

RASTRA

Installation Manual



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First things first . . .

Before we begin to discuss how to install RASTRA, let me take this opportunity to thank you for choosing what we believe is the best building product of its kind.

While this product may be new to you, we've been installing RASTRA for over 35 years with over 9 million units in service worldwide ~ from projects as small as a single room addition to multi-level hotels and office buildings. If you have questions, it's highly probable that we've been there before. After all, RASTRA invented the Compound ICF (ICCF).

The dedicated staff at RASTRA is ready and anxious to support you however possible. If you have the opportunity, send us a picture of your RASTRA creation.

Thanks again for choosing RASTRA.



Founder & President

RASTRA



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Introduction

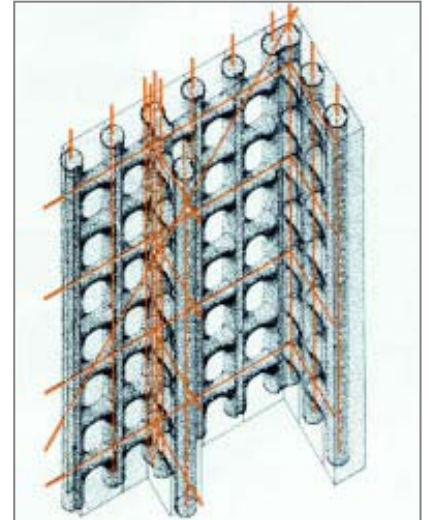
What is RASTRA?

RASTRA is a stay-in-place insulating concrete form system made of a lightweight material called THASTYRON, containing 85% recycled polystyrene and 15% cement. This unique material is pressed into panels shaped with interior channels which form a permanent skeleton of steel reinforced concrete. RASTRA is used to construct load-bearing walls, shear walls, stem walls, lintels, retaining walls, basement walls and other components of a home or commercial building.

The 6" diameter channels are designed to provide optimum strength while using the lowest possible amount of concrete. The square grid, with channels placed every 15" o.c. in either direction, allows panels to be installed either vertically or horizontally maintaining the grid and the runways for reinforcement. By using different strengths of concrete and various amounts of reinforcement, load capacities can be adapted to satisfy almost any requirement.

RASTRA is easily cut, rasped, routed or even carved into sculpture-like forms using common woodworking tools. Plaster and stucco adhere well directly to the face of RASTRA without any preparation. Tiles, brick and stone can also be adhered directly to the surface.

Approved by the International Code Council (ICC) under Legacy Report ER-4203, ER-9955, classified by UL under design U915, approved by the European Organization for Technical Approvals, and others RASTRA is the most extensively tested Composite Insulated Concrete Form available today. While copycat composite ICFs exist, these products do not carry ICC approvals. For verification of these standards, please check with your local ICC office or building authorities.



Two Components make up the entire system

A STANDARD single height panel has a surface area of 12.5 square feet and is generally used for walls. END panels are used to terminate wall sections, as headers, sills and corners. Panels are 15" or 30" high with four available different thicknesses of 8.5", 10", 12", or 14". Panels are available cut-to-length upon request.

Note: The 8.5" panel has a smaller 5"x4.5" oblong diameter interior core and is intended for interior use in non load bearing applications (Section 2-1).



Prefabricated Walls

Prefabricated wall segments are also available and can be delivered to the job site ready to install. Wall segments are fabricated from individual RASTRA panels.

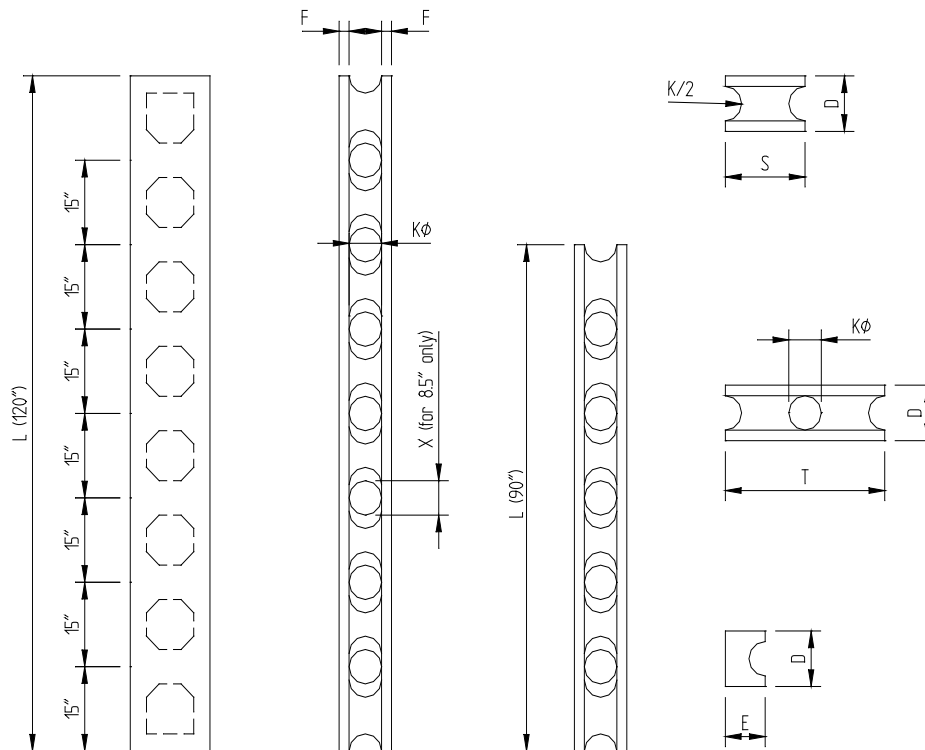
Walls can be built with rebar partially installed or without. Prefab panels are installed in a manner similar to tilt-up panels of an equivalent size.



Design and Specifications

Types of Panels

Standard panels are available in two heights, a 15" single height panel and 30" double panel. Panel thickness is 8.5", 10," 12," & 14". End panels are 7½" wide and available in the same thickness as the standard panel. **Note:** 8.5" panels are often used to construct non load bearing interior walls to save floor space and provide adequate acoustic performance and fire protection.



DIMENSIONS

Thickness	Core Diameter	Flange	Length	Single Height	Double Height	End Panel Depth	Core Diameter
D	K	F	L	S	T	E	X
8.5"(215)	5"(127)	1.75"(45)	60",90" (1525, 2286) or 120"(3050)	15"(380)	30"(760)	7.5"(190)	5.25"(135)
10"(250)	6"(152)	2"(50)		15"(380)	30"(760)	7.5"(190)	NA
12"(305)	6"(152)	3"(75")		15"(380)	30"(760)	7.5"(190)	NA
14"(355)	6"(152)	4"(100)		15"(380)	30"(760)	7.5"(190)	NA

FLAT PANEL

Thickness	Width	Length	Weight
2"(50)	30"(760)	60"(1525)	50 lbs(23kg)

Unloading

Note: Prior to shipment, directions to the job site and a map should be provided to the carrier.

Site Preparation

The same soil preparation normally used for foundations is usually adequate. If soil is soft or unstable, you should consult a soil engineer due to the added weight of the grouted walls.

An important part of project planning is to provide access for receiving and storing materials. A typical RASTRA factory-direct truck load contains up to 4,000 square feet of panels. RASTRA loads may range from 40,000 to 46,000 lbs with an overall truck length of 60' to 75'.

When choosing an area to unload, remember to allow enough space for both the truck and the unloading equipment. Once in position, there will need to be adequate clearance around the truck for off loading. All of these facts should be considered long before a load is delivered.

If access to the job site includes a steep road or driveway or there is no room for the semi, it may be necessary to unload offsite and shuttle material to the job site using smaller trucks.



Handling Characteristics

RASTRA panels are made of Thastyron™, a strong lightweight material that is somewhat flexible and not brittle. However, RASTRA components should not be stepped on during construction. The panels shall always be stored on a flat surface.

Note: Eye protection is recommended during unloading if windy weather conditions occur. Prior to unloading or stacking RASTRA elements, unloading safety instructions must be distributed to and read by all personnel. Check unloading instructions before starting to unload elements. The driver will need the instruction sheet signed.

Receiving

Truck and trailer should both be parked on level ground with sufficient room to maneuver a forklift on either side of the load. The truck and trailer should never be repositioned without tie down straps being in place and tight.

A forklift with standard forks is normally sufficient for unloading purposes. However, this task is made easier with less chance of damaging panels if a custom forklift rack is attached to the standard forks (Section 3-2).

The most important factor in selecting the proper forklift is the width of the fork tongs. Tongs 4" wide give adequate support to the panel for lifting with enough clearance for quick and easy entry.

For larger job sites a boom truck or crane with spreader bars and pipes can be used. Alternatively, other equipment can be used such as a logging truck with log loader boom and spreader bar and pipes or track hoe excavator with spreader bar and pipes.



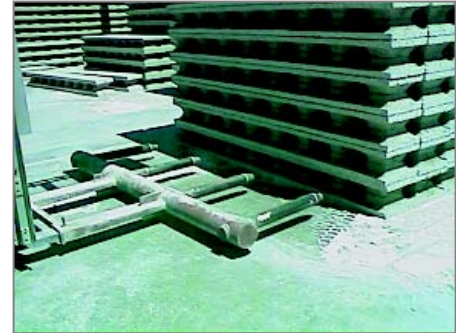
Tong Depth

Take care to ensure the length of the forklift tongs does not exceed the depth of the RASTRA panels being picked up. If the tongs extend into the adjacent row of panels, damage may occur. This may also result in the tipping of the adjacent stack, causing that stack to fall off the other side of the trailer.

Tong Spacing

If standard forklift tongs are used, optimal spacing of the tongs is 60" from center to center. As the panels are 120" long, the overhang on either side would be only 30" which provides adequate support for the RASTRA panels. If this span is not possible with the forklift available then a spacing of 30" or 45" may be used with the following notes of caution:

- A). Panels are 120" long. If only the center 30" of the panels are supported, nearly 48" will extend over each side of the tongs. In this scenario, if panels being transported over uneven terrain they may be damaged by sharp bumps and dips as the forklift travels.
- B). If using a tong spacing of 30" instead of 60", retrieve a maximum of only 9 panels (3 X 3) at a time. This lowers the outer edge weight and puts less stress on the bottom panels.



If larger amounts of Rastra panels are received frequently, a specially designed fork lift attachment should be considered (see the picture on the right).

Lifting Technique

Once the tongs are inserted into a stack of panels, lift slightly to clear the adjacent stack. If the forklift has a TILT feature, tilt the forks back slightly to facilitate clearance from the adjacent stacks. After separation from the rest of the material, lift the product and slowly back away. As soon as possible, lower the load to a manageable height for optimum balance and maneuverability.

Storage

By far the best place to stack panels is directly onto the dry slab. This provides a flat, even surface that lessens the chance of damage to the bottom panels. If stacking onto a slab is not an option, then panels should be stored in an area that is unobstructed, relatively level and void of rocks or other debris. Stacking on uneven ground may deform the bottom panels to the point of fracture and hard objects like rocks can create puncture damage.

RASTRA can be stored outside in any weather. While RASTRA does not wick water, gravity will allow water lying on top of the panels to soak in to the panels. If RASTRA panels are to be stored outside, they should be covered to avoid saturation from rainwater. Water will not weaken the product, but it can make the panels heavier which in turn may cause breakage if lifted improperly.



Safety First

Remember that SAFETY is first and foremost. Do not rush or work in the dark. The following tips have been called “**The 8 Unloading Absolutes**” and are a good guide for safe unloading.

1. Have two 8' step ladders on site for untying and unloading.
2. Truck and trailer must be on level and firm ground.
3. Only unstrap the stack being unloaded. RASTRA panels are loaded tightly for shipping with less than ½" between panels.
4. Look inside the stack. It's important to note that center units are also banded. If these bands are still attached to units not being unloaded, broken panels may occur. (Bands can be left on the unit groups two deep when unloaded by forklift).
5. Never reposition the truck with unsecured material.
6. Even if a flat and level unloading site is being used, use temporary bracing on both sides of stacks to prevent units from tipping off truck as upper units are being unloaded – OR - secure the lower units with one or two tie down straps.
7. Ideally, never climb up the sides of the stacks but if it becomes necessary to walk on the panels, do not step on edges or corners.

Note: Remember that RASTRA is more fragile and lighter than concrete. If you have to climb up stacks, never climb up the sides of unsecured stacks as they could shift. Take care not to step on the corners as they may break. When walking on top, please try to step along the center of the panels. Stepping on the edges may cause breakage and cause a fall.

8. Read the Unloading Instructions carefully. The “Unloading Safety” sheet comes with every load, distribute it to all personnel involved.

Getting Started

Now that your material is on site, it's time to begin the installation. If this is your first time installing RASTRA, take your time. The key is thinking ahead to avoid creating problems that you will be forced to correct later in the project.

Two terms you may be unfamiliar with as you review this manual are "grout" and "lift". Grout is simply the concrete that is added to the interior channels. Lift represents the height of the pour. As a general rule RASTRA allows for a maximum pour of 10'-12' (one story) high.

Before you start, make certain you have the tools and supplies you need to complete the installation. You don't want to have to stop in the middle of an installation to purchase supplies. The time you lose turns even a small item into an expensive purchase. For your convenience a Tools & Supply Checklist is provided (Section 5-1).

Keep in mind as you build your walls that RASTRA panels are simply forms designed to serve two primary purposes. First, the panel provides insulation. To maximize insulating efficiency, take care to construct the wall with tight seams to eliminate air leaks. Secondly – and most importantly – RASTRA panels are designed to provide a continuous and unobstructed grid of channels to be filled with concrete and steel reinforcement. These channels must line up properly and be kept clean of any debris. The RASTRA panel itself provides insulation and serves as a "mold" for the structural concrete.

RASTRA panels can be used to build both the exterior and interior walls, or as an exterior wall used in combination with wood/steel frame interior walls. If used as an interior wall solution in a multi-story project, walls on the upper floors must be properly supported .

RASTRA can be used to construct walls above or below grade. The design of the wall is to conform to building code requirements and with the engineer's specifications for size, strength and location of reinforcement, as well as slump, aggregate size, type and strength of concrete grout.

If RASTRA panels are laid horizontally the first row of panels is the most important. If this first course is not level and straight, the installation will be compromised.

Walls must be plumb and level prior to grouting and any excess debris from cutting must be removed from the cavities to avoid blocking the flow of grout.

Panels may be installed, horizontally, vertically or in combination. Panels are normally bonded together by applying polyurethane glue. They may also be stapled with reusable RASTRA staples or connected in any other manner, which temporarily holds panels in-place during the construction phase.

As the RASTRA panels serve only as the formwork for the structural reinforced concrete, they do not need to be staggered the way brick or concrete masonry block is. The strength of the walls comes from the reinforced concrete contained within the interior cavities. However, some builders prefer to stagger the panels purely as a matter of preference, because doing so breaks up the join lines. The choice is yours

For planning purposes the following represents a guideline for supplies you can use to plan your own project. Keep in mind that every project is different and the usage of these materials will vary.

Concrete consumption	0.30 cubic feet per square foot of wall surface.
Rebar consumption @ 15" o.c.	1.2 lineal foot per square foot of wall surface
Rebar consumption @ 30" o.c.	.9 lineal foot per square foot of wall surface
Adhesive	1 can per 10 panels

Plan ahead!

- A smooth, level and square surface of the footer, stem walls, or slab greatly facilitates installation of RASTRA panels.
- Have your supplies on site. Any excess can be used on the next project or returned.
- As you build your walls consider how you plan on running your utilities. If you plan on installing utilities inside the channel cavities, make arrangements to have the proper trades on site.
- Use remnants whenever possible to fill in small sections.
- Mark the interior wall or slab to indicate where the vertical channels are located, this makes installing electrical boxes easier.
- Have plywood and allthread/nuts on hand and made ready to repair any blowouts as the grout is being poured.
- Have rough buck frames already constructed and onsite with your windows before building walls.

