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Concrete Masonry DESIGNS

MARCH 2009

HARDSCAPE ISSUE

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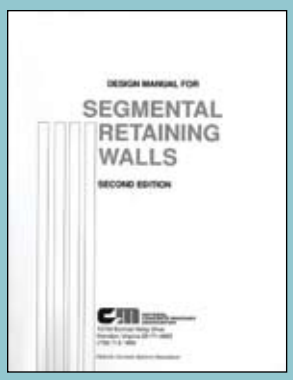

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Concrete Masonry DESIGNS

Hardscape Issue | March 2009

ON THE COVER:

Homeowners in Delaware Ohio wanted an inviting and impressive outdoor living space hardy enough for everyday use but yet special enough for entertaining. By unifying the color and finish of the concrete pavers and SRW units, their outdoor spaces are now as attractive as they are sturdy.

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Concrete Masonry Designs magazine showcases the qualities and aesthetics of design and construction using concrete masonry.

Concrete Masonry Designs is devoted to design techniques using standard and architectural concrete masonry units, concrete brick, unit concrete pavers, segmental retaining walls, and other concrete masonry products around the world. We welcome your editorial comments, ideas, and submissions.

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ELEVATE Property Values by Going from Good *to* GREAT

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Homeowners who don't wish to "buy up" in a cool economy are finding ways to make their current homes more luxurious and functional and many are looking outdoors for more living space and more return on their investment. A study by Clemson University found that homes with "excellent" landscaping can expect a sale price about 6 to 7 percent higher than equivalent houses with "good" landscaping. When you calculate that increase on a 2 or 3 million dollar home, it equates to $120,000 to $210,000. Even on a $500,000 home, the increase is still nothing to sneeze at—$30,000.

The Deck and Patio Company of Huntington Station, New York specializes in luxury outdoor living. And although they have done their share of top-of- the-line work on top-of- the-line homes, the majority

of their clients have average sized homes on average sized lots. And this is where helping clients get the most bang for their buck comes into play.

Bill Renter, President, of The Deck and Patio Company says that the key to taking a home from mediocre to grand is all in the details. "Why are some pools and spas gorgeous and some seem to lack panache? The answer lies not in the pool but with the surroundings." Bill explains, "Harmonizing and blending the play areas and entertainment areas with the water, hardscape, and landscape elements is what it's all about."

When Bill met with a client who'd recently purchased a home on the exclusive North Shore of Long Island, they realized they were all on the same page. The backyard was good—it had a large patio close to the house and a pool area overlooking Long Island Sound—but it wasn't *spectacular*. Bill and his crew were challenged to create a resort-style

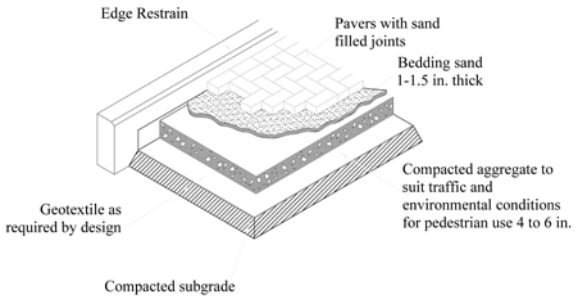
outdoor environment complete with a vanishing edge pool, free-form spa, swim up bar/barbeque, barstools, fire elements, waterfall elements, and multi-level patios.

Along with this lengthy "wish-list" came stringent constraints. The project was under close supervision by the New York Department of Environmental Conservation. The bluff that the property sits on is protected and thus under no circumstance could soil erosion or storm water runoff be allowed to migrate from the premises.

The first order of business was soil stabilization and a number of concrete segmental retaining walls were utilized on the bluff side of the property for their beauty and brawn. The designers at The Deck and Patio Company selected a unit that had a natural, aged look, and also had coordinating pavers, caps, steps and risers to harmonize the entire space. "I like the look of the matching tumbled concrete components and they wear so well without problems such as heat retention and deterioration during freeze and thaw," explains Bill.

The backyard space is a beautiful blending of function and nature. What you see is a beckoning resort, what you don't see is the painstaking preparation that allows the elements to function with little maintenance and impact on the surrounding environment. Hidden from sight are one mile of plumbing, five water pumps, gas and electric lines for an outdoor kitchen, and thousands of square feet of stabilization material. The four-tiered patio area is 3,000 square feet and the Deck and Patio Company routinely installs patios over 8 inches of recycled concrete aggregate (RCA)—twice as thick as the industry standard. "Doubling up on the RCA base extends the life of the patio and its durability. It also helps filter storm water and prevents run-off—both very important in this home's design", says Bill.

The homeowners are pleased with their new outdoor space. From every angle the views are stunning and well thought out and thanks to the durable construction materials installed, they will enjoy them for many years to come. **CMD**



Homeowners Get Cooking with Outdoor Kitchens

Outdoor cooking areas are the hottest trend in residential landscape design, thanks in no small part to the versatility of segmental retaining wall systems (SRWs). They can range from a modest firepit to a full-blown outdoor kitchen that will rival the most lavish indoor cooking areas, replete with stainless-steel appliances, granite countertops and fully plumbed sinks.

Simple Yet Stylish

An outdoor cooking area can be as simple as a paver patio framed with low, freestanding seat-walls and a firepit in the center, says Tom Zakoski, landscape designer with Villa Landscapes in Burnsville, MN.

"With a modest investment and a little sweat equity, homeowners can transform an unusable backyard space into a stylish entertainment area," says Zakoski. "Pairing an attractive paver patio with freestanding walls around the perimeter creates a cozy atmosphere for a firepit. I like SRW systems because they're available in a range of styles, colors and textures that complement the variety of paving stones on the market, giving you an array of design options. And they're easily installed by do-it-yourselfers and landscape contractors alike."

