

Concrete Masonry



DESIGNS

the **Breaking**
MOLD
in **Schools**



For Smart Schools, Concrete Masonry Gets an A+

When the carefree days of summer wind down for school-aged children, parents and children begin to focus on the upcoming school year. With children spending as many as eight hours a day in school, parents have good reason to be just as concerned about their children's safety when they're at school as they do when they are at home. The correct choice in school building materials can prevent and mitigate a number of potential threats, keeping children safe and keeping the

focus on learning.

Whether it's the "Kids First Approach" in the Northern Lebanon Pennsylvania school district, or masonry-only school construction in the Canton, Texas school district, communities of parents are learning that they must insist upon safe, healthy environments where kids can learn. They are also realizing how the properties inherent in concrete masonry make it an exceptional choice for school construction.

Concrete masonry provides

building security, durability, fire safety, easy maintenance, low cost, energy efficiency and noise management. Just as importantly, concrete masonry does not provide a ready food source for mold.

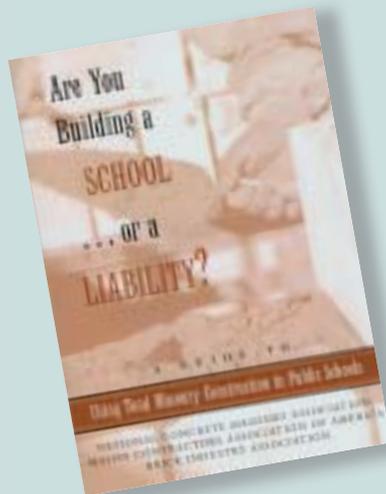
Many community schools constructed from the late 1980s to early 2000 were built using materials that do provide a ready food source and are disintegrated by mold. Even worse, many have found that roof leaks, wall leaks, window leaks or plumbing failures have damaged the material installed to protect the buildings. Concrete block is a material that can be cleaned and dried easily and will not be destroyed by mold.

A new book on the subject of mold in schools, *Are You Building a School or a Liability?* is available at no cost to architectural firms specializing in school building construction. If you are an architect or designer focused on school construction, you may request a free copy of this book by sending a letter written on your company letterhead stationery to National Concrete Masonry Association, 13750 Sunrise Valley Drive, Herndon, Virginia 20171.

Remember...school construction choices impact everyone in a community—children, parents, teachers, school administrators and taxpayers. The next time a school is being constructed in your area, insist upon concrete masonry. ■

School architects and designers!

Get your **FREE** copies today.



e-mail pfoldes@ncma.org and request your copy of this important book.

Concrete Masonry

8/04 DESIGNS



ON THE COVER:

Breaking the Mold in Schools: Mold growth requires moisture, oxygen and an organic food source such as found in paper and wood building materials. Concrete masonry, however, is not a food source for mold. That's just one of the many advantages of using concrete masonry in construction projects of all types. See the lead story on page 4.

Concrete Masonry Designs showcases the qualities 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 and segmental retaining walls; and other concrete masonry products around the world. We welcome your editorial comments, ideas and submissions.

It is the policy of **Concrete Masonry Designs** magazine to provide the names of authors of articles appearing in the magazine upon request.

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Concrete Masonry Designs is published monthly by the National Concrete Masonry Association and distributed to advance and support the concrete masonry industry and the public interest through research and educational programs designed to meet the future needs of the industry.

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The Magazine Group, Inc.

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Forgive

A new book argues that school districts need to insist on building materials that will stand up to mold and give taxpayers their money's worth.



LEARNING OBJECTIVES:

After reading

this article, you should understand:

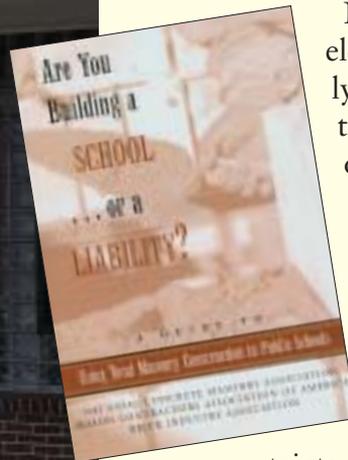
1. Ways to design buildings for mold control.