Note: For your convenience an instructional installation video is located on the RASTRA web site. It is highly recommended that you watch this short video before beginning your first installation.

Tools & Supplies

Suggested Tools & Equipment

RASTRA panels can be installed with conventional tools used on common building materials:

Common Tools

- √ Hand Saw with large teeth 3 tpi
- √ Keyhole Saw
- √ Chain Saw 14 bar
- √ Circular Saw
- √ Beam Cutting Attachment
- √ Reciprocating Saw
- √ Hack Saw
- √ Drill Motor
- √ Hole Saw
- √ Router
- √ Builder's Level – min 6'
- √ Mason's String Line
- √ Tape Measure(s)
- √ Hammer
- √ Ladders
- √ Gloves
- √ Dust Mask
- √ Safety Glasses
- √ Flashlight
- √ Shop Vacuum

Rental Tools

- √ Forklift
- √ Manual Lift
- √ Scaffolding
- √ Boom Truck
- √ Rebar Cutter / Bender

Supplies

- √ Polyurethane Foam Glue
- √ Connector Staples, Spreader Cleats or Mono straps
- √ Rebar – as specified
- √ Concrete Grout
- √ Framing Timber
- √ Shim Stock
- √ Stake Material
- √ Spray Paint – 2 each, 3 colors
- √ RASTRA Hollow Anchors
- √ Site-made Bucking
- √ Anchor Bolts

RASTRA Tools

- √ Rasp(s)
- √ Squeeze
- √ Panel Pick
- √ Foam Glue Gun
- √ RASTRA Wall Support
- √ RASTRA Saw Guide
- √ Goliath Panel Lifter
- √ RASTRA Hand Saw

Tools & Equipment Descriptions

Depending on the project or the method you prefer you may not need all the tools listed. The minimum required basic tools are only a few and printed in bold below..

Common Tools

- **Hand Saw** with large teeth - This saw is used to cut the RASTRA panels by hand. The teeth on this saw should be as large or coarse as can be found. A crosscut saw used for cutting trees works very well. Saws that work best are 36 to 42" long and have 2 to 4 teeth per inch. The stiffer the blade, the straighter the cuts will be. Dull teeth are ok.
- **Keyhole Saw** - This is a standard saw used for drywall. It's used to scribe or cut RASTRA panels as well as cut small holes for grout or electrical boxes.
- **Chain Saw** - This is used for cutting large sections out of the RASTRA panels for cutting the top of a parapet wall or cut out openings. An electric chain saw is preferable due to its slower speed and lower cost. Do not oil the bar. RASTRA dust can destroy a gas chain saw quickly. An old functioning dull saw works well for cutting and routing too.
- **Circular Saw** - This will be used to cut wood for bucking or for braces. It can also be used with the beam cutting attachment to make long cuts in RASTRA panels.
- **Beam Cutting Attachment** - This is a chain saw attachment for a worm gear circular saw. It's best to use a 14" bar. This saw can be used to cut window and door openings along with making long straight cuts. This type of chain saw can make straighter cuts than a conventional chain saw because it has a table to guide 90° or 45° angle cuts.
- **Reciprocating Saw** - This is an all purpose reciprocating saw. The saw is used in many ways - including cutting rebar and cutting RASTRA panels.
- **Hack Saw** - Standard metal cutting saw used to cut rebar or other metal and plastic items.
- **Drill** - Standard 3/8" or 1/2" electric drill.
- **Hole Saw** - The size will depend on the needs for each project. Typical sizes are 4" to 6". To be used along with the Drill to cut holes for anchor bolt supports, pipes etc.
- **Router** - A standard hand-held router can be used to ream out a channel in the Thastyron in preparation for electrical wiring and backing strips.
- **Level** - A standard 6' level is needed; however, an 8' level is better for making certain walls are straight and plumb.
- **String Line** - Standard mason's string line. Used to maintain alignment of RASTRA panels.
- **Tape Measure** - A 25' tape and a 100' tape are both needed.
- **Hammer** - A standard framing hammer.
- **Ladders** - Standard 8' step ladder along with extension ladders. Assorted ladders may be needed during construction. Two ladders are required to lift panels to upper rows.
- **Gloves** - Standard work gloves to protect hands from the roughness of the RASTRA panels.
- **Dust Mask** - This can be any type used in construction. It is used to protect from dust when cutting and rasping.
- **Safety Glasses** - Approved safety glasses to protect eyes when cutting, rasping or grouting.

Rental Tools

- **Forklift** - A forklift will be needed to unload the trucks during delivery and can also be used to set the panels (method explained later). The forklift should have 4" wide tongs and an upward reach extending a minimum of 4' higher than the highest walls.
- **Manual Lift** - This could be any type of hand-operated lifting device such as a Genie Lift, a simple rope or chain, or a block and tackle pulley arrangement. These devices may replace a fork lift when setting the RASTRA panels. They are used to place RASTRA panels into positions which extend above normal reach.
- **Scaffolding** - Used as a working platform when walls are above waist high (optional).
- **Boom Truck** - Used for unloading. Good for uneven, rough and tight job sites, and for lowering panels into a basement hole. Also good for installation of prefabricated RASTRA wall sections. Typically a medium-duty truck with a reach of at least 54' that can pick up approximately 1,000 pounds with the boom extended completely in a horizontal position. This is not necessary; however, when erecting large buildings, it can increase productivity by incorporating the use of double height RASTRA panels (30" x 10') which weighs over 300 lbs.
- **Rebar cutter/bender** - Used to cut and bend rebar for corners and stems. This is not mandatory but is easier and faster than sawing and bending by hand.

RASTRA Supplied Tools

- **Rasp** - This is a hand tool used to even up and shape RASTRA panels with an expanded metal face welded on a rigged frame with a handle. The size is approximately 6" by 8".
- **Squeeze** - This device resembles large ice tongs with flat pads in place of points to squeeze the panel on either side, allowing it to be picked up by any lifting device.
- **Panel Pick** - This is used primarily with 30" high panels and prefab wall segments. It's a round tube with a handle which retracts and extends two arms. The device is inserted into the center cell after which the arms are extended and locked open. The arms then lift the RASTRA panel by the solid nodes on either side.
- **Foam Glue Gun** - This is used to apply polyurethane foam glue to bond RASTRA panels. The gun attaches to special canisters by means of a threaded coupler and has proven to be more manageable than the conventional straw nozzle applicators.
- **RASTRA Wall Supports** - Supports the RASTRA wall before and during grouting. This support has a turnbuckle-like center section. This helps to bring an entire wall segment into plumb. The support is fastened to the slab or ground at one end and to the RASTRA wall by means of a rebar and wedge lock at the other.
- **RASTRA Saw Guide and Saw** - The saw guide is used to help cut RASTRA panels into rectangular shapes with a hand saw. It resembles a miter box and is placed on top of the panel and guides the saw. The RASTRA saw is a wide-toothed saw with hardened tips, designed for cutting mineral-based materials.
- **Goliath** - This tool is similar to one used to move dry wall sheets into place but bigger. The lifting arm inserts into the cavity of the panel.

Supplies

- Foam Glue - Used with glue gun to bond RASTRA panels as well as for buckings and pop-outs.
- Staples - Used as an alternative temporarily hold panels together while the glue dries or to reinforce some joints in high stress areas when grouting. They can be made from 1/8" flat steel. Bungee cords can also be used.
- Rebar - Used in the cores to reinforce the concrete walls. Size and spacing to be determined by a structural engineer.
- Wood Material - Used for bucking of openings and bracing. This could be 2x4 2x6, 2x8 along with 4x8 sheets of plywood.
- Wood Shims - Used for shimming RASTRA panels plumb or level prior to gluing.
- Stake Material - These could be either wood or metal stakes.
- Hollow Anchors - Used to attach items to the RASTRA walls.
- Anchor Bolts – Used to attach Bucking and Ledgers.
- Spray Paint – Different colors are used to mark locations of rebar, water lines and electric.

Basic Workmanship

RASTRA is much like working with a very light wood. Protective gloves and respiratory masks are recommended, particularly when you saw or rasp the RASTRA panels.

The RASTRA saw guide helps to make straight cuts either at 90° or 45° angle. The wide toothed RASTRA saw cuts easy through the panel. For more cutting a cheap electric chain saw can be used. The chain saw will hold up for at least a mid-size project and can be used with the saw guide. Don't use a gas-motor driven model; the dust is inhaled by the motor and it fails within short time.



The RASTRA rasp is a versatile tool to just fit panels, shape flanges for curved walls, smoothen wall surfaces, or make round corners and other shapes. RASTRA panels can be drilled or routed in the same way one would work with wood or drywall.



RASTRA foam glue is dispensed from a glue gun directly on the RASTRA panel, or between panels. If RASTRA panels are laid horizontally a good practice is to lay down the panel, correct its position and then spot glue it with squirts of glue by inserting the glue gun into the joint. For this you only need little glue. For other applications one would use more glue to get a stronger connection.

Note: Avoid contact with wet foam glue! It is extremely sticky and does not easy come off hands and never from cloths.

Reinforcement

Rebar Specifications

Reinforcement is to be the size and grade specified by the engineer and installed in accordance with the engineer's specifications. The following represents typical minimum specifications:

1. Use ASTM A615 Grade 40 or 60 deformed steel rebar complying with Section 1907 of the IBC. If the construction is based on the IRC, rebar must comply with IRC Section R611.6.2
2. Minimum vertical and horizontal reinforcement must be No. 4 rebar spaced a **maximum** of 30" on center.

Note: #4 rebar = 1/2" #5 rebar = 5/8"

Preparation

Begin by calculating how many pieces of rebar are required for the installation, then pre-cut that number of bars as a way to double check your work. Be sure to account for bars that are going to be placed under windows or in door openings. Check the plans to verify at what height the bottom of the openings occur to verify rebar will not interfere with these openings. Once all pieces have been cut, bend the bar to create at least a 2" hook or 'L' on the end. Confirm all reinforcement lengths and bends with your engineer's drawings.

Note: According to OSHA (Occupational Safety & Health Administration – USA) article 1926.701 (b), the following clause shall apply to the jobsite: "All protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement."

Placement of Rebar

The engineering specification will dictate the size and exact placement of the rebar. Experience has shown that the following guidelines represent a typical installation:

1. Typically, rebar is placed in every other cell horizontally, and in every cell vertically. Keep in mind that rebar is inexpensive and exceeding specification by using more rebar than required may be a good investment.
2. Spacing of rebar may be 15" or 30" o.c. dependent upon requirements for wind or seismic design. Size, strength, spacing and length of all rebar must conform to building codes.
3. RASTRA has been approved with the rebar placed directly on the bottom of the horizontal channel. However, placing rebar in the center of the cavities maximizes strength. Should the engineer specify, chairs or other devices may be used to position horizontal or vertical reinforcement in the required locations within the cavities. One easy and cost-effective way to accomplish this is by placing 8" long cuts of rebar across the cavity for support.
4. When installing RASTRA in seismic zone applications, rebar must be in every cell as per engineering. It may be necessary to center rebar in the cells.
5. Ensure that vertical rebar is 3" shorter than the very top of the wall, so no rebar extends beyond the top of the panels unless there is a second lift.
6. Review rebar placement under windows or in door openings. Check plans to ensure the rebar will not interfere with these openings.
7. Ensure that there is a minimum 24" overlap where two walls join. Lap splices for reinforcement must comply with IBC Section 1901.2 or IRC Section R611.7.1.

8. Vertical reinforcement can be placed into the cells from the top of the wall.
9. When required, place additional reinforcement at headers, bond beams, and lintels.
10. When installing rebar in corners, bend a piece of rebar at least 24" long at the mid-point and place one end in the horizontal grout channel of the first panel. As you place the next panel (around the corner) slide the bent rebar into the horizontal grout channel in that panel.
11. You must place vertical rebar in the nearest full grout channel on either side of any opening, even if there is no grout channel immediately adjacent to the opening.
12. In some cases such as in retaining walls or tall walls, the engineer may require that rebar be offset to one side of the cells. Preferably H-form or small triangular trusses can be used.
13. Vertical reinforcement can be hand centered unless otherwise directed by the engineer's specifications.
14. When installing a curved wall, bend the rebar to match the curve and thread it into the grout channel as panels are added to the wall.

Note: When installing rebar into a pre-poured slab, it's much easier to drill holes in concrete as soon as the concrete is dry enough to walk on – usually 24 to 48 hours.

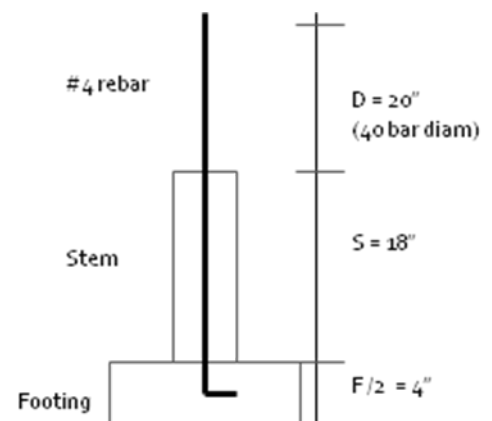
Reinforcement in Footings - Rule of Thumb

The length of each vertical rebar in the footing should be:

- ½ of the thickness of the footer (f)
- plus the height of the stem wall (s)
- plus 40 times the bar diameter (d)
- plus at least 2" for the hook on the end

Example: A footing (f) is 8" thick with a stem wall (s) reaching 18" above it. #4 rebar is used (½ diameter) (d). The length (L) to cut rebar is at least 44" as follows:

$$\begin{aligned}
 L &= f/2 + s + d + \text{hook} \\
 &= 4" + 18" + 20" + 2" \\
 &= 44"
 \end{aligned}$$



Dependent upon code requirements, the hook and rebar lengths may vary. The above is an example of one way of determining the length of dowels in footings. However, engineer's plans or specifications or codes may require lap splices between starter bars/dowels and vertical rebar to be a specific length or multiple of the rebar diameter. Always verify that all size, strength, and length of rebar requirements are met before pouring grout.

Rebar can be placed in slabs or footings in one of two ways. Either it may be placed prior to pouring the concrete or immediately following the pour while concrete is still wet. Either method is acceptable. Keep in mind that it's very important that the hook is placed at ½ the thickness of the footer with enough rebar exposed for the wall panels.

Foundation rebar must extend upward into the wall panel a minimum of 24" or a distance determined in accordance with IBC Section 1901.2 (normally 40 times the diameter of the rebar as mandated by code)

whichever is greater. If rebar is too short, drill through the slab with a roto-hammer and epoxy a longer piece of rebar in place.

If Only One Floor

If there is to be only one lift, it will be necessary to ensure the top of the rebar is below the top of the wall by at least 3" and that the grout is struck off flush with the top of the wall upon completion. The placement of any top plate anchor bolts should also be done at this time.

Grouting the 2nd Lift or Story

If the structure requires two separate grout applications, rebar will need to extend past the point of the first grout by **at least 24"** or 40 diameters of the rebar used to provide the overlap required to offset the cold joint. This may be accomplished in one of two ways, stop the grout application below the top of the bar the necessary distance, or cut your bars so they protrude above the top of the first grout lift to the prescribed overlap.

Visual Inspection of Rebar Placement

Verification that reinforcement has indeed been placed as required can be made visually by sighting down or diagonally through the cells with a flashlight.

Note: Do not install end panels before an official inspection has taken place, as rebar placement will be concealed.

Marking Location of Rebar

While walls are being constructed, it's helpful to mark the location of the vertical reinforcement in the walls. Typically, a small vertical slash of spray paint is used at the base of the wall and/or on the slab. Some contractors find it useful to use green marking for rebar, blue for water pipes etc. This marking is useful as not all walls are a multiple of 15" long. Electricians and plumbers find this marking helpful.

Marking Window and Door Openings

It should also be marked where window and door openings will be installed. Rebar needs to be placed on either side of these openings corresponding to the overall rebar configuration and building code requirements. These bars are usually required by the engineer. Care should be taken that the rebar will not interfere with the bottom of the window openings. In the case of doorways it will be necessary to make certain rebar does not extend above the slab into the actual opening. When allowing for door openings in stem walls, it's typical to cut out a section 6" below grade in the stem at the door opening to allow for a solid connection between the slab and stem pours. This allows for a concrete base at the door opening.

