Product Overview

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The RASTRA Building System

Background

RASTRA is the original Compound Insulating Concrete Form (ICF), developed in partnership with BASF in Austria in 1972. Since then over 9 million units have been placed in service. Today, RASTRA not only represents the original Compound ICF, but is recognized as the best product of any ICF category with installations throughout Europe, Middle East, Far East, North Africa and the Americas, in all types of climates from the Austrian Alps to the Saudi Arabian Desert, to the humid climate of Southeast Asia.

Over 9 million units in serviced worldwide

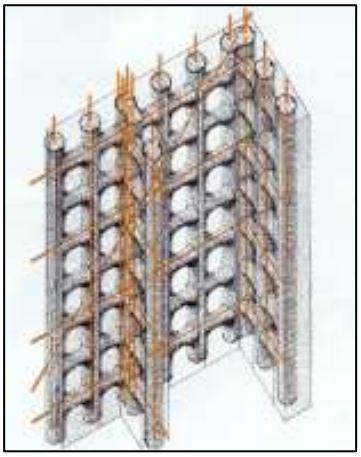
What Is RASTRA?

RASTRA is recognized as the ultimate building solution for economical and environmentally-friendly construction. This stay-in-place insulating concrete form system (ICF) is made of a lightweight composite material produced with 85% recycled polystyrene (EPS) and 15% cement by volume. RASTRA is the solution for this century to build environmentally conscious, energy efficient buildings that provide a safe and healthy living environment. **RASTRA is the original EPS Compound ICF**.

RASTRA panels achieve strength from a combination of features specifically designed to maximize both shear and compressive strength.

First, there is the THASTYRON - a lightweight mixture of small EPS beads and concrete combined to form a compound EPS concrete. EPS-concrete has been used before in other applications, but there was no real breakthrough until RASTRA found the right combination of shape, density, and structural material. Although RASTRA was initially manufactured using virgin polystyrene, only recycled material has been used since 1979. THASTYRON is ideal for use as a wall material; it provides superior heat/cold insulation, is dimensionally stable, highly resistant against fire, frost and other climate influence and accepts plaster, stucco or any other type of wall covering with ease.

By itself, RASTRA is not a structural building material. Wall strength is realized when steel reinforced concrete is added to the panels. The interior cavities of RASTRA panels are designed to maximize strength when filled with concrete and steel reinforcement, creating a rigid skeleton of 6" columns inside the panel. The interior channels provide an extremely strong wall using the lowest possible amount of concrete ranging from 0.26 – 0.31 cubic feet per square foot of wall. By using different qualities of concrete and/or various amounts of reinforcement, in horizontal, vertical or even diagonal directions, the load capacity can be adapted to satisfy nearly any building requirement, including multi-story and seismic applications. RASTRA is ICC certified for use above or below grade.



The lightweight components that make up the RASTRA system are used to form exterior and/or interior walls for residential, commercial, multi-family and industrial buildings. Building with RASTRA is fast, simple, and performed easily even by unskilled laborers and common woodworking tools. Vertical loads of up to 100 tons per lineal m (80 kips/lin.ft.) of wall have been successfully tested without failure. With optimum reinforcement, load-bearing capacity in all directions is increased. Installation is simplified as the RASTRA system consists of only two components:

Standard Panel - used for walls - has semicircular grooves on both length sides interconnected by a number of tapered transverse channels. A standard panel is up to 10' long, 15" or 30" high with a wall thickness of 8.5", 10", 12" & 14". One 10" x 120" single panel weighs 158 lbs dry, still light enough to be handled without a crane. The 8.5" panel is intended for use in interior non load bearing applications only.

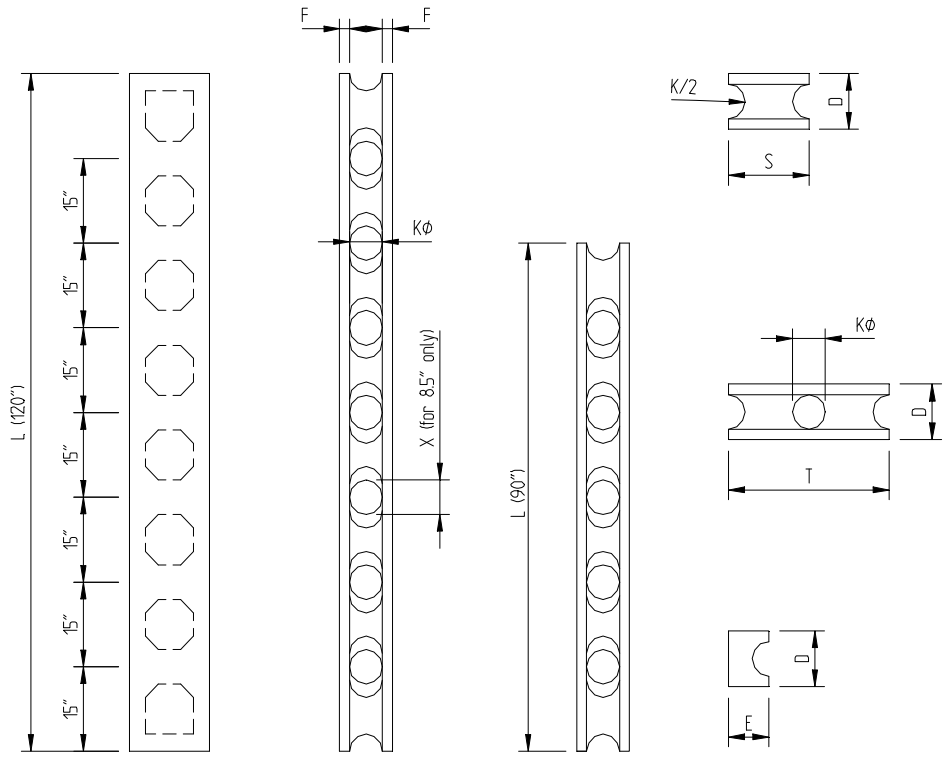
End Panel - used for wall ends, lintels, corners, window recesses and even ceilings - has half the width of the standard panel and has no transverse openings. For corners, cutouts are made in order to create channels for the concrete to connect two adjacent walls.

