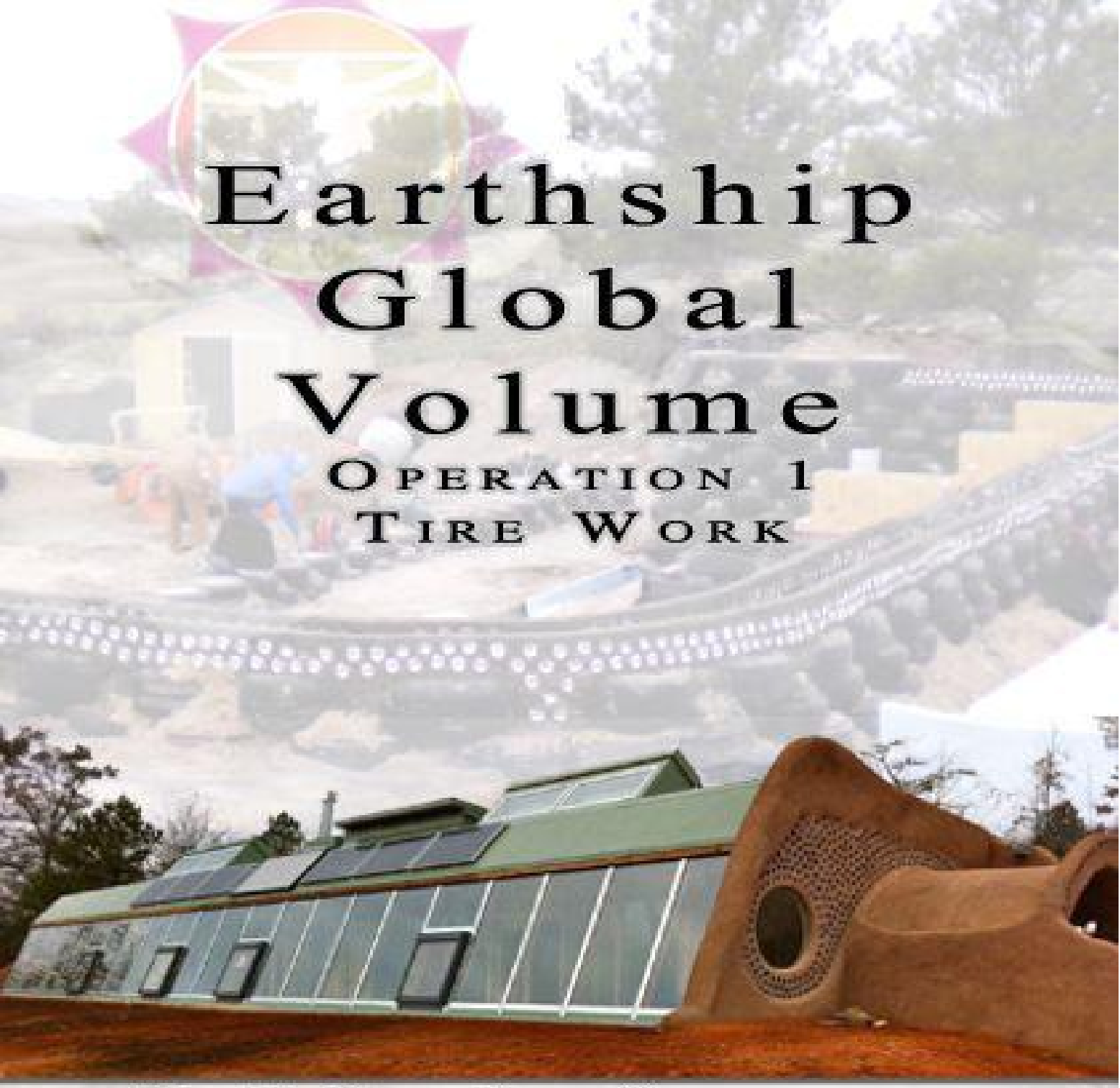
Earthship Global Volume

Operation 1
Tire Work



How To Build Your Own

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Earthship Biotecture
Radically Sustainable Buildings

Earthship Global Volume: Operation 1

Ground Course, Thermal Wrap, Vent Tubes, Cistern Installation, Front Stem Wall.

Table of Contents

Introduction

This booklet is the first in a twelve part series of "how to" operations booklets on building the Global Model Earthship. With input from the Earthship crew, this 38 page booklet takes you through, step by step, on the tire work phase of a typical Global Model Earthship. It covers building walls, thermal wrap, vent tubes, cistern installation and front stem walls. Photographs, diagrams and thorough explanations of procedures will guide you through the tire work phase of the building.

This will set you up for the next two phases, Operation 2 - Concrete Work and Operation 3 - Plating (coming soon). After those there will be

nine more phases to take you through to the finish of your Global Model Earthship. This is a valuable tool for the owner builder or a professional who wants to get familiar with the building of Earthships. Look for Operation 2 soon.

Operation 1: Overview

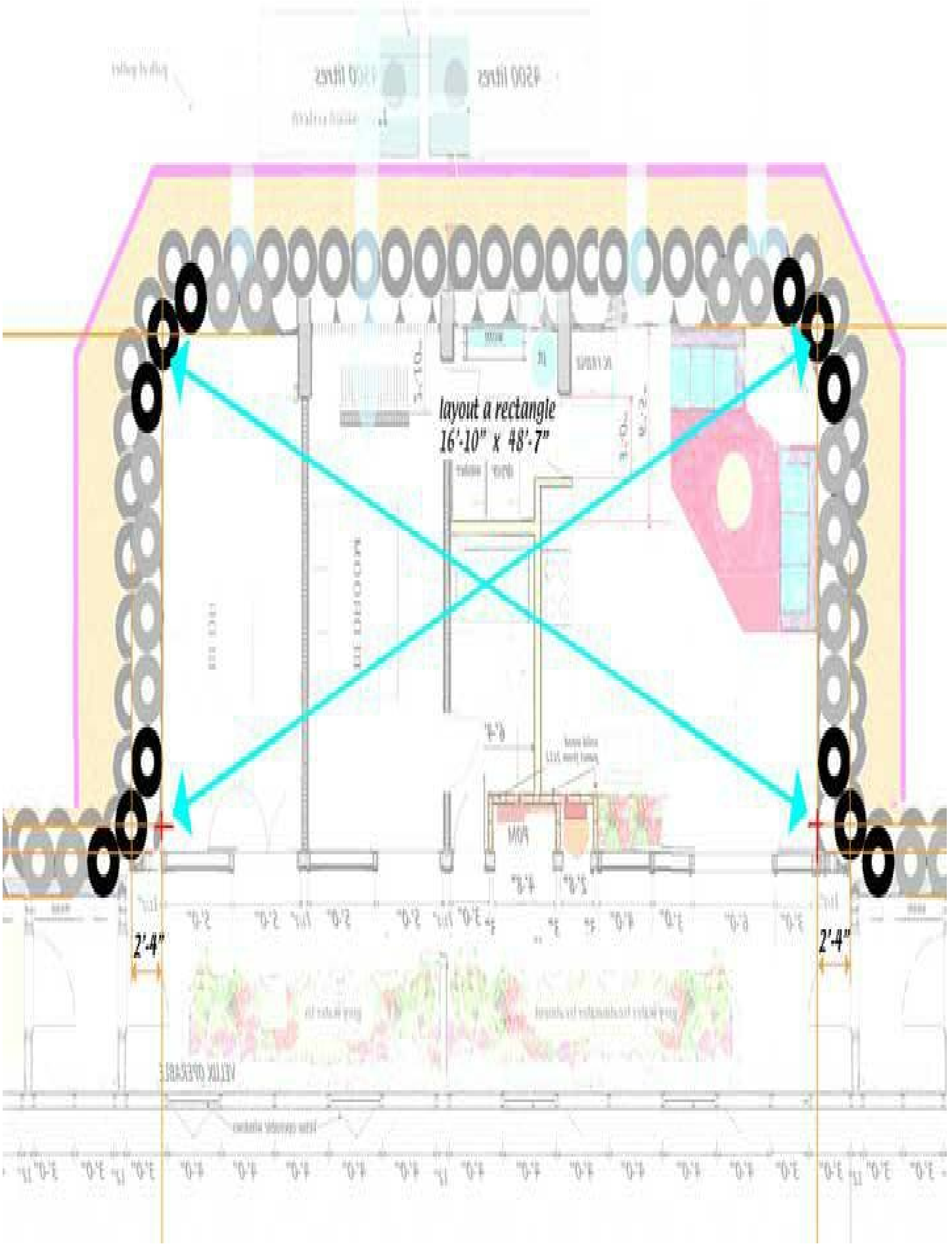
The first part of constructing your building is the most important part. Take your time, double check your work, then triple check your work.

- Layout first tires and string lines.
- Pound first few courses.
- Begin Thermal Wrap & Layout Vent Tubes.
- Pound more tires & prepare for Cisterns.
- Place Cisterns and finish Thermal Wrap.

Layout

Layout your building with string lines on a "table top" (flat and relatively level building site) as per the Layout Sheet in your construction drawing set. You will create a rectangle on the ground using the Pythagoras Method. This rectangle must be square, meaning each corner must form a precise 90 degree angle. The diagonal measurements must be the same to insure a precise square rectangle. The dimensions of the rectangle depend upon your specific design of your building. See the Layout Sheet in your construction drawing set.

The two ends of the rectangle are the North/South lines and are lined up 13.5 degrees East of Magnetic South. This allows the building to reach out and grab the morning sun.


layout a rectangle
16'-10" x 48'-7"
2'-4"
2'-4"

Ground Course

You are ready to place the first course of tires - again - on a relatively level site! Shoot the east and west empty tires in with a site level after placing them. It is important to start both ends level.

If you have a lot of people on site, you can work the entire course. Split up into groups with good spacing so swinging tools do not hit anyone.