Solid Construction

Richard Ventola of Green Acres Inc. in Palisades Park, NJ, used an SRW wall system to construct an outdoor kitchen, complemented with concrete pavers in a matching color and texture.

"It's the most popular part of the back yard," says Ventola. "The entire cooking island is made of solid retaining wall units." Some of the blocks had to be cut to create spaces for the grill and food storage areas. The solid construction of the units made those modifications much easier than using hollow blocks, he notes.

The segmental retaining wall system is versatile as well as attractive.

"We do a tremendous amount of natural stone in our landscaping," says Ventola, "but I often need the consistent

A versatile SRW system like this allows you to design a cooking island and freestanding seat-wall using the same materials.

Richard Ventola of Green Acres Inc. in Palisades Park, NJ, used over four pallets of random-pattern SRW units to create this outdoor cooking island, so it's not going anywhere. Granite countertops were attached with thinset mortar.

The cooking area became part of the retaining wall in this innovative design by Robert Daniels of Clearwater Swimming Pool Co. in Centre Hall, PA.

size and shape of concrete blocks. SRW units are the closest-looking to natural stone."

Kitchen-Wall Combo

Robert Daniels of Clearwater Swimming Pool Co. in Centre Hall, PA, recently was faced with the challenge of installing an outdoor kitchen in a back yard with a steep slope and deep, three-tiered retaining walls. The yard was adjacent to woods, so Daniels selected mosaic patterned SRW units for the tiered walls.

"You get more of the natural look with a mosaic pattern, and set back in the woods, that complemented the environment." Serpentine curves and stepped wall ends soften the appearance, and large beds of plantings separate the three tiers.

A paver patio was installed across the top of the first retaining wall tier to create a cooking and eating area. Built-in stairs connect this upper patio with the pool on the lower ground level.

Then, in a creative use of limited space, Daniels carved a kitchen area right into the middle retaining wall that includes a large gas grill, refrigerator and food preparation counter. The entire structure also was built with the same type of SRW units, so it's indistinguishable from the wall itself.

"We had to make a couple of modifications to some blocks to get power and gas into the grill area, but it was easy because these blocks were solid," says Daniels. **CMD**

DESIGN TIPS

Other things to consider when designing an outdoor kitchen include:

- Position the grill so prevailing breezes carry smoke away from where people congregate and eat.
- Use a solid segmental retaining wall system to achieve a natural look that's also "bulletproof" from the elements, easily modified and virtually maintenance-free.
- Slope countertops and patios slightly so rainwater doesn't pool on them.
- Make sure drainage issues are properly addressed, particularly where tiered spaces are used.
- Check with local utilities, building codes and manufacturers' specifications before installing outdoor appliances.

Photos: VERSA-LOK

NCMA TEK

National Concrete Masonry Association
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R-VALUES OF MULTI-WYTHE CONCRETE MASONRY WALLS

TEK 6-1B
Energy & IAQ (2009)

Keywords: cavity wall, insulation, multi-wythe wall, thermal properties, R-values, U-factors

INTRODUCTION

Thermal resistance values (R-values) are numerical estimates of a building material's or element's ability to resist heat flow under steady-state conditions. Historically, R-values alone have been used in simple hand calculations to estimate building energy consumption. Today, the R-value, and more commonly U-factor (coefficient of thermal transmission) are used with other factors such as building orientation, thermal mass, and climate to more accurately represent the building envelope's thermal performance for a given building occupancy.

R-values of building materials are determined in the laboratory by applying a constant temperature difference across a material or building element, then measuring the steady state heat flow through the test specimen. For design, calculation methods have been developed to aid in determining R-values of various building materials (ref. 1).

The thermal mass of concrete masonry walls significantly influences heat transmission. For most applications, the effectiveness of thermal mass is determined by construction material properties, climate, building type, and the position of the insulation within the wall (relative to the masonry). Due to the significant benefits of concrete masonry's inherent thermal mass, concrete masonry buildings can provide similar performance to buildings constructed of lightweight framing materials while using less added insulation. The benefits of thermal mass have been incorporated into sophisticated programs for modeling building performance. Prescriptive energy code compliance methods currently account for the benefits of thermal mass. While the thermal mass benefits in the prescriptive tables tend to be overly simplified and thus conservative, energy codes and standards such as the *International Energy Conservation Code* (ref. 2) and ASHRAE Standard 90.1 (ref. 3) permit concrete masonry walls to have less insulation than frame wall systems to meet the code requirements.

When a concrete masonry wall requires additional thermal resistance, concrete masonry lends itself to many strategies that allow the design to provide the necessary thermal envelope without jeopardizing the other performance criteria for the project. Foam inserts, foamed-in-place or granular fill insulation may be inserted in the cores of the concrete masonry units. Rigid board insulation may be adhered to the interior or exterior of the masonry, or the interior can be furred or studded and rigid board, foamed-in-place, or batt insulation placed between studs or furrings. In addition, multi-wythe construction lends itself to placing insulation between two wythes of masonry when the wythes are separated to form a cavity.

Placing insulation between two wythes of masonry offers maximum protection for the insulation. The means to meet or exceed model building code requirements are easily obtainable, since the cavity installation allows a continuous layer of insulation to envelop the masonry. Thus, this continuous insulation layer can also reduce heat loss due to air infiltration. Cavity walls are also sometimes built with interior insulation only, leaving the entire cavity open for drainage.