The RASTRA system has been granted some of the most stringent government approvals for use in single and multi-story buildings, above and below grade. Among others it has been approved by the Institute of Building Technology Berlin in West Germany and has been approved by ICC and Code 2000.

Note: RASTRA can also be ordered cut to specific size or as pre-assembled wall panels.

Feature & Benefit Summary

- Lowest cost-of-ownership
- Superior thermal performance, Effective R-value R-24 to R-48 depending on panel thickness
- Energy savings for the life of the property
- Greatly reduces air leaks
- Provides more consistent room-to-room temperature
- Extends HVAC service life
- Dimensionally Stable – reduces maintenance – maintains watertight shell
- Non-combustible - 4-hour fire rating; much safer than wood frame construction
- Enhances resale value
- Up to 700% stronger than wood frame construction
- Effective against hurricane force winds
- High sound insulation
- Impervious to rodents and insects including termites
- Does not promote mold growth
- More consistent room-to-room and floor-to-floor climate control
- Improved interior air quality; no offgassing
- Faster build-out; shorter construction cycles
- Constructed of 85% recycled-content; 100% recyclable
- Lifetime Warranty



DIMENSIONS

Thickness	Core Diameter	Flange	Length	Single Height	Double Height	End Panel Depth	Core Diameter
D	K	F	L	S	T	E	X
8.5"	5"	1.75"	90" or 120"	15"	30"	7.5"	5.25"
10"	6"	2"		15"	30"	7.5"	NA
12"	6"	3"		15"	30"	7.5"	NA
14"	6"	4"		15"	30"	7.5"	NA

VOLUMES & WEIGHTS

Thickness	Length	Standard Panel (cubic feet)			End Panel	Weight Single Panel
		Outside	Cavity	Net	Net	
8.5"	120"	6.64	1.97	4.67	-	147 lbs
	90"	8.83	2.63	6.33	-	110 lbs
10"	120"	10.42	3.67	6.75	4.22	158 lbs
	90"	7.81	2.73	5.08	3.17	120 lbs
12"	120"	12.5	3.67	8,83	5.26	197 lbs
	90"	9.37	2.73	6.64	3.95	148 lbs
14"	120"	14.58	3.67	10.91	6.31	243 lbs
	90"	10.94	2.73	8.21	4.73	183 lbs

FLAT PANEL

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

GENERAL DATA

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

Specification – Section 03135

Uses: RASTRA panels are used as permanent form work for structural concrete walls in buildings of any type of construction.

Description: RASTRA panels are hollow core forms comprised of a mixture of polystyrene beads, Portland Cement, admixtures and water; containing approximately 85% by volume of expanded polystyrene beads with a density of between 20 and 24 pcf. A RASTRA panel has a compressive strength of ≥ 56 psi and a tensile strength of ≥ 43 psi. The expansion of a RASTRA panel is the same as standard concrete (.0018 inch/ft.)

Concrete Fill: Normal weight concrete with 3/8" maximum aggregate size, 7½" to 8½" slump, and a minimum compressive strength of 2500 psi at 28 days.

Reinforcement: Steel reinforcement bars with a minimum yield stress of 40 ksi complying with ASTM A 615.

Structural Design: Structural analysis and design of the concrete fill, steel reinforcement, and waterproofing is prepared in accordance with Building Codes.

Applications

Single Family Homes

Accelerating interest in saving energy and building greener, healthier homes is generating unprecedented interest in ICF construction. In fact, according to the Portland Cement Association, ICFs have become the fastest growing alternative to wood frame construction. The number of single family homes built with ICFs has been increasing approximately 25% each year for the past several years.

Multi-Family

Townhouses, condominiums and hotels represent a rising and significant application for RASTRA. Due to the necessity for increased firewall protection and sound deadening between units, above grade RASTRA walls are becoming an increasingly popular and cost effective option for builders and developers.

Basements & Foundations

In cold climates, energy experts tell us up to 40% of a home's heat loss is through the ground. RASTRA creates the perfect basement walls for locking out winter, and keeping warm heated air inside. Currently, about 1/3 of all ICFs sold are used in residential basements. RASTRA represents a cost-effective and fast method of construction to build an energy-efficient basement.

Commercial Buildings

In addition to lowering operating costs and improved energy efficiency, using RASTRA for the entire structure can significantly decrease the construction cycle time. Non-residential uses of RASTRA - for hotels and motels, retail and professional buildings, warehouses, schools and churches, theaters, and others - are a rapidly growing application.

There are countless numbers of commercial applications suitable for RASTRA products. This fact is supported by thousands of commercial installations throughout the world.

Industrial – Preassembled panels installed with a tilt-up construction provides an economical build out. Good applicability has been developed for industrial projects, where load-bearing and good insulation is important.

Cold Storage Facilities - Cold stores have been designed with walls consisting of face to face doubled RASTRA panels to meet extreme insulation and highest load-bearing capacity at the same time.

Multi-Family & Hotels – Sound absorption and fire resistance make this an excellent application for any project designed with shared walls and need for fire walls.

Health Care & Retirement Living – The ability to improve indoor air quality is an important feature for healthcare facilities.

Agricultural Buildings – The ability to better control the interior environment provides an improved agricultural buildings more productive.

Interior & Exterior Finishes

As a general rule, any common finish can be applied to RASTRA panels.

Interior – Drywall, plaster, stucco, tile, stone and paneling can be applied directly to RASTRA.

