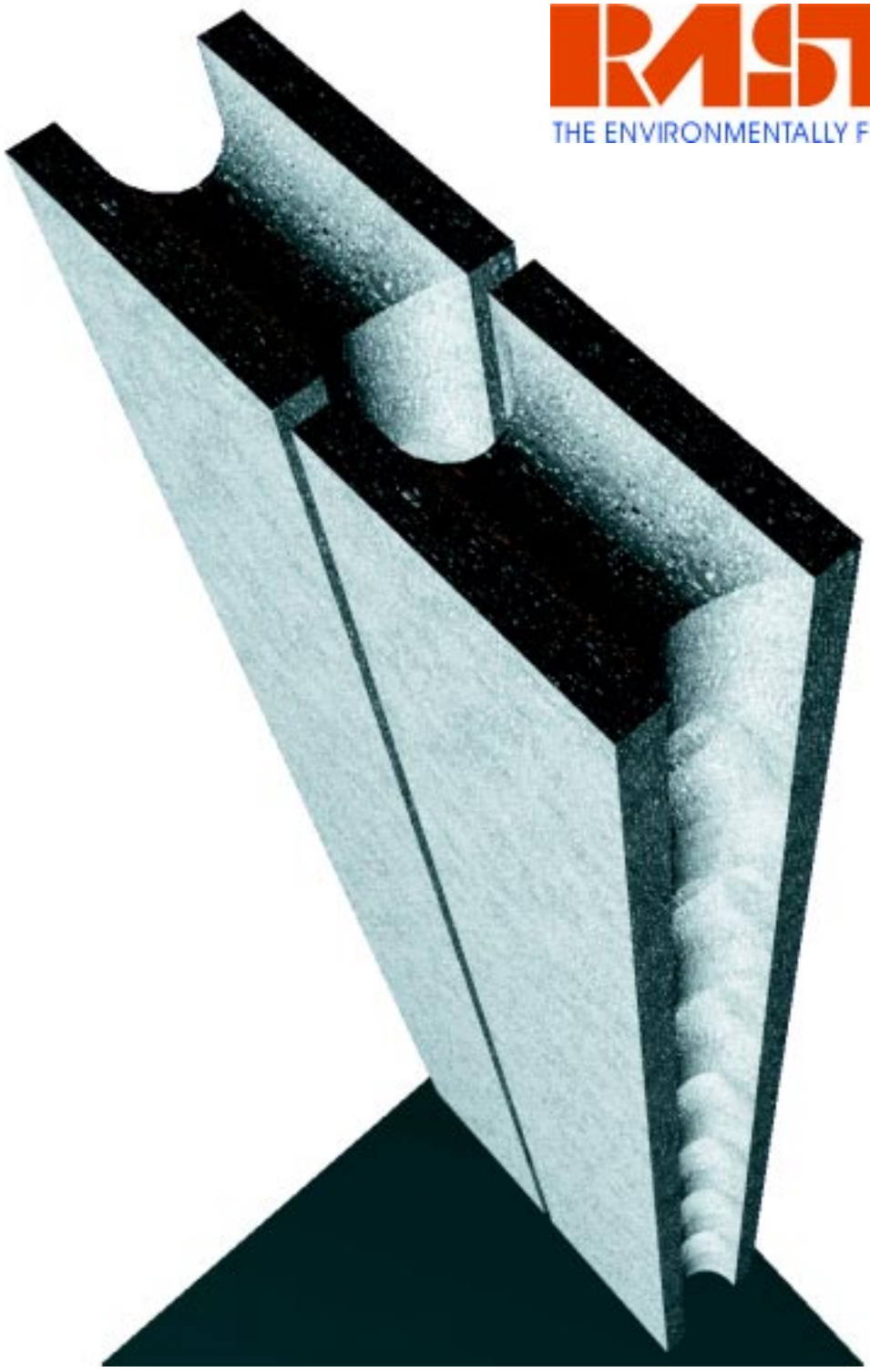
RASTRA®

THE ENVIRONMENTALLY FRIENDLY SOLUTION



INSTALLATION GUIDE

RASTRA®

THE ENVIRONMENTALLY FRIENDLY SOLUTION

INSTALLATION GUIDE

Build the Home of Tomorrow Today

FEATURES

- **QUIET**
- **ENERGY EFFICIENT**
- **FIRE RESISTANT**
- **VERSATILE DESIGNS**
  High Ceilings, Curved Walls, Custom or Standard Windows, Doors...
- **COST EFFECTIVE**

“HOW TO” SECTIONS

- WALLS
- WINDOWS
- DOORS
- PLUMBING
- ELECTRICAL
- CABINETS
- LINTELS
- LEDGERS
- FIREPLACES
- BASEMENTS
- FOOTINGS
- ROOFS & FLOORS

RASTRA® Installation Guide – Version 1.1 (04.2002)

Published by: Rastra of the Americas, L.L.C., 7621 E. Gray Road, Scottsdale, AZ 85260, 877-935-3545

WARRANTY

Manufacturer warrants that, at the time and place shipment is made, the Rastra building elements 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 can not 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.

DISCLAIMER

The information contained herein is included for illustrative purposes only and, to the best of our knowledge, is accurate and reliable. Any of the Rastra companies or their representatives cannot, however, under any circumstances make any guarantee of results or assume any obligation in connection with the use of this information. As Rastra or its representatives have no control over the use and application to which others may put its products, it is recommended that all applications be in compliance with local building codes and engineering. Responsibility remains with the architect or engineer, contractor and owner for the design, application and proper installation of the product. Specifier and user shall determine suitability of products for specific application and assume all responsibilities in connection therewith.

The RASTRA® Building System is produced worldwide under license by Rastra Est., Lichtenstein; in the Americas, under license by Rastra of the Americas, L.L.C.

FOREWORD

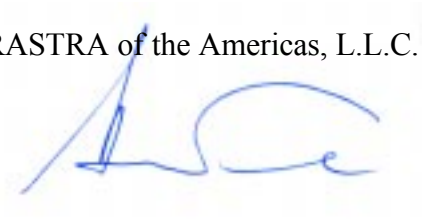
Planning to construct a new house, industrial site, or other structure is a serious undertaking. Selection of the most suitable material for your walls is an important decision that you will have to live with for a long time, perhaps all your life. The initial cost of the building is only one factor. Future performance and maintenance costs are usually of greater importance.

RASTRA® provides the ultimate solution for the many different tasks a wall has to serve.

In 1968, the first house was built using blocks of expanded polystyrene with cavities cut out to be filled with concrete after being set in place. Considering fire resistance, fuming, adhesion of plaster, and other disadvantages, we soon found that expanded polystyrene was not the ultimate solution for the face of a wall. In 1972, after four years of testing, the first houses were built using THASTYRON to produce room-high, stay-in-place forms with cavities. THASTYRON is a material made of polystyrene beads coated with cement and fused together with some additional cementitious mix. Over time, the shape of the RASTRA® element and the composition of the THASTYRON has been improved. From the late 70's, RASTRA® has mainly used recycled polystyrene for the production of RASTRA® elements. Polystyrene comprises approximately 85% of the volume of the element — a remarkable contribution to our environment.

RASTRA® has been used around the world in all climates and proven its value. We hope this manual will help to show you the advantages of the RASTRA® Building System, provide ideas for the architect, assistance to the engineer, information for the user and owner, and finally give you peace of mind that you have made the right decision in planning with RASTRA®.

RASTRA of the Americas, L.L.C.



1 INTRODUCTION and TECHNICAL

2 PLANNING

3 FOUNDATIONS

3 FOUNDATIONS (Continued)

4 FLOORS, ROOFS, AND PARAPETS

5 WALLS

5 WALLS (Continued)

5 WALLS (Continued)

6 FIXTURES & FINISHES

7 ARCHITECTURAL

8 COMMERCIAL & INDUSTRIAL

8 COMMERCIAL & INDUSTRIAL (Continued)

APPENDIX A

A ELECTRICAL AND PLUMBING

APPENDIX B

B RECEIVING, HANDLING & STORAGE

FIGURES

1 INTRODUCTION & TECHNICAL

2 PLANNING

3 FOUNDATIONS

3 FOUNDATIONS (Continued)

4 FLOORS, ROOFS, AND PARAPETS

5 WALLS

5 WALLS (Continued)

5 WALLS (Continued)

6 FIXTURES & FINISHES

CABINETS

FINISHES

WATERPROOFING

7 ARCHITECTURAL

FIREPLACES

8 COMMERCIAL & INDUSTRIAL

8 COMMERCIAL & INDUSTRIAL (Continued)

APPENDIX A

A ELECTRICAL & PLUMBING

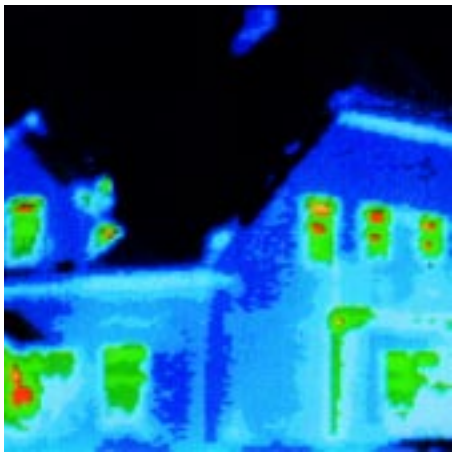
APPENDIX B

B RECEIVING, HANDLING & STORAGE

TABLES

WHAT IS RASTRA®?

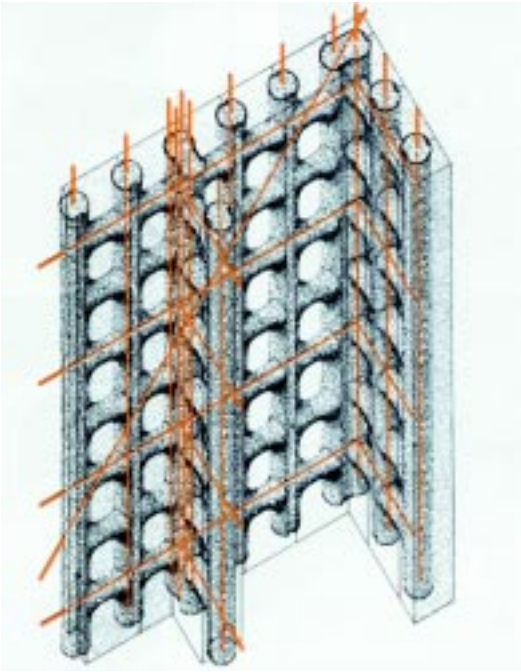
RASTRA® is a concrete form system made of a lightweight material THASTYRON, which provides a permanent framework for a grid of reinforced concrete to form load-bearing walls, shear walls, stem walls, lintels, retaining walls, and other components of a building.



THASTYRON offers the ultimate in properties for a wall, such as insulation, soundproofing, fire protection, all in one easy-to-install element. THASTYRON also is resistant against frost and heat radiation. It does not entertain mold or attract nesting insects. 85% of its volume is recycled postconsumer polystyrene waste which very likely would have ended up in landfills never to disappear.

This picture shows an infrared photograph of a RASTRA® house. The blue color represents the cold areas. Color shifts towards the red in warmer areas which indicates heat loss in those areas such as windows. The RASTRA® wall shows deep blue color!

CONCRETE filled into the cavities of the elements provides excellent strength. The channels inside the elements have been designed to provide optimum strength while using the lowest possible amount of concrete. The square grid allows use of the elements either vertically or horizontally, maintaining the grid and the runways for reinforcement. By using different strengths of concrete and various amounts of reinforcement, the load capacity can be adapted to any requirement.



TWO ELEMENTS MAKE A COMPLETE SYSTEM!

The STANDARD element has an area of 12.5 sq ft and is generally used for walls; the END element is used for ending wall-sections, members of headers, sills and corners. RASTRA® elements can be easily cut, rasped, routed or even carved into sculpture-like forms, using common tools for working with wood. Plaster adheres well to the face of RASTRA® elements without any preparation, tiles can be glued right onto the surface.

PRODUCTION STANDARD

The RASTRA® elements are produced in state-of-the-art facilities. All plants are highly automated and the process is computer controlled. Strict quality control is maintained and continuously monitored as well as audited by independent laboratories.

RASTRA® elements are molded in a special process. The spongy raw material used to make THASTYRON is compacted by applying a certain amount of pressure before elements are set upon a pallet for curing.

The RASTRA® elements are cut to exact dimension after they have been cured. This guarantees small tolerances and straight and even walls. Even the production process is designed to protect our environment. As no energy is used to cure the elements, on average less than 1 kWhr is needed to produce each RASTRA® element. During production, no byproducts are set free which may be considered a burden for the environment. All debris from trimming the elements is immediately recycled and made into new product.

Two views of an automatic RASTRA® plant show the section where the raw elements are molded (top) and a part of the curing section with a fully automatic transport "robot" (bottom).

For the high-quality, cost efficient construction that you desire,

RASTRA

is the ideal building system!

ELEMENT DIMENSIONS

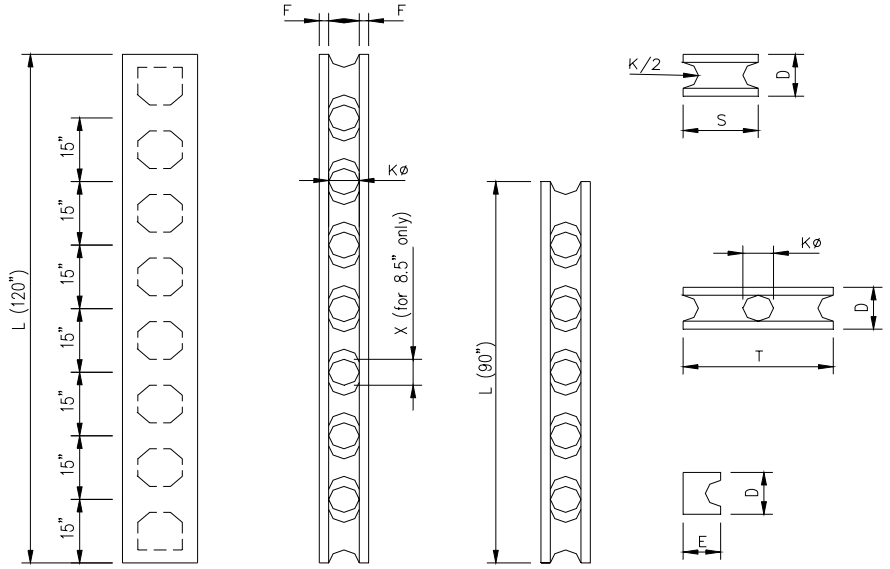


Figure 1.5

Table 1.1 **DIMENSION** - ins (mm)

D	K	F	L	S	T	E	X
8.5" (215)	5" (127)	1.75" (45)	90" (2286)	15" (380)	30" (760)	7.5" (190)	5.25" (135)
10" (250)	6" (152)	2" (50)	90" (2286)				N.A.
12" (305)	6" (152)	3" (76)	or				
14" (355)	6" (152)	4" (100)	120" (3050)				

Tolerances allowable per Quality Assurance Manual

Table 1.2 **VOLUMES and WEIGHTS**

Thickness ins (cm)	Length ins (cm)	Standard Element cuft (dm^3)			End Element	Weight Std. E. lbs (kg) ±10%
		outside	cavity	net	net	
8.5" (21.5)	90" (228)	6.64 (188)	1.97 (56)	4.67(132)	-	112 (51)
10" (25)	120" (305)	10.42 (294)	3.67 (104)	6.57 (190)	4.22 (119)	158 (72)
	90" (228)	7.81 (221)	2.73 (77)	5.08 (144)	3.17 (90)	120 (54)
12" (30.5)	120" (305)	12.5 (354)	3.67 (104)	8.83 (250)	5.26 (149)	197 (90)
	90" (228)	9.37 (265)	2.73 (77)	6.64 (188)	3.95 (112)	148 (68)
14" (35.5)	120" (305)	14.58 (412)	3.67 (104)	10.91 (308)	6.31 (178)	243 (110)
	90" (228)	10.94 (309)	2.73 (77)	8.21 (232)	4.73 (134)	183 (83)

Table 1.3 **FLAT STOCK**

Thickness ins (mm)	Width ins (mm)	Length ins (mm)	Weight lbs (kg) ±10%
2" (50)	30" (760)	60" (1525)	50 (23)
4" (100)	30" (760)	120" (3050)	190 (86)

RASTRA® elements 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® elements, showing permissible tolerances at the time of production:

Table 1.4 **FABRICATION TOLERANCES**

TOLERANCE *	D	K	F	L-long	L-short	E	S	T	J ****
8.5" ELEMENT	±1/8"	+3/4" **	±3/8"	+1/2" -3/8"	+1/2" -3/8"	+1/2" -5/8"	±3/32"	±3/32"	1/2"
10" ELEMENT	±1/8"	-1/2" ***	+1/2", -3/8"						
12" ELEMENT	±1/8"		±1/2"						
14" ELEMENT	±3/16"		±5/8"						

Straightness: Max. camber out of plane over L =< 1/2"
Max. camber in plane over L =< 1/8"

* Due to the nature of the product [1/8"] has to be considered the minimum reliably measurable dimension, thus a generally allowable tolerance.

** Openings may be oblong instead of round, created by reducing the thickness of 10" elements in the center. Tolerance is valid in longitudinal direction of element. In perpenticular direction tolerance results from flange thickness.

*** Cavity openings may be produced oblong to meet structural requirements. An upper (+)tolerance is not specified, it will result from the flange thickness (F).

**** J represents the offset of centers of the openings of the two element halves in either direction.

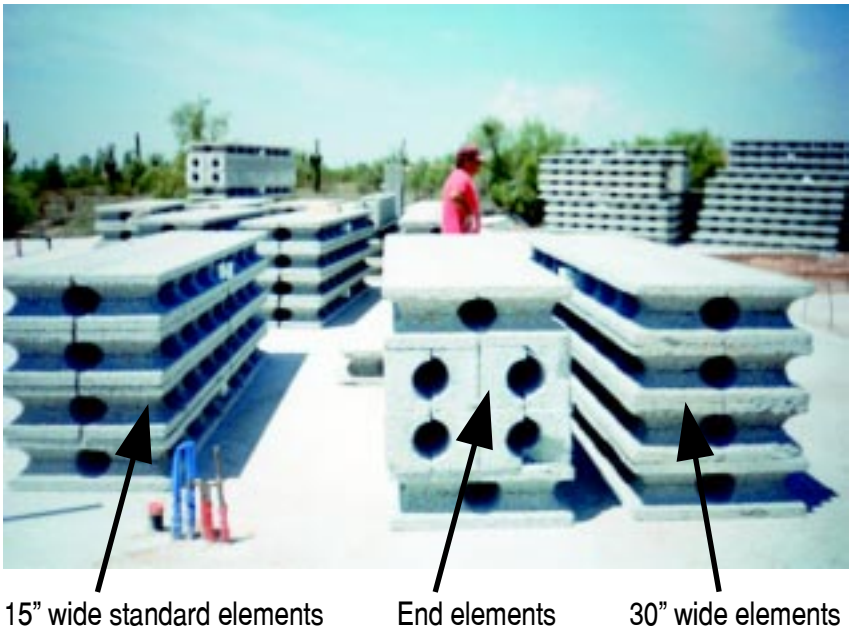


Figure 1.6 RASTRA® elements at job site.

GENERAL DATA

RASTRA® Element

- 8.5" wide
- 10",12" & 14" wide

Concrete Consumption:

0.21 cubic feet per square foot of wall surface (65 dm^3/m^2)

0.30 cubic feet per square foot of wall surface (93 dm^3/m^2)

Weight of Grouted Wall

(Approximate without plaster)

- 8.5" — 42 lbs/sq ft (201 kg/m^2)
- 10" — 57 lbs/sq ft (274kg/m^2)
- 12" — 60lbs/sq ft (288 kg/m^2)
- 14" — 64 lbs/sq ft (307 kg/m^2)

Reinforcement Consumption (coverage)**:**

- 15" Centers 1.17 lineal feet per square foot of wall surface
- 30" Centers 0.85 lineal feet per square foot of wall surface

PRODUCT APPLICATIONS AND USES

Residential - Homes (any style), Basements, Garages, Workshops, Barns, Greenhouses, Fences, Retaining Walls, Apartment Blocks, Condos.

Commercial - Office buildings, Restaurants, Strip Shopping Centers, Malls, etc.

Industrial - Factories, Warehouses, Equipment Rooms, Cold Storage Rooms

Sound Abatement - Freeway Sound Walls, Soundproof Rooms

THE MATERIAL COMPOSITION "THASTYRON"

RASTRA® elements are made from THASTYRON (which stands for **TH**ermo **A**coustic **STYR**ofoam c**ON**crete). Thastyron is a modified EPS-concrete, a proprietary material made from cement-coated recycled polystyrene and admixtures. Thastyron has ideal physical characteristics as a wall material. It interacts with the concrete grout to create a high performance wall system.

HANDLING CHARACTERISTICS

Thastyron is a strong lightweight material. It is somewhat flexible and not brittle. It can be easily tooled with all woodworking tools, such as hand or chain saw, rasp, drill, router. As a matter of fact, it can be sculptured and carved to achieve any look desired. RASTRA® elements can be stepped on during construction and will support prefabricated roof slabs.

SOUND QUALITIES OF RASTRA® ELEMENTS

The RASTRA® element has exceptional sound absorbing and attenuation qualities. This means that the interior of the new RASTRA® structure will be shielded from most outside noises. RASTRA® Elements are very effective when creating sound resistant rooms such as Theater Rooms, Sound Studios or Media Rooms.