Footings – Marking Corners

Start at a corner, set the corner bars at $\frac{1}{2}$ the wall thickness for mitered corner or $7\frac{1}{2}$ " for end panel corner and then space the bars at the proper spacing as called for by the structural engineer. This spacing is a multiple of 15" but may be interrupted by door openings. If the layout doesn't come out even, the difference can be compensated for near the next corner or at an window or door opening.

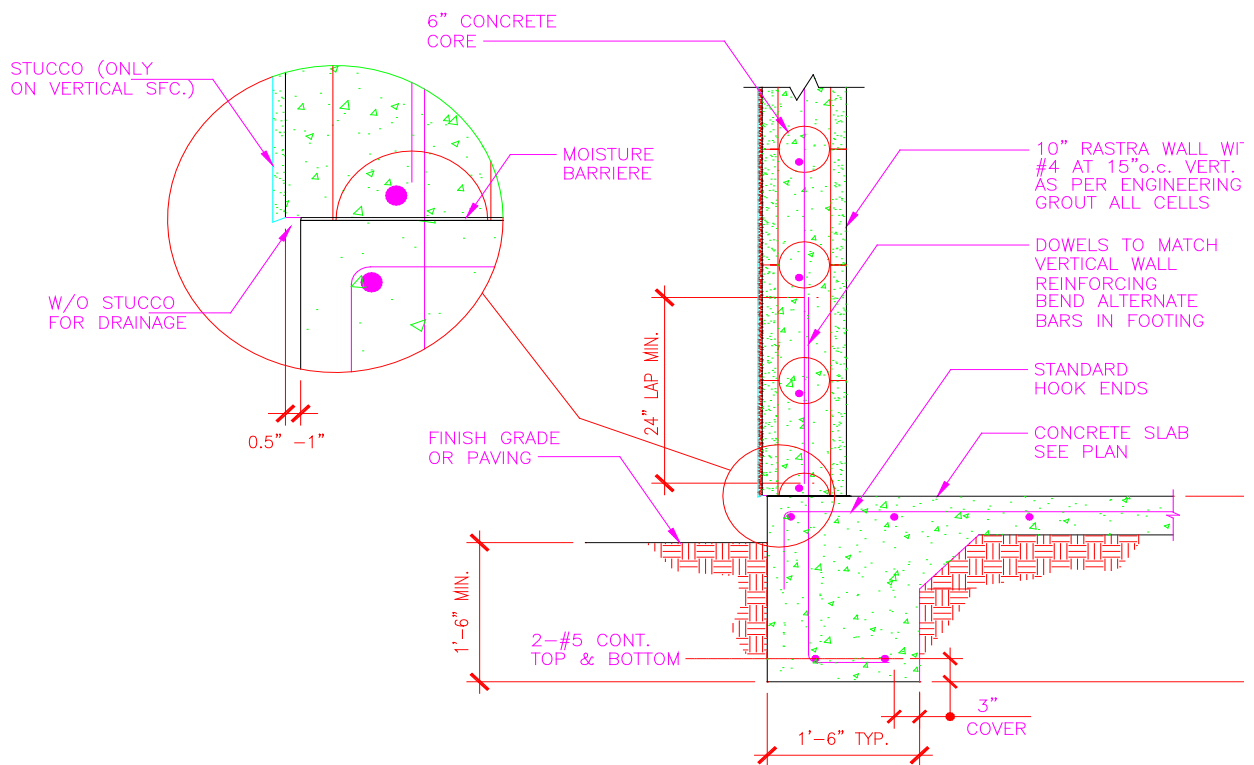
Raised Floor (crawl space) with Footing & Stem Wall

In many areas of the country, homes are built with a raised floor rather than slab on grade. In such cases, the footing and stem wall are built as usual with rebar dowels extending up from the stem wall to create the required length lap splice. Floors joists can be attached to RASTRA. Slab free from stem wall. If the

slab needs to float free from the stem wall, then the stem wall can be grouted prior to the pouring of the slab. The RASTRA panel will act as an expansion joint around the perimeter of the concrete slab.

Insulation of Foundation

The sub-grade water barrier has to be continued to height which will not be submerged in water or snow. If the stem wall is a RASTRA wall the above grade portion of the wall continues without break and has to be insulated at least 1 ft above grade. RASTRA does not wick water, however, if there is pressure water in the area the wall should be insulated against rising moisture inside the wall. This can be done by placing a layer of roof felt between the last row of RASTRA panels considered to be part of the stem wall and the first row of the up-going wall. In the same way a moisture barrier can be made between a concrete foundation and the RASTRA wall, using roof felt or other brushed on insulation material. It is also a good practice in some applications or locations to install the RASTRA panels slightly ($1/2"$ to $1"$; 10mm to 25mm) "hanging" out of the foundation. This creates a water-nose and allows moisture to drain.



Foundations

General

Design of any structural wall must conform to local code requirements and be in accordance with engineer's plans or specifications for size, strength and location of reinforcement as well as concrete grout slump, aggregate size, type and strength.

Horizontal Panels

When RASTRA panels are installed horizontally, they can be stapled together or spot glued together. What is important is that walls be plumb and level prior to grouting. It's not necessary to stack panels in an offset pattern. The strength of the wall is provided by the interior concrete grid which is continuous. Vertical seams can line up one over the other.

Vertical Panels

RASTRA panels may also be installed vertically and may be stapled, glued or connected in any other fashion which keeps them abutted together during grouting. Once again, what is important is that walls are plumb, secure and level prior to grouting.

Note: See Setting Panels Chapter 11.

Stem Walls & Footings

RASTRA panels may be used for stem walls, or with conventional poured-in-place concrete stems, standard block stems or mono-pour systems. The stem walls should rest on spread footings designed to support the wall, the building loads and the soil conditions at the site.

Three methods of installation for the first row of panels:

1. **Dry Set** - Pre-poured footer or slab with panels stacked on the hard set concrete.
2. **Wet Set** - Freshly poured concrete with the **first row only** of panels set into it, then leveled and plumbed.
3. **Mono Set** - Monolithic footing or slab with the **first row only** of panels already set in place on top of the forms before the pour (see below).



Raised Floor

Where a structure is built with a raised floor rather than slab on grade, the footing and stem walls are built as usual with rebar dowels extending up from the stem wall to create the required penetration of at least 24" into the RASTRA wall.

Slab Free Float

If the slab needs to float free from the stem wall, then the stem wall can be grouted prior to the pouring of the slab. In such cases, the RASTRA panels will serve as an expansion joint around the perimeter of the concrete slab.



Foundation Requirements

Requirement	Comment
Concrete poured at least 1 week prior to installing walls.	Construct foundations of concrete in accordance with the requirements of IBC Chapters 18 and 19 or IRC Chapter 4.
Stem walls are wide enough to support the full width of a panel.	Must be at least 10", 12" or 14" wide.
Surface is level.	Mark any uneven or non-level areas prior to setting panels.
Slab is square and true.	Verify that the corners of the slab are 90°. An easy way to confirm this is to draw out a 3' x 4' x 5' triangle on the slab.
ASTM A615 Grade 60 deformed steel reinforcement bars are used.	Vertical rebar must be minimum No. 4 and must comply with Section 1907 of the IBC. If the construction is based on the IRC, reinforcing steel must comply with IRC Section R611.6.2.
Rebar spaced as required in multiples of 15" o.c., to match grout channels in panels.	If slightly out of position, bend to re-position.
Openings are specified.	Be sure that you know where all planned openings are in relation to the foundation, and mark them on the slab or stem wall as needed.
Two pieces of rebar are placed on either side of any opening.	If rebar is missing, drill through the slab with a roto-hammer and epoxy a piece of rebar in place.
Rebar extends at least 24" above foundation.	Foundation rebar must extend into the wall panel a minimum of 24" or a distance determined in accordance with IBC Section 1901.2 (normally 22 times the diameter of the rebar as mandated by code) whichever is greater. If rebar is too short, drill through the slab with a roto-hammer and epoxy a longer piece of rebar in place.

Basement & Retaining Walls

Straight Walls

RASTRA panels can be laid horizontally, vertically or in combination without affecting the design. Combinations of 15" and 30" high panels can be used together. Larger sections may be fabricated on site and tilted-up in to place. Window and door openings may be cut out prior to the placement of the section, then these large sections can be set in place and will be ready for rebar and grouting as soon as they are plumb and level.

Curved Walls

RASTRA enables construction in a wide range of architectural styles. Walls, windows and doorways can be virtually any shape according to the architectural style desired.

Curved walls can be created using 15" wide RASTRA panels installed vertically. By trimming the inside edges of the panels to the correct angle, a curved wall can be created (Section xx).

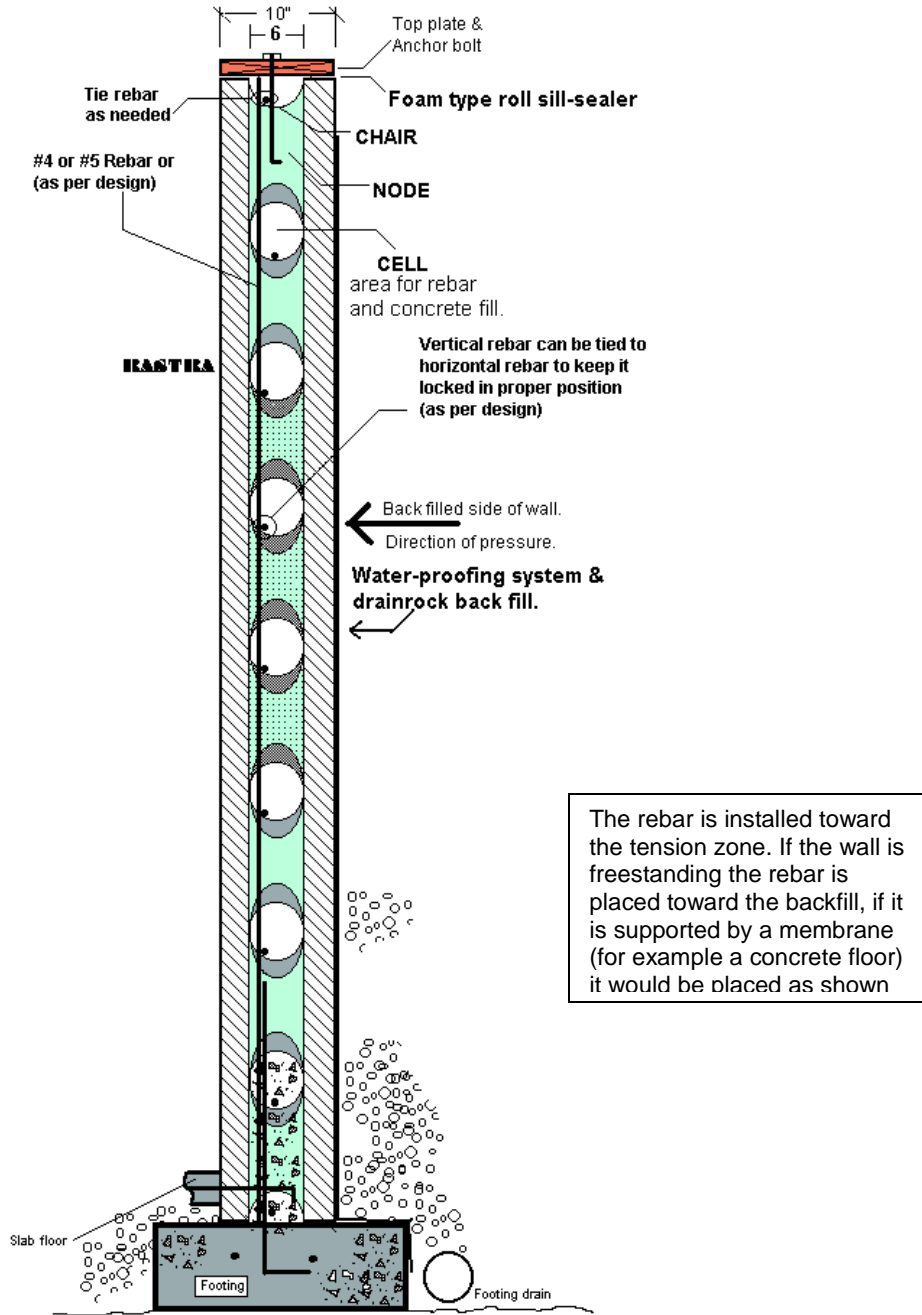
To create a clean even edge, the cut should be made along a wooden straight edge fixed to the panels at the proper distance in from the edge of the panels. The inside edge may require minor rasping to make a perfect fit.

When installing a curved wall, bend the rebar to match the curve and thread it into the grout channel as panels are added to the wall.

Note: All sub-grade walls must be waterproofed.

Note: The engineer may require the vertical rebar to be offset in a retaining wall (see Section 8-2).

Cross Section of Basement Wall with offset vertical reinforcement



Making Corners

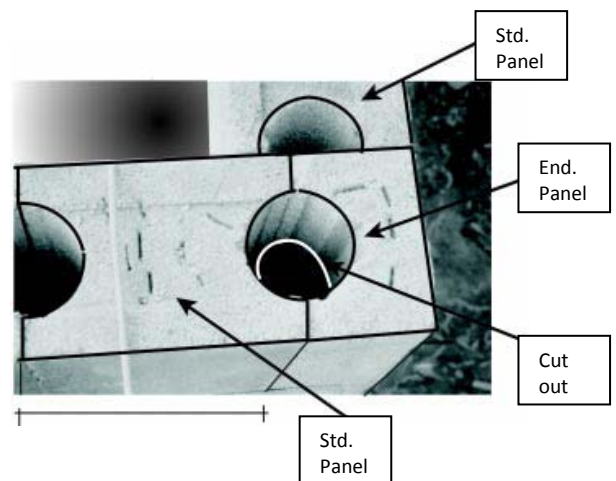
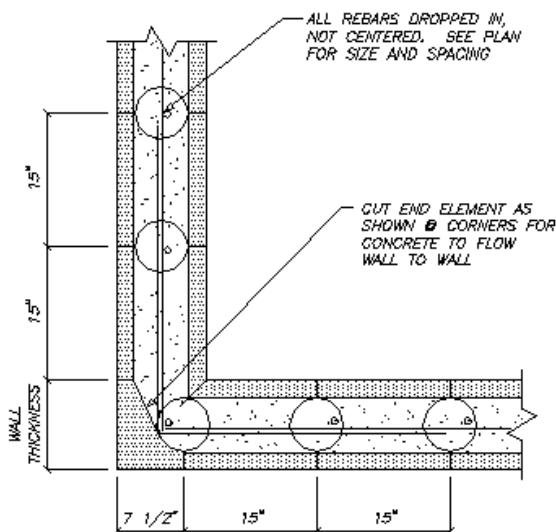
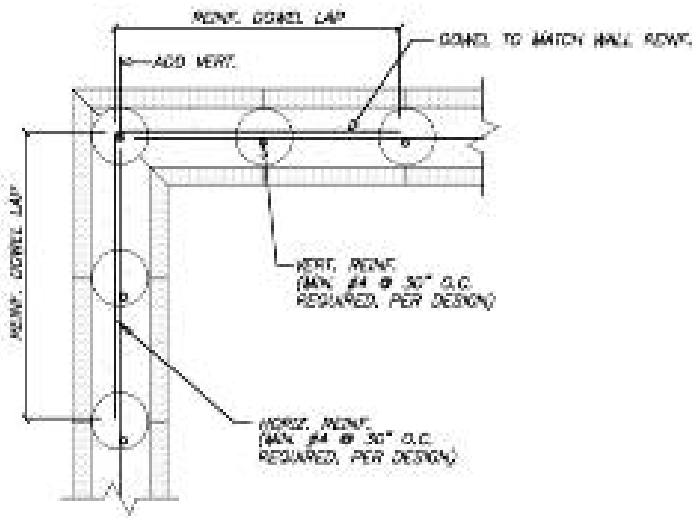
Mitered Corner

The most efficient way to make a mitered corner is to cut one panel at a 45° angle through the center of a vertical cell and simply 'flipping' one piece over to create a 90° corner. When making a mitered corner be sure to thoroughly coat the entire surfaces of the two cut faces where they make contact. The face of the mitered pieces can be rasp in the center to create a concave shape to make certain the toe and heel fit together tightly. Foam adhesive placed on the face of the panel will fill in any void.