Exterior - RASTRA is suitable for a wide range of exterior finishes including any type of siding, stone, brick and of course stucco.

Production

RASTRA is manufactured in state of the art facilities, offering all grades of automation - from hand formed custom pieces to fully-automated with a capacity of 300 panels per 8 hour shift. Highly developed production machinery provides smooth operation and consistent high quality. Production throughput is increased by the fact that only two types of components are manufactured. There is no shortage of raw material.

Transport of RASTRA panels is managed without pallets. The superior strength of RASTRA allows the bottom panel to serve as a pallet and the forklift or crane will lift a pile by taking it up in the holes of the panel.

Truck Load Capacity: Approximately 8,500 square feet

In addition to offering component sales, RASTRA offers pre-assembled wall panels built to your exact specifications.

Components can also be ordered cut to specific length to reduce construction waste and transportation costs.

Strength

It's easy to believe that a steel reinforced concrete wall is stronger than one made of wood. The impressive feature is just *how much* stronger. Dynamic shear tests designed to simulate earthquake loads have resulted in measured strength up to **700% stronger** than traditional wood frame walls. The system has been approved in Europe for up to six stories with limited reinforcement in some cells or up to nine stories with proper reinforcement.

RASTRA is an effective barrier against hurricane force winds. While you may not live in an area threatened by hurricanes, this rating is a clear indication of superior strength. Tests were also conducted to simulate the equivalent of a Level 8 earthquake on a six-story building with no measurable or visual damage. In fact, the test has been continued far beyond this strength.

Fire Protection

RASTRA's superior 4-hour fire rating helps protect homeowners from the devastating loss caused by fire. When an independent testing lab exposed a full scale RASTRA wall to constant 2000° F flames for five hours, the opposite side of the panel realized a temperature increase of only 7° F *with no ignition, smoke or airborne toxins*.

RASTRA uses a mixture of cement and recycled polystyrene, which is used as a spacer in the cellular lightweight concrete. While plastic materials are sometimes seen as a hazard to health when burned, this is not the case with polystyrene. In fact, polystyrene is entirely free of CFCs. It is manufactured by a polymerization of monostyrene. Styrene is a hexacyclic molecule that is composed of carbon and hydrogen.

In the event of a fire, the hydrogen oxidizes into water vapor. Carbon is set free and a minimum amount of carbon dioxide would be present. In a fire, no health hazard whatsoever is caused by the presence of polystyrene. In fact, fumes created by burning wood are far more toxic. In the event of fire, only those beads closest to the surface of a RASTRA wall will melt. Fire tests also revealed that in a two-hour fire, less than one inch of wall material lost any strength. At two inches deeper, the temperature did not even reach the melting point of the polystyrene beads.

Thermal Performance

The U.S. Department of Energy issued the following statement regarding air leakage. "The most common insulation, fiberglass, does not stop air leakage" (Technology Fact Sheet 10099-767, U.S. Department of Energy). Research shows that air leakage through exterior walls is the primary factor in moisture accumulation and heat loss. Wind pressures can greatly increase the air infiltration even further, resulting in increased energy use. Information presented in ASHRE indicates that for a two-story wood frame house with 8′ ceilings, 20 mph winds can easily double air infiltration.

Its a little known fact that fiberglass insulation loses as much as 40% of its insulating capacity when outside temperatures fall below 20˚F. When this happens, an R-19 fiberglass insulated wall performs as if it were only R-9. LEED confirms through a Canadian cold weather study that concluded fiberglass loses half its R-value below 0˚F.

Fiberglass also performs poorly in the presence of humidity within a wall cavity higher than just 30%. In winter this leads to condensation of moisture carried in by warm air through leaks through the wall. This raises humidity levels inside the building.

Once fiberglass insulation becomes damp its performance decreases dramatically. In fact, it only takes a 1.5% increase in moisture content in fiberglass to reduce its R-value by up to 50%. When moisture is trapped in a conventionally-built wall cavity insulated with fiberglass and sealed with a vapor barrier, insulation becomes damp and loses its ability to insulate. This also promotes mold growth and leads to structural damage.

Any type of insulation, including fiberglass or organic material loses its capacity to protect if it becomes wet and compresses from leaks or condensation from water pipes.

Rooms over the garage are often colder in the winter and warmer in the summer than the rest of the house. Floors made of RASTRA provide an increased level of insulation in these "bonus" rooms.

Today's standard method of assigning R-values to wood frame and fiberglass walls does not account for thermal breaks in the insulating envelope caused by studs, headers, corner details, electrical outlets and plumbing that create air leaks. This inflates the actual R-value beyond the wall's true capability. To arrive at a true R-value of an entire wall, other factors such as thermal mass, air tightness, and moisture tolerance must be accounted for as each contributes to the final result.

The typical wood frame wall has so many leaks, it's like having a window open all the time, accounting for 25% to 45% of the total heat loss of the building. RASTRA virtually eliminates air leaks, creating more energy-efficient buildings.

RASTRA provides an Effective R-value of up to R-48 with no heat loss caused by thermal breaks in the wall structure:

Besides air leaks, there is another factor that contributes to the insulation efficiency of the building exterior called a "Convective Loop". A convective loop occurs when air rises along a warm surface and falls along a colder surface, causing a circular movement of air. This movement of air is often found inside wall cavities containing fiberglass insulation because the insulation does not fill the entire wall cavity, providing air room to move. This movement of air transfers heat to the building frame and requires more energy to replace its loss. Because RASTRA is a solid mass of insulating material, there is no cavity or void to allow air to circulate. This eliminates the transfer of heat and reduces energy costs.

The insulation value of RASTRA is 15 to 20 times higher than solid concrete. The combination of RASTRA's high R-value, ability to restrict air migration, and elimination of convective loops makes RASTRA a superior insulation solution.