Cavity walls, as well as single wythe masonry with core insulation, also provide hard, durable surfaces on both sides of the wall, efficiently utilizing the inherent impact resistance and low maintenance needs of concrete masonry. While these needs are most commonly associated with multi-family dwellings, hospitals, schools and detention centers, the benefits of resistance to damage from hail, shopping and loading carts, gurneys, motorized chairs, and even sports make cavity wall construction ideal for many other applications.

CAVITY WALLS

The term cavity insulation, which in some codes refers to the insulation between studs in lightweight framing systems, should not be confused with the long established term: "masonry cavity wall." Cavity walls are comprised of two wythes of masonry separated by a continuous airspace (cavity). Cavity walls are typically designed and detailed using actual out-to-out dimensions. Thus a 14-in. (356-mm) cavity wall with a nominal 4-in. (102-mm) exterior wythe and 8-in. (203-mm) backup wythe has an actual cavity width of $2^3/_4$ in. (68 mm), allowing for $1^1/_2$ in. (38 mm) of rigid board insulation or $2^3/_4$ in. (68 mm) of granular fill insulation.

Loose fill insulations can occupy the entire cavity space since these materials allow water to drain freely through them. For this reason, these insulation materials are typically treated for water repellency. When using granular fill, screens or other methods must be employed at weepholes to contain the granular fill.

With closed-cell rigid board cavity insulation, a 1 in. (25 mm) clear airspace between the insulation and the outer wythe is required (2 in. (51 mm) is preferred) to help ensure free water drainage (ref. 7).

Typical cavity walls are constructed with a 4, 6, 8, 10 or 12 in. (102, 152, 203, 254 or 305 mm) concrete masonry backup

TEK 6-1B © 2009 National Concrete Masonry Association (replaces TEK 6-1A)

wythe, a 2 to $4^1/_2$ in. (51 to 114 mm) wide cavity, and a 4-in. (102-mm) masonry veneer. By reference to *Specification for Masonry Structures* (ref. 4), the *International Building Code* (ref. 6) allows cavity widths up to $4^1/_2$ in. (114 mm), beyond which a detailed wall tie analysis must be performed. More detailed information on cavity walls can be found in References 8 through 11.

R-VALUE TABLES

Table 1 presents R-values of uninsulated concrete masonry cavity walls with 4, 6, 8, 10 and 12 in. (102, 152, 203, 254 and 305 mm) backup wythes and a 4 in. (102 mm) concrete masonry veneer. These R-values should be added to the applicable R-values in Tables 2 and 3 to account for cavity insulation and/or interior furring with insulation, respectively. Table 4 contains the thermal data used to develop the tables.

To convert the R-value to U-factor (as may be needed for code compliance), simply invert the R-value, i.e.: $U = 1/R$. Note that U-factors of various wall components cannot be directly added together. To determine the overall cavity wall U-factor, first add the component R-values together, then determine overall U-factor by inverting the total R-value.

As an example, to determine the R-value of a concrete masonry cavity wall with 8 in. (152 mm) 105 pcf (1,682 kg/m^3) backup insulated with 2 in. (51 mm) of extruded polystyrene insulation in the cavity, first determine the R-value of the uninsulated wall from Table 1 (4.0 ft^2·hr°F/Btu, 0.70 m^2·K/W), then add the cavity insulation R-value from Table 2 (10 ft^2·hr°F/Btu, 1.8 m^2·K/W), to obtain the total R-value of 14.0 ft^2·hr°F/Btu (2.5 m^2·K/W). The corresponding U-factor for this wall is:

$U = 1/R = 1/14.0 = 0.071$ Btu/ hr°F/Btu (0.4 W/ m^2·K)

Calculations are performed using the series-parallel (also called isothermal planes) calculation method (refs. 1, 5). The method accounts for the thermal bridging that occurs through the webs of concrete masonry units. The method is briefly described on the following page, and its use is demonstrated on page 4 of this TEK.

Thermal values for concrete masonry walls are correlated to density, since the thermal conductivity of concrete increases with increasing concrete density. For each density, Table 1 lists a range of R-values as well as a single value, which represents the middle of the range. A range of thermal values is appropriate for concrete products because the thermal conductivity of concrete cannot always be accurately estimated from density alone. The thermal conductivity of concrete may vary with aggregate type(s), the mix design, moisture content, etc.

These published values reflect a compendium of historical data on thermal conductivity of concrete (refs. 1, 5). Locally available products and local conditions may result in thermal values which fall outside of this range. The middle-of-the-range values are presented for use in cases where more accurate values are not available from local manufacturers.

The values in Table 1 are based on an ungrouted backup wythe. However, the addition of grout to a hollow concrete masonry backup wythe does not significantly affect the overall R-value of an insulated cavity wall. For example, the R-value of a cavity wall with 8 in. (203 mm) ungrouted 105 pcf (1,682 kg/m^3) backup and 2 in. (51 mm) of perlite in the cavity is 9.3 hr·ft^2·°F/Btu (1.72 m^2·K/W). When the backup wythe is grouted solid, the R-value becomes 8.8 hr·ft^2·°F/Btu (1.67 m^2·K/W), a decrease of about 5 percent. With a partially-grouted backup, the difference in R-value is smaller than 5%.