Using End Panels

The end panel is positioned vertically at the corner and notched out at 15" intervals to create a path for the grout to flow from one wall to the other.

Types of Corners



Waterproofing

RASTRA walls have a large enough pore size that capillary action or 'wicking' of moisture is almost non-existent. However, **exterior wall surfaces below grade must use a water-proofing agent** applied in accordance with IBC Section 1806 or IRC Section R406, the same as masonry or concrete.

There are a wide variety of commercially available water or moisture barriers suitable for use on RASTRA walls. However, RASTRA below grade walls may be covered directly with standard waterproofing materials including cementitious or asphaltic sealing materials. As a general rule, if they are approved for use on masonry or concrete, they will work on RASTRA.

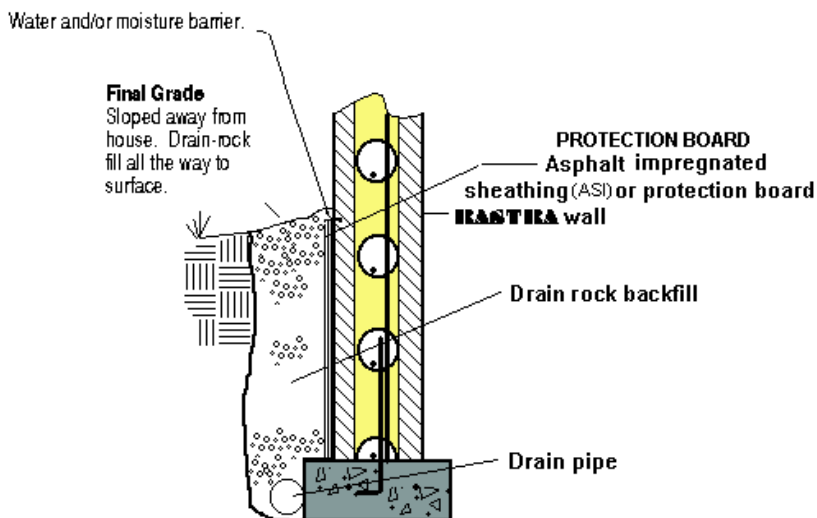
Once waterproofing is applied, and before backfill is placed against the walls, a protective layer of polystyrene board or other sheathing is then placed over the waterproofing material to protect the insulation from being punctured by backfilling materials. RASTRA panels may be covered directly with asphalt based sealing materials. There are other roll and sheet waterproofing products that also work well.

Note: Flat horizontal surfaces that could potentially collect water must be waterproofed.

Windows & Doorways

As with conventional construction, care must be taken to prevent moisture from penetrating the building around doors and windows. One method is to apply a membrane around the opening. This membrane along with adequate caulking of framing around windows and doorjamb should provide a weather resistant seal.

Note: Regardless of type of window installation; shim, sill seal, or rubber support plus caulk is recommended for weather proofing purposes. Use high quality urethane caulks and urethane foam sealants to glue and seal windows to RASTRA.



Basement wall with waterproofing and protective sheet

Setting Panels

All panels are produced with both horizontal and vertical channels 15" o.c. This allows panels to be installed vertically, horizontally or in combination and channels will always line up. Panels of different heights (30" & 15") can also be used in combination. Panels can be trimmed to create the desired height of wall. Before setting the first row, check the foundation to ensure that it's square and level.

Stacking Options

Horizontal

As RASTRA panels serve only as the formwork for the structural reinforced concrete, they do not need to be staggered. The strength of the walls comes from the reinforced concrete contained within the interior cavities. However, some builders prefer to stagger the panels purely as a matter of preference, because doing so breaks up the join lines. The choice is yours

Vertical

If panels are installed vertically, lifting is minimized as panels can be tilted up into place. Uneven foundations are not as challenging and fitting and plumbing of panels is easier. Panels standing on end are more unstable and require more bracing.

Straight Walls

RASTRA panels can be laid horizontally, vertically or in combination without affecting the design. Combinations of 15" and 30" high panels can be used together. Larger sections may be fabricated on site and tilted-up in to place. Window and door openings may be cut out prior to the placement of the section, then these large sections can be set in place and will be ready for rebar and grouting as soon as they are plumb and level.

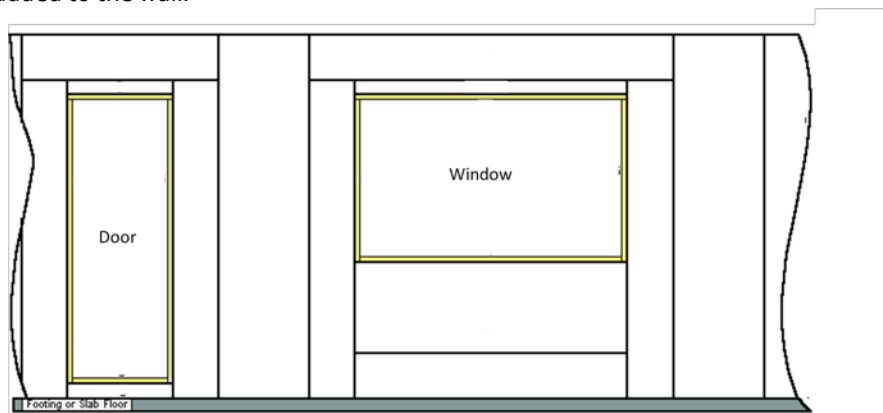
Curved Walls

RASTRA enables construction in a wide range of architectural styles. Walls, windows and doorways can be virtually any shape according to the architectural style desired.

Curved walls can be created using 15" wide RASTRA panels installed vertically. By trimming the inside edges of the panels to the correct angle, a curved wall can be created ([Section xx](#)).

To create a clean even edge, the cut should be made along a wooden straight edge fixed to the panels at the proper distance in from the edge of the panels. The inside edge may require minor rasping to make a perfect fit.

When installing a curved wall, bend the rebar to match the curve and thread it into the grout channel as panels are added to the wall.



RASTRA panels may be assembled in several ways:

1. Dry-stacked
2. Glued
3. Stapled

Dry Stacked

If dry-stacked, panels are usually held plumb and level by whalers (used as stiffeners) or supports until concrete has been poured.

Glue

If using adhesive, proceed along the joint between the RASTRA panel and the foundation and inject a small amount of glue every 6" to 12". This is not a caulking procedure but a gluing one, so a lot of adhesive is not required. When grout is poured, concrete will fill the cells and, in essence, cement panels together to form a seal. Glue is simply used to hold panels in position during the construction phase. Allow glue to dry for 30 minutes before plumbing or grouting. If foam adhesive expands into the cells, it can be knocked off but care should be taken not to let it fall down into the wall cavity. The same gluing procedure is followed for vertical and horizontal joints regardless of how the panels are laid.

Staples

Reusable RASTRA staples are often used to temporarily secure corners or around windows or doorways as seen in this photo during construction.



Installation of the First Row

How well you construct the first course of panels on the foundation is the most important part of building with RASTRA. The first course must be square, straight, and plumb. It may be useful to cut and fit the entire first row without gluing panels. Once you are satisfied, then level and glue into place.

After setting the RASTRA panels on the first corner, continue around the building. In the likely event that a wall is not built in even 15" increments, compensate in mid wall or at openings by trimming a panel to the desired length and then in future courses always adding the trimmed panel above the previous ones. This will ensure a continuous vertical grout cell.

Note: When making first row, if brick or stone is to be applied to the exterior, you can recess the panel slightly to provide a support ledge for the first course of finish.

If the first row is set upon the top of the stem wall and electrical conduit is to be installed within the cells, this is the time to start the electrical installation. At this point, the electrician can cut and set outlet boxes, attach conduit and install any horizontal runs. When setting electrical boxes, openings should be cut to fit as tightly as possible and boxes set in place with foam glue.

Installation of the end panels for corners should be performed last and either stapled or glued once all reinforcement is in place. As mentioned, corners may be created either by using end panels or by cutting two 90° mitered corners from standard panels. Building inspectors may require end panels to be removed to be able to visually verify rebar placement, so avoid using glue until after the inspection.

Installation of Additional Rows

Panels can be stacked with seams between panels lined up or staggered as long as cells line up. Installation of additional layers of panels is performed in the same pattern as the first horizontal layer –

start with a corner and then complete the rest of the layer. **GROUT CELLS MUST LINE UP.** Work around the building one layer at a time. Install the RASTRA panels, level, plumb and glue each joint between layers.

When installing each layer, work from the same side of the wall all the way up. Try to keep one side of the wall flush (usually the inside) and let any differences show on the other side. This reduces the amount of rasping needed to achieve a smooth finish on both sides of the wall.

Leveling and Plumbing Panels

When leveling and plumbing RASTRA panels, one method is to use wood shims. Shims are placed on one side or the other of the wall to level or raise the panels.

When placing wood shims, gently tilt the panels and slide the shim in place. Do not drive the shim into the joint; this may crush the panel as opposed to raising it. Shims should remain in place for 48 hours or until the foam glue has dried completely, and then they may be cut off or removed.

Always start at a corner to ensure stability. This is possible due to the symmetric nature of the cells created when panels are connected. The method of leveling panels is similar to laying cement block, only much faster. Bracing (= keeping the wall plumb) before grouting should occur at all times to ensure wall stability against high winds and after the crew has left the jobsite.

Second Story

Installing RASTRA panels for the second story is accomplished in the same manner as the first story. Start at one corner and go around the building. If you set panels horizontally, level and plumb each layer as you go. Glue each layer after leveling and plumbing. Fabricate any openings in the same manner as performed in the first lift

Bracing Walls

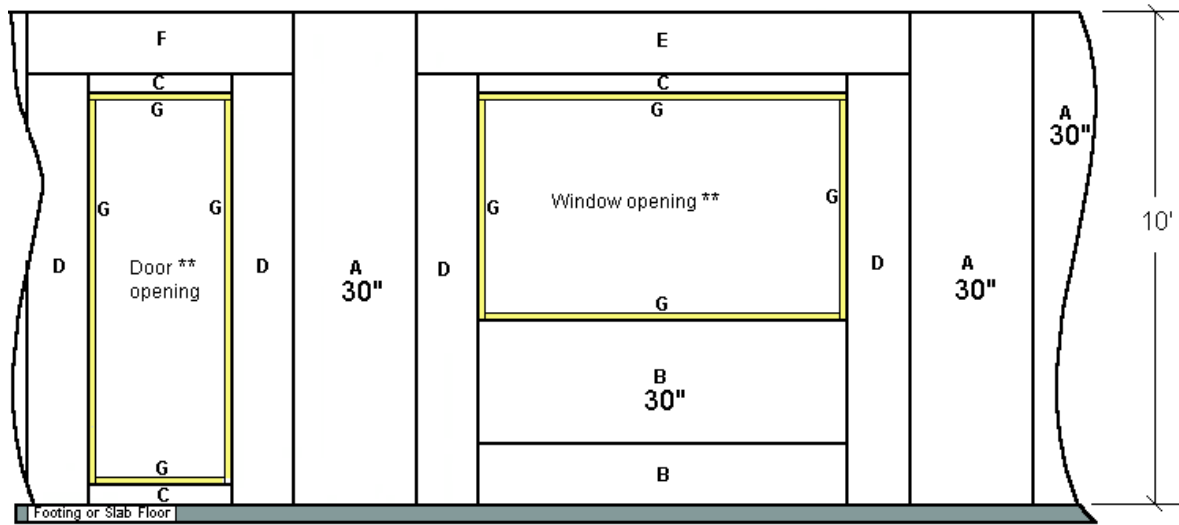
Use bracing as needed on the inside and outside of the walls to keep walls plumb and level for the grout pour. Most comfortable is the use of supports with turn buckles by which the wall section can be pushed or pulled to its plumb position. These supports can be fastened to the ground by anchors and to the RASTRA wall with pieces of thin rebar locked in place with snap ties. Areas where nodes have been cut out or the ends of mitered corners have to be braced.



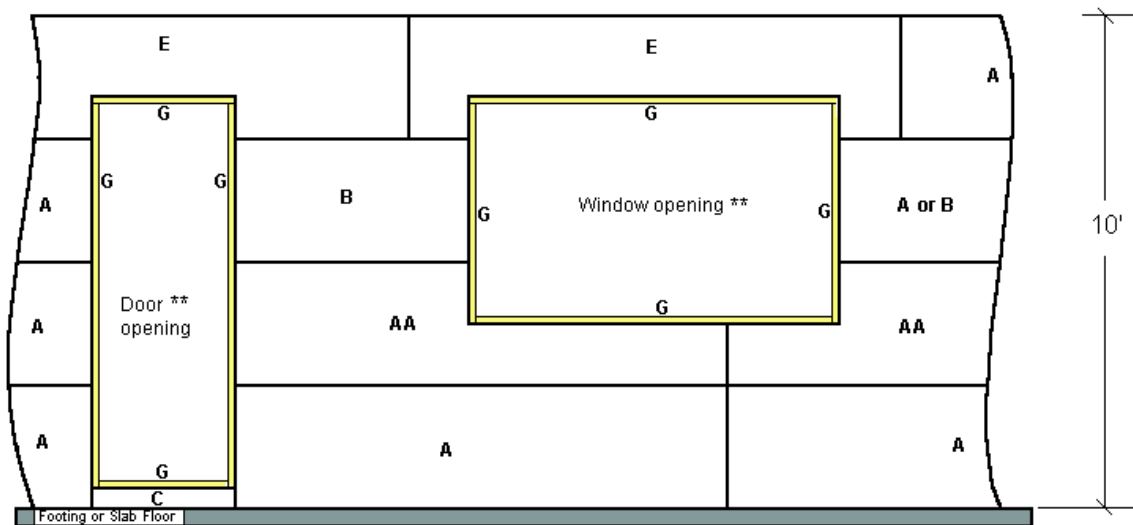
Stabilizing Weak Panels Prior to Grouting

Before you can pour grout, make certain that no panels have been weakened by hollowing or significant reduction of RASTRA material. For panels that have been damaged or significantly modified, follow these steps to reinforce any weak areas:

1. Cut two pieces of OSB or plywood to cover the weakened area.
2. Drill holes through both boards, spaced no more than 24" apart.
3. Place one board against the weak area of the panel, and feed allthread rods with a washer and nut on one end through the hole and through the RASTRA panel. From the other side of the wall, take the second board and feed the allthread through the hole and install washers and nuts. Instead of allthread it may be more comfortable to use thin rebar and snap ties.
4. Once both rods are installed, tighten to draw boards tight against wall.