FIRE RESISTANCE

RASTRA® elements are very effective in areas where high fire resistance is required. In full-scale tests of RASTRA® walls it has been shown that the RASTRA® wall does not support combustion, does not emit smoke and has a four-hour fire rating.

The fire rating, in combination with the sound absorption qualities, makes RASTRA® a natural for multi-unit /multi-family projects. In addition, RASTRA® has been approved as a thermal barrier.

Figure 1.7

FROST PROTECTION - THERMAL PERFORMANCE

The same component matrix Thastyron which gives RASTRA® its fire resistance, also insulates the concrete grout placed inside the grout channels resulting in extreme frost protection both during the pour and thereafter.

Because of the minimal heat and cold transfer through the RASTRA® element , the concrete grout retains its heat and moisture longer thus allowing a consistent cure unhindered by outside temperatures. This results in a stronger end product.

During five-hour fire endurance testing of full-scale 10-inch thick RASTRA® walls, applied temperatures exceeded 2000^0 F on the exposed face. However, the recorded temperature increase on the unexposed face was only 7^o F and that was attributed to changes in ambient temperature during the test. In essence, the wall did not conduct heat during the test. This low conductivity together with the thermal storage capacity of the concrete core make for excellent thermal performance of a RASTRA® wall.

MOLD & MILDEW RESISTANCE

RASTRA® elements also have other features and qualities that make it unique. Because the component matrix Thastyron will not hold or wick water the way concrete block or wood products do, RASTRA® elements will not promote or sustain mold or mildew. Rot is a thing of the past. As a building system in use in Europe for more than 25 years, numerous tests have proven RASTRA®'s ability to resist mold or mildew.

INSECT & VERMIN RESISTANCE

The mixture of Portland cement and polystyrene also creates an undesirable atmosphere for insects. Additionally, the concrete grout placed in the channels penetrates the porous Thastyron surface fusing the concrete and the Thastyron together, therefore eliminating channels that termites and other insects could use for migration and nesting.

MATERIAL DATA AT A GLIMPSE

The following table presents a few physical properties of Thastyron and the RASTRA® wall and is based upon material tests conducted.

Table 1.5 **MATERIAL TESTING AND RESULTS**

Parameter	Rating/Value	Remarks
Recycled Content	± 85% by volume	Mainly postconsumer expanded polystyrene.
Bulk density	22 lbs/ft^3 ± 10% (350 kg/m^3 ± 10%)	Elements for specific applications may be produced with higher density.
Compressive strength of THASTYRON	≥ 56 psi (0.4 N/mm^2)	Dependent upon density.
Tensile strength of THASTYRON	≥ 43 psi (0.3 N/mm^2)	Dependent upon density.
Water vapor transmission	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.
Sound insulation	>50dB(a)	Measurements have been taken in laboratories and in real buildings; dB is value measured on a logarithmic scale, therefore, f.i. the difference between 27dB (an average value for a 2x4 framed wall) and a 50dB RASTRA® wall result in a 199 times lower sound intensity; another aspect is sound absorption which a RASTRA® wall provides.
Fire endurance	4 hour rating (ASTM E119)	A 10" unplastered RASTRA® wall was tested for 5 hours under a axial load of 10,000 lbs/lin.ft.; two tests were performed with an additional positive and negative load perpendicular to the wall, simulating a 35 mph wind pressure; with a temperature in excess of 2000o F on the exposed side, the surface temperature on the unexposed side of the wall did not increase more than 7o F; a high pressure water stream directed towards the wall immediately after burning did not penetrate the wall.
Thermal barrier (Room fire test)	No flame spread, No smoke development, Meets UBC 26-3	A wood crib was burned in a corner built from unplastered RASTRA® walls exposing them to appr. 1700o F; flame spread, smoke and any damage of the wall was monitored.
Frost resistance	Highly frost resistant	Thastyron specimens were soaked in boiling water and frozen at -4 o F; after 50 cycles no reduction of compressive strength could be found.

Surface burning characteristic	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 elements were exposed to flame and spreading of the flame front and smoke density was measured and compared to red oak. The flame front proceeded less than 0.5 ft, which is within the flame spread of the burner. For smoke development, light absorption was measured. The test showed some very low absorption, for the test result values are always rounded to the next figure divisible by 5.
Toxicity	Low toxicity	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 found of 4 volatiles out of 40 tested.
Formation of mildew	Mildew and fungus growth is not anticipated	Test cubes were kept under moist conditions for 40 days after innoculation of test germs (Aspergillus Niger, Rhozopus Nigricans). No growth of cultures was observed; formation of mycel or konidien culture did not take place.
Water transmission	Meets requirements of ASTM E331, ASTM E514, Meets UBC 14-1 (grade "C" kraft paper)	10" thick RASTRA® wall with skim coat has been exposed to a water spray with a flow rate of 5.0 USgal/ft2.hr at a differential pressure to simulate a 125 mph wind. Extended time testing has been done by US Navy and met standards).
Average wall humidity	< 2.5% by volume	Samples were taken from a home more than 5 years old from areas where most humidity was expected.
Expansion	0.0018 inch/ft (0.3 mm/m) (as standard concrete)	Even though RASTRA® elements without concrete grout show shrinking and swelling with changes in humidity, shrinkage is negligible once the concrete is poured.

MATERIAL TESTING

In order to provide sound information about a building material, values derived from practical experience can be accumulated, and engineering concepts can be worked with. However, the most reliable information is based upon full-scale controlled testing. RASTRA® is certainly one of the most tested building systems. Starting in the 1970's with the first tests conducted in Europe, new aspects of RASTRA® have been investigated in Europe, Asia, and the Americas. Here are some peeks into the testing laboratories where recent tests have been done.

Some Full Scale Testing of RASTRA® Walls

Fig.1.8 Corner burn test - elapsed time UBC 26-2

Fig.1.9 Fire rating test - ASTM E 119

Fig. 1.10 Hose stream test after 5 hrs of 2700° F flames - ASTM E119

Fig. 1.11 Full-scale Shear Wall Tests - combined axial and in-plane shear loads.

Fig. 1.12 Full-scale Slender Wall Test - compined axial and out-of-plane load.

PROJECT PLANNING

Whether building your home as an owner-builder or working with a contractor, there are a number of steps that can make the whole process easier and more enjoyable. The RASTRA® environmentally friendly building system makes it possible to build the home of your dreams at a competitive price. The versatility of the RASTRA® system means that architectural touches such as curved windows or walls, art niches, and high ceilings are all possible.

Heating and air conditioning costs are much lower due to the insulative quality of the walls. Termites and other pests are a thing of the past as the tough inedible material offers no food source. Natural disasters such as brush fires and earthquakes are less of a concern as the walls are fire resistant (have a 4-hr fire rating), and the RASTRA® walls have proven to be strong yet ductile under tests to simulate earthquake loads.

A few suggestions:

- Early planning makes a smoother project.
- Contact your local RASTRA® Dealership for information and ideas. There may be some RASTRA® homes in your area under construction that you can see. There may also be a training program in your area.
- Do your preliminary plan and elevation drawings. This gives you the room layout and what the house looks like from the outside from all directions. These can be done by yourself or by an architect, or they can be packaged drawings bought from a source such as Better Homes or from a developer. This manual has a number of ideas of how RASTRA® buildings can look. Talk to your RASTRA® Dealership.
- Contact an engineer who is familiar with RASTRA® (we have some names we can give you)
- Discuss your preliminary plans from a structural point of view, your building site, code requirements such as set backs, height restrictions if any. (At this point changes are easy. Not a lot of drawings have been made, no lot grading has been done, no foundations or footings have been poured etc). Keep in touch with us.

- You may want to visit your local building department at this point. If you are working closely with your design professional (engineer or architect) they can handle this for you.
- Continue to develop your plans. Once a working set of drawings has been done, it's time to do some cost estimating - for materials and labor AND scheduling. Projects almost always take longer than expected because it's almost impossible to know everything in advance.
- Somewhere about here (if you haven't already done it) is the time to see about funding. There are a wide variety of options. Variables that affect funding include: land cost, size and type of structure, the community, and how much of the work/money you will be providing.
- Permits - continue working with your engineer or architect or contractor to make certain permits are issued as required. Allow time for the permitting process. It can sometimes take longer than the construction process. This is where working with a professional can help.
- Identify your contractor or subcontractor short list.
- Ask for quotes on whatever you will not be doing yourself - electrical, plumbing, heating/air conditioning etc. OR the whole project.
- Keep talking to your RASTRA® Dealership.

The following pre-build check list has been handy in the past:

1. Blue prints of the building project.
2. Engineer's report on the RASTRA® building system.
3. Necessary tools to install RASTRA® elements.
4. Arranged for rental of whatever equipment is needed.
5. RASTRA® element order and delivery time verified.
6. Subcontractors scheduled.
7. Building permits.
8. Necessary inspections scheduled.
9. Double check all of the above.

The following pages in this section cover other things to be considered during the planning phase: utilities, tools and supplies, receiving, handling and storage. For additional information or if you have questions - keep in touch with your RASTRA® Dealership.

RECOMMENDED TOOLS AND SUPPLIES

RASTRA® elements may be installed with conventional tools normally used in the installation of common building materials. Figure 2.1, however, shows a "starter kit" basic set of tools sufficient for a smaller project.

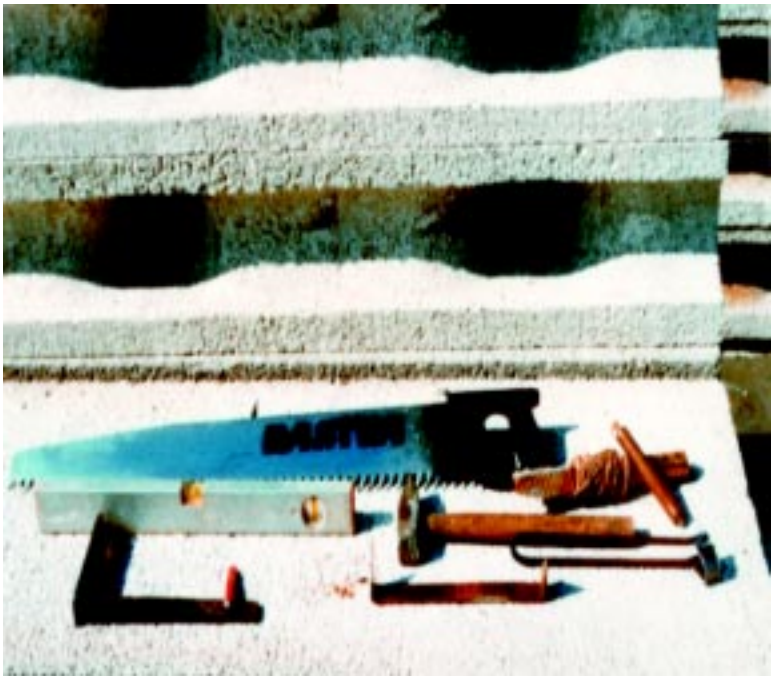


Figure 2.1
Some Typical Tools used with RASTRA®

- **Hand Saw (or Chain Saw - not shown)**
- **Masoner's String Line, Levels**
- **Carpenter's Square**
- **Hammer**
- **Router**
- **Stapels**

A list and brief description of other tools which can be used on RASTRA® projects is shown below. Most of these tools may already be owned or may be purchased at a local hardware store. Others can be found at a rental outlet, and many are available through the local RASTRA® Dealership.

Common Tools
1. Hand Saw w/ large teeth 3tpi
2. Keyhole saw
3. Chain saw 14" bar
4. Circular saw
5. Beam cutting attachment
6. Reciprocating saw
7. Hack saw
8. Drill motor
9. Hole saw
10. Router
11. Level
12. String
13. Tape measure
14. Hammer
15. Ladders
16. Gloves
17. Dust mask
18. Safety glasses
19. Shop vacuum

Rental Tools
1. Forklift
2. Manual Lift
3. Scaffolding
4. Boom Truck
5. Rebar cutter / bender

Supplies
1. RASTRA® elements
2. Foam glue
3. Staples or Spreader cleats or Mono straps
4. Rebar
5. Concrete grout
6. Framing timber
7. Shim stock
8. Stake material
9. RASTRA® hollow anchors
10. Site-made bucking

RASTRA® Tools
1. Rasp
2. Squeeze
3. Element pick
4. Foam glue gun
5. RASTRA® wall support
6. RASTRA® saw guide
7. "Goliath"
8. RASTRA® hand saw

Common Tools

1. **Hand saw with large teeth**. This saw is used to cut the RASTRA® elements by hand. The teeth on this saw should be as large or coarse as can be found. A crosscut saw that is used for cutting trees works very well. A logger's one-man crosscut saw also works very well. Saws that work the best have 2 to 4 teeth per inch and are 36 to 42 inches long. The stiffer the blade is, the straighter the cuts will be. Dull teeth are ok.

2. **Keyhole saw**. This is a standard saw used for drywall. It is used to scribe or cut the RASTRA® elements as well as to cut small holes for grout or electrical boxes.

3. **Chain saw.** This is used for cutting large sections out of the

RASTRA® elements 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.

4. **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® elements.

5. **Beam cutting attachment**. This is a chain saw attachment for a worm gear circular saw. It is best to use a 14 inch 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.

6. **Reciprocating Saw**. This is an all purpose reciprocating saw. The saw is used in many ways - including the cutting of rebar and the cutting of the RASTRA® element.

7. **Hack Saw**. Standard metal cutting saw used to cut rebar or other metal and plastic items.

8. **Drill**. Standard 3/8" or 1/2" electric drill.

9. **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.

10. **Router**. A standard hand-held router can be used to ream out a channel in the Thastyron in preparation for electrical wiring.

11. **Level**. A standard 4 foot level is needed; however, a 6 foot or 8 foot level is handy for making and checking straight, plumb walls.

12. **String Line**. Standard mason's string line. Used to maintain alignment of RASTRA® elements.

13. **Tape measure**. A 25 foot tape and a 100 foot tape is needed.

14. **Hammer.** A standard framing hammer.

15. **Ladders.** Standard 6’ or 8’ step ladder along with extension ladders. Assorted ladders may be needed during construction. An 8-ft step ladder is recommended for unloading elements during delivery.

16. **Gloves.** Standard work gloves to protect hands from the roughness of the RASTRA® elements.

17. **Dust Mask.** This can be any type used in construction. It is used to protect from dust when cutting and rasping.

18. **Safety Glasses**. Standard safety glasses to protect eyes when cutting, rasping or grouting.

Rental Tools

1. **Fork lift**. A forklift will be needed to unload the trucks during delivery and can also be used to set the elements (method explained later). The forklift should have 4" wide tongs and an upward reach extending a minimum of 4’ higher than the highest walls.

2. **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® elements. They are used to place RASTRA® elements into positions which extend above normal reach.

3. **Scaffolding.** Used as a working platform when walls are above waist high.

4. **Boom Truck.** Used for unloading. Good for uneven, rough and tight job sites, and for lowering elements 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 foot 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 size RASTRA® elements (30" x 10').

5. **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.

Dealership-Available Tools**

1. **Rasp.** This is a tool used to even up and shape RASTRA® elements. It is an expanded metal face welded on a rigged frame with a handle. The size is approximately 6" by 8".

Figure 2.2 Shaping edge with hand rasp.

2. **Squeeze**. This device resembles large ice tongs with one exception, the points have been replaced with flat pads to "squeeze" the element on either side, allowing it to be picked up by any lifting device.

3. **Element Pick.** This is used primarily with 30" high double RASTRA® elements and prefab elements. It is 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® element by the solid nodes on either side.

4. **Foam Glue Gun.** This is used with the polyurethane foam glue used to bond the RASTRA® elements. The gun attaches to special canisters by means of a threaded coupler and has proven to be more manageable than the conventional straw applicators.

5. **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. Figure 2.3 shows the supports used in installation where the elements are vertically installed. Figure 2.4 shows a larger version of the supports in a 30,000 sq ft commercial installation where the elements are dry-stacked.

Figure 2.3 Turnbuckle adjusted to bring wall into plumb.

Figure 2.4
RASTRA® supports used in 30,000 sqft commercial structure.

6. **RASTRA® Saw Guide and Saw.**
The saw guide is used to help cut RASTRA® elements into rectangular shapes with a hand saw. It resembles a miter box and is placed on top of the element and guides the saw. The RASTRA saw is a wide-toothed saw with hardened tips, designed for cutting mineral-based materials.

Figure 2.5 RASTRA® saw guide for cutting elements.

7. **"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 element.

Figure 2.6
Goliath panel lifter.

**Note: All Dealership-available tools may be purchased and/or rented from the local Dealership. Check for cost and availability.

SUPPLIES

1. **RASTRA® elements.** Order from the local Dealership in advance so it may be delivered when needed. Double check quantities and sizes.

2. **Foam Glue**. Used with glue gun to bond RASTRA® elements, for grouting as well as for bucking and pop-outs.

3. **Staples**. Used as an alternative to glue to hold elements together. Can also be used to hold pieces 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 instead.

4. **Rebar.** Used in the cores to reinforce the concrete walls. Size and spacing to be determined by structural engineer.

5. **Concrete Grout**. Used in the cores of RASTRA® elements for structural strength. The psi strength to be determined by a structural engineer. Slump can range from 8 ½" ± 2" dependent upon complexity of design.

6. **Wood Material**. Used for bucking of openings and bracing. This could be 2x4 2x6, 2x8 along with 4x8 sheets of plywood.

7. **Wood Shims**. Used for shimming RASTRA® elements in plumb or to level the elements prior to gluing.

8. **Stake Material**. These could be either wood or metal stakes.

9. **RASTRA Hollow Anchors** Used to attach items to the RASTRA® walls. Check with local Dealership.

GENERAL

Basement and retaining walls can be built from RASTRA® elements. Design of walls is to 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 slump, aggregate size, type and strength of concrete grout. Figure 3.1 shows a typical basement wall prior to grouting and water proofing.

Figure 3.1 RASTRA® retaining wall prior to placement of vertical rebar, grouting and waterproofing.

Horizontally Laid Elements

When RASTRA® elements are laid horizontally, they can be dry-stacked using whalers, or stapled together, or glued together or laid in another manner if desired. What is important is that the walls be plumb and level prior to grouting.

Vertically Set Elements

RASTRA® elements may also be installed vertically and may be stapled or glued together or connected in any other fashion which keeps them abutted together during grouting. Once again what is important is that the walls are plumb and level prior to grouting of elements. However, make sure that no excess amount of debris from cutting or rasping the RASTRA elements has fallen into the cavities.

Placement of Reinforcement
When elements are laid horizontally, horizontal reinforcement can be placed directly on the bottom of the horizontal grout cells and vertical reinforcement can be hand centered prior to grouting of the wall unless otherwise directed by the engineer's plans or specifications.

When elements are set vertically, horizontal reinforcement can be fed into the resulting horizontal cells and laid directly on the bottom of the cells. Vertical reinforcement can be hand centered prior to grouting of the wall.

Should engineer plans specify, chairs or other devices may be used to position horizontal or vertical reinforcement in required locations within the cells.

Footing and Length of Starter Bars or Dowels
Starter bars or dowels are placed into the footing and extend up into the wall a distance of 24" or the length required by code.

Length of Vertical Reinforcement and Depth of Grout
In a multi-story structure, it is important to provide for vertical lap-splices of reinforcement. For example, if a 10 ft high basement wall is being constructed, the wall may be grouted to the 10 ft level with the required length of rebar extending above the wall thus creating the lap splice in the upper story OR the wall may be grouted to less than 10 ft with the lap splice occurring in the lower story. In either case, the required length of rebar is now available to provide the necessary lap splice for the next story to be constructed.

Note that no cleanouts are required for RASTRA® walls as no mortar is used in assembly of elements. Make sure, however, that no pieces or excess amount of debris from rasping or cutting elements have fallen into the cavities.

WATERPROOFING

RASTRA® walls have a large enough pore size that capillary action or wicking of moisture up into the wall will not occur. However, as RASTRA® elements are porous, care should be taken to waterproof basement walls. There are a wide variety of commercially available water or moisture barriers suitable for use on RASTRA® walls. They may be cement or petroleum based materials. As a guideline, if they are approved for use on masonry or concrete, they will work on RASTRA®.

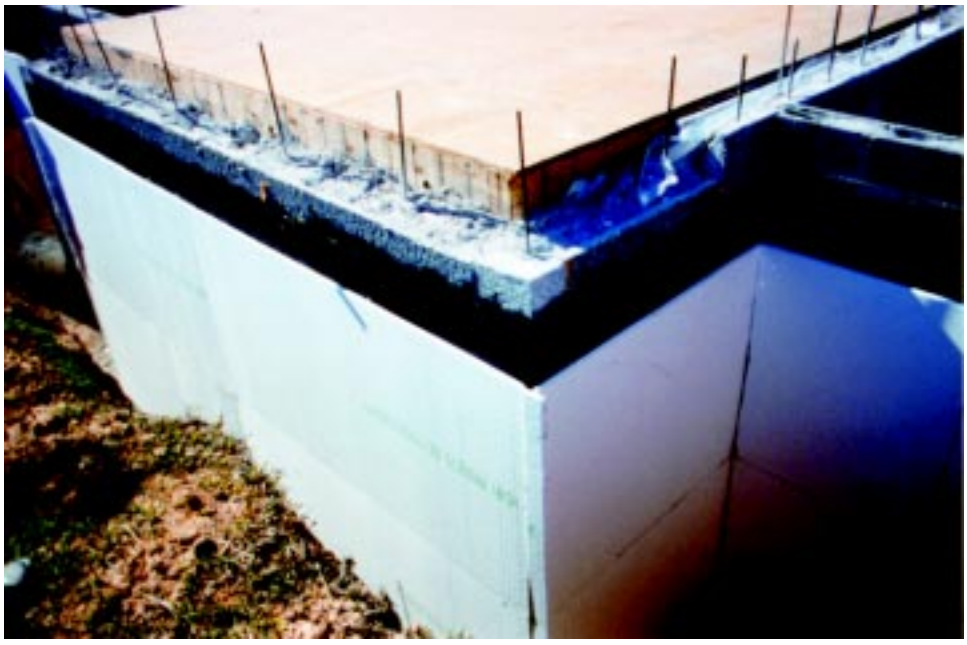


Figure 3.2 Completed basement wall after grouting and waterproofing. Note length of rebar extending up from wall ready for installation of next story.