Climate Related Mass Wall R (dy) Values

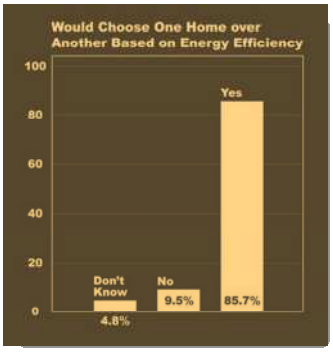
DBMS value was created by the engineers at Oakridge National Laboratory and means "Dynamic Mass Benefits of a Mass-Wall System". To express the R-value as an "effective" or "dynamic" R-value has become standard for mass wall systems. Most ICF manufacturers use the Effective R-value as their method of rating.

Energy Savings

Until recently, buildings were built with limited emphasis placed on energy conservation largely because we enjoyed low energy prices. These are different times, and with unprecedented increases in energy costs, improving insulating efficiency is a financial decision that pays dividends for the life of the property.

RASTRA's superior thermal performance and air tightness greatly reduces heat transfer and lowers energy consumption by 40 to over 50%. By increasing the property's true R-value with RASTRA, HVAC equipment operates less often, also reducing energy costs. Because less moisture filled air penetrates the exterior walls, the

air conditioner doesn't have to work as hard to remove the humidity from the air. RASTRA even reduces heat loss from hot water pipes.



On a recent Homebuyer Survey conducted by the Shelton Group, energy conservation is clearly front-of-mind with consumers. Some highlights of this survey include . . .

- 61.9% consider energy conservation to be extremely important.
- 63.1% said energy prices have already increased enough to make me change.
- 77.6% said the solution is reducing consumption *and* increasing efficiency.
- 85.7% said they would choose one home over another based on energy efficiency→
- 84.2% would make home improvements to become more energy efficient.

Mold & Indoor Air Quality

Scientific evidence has shown that the air inside the places we live and work can be more polluted than the air outdoors. This poses a serious health risk to occupants. Poor indoor air quality can lead to sore eyes, throat, and nose, headaches, increased susceptibility to viruses, and asthma-like symptoms. This is a concern when you consider that people spend 90% of their time indoors.

Molds are extremely common in building structures and will grow anywhere there is the right combination of moisture, warmth, and organic material (wood) to serve as a food source. Interior wall cavities found on wood frame walls provide the perfect environment for mold growth. RASTRA eliminates these cavities.

The key to controlling mold growth is to control moisture. There is no practical way to keep mold spores from entering buildings, but mold problems can be prevented before they arise by regulating humidity levels. A certain amount of moisture occurs naturally in the air within a building, but when moisture reaches excessive levels the likelihood of mold growth is increased. The most common sources of excessive moisture are leaks. RASTRA is inert and does not promote mold growth.

The unique composition of RASTRA enables better control over indoor environmental quality. Because RASTRA will not hold or wick water the way concrete block or wood products do, RASTRA will not promote or sustain mold and mildew.

In blower door tests, a RASTRA built home tested at 0.0379 air changes per hour, or once every 26 hours. Because so much unfiltered air leaks into a wood-frame house, the interior air of a typical new wood house changes completely .5 times per hour, or once every 2 hours. It's much easier to control indoor air quality when the indoor air is held longer inside the building. The air exchanger continually pumps fresh, filtered clean air into the heating and cooling system keeping the interior environment clean and comfortable throughout the house. This means that the interior air in a RASTRA structure is virtually free of airborne dust, pollen and other allergens.

The unique composition of RASTRA allows a slow interchange of air, which in turn allows the building to "breathe." The exchange is slow enough that it does not allow heat or cold to escape but helps maintain good air quality, preventing "sick building syndrome." This slow exchange of air also prevents condensation that can lead to mold growth.

Air conditioning units more effectively dehumidify indoor environments in a building with low levels of air infiltration. Both mold and dust mites cannot survive in low humidity environments. The solid core insulation of RASTRA is free of the voids, compressions, or thermal bypasses often associated with mold growth in wood frame construction. Because RASTRA is erected quicker than wood frame construction, there is less time for building materials to be exposed to the elements and therefore less moisture that must be removed from the completed building. RASTRA panels are inert and stable, and do not offgas chemicals.

Vapor Barrier

Air movement is the primary mechanism for moisture transfer. In fact, air accounts for 98% of all vapor movement in insulated cavities. To control moisture, builders often add a plastic vapor barrier on the inside wall frame. **Vapor barrier is not required with RASTRA**. This is due to RASTRA's unique ability to naturally block moisture. The density and mass of RASTRA does two things: stops the flow of moisture into the wall cavity, and slows the transmission of heat or cold.

ASHRAE standards warn against the use of plastic vapor barriers in any structure built in warm climates. There is also danger with moisture problems in cold climates caused by moisture being driven into the wall in the summer. Vapor barriers are often installed on the interior in cold climates to control moisture movement from inside out during warm season however those same vapor barriers trap the moisture contained in warm summer air. RASTRA eliminates this problem.

Insect & Vermin Resistance

Unlike solid polystyrene, the mixture of cement and polystyrene in RASTRA creates an undesirable environment for insects. Unlike foam panel ICFs, concrete fills the interior channels and pores of the RASTRA surface, thereby eliminating channels that termites and other insects could use to migrate and nest.

Acoustic Performance

RASTRA provides outstanding acoustical performance. The increased mass and density of RASTRA provides a very effective sound barrier, keeping outside noise from penetrating the exterior wall. In an independent survey, owners of 74 new ICF homes and 73 new wood frame homes were asked what they liked about their homes. Over 60% of ICF homeowners mentioned the quietness of their homes, versus only 2% of the wood frame homeowners.