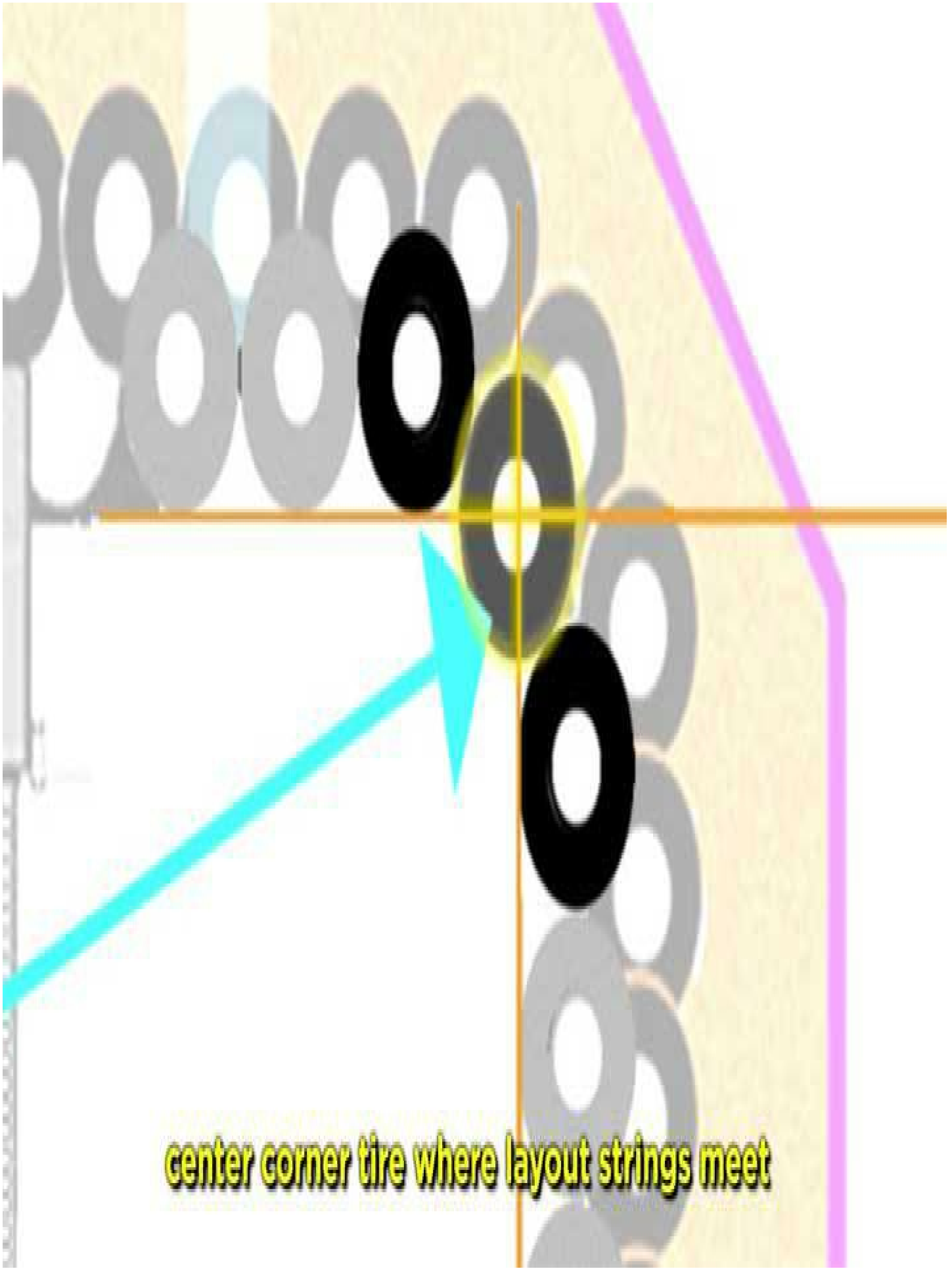
A tire size of 235-R75-15 is ideal for the first two courses. You may also use 245 75 R16s for the first few courses. Cut pieces of 6 mil plastic 3' x 6' and fold in half so you have a 3' x 3' double thickness piece. Place the cut and folded piece of plastic in each tire for the FIRST course.

This is most important in more moist climate. Cardboard goes into the rest of the tire courses before dirt.

On the first course of tires, be sure each tire just barely touches the string lines from the Layout section. Each tire must touch the tire next to it and be in line with the rest of the tires when the tire is complete. Pound the first course of tires and define your building. Pound tires hard and tight to eliminate the potential of settling.

Day 1: Layout and Ground Course.

Three Tire Turn


center corner tire where layout strings meet

To establish the corners of the building (the three tire turn), extend the layout tangent lines until they cross, where they cross is the center of the corner tire. The three tire turn occurs at all corners.

As you pound the tires, identify a 'bench mark tire'. This tire will be used to level all others tires, so it must be hard, tight and level. When you have tires pounded on both ends of the building, shoot them in with a builder's level to be level with the bench mark tire. Level tires at either end of the building with each other and the bench mark tire. This is an important measurement to do on every course in a few different places. Making sure the tire courses go up level is very important to the structure and up coming details of the building.

The first course of tires takes the most amount of time and requires proper placement. All other courses of tires, the rest of the tire walls, will be defined by the first course. Double check all of your measurements when the first course of tires is complete. Make sure the building is the correct size and all tires are level to each other.

Pounding Tires

Tire walls are made by laying tires in staggered courses like bricks or concrete blocks. Each tire is filled with compacted earth, so that it becomes a rammed earth brick encased in steel belted rubber. A pounded tire weighs 250 - 300 pounds, therefore, all tires are pounded in place and only minor movements can be made after the tire is fully pounded.

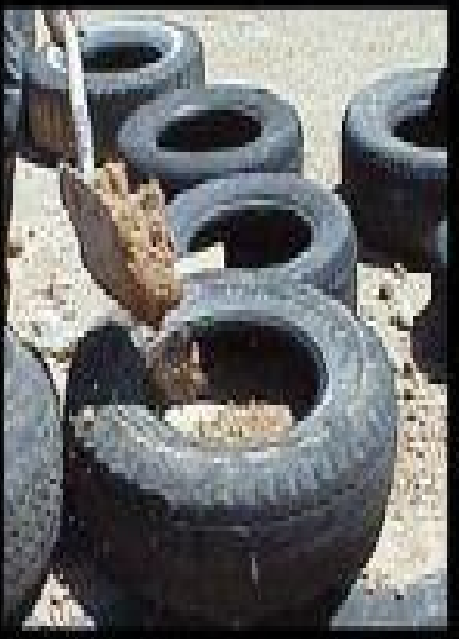
The tires are set on leveled undisturbed ground and pounded in place using a sledge hammer. Each tire takes about three wheelbarrows of dirt. The tires are pounded level in all directions. Scrap cardboard or empty cement bags are used to fill in the holes in the tires and make them contain the earth on all courses other than the first course which is flat on

the ground.

The first course gets a double layer of 6 mil plastic in the bottom of each tire. Since both sides of the tire wall will eventually be buried or covered by plaster, the cardboard could decompose without affecting the structure.

Basic step-by-step to pound a tire:

1. Layout tires for pounding in place.
2. Place two to three layers of cardboard in the bottom of each tire to temporarily keep the dirt in - plastic in the first course.
3. Stuff tires with dirt by hand.
4. Pound dirt into tire casing with an 8 lb. sledgehammer
5. Level the tire in all directions and to the other tires nearby.
6. Tamp the dirt in the middle of the tire.



What size tires to use where?

Large sized tires are used at the bottom of the wall, smaller sized tires are used at the top of walls. 15s or 16s (a large tire size) with plastic in the bottom are used for the first course of tires (see image, pg 7).

245 75 R16s can be used for the 1st, 2nd and 3rd courses, then you can use 15s. 235 15s for course 4 and 5; 225 15s for course 6 and 7; then 215 15s for course 8 and 9, then course 10 can be 205 15's. Also 14s can be used on the top courses.

Important: Larger sized tires at the bottom of the wall, smaller sized tires at the top of walls.


215/15 or 205/15
215/15
225/15
235/15
235/15 or 235/16

Tire Walls

As described previously, tires in the second and above course have cardboard in the bottom to hold the dirt in. Each course is battered, meaning each tire is 1.5 inches back from the tire course below it.

The adjustment of the tire batter is done just before the tire is finished being pounded. When the tire is level but the center of the tire has not been tamped yet, adjust the tire to be battered back 1.5 inches from the course below.

When the tire is where you want it,level the tire and tamp the middle. Check the batter again, be sure it is 1.5 inches back from the tire below it. Check the level of the tire again. When the tire is level and battered correctly, the tire is complete, move on to the next one.

Every course of tires is set back / battered

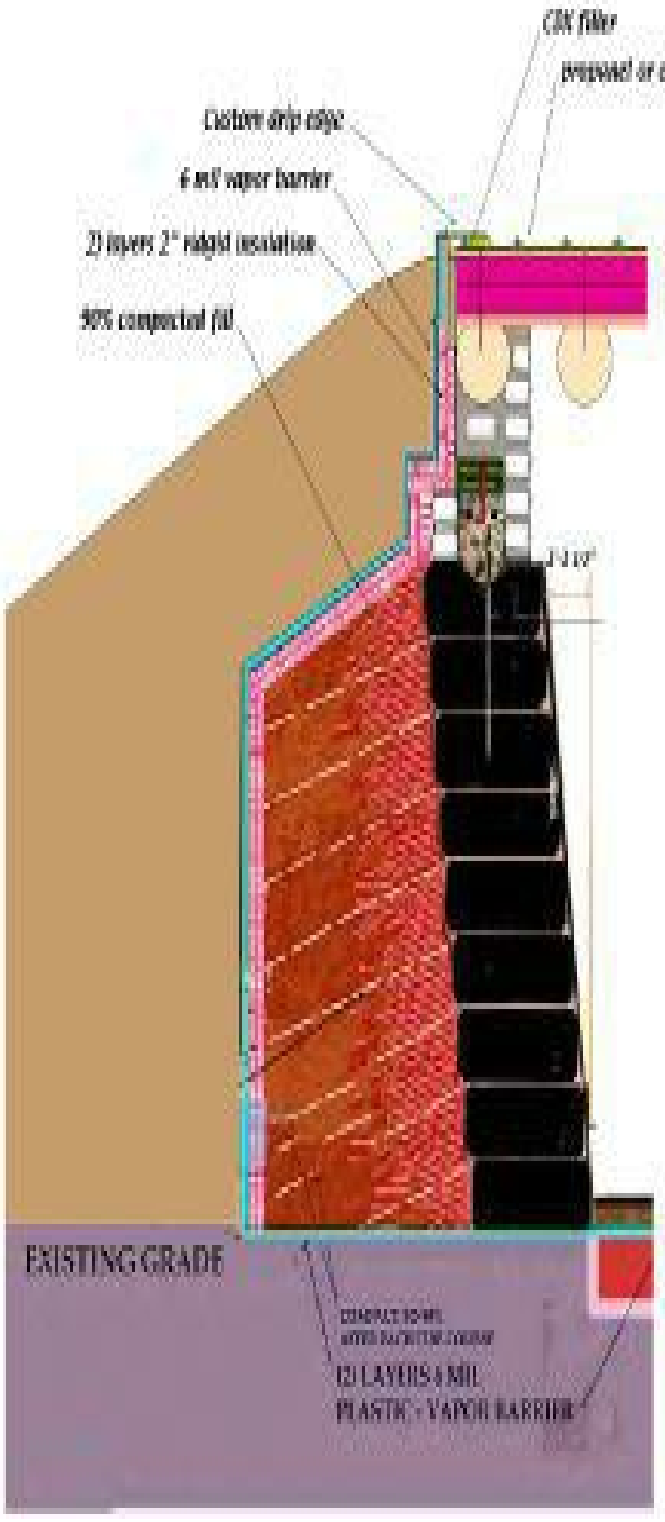
1.5 inches from the course below it.

To check the batter you can use a four foot level vertically. Place the level on the tire below and hold it vertically. When the level is plumb, straight up and down, measure 1.5 inches back from the level to the tire in the above course.