Table 1—R-Values of Uninsulated Cavity Walls With 4 in. Concrete Masonry Veneer (ft^2·hr°F/Btu)[A]

Nominal thickness of backup, in.	Density of concrete used in concrete masonry backup unit (pcf): 85 range	85 mid	95 range	95 mid	105 range	105 mid	115 range	115 mid	125 range	125 mid	135 range	135 mid
4	3.8-4.0	3.9	3.7-3.9	3.8	3.6-3.8	3.7	3.5-3.7	3.6	3.4-3.6	3.5	3.3-3.6	3.4
6	4.0-4.3	4.1	3.8-4.1	4.0	3.8-4.0	3.9	3.6-3.9	3.8	3.5-3.8	3.6	3.4-3.7	3.5
8	4.2-4.4	4.3	4.0-4.3	4.2	3.9-4.2	4.0	3.8-4.1	3.9	3.7-4.0	3.8	3.6-3.9	3.7
10	4.2-4.5	4.3	4.1-4.4	4.2	4.0-4.2	4.1	3.8-4.1	4.0	3.7-4.0	3.8	3.6-4.0	3.7
12	4.3-4.5	4.4	4.1-4.4	4.2	4.0-4.3	4.1	3.9-4.2	4.0	3.8-4.1	3.9	3.7-4.0	3.8

[A] (ft^2·hr°F/Btu)(0.176) = m^2·K/W. Includes a minimum 1 in. (25 mm) nonreflective air space, and inside and outside surface air films (R ≅ 0.85). Mortar joints are assumed to be $^3/_8$ in. (9.5 mm) thick. For 4-in. solid concrete masonry veneer, subtract 0.45 from the R-values above; for clay brick veneer, subtract 0.40.

Table 2—R-Values of Cavity Insulation[A]

Insulation type	Insulation thickness, in.	R-value (hr·ft^2·°F/Btu)
Vermiculite loose fill	1	1.3
	2	3.6
	3	5.8
	$4^1/_2$	9.3
Perlite loose fill	1	2.2
	2	5.3
	3	8.4
	$4^1/_2$	13.1
Extruded polystyrene[B]	1	5.0
	$1^1/_2$	7.5
	2	10.0
	$2^1/_2$	12.5
	3	15.0
	$3^1/_2$	17.5
Polyisocyanurate[C]	1	8.3
	$1^1/_2$	11.6
	2	14.8
	$2^1/_2$	17.6
	3	20.8
	$3^1/_2$	23.9

[A] Values should be added to the values presented in Table 1 to achieve the total R-value of an insulated cavity wall.
[B] A minimum 1 in. (25 mm) nonreflective air space is included in the values in Table 1.
[C] Values adjusted to include a 1 in. (25 mm) reflective air space.

Table 3—R-Values of Finish Systems[A]

System:	R-value (hr·ft²·°F/Btu)
1/2 in. gypsum board on furring	1.4
1/2 in. foil-faced gypsum board on furring	2.9
Continuous rigid insulation, 1 1/2-in. metal furring (for electrical rough-in) and 1/2-in. gypsum wallboard:	
3/4 in. extruded polystyrene[B]	5.2
3/4 in. polyisocyanurate[C]	8.1
1 1/2 in. extruded polystyrene[B]	8.9
1 1/2 in. polyisocyanurate[C]	13.0
2 in. extruded polystyrene[B]	11.4
2 in. polyisocyanurate[C]	16.2
2 1/2 in. extruded polystyrene[B]	13.9
2 1/2 in. polyisocyanurate[C]	19.0
3 in. extruded polystyrene[B]	16.4
3 in. polyisocyanurate[C]	22.2

Wood furring, insulation (between furring) and 1/2 in. gypsum wallboard:	Furring strip spacing: 16 in. o.c.	24 in. o.c.
3/4 in. extruded polystyrene[B]	5.2	5.2
3/4 in. polyisocyanurate[C]	8.0	8.1
1 1/2 in. extruded polystyrene[B]	8.9	8.9
1 1/2 in. polyisocyanurate[C]	13.2	13.4
R-11 batt	9.6	10.2
R-13 batt	10.8	11.6
R-15 batt	11.9	12.9
R-19 batt	15.9	16.9
R-21 batt	17.1	18.3
Metal furring, insulation, and 1/2 in. gypsum wallboard[D]:		
R-11 batt	6.0	7.1
R-13 batt	6.5	7.7
R-15 batt	6.9	8.3
R-19 batt	7.6	9.1
R-21 batt	7.9	9.5

[A] Add values to those in Table 1 as appropriate.
[B] Values include a 3/4 in. (19 mm) nonreflective air space.
[C] Values include a 3/4 in. (19 mm) reflective air space.
[D] Values from ref. 3, Appendix A.

Table 4—Thermal Data Used to Develop Tables

Material:	Thermal resistivity (hr·ft²·°F/Btu·in)
Vermiculite	2.27
Perlite	3.12
Extruded polystyrene (XPS)	5.00
Cellular polyisocyanurate, gas-impermeable facer (refs. 12, 13)	6.5
Concrete:	
85 pcf	0.23-0.34
95 pcf	0.18-0.28
105 pcf	0.14-0.23
115 pcf	0.11-0.19
125 pcf	0.08-0.15
135 pcf	0.07-0.12
Mortar	0.10

Material:	R-value (hr·ft²·°F/Btu)
1/2 in. gypsum wallboard	0.45
Surface air films:	
inside	0.68
outside	0.17
Air spaces:	
3/4 - 1 in. nonreflective	0.97
3/4 - 1 in. reflective	2.80
4 in. hollow concrete masonry exterior wythe[A]	0.84
4 in. solid concrete masonry exterior wythe[A]	0.39
4 in. clay brick exterior wythe	0.44

[A] Applies to both full- and half-height units.