Combination Stacking using 15" and 30" panels



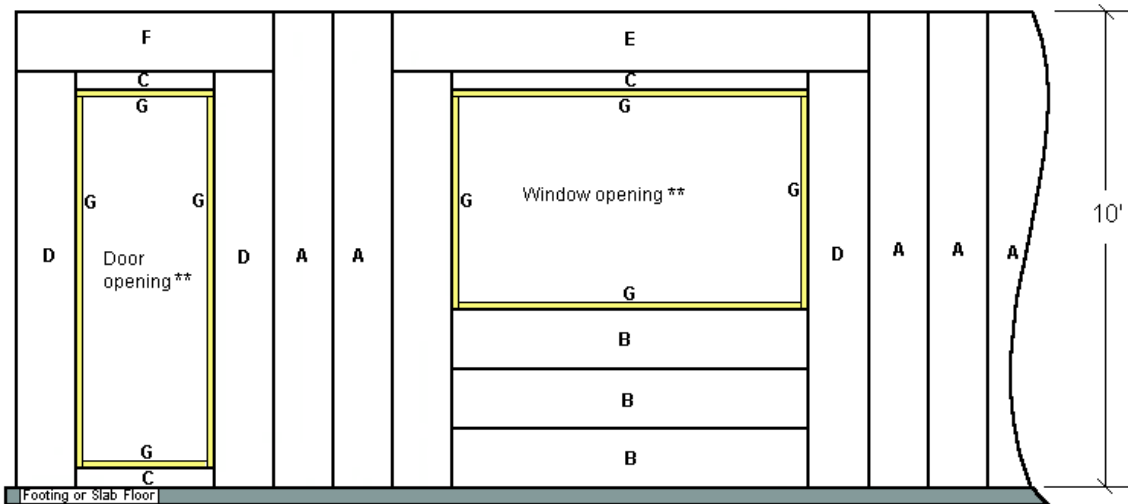
Horizontal Stacking with 30" panels

- A – Full length panel. Stack horizontally and/or vertically.
- AA – Full length panel. Cut to fit as needed for window opening. Stacked horizontally.
- B – Panels cut to desired length to fit between openings and corners.
- C – Filler Strips as needed. Cut from scrap to reduce waste. Add extra backing and/or bracing as needed.
- D - Trim panel. Cut to desired length. Supports header & lintel.
- E – Full length header/lintel panel. Cut to fit as needed. Rebar and concrete as specified.
- F – Header/lintel panel cut to desired length. If possible always use single length piece supported at each end by trim panel. Header configuration, rebar & concrete as specified.
- G – Wood buck to block opening. Glue all stay-in-place bucks to RASTRA with non-expanding foam adhesive.

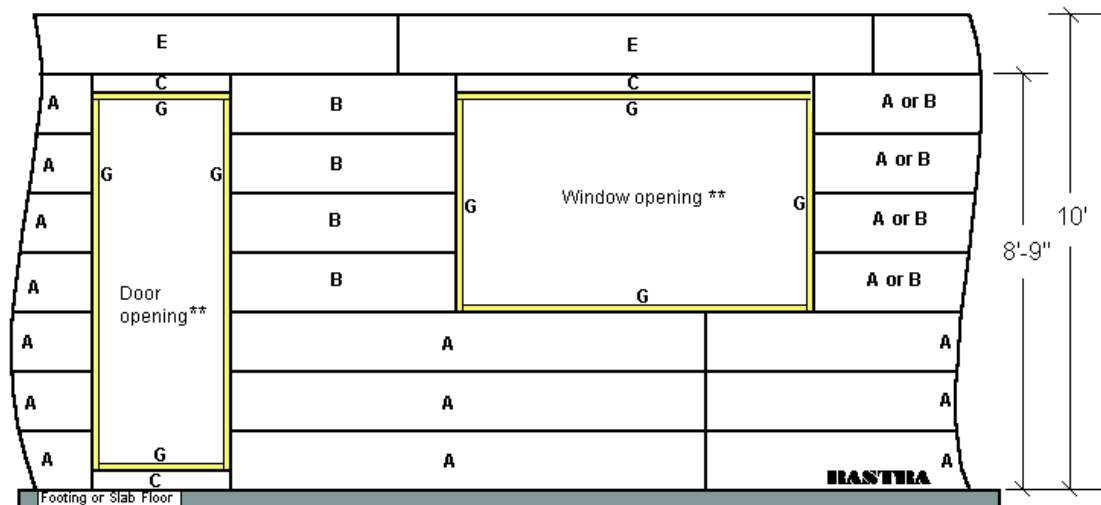
Note: Sure and brace all opening bucks horizontally and vertically, 2' to 3' on center.

INSTALLATION MANUAL

11-5



Combination Stacking horizontal & vertical using 15" panels



Horizontal Stacking with 15" panels

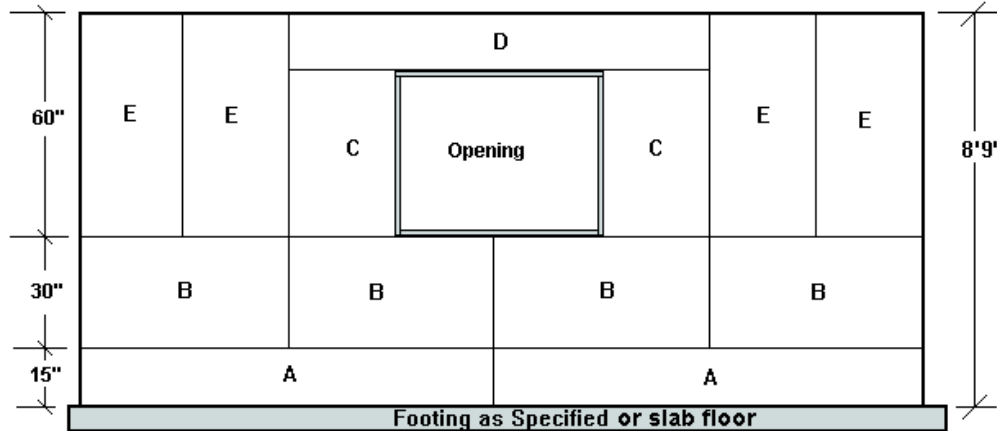
- A** – Full length panel. Stack horizontally and/or vertically.
- B** – Panels cut to desired length to fit between openings and corners.
- C** – Filler Strips as needed. Cut from scrap to reduce waste. Add extra backing and/or bracing as needed.
- D** - Trim panel. Cut to desired length. Supports header & lintel.
- E** – Full length header/lintel panel. Cut to fit as needed. Rebar and concrete as specified.
- F** – Header/lintel panel cut to desired length. If possible always use single length piece supported at each end by trim panel. Header configuration, rebar & concrete as specified.
- G** – Wood buck to block opening. Glue all stay-in-place bucks to RASTRA with non-expanding urethane foam adhesive.

Note: Sure and brace all opening bucks horizontally and vertically, 2' to 3' on center.

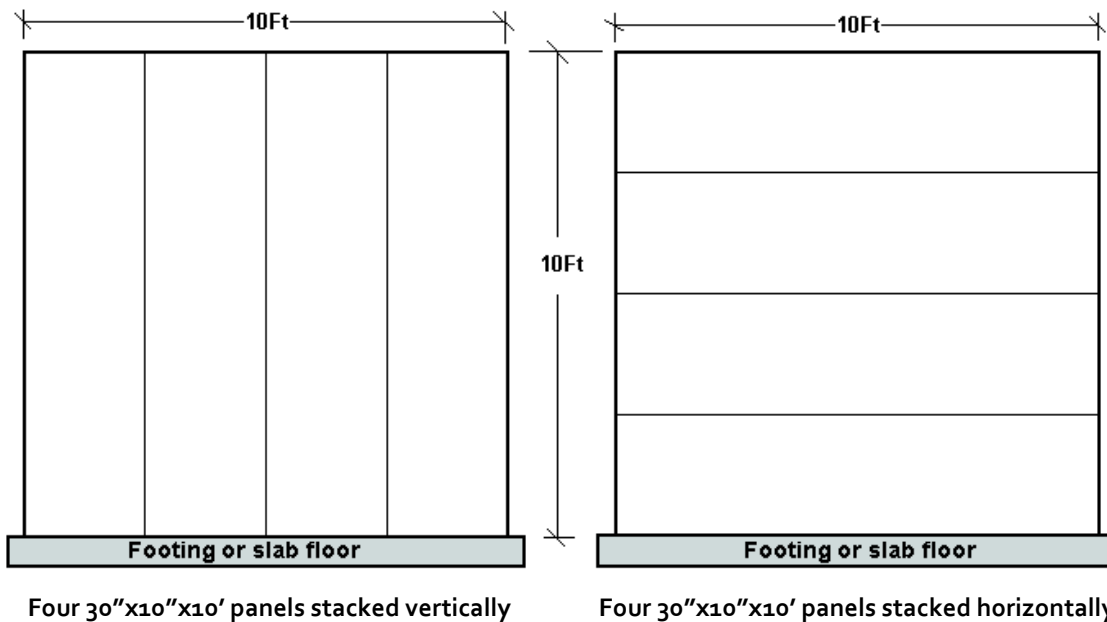
INSTALLATION MANUAL

11-6

30" double panels cut in half for hand stacking on top of (mono, wet or dry set first course) 8'-9" high wall. Be certain the top of the row A is level and straight before setting row B.



- A – 15" panels first course glued to footing, or wet set or mono poured in footing.
- B – 30" panels cut in half (60") for hand stacking (160 lbs) and stacked horizontally.
- C – 30" panels cut to fit.
- D – 15" panel notched to accept 10" window buck (see lintel detail drawing and span & load requirements).
- E – 30" panels cut in half and hand stacked vertically. No scaffolding required.

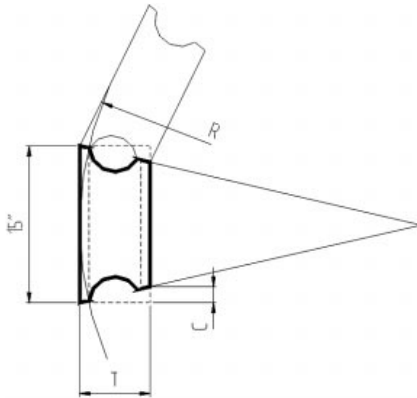


Curved Walls

Curved walls are easily created using single 15" wide RASTRA panels installed vertically and trimming the inside edges of the panels to the correct angle. The radius of the wall will be dictated by the angle the panel flanges are cut (see below).

To create a clean even cut edge, use a wood straightedge fixed to the panel the proper distance in from the edge of the panel. The inside edge may require a little rasping to make a perfect fit. If there are panel scraps on the jobsite you may want to practice making cuts before cutting a full sized panel.

If the radius exceeds 7', the wall will appear round with very little rasping required to create a smooth curve. Smaller radius curves may require more rasping. In either case, a plaster finish will provide a finished result.



Note: A helpful tool is to use a long flexible piece of 4-6" wide Masonite or ¼" plywood that can be held against the curved wall at both ends. If there are high points in the wall at the seams, gaps will appear behind the Masonite. Move the Masonite along the wall to identify high points that still need to be rasped to a smooth finish.

Note: To support vertical panels during installation use temporary RASTRA staples on both sides of the panels. Brace as required.

Radius "R"	CUTOFF "C" FOR WALL THICKNESS "T" (inch)			
	8½"	10"	12"	14"
3'	1.8	2.1	2.5	2.9
4'	1.3	1.6	1.9	2.2
5'	1.1	1.3	1.5	1.8
6'	0.9	1.0	1.3	1.5
7'	0.8	0.9	1.1	1.3
8'	0.7	0.8	0.9	1.1
9'	0.6	0.7	0.8	1.0
10'	0.5	0.6	0.8	0.9

For other radii calculate $C = 0.625 \times T \text{ (inch)} / R \text{ (ft)}$

Interior Walls

RASTRA panels can be used to build both the exterior and interior walls, or used only as the exterior wall with wood frame interior walls. If used as an interior wall solution in a multi-story project, walls on the upper floors must be properly supported. This will require continuous support to the slab or poured floors designed to support the additional weight load of concrete walls.

Note: 8.5" panels are designed to serve as non or low load bearing interior walls to save floor space. This solution creates a safer, quieter and more fire resistant building.

Anchorage of Wood (Steel) Frame Interior Walls

If the method of using anchor bolts to attach wood frame interior walls to the RASTRA panels is selected, it will also be necessary to place them prior to grouting. Connection of interior walls to the RASTRA wall does not require a hole around the anchor bolt. The anchor bolts can be driven through the RASTRA panels in the desired locations with enough of the bolt protruding to allow the bolt to extend through the wooden stud far enough to place a washer and nut.

The easiest way to perform this is to pre-drill holes to accept anchor bolts in the stud to be attached to the RASTRA wall. Place the stud in position against the wall and mark locations for anchor bolts. Remove the stud, pre-drill pilot holes, apply adhesive to the back of the stud and install using anchor bolts.

Using RASTRA Panels as Interior Walls

If desired, interior walls can also be made from RASTRA panels. With this method, holes are cut into the main wall to coincide with the horizontal cells in the end of the interior wall. Rebar bent 90° is placed to provide a physical connection between the two walls and concrete grout will flow into both walls.

Windows & Doors

Window and door openings are typically fabricated by one of two methods:

1. Fabricated as the wall is being installed
2. Cut out of the solid wall prior to grouting

Usually, larger window and door openings (garage doors) are fabricated during wall installation to save time and materials. However, small doors and windows are simply cut out of the installed wall. In either case, they may be bucked out with lumber, or lined with RASTRA end panels for enhanced aesthetics.

When designing an opening, the rough dimensions need to be known of the window or door being installed. If RASTRA end panels are being used around the window openings, an additional 15" must be added to the rough opening dimension in both directions. For example, if the rough opening size is 36" wide by 48" high, cut the opening to be 51" wide by 63" high. This will accommodate the 7½" end panels on all four sides. Regardless of the method used, spreaders should be used to stabilize the openings while grouting.

If a BULLNOSE or FLARED opening is desired, then RASTRA end panels can be shaped. The RASTRA end panel has about 4" of material that can be cut and/or shaped to create the desired effect. End panel dimensions are 7.5" wide by the thickness of the wall. A RASTRA end panel or RASTRA flat stock may be used or a standard plaster sill, or window sill made of stone, marble, or weather protected metal may be applied directly over a standard panel.

It's also possible to order wider end panels than the wall panels. In other words, if you are installing 10" walls, order 12" end panels to frame the openings. The 6" core is still centered and will align properly, but you will have a very cost-effective and easy-to-install 1" overhang that will frame your window. The 1" overhang on the inside can be left or easily be removed by placing a flat saw blade against the wall.



Wood Buck Openings

If the decision is made to buck out the opening with lumber, one of three sizes of lumber will be needed: 2x4, 2x6, or 2x8. If the bucking is to be left in the wall as a nailer 2x6 lumber will be needed. If the bucking is to be removed after grouting, 2x8.s should be used for all panel sizes of RASTRA panels. In both cases, the finished opening will be the same size as the rough opening design required for the window or door. If the buck is removed or RASTRA end panels are used the windows can be glued in the opening with foam.



If openings are to have wrapped, slightly rounded or square edges, then the openings may be bucked out using 2x lumber. These buckings may be secured to the opening either by gluing them in place with foam adhesive, or attached by inserting anchor bolts into grout cells prior to grouting, or after grouting by drilling holes and gluing the bolts in place with epoxy..

The simplest way to connect wood bucks to the concrete wall is to insert galvanized larger deck screws or hooks from the back into the bucks, so the screws will be embedded into the concrete when it is poured.

It's a good idea to have the rough buck openings already made and on site along with your windows as you build the RASTRA walls. This allows you to drop in the rough buck opening as you go along to ensure you have a perfect fit. The 6" diameter interior channel will accept a 2x6 with only slight modification for a recessed wood buck..

Vinyl Bucked Openings

Increasingly builders are using bucks made from extruded vinyl. The advantage of vinyl bucks is that will not rot or decay and rounds are much easier to shape on site. Vinyl bucks are not as stiff as wood bucks and require more bracing to prevent flexing and to maintain square and plumb position during the concrete pour.

These bucks come in sections and are commonly cut on site with either a portable power saw, or more conveniently a compound miter saw. Connectors are used at the corners to tie the cut sides together.

Vinyl bucks come in standard 16' lengths with full accessory packages. They can be ordered pre-built to required size, which is recommended since it reduces on site labor. Packages contain corner connectors, straight connectors and metal squaring pans. Bracing pans must be used with vinyl bucks.



Arched Openings

Arched openings are easily created with RASTRA. First set up shoring underneath the arch to support the bottom of the panels to be cut. Next, mark the vertical and horizontal outlines of the opening. Then you can use a string centered in the opening to swing across the opening to shape your arch. Another method is to drive nails into the RASTRA panel at the top center of the opening and at the point on the vertical walls you want the arch to begin. Then take a 2" wide piece of Masonite, hang it over the top nail and pull the ends of the Masonite down and under the two side nails. You should be able to release the Masonite and it will hold in place. While the Masonite is in place, mark the underside to create an outline to cut.