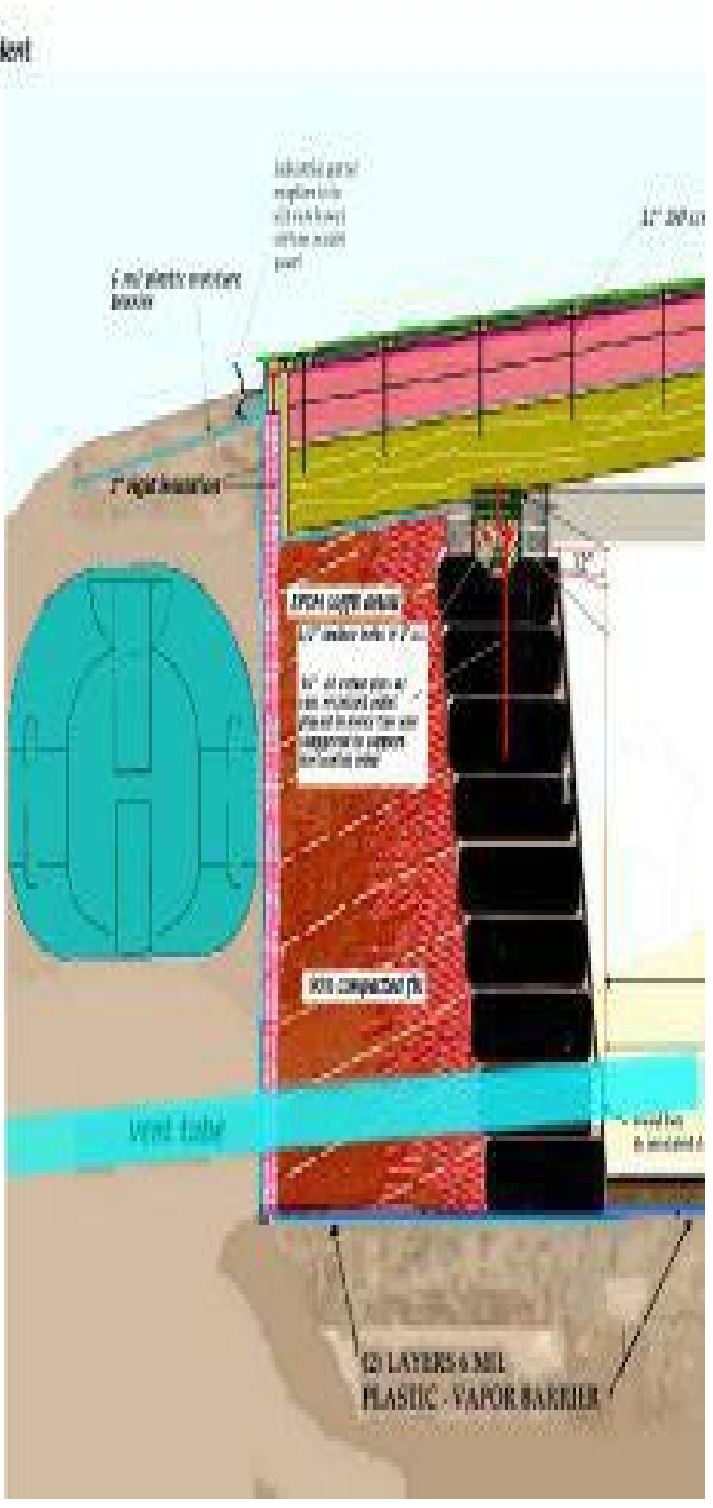
To double check, you can measure 3 inches back from two course below. The picture at right shows a 3” batter from the second tire course below.

Thermal Wrap

EAST/WEST



REAR



The thermal wrap is a four inch barrier of

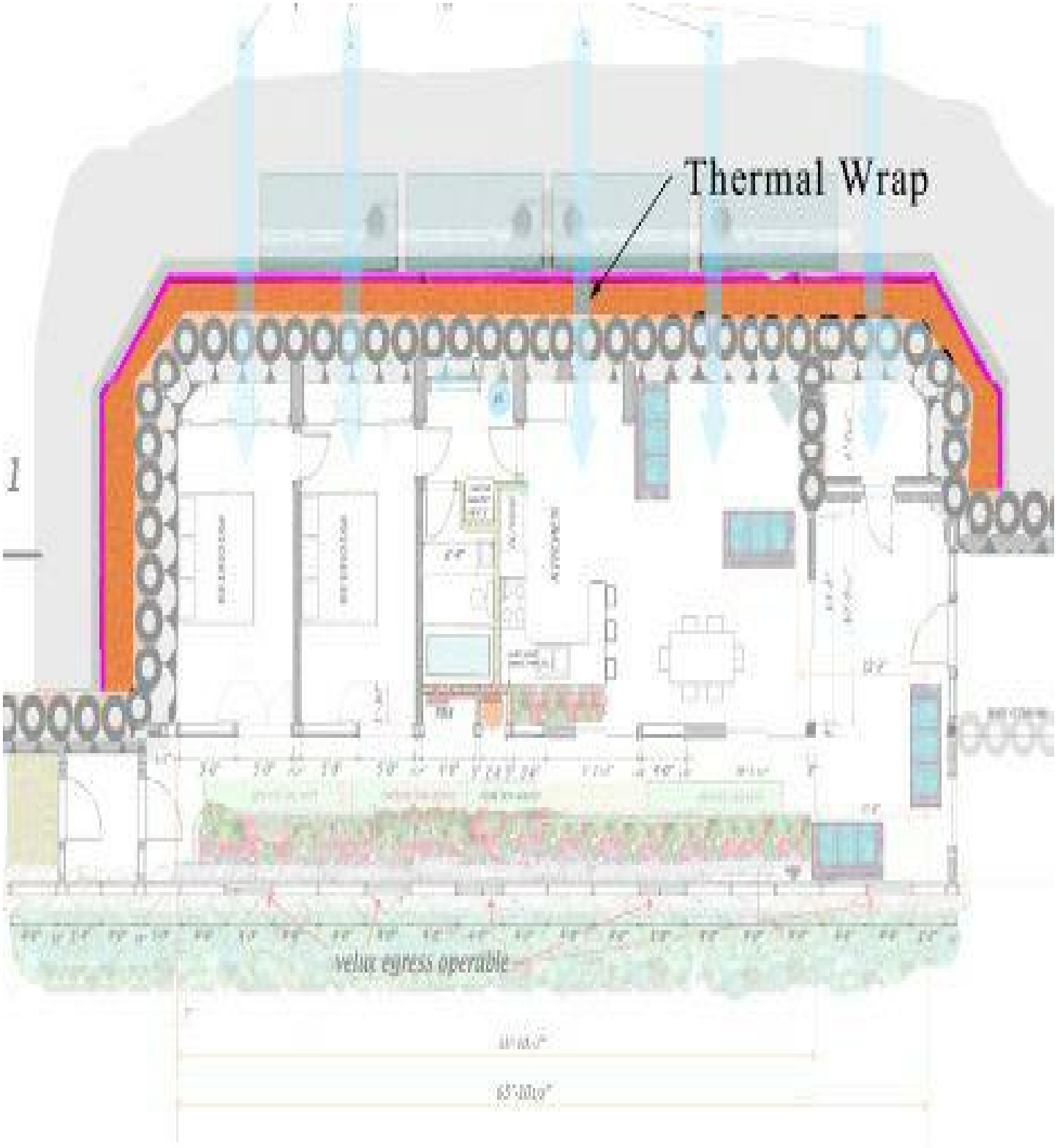
perimeter insulation (about R20) around the building. This barrier starts at the same level as the first course of tires and is four feet away from the tire walls. The thermal wrap stops directly into the tire wing walls. As the batter of the tire courses go up, the thermal wrap insulation is cut to fit into the wing wall.

As the thermal wrap goes up, it must be plumb (vertically level). This means it must go up straight. The entire thermal wrap will be done in

24” or 48” tall sections and plastic is hung to the outside of the thermal wrap as one of the vapor barriers to help keep moisture out of the building.

The thermal wrap is capped at the top with another four inches of insulation going back to the building. The entire mass of earth within the thermal wrap combines with the rammed earth of the tire wall to become a ‘thermal battery’ for your home.

This is a ‘system’ being installed. This ‘comfort system’ has no moving parts and uses no electricity. The ‘comfort system’ interacts with the physics of the earth to help keep the home comfortable in any climate, anywhere on the planet. The ‘comfort system’ costs nothing to run, requires no fossil fuels and is always on.



Steps to install the thermal wrap:

1. Prepare the rigid insulation into 24” or 48” tall pieces.
2. Fasten (2) two inch thick pieces together with a few16d nails.
3. Measure four feet from the tire wall at the first course.
4. Cut around vent tubes.
5. Install vapor barrier and top flap of plastic.
6. Place the second section on top of and plumb with first section, stagger joints.
7. Shingle plastic down over first section plastic.
8. Cap thermal wrap, maintaining good connections.
9. Place 6 mil plastic on top and extend out past thermal wrap.

Install the thermal wrap

1. Prepare the rigid insulation into 24” or 48” tall pieces.

The 4” thick 24” tall rigid insulation panels should be ready and available and close to the people installing the thermal wrap. The ‘pink’ or ‘blue board’ as it is called, is available at most hardware stores. It comes in 4’ x 8’ sheets that you break in half the long way and then double them.

2. Fasten (2) 2” pieces together with a few 16d nails.

The panels are formed by pinning together (2) 2” layers of the perimeter insulation When the connection between the insulation panels are tight, push or hammer though the 16d nails every 24 inches or so to temporarily connect the

insulation panels together.

3. Measure four feet from the tire wall at the first course.

Place the insulation panels four feet away from the tire work. Begin on the ground, the same level as the bottom of the first course of tires. A common four foot level available at most hardware stores works well as a measuring device as to where to place the thermal wrap. Bury the insulation panels on both sides making sure the panels remain plumb, vertical straight up and down. On the exterior, bury only to ten inches BELOW the top of the first level of insulation panels. Use the four foot level vertically to make sure the insulation panels are plumb, straight up and down. Each panel should fit together as tightly and 'cleanly' as possible. We do not want any gaps where temperature can leak in through the thermal wrap making a cold bridge. Place the insulation panels with the plastic

in the outside of the thermal wrap facing away from the building. Be sure to overlap (shingle) all pieces of plastic.

4. Cut around vent tubes.

As it is very important that all seams and connections are as tight as possible, the holes cut for the vent tubes must be sealed with plastic and even use duct tape to tape the plastic to the vent tube. Cut the hole in the insulation panels as close to the size of the vent tube as possible. Plug any gaps in the insulation panel with smaller pieces of insulation.

5. Install vapor barrier and top flap.

Attach a layer of 6 mil plastic to the OUT side of the 4”thick x 24” or 48” tall rigid

insulation panels. The top of the insulation panel needs to be covered with plastic to prevent any dirt from getting in between the panels. This is achieved by just lapping the outside plastic cover up and over the top of the insulation panel. This plastic on the outside of the panel is one of the vapor barriers of the building to isolate the thermal wrap from moisture.

6. Place second section on top of and plumb with first section.

The second level of insulation panels are placed directly on top of the first level panels. Again, you want a tight seal between panels, be sure to clean dirt off the top of the first level insulation panels.

7. Shingle plastic down over first section plastic.

The plastic on the sides of the insulation panels facing away from the building are

‘shingled’ - overlapping about ten inches down so that if water were to run down the side, it would not get into and touch the insulation. This creates a kind of vapor barrier around the thermal wrap insulation panels. Bury the insulation on both sides, make sure the insulation panels remain vertically plumb. Make sure all seams remain tight and as sealed as possible.

8. Cap thermal wrap, maintaining good connections.

Now the two levels of 2” vertical insulation panels are capped with plastic and buried on both sides. The dirt inside of the thermal wrap insulation panels is smoothed out sloped to receive the insulation panels on top. The goal is as few air gaps as possible. The top cap insulation panels are cut to achieve the least amount of gaps possible AND connect to and over lap the top of the vertical insulation panels

securely and tightly. Always stagger joints to keep the cold temperatures from leaking into and under the thermal wrap.

9. Place 6 mil plastic on top and extend out past thermal wrap.

Place a double layer of 6 mil plastic on top of the insulation panels and down over the last level of vertical insulation panels. Again, shingling over the next layer of plastic by about ten inches. Bury the top of the insulation panels with ten inches of dirt and cover that with a 6 mil plastic skirt going out eight feet beyond the thermal wrap.