R-VALUE CALCULATION

The series-parallel calculation method is recommended (refs. 1, 5) for estimating R-values of concrete masonry walls. This calculation treats the block as a series of thermal layers, as illustrated in Figure 1. The face shells form continuous outer layers, which are in series with the layer containing webs and cores. The total R-value, R_T, of the block is the sum of the R-values of each layer, as outlined below. An example illustrating use of the equation is provided on the following page Note: When the core is partially filled (i.e. when using insulation inserts), the core is divided into multiple layers.

$$R_T = R_i + \frac{R_f R_m}{a_f R_m + a_m R_f} + \frac{R_w R_c}{a_c R_w + a_w R_c} + R_a + R_v + R_o$$

where:

a_c = fractional core area, seeSection A-A
a_f = fractional face shell area, see elevation
a_m = fractional mortar joint area, see elevation
a_w = fractional web area, see Section A-A
R_a = thermal resistance of cavity
R_c = thermal resistance of cores
R_f = thermal resistance of both face shells, r_c x ($2t_{fs}$)
R_i = thermal resistance of inside air surface film
R_m = thermal resistance of mortar joint, r_m x ($2t_{fs}$)
R_o = thermal resistance of outside air surface film
R_T = total thermal resistance of wall
R_v = thermal resistance of veneer
R_w = thermal resistance of concrete webs, r_c x t_w
r_c = thermal resistivity of concrete
r_m = thermal resistivity of mortar
t_{fs} = face shell thickness
t_w = length of concrete webs

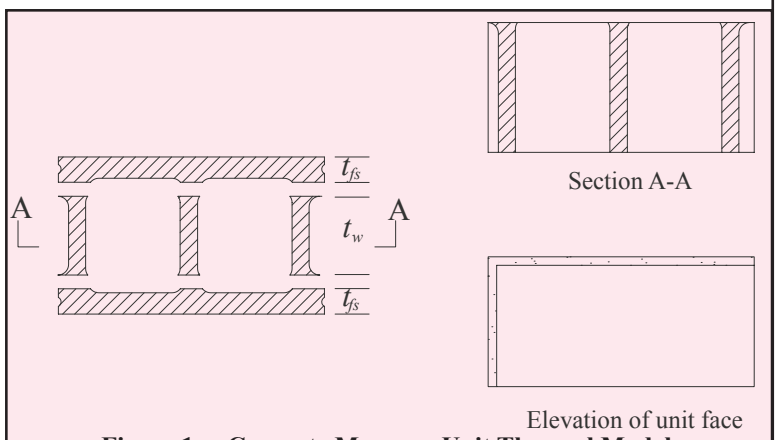
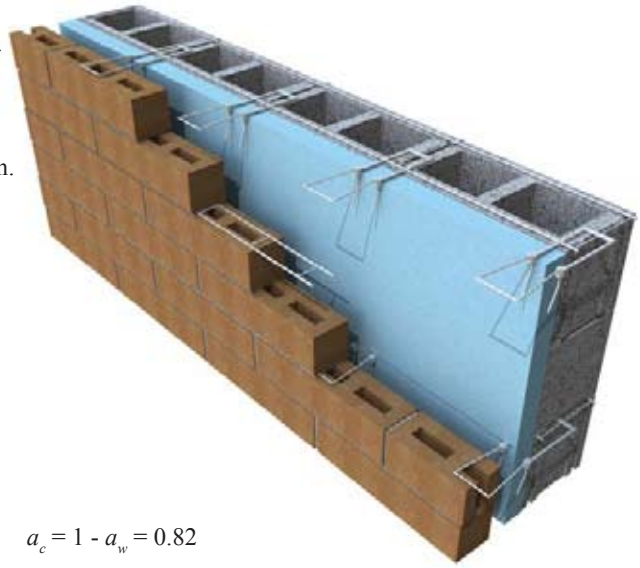


Figure 1— Concrete Masonry Unit Thermal Model

EXAMPLE R-VALUE/U-FACTOR CALCULATION



Determine the total R-value and U-factor of the masonry cavity wall shown below.

Calculate R-value of 8-in backup (series parallel calculation):

Given: r_c = 0.085 hr·ft²·°F/Btu·in t_{fs} = 1¹/₄ in.

unit length = 15⁵/₈ in. unit thickness = 7⁵/₈ in.

unit height = 7⁵/₈ in. mortar joint thickness = ³/₈ in.

r_m = 0.1 hr·ft²·°F/Btu·in t_{web} = 1 in.

R_i = 0.68 hr·ft²·°F/Btu R_o = 0.17 hr·ft²·°F/Btu

R_a = 0.97 hr·ft²·°F/Btu R_v = 0.84 hr·ft²·°F/Btu

R-value of cavity insulation (XPS) = 10.0 hr·ft²·°F/Btu

t_w = width of unit - $2t_{fs}$ = 7⁵/₈ in. - 2(1¹/₄ in.) = 5¹/₈ in.

Determine fractional areas:

Total face area of one unit and mortar joints (see Figure 1 elevation),

A_{tot} = 8 in. x 16 in. = 128 in.²

Face shell area = 7⁵/₈ in. x 15⁵/₈ = 119.14 in.² a_f = 119.14/128 = 0.93

Mortar joint area = ³/₈ in.(16 + 7⁵/₈) = 8.86 in.² a_m = 8.86/128 = 0.07

Web area = 3 x 1 in. x 7⁵/₈ in. = 22.87 a_w = 22.87/128 = 0.18 a_c = 1 - a_w = 0.82

Determine thermal resistances:

$R_f = r_c$ x ($2t_{fs}$) = 0.085 x (2 x 1¹/₄ in.) = 0.213 $R_m = r_m$ x ($2t_{fs}$) = 0.1 x (2 x 1¹/₄ in.) = 0.250

