attachment, and extra strength for the engineered shear system. In seismic studies performed by engineers in California, the 4x4 sills and toe-ups performed significantly better than 2x4 or double 2x4 sills and toe-ups.

Interior toe-ups should be installed only after you have completed all the framing and right before you are ready to begin baling. Installing these boards too early creates a tripping hazard on the site. Be sure to know the width of the bales you will be using before you install the toe-ups. Pull a tape from the outside of the foundation and

mark the location for the toe-ups so that the bales will overhang the toe-ups by roughly one inch once installed. Snap a chalk line to delineate the outside edge of the toe-ups.

Toe-ups need to be anchored into the foundation. (When working on a concrete slab foundation, install the bolts after the concrete has cured. Placing them during the concrete pouring stage will only create a tripping hazard during the framing process.)



To ensure the correct bolt location, I do my layout on the toe-ups and drill out the bolt location with a spade bit on the 4x4s first. I then place the wood on the chalk line and use a rotary hammer drill to drill out the concrete.

There are a number of ways to anchor the toe-ups to a concrete slab. A simple and inexpensive way is to use “all-thread” bolts and epoxy adhesives. The simplest adhesive I have seen is made by Simpson Strong Tie™ and is called VGC-50. This product

comes in small glass tubes so there is no mess and no mixing of adhesives necessary.

The size of the hole drilled in the concrete will need to be a bit bigger than the size of the bolt to be placed into it. This allows for the epoxy to cover the sides of the bolt with enough material to hold the bolt to the concrete. For a 1/2" bolt, drill a 9/16" hole. Be careful not to drill below the bottom of the concrete as the adhesive will simply squish into the sand bed below the concrete and not hold the bolt in place. Use an air compressor to clean out the hole, scrub it out with a pipe cleaning brush and then



spray it out one more time. This removes the loose debris which may interfere with adhesion. Slide the glass tube in and place the all-thread or bolt on top of it. The toe-up will hold the bolt from falling over. Place a washer and nut on the bolt and hammer the bolt down into the hole. This breaks the adhesive tube and sets the bolt in place. Be

sure to have the nut covering the end of the threads before you hit them with a hammer.

If you forget the nut, the threads will be damaged and the nut will not fit the bolt anymore. The set time is about twenty minutes in 68° F weather.



If you don't have the luxury of waiting 20 minutes for the epoxy to set up, use expansion bolts or wedge anchors similar to the one shown below. Once you have drilled the holes as described above, blow them out with compressed air and drive the bolt down with a hammer. No mess, and no wait. As soon as they bottom out, you can start installing the toe-ups. These bolts are a bit more expensive; however, if you are paying for labor, the time spent in waiting around for epoxy to dry will far exceed the cost of the bolts.

Toe-up sections that run parallel with exterior walls are part of the shear system and by code, need to be anchored down at the same intervals as your exterior mud sills. This could vary from every four feet on center to every two feet on center. Regardless of what spacing local codes require for the anchor bolts, a bolt must always be placed within one foot of the end of a sill or toe-up. Smaller sections of toe-ups that connect the interior toe-ups to exterior sills at doors and other stops in the bales, do not need to be anchored to the concrete. These are not structural and as such, can simply be toenailed to the sills and toe-ups.

If you intend on having rounded door openings, hold the toe-ups back a reasonable distance from the line of the door jamb. I like to hold the toe-up back by a 45° angle from the jambs. This gives me plenty of room to create curved openings during the baling phase.

Once all of the toe-ups are installed, place a strip of 15# roofing felt in between them directly on top of the concrete. This helps keep moisture from seeping from the



concrete to the bales and is required by most building codes. On top of the roofing felt, add clean gravel or three inch rigid insulation. The insulation acts as an additional weather barrier in cold climates and the gravel acts as a drainage way for any water that may find its way into the house. I prefer to use gravel on the first story and insulation on the second floor as the weight of the gravel on the post and beam frame can require extra engineering and larger framing members.

Lastly, drive 20 penny nails every three or four inches, staggered from one side of the toe-up to the other. Do this on both the toe-ups and the mud sills.

These nails act as grabbers for the bales and are used in place of the old system which required the bales be impaled on rebar embedded in the concrete. The old

system did not work nearly as well and it created a path for moisture to enter the bales. When the bales are pushed down on these nail beds, they are rigid and secure. They are then attached firmly to the toe-ups and thus the foundation.

# Special Report Quiz

## *Installing Toe Ups*

1. Is it just as good to use doubled up 2x4's for sills as a 4x4's?

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2. When should the anchor bolts for the toe ups be installed? How about the toe ups?

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3. What is the easiest way to anchor interior toe ups? Is it also the most economical?

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4. Where do you stop the interior toe ups around door entries?

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5. What two things are placed in between the sills and toe ups on the first floor?

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6. What is the minimum requirement for anchor bolts, regardless of the spacing?

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7. How are the bales anchored to the foundation?

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8. Why are 4x4 sills and toe ups important for a straw bale house?

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9. How do you ensure the toe ups are installed straight and exactly where you want them?

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10. Is it easier to drill the holes in the concrete and install the anchor bolts first or should you drill the holes in the toe ups first and then drill and install the anchor bolts?

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# INSTALLATION CHECKLIST

## *Installing Toe Ups*

1. Do not install any anchor bolts for the interior toe-ups during the concrete pour. Use drilled in wedge anchors, expansion bolts, or epoxy bolts during toe-up installation.
2. Know the width of your bales before laying out any interior toe-ups.
3. Measure from the outside face of the foundation to the width of the bale. Make a mark at either end of the run and snap a chalk line between the two marks.
4. Cut 4x4 material to length, keeping in mind that you will need to hold back the interior toe-ups from doorways. Layout a 45° angle from the door jambs to locate the edge of the toe-up.
5. Layout anchor bolt locations based on local code requirements. One bolt must always be placed within 12" of the end of a board.
6. Drill holes into toe-ups with a spade bit and place back on chalk line.
7. Use a rotary hammer drill to drill concrete through the holes in the toe-ups to transfer layout accurately to the slab. Be sure the toe-up is on the chalk line before you drill the hole.
8. Attach toe-ups with anchor bolts of your choice. Securely tighten the nuts on the anchor bolts being sure the toe-ups are on the chalk line.

9. Cut and place tar paper in between the toe-ups and the sills.
10. Add clean 3/4" minus gravel on top of the tar paper. (Use 3" rigid insulation on the second floor)
11. Stagger 20d nails from one side of the 4x4 to the other, 3" on center on both the interior toe-up and the exterior sill. Only sink the nails enough to grab the lumber as the heads of the nails are required to grab the bales.
12. Clean the site and prepare for bale installation.