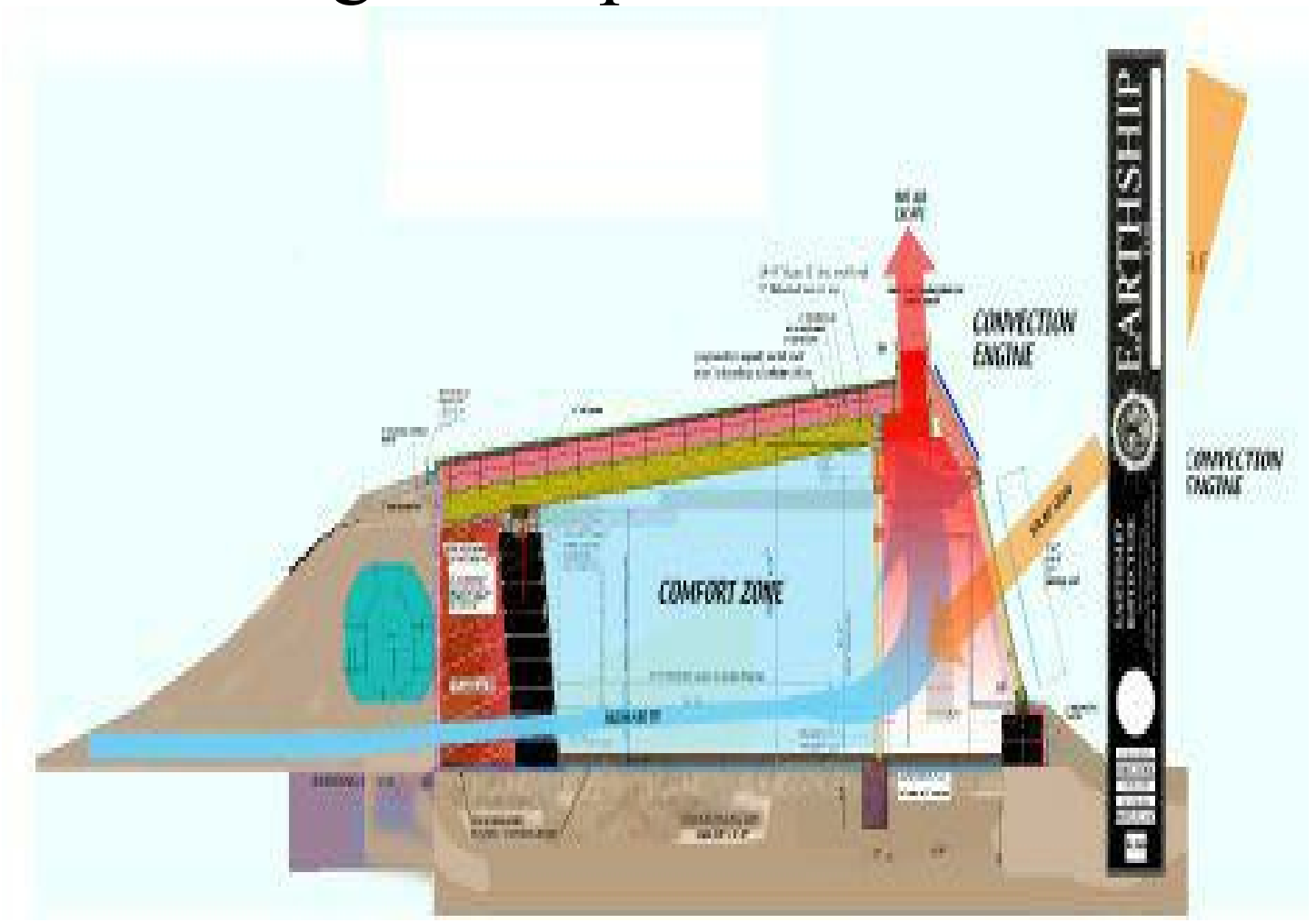
The thermal wrap is a very important aspect of how an Earthship helps to keep you comfortable all year long in any climate. Be sure to spend the time and attention to detail and seal the four feet of thermal mass/compacted earth with the perimeter insulation panels. The earth mass encased in the thermal wrap is a

temperature battery that stabilizes and charges the thermal mass in the tire wall.


CASE

Vent Tubes

Vent Tubes are installed within the first courses of tires. The specific course of tires depends upon landscape, room configuration and other factors. The vent tubes usually enter the building in course two and gently slope away from the building at 1/4" per foot.



Steps to install the vent tubes:

1. Prepare dirt slope and gap in tires for vent tubes.
2. Place the vent tubes.
3. Concrete Block.
4. Bury the vent tubes.

The vent tubes are 10 inches in diameter and 40 feet long, although the length may vary depending on your site and climate. The vent tubes may also be perforated to allow condensed

moisture to leave the vent tube. The moisture is collected when the temperature of the air in the tube is hotter than the surrounding earth. This causes condensation on the inside of the tube. In a typical two bedroom Earthship, there can be six vent tubes.

Air movement through the tubes is created from a natural convection via heated air in the top of the greenhouse. There is a door to close or open the vent tube from the inside of the Earthship.

Install the vent tubes

Vent tubes that are typically used in Earthships come in 20 foot lengths and have a 10 inch diameter. In most cases the lengths of the vent tubes in an Earthship are 40 feet. There are couplers available to connect the two 20' lengths of vent tubes. Depending on your specific drawings, the vent tubes will penetrate the back tire wall at the second course.

1. Prepare dirt slope and gap in tires for vent tubes

The vent tubes must have full support and be sloped away from the building. Rocks cannot be touching the vent tubes. The dirt under the vent tubes must be fairly compacted.

2. Place the vent tubes.

The vent tubes are placed so they will enter

the building flush with the inside of the wall. Place two-inch rigid insulation around the vent tubes where the vent tubes go through the tire wall and thermal mass inside the thermal wrap. Use duct tape for all seams between the pieces of two inch rigid insulation. This is so the cooler temperature in the vent tubes does not drastically effect the temperature in the thermal wrap. Confirm the slope of each vent tube is accurate before continuing to the next step.

3. Conrete Block

Where the vent tubes enter the building, a concrete block is formed to secure the vent tubes and to allow for the continued, consistent layout

of the tire work. The concrete block is formed with metal lath. Allow 24 hours for the concrete to dry and setup before placing the next course of tires on top of the concrete block.

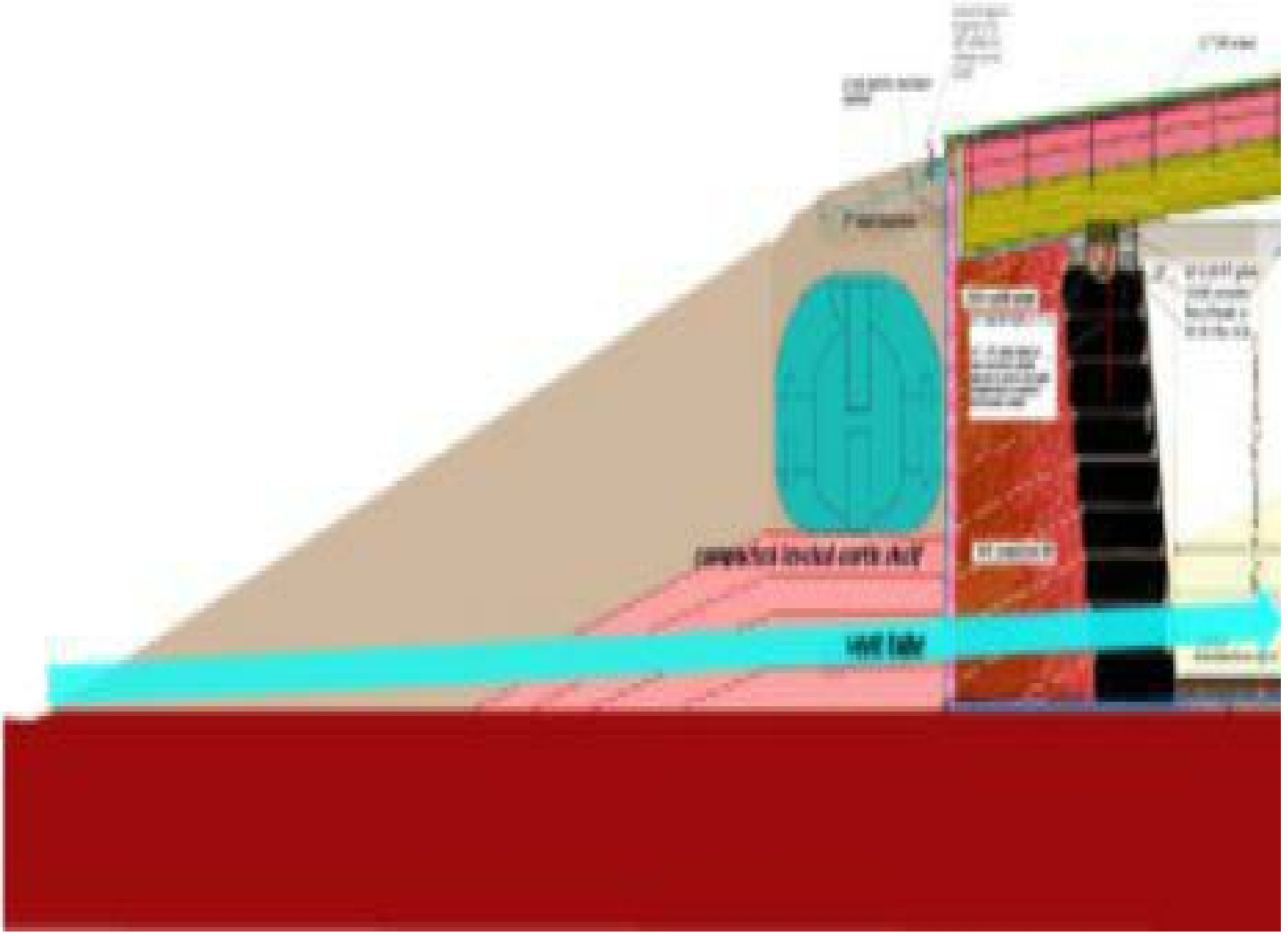
4. Bury the Vent Tubes

When the concrete tube has its block poured, you can bury the vent tubes. Be careful

not to move the vent tubes. Bury the vent tubes by hand at first, then a backhoe or front-end loader can be used. Cover the open end of the vent tubes with plastic and mark the ends with a 5 foot long stake with a surveying flag.

Cistern Installation

Cisterns sit on a compacted and leveled earth shelf. The height of this shelf takes in to consideration the height of the cistern itself. The top of the cistern must be low enough to allow the scupper and silt catch bowl to be installed with an adequate slope on the scupper. Then the cisterns are connected to each other and piped into the house.



Steps to install the cisterns:

1. Make the compacted level pad for cistern placement.

2. Drive the backhoe or skidsteer on it and shoot it in level and rake any small pebbles or rocks off of the leveled pad. The cisterns could

be damaged from sitting on a rock or pebble

3. Place the cisterns. As per the diagram on the Water Supply page in the drawings set. The cisterns could be slightly sloped to the north to direct water toward the bulkhead fittings on the north side of the cisterns.

4. Plumb the cisterns. With the Cistern Hook Up Kit provided by Earthship Biotecture.

5. Insulate the north side and the top of the cisterns. With two layers of 2” perimeter insulation if you are in a cold climate.