& Forget

In 1972, the Canton school district, a modest community some 60 miles southeast of Dallas, put up a metal building as an answer to the high school that the community had outgrown. “We tore it down last year,” says school Superintendent Larry Davis.

Not far away stands an elementary school of roughly the same vintage. Unlike the high school, it was built of concrete block. Not only is it still in use, Davis says, it hasn’t even needed a new coat of paint since its doors first opened in 1976.

Canton is one of several Texas school districts profiled in “Are You Building a School...Or a Liability?” published this year by the National Concrete Masonry Association, Texas Masonry Council, Masonry Contractors Association of America and Brick Industry Association. Written for the lay reader—no mind-numbing engineering specs or industry code here—the 64-page book makes the case that “Total Masonry Construction” is the most cost-effective and aesthetically pleasing system for building schools in the long term.



In a state where mold in schools has made national headlines and school buildings only 20 years old are slipping into decrepit old age, communities that sought to build cheap and fast are finding that their initial savings are not paying off, the book argues.

“We’re planting seeds. We want people to begin asking questions,” says Kyle Montgomery, executive director of the Texas Masonry Council, a 120-member organization based in Austin, representing commercial masonry contractors and suppliers in the state.

The book encourages school districts and school designers to ask: How can we make sure that the next school we build is a masonry building?

“We want to educate the client and architects so they better understand material selection,” says architect Chris Huckabee, president and CEO of Huckabee, Inc. Huckabee wrote “Are You Building a School... Or a Liability?” largely based on the lectures he gives on the advantages of masonry con-

“A combination of 8-inch [203-mm] concrete unit masonry backup and face brick outside with a 2-inch [51-mm] cavity provides a superior system that has also proven to be low-maintenance.”

struction. Montgomery also contributed to the book.

Based on the Canton school district’s experience, Larry Davis says he will push for only masonry buildings from now on. “Our district has traditionally been poor, so it’s important to give the taxpayers their money’s worth. If we’re not going to build something of quality, we’re just not going to do it.”

Addressing the Envelope

In six chapters, the book discusses mold, the importance of a strong building envelope, and the basic details and costs of what “Are You Building a School...” calls “Total Masonry Construction”—which utilizes exposed architectural masonry for structural support in exterior walls as well as interior partitions. The book also includes case studies and success stories, and does battle against other building systems.

The two most important factors contributing to a long-lived, sustainable, cost-effective school that



requires little maintenance, according to the book, are forgiving materials and redundancy.

A forgiving material is any material that is not destroyed by a moisture event, such as a leak. Designers and building owners must think about the life cycle of a building during the selection of a material. Most buildings will experience roof leaks, plumbing leaks or building movement that may lead to wall leaks. Material that is forgiving will allow for these breaches and allow the problem to be repaired without destroying the building material surrounding the breach. If a forgiving material encounters mold growth, the extent of repair will be to stop the moisture source and clean up the material. Material replacement will not be required and thus the cost of mold remediation will be minimal.

Redundancy is recognition that construction is not perfect. It also recognizes that during the lifetime of a building, many elements may affect the performance of the envelope. With redundancy, the wall system



Canton Intermediate School

itself can be designed with several backup systems that are designed to take moisture away from the envelope if the primary system is breached. Not only that, a redundant wall system can do this while also providing structural support and interior walls that would be an additional expense with systems that use steel studs and sheathing as the backup to the veneer.

“That’s the bottom line,” Huckabee says. With his corporate headquarters in Fort Worth, and offices in Dallas and Austin, Huckabee’s firm works on eight to 12 public school facilities a year, offering architectural, engineering and program management services. He’s become a Johnny Appleseed for masonry buildings, extolling the advantages of block in speeches he gives around the country.

“I spend a lot of time helping school clients clean up their messes—their mold and maintenance problems,” he says. “They don’t trust architects and they don’t trust contractors.” Huckabee hopes that by putting his book in the hands of school officials and

architects, they can make the choices that will ultimately rebuild that trust.