To increase coverage of the waterproofing material, a skim coat of plaster or similar material can be applied to the surface of the wall to provide a smoother surface for the waterproofing material. However, RASTRA® retaining or basement walls may be covered directly with standard waterproofing materials including cementitious or asphaltic sealing materials.

To protect the water or moisture barrier from damage during backfilling, a layer of “protection board” such as polystyrene elements as shown in Figure 3.3 or asphalt impregnated sheathing may be placed between the barrier and the backfill. Figure 3.4.

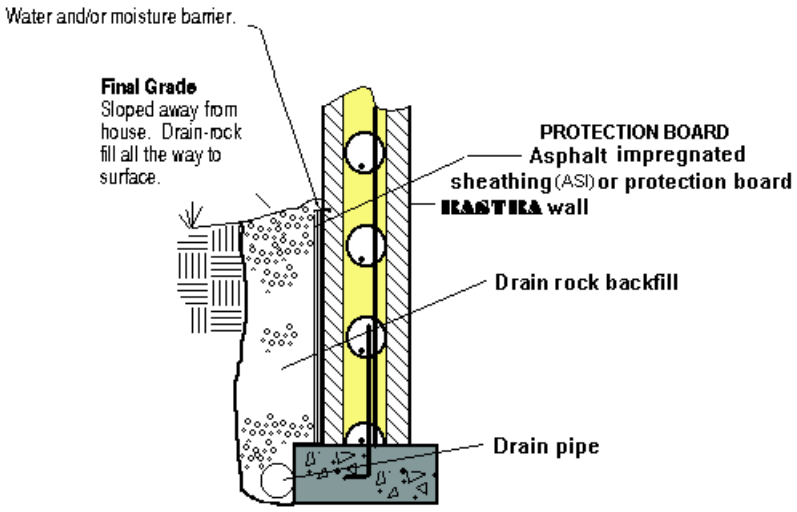


Figure 3.3 Typical below-grade installation.

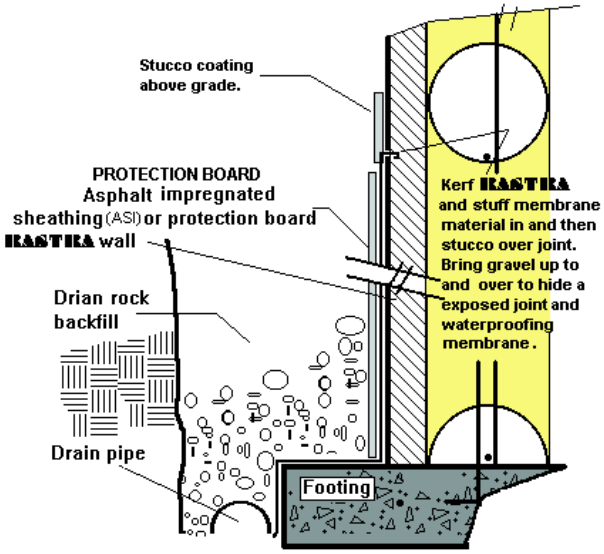


Figure 3.4 Protection board example.

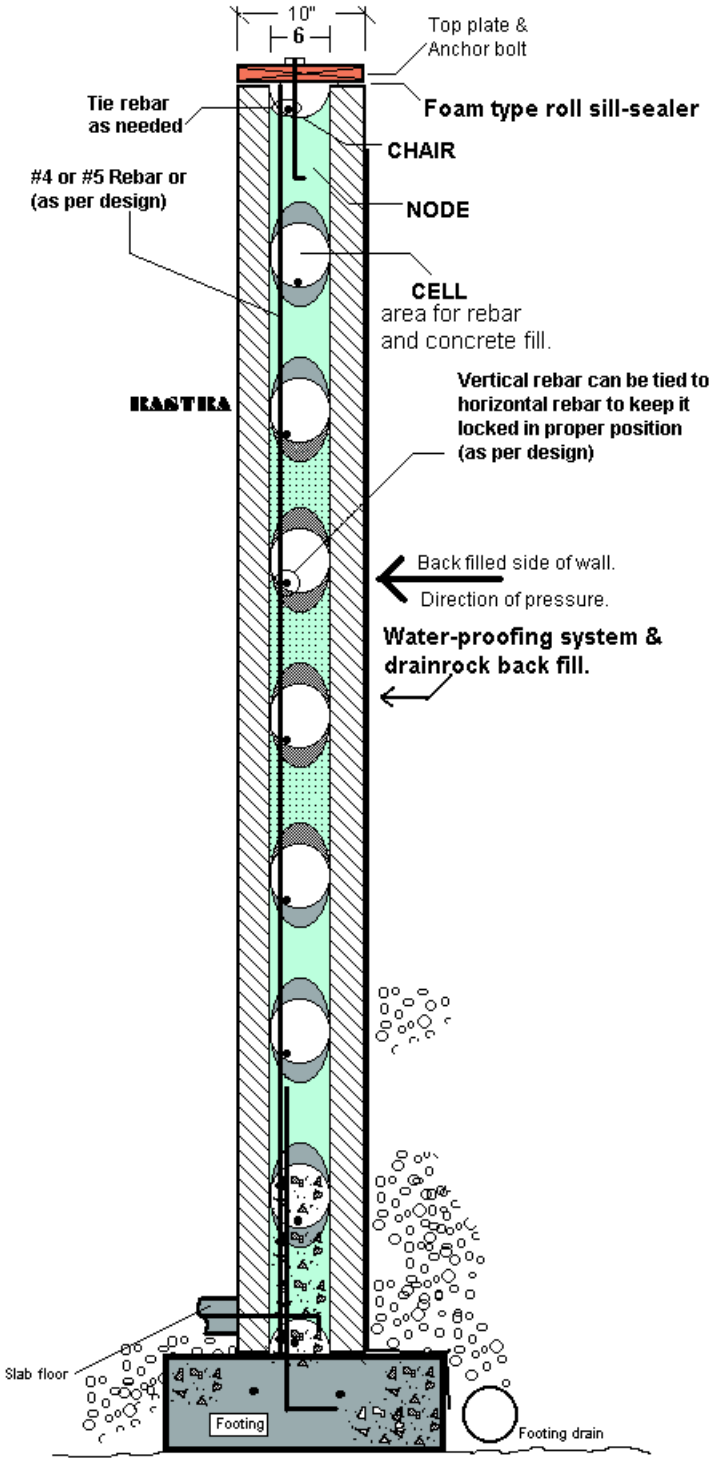


Figure 3.5 Cross-section of basement wall with offset vertical reinforcement.

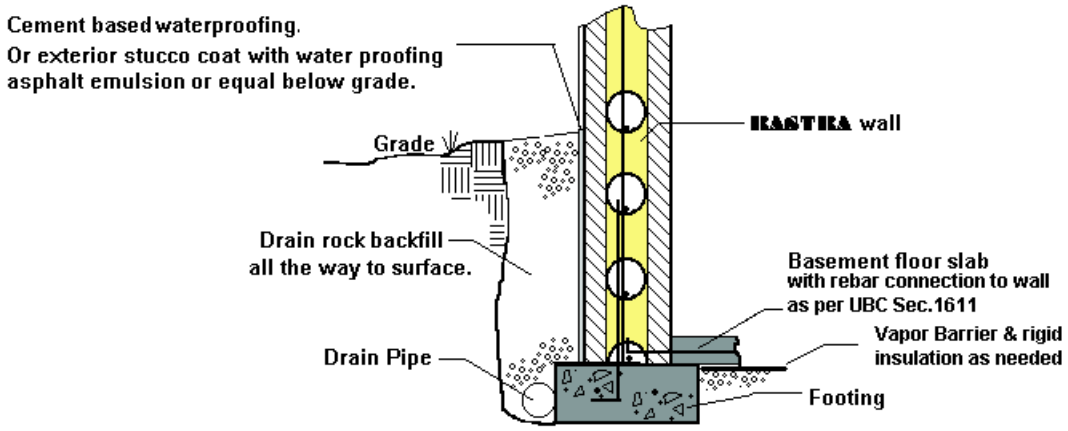


Figure 3.6 Typical backfill placement. Note location of drain pipe below top of footing.

Figure 3.7 Basement wall with bracing prior to grouting.

STEM WALLS & FOOTINGS

RASTRA® elements may be used for stem walls, or with conventional poured-in-place concrete stems, standard block stems, or mono-poured systems. All of these types of stem walls will work with RASTRA® elements. However, using the RASTRA® element for the stem wall offers quite a few advantages over the other methods.

All RASTRA® walls or stem walls should rest on spread footings designed to support the wall and building loads and be designed for the soil conditions at the site.

Figure 3.8 First course of elements, starter bars and first horizontal rebar in place.

Energy Efficient

RASTRA® elements used for stem walls are more energy efficient than conventional systems. When RASTRA® elements are used for stem walls, the concrete slab in effect becomes insulated providing a thermal break, thus reducing the effect of outside temperatures on the inside of the building.

Crack Reduction in Stem Walls

In a RASTRA® building, the insulative qualities of the Thastyron reduces expansion and contraction of the walls. Hence, using RASTRA® elements for stem walls practically eliminates stucco cracks. In addition, no foundation lines occur to dictate landscaping heights. This is in contrast to conventional construction where stucco cracking is generally associated with expansion and contraction of the underlying material.

Mono-Pour Footing and Stem Wall

A very popular option in some areas of the country is to use RASTRA® elements in a mono-pour footing and stem wall. This means that the concrete slab or footing and the stem wall are poured at the same time, thus inter-locking them together.

Methods for Footer and 1st Row Installation

(1) Dry Set - pre-poured footer or monolithic slab with dry tacked RASTRA® elements on hard set concrete

(2) Wet Set - Freshly poured concrete with first row of RASTRA® elements set into it, then leveled and plumbed.

(3) Mono-Set - Monolithic footing or slab with first row of RASTRA® already in place on top of forms before pour as shown below in Figure 3.9. Note: Can pour footing only, or fill footing forms and then 1st row of elements. Be certain that rebar extends past top of concrete pour the amount required for lap splice.

Figure 3.9
Setup for Mono-set-pour

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 the RASTRA® as shown in the Ledgers portion in Section 4 of the Manual.

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® element will act as an expansion joint around the perimeter of the concrete slab.

Rebar Placement
It is recommended that considerable thought be given as to which method is to be used for installing RASTRA® elements. Always verify the correct placement of rebar with the engineer's report. In some cases such as in retaining walls or tall walls the engineer may want the rebar offset to one side of the cells. In addition, spacing of rebar may be 15" or 30" oc dependent upon requirements for wind or seismic design. Size, strength, spacing and length of all rebar is to be in conformance codes.

Rebar in footings can be placed one of two ways. It may be placed prior to pouring or immediately following the pour. Either method is acceptable. However, the rebar must be long enough for correct embedment in the footings and provide the correct length above the footings for lap splices. Additional information on reinforcement is contained in Walls - Rebar Placement in Section 5 of the Manual.

Electrical & Plumbing Considerations
Electrical conduit and water/waste piping can be run through the footer or slab per customary usage and then fed up into the cavities within the RASTRA® wall if desired. Placement of all electrical and plumbing runs within RASTRA® walls needs to be made before the walls are grouted. Alternatively, utilities can be brought through the stem wall or slab into the interior of the structure and run up partition walls as required. More information on Electrical and Plumbing is located in the Appendix.

NOTES

LEDGERS AND ANCHOR BOLTS

While RASTRA® elements may be assembled either horizontally or vertically, the method of attachment of ledgers is the same. The size and location of ledgers, and the size and spacing of anchor bolts should be called out by the engineer either on the plans or in the engineer's report.

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

After snapping the line, locate the vertical cells that anchor bolts will be placed in and cut holes as called for by the engineer. Figure 4.1. These holes are typically 4" or 6" in diameter and may be cut with either a key hole saw or a drill with a hole saw of the proper size. To ensure proper flow of grout within the wall, do not allow the cut out pieces to fall down inside of the wall.

Figure 4.1 RASTRA® wall with cutouts prepared for ledger/anchor bolt installation.

As the holes cut into the RASTRA® elements are larger than the anchor bolts, it is 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. The simplest is to glue the ledger directly onto the wall. However, it is recommended that all-thread rods be used to bolt the ledgers to the wall. The ledger can be predrilled to accept the all-thread rods and the rods driven through the RASTRA® elements. A large washer made of plywood (typically 6" in diameter) can be placed on the opposite side of the wall, and then nuts and washers used on both sides to snug the ledger to the wall.

Once the ledger is snug, check that the ledger is placed on the chalk line and then finish tightening the threaded rods. The threaded rod should be placed about 60" apart and if possible through areas in the RASTRA® elements that are solid. This will allow recovery of the threaded rod after the grout is cured.

Figure 4.2 Ledgers with anchor bolts held in place with all thread rod prior to grouting of wall.

Once ledgers are in place as shown in Figures 4.2 and 4.3, joists can be installed prior to pour of concrete if desired.

Figure 4.3 Ledgers in place prior to grouting of wall.

Figure 4.4 Installation of Truss-Joist system.

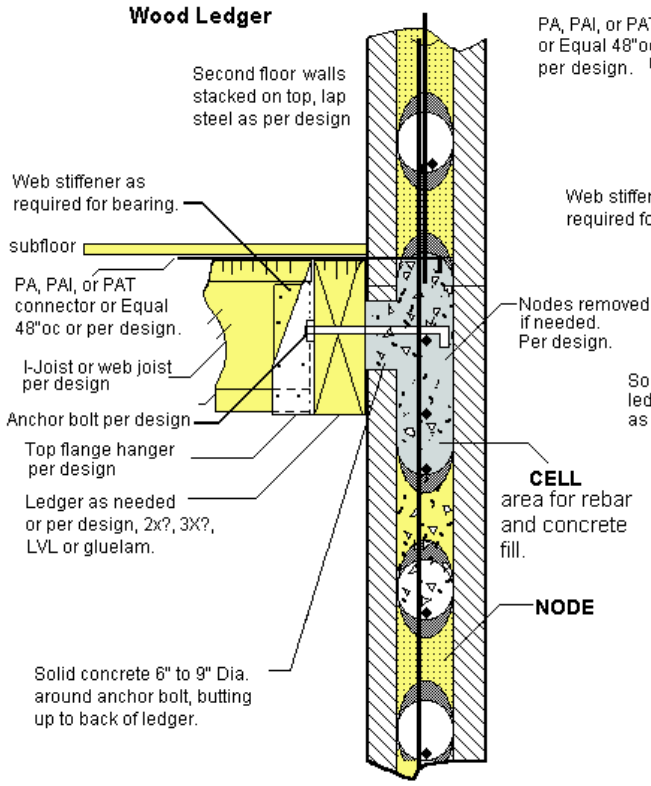


Figure 4.5 Wood Ledger

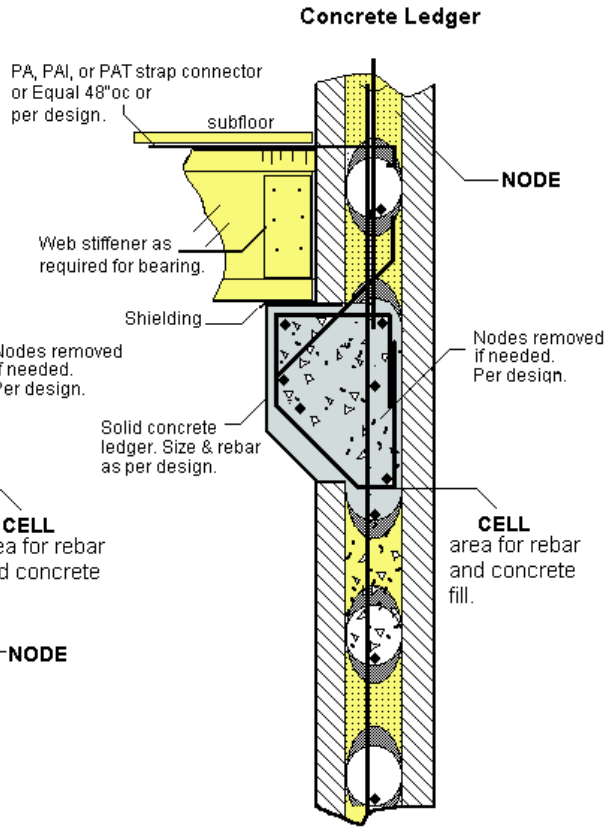


Figure 4.6 Concrete Ledger

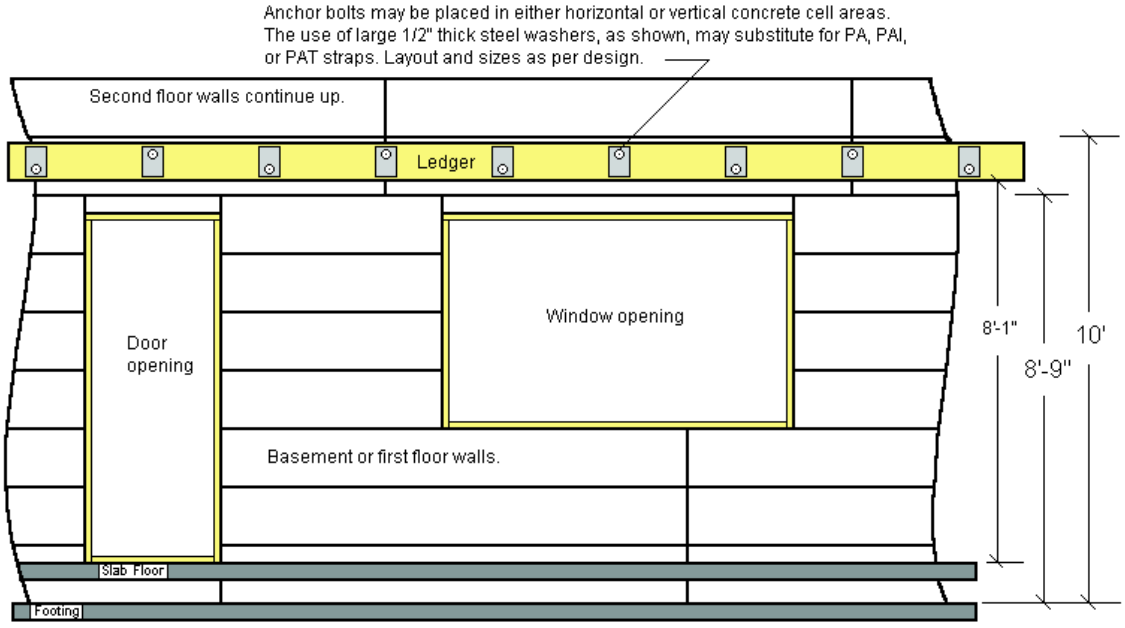


Figure 4.7 Schematic with relative floor to ledger distances

RASTRA® FLOORS AND ROOFS

As can be seen from the preceding section on ledgers, conventional floors and flat roofs can be built in a RASTRA® structure. In addition, RASTRA® elements can be used to create RASTRA® floors and roofs which have the added advantage of being insulated, and can be constructed without creating a cold joint between the walls and floor/roof diaphragm.

The following figures show inverted RASTRA® end elements 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® elements provide a stay-in-place insulating form, the 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.

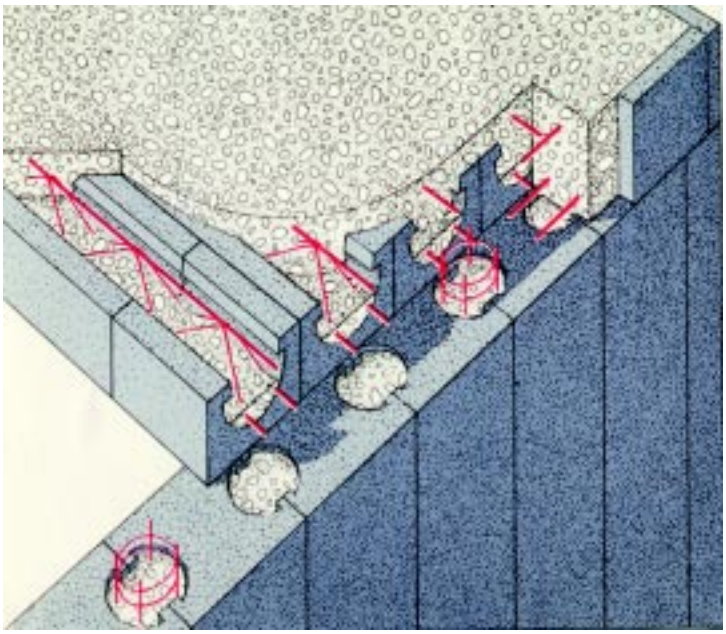


Figure 4.8 Illustration of Monolithic Pour for Walls and Floor or Roof.

* "Double" end elements (2 connected end elements) may be available upon request for use in floors or roofs.

As can be seen from above, the roof/wall connection is poured in a monolithic fashion. To make room for the tie beam, the top of the RASTRA® elements in the wall can be cut in an L-shape; or flat stock can be used and glued on top of the wall element as seen in Figure 4.8.