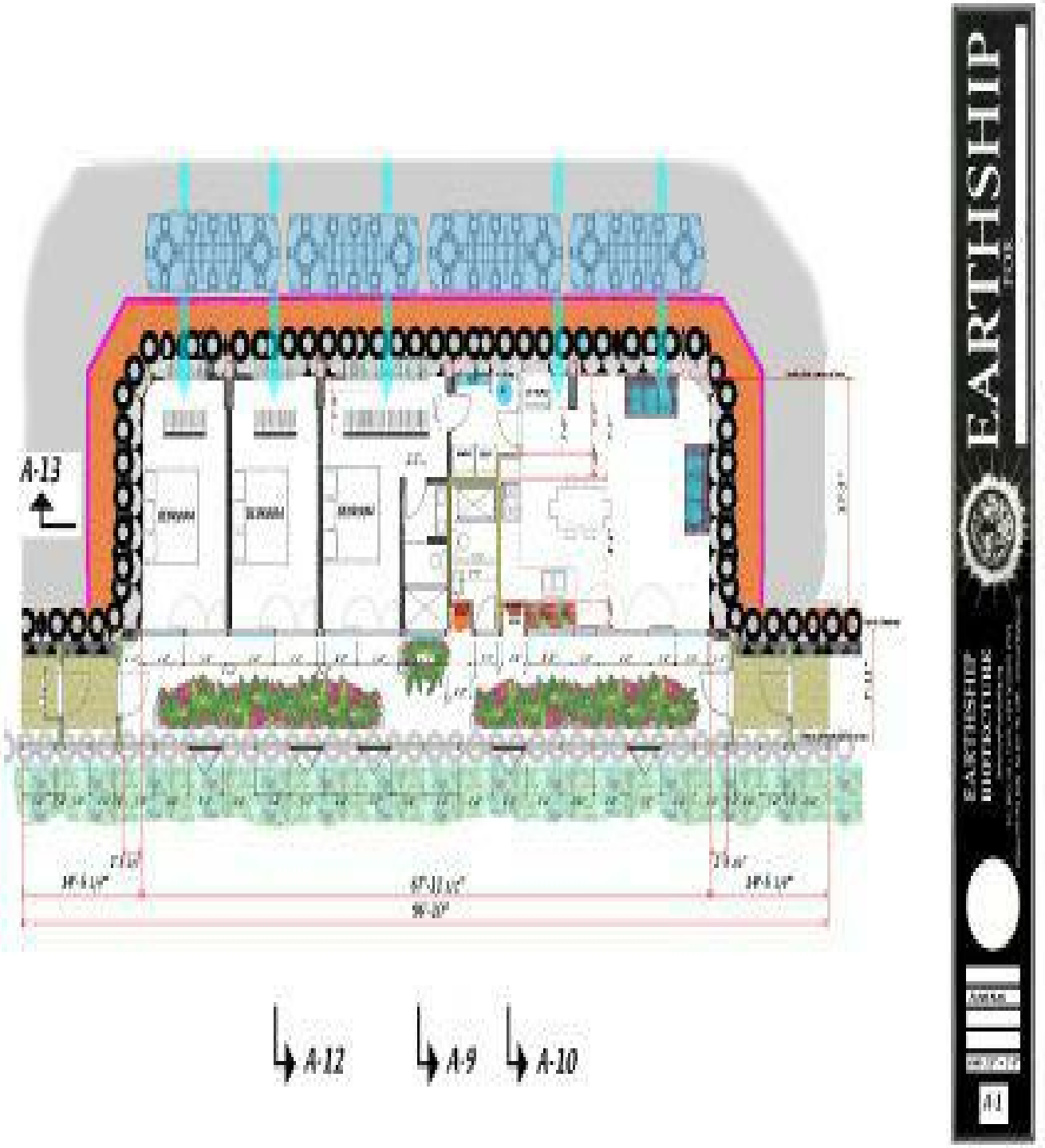
6. Fill cisterns and test all fittings.

7. Gently bury the cisterns.

8. Insulate or hand-bury around all hook-up fittings and on the north side up to the insulation.

The object is to place the cisterns where they

are shown on the plans. If freezing is a problem then insulation will be required on top and down the north side. Once the cisterns are installed and tested, you will have water storage on-site with access inside the building or from the top of the tanks.



There are several different types of burial cisterns on the market. Earthship Biotecture will specify the size, quantity and model of cistern for

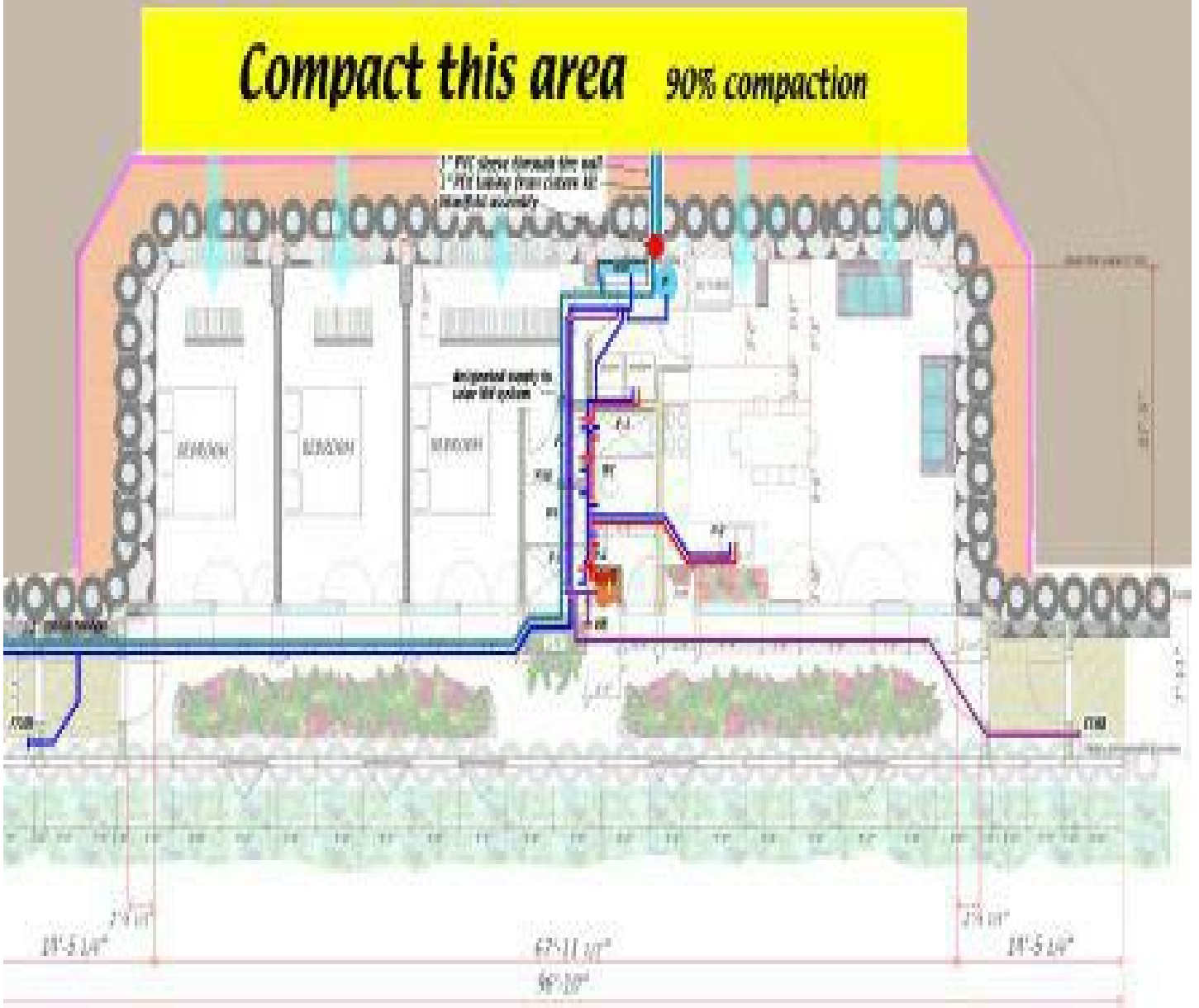
your particular floor plan, location and water needs. This sizing is based on annual rain fall in your area, how it is dispersed throughout the year, roof size and projected use. With all of this information your plans will accurately guide you in proper cistern placement.

Typically the cisterns are 16 feet long, 5 feet wide and 4 foot 6 inches tall. This makes placement behind the building easy while still leaving room for the thermal wrap and the silt catch assemblies.

Install the Cisterns

STEP ONE - Make the compacted level pad for cistern placement.

Once the tires are pounded to the course that your cisterns are on you can prep the pad for placement. At this point the dirt should be nearly up to the cistern height and the thermal wrap should be at that point as well. The cisterns are placed directly against the thermal wrap so you can measure out about six feet from that and then refer to either our water supply plan or our floor plan to determine the length of your pad. The example floor plan shows that you need a length of about 70 feet for that particular plan. So essentially you need to compact the earth behind the building within a rectangle 6 feet x 70 feet.


Compact this area
90% compaction

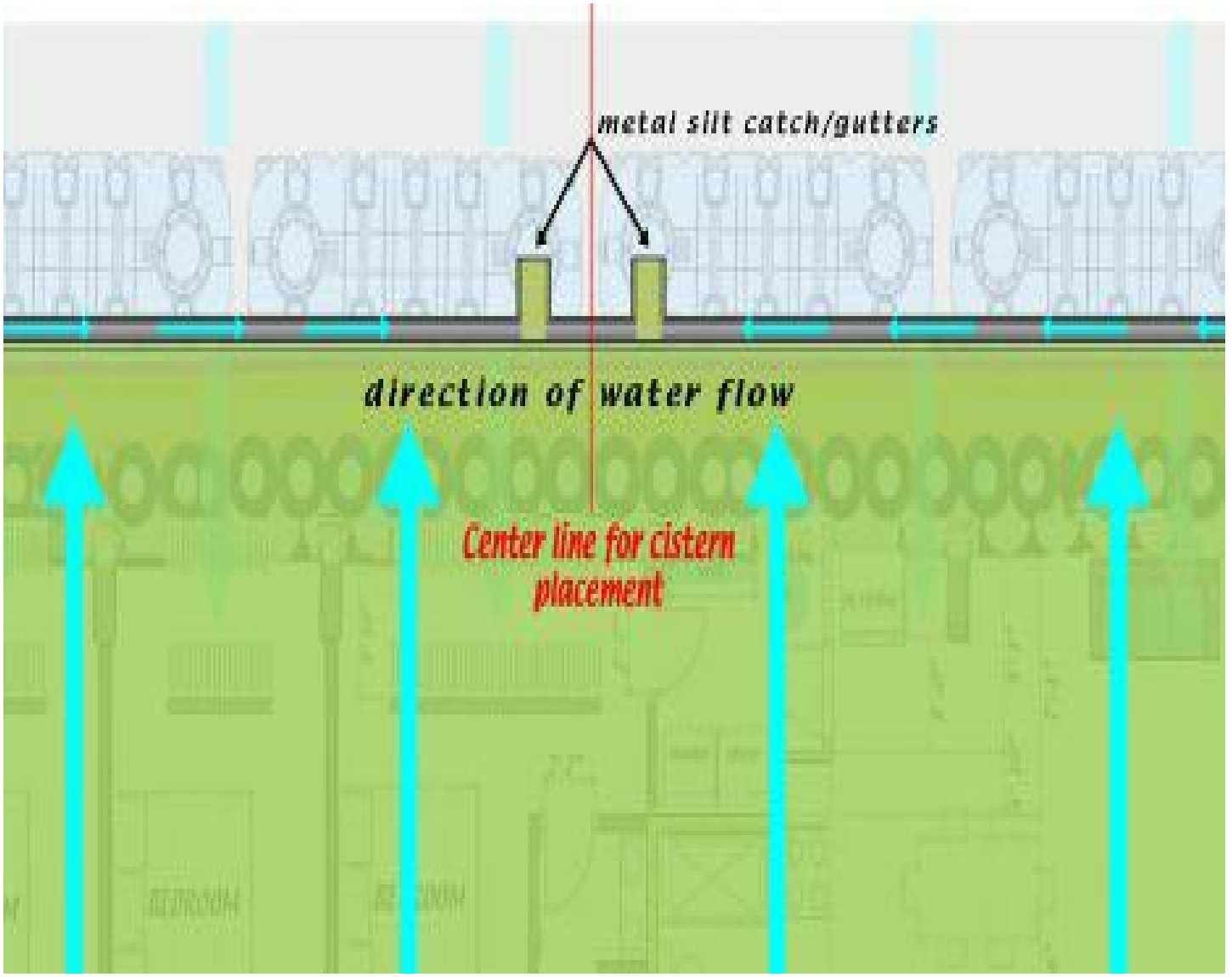
In order to compact the earth in this area you first move dirt into the rectangle to the approximate height required. Then use the machine - skidsteer or backhoe - to drive over the dirt overlapping its tire tracks. Then you bring in more dirt to get back to the desired height and repeat the process. Once you have compacted the dirt to the desired height then, using a bow rake, gently slope away from the building to create a slight tapered surface so that when you place the cisterns the water drains to the outside outlets. Also raking the surface removes any unwanted rocks or sharp objects that could damage the tanks. Once you are happy that the pad is level the length of the rectangle and sloping away from the building you are ready to place the cisterns.