Once the outline is drawn, cut about $\frac{3}{4}$ of the way through the arch outline and insert a 9-10" wide piece of Masonite to block the flow of grout into the panels below. Place all necessary rebar. Once grout is poured and set, finish cutting through the panel below to reveal your arch. The cut out panels can even be used elsewhere.



Arched windows can also be formed by using pre-made vinyl bucks in a variety of shapes and sizes.



Jambs

When framing the opening with end panels, the window and door jambs are attached by countersinking anchors through the end panel into the concrete core. This is easily done prior to the placement of the concrete grout, then pouring with the anchors in place. If attached after the placement of the concrete grout, the anchors may be drilled into place.

Wood bucks may be surface mounted or recessed. Regardless of the application, bracing should be inserted to hold the bucking or end panels in place during the grouting process to insure that the pressure of the concrete does not move or bow the openings.

Headers

In addition to the use of end panels and bucking, a more decorative header can be created by recessing the header into the wall as shown here. The bottom of the header may be grooved if required to accept windows. Careful caulking is necessary that no moisture can intrude the wall between the wood header and wall or through cracks in the wood.



Sills and Trim

For sill or window trim applications that would normally use polystyrene stick-ons or pop-outs, RASTRA flat panels may be utilized. RASTRA flat panels measure 30" by 120" by 2" or 4" thick and may be cut and shaped into almost any configuration. This offers the designer total creativity in and around window and door openings.

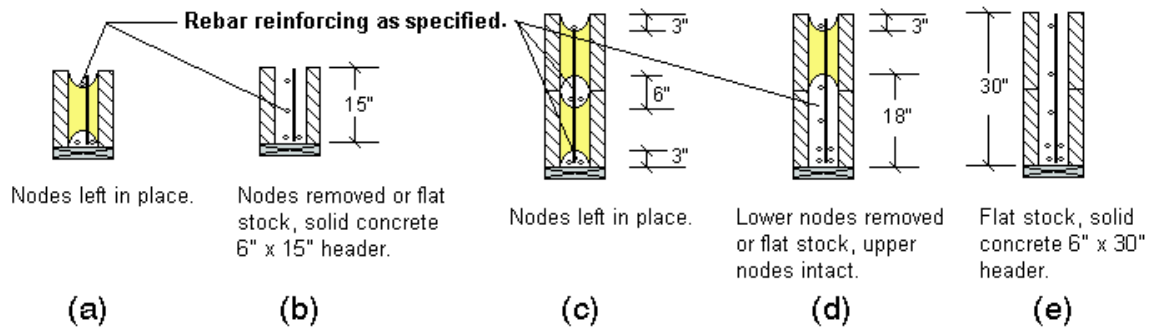
Lintels & Headers

Lintels and headers can be made from RASTRA panels in a number of ways. Lintels can be fabricated from RASTRA end and standard panels. Alternatively, wood bucks can be used instead of the end panels to form the base of the lintel. Also, nodes can be partly removed to enlarge the concrete core for higher strength or depending upon the length of lintel required, flat stock can be used to create a solid concrete lintel.

Note: Regardless of type of window installation, caulk is recommended for weather proofing purposes. Use high quality urethane caulks and urethane foam sealants to glue and seal windows to RASTRA.



Engineer should check & specify design to meet or exceed all load and span criteria.



Grouting

Concrete Mix Design

The concrete mix design should be a pea-gravel mix with aggregates smaller or equal $\frac{3}{4}$ ". A slump of at least 6.5" is required, regardless of the concrete strength (psi). Preferred slump range is from 7 to 8 1/2". This will provide sufficient slump for pumping and also allow the concrete to penetrate into the Thastyron material thus integrating the form and the structural core. Concrete strength has to be according to engineering, however, the minimum recommended quality is 2,500psi.

When ordering concrete, make certain to order a pump truck with a boot reducer or "sock" to direct grout into small RASTRA openings.

Note: Grout will set up in an average of 48 hours and reach full strength in 28 days.

Lift Heights

The height of the first grout pour will depend on the building itself and local code requirements. Grouting of lifts which exceed a height of 10-12' are not recommended, as hydraulic pressure at the base of the lift could exceed material capacities. If 48" lifts are required by building authorities, although we do not recommend, walls can still be constructed to 10' or greater heights. All that is required is to cut grouting access holes into the wall at a 48" height and about 5' apart to serve as "feeder holes". The cutouts can be glued back into place and grouting resumed for the next lift.

Note: Testing has shown that vibration of grout is not required either during or after grouting even if slump is in the lower range.

Grouting Tip

A good trick to ensure thorough filling of concrete inside the wall, particularly in dry hot weather, is to completely wet the **inside** of the RASTRA panels from top to bottom either the evening before the pour or several hours beforehand. Excess water will bleed out and any puddles that may occur at the bottom will be displaced by the grout flowing into and throughout the wall. In hot weather, wetting down the inside of the wall helps to cool the wall and adds extra humidity, which can improve the concrete cure.

Note: To verify that concrete has completely filled all of the panel cores, push a small diameter, smooth steel rod, or a key-hole saw, through the RASTRA panel and into the grout channels. Wet concrete on the rod when you pull it out will confirm that the grout channel has been filled completely.

Small Jobs

If a small amount of concrete is required for a project such as a planter or bench, small batches of concrete may be hand poured.

Note: The slump test cone can be inverted and used as a funnel for filling cells.



Typical Slump Test



Grouting Technique

Upon starting installation of the grout, place grout first in the bottom of any window openings that are over 5' wide. To do this, cut a hole in the end panel or just below the bucking to let the grout pass through. The cut out can be put back in place if desired. With bucking, it may be necessary to remove the bottom piece and replace it when the section is full, to ensure the grout stays below the level of the bucking and that there will be a smooth opening when removed or less of a void if bucking is left in place. After grouting under windows, start grouting near a corner (but not directly in the corner) and move around the building. In essence, create a wave and surf the top leading edge of that wave around the building. Continue to fill the wall, holding the pump hose to the nodes of the panels rather than into the cavities. The grout, if at the right slump will flow at about a 45°+ angle as it fills. Be prepared to move back and forth along the wall as the grout reaches about the 2/3 full mark. Keep moving two to four cells at a time and watch that the grout is filling to the desired level.

Try not to over-fill to avoid excessive cleanup. If a slab floor has already been poured, using polyfilm, cardboard or Kraft paper next to the wall makes cleanup easier. If grout spills on to the finished concrete slab it will need to be cleaned up immediately after grouting is complete so it does not adhere to the concrete.

If Only One Lift

If there is to be only one lift, make certain the top of the rebar is below the top of the wall by at least 3" and that the grout is struck off flush with the top of the wall upon completion. The placement of any top plate anchor bolts should also be done at this time.

Grouting the 2nd Lift or Story

If the project requires two separate grout applications, rebar will need to extend past the point of the first grout by **at least** 40 bar diameters to provide the overlap required to offset the cold joint. This may be accomplished in one of two ways, stop the grout application below the top of the bar the necessary distance, or cut your bars so that they protrude out above the top of the first grout lift to the prescribed overlap.

Each pour can be made in lifts up to 10'. Follow the same checklist for grout preparation. Pour the grout in the same manner as before, large window bottoms first and then from the top, working around the building.

When building multi-story buildings, it's sometimes helpful to proceed floor by floor. By this it's meant to build the walls to the height just past the first floor ledger height and then after grouting, placing the floor joist and sub-flooring. This will create a surface to work from and eliminate the need for additional scaffolding. This is purely optional, as the walls could be installed to full height and the floors added later. If however, a concrete floor is to be used, each story must be finished and grouted with the floor above before starting over with the next story.

If a concrete flooring system is used, the walls for the first floor are installed and the floor system is laid out, then concrete is poured for the floor and RASTRA walls at the same time.

Anchor Bolts and Other Connections

As the wall is being grouted, be sure all anchor bolts for ledger plates, adjoining walls and any other connections are mounted in the wall in such a fashion that will permit proper connection and tightening.

To save time when installing top plates, have the top plates pre-cut and drilled for anchor bolts before the grout pour begins. This will allow you to lay the top plates over the top of the wall immediately after the grout pour and easily insert the bolts into the wet grout.

Pre-Grout Checklist

After all panels and trim panels are in place, and prior to grouting completed wall segments, check the following items to help ensure a successful concrete installation:

1. Make sure that all RASTRA panels are glued or securely installed and add extra bracing at potentially weak areas.
2. Brace any long straight runs thus minimizing any movement that would make the wall difficult to walk when grouting.
3. Verify that all walls are straight and plumb. Brace walls as necessary.
4. Install all electrical and plumbing to be embedded inside cell areas.
5. Cut all window and door openings. Brace all bucking.
6. Place all rebar per engineer's design.
7. Place all end panels or bucking.
8. Brace all end panels, corners, wall ends and bucking to withstand the force of the grout. Add extra staples or spot glue if desired.
9. Place any anchor bolts and ledgers that are needed. (Ledgers and anchor bolts may be held in place prior to the pour by bolting them to the wall using all-thread rod).
10. Complete any needed inspections from the local building authority.
11. Schedule pump truck and concrete grout per engineer's mix design.
12. If openings for windows have been cut out of solid walls, check those openings for cuttings that may have fallen into the wall channels. These cuttings may be removed with a vacuum or washed out with a water hose.
13. Hose down the inside of the RASTRA panels - this not only promotes and improves the flow of concrete into the wall, and also improves cure strength by increasing humidity and lowering temperature on hot days.
14. If a slab floor is already in place, cover the surface area against the wall with polyfilm, cardboard or Kraft paper to catch spillage. This makes cleanup after pour much easier.
15. Search for damaged or fractured panels that could lead to a blowout when grout is poured. Repair these areas with a plywood brace.
16. Have several pre-made braces available to be able to quickly respond to a potential blowout.

Conventional Roof & Floor

Ledgers and Anchor Bolts

The size and locations of ledgers and the size and spacing of the anchor bolts should be specified by the engineer.

To install a ledger, first locate the correct height for the ledger and snap a line on the wall at the top or bottom of the ledger, to allow correct positioning of the ledger. If the top of the ledger needs to be in a particular location then the chalk line should be snapped for the top of the ledger.

After snapping the chalk line, locate the vertical cells that anchor bolts will be placed in and cut holes as specified by the engineer. These holes are typically 4" or 6" in diameter and may be cut with either a keyhole saw or a drill with a hole saw of the proper size.

Note: To ensure proper flow of grout within the wall, do not allow the cut out pieces to fall down inside of the wall.

Because the holes cut into the RASTRA panels are larger than the anchor bolts to allow adjustment of the ledger, it's easiest to install the ledgers and anchor bolts together. Drill holes to accept the anchor bolts at the desired spacing and bolt the anchor bolts onto the ledger.

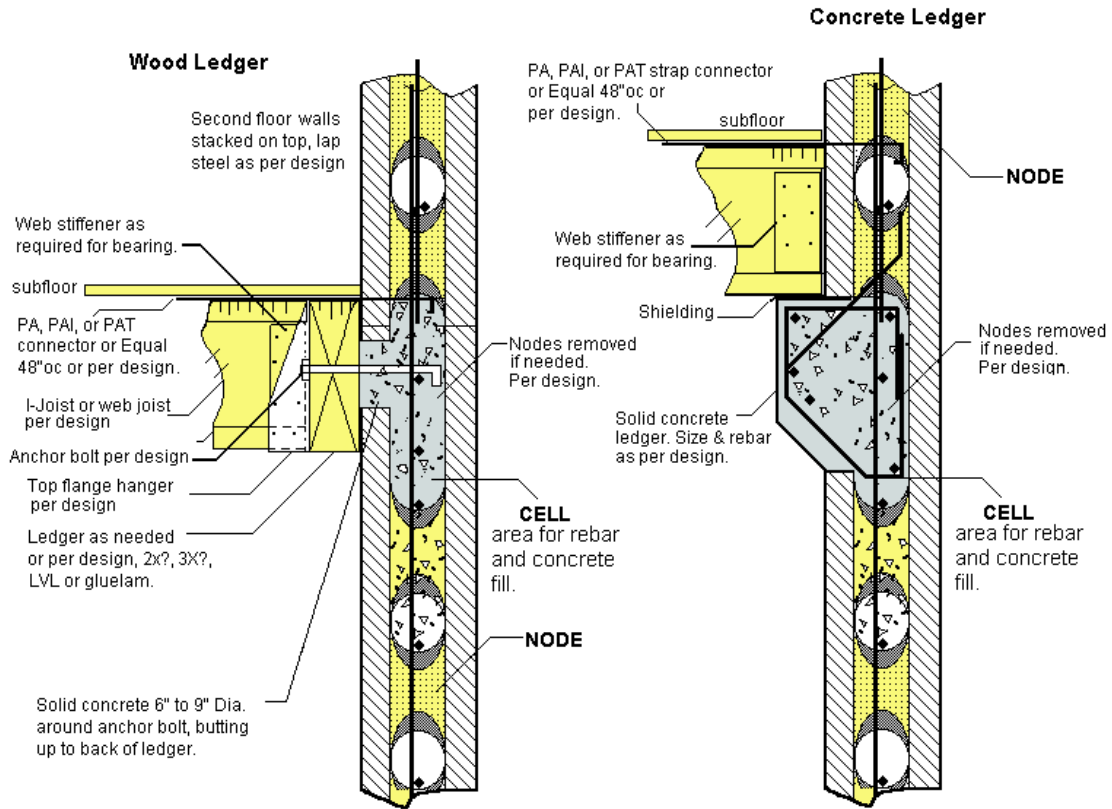
There are several methods which can be used to attach the ledger to the wall. However, it's recommended that all-thread rods or "J" bolts be used to fasten ledgers to the wall (Section xxx). The ledger can be predrilled to accept the all-thread rods and the rods driven through the RASTRA panels with a large washer made of plywood (typically 6" in diameter). These wooden washers seal the hole so grout does not escape during pour.

Once the ledger is snug, check that the ledger is flush with the chalk line, and then finish tightening the threaded rods. Threaded rods should be placed about 60" apart and if possible through solid areas of the RASTRA panels. This will allow recovery of the threaded rod after the grout is cured. Once ledgers are in place, joists can be installed prior to pour of concrete if desired.

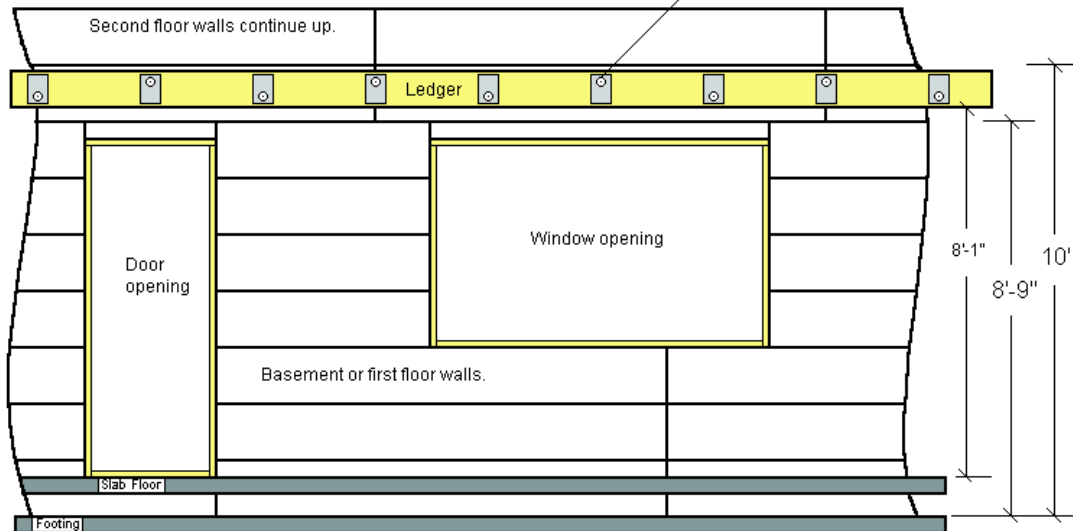
Note: Refill any clear holes made for temporary rods with foam insulation.