Reinforcement in the walls may be as shown or in the more traditional method of individual rebars 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.

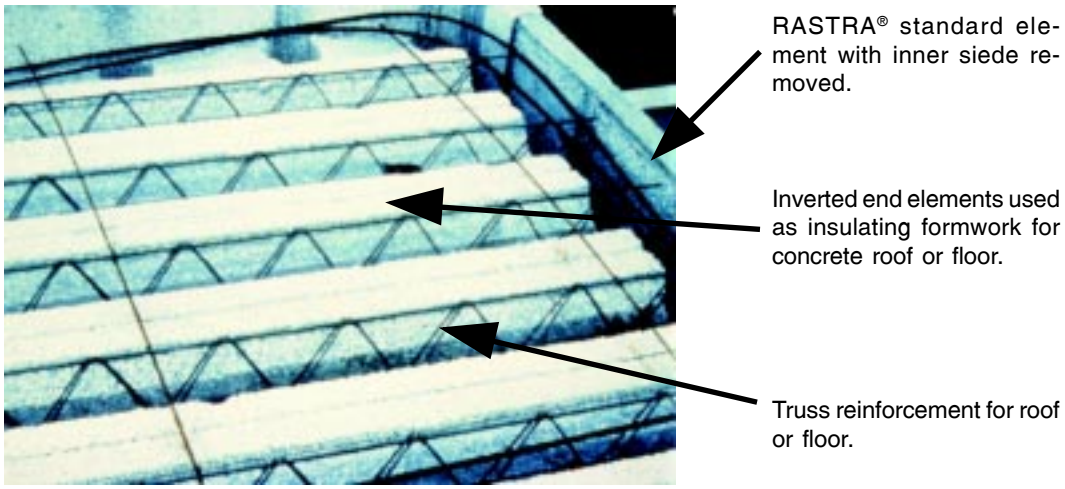


Figure 4.9 RASTRA® elements as insulating formwork.

RASTRA® Flat Roof with Parapet Wall

Figure 4.10 shows a RASTRA® floor or roof being poured. Before grouting, the top of the RASTRA ® wall is cut flush with the roof or floor. The walls are grouted first and then the slab is poured to create a monolithic entity. 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 if required. Once the finished concrete slab has set, the RASTRA® elements for the additional story or parapet wall can be set into place and cut into whatever shape is desired.

Figure 4.10 Monolithic pour of walls and floor at the same time.

When grouting is completed, make certain to strike the grout off even with the top of the wall.

For low parapet walls (less than 1 ½ feet high), extend flashing or waterproofing all the way to the top of the parapet. For higher parapets, particularly in snow country, make certain the flashing or membrane extends higher up on the parapet than the expected snow load. As RASTRA® roofs are well insulated, snow is apt to melt more slowly and from the top rather than from the heat of the house at the base of the snow.

Parapet / Roof Connection

Figure 4.11 illustrates a typical parapet/roof connection for both a RASTRA® wall and either a RASTRA® roof or a wooden flat roof. In either case, the roof is finished with a waterproofing membrane with the flashing/membrane run up the wall a sufficient distance to ensure water from driving rain or melting snow does not seep behind. In either case, the top of the wall typically is sloped and sealed prior to finishing. Further discussion of waterproofing is contained in Section 6.

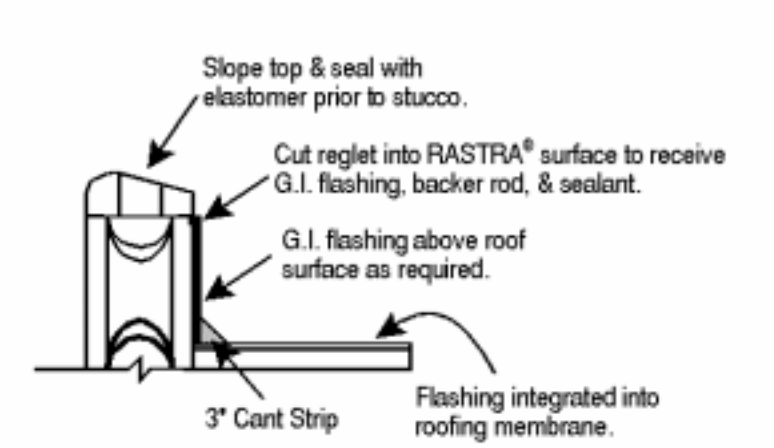


Figure 4.11 Example of parapet cap.

Truss Roofs

Truss roofs may be connected to RASTRA® walls 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 and diameter and spacing of the anchor bolts is to be per engineer's design. The top plate is typically a 2x whose width depends upon the RASTRA® wall selected (whether 8 ½, 10, 12, or 14 inches in width). Figure 4.12 illustrates one way of installing a truss roof on a RASTRA® wall.

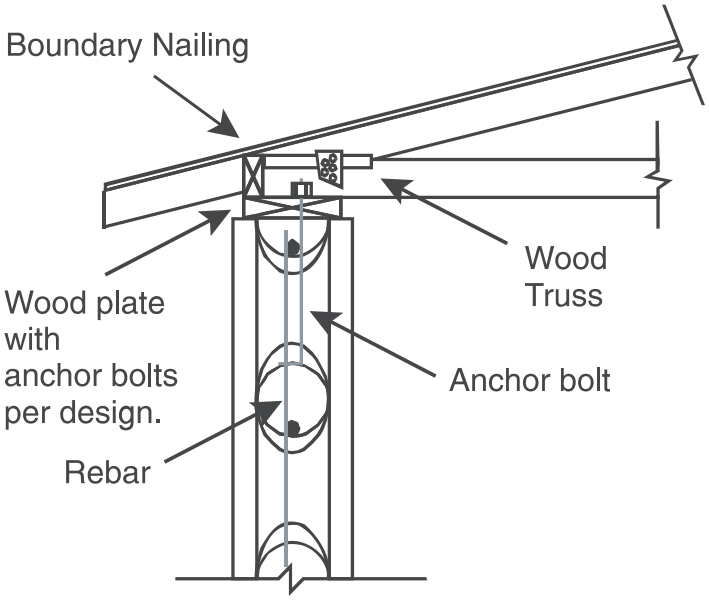


Figure 4.12 Truss roof installation or as per design.

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

Symmetrical Interior

The interior reinforced concrete pattern is symmetrical so RASTRA® elements may be laid horizontally or vertically without affecting the design. Some contractors prefer to lay the elements horizontally in courses similar to laying masonry block. Other contractors prefer to install the elements vertically, or use the prefabricated panels which can be delivered to the site in sections as large as 10-ft x 25-ft with or without electrical and reinforcement installed. These large sections can be set in place and be ready for rebar and grouting as soon as they are plumb and level.

Types of Elements

Standard elements are available in two widths, 15" for the single element, and 30" for the double element. Element thicknesses are 8.5, 10, 12, and 14 inches. End elements are 7.5" wide and come in the same thicknesses as the standard element.

Pre-fabricated Panel Sections

Pre-assembled or custom sections of walls are available in these thicknesses in sizes as large as 10-ft x 25-ft. Window and door openings, wiring and reinforcement can also be included in these prefabricated panels. Inspection would be as required for any other installation. For projects where speed is of the essence, the prefabricated panels are excellent. It is possible for a project to have the prefabricated panels delivered in the morning, plumbed and leveled and ready for grouting in the afternoon.

Section Contents

This portion of the manual contains the following sections:

- Corners
- Rebar Placement
- Curved Walls
- Partition Walls
- Windows and Doors
- Lintels
- Stacking Options
- Grouting

Types of Corners

Corners can be made in a variety of ways. Figure 5.1 illustrates one way of making a corner for 10, 12, or 14 inch wide walls. The end element is notched out at 15" intervals to create a path for the reinforced concrete. Figure 5.2. If needed, all or most of one flange of an end element can be cut off to allow a stronger bond between the two wall sections. In this figure, the elements are installed vertically. However, the corner is constructed the same even if the standard elements are installed horizontally as shown in Figures 5.3 and 5.4.

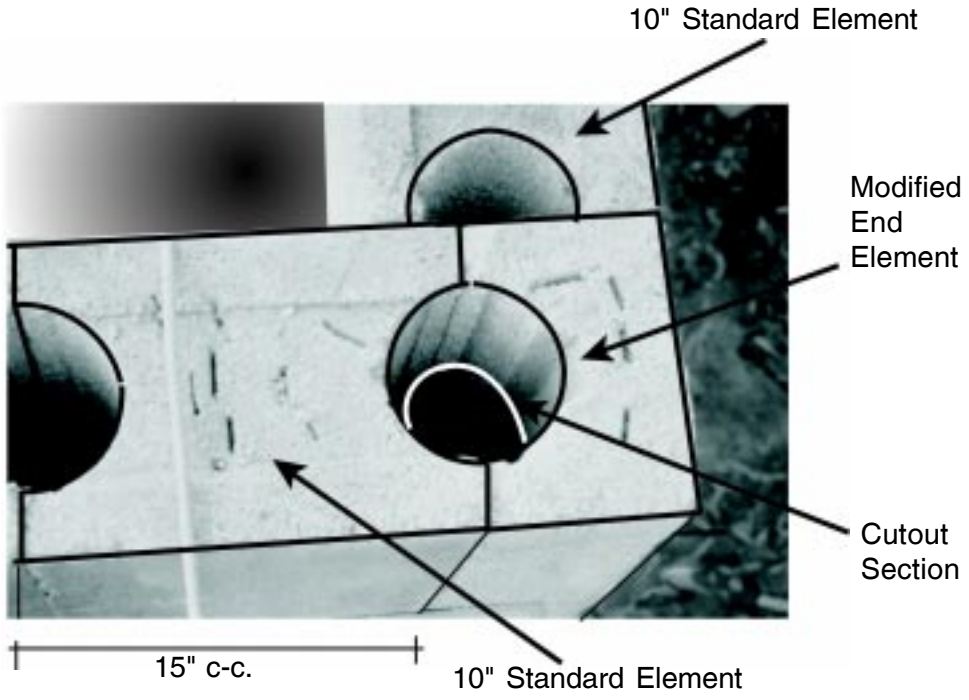


Figure 5.1 Top view of corner made with end element.

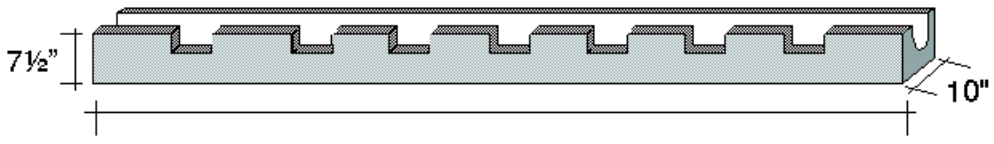


Figure 5.2 Side view of end element modified for corner.

Figure 5.3 Ready for installation of corner element. Horizontal and vertical rebar in place.

Figure 5.5 Millwork detail on house corner.

Figure 5.4 End element corner held in place with staples.

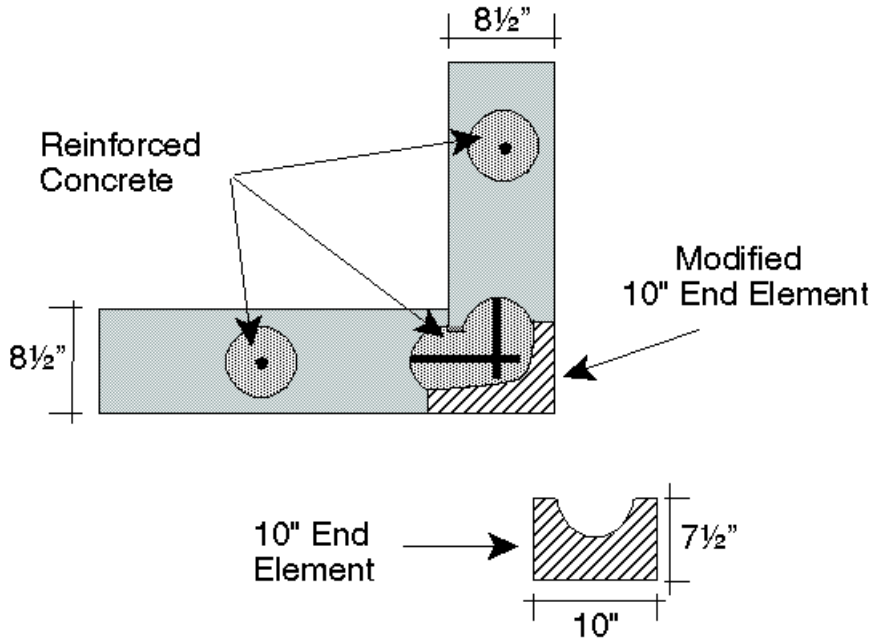


Figure 5.6 Cutaway view of corner for 81/2" wide wall.

The following figure presents a different way of creating a corner by cutting standard elements. The corner shown below is fabricated from one double element 30" wide and a standard element 15" wide. This is but one of a number of ways to create a corner with RASTRA.

Figure 5.7 Corner made from standard elements cut to 45°.

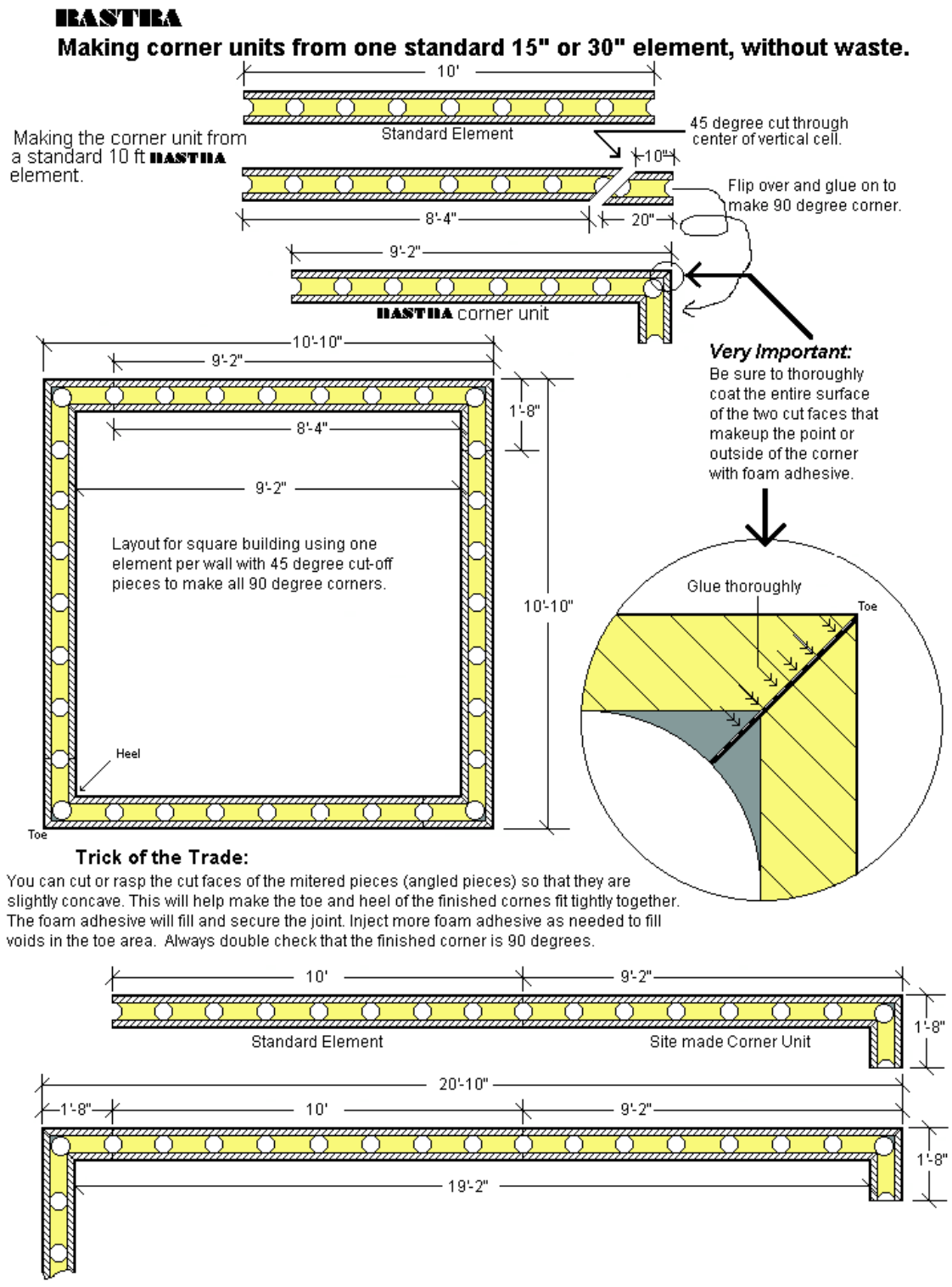


Figure 5.8 Schematic - making corners from standard elements.

Reinforcement

Reinforcement is to be of the size, grade, and placed in accordance with the engineer's report. Prior to pour of concrete, it is wise to verify that placement is indeed where the engineer has specified. In some cases the engineer may want the rebar offset to one side of the cells, such as in cases where a tall slender wall or a retaining wall is to be built.

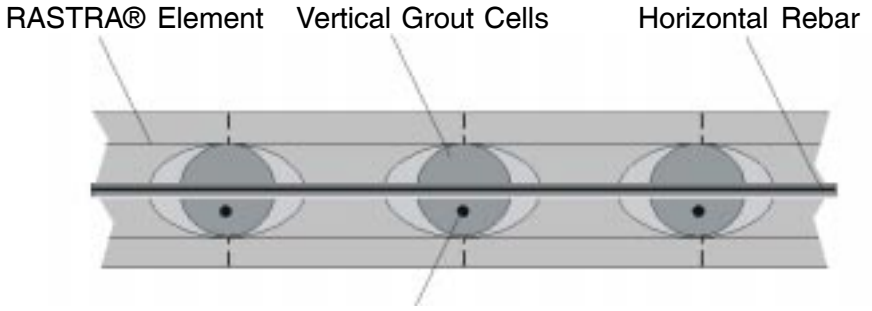


Figure 5.9 Vertical rebar placement.

Footings - Marking Corners

Start at a corner, set the corner bars and then space the bars at the proper spacing as called for by the structural engineer. This spacing is usually either 15" or 30" on center.

If the layout doesn't come out even, the difference can be compensated for near the next corner or in the middle of the wall under a window opening or in a doorway or elsewhere as desired. However, it is important that wherever the compensation takes place, the elements at that location must be stacked directly upon one another and not staggered. The purpose for this is to ensure that a continuous vertical core is created. Remember, the RASTRA® elements are actually formwork for the interior reinforced concrete and thus 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.

Measure and mark the forms at the proper spacing as called for in the engineering drawings. Continue all the way around the footing. This is a good time to also make a small mark at the vertical rebar locations on the inside face of the wall near the base.

Marking Window and Door Openings

When laying out walls, note where window and door openings are to be placed. Forms should be marked with the location of these openings. Rebar needs to be placed on either side of these openings corresponding to the overall rebar configuration and the 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 sure the rebar does not extend above the slab into the actual opening.

Counting and Cutting Rebar to Length

Make certain that the rebar size, grade, and spacing called for by the structural engineer is in fact being used. Start by counting how many pieces are needed, then cut that number of bars.

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:

L = f/2 + s + d + hook"
= 4" + 18" + 20" + 2"
= 44 inches

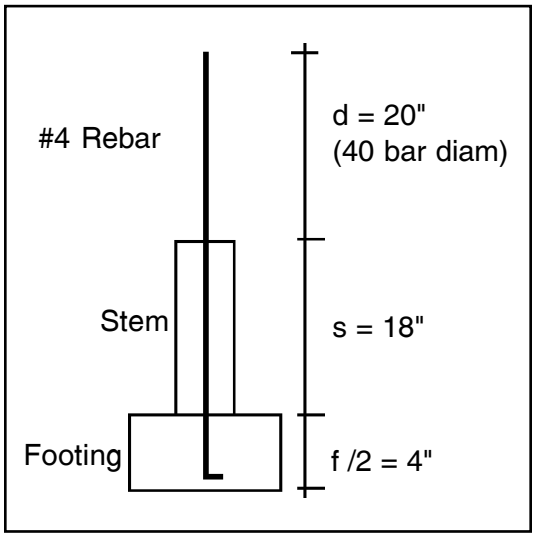


Figure 5.10 Rebar example.

Note: 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.

Once the pieces have been cut, bend them so they have at least a 2" hook on the end. Check this with your engineered drawings. Bend all of the pieces that have been cut. Be sure that consideration has been taken 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 and to be sure the rebar will not interfere with these openings.

Upon completion of this task, place and tie the rebar itself. Rebar can be placed in one of two ways. Either it may be placed prior to pouring footers or immediately following the pouring of the footers. Either method is acceptable. Keep in mind that it is very important that the hook is situated at ½ the thickness of the footer so that the top will be sticking out of the stem wall a minimum of 40 bar diameters high.

It should be noted that a smooth surface of the footer, stem walls, or slab greatly facilitates installation of RASTRA® elements.

Wall Horizontal and Vertical Reinforcement

Once the reinforcement dowels for the footing have been placed and the concrete poured and cured the required number of days, the elements can be placed - either horizontally or vertically.

If laying the elements horizontally (in a manner similar to masonry construction), horizontal reinforcement can be laid directly upon the element material unless otherwise required by the engineer. Vertical reinforcement can be dropped down into the cells prior to grouting the wall.

If installing the elements vertically, horizontal reinforcement is fed into the horizontal cells as required and vertical reinforcement can be dropped down into the cells prior to grouting the wall.