The water supply sheet provides a comprehensive overview of the cistern plumbing

and a placement guide for the cisterns. Here you can see they are centered on the building and placed directly behind the thermal wrap. They are placed about 1’- 6” apart in order to provide clearance during installation and prevent and unwanted contact during the initial burial.

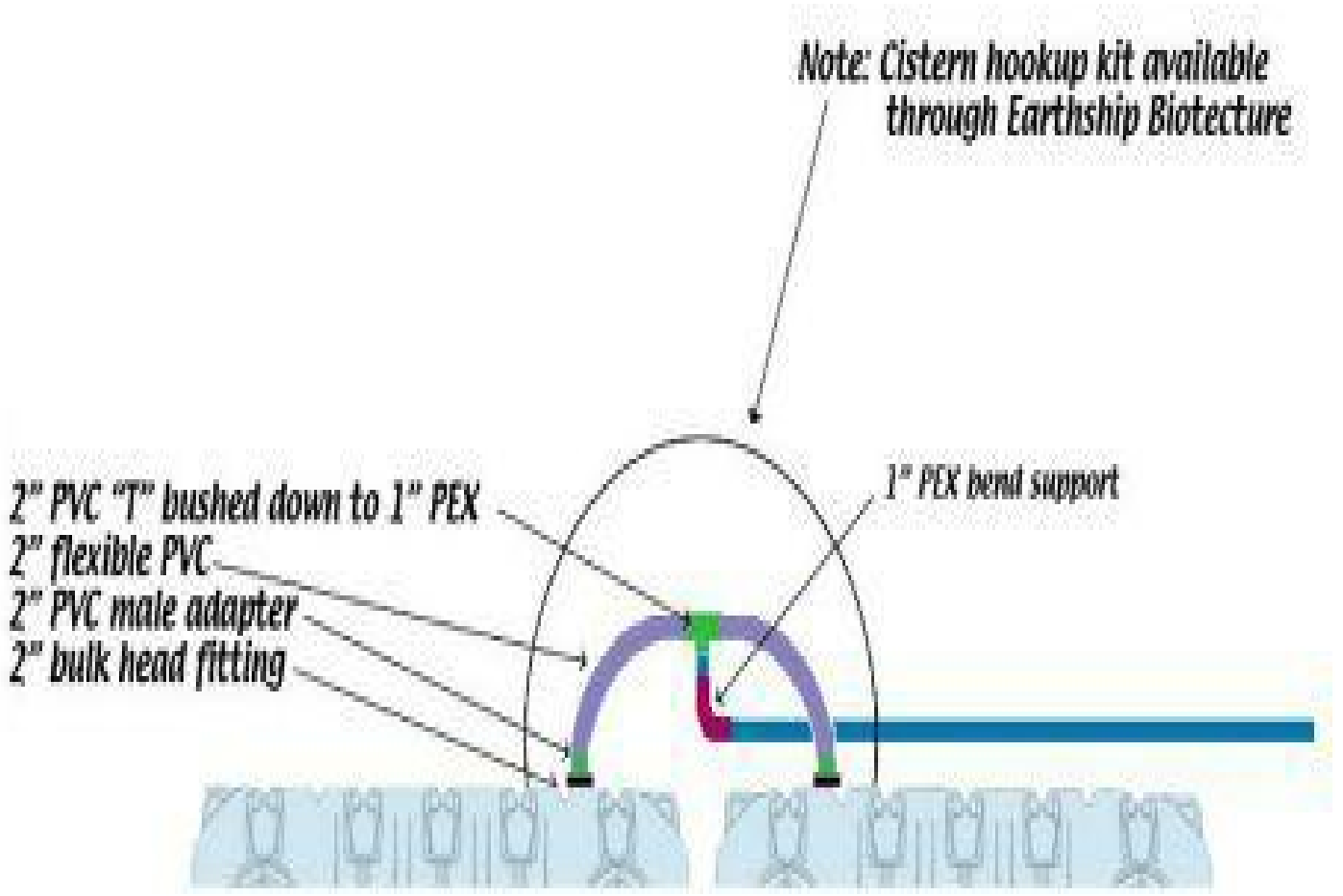
STEP TWO - Place the cisterns.

Bring in the cisterns, place the two center ones first, they are the most critical. They must be placed correctly in order to relate to the silt catch locations. Spacing between the cisterns should be approximately 1'-6". Once these two cisterns are placed the next set may be placed if there are more than two.



Now that they are all placed it is imperative that you make sure they are level with each other. You will do this with the aid of a builders level. Once you have checked that they are level with each other you will make sure they are level individually. This is accomplished with a 4 foot level. You first check with the 4 foot level the

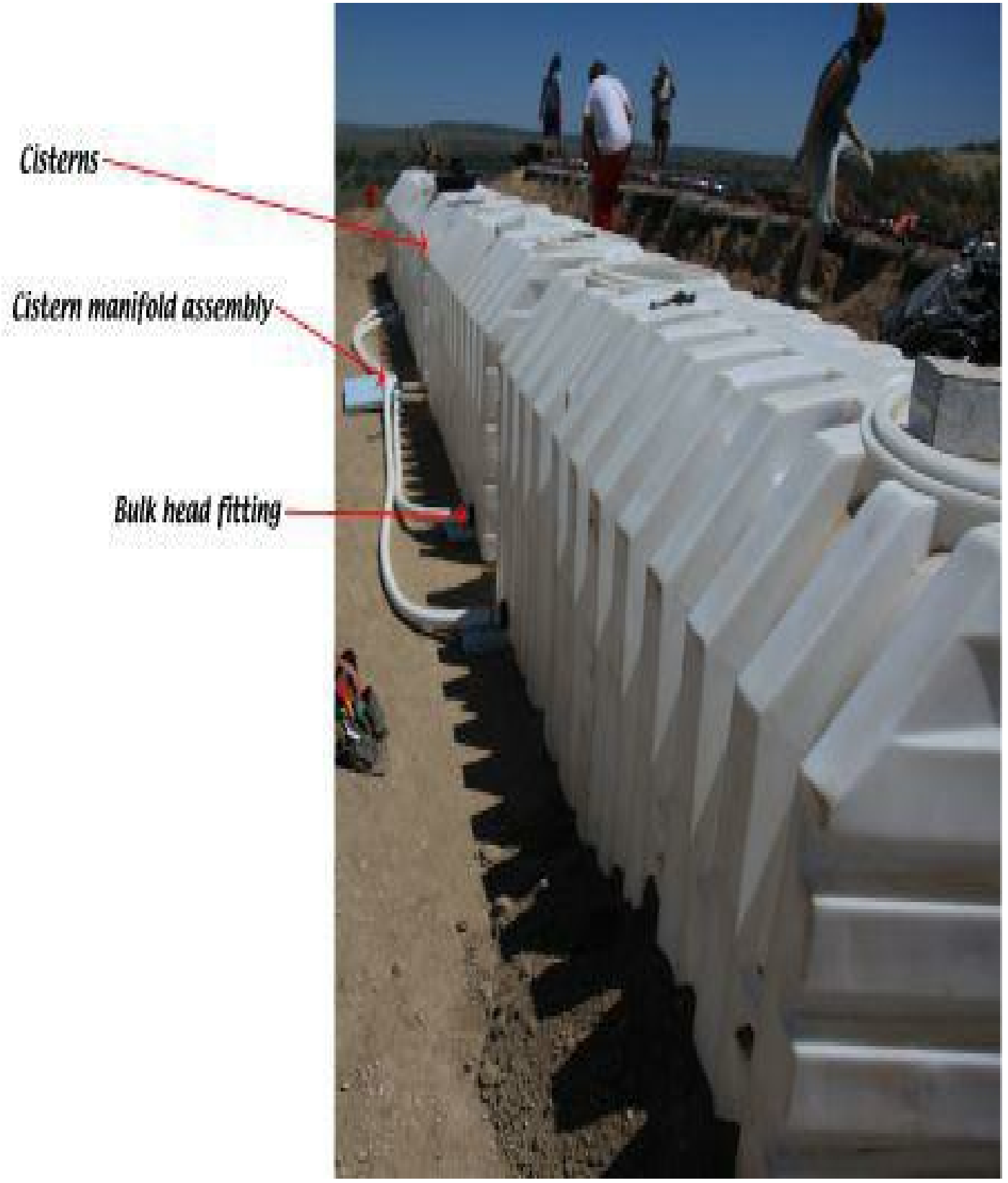
individual cisterns length - it should be level- then you check its width it should be sloping slightly away from the building. If they are all good then it is time to plumb them.



STEP THREE - Plumb the cisterns.

This cistern hookup arrangement requires the cisterns to be connected in pairs with the 2"

flexible PVC then these pairs are tandemed with the 1" PEX tubing. Earthship Biotecture provides a kit containing all the necessary material for the installation. Also a diagram is available on the water supply sheet in your set of plans.



The plastic cisterns have structural ribs providing a flat spot that will accommodate a 2”

bulkhead fitting. These are part of the cistern installation kit provided by E.B. In order to install the bulk head you will need a 3" hole saw. The first thing is to get into the cistern with your hole saw, bulk head fitting and a drill. Then you pick a rib on the cistern that matches the approximate location on the plan and will fit the bulkhead fitting. After you have found a rib you will place the bulk head against the location of the cistern that you plan to drill. What you are trying to do here is find a spot flat enough for the gasket to seal properly. Once you have a spot like this you then carefully drill your three inch hole. Once your hole is drilled you then clean off the rough edges. Now you insert the bulk head through the hole from the inside with the gasket installed on the fitting. No sealant of any kind is required here. While one person holds the bulk head fitting in place another can be outside of the cistern

installing the nut. While the person outside is tightening the nut the person inside should be checking the gasket to make sure it seals properly. Once it looks like it has made an adequate seal the person tightening can stop. The reason you do this carefully is because it is not hard to over tighten the bulk head fitting and strip it.


Structural rib
Bulk head

A 2” PVC male adapter is then screwed into the bulkhead after the threads are wrapped with teflon tape and then coated with pipe dope. Once inserted this fitting may then be tighten down while ensuring the bulk head is not disturbed. Once both of the cisterns you are working with in this stage are at this point, you connect them with the 2” flexible PVC.