$R_w = r_c$ x t_w = 0.085 x 5¹/₈ in. = 0.436 R_c = 0.97 (nonreflective air space within masonry cores)

Calculate R-value of 8-in. concrete masonry unit:

$$R_{CMU} = \frac{R_f R_m}{a_f R_m + a_m R_f} + \frac{R_w R_c}{a_c R_w + a_w R_c} = \frac{(0.213)(0.250)}{0.93(0.250)+0.07(0.213)} + \frac{(0.436)(0.97)}{0.82(0.436)+0.18(0.97)} = 1.01$$

Calculate R-value of insulated cavity wall:

$R_T = R_i + R_{CMU} + R_{insulation} + R_a + R_v + R_o$ = 0.68 + 1.01 + 10.0 + 0.97 + 0.84 + 0.17 = 13.7 hr·ft²·°F/Btu

Calculate the U-factor of the insulated cavity wall:

$U = 1/R$ = 1/13.7 = 0.073 Btu/hr·ft²·°F

Note that with 2 in. of polyisocyanurate insulation and a reflective cavity air space, the calculations become:

$R_T = R_i + R_{CMU} + R_{insulation} + R_a + R_v + R_o$ = 0.68 + 1.01 + 13.0 + 2.67 + 0.84 + 0.17 = 18.4 hr·ft²·°F/Btu

$U = 1/R$ = 1/18.4 = 0.054 Btu/hr·ft²·°F

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Durable Community Fencing Improves the Property Value of Many Homes

Evergreen Community Association, Woodbury, Minnesota

PROJECT SIZE
1,400 ft (427 m) long; 8 ft (2.4 m) tall

MORTARLESS CONCRETE UNIT LICENSOR
Allan Block

MORTARLESS CONCRETE UNIT PRODUCER
Amcon Block, St. Cloud, Minnesota

CONTRACTOR
Sierra Exteriors, St. Paul, Minnesota

The Evergreen Community Association (ECA) in Woodbury, MN, an eastern suburb of Minneapolis and St. Paul, was sculpted on the site of a former Christmas tree farm back in 1980, and since that time, the population has quadrupled in the City of Woodbury. In 1985 the ECA constructed a 6'ft (1.8 m) cedar fence on the eastern edge to add a little privacy to the homes as the traffic increased along the bordering roadway. Now, 23 years later, the ECA was facing two major problems, deterioration of the existing fence and increase traffic noise.

PLAN

The existing cedar fence had deteriorated beyond repair and was becoming an eyesore. Since the main entrance to the association was framed on either side by this fence, the association was looking for a fence option that was maintenance free and enhanced the curb appeal of their main entrance. Simply replacing the fence with a second cedar fence was considered, but the future maintenance of a wood fence was not heavily favored.

Through their investigation, the Association found that a mortarless concrete unit fence would be the best option for the community.

- **Durability:** A system built using mortarless, stackable concrete units would have the proven performance of reinforced concrete and long term durability.

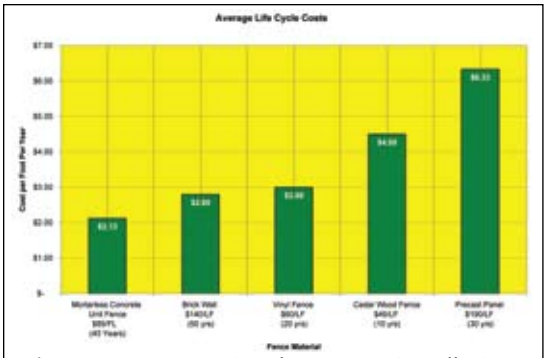


Figure 1. By comparing the average installation costs, expected life cycle of the product with any future maintenance costs, the concrete Fence provided the best value.

- **Cost:** A lower total cost when compared to other concrete fencing options. See Figure 1 for a cost comparison between different 8 ft (2.4 m) fencing options.
- **Aesthetics:** By combining four different unit shapes, an attractive pattern was created to best fit the look and feel of the surrounding area.
- **Sound Abatement:** A concrete product would provide the best sound barrier from the traffic noise coming from the four lane road that ran along the eastern border of the development. See Figure 2 for a comparison of sound transmission between fence construction material

DESIGN

The new fence was to be located in the same place as the existing wooden fence; however, this required a little creativity in design and layout. The fence height was expanded to 8 ft (2.4 m) to further reduce noise transmission. The fence needed to accommodate over a 40 ft (12.2 m) grade change, which meant the panels had to step down at both the post locations and, at times, within the panel itself.

Designers from the fence licensor worked with the ECA to come up with the preliminary design for the Fence. The fence was designed with a wind loading of 80 mph (129 Km/hr) with moderate exposure. This design allowed the 8 foot (2.4 m) tall fence to have spacing between the posts of over 16 feet (4.9 m). The designed pile footings for the fence were 2 ft (0.6 m) in diameter and 4.5 ft (1.4 m) deep, however the City required a 5 ft (1.5 m) minimum depth. The panels were designed with reinforced bond beams located at the top and bottom of the panel sections. The bond beams were constructed by using a # 4 (M# 13) reinforcing steel between two courses of block that were grouted together. Since the panel sections were 12 courses tall, this meant that eight courses for a total height of 5.3 ft (1.6 m) were dry stacked between the bond beams making the pattern easier to install. To carry the same look throughout the full panel, a single course pattern was used to build the bond beams. The design also called for flipping random blocks around to change the appearance of the fence. This ensured that both sides of the fence had the aesthetics of a random pattern.