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.

Marking Location of Rebar

As mentioned earlier while the walls are being constructed, it is helpful to mark the location of the vertical reinforcement in the walls. Typically, a small vertical slash of spray paint is used to mark the base of the wall. 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 also find this marking helpful.

CURVED WALLS

Curved walls can be created using 15" wide RASTRA® elements in their vertical position as shown below in Figure 5.11. By trimming the inside edges of the elements to the correct angle, a curved wall can be created which is in effect a polygon with 15" long sides. The inscribed radius depends on the angle the elements' flanges are cut. For radii exceeding approximately 7 ft., the wall will appear round and very little rasping should be required on the outside to smooth the curve. Smaller radius curves may require more rasping on the outside. In either case, a plaster finish will give perfect results for small towers, bays or just rounded corners.

To create a nice even edge, the cut should be made along a wood straight-edge fixed to the element the proper distance in from the edge of the element. The inside edge may require a little rasping to make a perfect fit. Figure 5.12 is a schematic of how to determine the amount to be removed from the inside edges of the element.

The relationship of curve radius, thickness of element, and amount to be trimmed are listed in the following table. For other radii an equation is given to determine the amount (C) to be trimmed.

Figure 5.11 Curved walls under construction.

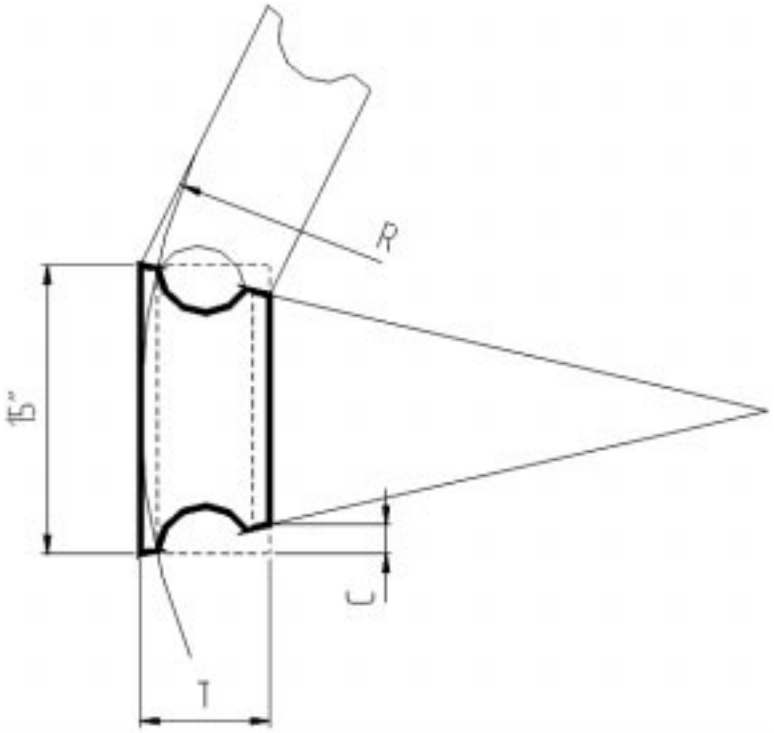


Figure 5.12 Method of creating curved walls.

Table 5.1 DESIGN AID FOR CREATING CURVED WALLS

RADIUS "R"	CUTOFF "C" FOR WALL THICKNESS "T" (inch)			
	8.5 inch	10 inch	12 inch	14 inch
3 ft	1.8	2.1	2.5	2.9
4 ft	1.3	1.6	1.9	2.2
5 ft	1.1	1.3	1.5	1.8
6 ft	0.9	1.0	1.3	1.5
7 ft	0.8	0.9	1.1	1.3
8 ft	0.7	0.8	0.9	1.1
9 ft	0.6	0.7	0.8	1.0
10 ft	0.5	0.6	0.8	0.9

For other radii calculate C = 0.625 x T (inch) / R (ft)

Figure 5.13 Curved planter and retaining wall.

Figure 5.14 Multi-story tower at visitor center & clinic.

Anchorage of Wood Frame Interior Walls

If the method of using anchor bolts to attach wood frame interior walls to the RASTRA® elements is selected, it will also be necessary to place them prior to grouting the RASTRA® walls. 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® elements 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.

Connection of RASTRA® Interior Walls

If desired, partition walls can also be made from RASTRA® elements. Method is similar to that of 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 can then be placed to provide a physical connection between the two walls and concrete will flow into both walls when the grouting is done. Figure 5.15 shows a number of partition walls in place prior to grouting. Note also the waste stacks prepositioned in a partition prior to pour.

Figure 5.15 Example of interior RASTRA® walls.

WINDOW AND DOOR PLACEMENT

In a RASTRA® structure, doors and windows can be installed in a variety of ways. Prior to grouting the walls, openings can be created when elements are being installed as shown in Figure 5.16 or cut into the walls and the resulting opening lined or bucked out to contain concrete during the pour.

Figure 5.16 Framing window opening with RASTRA® end elements.

If a “BULLNOSE or FLARED” opening is desired, then RASTRA® end elements can be used as above to finish out the openings. Figure 5.16 illustrates a typical end element window installation.

The RASTRA® end element has about four inches of material that may be cut and/or shaped as required to create the desired effect. End element dimensions are seven and one-half inches wide by the thickness of the wall. Figure 5.17 shows end element dimensions for a 10" thick RASTRA® wall.

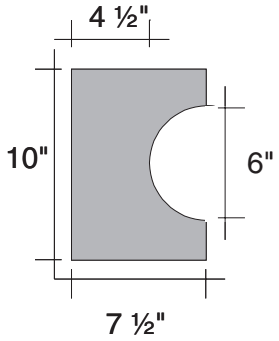


Figure 5.17 Typical 10" end element.

A RASTRA® end element or RASTRA® flat stock may be used as shown in Figure 5.18 and Figure 5.18a, or a standard plaster sill may be applied directly over a standard element. Figure 5.19.

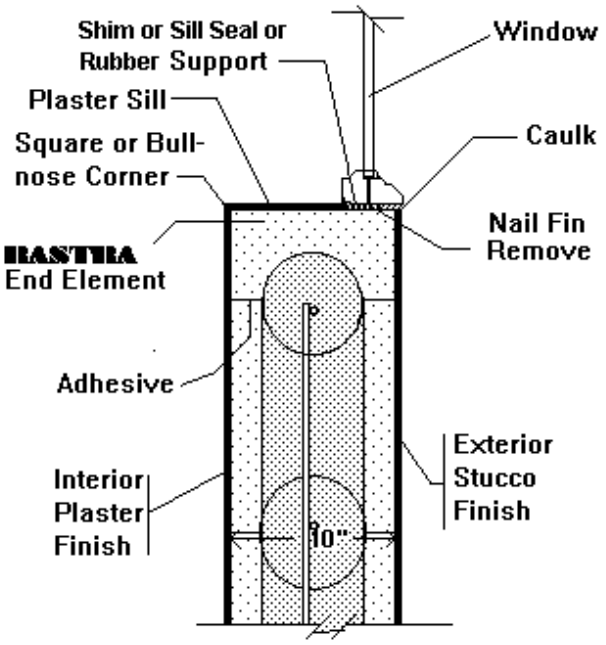


Figure 5.18 Window installation using plaster sill over RASTRA® end element.

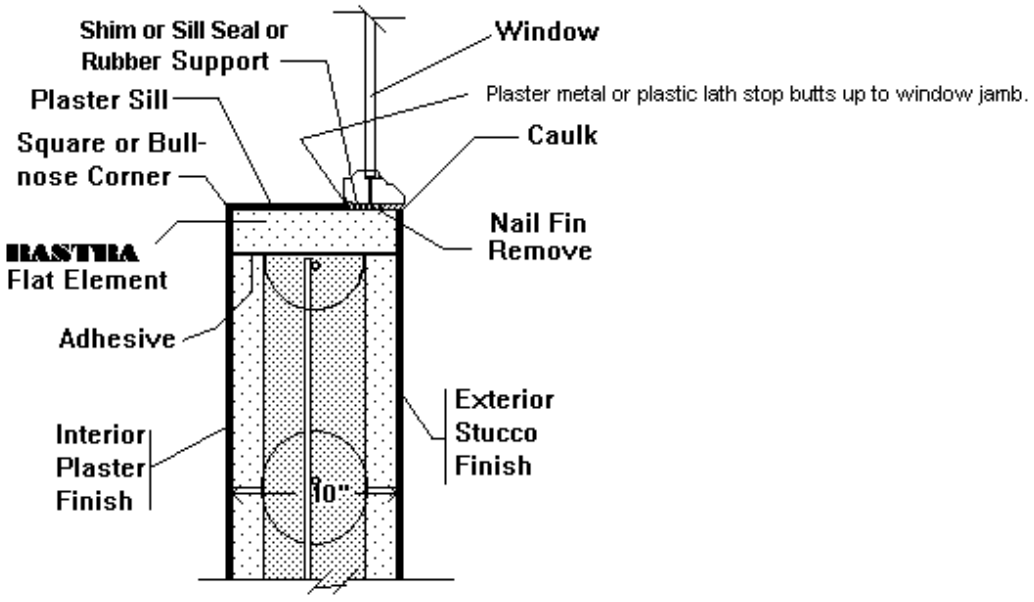


Figure 5.18a Window installation using plaster sill over RASTRA® flat stock.

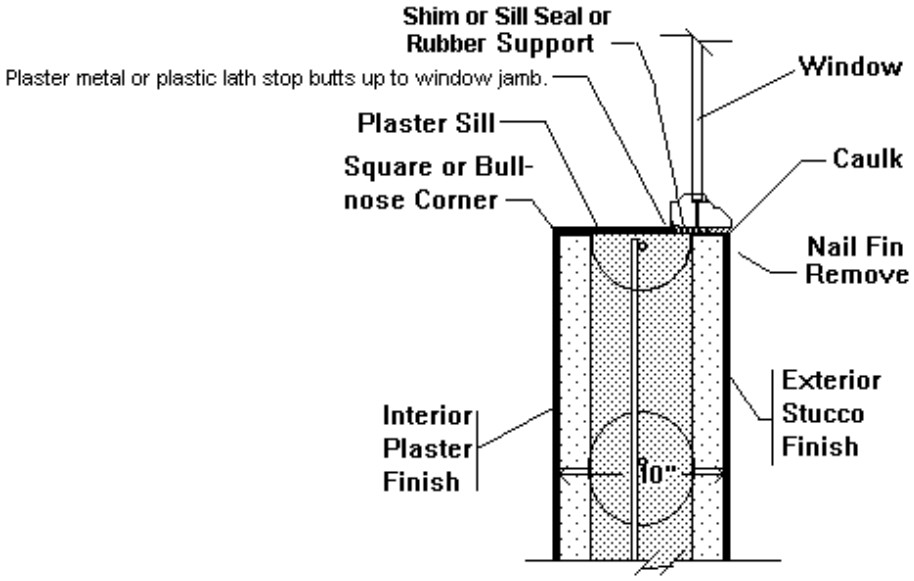


Figure 5.19 Window installation using plaster sill over RASTRA® standard element.

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

Bucked Openings

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 expanding foam sealant or they can be attached to the opening by inserting anchor bolts into grout cells prior to grouting, or after grouting by drilling holes and gluing/epoxying the bolts in place.

Figures 5.20 and 5.21 show typical window installation in a bucked out opening. Note these two figures also show two different ways in which wood siding may be attached to RASTRA® Walls. Virtually any type of code-approved exterior finish may be applied to RASTRA® walls. As can be seen from photos within this section and elsewhere, siding, stucco, stone, tile or brick finishes can be readily applied.

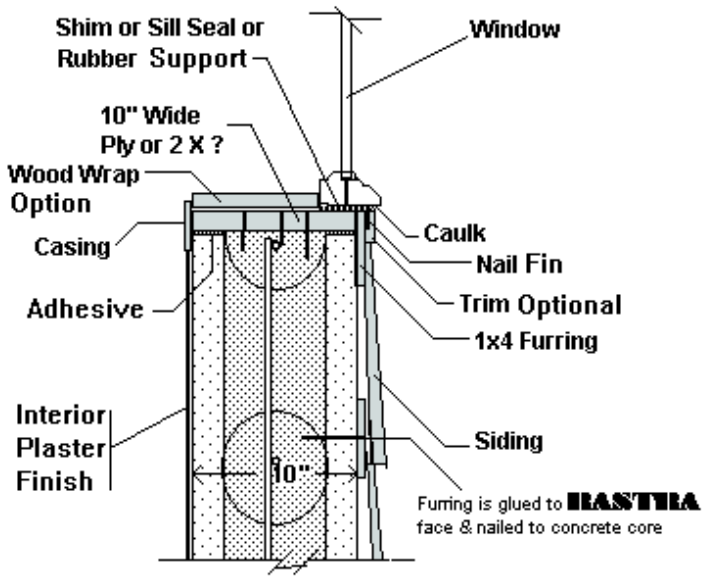


Figure 5.20 Window installation with wood buck and exterior siding - furring glued to face of wall.

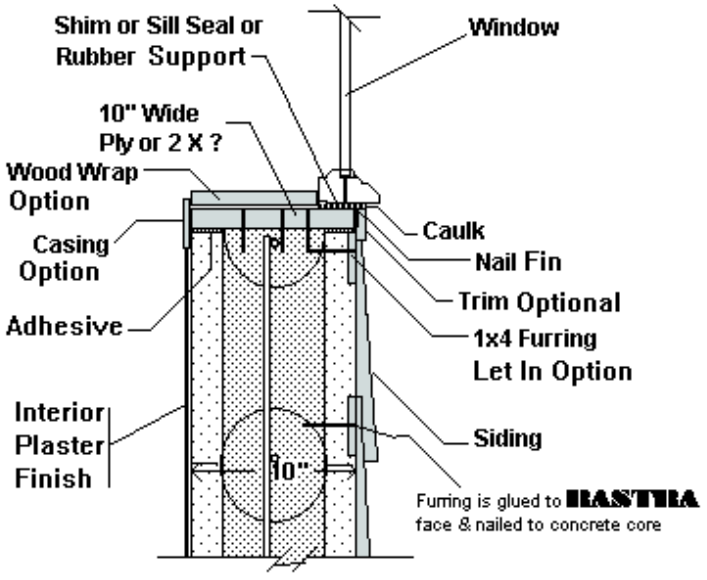


Figure 5.21 Window installation with wood buck and exterior siding - furring let into RASTRA® wall.

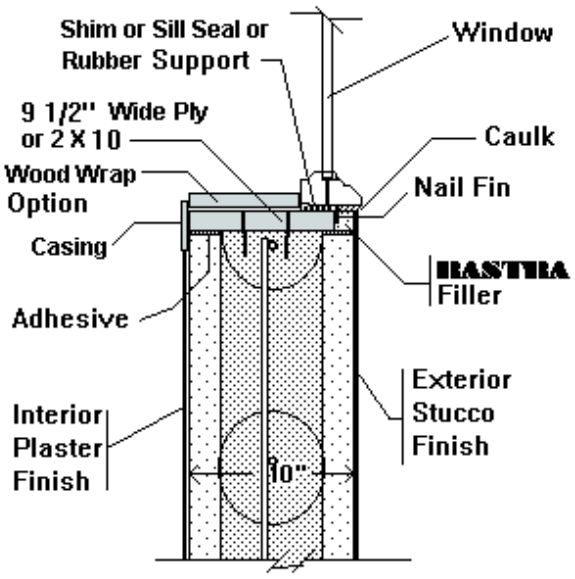


Figure 5.22 Bucked window with interior plaster finish and stucco exterior.

WRAPPED, SLIGHTLY ROUNDED OR SQUARE EDGES

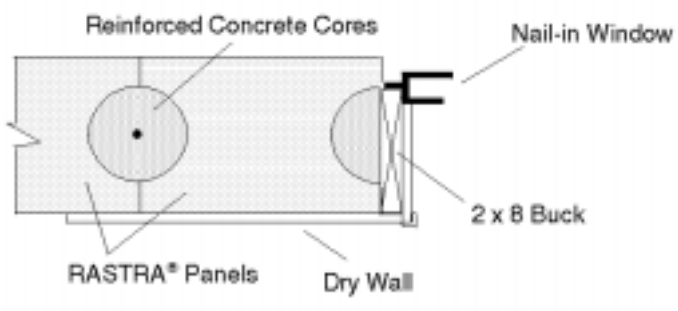


Figure 5.23 Bucked window with interior drywall finish.

BULLNOSE OR FLARED EDGES

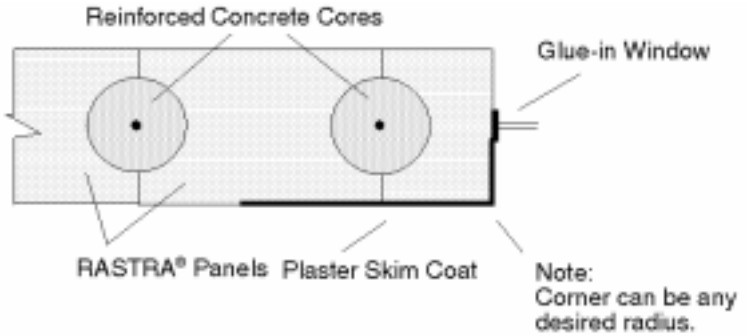


Figure 5.24 End element window installation - plaster interior finish.

Headers

In addition to the use of end elements and bucking, another type of window treatment is possible - use of a header which is inserted into the wall as shown in Figure 5.25. The bottom of the header may be grooved if required.

Figure 5.25 Wooden header - architectural detail.

Custom Windows and Doorways

One of the most interesting characteristics of RASTRA® construction is the ease with which custom window and door shapes may be created. Figures 5.26 and 5.27 are examples of the type of gracious windows and doorways possible with RASTRA®.

Figure 5.26 Custom window opening with deep sill and accent lighting.

Figure 5.27 Window and door possibilities.

Jambs

When utilizing RASTRA® end elements, the window and door jambs are attached by countersinking anchors through the RASTRA® end element into the concrete core. This is easily done prior to the placement of the concrete grout, then pouring 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 as shown in the figure below. Regardless of the application, bracing should be inserted to hold the bucking or RASTRA® end elements in place during the grouting process to insure that the pressure of the concrete does not move or bow the openings.

Figure 5.28 Recessed wood buck for swinging doors.

Sills and Trim

For sill or window trim applications that would normally use polystyrene stick-ons or pop-outs, RASTRA® flat elements may be utilized as shown in Figure 5.29. RASTRA® flat elements measure 30 inches by 120 inches by 2 or 4 inches thick and may be cut and shaped into almost any configuration. This offers the designer total creativity in and around window and door openings.

Figure 5.29 RASTRA® used for window trim.

Figure 5.30 Trimming RASTRA® for curved support.

Figure 5.31 "Fine tuning" RASTRA® exterior.

Lintels and headers can be made from RASTRA® elements in a number of ways. As shown in Figure 5.32 below, lintels can be fabricated from RASTRA® end and standard elements. Alternatively, wood bucks can be used instead of the end elements to form the base of the lintel as shown in Figure 5.33. Also, Thastyron 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 as illustrated in Figures 5.33 b and e.

Figure 5.32 RASTRA® lintels with supports shortly after concrete pour.

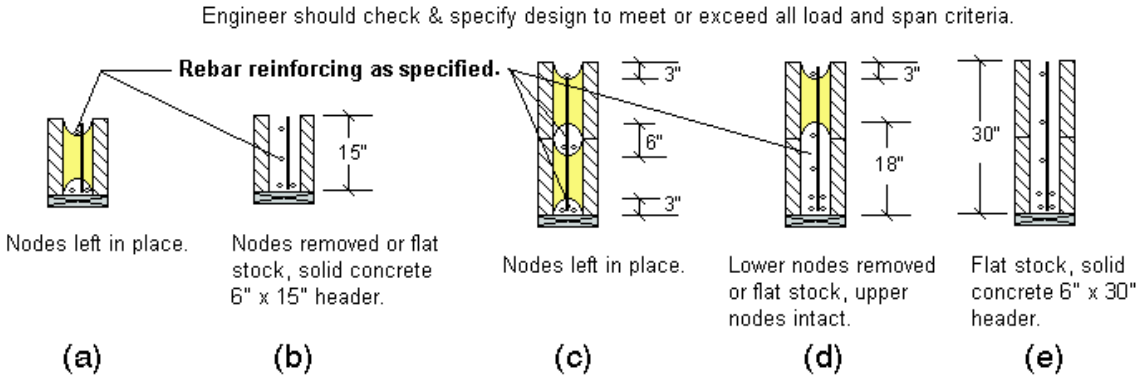


Figure 5.33 Some lintel and header options.

If solid concrete lintels are to be used, Figures 5.34 and 5.35 show two of the methods which can be used to hold the RASTRA® in place during grouting.

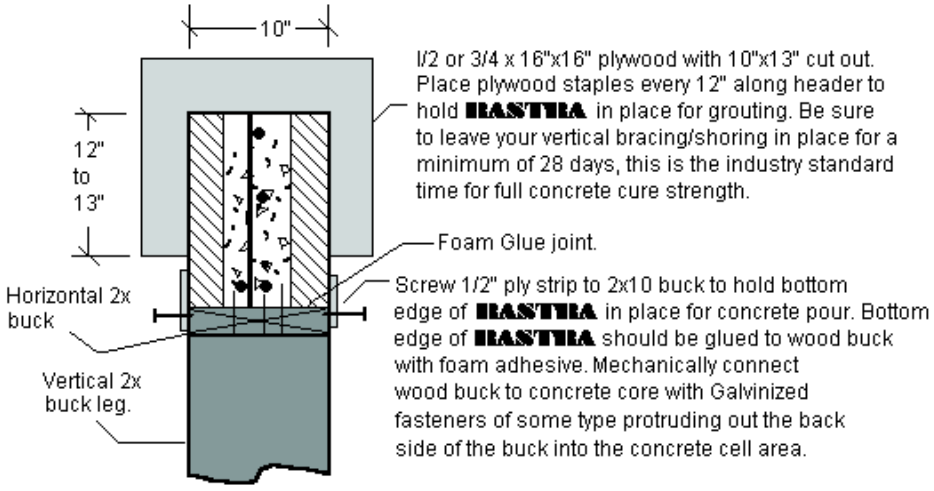


Figure 5.34 Plywood staples at 12" intervals used to hold RASTRA® in place during grouting.