You will notice the flexible PVC comes in a roll with a definitive curve. This material is not willing to give up this curve so you must work with it order to prevent unnecessary stress occurring at the glued joints. At this point you have two cisterns fitted with the bulk head fittings and the 2” PVC male adapters. You must now connect them.


2" flexible PVC
2" PVC 'T' reduced to 1" PEX
1" PEX tubing

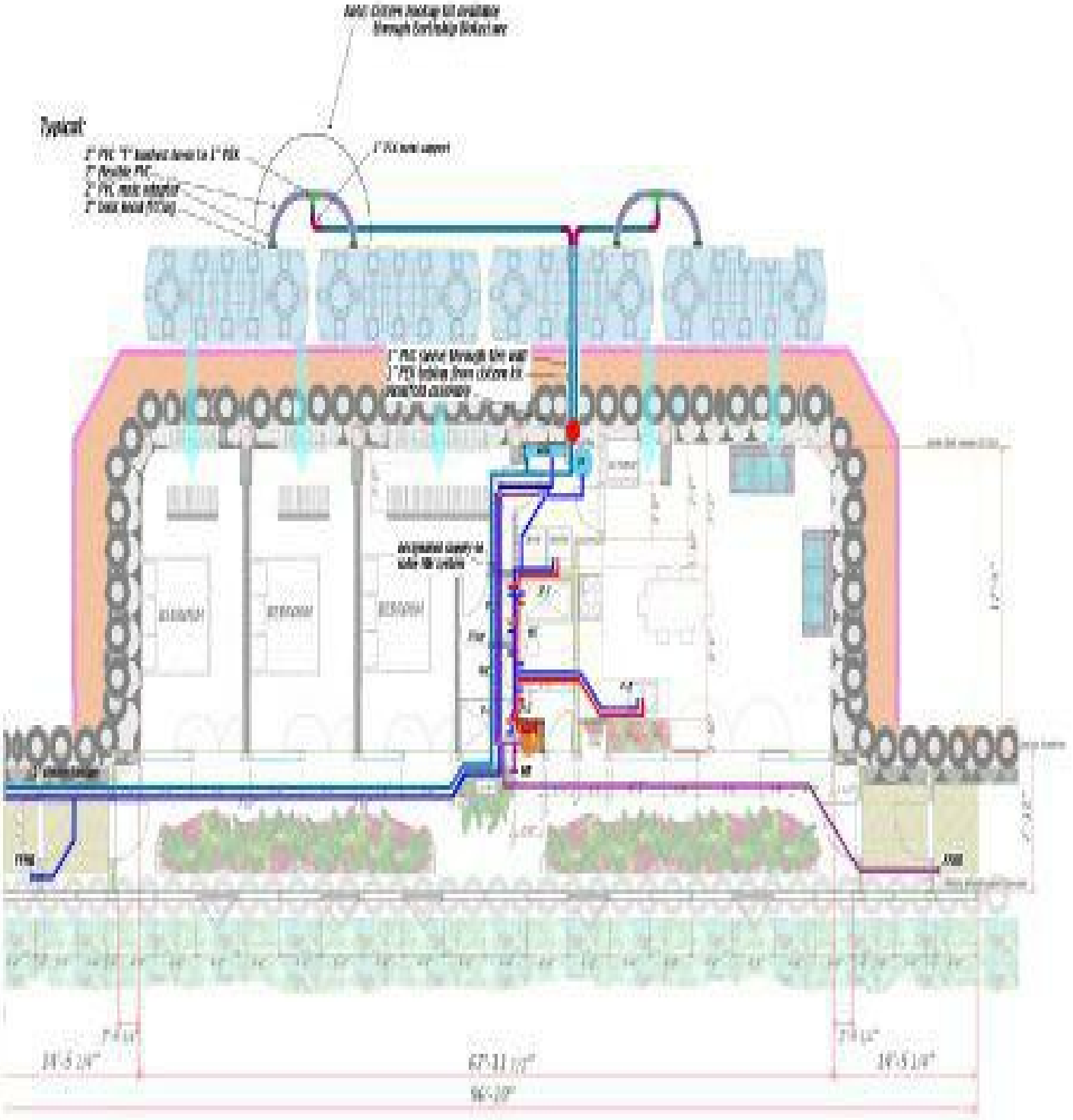
Unroll a length of the 2” PVC tubing letting it relax and cut a generous piece that will allow the cisterns to connect while the tubing still is allowed to maintain its natural curve. You then dry fit one end of the tubing into one of the male adapters ensuring that the tubing is going straight into the fitting. You will then attempt to dry fit the tubing into the other cistern, if this one is the same then you are good. If the tubing tends to want to push one way or another on the fitting - or not go in straight - you must cut it to a length that does not stress the joint between the tubing and the male adapter.

Now that this connection between the two cisterns is dry fitted it is time to cut in the PVC ‘T’ assembly. In order to do this, you lay the ‘T’ down on the flexible PVC where the plan shows it should be. You can see on the ‘T’ assembly where the flexible tubing will be inserted and the

depth in which it will stop. The distance between these two stopping points within the ‘T’ (approx. 3”) is the amount of flexible tubing that must be removed from the arc you have just created between the two cisterns. Once this material is removed you can dry fit the ‘T’ assembly and then proceed to inspect the other joints making sure once glued they will not be strained by the tubings tendency to retain its natural curvature.

NOTE: Fast setting glue must be used this type

of glue is typically used
for connection pipe that are either wet or being installed in cold conditions.
Regular purple primer is fine for this type of installation.

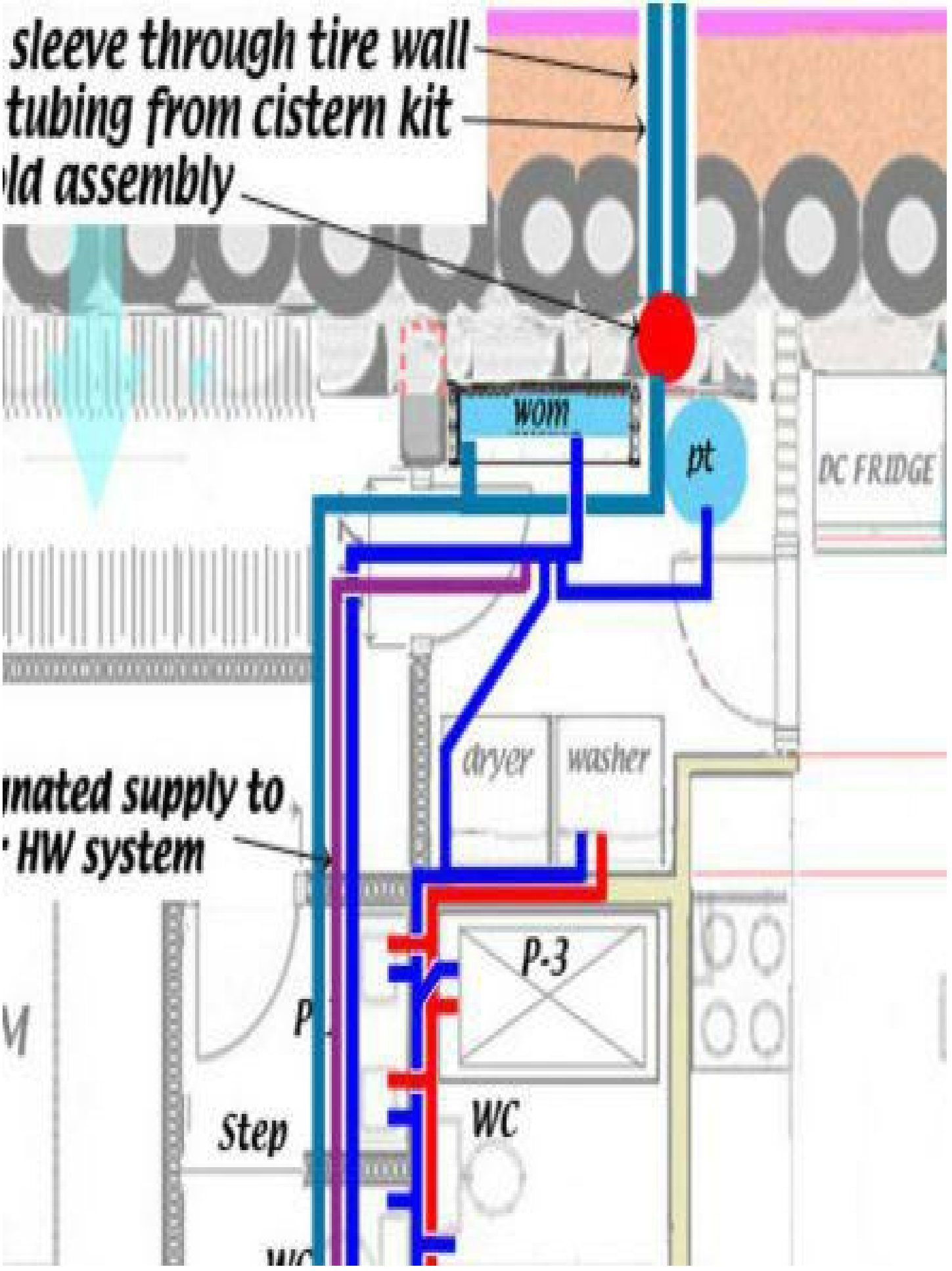


Now that you are sure you have a proper fit it is time to glue the fittings together. Using typical PVC glue for this application will result in joint

failure. You will start by disassembling your dry fit arrangement while keeping the pieces laid out in the proper positions. Then you should work from one side by priming the inside of one of the 2" PVC male adapters then by priming the end of the tubing you plan to insert into the adapter. The tubing should receive a coat of primer about the depth of the fitting so that you can tell if it is properly inserted. Once both pieces are primed you will apply glue to both the outside of the tubing and the inside of the fitting. After they are both thoroughly coated insert the tubing into the fitting about 90 degrees from where you plan for it to set. Then immediately rotate it to it's appropriate position then hold it for about a minute so that the tubing does not try to push out of the fitting. Now you will glue the 'T' into position as well as making sure that the PEX fitting coming out of it is facing the building as

shown on the water supply sheet.

Now that we have readied as many pairs of cisterns that we are going to connect, lets tandem them all together. The is involves simply running a 1” PEX line from each set of cisterns into the building where the plans say it should go, typically near the WOM. Once they are inside we will manifold the together using the manifold provided by E.B. Which is simply a series of ball valves manifolded together in order to be able to isolate one set of cisterns from the others.


sleeve through tire wall
tubing from cistern kit
ld assembly
wom
pt
DC FRIDGE
dryer
washer
nated supply to
HW system
P-3
P
Step
WC

The connection process is simple we are using 1” quick release male adapters in order to make the connections. This type of fitting simply requires that the tubing be wiped clean and inserted into it. Once this is done our cisterns are now connected. You may now fill them with water and check for leaks particularly around the bulk head fittings. Once you have determined that there are no leaks you are ready for the next step.

STEP FOUR - Insulate the top of the cisterns.

Some regions will require the cisterns be insulated on the sides and top to prevent freezing. For this we will use 2” rigid insulation. The insulation starts at the bottom of the cisterns and then is lapped over the top essentially creating an insulated box that the cistern are in. As the

insulation is coming up the burial can happen at the same time to hold it in place.

STEP FIVE - Gently bury the cisterns.

Burial entails gently using a machine, back hoe or skid steer, to place dirt over the cisterns and retain the insulation in place. Depending on the depth of the cisterns you may need to install extensions. These are available from your cistern supplier. Once these are installed you may bury up to the point where your vapor barrier needs to be placed.

note: Keep heavy equipment away from cisterns by at least 5 - 6 feet. You do not want lateral compression against the cisterns.