Additionally, water management was crucial. There were specific drainage points that the City of Woodbury required to be maintained to ensure that backyards would not flood. Working with the City to identify these areas, the contractor, Sierra Exteriors, was able to construct the bottom bond beam with openings to allow any water to flow through the fence.

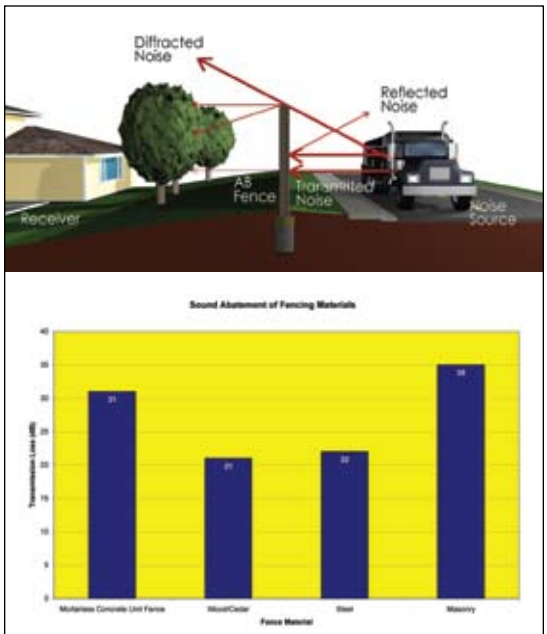


Figure 2 The chart compares the transmission loss in decibels (dB) of different fencing materials. By using the SRW Fence, the sound was reduced by twice as much when compared to a wooden or vinyl product.

BUILD

Construction began in November which allowed the contractor to keep his crews busy during the winter months. Like any successful fence project the contractor started with marking out the proper locations for the pile footings. As the pile footings were being excavated, they encountered boulders and rocks below grade. Each rock had to be removed to maintain the proper location of the post. The pile footings were then filled with concrete and jigs were used to ensure that the vertical steel was properly positioned.

Once the footings were completed, the posts and panels of the fence were started. The fence design used the full sized panel blocks for the base. This made it easier to install the panels straight and level and simplified the installation of the reinforcing steel and 9 gauge wire stirrups through the bond beam. To finish the bond beam the cores of the panel blocks were filled with concrete. Because of the winter conditions, the contractor did have to protect the fresh concrete when the temperature dropped below freezing during the evenings. Temporary tents, heaters and insulated blankets were used throughout the project.

With the high visibility of the project, everybody was interested in the color of the unit and the pattern options for the fence. The manufacturer provided a beautiful three colored blend unit for the project. To add to the random pattern look of the pattern, random units were flipped backwards to create a change in the face appearance. This meant that both the City of Woodbury and the homeowners enjoyed the beautiful aesthetic color and finish of the mortarless concrete unit fence. A local building inspector from the City of Woodbury commented that, "This fence has just set the standard for the fence projects in the City and it has exceeded our expectations". **CMD**

SHARING THE COST

According to Money Magazine, home hardscaping can bring a recovery value of 100 to 200 percent at selling time. The whole Evergreen community was bound to benefit from the fence upgrade, but the ECA understood that homes that bordered the eastern edge would receive the maximum benefit from the sound reduction and the property enhancement and therefore, the ECA proposed that these homeowners paid 50% of the cost while the ECA would pay for the remaining 50%. By dividing up the cost this way, each residence only paid $125, and will likely get a large return on that investment through increased property values and noise abatement.

Versatile Wall and Paver System Create a Dramatic Retreat

Private Residence, Delaware, Ohio

ARCHITECT
Garry Ferrell, Wilson Landscape Associates, Columbus, Ohio
MASONRY CONTRACTOR
Wilson Landscape Associates, Columbus, Ohio
SRW AND PAVER LICENSOR
Versa-Lok
SRW AND PAVER PRODUCER
Oberfield's Inc., Columbus, Ohio

When Garry Ferrell was called in to create an inviting and impressive outdoor living space for a private residence in Delaware Ohio, the owner was concerned about the site. "They wanted a series of outdoor living and entertaining spaces, but worried about fitting them all in with the dramatic changes in grade on the property," says Ferrell. "I assured them that with a concrete SRW [segmental retaining wall] and paver system, it could be done. I knew that free standing walls, screening walls, retaining walls, planters, stairs, pavement, pool decking, and mosaic columns could all be coordinated into a hardworking, yet attractive design."

Starting in the front of the house, Ferrell's crew built steps and tiered walls to tie the grade changes together to give the impression that the house is elevated high on a hill. The dramatic entrance to the house features curved retaining walls that double as seat walls surrounding planting beds.

The backyard design was intended to lead visitors out the back door, through the upper wooden deck to the uppermost tier of the paver patio system that progresses to the lower tiers featuring a swimming pool, grill unit, hot tub, gas fireplace, and numerous planters. "This project really shows off the versatility of these [SRW] units, within one wall you can see them function as a seat in one section to an 11 foot retaining wall in another section. The material proved to be an excellent choice for encasing the gas grill and fireplace. It provides a sturdy frame while maintaining a naturalistic appearance," says Ferrell.

When the project was completed, the variance in grade was not so much a detriment to the design objectives, but rather an asset. "The nature of the site allowed us to incorporate a multi-level plan that worked well with the terrain and visually enhanced the outdoor living spaces," shares Ferrell. "The owner told me that his expectations for a flowing series of spaces for relaxation, recreation, and entertainment that blend in with the surroundings were exceeded. This one is a success story." **CMD**

BUILDING A FIRE PIT

Homeowners are requesting fire pits for their outdoor entertainment area; this can be easily accomplished through the use of a flexible SRW system.