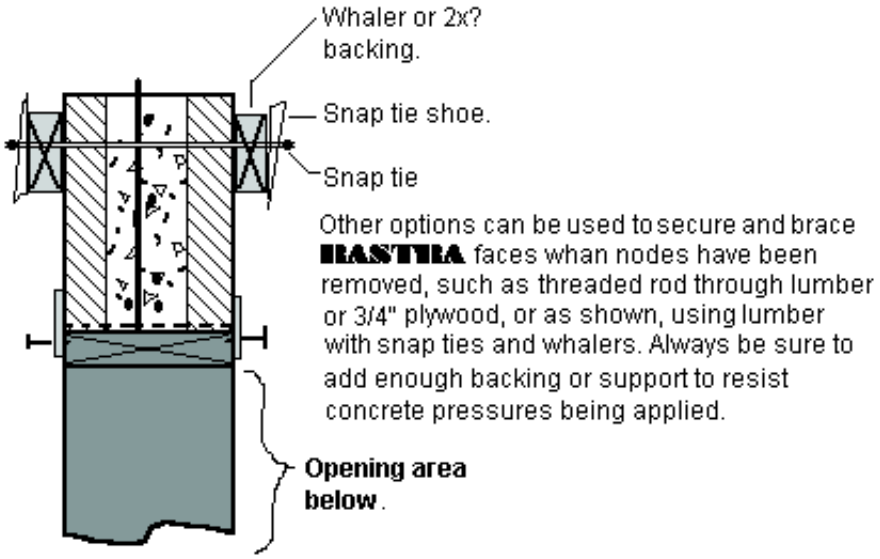


Figure 5.35 Lumber support of RASTRA® faces.

Figure 5.36 Curved lintels are also possible.

Figure 5.37 Architectural use of wooden header.

STACKING OPTIONS

Elements may be installed either vertically or horizontally or a combination of horizontal and vertical. This is possible due to the symmetric nature of the cells created when elements are connected. The method of leveling elements is similar to laying cement block except elements may be dry stacked or glued or stapled together. The following figures illustrate the various ways in which RASTRA® elements may be installed. Note that elements come in 15" and 30" widths.

ASSEMBLING ELEMENTS

Elements may be:

- dry-stacked or
- glued or
- stapled together.

Dry Stacking

If dry-stacked, elements are usually held plumb and level by whalers (used as stiffeners) or supports until the concrete has been poured. Figure 5.38 illustrates one method of dry stacking.

Glue

If using gun foam for bonding, proceed along the joint between the RASTRA® element and the foundation and inject a small squirt about every 6 to 8 inches. This is not a caulking procedure but a gluing one, so not a lot of foam adhesive is required. When the walls are poured, concrete will fill the cells and, in essence, cement the elements together. If some of the foam adhesive expands out into the cells, it can be knocked off but care should be taken not to let it fall down into the wall.

The same gluing procedure is followed for vertical and horizontal joints regardless of how the elements are laid. Figures 5.40, 5.41, and 5.42 show how a mixture of different size panels can be installed in a wall in a mixture of horizontal and vertical ways. This is possible because the grout cell pattern is square and symmetrical.

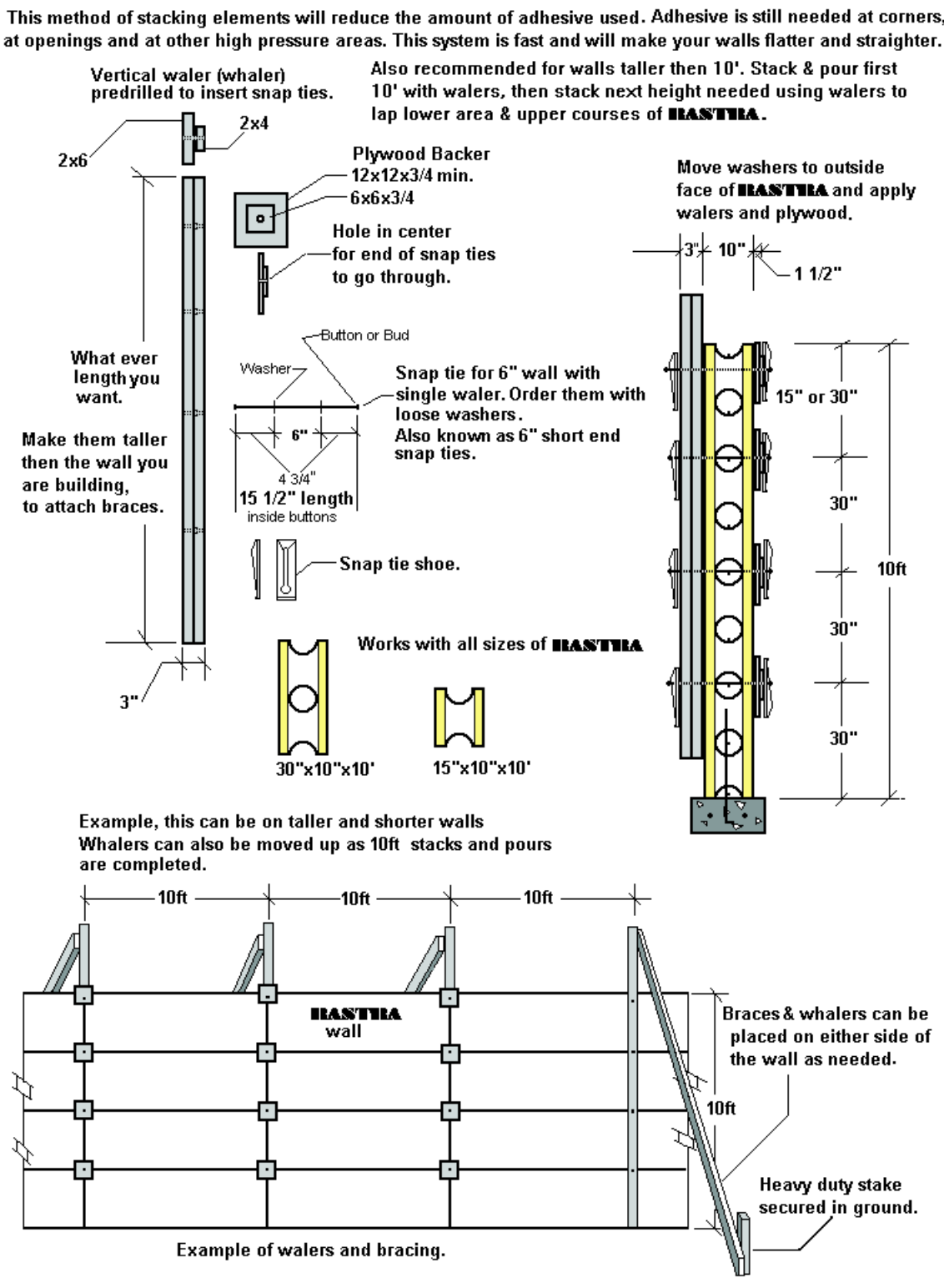


Figure 5.38 One way of using whalers and bracing.

Staples

Staples are often used to secure corners or around windows or doorways. Figure 5.39

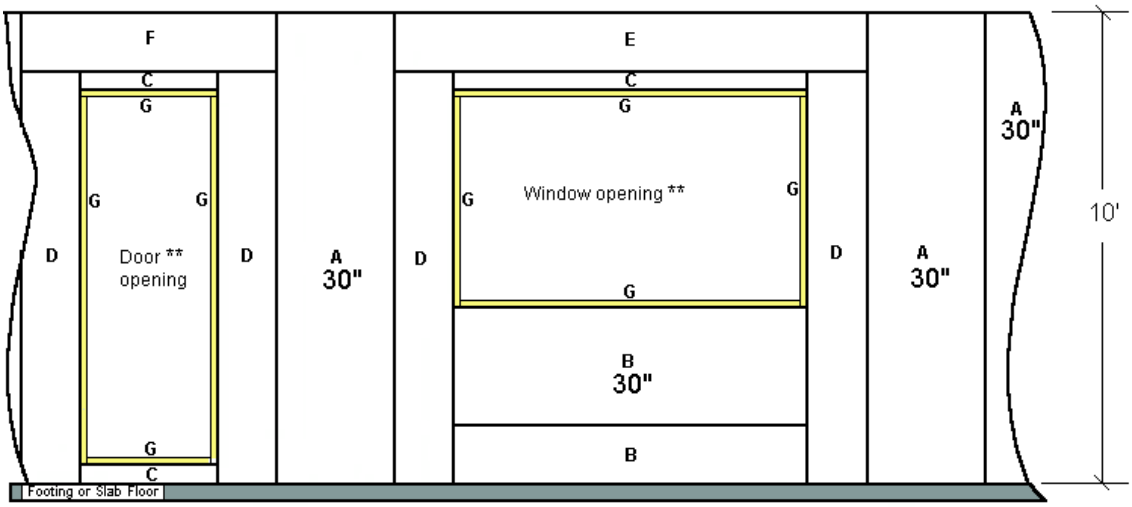
Figure 5.39 Standard elements laid horizontally and glued. End element installed vertically and stapled.

Element Orientation

As can be seen from the following illustration, elements can be laid horizontally and vertically within the same wall. They can also be of different widths, using 30" and 15" side elements together. In addition as can be seen in the upper figure on the following page, they can be trimmed to create the desired height of wall.

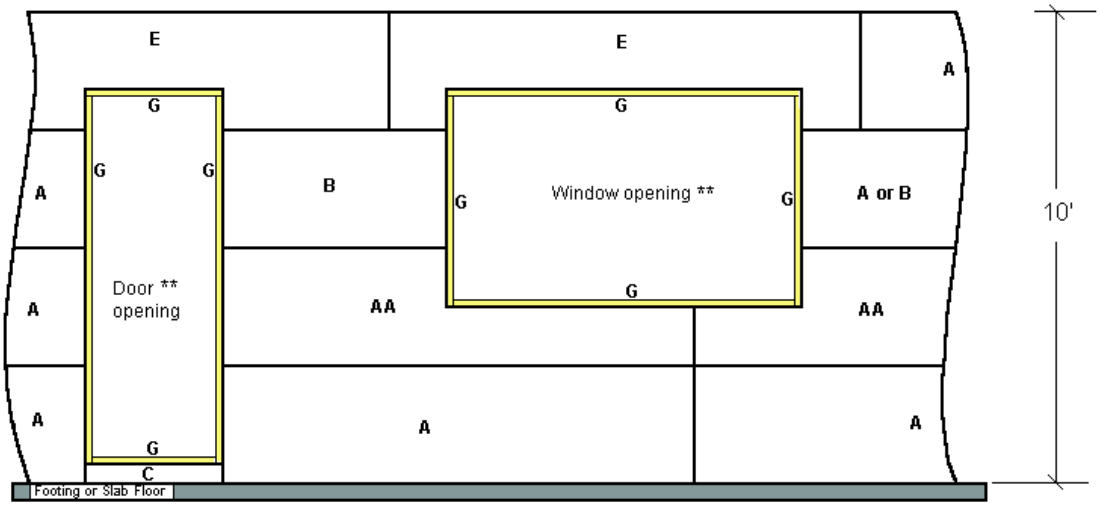
Other illustrations showing stacking options are contained on the following pages. Figures 5.40 shows horizontal and vertical use of 15" wide elements around windows and doors. Figure 5.41 shows the same stacking options for the 30" panels.

If installed vertically, there is no lifting, an uneven foundation is not as disturbing and fitting and plumbing of elements is easier. Always start at a corner to ensure stability.



Combination stacking, horizontal & vertical for 15" & 30" elements.

Use lifting equipment to move and set 30" elements.



Horizontal stacking. 30" elements.

A – Full length element. Stack horizontally and/or vertically.

AA – Full length element. Notch out as needed for opening. Stack horizontally.

B – Elements cut to desired length, to fill between openings and corners.

C – Filler strips, as needed. Cut from scrap to reduce waste. Add extra backing &/or bracing as needed.

D – Opening trimmer element, cut to desired length, supports header / lintel element.

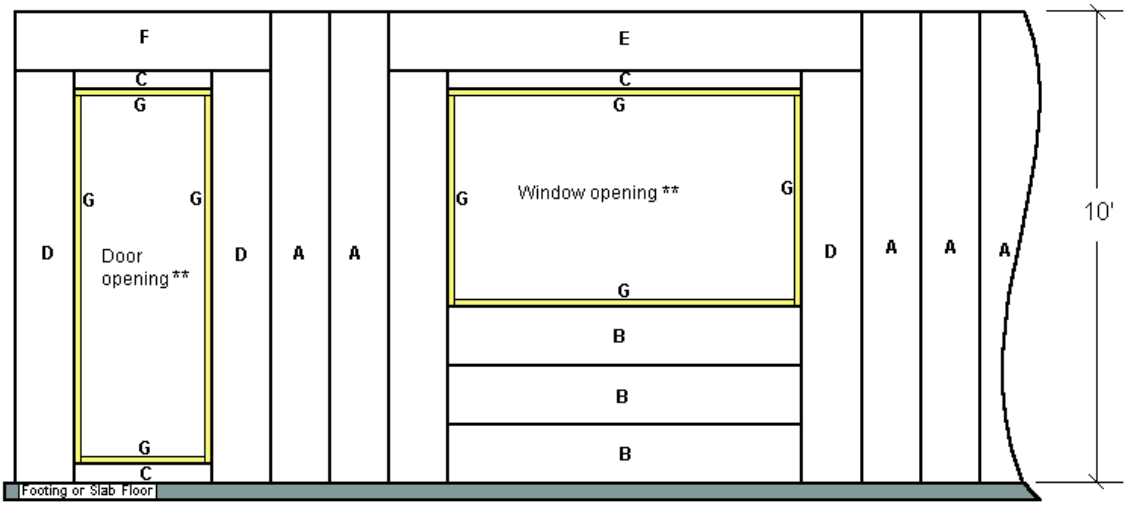
E – Full length header / lintel element. Notch out as needed for opening. Rebar & concrete as per design.

F – Header / lintel element, cut to desired length. If possible always use single length piece supported at each end by trimmer. Header element configuration, rebar & concrete as per design.

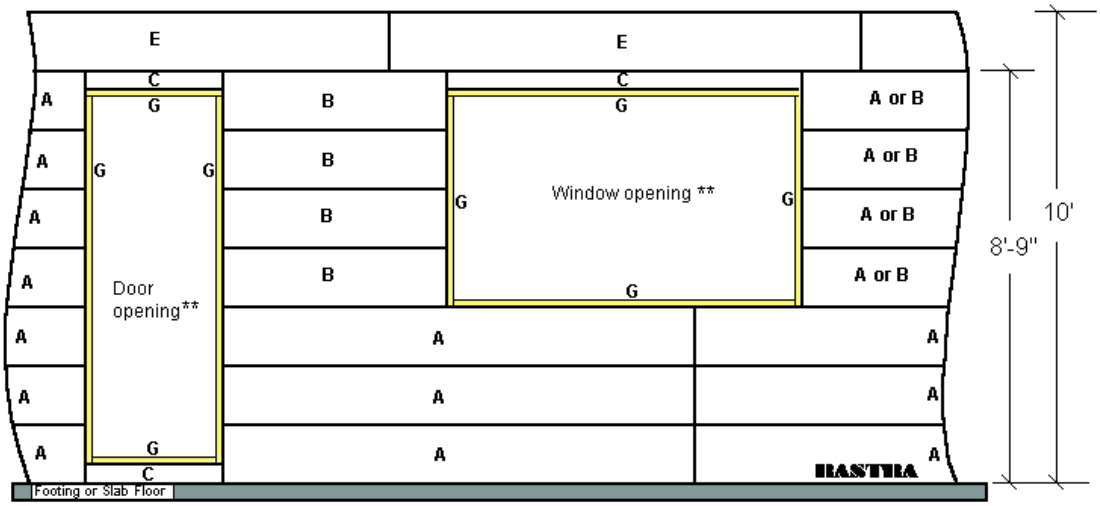
G – Wood buck, to block out opening. Glue all stay-in-place bucks to **BASTRA** with non-expanding urethane foam adhesive.

** Shore and brace all opening bucks, horizontally and vertically, two to three foot on center.

Figure 5.40 Combination stacking of 15" and 30" elements.



Combination stacking, horizontal & vertical. 15" elements.



Horizontal stacking. 15" elements.

A – Full length element. Stack horizontally or vertically.

B – Elements cut to desired length, to fill between openings and corners.

C – Filler strips, as needed. Cut from scrap to reduce waste.

D – Opening trimmer element, cut to desired length, supports header / lintel element.

E – Full length header / lintel element. Header element configuration, rebar & concrete as per design.

F – Header / lintel element, cut to desired length. If possible always use single length piece supported at each end by trimmer. Header element configuration, rebar & concrete as per design.

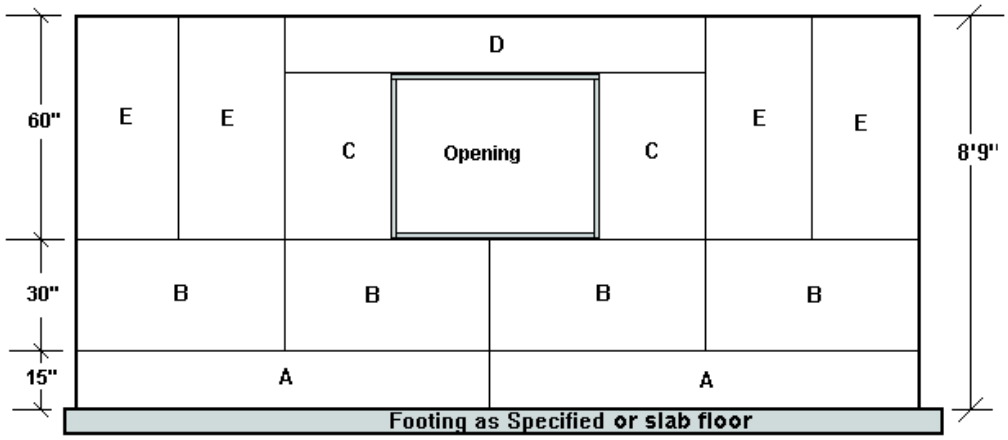
G – Wood buck, to block out opening. Glue all stay-in-place bucks to RASTRA with non-expanding urethane foam adhesive.

** Shore and brace all opening bucks, horizontally and vertically, two to three foot on center.

Figure 5.41 Stacking option for 15" RASTRA® elements.

30" Elements cut in half for hand stacking on top of (Mono, wet or dry set first course). 8'-9" tall wall. Be sure that the top of row A is level & straight before setting row B.

No scaffolding is required to stack these units to make this wall accept to set the header/lintel unit.



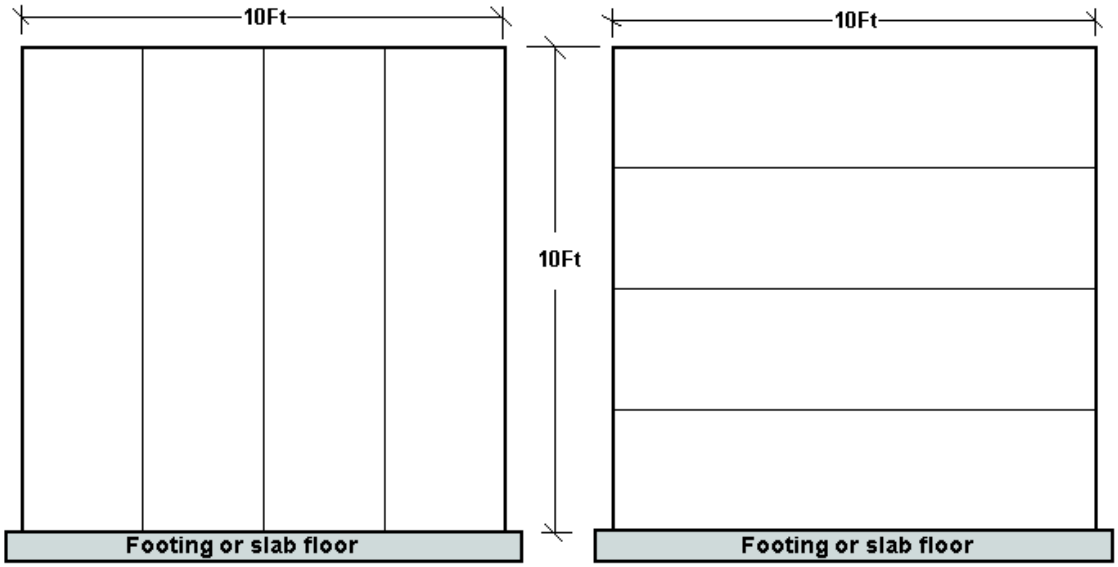
A- 15" elements 1st course glued to footing, or wet set, or mono poured in footing.

B- 30" elements cut in half (60") for hand stacking (160 lbs). stacked horizontal.