Ledgers and Anchor Bolts



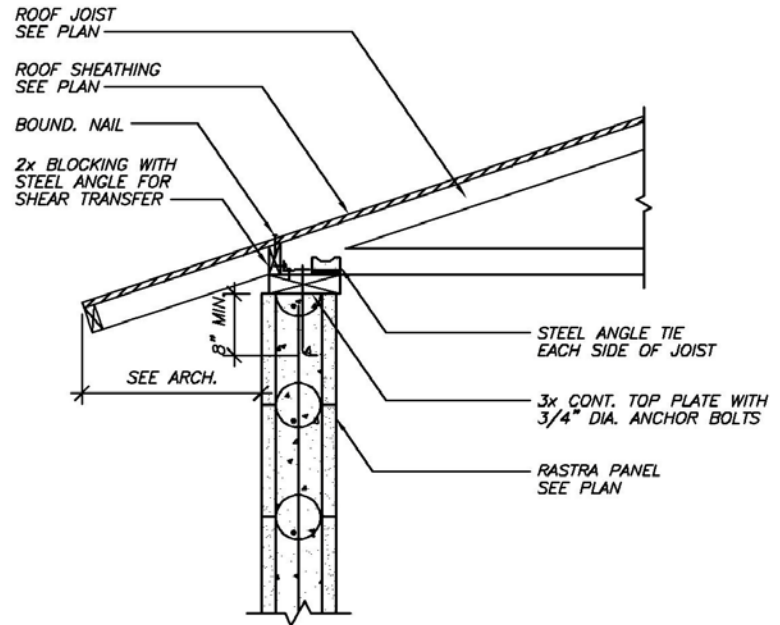
Anchor bolts may be placed in either horizontal or vertical concrete cell areas. The use of large 1/2" thick steel washers, as shown, may substitute for PA, PAI, or PAT straps. Layout and sizes as per design.



Truss Roofs

Truss roofs may be connected to RASTRA panels in a manner similar to conventional frame construction. A top plate is attached to the wall by means of anchor bolts set into the top of the wall when the concrete is poured.

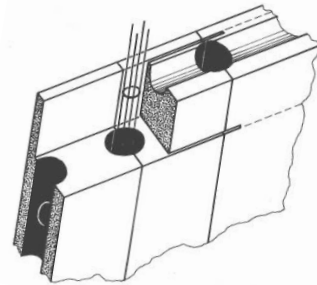
The length, diameter and spacing of the anchor bolts are to be installed per engineer's specifications. The top plate is typically a 2x where width depends upon the size of the RASTRA panel selected (10," 12," or 14").



Concrete Flooring

Any conventional prefab or poured in situ concrete flooring system works with RASTRA.

A simple way to support a prefab slab is to cut the top of the RASTRA wall L-shaped. The cut out area will form a tie beam once concrete is poured. Also prefab slabs or hollow core elements can be supported on the cut out of the wall. The next floor can be started on the top of the wall and the ready poured floor.



RASTRA Floor & Roof

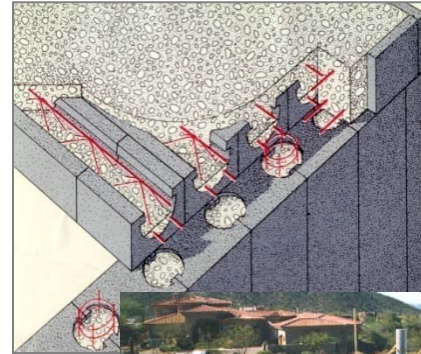
In addition to conventional wood floors and roofs, RASTRA components can be used to create RASTRA floors and roofs which have the added advantage of being insulated, and eliminate cold joints between the walls and floor/roof diaphragm.

Inverted RASTRA end panels are used as stay-in-place form work for a flat roof or floor. The floor or roof from a technical point of view is basically a slab with T-beams at 10", 12" or 14" intervals. The RASTRA panels provide a stay-in-place insulating form, the flat bottom of which can be finished as a ceiling and the upper surface finished as a floor or roof. For roofs, whatever slope is required for drainage can be created when the concrete slab is poured.

Note: Double end panels (2 end panels connected side-by-side) are available upon request.

As seen in the illustration to the right, the roof/wall connection is poured in a monolithic fashion. To make room for the tie beam, the top of the RASTRA panels in the wall can be cut in an L-shape; or flat stock can be used and glued on top of the wall panel.

Reinforcement in the walls may be as shown or in the more traditional method of individual rebar placed in the horizontal and vertical cells. Roof or floor reinforcement may be mini-trusses as shown or standard rebar which may be laid in the horizontal cavities and connected via hooks or hoops to a welded wire mesh or rebar mat as would be required for a slab roof or floor.



RASTRA Flat Roof with Parapet Wall

Before grouting, the top of the RASTRA wall is cut flush with the roof or floor. Walls are grouted together with the slab pointing the hose on the slab near the wall and allow it to run down into the wall to create a monolithic structure. If an additional story or a parapet roof is to be constructed, then the additional story or parapet wall's vertical reinforcement is installed in the wet concrete at this point to create the lap splice. Once the finished concrete slab has dried, RASTRA panels for the additional story or parapet wall can be set into place and cut into the desired shape.

The process is similar with other concrete flooring systems.



Electrical

RASTRA enables electrical conduit to be either incorporated into the interior wall cavities or recessed into the surface. In either method, planning ahead is highly recommended.

Electrical conduit can be run through the footer or slab and then fed into the cavities within the interior of RASTRA panels before walls are grouted. Alternatively, they can be brought through the stem wall or slab into the interior of the structure and run up interior walls as necessary.

Interior Conduit

Prior to grouting, conduit may be placed within the wall in a manner similar to the method employed in masonry block construction. If this method is selected, it may be necessary to have the electrical contractor on site during assembly of the walls to place the electrical conduit inside the cells as walls are constructed. This method may be more expensive and slow the panel assembly process.

Planning Surface Recess Layouts

As in conventional construction the requirement for conduit varies from area to area. Regardless, conduit is relatively small and can be easily embedded in the surface of a RASTRA panel whether it is a rigid metal conduit, thin-wall metallic tubing, flexible metal or non-metallic conduit. In most residential applications Romex wire can be placed in grooves cut into the surface of the RASTRA wall. If necessary it can be covered with a wire mold (use only the cover).

Typical embedment depth from the surface of the wall is 2." As the depth-to concrete in a RASTRA panel is at least 1-7/8" this can be accommodated. However, first check with your local code authority for required installation depths, as this requirement varies. Typically, codes restrict the radius and number of bends between boxes, thus the straighter the run the better. Coordination of electrical, cable, sound or security wiring, location of thermostats etc., is best considered at the planning stage. In addition, the location of plumbing runs must be considered to avoid conflicting paths.



Face Grooves

This method is considered easier, less expensive and more closely resembles the method electricians use in conventional wood frame construction. With this method, most of the electrical wiring is installed after RASTRA panels are in place and grouted. Once the wire or conduit is set into the routed groove, the groove can then be filled secured with foam or plaster patches. All grooves are covered finally with plaster or sheetrock when the wall is finished. Grooves can be cut easily using a chain saw with a C-clamp as depth guide.



Furring Strips

The interior may also be framed with furring strips in the usual manner and electrical conduit run between the panels and the sheetrock attached to the furring strips.

Setting Electrical Boxes

The placement of electrical boxes needs to be planned in advance. If the location of an electrical box will be in the area of a grout cell, the box must be installed prior to grouting to ensure the box can be set deep

enough into the panel. Otherwise, electrical boxes may be installed either before or after grouting. If the interior is furred out, place the boxes in the normal manner.

To mark the location of the electrical boxes, place the box face against the wall in the precise location to be installed and tap it with a hammer. This will embed the outline of the box into the panel. If installing boxes after grouting, be certain to place junction boxes in parts of the panel that are solid RASTRA. Junction boxes are more than 2" deep, and the RASTRA panel over a grout channel in a 10" panel is just 2" deep. So, if you try to place a "J" box over a grout channel, the grout will keep the box from setting flush with the surface of the wall.

To create a hole the exact size of the box, cut along the outline with a keyhole or wallboard saw and pull out the core. The electrical box can then be pressed into the opening and sealed with an adhesive at each edge. Generally, the foam sealant used in the bonding of the RASTRA panels will be sufficient. However, there are other adhesives that will accomplish the same results.

Note: If plastic boxes are being used, be careful not to over-apply the expanding foam sealant as it could deform or collapse the plastic boxes.

Other Wire Installations

Other wire installations such as telephones, alarms, TV cables or speaker wires may also be installed in the same manner as the electrical conduit.

Plumbing

Plumbing installations may be managed in a manner similar to electrical conduits with few exceptions.

Plumbing feeds can be run through the footer or slab and then fed into the cavities within the interior of RASTRA panels before walls are grouted. Alternatively, they can be brought through the stem wall or slab into the interior of the structure and run up interior walls as necessary. Installation of electrical conduit may also be placed in routed grooves made in the interior surface of the walls.

Copper Piping

When copper pipes are placed inside the cells they should be completely wrapped with plastic shielding tape or equivalent to protect pipes from concrete grout.

Plastic Piping

Where permitted by code, plastic pipe may be placed either within the wall cavity, or embedded in the surface without concern. When placed within the wall, holes are simply cut out of the face of the panels with a drill or keyhole saw. Access holes are made for installation in order to connect pipes running up from foundations or lower floors with piping for the next floor, which will be inserted from the top of the panel once the panels are in place.

Plumbing Rough-ins – Slab on Grade

Plumbing can be run under the slab as would be the case in conventional construction and stubbed out as usual. No special work is required.

Vent Pipes

Vent pipes can also be placed within the walls prior to grouting, be face-mounted and hidden behind a cabinet, or if the vent pipe goes straight up the face of the wall, 2x4 lumber can be used to build a furred wall to cover all plumbing.

Face Grooves

This method is considered easier, less expensive and more closely resembles the method plumbers use in conventional wood frame construction. With this method, most of the plumbing is installed after RASTRA panels are in place and grouted. Once pipe is set into the routed groove, the groove can then be filled with hydraulic cement and finally plastered over.



Interior Build Out

Anchoring Wood Frame Interior Walls

If using anchor bolts to attach wood frame interior walls to the RASTRA panels, it will be necessary to place them prior to grouting the walls. Connection of interior walls to RASTRA panels does not require a hole around the anchor bolt. Anchor bolts can be driven through RASTRA panels in the desired locations with enough of the bolt exposed to allow the bolt to extend through the 2x and far enough to place a washer and nut.

Using RASTRA Panels as Interior Walls

Interior walls can also be made from RASTRA panels. This method is similar to creating corners in that holes are cut into the main wall to coincide with the horizontal cells in the end of the partition wall. Rebar or anchors are then placed to provide a physical connection between the two walls. Concrete will flow into both walls when grouting to create a seamless transition. For this purpose RASTRA provides a 8 ½" thick panel with a smaller 5" diameter core. The 8 ½" panel is intended for non load bearing applications only.

Interior Door Openings

Interior door openings can be installed in a variety of ways. Prior to grouting the walls, openings can be created when panels are being installed or cut into the walls and the resulting opening lined or bucked out with 2x lumber to contain grout during the pour. End panels or flat panels can also be used to form the opening. End panels are 7½" deep and must be added to the opening dimension. Flat panels are 2" or 4" deep. Flat panels can also be cut as trim and used to trim an opening. This is an excellent detail in a plaster finish.

Pre-hung door frames can be installed prior to grouting to ensure a perfect fit. Bracing between sides should be installed to support sides during grout pour.

Arched door way openings are easily created with RASTRA in the same way as for windows and doors on an outside walls (Chapter 14.2). A simple way to form a door frame is also to use metal door frames . They usually come with grooves for a door seal and fastening points for hinges and lock plate. Metal frames for different wall thickness are available.

Headers

In addition to the use of end panels and bucking, a header may be inserted into the wall. The bottom of the header may be grooved if required. One of the most interesting characteristics of RASTRA construction is the ease with which custom window and door shapes are created.

Window & Door Jambs

When utilizing RASTRA end panels, the window and door jambs are attached by countersinking anchors through the RASTRA end panel into the concrete core. This is easily done prior to pouring grout. If attached after grout is poured, the anchors may be drilled into place.

Wood bucks may be surface mounted or recessed. Regardless of the application, bracing should be inserted to hold the bucking or RASTRA end panels in place during the grouting process to insure that the pressure of the grout does not move or bow the openings

Sills & Trim

For sill or window trim applications that would normally use polystyrene stick-ons or pop-outs, RASTRA flat panels may be utilized. RASTRA flat panels measure 30" by 120" by 2" or 4" thick and may be cut and shaped into almost any configuration. This offers the designer total creativity in and around window and door openings.



Wood Bucking

If the decision is made to not use end panels to frame the opening, the openings may be "bucked" with lumber. To do this, one of the following three sizes of lumber will be needed: 2"x4," 2"x6," or 2"x8." If the bucking is to be left in the wall as a nailer, either 2"x4," or 2"x6" lumber will be needed depending on the panel thickness of either 10", 12", 14." If the bucking is to be removed after grouting, 2"x8" should be used for all sizes of RASTRA panels. In either case, the finished opening will be the same size as the rough opening design specified for the window or door. Regardless of the method used to form openings, temporary spreaders should be used to stabilize the openings while grouting.



Fastening and Finishing

Depending on the design of the windows they are anchored to the RASTRA core, or by cutting grooves and held by the flange. When using a ledger made of a RASTRA flat panel the window frame is set against it and can be glued in place with RASTA PU foam glue. In every case a perfect insulation between window frame and RASTRA wall is essential to prevent moisture penetrating in the RASTRA wall. If wood bucks are used a netting is required covering before applying stucco in the area wood and RASTRA material meets. If the window frame is recessed the slightly sloped or horizontal part of the window sill has to be treated with a sealer. In some areas water-noses above the window (door) opening should be considered. Caulk between the window frame or window sill will be done or repeated after the stucco has been given time to dry. The caulking gap shall be wide enough ($\approx 1/8"$, 3mm) to enable slight movements between the window and the stucco/wall to bridge differences in expansion of both the materials.

Interior & Exterior Finishes

Finishes and Wall Preparation

Once the grout has setup, braces and supports can be removed. To correct any offset of panels which may have occurred during installation, some rasping may be required, or a very thin layer of plaster may be used instead of rasping. In essence, the amount of rasping required depends largely on personal visual approval and the final finish to be used.



Interior Finishes

RASTRA panels can be finished in a variety of ways including plaster, drywall, paneling, or tile. Gypsum plaster, tile or stone are applied directly to the wall with no need for lath, fiber mesh or backerboard.

Drywall

Drywall can be directly applied to the wall without furring strips. The preferred method is to use patches of gypsum adhesive to attach sheetrock to the wall. Alternatively, special screws are available. RASTRA panels may also be painted using an acrylic or similar paint in less finished (basement) applications to control dust.

To attach drywall to the panel, follow these steps:

1. Spread drywall mud or ICF foam on the back side of a sheet of drywall.
2. Press the sheet of drywall onto the RASTRA wall.
3. Hit the drywall gently with a rubber mallet to distribute the mud.
4. When all drywall sheets are in place finish over



Plaster

Apply plaster directly to the surface of the RASTRA panels in accordance with the manufacturer's installation instructions. The only preparation necessary is to rasp any problem areas and blow off loose "crumbs".

Brick or Stone Veneer

Veneer, brick or stone can be attached directly to RASTRA panels. Bricks and natural or cultured stone veneers can be attached to Rastra in several ways. You can create a brick ledger and rest the veneer on it or you can attach the stones similar to tiles with mortar or other tile adhesives. To securely attach stone to the wall ties can be used (as they are used for hanging duct work). Wall ties can either be grouted in place or nailed to the concrete. Care should be taken to ensure that water cannot enter from the top and be trapped behind these surfaces. If an air-gap is created between the RASTRA wall and the veneer waterproofing and/or weep holes are required.