Compared to a typical wood frame wall, only about one-quarter to one-eighth as much sound penetrates through an ICF wall. Scientists describe loud speech on the opposite side of a frame wall as "audible, but not intelligible." On the opposite side of a RASTRA wall, a listener would "strain to hear" loud speech. It would be virtually "inaudible."

Interior walls built with RASTRA reduce the movement of airborne sound from one room to another. Privacy is enhanced. Buildings built with RASTRA have a noticeable "quietness". RASTRA provides more than sufficient for separation walls between apartments, condominiums, offices and hotels. RASTRA is often used to create sound-sensitive rooms such as theater rooms, sound studios or media rooms. Surround sound systems sound better in rooms built with RASTRA.

In independent testing, a RASTRA wall measured a transmission loss of 50 dB according to the limits set by the ASTM Standard E90-97, thus giving the wall a sound transmission class rating of 50. By comparison, a 2x4 wood-frame wall filled with fiberglass insulation and with ½" drywall on both sides has a sound transmission class of 36. A sound transmission class of 50 is inaudible.

Water pipes in walls, floors and ceilings can also be noisy. When pipes are installed inside a RASTRA wall, not only is noise generated by the pipes greatly reduced, condensation on cold water pipes is also reduced.

Foot traffic noise from overhead floors is reduced with sound-deadening RASTRA floors. Continuous foot traffic also loosens deck boards that "squeak" as you walk over them. A RASTRA built floor eliminates noisy deck boards.

Maintenance

Maintenance is reduced in several areas that save time and money for the life of the property. This money saving feature reduces your cost-of-ownership, a good selling feature when you sell.

Traditional wood frame construction is prone to decay and insects which deteriorate wood. As lumber breathes and ages, it shrinks, twists and warps. Over time walls loosen and eventually weaken. Gaps appear that allow destructive moisture to gain access. In fact, most stucco cracks are actually caused by substrate walls moving as lumber twists and warps – this problem is virtually eliminated with RASTRA. RASTRA is dimensionally stable and provides a more watertight layer of protection to reduce maintenance. **Wood rot is a thing of the past**.

Painting – Because RASTRA is dimensionally stable, in other words it does not expand and contract like wood, paint is less susceptible to cracking and lasts longer.

Wood Rot – Eliminating wood frames eliminates wood rot caused by moisture and insects.

Stucco – Most stucco cracks are caused by the natural movement of substrate walls moving as wood frames shrink, twist and warp. RASTRA is dimensionally stable and greatly reduces stucco cracks.

HVAC – Because the interior air is more controlled in a RASTRA built building, the HVAC unit doesn't have to work as hard or often. Fewer on-off 'cycles' reduces wear and tear on the HVAC unit and extends its useful service life.

Interior Comfort

In an independent survey, owners of 74 new ICF homes and 73 new wood frame homes were asked what they liked about their homes. Over 80% of the ICF owners mentioned the great comfort, compared with 22% of wood frame owners.

Being in a RASTRA built home is a comfortable experience. This results from more consistency in room-to-room temperature & humidity, improved air quality, and a much quieter space.

By restricting air leakage and improving the insulation value of the exterior walls, air temperature is more consistent throughout the building. It virtually eliminates "cold spots" that occur in wood frame buildings along the studs or at gaps in the insulation. Because heat loss is greatly reduced, interior air temperature remains more consistent with less variation. The heavy RASTRA wall gives it the heat-absorbing property of "thermal mass".

This minimizes swings in temperature so the house doesn't overheat or get suddenly cool as the furnace or air conditioner cycles on and off.

RASTRA is a porous material containing small insulating bodies and tiny air pockets, which are responsible for the low specific heat of the wall-surface material. Therefore, the wall surface maintains a temperature that is very close to the average comfort level.

RASTRA's unique composition also absorbs sound and creates a much quieter space. Noise that normally passes through wood frame walls is absorbed. If RASTRA is used as an interior wall solution, privacy is enhanced in delicate areas of the home such as common bathroom or bedroom walls for example. Theater rooms with surround sound systems are enhanced with a more acoustical wall system.

Air quality is improved by eliminating irritants which cause discomfort to the eyes, nose and throat. This is possible because the HVAC unit is more effective keeping air clean when the air exchange rate is greatly reduced.

The solidity of concrete construction reduces flexing in floors, as well as shifting and vibration from the force of the wind or the slamming of a door.

Cost-of-Ownership

Determining the true cost of any building material goes beyond the initial product cost.

1. **Product Cost** – RASTRA may cost slightly more than traditional building materials on a given project. However, RASTRA provides savings in other areas including tax credits, eliminating membrane and wire mesh on stucco installations; eliminating vapor barriers, eliminating air exchangers and downsizing to a less expensive HVAC unit to compliment RASTRA's superior air retention capabilities.
2. **Installed Cost** – RASTRA installs much faster and requires less trade coordination. Construction cycles are shortened and properties are available for sale faster.
3. **Life-Cycle Cost** – RASTRA is the least expensive option by far over the life of the property. Heating and cooling costs are reduced by at least 40% each and every year. Maintenance costs are reduced because timber that warps and degenerates is replaced by RASTRA which does not. The HVAC unit has a longer service life because it doesn't work as hard or often to maintain environmental settings. ; Insurance premiums are lower. RASTRA provides the lowest cost-of-ownership possible.

As energy costs continue to rise, and as ICF construction is more widely understood, it is reasonable to project that RASTRA houses will command a 10-15% premium over comparable wood frame homes in the not too distant future. According to The Association of Realtors, for every $1 savings in energy expense per year, a home's value on the resale market increases by $20.

Diversification

Real estate is an extremely competitive industry. This makes your ability to differentiate your property from the competition invaluable. For most, differentiation is limited to aesthetics or maybe a unique design feature. A RASTRA built home provides meaningful differentiation in important areas such as increased strength, lower

energy bills, lower maintenance costs, increased fire resistance, improved air quality – not to mention a more environmentally-friendly home. These are significant selling features that add value to your property.