C- 30" element pcs cut to fill in.

D- 15" standard element notched out for 10" window buck. (see lintel detail and engineering build as per design for span and load requirements.

E- 30" elements cut in half and stacked vertically by hand, on scafolding required.



Four 30"X10"X10' Elements stacked vertically.

Four 30"X10"X10' Elements stacked horizontally.

Figure 5.42 Stacking options for 30" RASTRA® elements.

INSTALLATION OF THE FIRST ROW

As illustrated on the preceding pages, RASTRA® elements can be installed in either a vertical or horizontal manner. If placed in a horizontal fashion, the first row is installed directly on the footing, stem wall or slab whichever the case may be. In any case, before starting to set the first row, check the foundation to ensure that it is square and level.

If setting elements horizontally, a string line should be placed at one-half the thickness of the RASTRA® element being used. Place it to the outside of the rebar extending out of the footing. For example, if a 10" inch thick element is being used, the distance from the center of the rebar will be 5" inches. Be sure that this string line is kept tight and that it does not sag in the middle. This line will be used to set the height of the RASTRA® elements and to help to keep them straight. Be sure also that this line is at the proper height and on the outside of the building. This string can be moved to the inside of the wall on the next course if desired. Hint: it is best to use red chalk to snap the lines because red does not wash off.

After setting the RASTRA® elements on the first corner, continue around the building. If a wall is not an even increment of 15", compensation can be made at the corner by trimming an element to the desired length and then in future courses always adding the trimmed element above the previous ones. This will ensure a continuous vertical grout cell. Installation, alignment, and plumbing of the end elements for corners can be left to the last and they can be either stapled or glued in once all the reinforcement is in place.

As shown earlier in the section on corners, they may be constructed either by using end elements or by cutting a mitered corner from standard elements. If the two walls are to meet in a curved fashion the Section on Curved Walls shows a good way to do this. Curved walls are typically fashioned from elements set up vertically. If the adjacent walls were set up with elements in a horizontal fashion, this does not present a problem - due to the symmetric square pattern of the grout cells.
If the first row is set upon the top of the stem wall and electrical conduit is to be installed in the cells, this is the time to start the electrical installation.

The electrician can, at this point, cut and set outlet boxes, attach conduit and install any horizontal runs. When setting the electrical boxes, the openings should be cut as tightly as possible and the boxes set in place with the foam glue.

INSTALLATION OF ADDITIONAL ROWS

Installation of additional layers of elements is performed in the same pattern as the first horizontal layer – start with a corner and then complete the rest of the layer. MAKE SURE THE GROUT CELLS LINE UP. Work around the building one layer at a time. Set the RASTRA® elements, level, plumb and glue the joint between layers. For best results stretch strings for each layer much as done during setting of regular concrete block. This will help keep the rows straight and level.

When setting each layer, work from the same side of the wall all the way up. Remember that RASTRA® elements are like any other material in that the thickness may vary slightly. 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.

WINDOWS AND DOOR OPENINGS

Window and door openings may be fabricated by one of two methods: (1) they may be fabricated while the wall is being installed, or (2) they may be cut out of the solid wall prior to grouting. Usually, larger window and door openings (garage doors) are fabricated during wall installation resulting in the saving of time and materials. However, standard doors and windows of 12 square foot or less are simply cut out of the installed wall. In either case, they may be bucked out with lumber, or they may be lined with RASTRA® end elements for enhanced aesthetics.

RASTRA® End Elements Around Openings

When designing the openings, the rough dimensions need to be known of the window or door being installed in the opening. If RASTRA® end elements are being used around the window openings, an additional 15 inches will need to be added to the rough opening measurement in both directions.

For example, if the rough opening size needs to be 36 inches wide by 48 inches high, cut the opening to be 51 inches wide by 63 inches high. This will accommodate the end elements. Figure 5.16 shows RASTRA® end elements being installed into window and door openings.

Wood Bucking

If the decision is made to not use end elements to frame the window opening, the openings may be "bucked" with lumber. To do this one of the following three sizes of lumber will be needed: 2x4, 2x6, or 2x8. If the bucking is to be left in the wall as a nailer, either 2x4, or 2x6 lumber will be needed depending on the element thickness of either 8½" or 10", 12", 14". If the bucking is to be removed after grouting, 2x8's should be used for all sizes of RASTRA® elements. In both cases the finished opening will be the same size as the rough opening design called out for the window or door.

Spreaders

Regardless of the method used in openings, spreaders should be used to stabilize the openings while grouting.

LEVELING AND PLUMBING ELEMENTS

When leveling and plumbing RASTRA® elements, one method is to use wood shims. The shims are placed on one side or the other of the wall to level RASTRA® elements or to raise then as needed. When placing the wood shims, gently tip the RASTRA® element up and put the shim in place. Do not drive the shim into the joint as done while working with other materials, this will only crush the Thastyron material as opposed to raising it. These shims should remain in place until the foam glue has dried completely, then they may be cut off or pulled out .

Whole walls can be plumbed and leveled using RASTRA® supports. The Tools & Supplies section of the manual has a description of the supports as well as two photos showing two different types of installations - residential and commercial in which these supports are often used.

PRE-GROUT CHECKLIST

Upon completion of the RASTRA® elements installation process and prior to the grouting of the completed wall segments, checking the following items will help ensure a successful concrete installation:

1. Make sure that all RASTRA® elements are glued or securely installed and add extra backing at questionable areas.
2. Brace any long straight runs thus minimizing any movement that would make the wall difficult to walk when grouting. Bracing can also be used to maintain straightness of walls.
3. Install all electrical and plumbing to be embedded in concrete cell areas of RASTRA® wall.
4. Cut all window and door openings.
5. Place all rebar--horizontal and vertical per engineer's design.
6. Place all RASTRA® end elements or bucking.
7. Brace all RASTRA® end elements, corners, wall ends and bucking to withstand the force of the grout. Add extra staples or spot glue if desired.
8. 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).
9. Verify all walls are straight and plumb, adjust as needed.
10. Complete any needed inspections from the local building authority.
11. Schedule with the concrete company to deliver the grout per engineer's mix design.
12. Schedule the grout pump.
13. 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.
14. Hose down the inside of the RASTRA® elements - this not only promotes and improves the flow of concrete into the wall, but also helps increase cure strength by raising humidity and lowering temperature on hot days.
15. If slab floor is already in place, cover the perimeter area against the wall with polyfilm under cardboard or kraft paper to catch spillage. This makes cleanup after pour much easier.

Mix Design

The concrete mix design should require a slump of at least 6.5" regardless of the concrete strength (psi). Preferred slump range is from 8 1/2" ± 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. Figure 5.43 shows a typical slump test.

Figure 5.43 Slump range is 8 1/2" ±2".

Lift Heights

The height of the first grout will depend on the building itself and local code requirements. While grouting lifts have exceeded 20 feet, in general grouting of lifts which exceed a height of 10 to 12 feet are not recommended as hydraulic pressure at the base of the lift could exceed material capacities. However, it has been found in testing, that vibration of concrete was not required either during or after grouting even if slump was in the lower part of range from 6.5" to 8".

If 4-ft lifts are required by building authorities, walls can still be constructed to 10-ft or greater heights. All that is required is to cut grouting access holes into the wall at a 5 ft height and about 5-ft apart as shown in the figure below. Then the cutouts can be glued back into place and grouting resumed. Figure 5.44.

Figure 5.44 Grouting access holes.

If only 1 lift

If there is to be only one lift, it will be necessary to make sure that the top of the rebar is below the top of the wall at least 3 inches, 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 now.

Second story or lift

If the structure being grouted will need two separate grout applications, it should be noted that the rebar will need to extend past the point of the first grout lift at least 40 bar diameters to provide the overlap required to offset the cold joint.

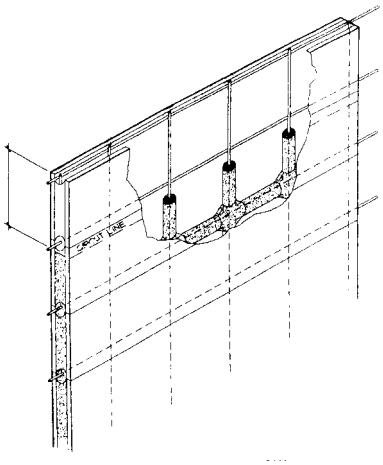


Figure 5.45 "Pour Low"

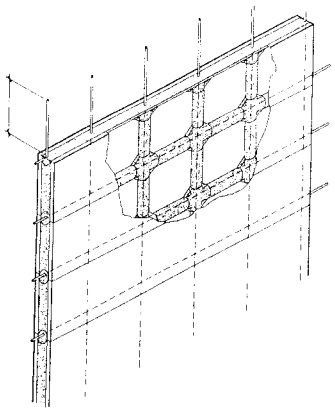


Figure 5.46 "Lap High"

This may be accomplished in one of two ways, stop the grout application below the top of the bar the necessary distance as shown in Figure 5.45, or cut your bars so that they protrude out above the top of the first grout lift to the prescribed overlap as illustrated in Figure 5.46.

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 which will permit proper connection and tightening.

PUMPING THE GROUT

Upon starting installation of the grout, place grout first in the bottoms of any window openings that are over 5 feet wide. To do this, cut a hole in the end element or just below the bucking to let the grout pass through. The end element can be replaced 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 voidless if bucking is left in place.

After grouting under the 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, remembering that the grout, if at the right slump will flow at a 45^0 angle as it fills. Be prepared to move 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 to avoid over-filling as cleanup will have to be performed after completion of the grouting. If a slab floor has already been poured, using the polyfilm under cardboard or kraft paper next to the wall makes cleanup easier. If grout is spilled on the finished concrete slab it will need to be scraped up right after the grouting is completed so it does not stick to the concrete.

Grouting The Second Lift or Story

Installing RASTRA® elements for the second story is accomplished in the same manner as with the first story. Start at one corner and go around the building. If you set elements horizontally, level and plumb each layer as you go. Glue each layer after leveling and plumbing. Fabricate any openings in the same manner as done for the first lift. Again, each pour can be made in lifts up to 10 or 12 feet. Follow the same check list 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 is sometimes helpful to proceed floor by floor. By this it is 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 shall be finished and grouted before starting over with the next story.

Figure 5.47 Grouting access holes.

Grouting a RASTRA® Floor or Roof.
If a RASTRA floor or roof is also being installed, these can be poured at the same time as the walls as shown in the previous figure. Typically, the walls are filled first and then the floor or roof is poured and floated. This creates a monolithic pour.

Grouting Tip
A good trick to ensure thorough filling of concrete inside the wall, is to completely wet down the inside of the RASTRA® elements from top to bottom either the evening before the pour or several hours before-hand. Excess water will bleed out through the Thastyron and any puddling that may occur at the bottom will be displaced by the concrete flowing into and throughout the wall. In hot weather, wetting down the inside of the wall helps to cool down the wall and adds extra humidity which can improve the concrete cure.

Verification of Complete Grouting
Verification can be had by visual inspection or by penetration of the Thastyron by a sharp instrument in the area in question.

Clean Up
When completed, remember to clean any grout off the slabs. If there are colored concrete slabs and they are going to be left exposed, then it will be necessary to cover the concrete slabs before grouting for protection from stains.

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 as shown in Figure 5.48. Note that the slump test cone can be inverted and used as a funnel for filling cells. However, In this figure, the worker is just topping off the cell using a bucket before troweling it smooth in preparation for finishing.

Figure 5.48 Finishing the top.

As in conventional construction, cabinets and fixtures can be attached to RASTRA® walls. For items up to approximately 50 lbs per bolt small hollow anchors can be used as shown in Figure 6.2.

Figure 6.1 Setting anchor into RASTRA® element.

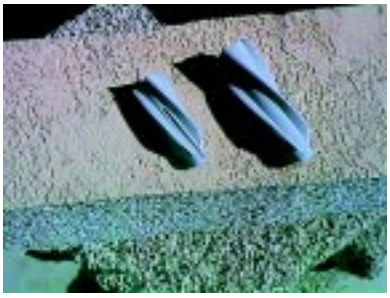


Figure 6.2 Example of hollow anchors.

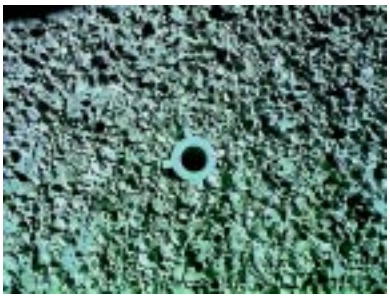


Figure 6.3 Closeup of embedded anchor.

The GB-plastic anchors can be used without drilling, and can be just hammered in as shown in Figure 6.1. Sizes are 8mm (3/8"), 10mm (7/16"), and 14mm (9/16"). 14mm anchor holds up to 100 lbs (centric tension was tested with 313 lbs). Higher load capacities can be attained by drilling a hole smaller than the anchor by 1mm (1/16") and filling it with binder (foam), then pushing in the anchor.

Threaded Bolts for Heavier Items

For heavier items threaded steel bolts or rods can be used. First, drill a hole slightly larger than the diameter of the bolt (1mm - 1/16"), fill the hole with binder (foam), and insert the bolt. Figure 6.4. Bolts should be embedded a minimum of 100mm (4 inches).

Figure 6.4 Threaded bolt for installing heavier items.

Backing Strips

Another alternative for heavier fixtures such as kitchen cabinets is to attach them via a wooden backing strip as shown in Figure 6.5. To set backing into the RASTRA® elements, simply route out the face of the RASTRA® element to the depth of the backing. Typically this will be a one-by, (1x2, 1x3, 1x4). The furring is glued to the element face and nailed to the concrete core. The wooden backing let into the surface of the wall can later be covered by sheetrock or plastered over. Screws can then be used to attach the fixture or cabinet to the wall.

Garage Doors

Similarly, one method of installing garage doors is to use surface mounted 2x6 or 2x8 or larger with anchor bolts embedded in the concrete cores.

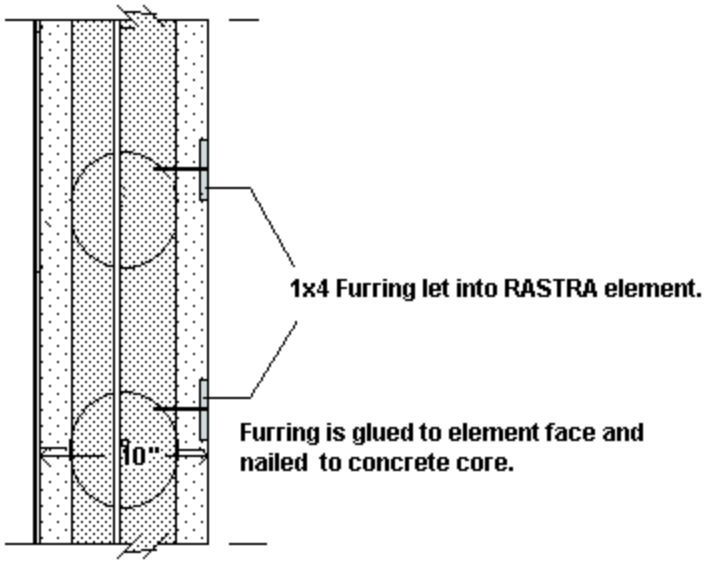


Figure 6.5 Example of furring let into face of RASTRA® element.

Kitchen or Bath Cabinets

Kitchen or bath cabinets can also be installed using a 1x3 routed into the surface at three locations: top of the wall cabinets, bottom of wall cabinets and top of base cabinets. For cabinet backing 1/4" anchor bolts can be placed at 48" o.c. along with gluing them in with the same foam glue as used to glue the RASTRA® elements together.

For other types of backing, all that is needed is to route out the face of the RASTRA® elements and glue the wood backing to them with the foam glue. Remember to mark on the blueprint where the backing was placed so it can be found later on after the wall has been finished.

FINISHES AND WALL PREPARATION

After the grout has had time to setup, remove any braces and supports. To correct any offset of elements which may have occurred during installation some rasping may be required as shown in Figure 6.6 below, or a very thin layer of plaster may be used instead of rasping. In essence, the amount of rasping needed depends largely on personal visual approval and the final finish to be used.

Figure 6.6 Rasping the interior surface.

Interior Finishes

RASTRA walls can be finished in a variety of ways including plaster, wallpaper, sheetrock or paneling, or paint. Gypsum plaster is applied directly to the wall with no need for lath or fiber mesh. For wallpapering, the pores of the wall are first filled and then wallpaper can be applied in the usual manner. Sheetrock can be directly applied to the wall without furring strips. The preferred method is to use patches of either sheetrock joint compound (such as Gold Bond) or stucco mix to attach sheetrock. Use a minimum of 6 square inches of bonder per square foot of wall board (50cm^2 per m^2 of the area, appr. 5%). Alternatively, special screws are available. RASTRA walls may also be painted using an acrylic or similar paint as can be seen in the RASTRA Plant in Figure 8.9.

Veneer Brick or Stone

Veneer brick or stone may also be attached to RASTRA®walls. Application would be the same as for any conventional wall. The wall ties can either be grouted in place or nailed to the concrete.

Care should be taken to ensure that water cannot be trapped behind these surfaces. Waterproofing and/or weep holes may be required.

Figure 6.7 Brick veneer finish on RASTRA® home.

Figure 6.8 Veneer stone finish on curved RASTRA® wall. Insert shows wall ties.

Stucco Exterior

Other than any 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 and plaster can be applied directly to the RASTRA® elements. Special bonders, chicken wire or any type of lath are normally not required except where wood bucking is left in place. Then mesh or lath should be used to bridge between the RASTRA® and the wood or other dissimilar materials to be covered by the stucco or plaster. Tip: Slightly wetting the walls when applying lime/cement plasters improves the workability of the finish.

Siding

If exterior walls are going to be covered with siding, one method is to first attach nailers to the surface of the RASTRA® wall in a manner similar to that used for masonry or concrete walls. The siding can then be nailed or screwed to the nailers as shown in Figure 6.9 (Nailers are in the foreground, siding can be seen in place at far end of structure).

Figure 6.9 Nailers and siding on RASTRA® wall.

Basement or Retaining Walls

For retaining or basement walls, the RASTRA® wall is covered with a standard waterproofing material, a protective layer of polystyrene board or other sheathing to protect the insulation from being penetrated by backfilling materials. Care should be taken not to puncture the membrane when backfilling these walls. RASTRA® walls may be covered directly with asphalt-based sealing materials. There are other roll and sheet waterproofing products that also work well. If the waterproofing material will work on cement or masonry block, it will work on RASTRA®. (See Basement & Retaining Walls Section for additional information).

Figure 6.10 RASTRA® basement walls waterproofed and ready for backfilling.

Windows and Doorways

As with conventional construction, care must be taken to prevent penetration of moisture around doors and windows. One method is to apply a membrane for at least 12" - 24" around the opening. This membrane in addition to adequate caulking of framing around windows and door jambs should create a weather resistant seal.

Roofs and Parapets

Roofs may be constructed using RASTRA® elements as described in the Roofs and Parapets section of the Manual. The RASTRA® roof is poured much the same as a standard concrete roof with sufficient slope designed by the engineer to ensure rainwater runoff.

In a typical parapet design, the flashing should extend up from the roof to a height sufficient to ensure that exposure to beating rain will not result in entrance of water. The surface of RASTRA® parapet 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 either a stucco finish or tile or other finish in customary use.

Figure 6.11 Southwest style home - flat roof & parapet.

Figure 7.1 Decorative cactus made from RASTRA® flat stock.

Figure 7.2 Decorative corner and wall detailing.

Figure 7.3 RASTRA® 's versatility permits a wide variety of architectural and structural approaches.

Figure 7.4 Stone veneer finish under windows, stucco finish elsewhere.

Figure 7.5 Home with RASTRA® walls, columns and molding.

Figure 7.6 Windows with carved medallions above.

Figure 7.7 Closeup of planters and retaining wall fabricated from RASTRA® elements.

Figure 7.8 Window detail with sculptured arches.

Due to the fire-resistive nature of RASTRA® it can be used as a cover for zero-clearance fireplaces. Figures 7.9 & 7.10 illustrate the results.

Figure 7.9 Zero-clearance fireplace coated with RASTRA® flat stock.

Figure 7.10 Same fireplace with RASTRA® flat stock finished architectural detailing.

NOTES

Commercial and Industrial Projects

The RASTRA® building system is versatile and lends itself to many different types of construction. RASTRA® is competitive with tilt-up construction for commercial and industrial projects and can be used for walls, floors and roofs.

Custom Panel Sections

Custom sections can be shipped to the job-site complete with window and door openings, even with part or all of the reinforcement pre-installed. These prefabricated sections offer a quick way to construct facilities as they can be positioned by a light crane or fork lift immediately as they are taken off the truck. They are particularly suitable where speed of construction is important or space is limited.

Time Saving

Walls can be in place quickly, creating a closed structure even while curing, thus reducing time from pour to occupancy. There is no form work to erect and dismantle, no furring strips required for interior finishes - just a skim coat of plaster, no additional insulation required, and exterior finishes can be applied directly to the outside.

4-hr Fire Rating

The RASTRA® building system has been tested extensively. Tests have shown it does not support combustion, does not emit smoke and has a four-hour fire rating. As can be seen from Figure 8.1, it does not transmit heat readily.

Figure 8.1 4-hr rating.

McDonald's Restaurant at Tempe, Arizona

Figure 8.2 Completed restaurant.

Figure 8.3 Tempe McDonald's under construction.

14,000 SqFt Two-Story Office Building

Figure 8.4 Completed 2-story office building.

Figure 8.5 Office building ready for stucco finish.

Four-Story plus Basement Hotel

Figure 8.6 View of lower level waterproofing.