For tiles follow the steps below:

1. Apply a scratch coat of mortar 1/4" to 1/2" thick.
2. Use a small piece of lath to lightly rake horizontal grooves into the scratch coat.
3. Allow the scratch coat to cure for a minimum of 24 hours.
4. Continue by applying mortar and attaching the tiles, using normal methods.

Stucco Exterior

The composition of RASTRA is slightly flexible and reduces the expansion and contraction of the walls, thus eliminating much of the stucco cracking generally caused by the expansion and contraction and tension between stucco and underlying substrate material.

Other than possible rasping and blowing off dust, crumbs, and loose bits, nothing else needs to be done to the wall to prepare it for the finish coat. Stucco can be applied directly to the RASTRA panels.

Above Grade

Although, Rastra does not wick water, rather drains it and can be left without finish for extended time, it is not water tight. Once stucco is applied care has to be taken that water does not seep into the wall where it could get trapped and accumulates until it has to find a way out. Stucco systems shall be recognized by codes and applied in accordance to the manufacturer's specification and code official's satisfaction. Recommended are Portland cement stucco systems with content of fibrous material, such as Ultrakote Products, Kwik Kote Corp., Sacramento Stucco Western 1-Kote, or the like. If a top coat is to be applied preferably elastomeric (PU or acrylic based) products are being used.

Begin the process by removing loose debris, dust and any protrusions from the wall surface. **Dampen the surface before applying any mortar** - this helps prevent the wall from pulling moisture out of the stucco too quickly, which could cause cracking and loss of bond. Coatings can be applied in one, two or three layers.

If applying a two coat system, the base coat is the leveling coat with the second serving as the finish coat. In this case the base coat is approximately 1/4" or as required to create a level coat. The final coat is 1/8" or as needed for a uniform finish.

If using a three coat system. The first layer is normally 1/8" to 3/8" thick and is referred to as a "scratch" layer because once applied, the surface is 'scratched' to provide a more receptive surface for the second layer. If the wall will be exposed to significant temperature or humidity swings, or the wall area is very large, or in high exposure areas of the wall, the first coat can be a reinforced base coat (usually cement based with elastomeric additives). This is using a reinforcing mesh troweled in the base coat so it is fully covered. The second layer is usually applied 1/8" to 3/8" thick. This coat is sometimes referred to as a "floating" or "brown" coat. The third or final layer is typically 1/8" or less thick and often colored and/or textured.

Allow the first layer to harden for 24 to 36 hours. **Do not let this layer dry out**, if necessary, keep it damp by misting it with water, do not spray it with a pressure hose as it will dislodge the mortar. After the stucco installation is complete, **keep the stucco damp over several days**; lightly mist the surface occasionally if necessary. Allow mortar to dry for at least six weeks before applying cement paint or color wash

Complete the job by sealing around doors and window frames - these areas are especially susceptible to water penetration. This step is extremely important, **intrusion of water into the Rastra wall has to be avoided**. Particularly check all horizontal areas, like parapets and window sills. If needed seal these areas with a clear masonry sealer like Loxon primer, a Sherwin Williams product, or Seal Crete sealer. Carefully



follow application instructions of any sealant product you choose. Caulking gaps around windows, doors, or headers etc. shall be of adequate size in order to have sufficient caulking material to bridge any difference in expansion of the stucco and other materials. In critical cases it might be worth to consider a damp proof layer between slab and the Rastra wall to block moisture rising from the foundation. Also you may consider providing some possibility of moisture drainage. This can be done by installing the Rastra wall protruding for approximately $\frac{1}{2}$ " over the slab. Water getting caught in a Rastra wall (or as in any wall; wood or masonry) which is sealed with stucco with no way to go may lead to wet spots, discoloration and damage.

. Below Grade

RASTRA walls installed to be below grade must be treated with a layer of protective sup grade waterproofing in accordance with Section 1806 of IBC. Any type of code approved system can be used (solvent containing products are no problem as only few EPS particles on the surface of the Rastra wall will be affected). Roll on, spray on, or membranes. Protect the sealant before backfilling from being penetrated by rocks; this can be done by covering the sub-grade portion of the wall with a thin ($\frac{1}{2}$ ") EPS sheet.

Siding

If exterior walls to be covered with siding, one method is to first attach nailers to the wall surface in a manner similar to masonry or concrete walls. The siding can then be nailed or screwed to the nailers.

Nailers are attached to the RASTRA panels with a combination of foam adhesive and concrete screws or nails. Nailers should be installed with nails or screws long enough to provide an adequate connection to the grout core. Nailers can also be fastened with self drilling screws to galvanized sheet metal inserts which are put into the RASTRA wall before grouting to be anchored.

Note: Each different sized panel has a different wall thickness from the face of the panel to the concrete core. Make certain fastening hardware is long enough to reach and penetrate the concrete core. Flange thicknesses are as follows:

- 8.5" panel = 1.75"
- 10" panel = 2"
- 12" panel = 3"
- 14" panel = 4"



Parapets

In a typical parapet design, the flashing should extend up from the roof to a height sufficient to ensure that exposure to beating rain or melting snow will not result in the entrance of water. The surface of RASTRA walls can be finished with standard waterproofing material. As a guideline, if the waterproofing method/material is used on either masonry or concrete walls, it will work on RASTRA, including application of bituminous or asphalt-based materials. The top of the wall should be finished in a manner similar to a masonry or concrete parapet wall with a stucco finish, tile or other finish in customary use, which guarantees a good water seal.

Cabinets & Fixtures

As in conventional construction, cabinets and fixtures can be attached to RASTRA panels. For items up to approximately 50 lbs per bolt, small hollow anchors can be used. GB-plastic anchors can be used without drilling, and just hammered in place. Typical sizes are 8mm (3/8"), 10mm (7/16"), and 14mm (9/16"). A 9/16" anchor holds up to 100 lbs.

For heavier items threaded steel bolts or rods can be used. First, drill a hole slightly larger than the diameter of the bolt by 1/16", fill the hole with binder (foam), and insert the bolt. Bolts should be embedded a minimum of 4." An alternative method would be to drill into a concrete core located 15" o.c. and glue an anchor using concrete epoxy glue. Once set, the strength of this material can match that of the actual concrete.



Cabinets

An alternative for heavier fixtures such as cabinets is to attach them via a wooden backing strip recessed into the RASTRA panel installed the length of the cabinet run. To install a backing strip into a RASTRA panel, simply route the face of the panel to the depth of the backing strip, **making sure the strips are level.** The backing is then glued into the recess and screwed to the concrete core 15" o.c. or they are installed before grouting and held in place by the concrete and hooks inserted from the back. Screws can then be used to attach the cabinet to the backing strip.



Note: The wood backing strip is covered by drywall or plaster so remember to mark on the blueprint where backing strips were placed so it can be found after the wall has been finished.

Backing strips are typically recessed into the panel surface at three locations including the top of the wall cabinets, bottom of wall cabinets and top of base cabinets. Anchor bolts are placed no more than 45" on center and glued in place with the same foam glue used to glue the RASTRA panels together. Alternatively metal inserts as mentioned in Chapter 21.3 (Siding) can be used to fasten backing strips or cabinets.

Garage Doors

The most common method of installing a garage door is to use a surface mounted 2" x 6" or 2" x 8" (or larger) with anchor bolts embedded in the exposed ends of the concrete cores 15" o.c. Remember to account for the thickness of the 2x when forming your opening.

Clean Up

Before leaving the job site it's important that all debris is collected and placed in the proper waste container. Excess RASTRA material should be either returned to be recycled or if pieces are larger they can be saved for use on another project. All wood used for temporary bracing should be reused.

No excess glue should be left on either the panel face or inside the interior cavities which may obstruct the flow of grout. If the face of the panel is scheduled to receive stucco or plaster, all glue residue should be removed to expose the raw material of the RASTRA panel. Remove any glue or grout that has fallen on to the slab.

Appendix A

Volumes & Weight Data

STANDARD PANELS

Thickness	Length	Standard Panel (cubic feet)			End Panel	Weight Single Panel
		Outside	Cavity	Net	Net	
8.5"	120"	6.64	1.97	4.67	-	147 lbs
	90"	8.83	2.63	6.33	-	110 lbs
10"	120"	10.42	3.67	6.75	4.22	158 lbs
	90"	7.81	2.73	5.08	3.17	120 lbs
12"	120"	12.5	3.67	8.83	5.26	197 lbs
	90"	9.37	2.73	6.64	3.95	148 lbs
14"	120"	14.58	3.67	10.91	6.31	243 lbs
	90"	10.94	2.73	8.21	4.73	183 lbs

FLAT PANEL

Thickness	Width	Length	Weight
2"	30"	60"	50 lbs

For additional volumes and weights refer to www.rastra.com

Appendix B

General Data

RASTRA Panel	Concrete Consumption
10", 12" & 14" wide	0.30 cubic feet per square foot of wall surface
Approximate Weight of Grouted Unfinished Wall	
10"	57 lbs per square foot
12"	60 lbs per square foot
14"	64 lbs per square foot
Reinforcement Consumption	
15" centers	1.17 lineal feet per square foot of wall surface
30" centers	0.85 lineal feet per square foot of wall surface

Appendix C

Manufacturing Tolerances

RASTRA panels are produced to very small tolerances. This makes it possible to obtain straight and smooth walls. Below there is an excerpt of the Quality Control Sheet for the production of RASTRA panels, showing permissible tolerances at the time of production:

Tolerance*	D	F	F	L - long	L - short	E	S	T	J****
8.5"	$\pm 1/8"$	-1/2" ***	$\pm 3/8"$	+1/2"	+1/2"	+1/2"	$\pm 3/32"$	$\pm 3/32"$	1/2"
10"	$\pm 1/8"$		+1/2", - 3/8"						
12"	$\pm 1/8"$		$\pm 1/2"$	-3/8"	-3/8"	-5/8"			
14"	$\pm 3/16"$		$\pm 5/8"$						

Appendix D

Physical Properties

Parameter (report numbers)	Rating/Value	Remarks
Recycled Content	± 85% by volume	Mainly post-industrial expanded polystyrene (EPS).
Bulk Density	22 lbs/ft ³ ± 10%	Panels for specific applications may be produced with higher density.
Compressive Strength of THASTYRON	56 psi	Depending on density required.
Tensile Strength of THASTYRON	43 psi	Depending on density required.
Water Vapor Transmission PI-4582/ws, 5/80	7.3	This is a (dimensionless) factor to measure possibility of condensation in the wall, particularly in cooler periods or with high air conditioning; the low value of Thastyron is a guarantee that no condensation will occur.
Fire Endurance UL – R14366, 9/91, 2/99	4 hour rating (ASTM E119)	A 10" un-plastered RASTRA wall has been tested for 5 hours under a load of 10,000 lbs/lin.ft.; two tests have been performed with an additional positive and negative load perpendicular to the wall, simulating a 35 mph wind pressure; with a temperature in excess of 2000°F on the exposed side the surface temperature on the unexposed side of the wall did not increase for more than 7°F; a high pressure water stream directed towards the wall immediately after burning did not penetrate the wall.
Thermal Barrier (Room Fire Test) OPL – 15715-1808, 9/97	no flame spread no smoke development wall meets UBC 26-3	A wood crib is burned in a corner built with un-plastered RASTRA walls exposing it to 1700°F +/-; flame spread, smoke and any damage of the wall is monitored.
Surface Burning Characteristic SGS – 113924. 9/98	Flame Spread Index 0 Smoke Development Index 5 NFPA Class A UBC Class 1 ASTM E 84 (NFPA 255, UBC 8-1)	4" thick Thastyron panels were exposed to flame and spreading of the flame front and smoke density, compared to red oak was measured. The flame front was produced at less than 6", which is within the flame spread of the burner. For smoke development light absorption is measured. The test showed some very low absorption, for the test result values are always rounded to the next figure divisible by 5.

Frost Resistance TIB – KR/SI, 10/84	Highly Frost Resistant	Thastyron soaked in boiling water and frozen at -4°F; after 50 cycles no reduction of compressive strength could be found.
Toxicity BI – 08-95-0338, 5/95	Low Toxic	Testing conducted using Leaching Procedure by EPA SW-846 method 1311, metals by method 6010 & 7470, volatiles by method 8240; metals are less than 1/20 of regulatory limit, only traces of 4 volatiles out of 40 tested found.
Formation of Mildew API – 17137, 4/83	No mildew & fungus growth including black mold	Test cubes were kept under moist conditions for 40 days after inoculation of test germs (aspergillus niger, rhizopus nigricans). No growth of cultures could be observed; formation of mycel or konidien culture did not take place.
Water Transmission ATI – 03-30070.01, 12/98 ATI – 03-30305.01, 12/98	Meets requirements ASTM E331, ASTM E514, meets UBC 14-1 (grade "C" craft paper)	10" thick RASTRA wall with skim coat has been exposed to a water spray with a flow rate of 5.0 USgal/ft ² /hr at a differential pressure to simulate a 125mph wind. (extended testing done by US Navy and met standards).
Average Wall Humidity MA-39 – f711/83, 10/83	Average 2.5% by volume	Samples taken from a home more than 5 years in use from areas where most humidity is expected.
Expansion TUG – 52.620/83, 7/83	0.0018inch/ft (as standard concrete)	Even as RASTRA panels without concrete grout show shrinking and swelling in changing humidity, shrinkage is neglectible once the concrete is poured.
Thermal Performance MPA – 970344-Hu, 1/98	Effective R-values 20 to 49 h.°Fs.f./Btu	European testing on a 1.5m x 1.5m, and US testing of 8'x8' walls revealed heat conductivities of 0.084 to 0.053 Btu/h°F/ft of dry, grouted 10", 12" and 14" walls. DBMS values between 1.79 and 2.17 have been established for 6 U.S. climate zones. Energy usage shows even better efficiency.
Sound Insulation BVFS – U3/19A/87, 2/87 MA-39 – F956/85, 6/85	>50dB(a)	Measurements have been taken in laboratories and in real buildings; dB is a value measured on a logarithmic scale, therefore, f.i. the difference between 27dB (good for a 2x4 framed wall) and a 50dB RASTRA wall result in 199% lower sound intensity. The value indicated results is an average measured on a band width of 100 to 3150 Hz. Another aspect is sound absorption, which RASTRA provides.

Appendix E

Warranty & Disclaimer

Warranty

Manufacturer warrants that, at the time and place shipment is made, RASTRA building panels are free from manufacturing defects, of good quality and conform to the published specifications in force at the date of acceptance of the order. THIS WARRANTY SHALL BE EXCLUSIVE AND IN LIEU OF ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY AND FITNESS. As the exclusive remedy for breach of this warranty, defective materials will be replaced, provided, however, that the buyer examine the materials when received and promptly give notice in writing of any defects before the materials are used or incorporated into a structure. Three (3) months after shipment of the materials our warranty and other duties with respect to the quality of the materials delivered shall conclusively be presumed to have been satisfied, all liability therefore terminates, and no action for breach of any such duties may thereafter be commenced. Any of the RASTRA companies or their representatives shall in no event be liable for consequential damages. Unless otherwise agreed in writing, no warranty is made with respect to materials not manufactured by the RASTRA companies. It cannot be guaranteed nor can any warranty be given for any particular method of use or application or performance of materials under any particular condition. Neither this warranty nor any liability may be extended or amended by any affirmation or promise of the manufacturer or its employees, representatives, or agents by words or action, by any sales information, publication, or drawings.

Due to the potential danger from misuse of the manufacturer's product, manufacturer's warranties of fitness and merchantability as well as any other express warranties made in connection with the sale shall not be effective or actionable unless the goods are used in accordance with the local building codes, code approvals, and good building practices. The manufacturer is relieved of all obligations and liabilities under this warranty, if the building is not constructed in strict accordance with the aforementioned.

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