It was at one of Huckabee’s presentations that the idea for the book began to take shape. Montgomery was in attendance. “I wondered how we could take his presentation and do more with it,” Montgomery says.

The first print run in January of “Are You Building a School...” was 1,000 copies. The Texas Masonry Council is printing another 3,500 copies, Montgomery says. “Most of the folks buying it are our members buying in bulk to distribute,” he says. The 1,400 school districts in Texas are receiving copies. And state masonry associations in Pennsylvania, Arizona, Utah, Colorado and Washington are using the book. Since then, the National Concrete Masonry Association, Masonry Contractors Association of America and Brick Industry Association have also published the book and are selling it.

This School Is Delicious

The nationwide mold scare, which has hit Texas particularly hard, has created an opening for marketing all-masonry design.

“Why has mold suddenly become such a hot topic?” the book asks. “The answer is simple. Material selection in the past 15 years yields little tolerance for mold.

“Moisture is primarily kept from the building through the roof and wall systems,” it continues.

Built of a forgiving material—concrete block—and with a redundant design that can reduce the likelihood of water infiltration and the growth of mold, Mansfield’s new schools can be places of uninterrupted learning for generations.

“Unfortunately, as roof systems have greatly improved, wall systems have trended toward cheap and fast systems that require less-skilled labor and less time to install. It is this short-sighted trend that is the single greatest factor in the mold crisis that we know today.”

So while students are lunching in the cafeteria, mold is making a meal of the school building itself.

“Are You Building a School...” faults the popular, fast and inexpensive steel-frame-and-stud building system for the mold crisis.

Over the past 15 years or so, this assembly has typically been covered with an interior sheathing made from gypsum. This sheathing has a paper-faced covering with a gypsum core. Normally this wall system has a covering called a veneer. The veneer is provided in many forms: brick, stucco and stone. Unfortunately designers and installers have failed to recognize that veneers are simply a nice covering that will at some point still allow moisture through to the material beyond. As moisture breaches the veneer covering, it settles on the sheathing. As the sheathing becomes saturated with moisture, the environment becomes ripe for mold growth.

Porous and paper-made products are destroyed by mold, according to the book. “In fact, the mold actually consumes this material as a food source.”



The answer, then, is block, and Total Masonry Construction, which has the virtues of being both forgiving and redundant.

“A combination of 8-inch (203-mm) concrete unit masonry backup and face brick outside with a 2-inch (50-mm) cavity provides a superior system that has also proven to be low-maintenance,” the book says.

That’s the lesson they’re learning in the Mansfield School District, between Dallas and Fort Worth. Mansfield, which is offered as a testimonial in “Are You Building a School...” has spent the last few



years bouncing between being the first- and third-fastest growing school district in Texas. In the last couple of years, Mansfield has seen an annual student increase of 13%—or about 2,200 additional desks each fall, according to Rick Cash, the district’s assistant superintendent of operations.

With that kind of growth, Cash clearly has his hands full. “We’re going to open six schools this fall. Two more we’ve broken ground on and we have six more that are in some phase of design,” he says. “That will take us through 2006.”

All the new buildings will be constructed entirely out of masonry. The 2-year-old Mansfield High School is typical. Designed by Huckabee, the \$36.6 million, 392,000 ft² (36,417 m²) facility doesn’t skimp on quality. In addition to the concrete block, the high school was built with terrazzo floors, a contributing factor to the higher up-front costs of the new school.

“We built some buildings in the early 1990s using a lot of gypsum. It cost from the high \$70s to low \$80s per square foot,” Cash says. “Masonry buildings with terrazzo floors run in the low \$90s.”

It’s the lifetime cost of the masonry buildings where Cash looks to come out ahead. Block saves on maintenance. “It’s much easier to wash block than it is gypsum. In the long haul we think we’ve

actually saved money.” And because block provides a higher level of fire resistance, insurance costs are down, too, he says. Metal-stud-and-sheathing construction looks even less attractive, now that the price of steel is rising, he adds.