Figure 8.7 Side view of hotel.

Figure 8.8 Front view of hotel - roof under construction.

25,000 SqFt RASTRA® Manufacturing Plant

Figure 8.9 Painted exterior - 25ft high walls.

30,000 SqFt Cold Storage Plant under Construction

Figure 8.10 20ft upgoing Walls with Rastra Pillars

National Park Service Visitor Center and Clinic Bullfrog, Utah

Figure 8.11 Front view of visitor center.

Figure 8.12 Curved wall and architectural elements.

Sound Walls

Figure 8.13 Sound wall with woven wood covering.

Figure 8.14 Sound wall next to railway.

Four-Story Apartment Building

Figure 8.15 Prefabricated panels and window detail.

Prefabricated Panels

Prefabricated panels up to 25-ft x 10-ft can be delivered to the job site ready for installation. Panels are fabricated from individual RASTRA® elements either 15 or 30 inches in width and wall thicknesses of: 8 ½, 10, 12, or 14 inches. These panels can be pre-reinforced and poured to meet design criteria and installed in a manner similar to tilt-up panels of an equivalent size. Alternatively, the panel sections can be delivered ready for reinforcement and grouting on site.

Figure 8.16 Prefabricated panel being lowered into place.

Speedy Installation
Prefabricated panels offer a quick way to construct facilities. They are particularly suitable for sites with limited space or where speed of construction is important. With proper planning and coordination it is possible to set the wall units in place, insert the reinforcement, plumb and level them in the morning and grout the walls in the afternoon.

Cost Savings
Prefabricated panels reduce on-site labor costs as delivery can be timed to provide panels in the correct order as needed.

Custom Sections
Custom sections can be shipped to the job-site complete with window and door openings. Figure 1 shows custom 15-ft long panels made from 30" wide elements.

Figure 8.17 Racks with custom panels awaiting delivery.

Loading Panel Rack onto Truck

Figure 8.18 Prefabricated panel 14" thick.

Figure 8.19 Four-Story apartment complex.

(a) Roof construction using RASTRA® prefabricated panels.

(b) Finished roof.

(c) Nearly completed complex.

NOTES

ELECTRICAL & PLUMBING

GENERAL

The RASTRA® building system enables electrical conduit and plumbing to be either incorporated into the walls or set into the surface. In either case, taking a little time in the planning stage is worthwhile.

Figures A.1(a), and (b), on the following page show two ways to create grooves for conduit or piping. While only two methods are shown: the chain saw approach, and a hand tool made from a bent blade welded to a bent steel rod, there are a number of ways this can be done including use of a common router. The local codes should be examined for guidelines as to embedment depth or other parameter such as spacing and number of receptacles along walls or per a given square footage of space per room.

Planning Surface Embedment Layouts

As in conventional construction the requirement for conduit varies from area to area. Some cities have their own specific requirements. Regardless, conduit is relatively small and can be easily embedded in the surface of a RASTRA® wall whether it is a rigid metal conduit, thin-wall metallic tubing, flexible metal or non-metallic conduit. Typical embedment depth from the surface of the wall is 1 ¼ inches. As the depth-to-concrete in a RASTRA® wall is at least 1 f inches this can be accommodated.

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.

Running Conduit or Piping within Walls

Also as in conventional construction, electrical conduit and water or waste pipes can be installed within RASTRA® walls. Page A - 9 shows a schematic of common ways of accomplishing this.

Figure A.1 Different methods of creating grooves for electrical or plumbing runs.

(a) Chain saw with C-clamp used as depth guide.

(b) Cutting groove with hand router.

ELECTRICAL

As discussed above, electrical wiring may be installed within the wall itself or in grooves cut into the exterior face of the wall.

Interior Conduit

Prior to pouring concrete, 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 needed. This method may be more expensive and slow the element assembly process.

Exterior Face Grooves

This method is generally easier, less expensive and more closely resembles the method electricians use in conventional frame buildings. With this method, most of the electrical wiring can be installed after the RASTRA® elements are in place and grouted. Once the wire or conduit is set into the routed groove, the groove can then be filled and concealed either by a skim coat of plaster or wall board.

Figure A.2 Embedded wiring prior to plastering.

In Figure A.2, the wiring is run down from the top of the wall to the desired location and across as required for placement of outlets. Alternatively, the conduit or wire can be run up from the floor. This is particularly useful for second or upper story installations.

Figure A.3 shows a closeup of a Romex installation under a window. Note the foam filler does not completely fill in the channel. As this wall will be plastered, this method is adequate in that the Romex cable is held securely in place by the foam, less rasping of foam is required, and the plaster will fill in the remaining spaces and make the installation invisible. Figure A.4 shows the type of fit possible for cable or conduit.

Figure A.3 Wiring installation ready for plastering.

Figure A.4 Closeup of conduit installation in progress.

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 the RASTRA® wall. Otherwise, electrical boxes may be installed either before or after concrete placement. Figures A.5 and A.6 show installation of gang and single boxes.

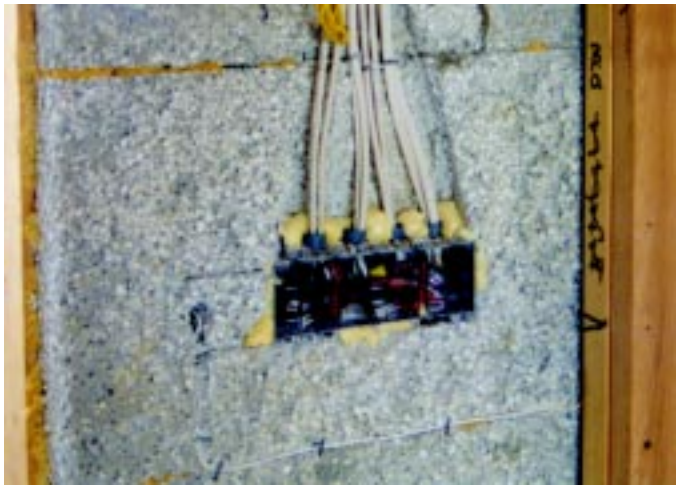


Figure A.5 Embedment of 4 gang box into face of RASTRA® element.

Figure A.6 Closeup of electrical box.

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 Thastyron. 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 seated with an adhesive at each edge. Generally, the foam sealant used in the bonding of the RASTRA® elements will be sufficient. However, there are various adhesives that will accomplish the same results.

If plastic boxes are being used, care should be taken 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 placed within a small groove routed into the RASTRA® element's face at any time. Again, these installations can later be covered by sheet rock or a skim coat of plaster.

PLUMBING

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

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

If the copper piping is to be set into the face of a RASTRA® wall, the installation would be the same as previously described for electrical conduits. Figure A.7 below shows a pipe set into the surface of a RASTRA® wall prior to plastering.

Figure A.7 Closeup of pipe installation.

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.

Plastic Piping

Plastic pipes may be placed either within the wall, or embedded in the surface without concern. When placed within the system, holes are simply cut out of the face of the RASTRA® elements with a keyhole saw for access as shown below in Figure A.8.

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 element once the elements are in place.

Figure A.8 Access hole for plastic pipe.

Plumbing Rough-ins - Slab on Grade

As can be seen in Figure A.9, 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.

Figure A.9 Roughed-in plumbing.

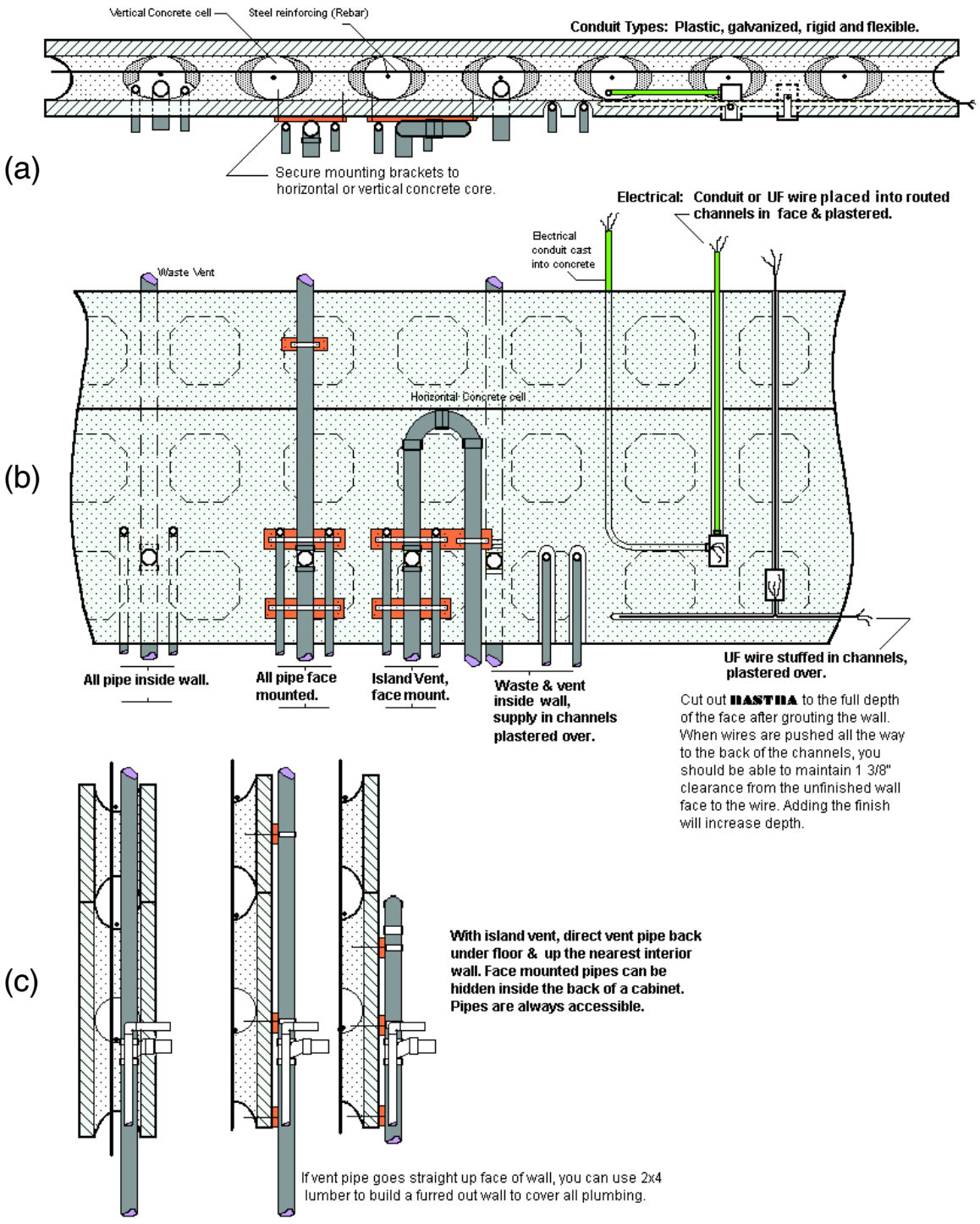


Figure A.10 (a) Plan view. (b) Elevation. (c) Cross-section of interior or face mounted plumbing and electrical installation.

NOTES

RECEIVING

Job Site Access and Directions

An important part of project planning is to provide access for receiving and storing materials. A typical RASTRA® factory-direct truck load contains approximately 240 - 270 Standard Elements and 15 Double Elements or a combination of Standard, Double, End elements and flat stock as required. RASTRA® loads may range from 40,000 to 46,000 lbs and overall length of truck and trailer may be 60 to 75 feet long. Thus, lots of flat and level space is required.

Figure B.1 A HUGE truck is coming!

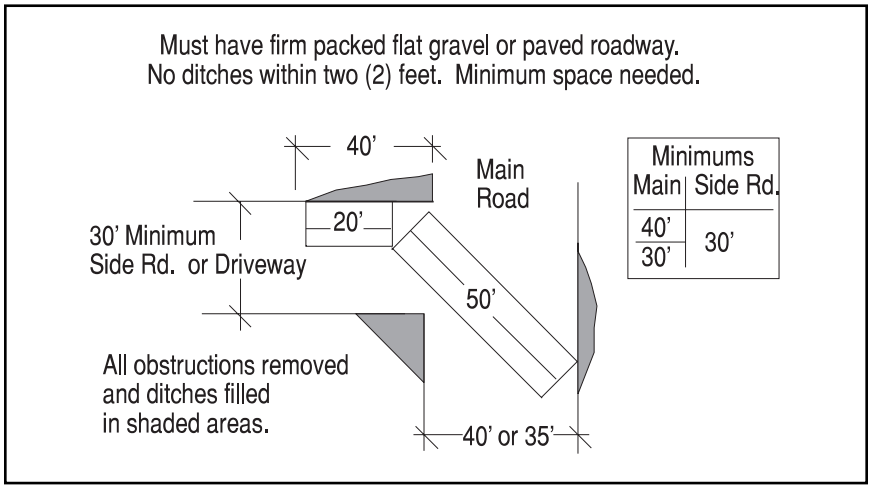


Figure B.2 Space required for semi-truck delivery.

SAFETY FIRST

The unloading area must be level and firm with sufficient room to unload the truck from either side. Typically, a low crown flatbed trailer 48 ft long by 96 to 105 inches wide is used *without* a headache rack. The truck and trailer should never be relocated without tie down straps being in place and tight. Remember that SAFETY is first and foremost. Do not get into a rush or work in the dark.

The following tips have been called "The Eight Unloading Absolutes!" and are a good guide for safe unloading.

1. Have an eight foot step ladder 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® elements pack very efficiently for shipping with less than ½" between elements.
4. Look inside the stack. It is important to note that center units are also banded. If these bands are still attached to units not being unloaded, broken elements may occur. (Bands can be left on the unit groups two deep when unloaded by forklift).
5. Never move 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 4" wide tie down straps.
7. Ideally, never climb up the sides of the stacks but if it becomes necessary to walk on the elements, do not step on the edges or corners. See Item # 1.
   Comment:
   "Remember that a RASTRA® element is not a concrete block. It is somewhat fragile and soft. 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 elements. Stepping on the edges may cause breakage and cause a fall."
8. Read the unloading instructions carefully.

Prior to shipment, full directions to the job site and a map should be provided to the shipper.

UNLOADING OPTIONS

For larger job sites a boom truck crane with spreader bars and pipes can be used as shown in Figure B.3.

Figure B.3 Unloading RASTRA® elements using a boom crane.

Alternatively, other equipment can be used such as: a logging truck with log loader boom and spreader bar and pipes, or a track hoe excavator with spreader bar and pipes, or a forklift or Load-all rough terrain forklift.

Limited Site Access

If access to the job site is via a steep angled road or driveway it may be necessary to unload at an adequate site elsewhere and shuttle the material to the job site using smaller trucks. Similarly, if there isn't room to get the big semi-trailer onto the job site, it is possible to have the boom truck operator load material onto a smaller truck and shuttle it into the site.

HANDLING

A standard forklift with four custom tongs spaced 30" apart is shown in Figures 4 and 5. Preferred width of tongs is 4" to enable quick and easy entry. As can be seen, RASTRA® elements can be lifted directly by fork lifts without using pallets.

Figure B.4 RASTRA® elements moved by forklift with custom rack.

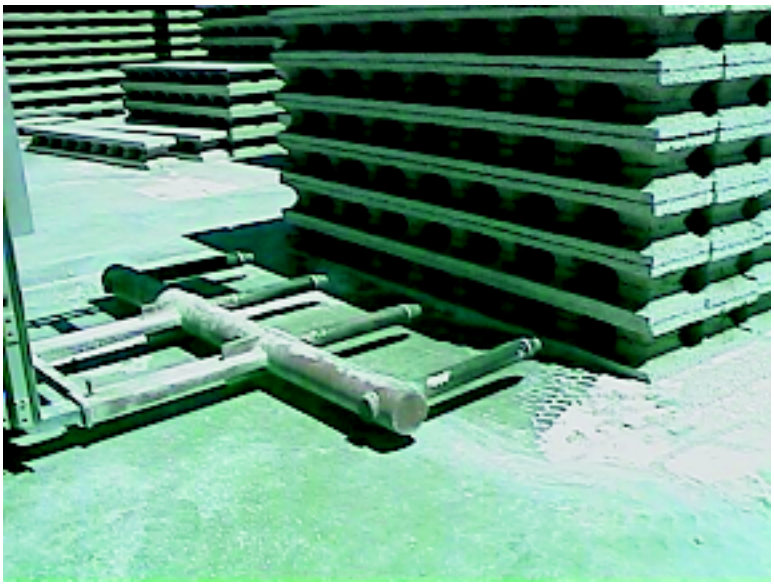


Figure B.5 RASTRA® custom forklift rack.

Table B.1
Comparison of Forklift Loading Capacity
RASTRA® and Standard Tongs

Feature	RASTRA® Tongs	Standard Forklift Tongs
Number of Tongs	4	2
Tong Width	4"	4" (prefered) or 5"
Spacing	30"	60" (prefered) or 30"
Depth of Tongs	30"	45"
Number of Elements in one lift	18 (9 high - 2 deep)	9 (3 high - 3 deep)

Tong Size

Figures B.4 and B.5 show the custom tongs available for moving RASTRA® elements. However, RASTRA® elements may be moved using standard fork tongs. The most important factor in selection of the proper forklift is the width of the fork tongs. 4" wide tongs give adequate support to the block for lifting with enough space around the tongs to enable quick and easy entry.

Tong Spacing

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

a) Be aware that the elements are 10-ft long. If only the center 30" of the elements are supported, almost 4 feet will extend over the sides of the tongs. With only the center 30" supported, elements being transported over rough or uneven terrain are vulnerable and may be damaged by sharp bumps and dips as the forklift travels.

b) If using a tong spacing of 30" instead of 60", only retrieve a maximum of 9 (nine) RASTRA® elements (3 high and 3 deep) at a time. This will lessen the pressure on the lifting points and lower the outer edge weight than would be the case with a larger stack.

Tong Depth

Caution should be taken to insure that the length of the forklift tongs do not exceed the depth of the desired amount of RASTRA® elements to be retrieved in one lift. If the tongs protrude past the desired point and lift is initiated, damage may be incurred on the adjacent RASTRA® element. This may also result in the tipping of the adjacent stack, causing that stack to fall off the other side of the trailer.

Truck and Trailer

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

Lifting Technique

Upon placement of the tongs into a stack of RASTRA® elements, lift them slightly to clear the adjacent stack. If the forklift has a TILT feature, tilt the forks back slightly at this time to facilitate clearance from the adjacent stacks. Then after separation from the rest of the material has been accomplished, lift the product to the desired clearance level and back away. As soon possible, lower the load to a manageable height for optimum balance and maneuverability.

STORAGE

RASTRA® elements should be stored on a flat area. If the storage area is rough or not level , warped or broken elements could occur. Due to the length of the RASTRA® elements, proper storage is an important item to remember and to plan for. In some projects, the slab on grade area can be used for storage.

Storage and Weather

If RASTRA® elements are to be stored outside for a period of time, they should be covered in order to keep rainwater from saturating them. It does not weaken the product, but it can make the elements heavier which in turn may cause breakage if lifted when wet.

Figure B.6 Job site storage of RASTRA® elements.

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. A sample Unloading Safety Form is shown on the following page.

As with all concrete materials, masks and goggles are recommended when cutting and rasping to avoid inhaling particles or dust and to protect the eyes. Masks and goggles are also recommended during unloading if windy weather conditions occur.

UNLOADING SAFETY
PLEASE READ THIS BEFORE UNLOADING

Special instructions for anyone handling RASTRA® during and after truck unloading.

PLAN & THINK SAFETY FIRST

Before unloading, check for and document (photograph) any damaged or broken material. Also document any damaged material found during unloading. All broken units can be glued back together with foam adhesive, keep pieces together.

Material broken during unloading and handling is the responsibility of purchaser.

1. Before undoing any straps or other securing devices, be sure the truck is absolutely level side to side and as much as possible end to end. Also, use good quality 2x4 or 2x6 lumber for diagonal braces on both sides of any stack on the truck which is being unstrapped. Always stand clear when straps are released. Move the braces down the sides of the stacks as the upper units are removed. Must have an 8-ft step ladder on site for unloading.

2. Unload only onto a flat and level staging area and place RASTRA® elements on a flat and level storage spot or stack them on two 2x6s placed on the ground under the second node (22") in from the end of the element.

3. Unstrap only the stack of RASTRA® elements being unloaded from the truck, keep all other stacks securely tied down. Never move the truck with unsecured material.

4. **Do not let anyone climb up the sides of any unsecured stacks of RASTRA® elements.** Stacks of seven or more elements can be unstable whether on the truck or the ground.

5. If equipment is being used to unload the shipment, other personnel must stand clear while the RASTRA® elements are being picked off the truck and placed on the ground as lower elements could be dragged or knocked off the truck when upper units are moved. To prevent this, use diagonal braces at a secure angle (45°) from the ground to the side of the RASTRA® elements at a point high enough to stabilize the stack being unloaded. 12-ft or 14-ft 2x4s may be used.

6. If units are being unloaded by hand, use diagonal braces to stabilize the stack being unloaded as described in Item 5.

7. If elements are going to be moved by hand on the job site, keep the working stacks at a comfortably safe height of 4 - 5 elements high. Keep all RASTRA® elements covered, clean, and dry.

8. Make certain all lifting tools, devices, and equipment are safe to use, in good condition, and can handle the weight and number of RASTRA® elements desired.

9. Maintain eye contact with the equipment operator. **Work out hand signals before unloading and use them.**

10. Start working with smaller loads and unload more at a time as the procedure becomes more familiar.

I have read and understand these instructions. Signed _____ Date: _____

NOTES