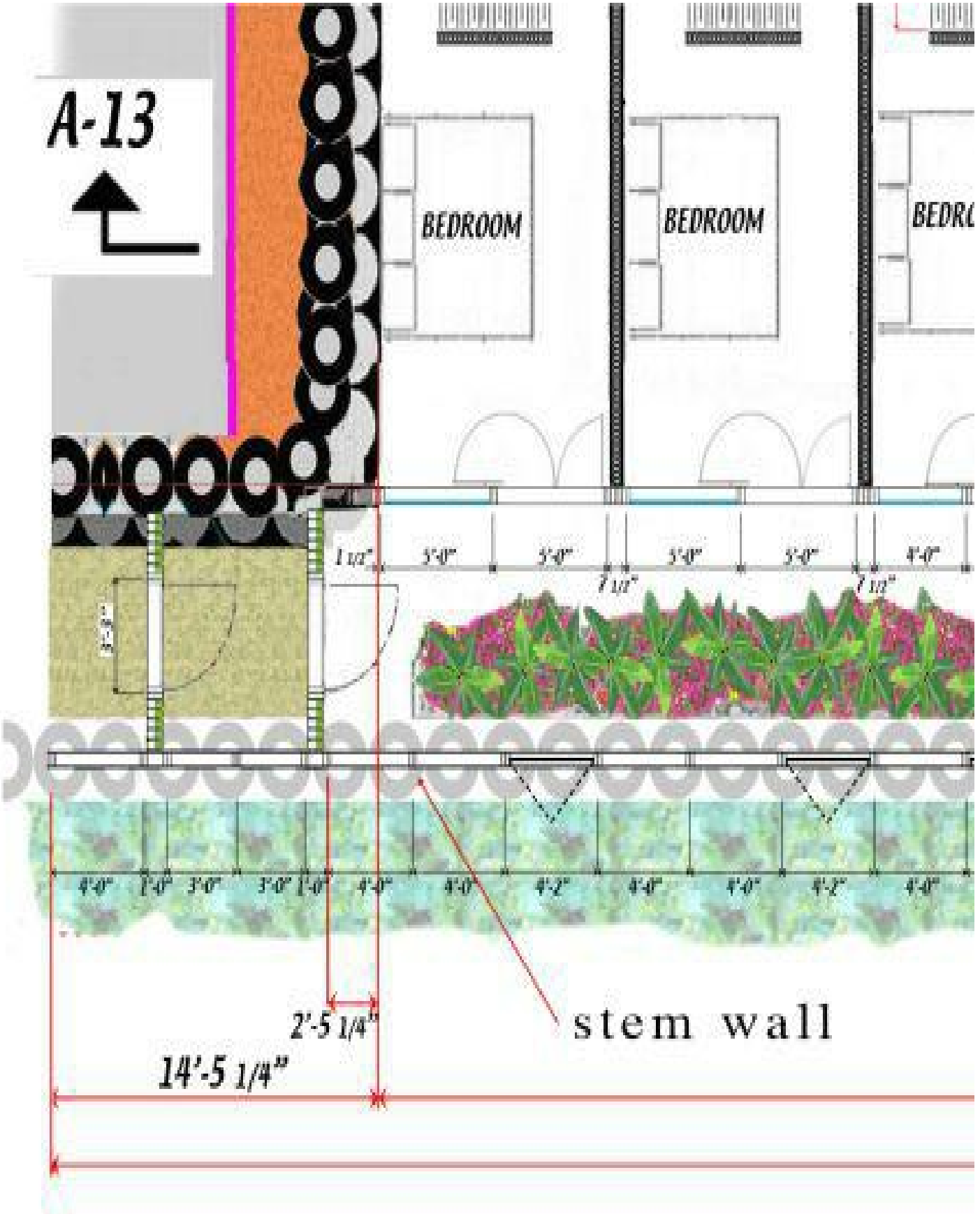
Front Stem Wall

The Front Stem Wall is short (usually two courses) and receives minimal weight and thrust of the redwood or cedar front face struts. These struts frame the windows that face the sun / equator. The stem-wall is lined on the outside with four inches of rigid insulation which are over with a 6 mil plastic vapor barrier. The toilet flush line goes to the outside under this wall. Always see your construction drawings for exact measurements and other details to your specific design.

This is a simple tire wall, usually completed in a day or two. The layout is simply a straight line (depending on your specific design) parallel to the back wall. Many people can work on this wall at once.

Step 1 - Locate the stem wall

Measure 24’- 6” (depending on your specific design) from the inside of the first course of the rear tire wall. Do this at both ends of the building. Establish a parallel line at this dimension by pulling a string from one mark to the other. You should now have a string line marking the inside line of the front stem wall. Be sure to pull the string very night to insure the string line remains straight.

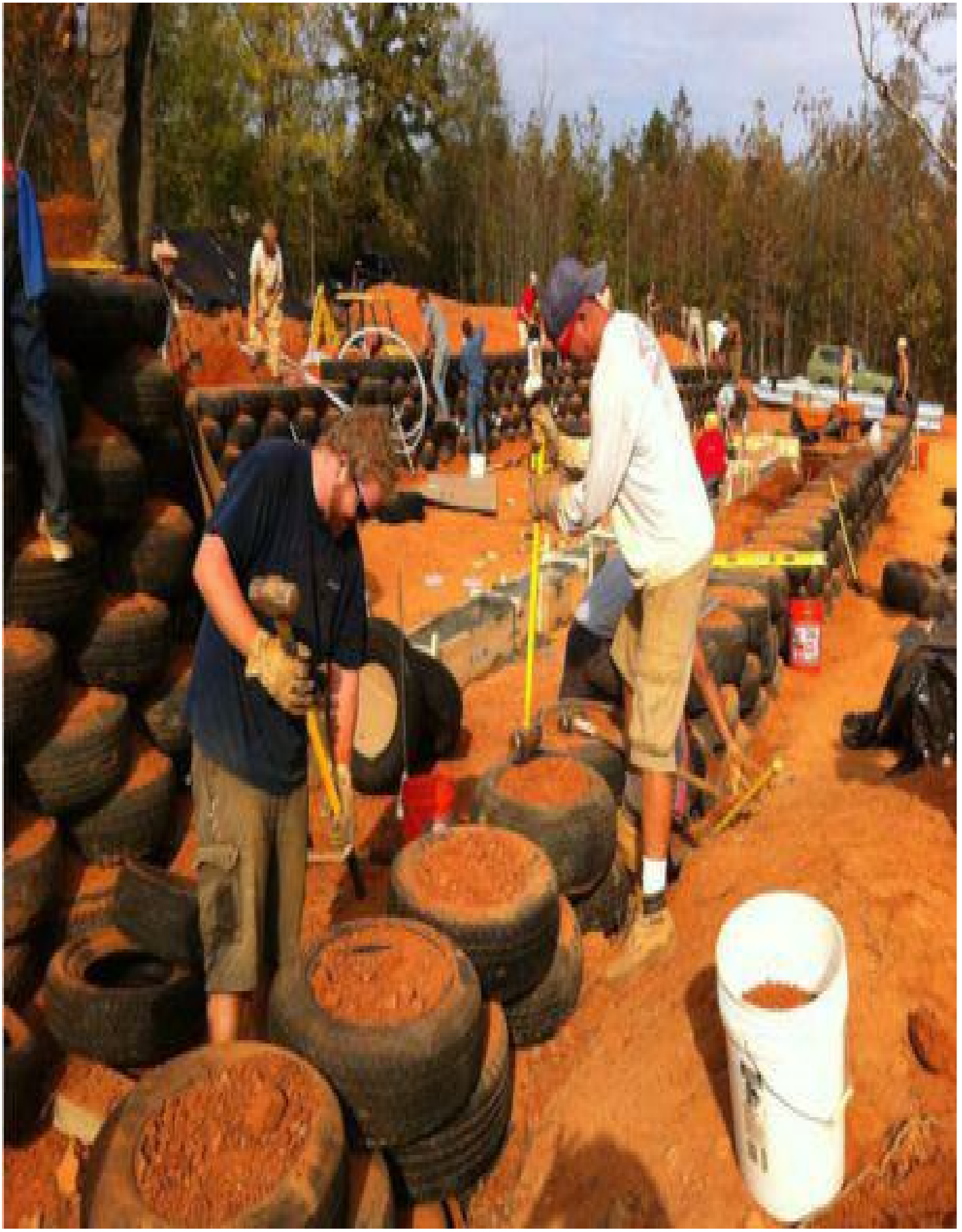

A-13
BEDROOM
BEDROOM
BEDRO
1 1/2"
5'-0"
5'-0"
5'-0"
5'-0"
4'-0"
7 1/2"
7 1/2"
4'-0"
1'-0"
3'-0"
3'-0"
1'-0"
4'-0"
4'-0"
4'-2"
4'-0"
4'-0"
4'-2"
4'-0"
2'-5 1/4"
stem wall
14'-5 1/4"

Step 2 - Layout first course

Layout the first course of tires, from one end to the other. Use larger tires for this first course, 16's if available. Place two layers of 6 mill plastic in the bottom of each tire, this is to prevent moisture from wicking its way up. Pound away!

Step 3 - Layout second course

Layout the second course of tires, slightly smaller size. Place two layers of cardboard in the bottom of each tire, this is to prevent the dirt from falling out of the tires as you pound. When finishing each tire on the second course, make sure it is centered over the course below it.



Step 4 - End caps

At either end of the stem wall will be a concrete half block. This can be formed out of metal lathe or cans.

note: This part of building the Front Stem Wall only covers the tire work. For the finishing steps, go to Operation Three: Structural Front

Face & Bearing Plates.

- *End caps*
    - Cut a piece of metal lathe so it can be wrapped around the next tire just past half the tire. (see the picture at right).
    - Screw or Nail the metal lath to the tires next to where the half-block will be.

- Fill any voids with smallish rocks so the concrete doesn't leak out.

- The concrete should be sticky and not too wet. Fill all the way to the top and level with the top of the next tire.
- As the block is filled, be sure to ‘rod the concrete’. This means you poke the concrete to be sure all voids are filled with concrete.

Resources

Staging List

Operation One: Tire Work

assuming a two bedroom typical Global Model Earthship

MATERIALS

(750) tires
(750) cardboard boxes
(4) 1700 gallon tanks/cisterns
(8) 20 foot long x 10” diameter galvanized culvert tubes
(4) couplings with bolts (for culvert tubes).
(150) 2” blue/pink board
(72) thermal wrap
(24) south stem wall
(8) wing walls
(2) bundles metal lath

(2) rolls six mil plastic
One dump truck for loads of concrete sand
One dump truck for loads of gravel - 1" aggregate.
Water on site to build with.
TOOLS
(20) Five gallon buckets
(1) IMER (brand) mixer
Skidster or Bobcat or Backhoe on hand.
(6) shovels
(3) picks/maddox
(6) sledgehammers
(6) 4' levels
(5) 25' tape measures

Glossary of Terms

Shoot the east and west empty tires.

To "shoot in" means to use a builder's level to measure the relative level of one or more points. In this case, one would be checking the

level of empty tires on each end of the building. When these two tires are at the same level, you can begin. Starting level makes it easier to stay level throughout the entire wall.

1 mil

1/1600 of an inch. Has nothing to do with millimeters.

tamp

To force or pack down firmly by repeated blows.

R20

The R-value is a measure of thermal resistance used in the building and construction industry. Under uniform conditions it is the ratio of the temperature difference across an insulator and the heat flux (heat transfer per unit area).

wicking

To convey or draw off (liquid) by capillary action.