Safety

One of the most important features of any home is its ability to protect human life. RASTRA walls provide an extremely safe and secure environment.

Because the concrete in RASTRA steel-reinforced concrete walls cures to strength at least 50% stronger than conventionally poured concrete, walls are stronger when it comes to standing up to the elements including tornados, hurricanes and even earthquakes.

Fire safety is another benefit of RASTRA. When independent tests applied a constant 2000° F flame to a fixed point from one side of a RASTRA panel for five hours, the opposite side of the panel realized a temperature increase of only 7° F with no ignition. Fire tests concluded that RASTRA produced a Flame Spread of zero and Smoke Density of 5 (450 is permissible).

- Highly fire resistant – 4 hour rated @2000°F; material will not ignite; does not produce toxins; Flame Spread 0; Smoke Density 5 (450 permissible).
- Effective barrier against hurricane force winds.
- Effective barrier from wind-driven debris.
- Earthquake tested up to magnitude level 8 with no structural damage.
- Cleaner indoor air quality - removes mold & toxins from wood preservatives; healthy living environment.

Installation

Installation of RASTRA does not require special skills or tools. Panels can be used horizontally or even a combination of horizontal and vertical assembly is possible. The system of cavities always fits, as the distance between the horizontal cores is equal to the width of the panel. The panels are installed with interior channels lined up and inter-connected with rebar. Panels are easily cut to the proper dimension by handsaw or chain saw. The wall is supported by adjustable wall support rods, which help to bring an entire wall panel into plumb. Thus an entire wall section can be adjusted. By cutting the panels and using end panels for the jamb, window and door openings are easily formed. Small window openings can simply be cut to fit. Arches are easily made without expensive formwork.

Any type of ceiling or roofing system can be used with RASTRA. When using massive ceilings the top of the supporting wall is cut out L-shaped along a level line. In this way no formwork for the tie-beam is necessary. A 2-3" thick flange of RASTRA remains. Thus, cold bridges are avoided. RASTRA ceilings can be made out of end panels or special flooring panels. These units are light enough to be carried and placed without cranes. But any type of flooring system will work with RASTRA. The concrete is filled floor-by-floor. Whenever a concrete ceiling is used it is cast with the walls.

For most projects concrete pumps are used to pour the concrete. However, for a small building a bucket system may be used to fill RASTRA walls. A monolithic load bearing structure is the result of the unique shape of the interior channels as concrete fills the cavities completely.

RASTRA components allow for complete freedom of design and can be designed to fit each architectural idea. Curved walls, for example, can be made by beveling off one flank of the panel to achieve a desired radius. There are no limits to the ways the panels can be cut. Partition walls can be connected everywhere by cutting connection channels in order to allow the concrete flow into the adjacent wall section. Columns for excessive loads can be formed by using two panels, doubling the wall thickness and thus creating a 3-dimensional structure.

Ducts for water and electricity are cut with simple tools and conduits for electric lines are retained in the RASTRA without any additional fastening. Plumbing can also be inserted into the cavities before pouring the concrete. RASTRA accepts plaster very well and usually requires only a single layer of plaster. Tiles are applied directly on to the RASTRA surface.

The most common installation method is to build walls in-place, on the job site. However, another method of installing RASTRA is to erect prefabricated wall segments. These panels may include factory-installed window frames, reinforcement, plumbing and electrical. Even so, such a panel will not weigh more than around 2 tons, as concrete is added on site once the panels are in place. No special trailers are required for transportation and eight or more panels may be loaded on one trailer.

Well-known problems that plague other prefab systems do not exist with the RASTRA building system. There is no time needed for curing the panels as they are taken from storage. Therefore, borders can be dealt with swiftly. No connectivity problems have to be solved - the cast-on-site concrete will do that. Field adjustments are easily made by cutting or adding panels.

Concrete Details: 1cy of minimum 2,500 PSI concrete, 3/8"pea gravel concrete fills 90 square feet of RASTRA wall with a 6" core. A good budgetary estimate is 0.30 cubic feet required per square foot of wall surface. The concrete mix design should require a slump of at least 6½" regardless of the concrete strength (psi) specified. Preferred slump range is from 7½ to 8½". This will provide sufficient slump for pumping and also allow concrete to penetrate into the panel and effectively integrate the form and the structural core. Because of the thermal insulation properties of RASTRA, concrete can be poured at temperatures far below freezing.

Sustainability

More homebuyers are demanding cleaner home environments, free from toxic gases that can come from the carpeting, plywood and adhesives used in traditional home construction. People also want to save trees. *Consider this* - in the minute it takes to read this page, the equivalent of 10 city blocks of tropical forest will disappear forever! According to the National Association of Home Builders, a typical 2,000 square foot home uses 16,000 board feet of lumber plus 6,000 square feet of wood panels. RASTRA greatly reduces consumption of our timber resources and reduces toxins caused by wood preservatives.

The depletion of forests for building materials has become an issue in many parts of the world with environmentalists and conservationists. An average framed home consumes an average of ten mature fir trees. Why is it important to save trees? Because mature trees absorb carbon dioxide, a major contributor to global warming.

Building with RASTRA reduces energy consumption, and with energy savings comes environmental benefits. Specifically, the reduction of fossil fuels burned to create energy. By reducing energy consumption, we reduce combustion by-products that lead to smog and contribute to global warming. The Intergovernmental Panel on Climate Change (IPCC) unveiled its official report on global climate change. This report, produced by 600 representatives from 40 countries, concluded that there is a 90% chance that global warming is caused by the burning of fossil fuels which emit carbon dioxide.