STEP 1: LAYOUT
Determine the location of your fire pit. Then lay out the first course of blocks to find the size of your fire pit and establish where the sod and soil will be removed to construct the base.

STEP 2: BUILD THE FOUNDATION PAD
Mark the location of the blocks with a shovel, remove the blocks and sod, and dig a level trench that is 3 in. (75 mm) deep and 7 in. wide (178 mm). Fill the trench with crushed rock and compact using a hand tamper. NOTE: The soil beneath the foundation pad must be a good quality compactable material. If soft soils are encountered, they will need to be removed and replaced with additional crushed rock. A good foundation will ensure a stable wall for years to come.

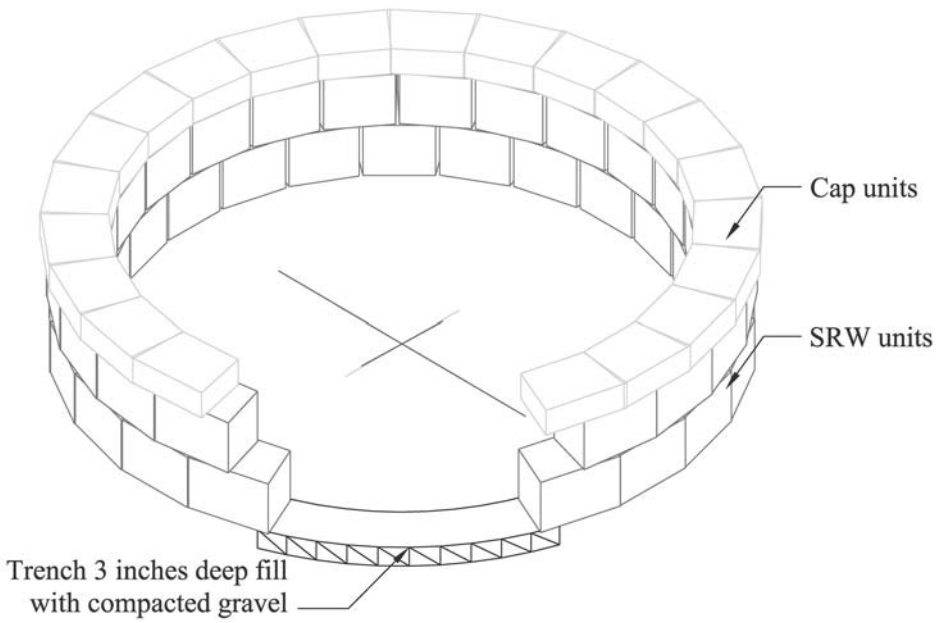
STEP 3: LEVEL
Place 4 blocks at the cross points of the circle. Use a straight 2" x 4" and a level to check the entire trench for level. Make adjustments as necessary by adding or removing crushed rock.

STEP 4: BUILD THE FIRST COURSE
Place the base course of block on the foundation pad, checking each block for level from front to back and side to side before placing the next block. This will ensure a level base course.

STEP 5: BUILD THE SECOND COURSE
Stack the next course of blocks, making adjustments as necessary. Once the second course is installed, remove any sod or vegetation from the center of the fire pit area. Lay in approximately six 50 lb (23 kg) bags of clean rock within the circle to cover the bottom of the fire pit. Then using a shovel, rake it smooth.

STEP 6: INSTALL DECORATIVE ROCK AND FIRE RING
Install decorative rock to line the interior of the fire pit (optional). Then place an iron fire ring in the center of the fire pit area.

STEP 7: INSTALL WALL CAPS
Finish the fire pit with wall caps. Once all the caps are installed, secure them in place with a bead of masonry adhesive on both sides of the raised rings



Learning Units Reporting Form

AIA QUESTIONS (CIRCLE THE CORRECT ANSWER)

1. **To design fences wind loads, exposure and height are considered.**
   a. True
   b. False

2. **Fences are provided with a foundation.**
   a. True
   b. False

3. **On the featured story, what grouting system did the fence require?**
   a. Solid grouting
   b. Two bond beams were grouted
   c. No grouting was necessary

4. **What protection the contractor used to guard the fresh concrete from the freezing conditions during construction?**
   a. Temporary tents
   b. None. There is no need to protect concrete from freezing temperatures.
   c. Heaters and insulated blankets
   d. a and c only.

5. **What is the minimum recommended base thickness for paver installation for pedestrian use?**
   a. 12 inches minimum.
   b. 4 to 6 inches.
   c. 2 inches.

6. **What are the advantages of using a mortaless concrete unit fence as sound barriers?**
   a. Durability and cost
   b. Aesthetics.
   c. Sound abatement.
   d. All of the above.

7. **What are the phases the sound is distributed around a sound wall?**
   a. Diffracted noise
   b. Reflected
   c. Transmitted
   d. All of the above
   e. b and c only

8. **To achieve a good base to install a fire place, what material needs to be placed?**
   a. Compacted clean gravel.
   b. Compacted natural soil.
   c. All of the above.

9. **What materials are more efficient to abate sound on sound fences?**
   a. Wood and steel fences
   b. Masonry and SRW units
   c. All of the above.

10. **According to Money Magazine home hardscaping can bring a recovery value of:**
    a. none
    b. 60% when selling
    c. 100 to 200% at selling time
    d. 30% when selling

To receive one learning unit, read "Elevate Property Values by Going from Good to GREAT" on page 4, "Durable Community Fencing Improves the Property Value of Many Homes" on page 9, "Versatile Wall and Paver System Creates a Dramatic Retreat" on page 18, and "Detail of the Month" on page 22

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March 2009

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