The Environmental Protection Agency (EPA) estimates that the average U.S. home releases 22,000 lbs of carbon dioxide (CO_2) into the atmosphere each year. That's twice the amount of the average vehicle. By reducing the amount of energy used for heating and cooling, RASTRA significantly reduces CO_2 emissions. In fact, an average sized RASTRA home can reduce enough energy consumption to eliminate 2-3 tons of CO_2 emissions from our atmosphere per year when compared to a wood frame home. Over the life of a 30-year mortgage, homes built with RASTRA save our atmosphere 60-90 tons of carbon dioxide emissions.

RASTRA is produced from recycled post-consumer and post-industrial expanded polystyrene (Styrofoam), which is then mixed with a cement binder. By volume, RASTRA is 85% recycled polystyrene, which would otherwise end up in landfills never to decompose. It is a truly "green" building material.

The production of RASTRA can also be classified as ecologically clean. No particles or fumes are set free during its production. Only a minimum of energy is required - producing one RASTRA panel consumes less than 2 kWh of electricity; curing requires no external energy; and no heat is involved in the production process.

All production waste is recycled and converted into new RASTRA product. In addition, remnants from the building site can also be returned to RASTRA and recycled.

Another measure of sustainability is increased service life. Products that last longer make a large impact on our solid landfills. RASTRA provides an almost limitless service life. This saves space in our landfills, reduces the consumption of fossil fuels to transport new and discarded products, saves timber resources and the energy required to produce new products.

Per the most recent LEED New Construction checklist v2.2, RASTRA can contribute up to **22** of the required 26 points for a LEED certified project. The potential points can be derived from the following rating credits:

Properties of the Building

The physical properties of a building often influence the ecosystem either, directly or indirectly. The following table tentatively classifies the material properties of the RASTRA Building System in comparison with concrete walls (block or precast) and wood framed walls. It also details such materials' impact on the ecosystem:

Property	Remarks	Evaluation		
		RASTRA	Frame	Concrete
Heat Insulation	Direct :: constant room climate	+	-	-
	Indirect :: reduces pollution due to energy consumption,	+	-	-
	Tightness	+	-	+
Mass Effect	Direct :: equals out temperature changes	+	-	+
	Indirect :: energy savings	+	-	+
Surface Temperature	Direct :: low heat penetration depth	+	-	-
	Indirect :: energy savings by lower thermostat settings	+	-	-
Vapor Diffusion	Direct :: avoids condensation, constant humidity, avoids molding	+	-	-
	Indirect :: none	-	-	-
Sound Absorption	Direct :: suppresses reverberation maximizes living quality, high attenuation	+	-	-
	Indirect :: none	-	-	-
Formation of Fumes	Direct :: minimizes health hazard in fire	+	-	+
	Indirect :: easier to fight fire and repair	+	-	-
Environmental	Direct :: conserves resources	+	-	+
	Indirect :: reduces waste	+	-	-

Conclusion: A RASTRA built structure contributes to a healthy living environment. It also indirectly improves the environment by conserving energy. Therefore, RASTRA reduces pollution. Builders use up to 60% smaller air conditioning/heating units, saving even more on utilities. RASTRA reuses worthless waste, which would otherwise end up in landfills. Environmentally sound also means that RASTRA improves "quality of living."

PanelCrete™

PanelCrete™ is an extension of the RASTRA product offering. The heart of the RASTRA Exterior Finish System (EFS) is the innovative use of flat (or structured) boards made of a specifically designed polystyrene concrete, engineered into a panel that creates a proprietary exterior wall system. A system to meet the demands of state of the art construction and to solve the problems associated with exterior wall construction, which has always plagued the industry.

PanelCrete provides superior wind and fire resistance, offers the architect wide flexibility in design, can be shop fabricated or job applied to meet virtually any requirement, is easily cut by hand or with power tools but is very puncture/vermin resistant and is the first exterior wall system to solve the drainage problem associated with virtually all other wall systems.

PanelCrete polystyrene concrete substrate will not hold water. It will quickly and completely self drain. The EPS concrete for this application is formulated to provide a matrix, which allows water to drain completely. It has an insulation R-value of approximately 2 per inch of thickness. Since its principal application is over standard framed construction, R-values for walls in excess of 20 can be achieved by insulating the stud cavity of the wall assembly.

Practically any finish or cladding can be applied to the basic PanelCrete. It can be made to look like pre-cast concrete, wood, brick, stone or stucco with a wide variety of finishes from which to choose. And since it is made from real concrete with polystyrene aggregate instead of stone, PanelCrete is lightweight, not affected by water or frost-and thaw cycles.

PanelCrete utilizes a waterproof membrane, which is directly applied to a cement-based sheathing. Should the finish on the face of a panel become damaged or should a window or other opening leak, all water entering the polystyrene concrete substrate is quickly drained through a weep system built into this substrate, preventing water from reaching the building. The PanelCrete substrate has a porous structure making it an "open rain screen" and avoids buildup of any differential pressure in the wall system.

Millwork and Decorative Products

There are unlimited applications for decorative panels and millwork made of EPS concrete. The possibilities offered due to the outstanding workability of the raw material are limitless. The end result is a decorative product which is non combustible, frost resistant, does not shrink and expand, accepts all types of stucco, does not age, and is easy to use and install. All forms can be milled out of standard raw units, thus special orders are cost-effective with no or minimal tooling costs. Decorative units come in many forms: This product has been used extensively for decoration of new classic and modern buildings but also for restoration of art work. Amazing results have been realized in the restoration of deteriorating and war damaged historic buildings in Berlin, Prague, Moscow, Budapest, London and throughout Europe.

RASTRA vs Foam Panel ICFs

The green building movement, already a huge factor in the commercial sector, is likely to transform residential construction as well. One pundit claims it will transform building in the same way electric lights and air conditioning did last century.

Insulating Concrete Forms (ICFs) are well-positioned to take advantage of this trend; they're durable, energy-efficient, and widely available. Among the various types of ICFs on the market, the most environmentally friendly are the so-called Compound ICFs, panels made from a mix of recycled expanded polystyrene (EPS) and Portland cement. RASTRA is the original EPS Compound ICF.

Recycled Content

RASTRA uses a huge amount of recycled Styrofoam that is otherwise destined for landfills to never decompose. Thousands of gallons of fuel, energy and labor are saved annually by no longer running landfill equipment. Foam panel ICF manufacturers use virgin polystyrene to produce their panels.

Installation

RASTRA panels install faster and require far less bracing than foam panel ICFs. Because RASTRA panels are produced with concrete, panels are stronger and less likely to blow out or bend as concrete is being poured. Unlike foam panels that limit pours to 3 to 4' high, a full height RASTRA wall up to 12' high can be installed and poured in a single pour.

Design flexibility is enhanced with RASTRA as curved walls, arched openings and three-dimensional features can be created easily and cost-effectively.

Thermal Performance

One of the most important differences between RASTRA and a foam panel ICF is the ability to utilize the wall's Thermal Mass. Thermal mass is a property that enables building materials to absorb, store, and later release heat. Buildings constructed with mass walls of concrete have a unique energy-saving advantage over framed walls.

However, because foam panel systems install half of the insulation between the wall's core where energy is stored and the interior, this benefit is greatly reduced. RASTRA does not use solid foam panels and as a result allows for much greater use of the stored energy. This lowers energy costs and creates a more consistent climate.

Fire Rating

Foam panel ICFs must be covered with drywall to meet fire code. RASTRA does not require drywall or additives to satisfy fire codes and has achieved a 4-hour fire rating without covering. Unlike foam panels RASTRA doesn't melt, smoke or produce airborne toxins.

Increased Durability

RASTRA panels are made up of foam ground to a very specific consistency and coated with cement, which changes the properties completely. This result is a panel that is non-burnable, and still has a very high insulation

value. Independent lab testing subjected RASTRA panels with no coatings of any type to constant 2000˚F flames. After five hours of continuous burning, the opposite surface of the full scale wall rose only 7˚ Fahrenheit.

RASTRA walls are similarly impervious to mold, termites, and other pests without any type of pesticide or special treatment that may leach into the soil.

Less Material

Compound ICFs will accept plaster, drywall mud, Portland stuccos, and acrylic polymers applied directly to the panel. Foam panel ICFs must be covered with drywall to meet fire code. RASTRA does not require drywall.

Because Compound ICFs are heavy - about 10 pounds psf. - and are ten times as dense as pure EPS foam, they require less bracing during construction. Reduced bracing and seam reinforcement means using less wood and shorter construction cycles.

There are other environmental savings as well, such as using less petroleum to make virgin EPS beads, and less cement, which is a notoriously energy-intense process.

RASTRA uses approximately 30% less concrete on average than a comparable wall made from foam panel ICFs. Cement production uses an extreme amount of energy and produces a lot of carbon. By decreasing the amount of cement required, carbon emissions are also decreased by a significant amount.

Other Considerations

Reducing the concrete in the wall translates to better insulating properties. Using 2/3 the concrete puts 1/3 more insulation in the wall. When completed, the wall performs even better; its substantial thermal mass dampens temperature swings.

Homeowners like the fact that the dense blocks can hold nails and screws wherever they're driven. Builders like the fact that they can be cut and shaped with standard carpenters tools.

Unlike foam panel ICFs RASTRA can be used below grade as insects are not attracted to our panel. Foam panels provide an ideal place for insects to tunnel and nest and therefore are restricted by code in many parts of the country from being used below grade.

In the residential sector, Compound ICFs represent the best option for minimizing the environmental impact of construction. If LEED certification is important to the builder or owner, they will receive extra LEED points for using composite blocks. Compound ICFs were used in the first Gold-Level LEED building in Texas.

When researched by people who are looking for the best, most insulated structure they can build, people find Compound ICFs to be the greenest, most sustainable solution available.

Advantages over Foam Panel ICFs

- Superior thermal performance
- Uses average 30% less concrete
- Can be used below grade
- Meets fire code without drywall covering
- Uses 100% recycled EPS – more LEED points
- Curved walls and arched openings are fast and easy
- Dense panels hold screws and nails
- Able to pour full height wall in single pour
- Far less bracing required
- Stronger panel results in far fewer blowouts
- Faster installation
- Impervious to insects

Testing

Fire Endurance UL-R20638, 6/01 U915, 5/01	4 hour rating (ASTM E119)
Thermal Barrier (Room Fire Test) OPL-15715-101808, 9/97	No flame spread, no smoke development. Wall meets UBC 26-3
Surface Burning Characteristics SGS-154683, 9/98 ASTM E 84 (NFPA255,UBC8-1)	Flame Spread Index 0, Smoke Development Index 5, NFPA Class A, UBC Class 1,
Water Transmission ATI-03-30070.02, 4/01 ATI-03-30305.02, 4/01	Meets requirements ASTME331, ASTM E 514, meets UBC 14-1 (grade "C" Kraft paper)
Sound Attenuation ITS – J20031297-003, 1/01	STC 50
Structural RAL#20177-IP, 9/96 In-plane cyclic shear RAL#23940-SW, 10/97 Slender wall RAL#25683-NSW, 11/98 Narrow shear wall RAL#20177-L, 9/96 Flexural/Lintels	Approved for multi-story use in all four seismic zones
Fungus Resistance ARL - 30230, 8/01 ASTM G21-96	The following cultured organisms were tested on RASTRA with zero growth detected: Aspergillus niger Penicillium pinophilum Chaetomium globosum Gliocladium virens Aureobasidium pullulans Stachybotrys chartarum (Black Mold)