Cash is not a fan of tilt-up construction, another concrete alternative. “We didn’t think we could get the same aesthetics that we could with the brick and block.” The new schools rising in Mansfield are “just gorgeous buildings. I don’t think we’ll ever see a day that we aren’t doing what we are doing now.”

Cash expects that in 60 years, long after his schools are paid for, Mansfield High and the district’s other new schools will still be in use—and, except for utility systems, practically maintenance-free. Built of a forgiving material—concrete block—and with a redundant design that can reduce the likelihood of water infiltration and the growth of mold, Mansfield’s new schools can be places of uninterrupted learning for generations.

The alternatives provide stark and sad lessons, which the author of “Are You Building a School...Or a Liability?” hopes to warn against. “I’m tearing down a 3-year-old school right now and working on a 2-year-old school that’s completely abandoned,” Huckabee says, “the taxpayers have 28 more years to pay on that building.” ■

THE *Kids First* APPROACH

The “Kids First Approach” in the Northern Lebanon, Pennsylvania, school district means building schools that create a safe, healthy environment where kids can learn. Under this approach, school construction projects are designed with a focus on building security, fire safety, maintenance, durability, energy efficiency and noise management. But topping the list is the remediation and control of mold.

“As a superintendent, mold is a four-letter word,” said Dr. Don L. Bell, superintendent of the Northern Lebanon School District. Bell has spearheaded the “Kid’s First Approach” and supports concrete masonry design as one of the best ways to achieve this approach. He has made presentations before the Pennsylvania School Board Association and House Appropriations Committee on Education and currently serves on the Pennsylvania Governor’s School Construction Task Force.

In 2002, when Bell began plans for the addition and renovation of Northern Lebanon Middle School, he and architect Jay Darkey of JPD Architects agreed to build with concrete masonry. “We have a vision to prevent mold in the first place and concrete masonry is one of the best construction materials to prevent mold. I have seen the benefits of using concrete masonry in the past and the horror stories when it was not used,” said Bell who has been a teacher and administrator in three different Pennsylvania public school systems for more than 18 years and has been involved with six separate building projects.

“As far as mold goes, it is a hot issue right now,” said Darkey, explaining that architects must address moisture in design and that masonry is one of the best ways to do that. “The structure has to be detailed properly to address any potential for moisture getting in the walls. Traditional masonry cavity wall systems have built-in weeps and venting systems to allow the moisture to escape so mold will not grow.”

The intrinsic properties of concrete masonry make it virtually impervious to mold growth according to Jan Boyer, executive director of the Pennsylvania Concrete Masonry Association “Masonry does not provide a ready food source for mold and if there is a mold problem it is easily remediated by cleaning it instead of replacing the entire wall,” said Boyer, who recently asked Bell to create a program for her organization that will be presented at American Institute of Architecture meetings. “In Pennsylvania especially, masonry is used heavily in the school context because it is mold resistant.”

Northern Lebanon Middle School’s construction project added a new 50,000 ft² (4,645 m²) wing and a new roof to the 155,000 ft² (14,399 m²) building. There are 12 new classrooms, an office area, a teacher’s workroom, a new gym and locker rooms and a satellite cafeteria. Existing classrooms were gutted and now house a new art classroom, music area and family and consumer science area.

Darkey says they used a standard 8 × 8 × 16 inch (203 × 203 × 406 mm) concrete block as the finishing material that was sealed and painted for the

“Masonry does not provide a ready food source for mold and if there is a mold problem it is easily remediated by cleaning it instead of replacing the entire wall.”



interior walls. The exterior walls are a masonry veneer over a 8 x 8 x 16 inch (203 x 203 x 406 mm) concrete block cavity wall system. “The facing masonry was a combination of brick that matched the existing building and split face concrete block that is maintenance-free and adds a texture and a color that is integrated throughout the perimeter brick,” he said.

During the roof replacement phase of construction the benefits of using concrete masonry as a mold deterrent came into play. A section of the roof leaked into a classroom behind old wooden cabinets and mold started growing in the wood. “We saw it on a Friday morning and contacted the state and had a test done that day and they reported it was mold,” said Bell. “That afternoon we closed that hallway down and had people come on Saturday and take all the wood cabinets out, clean the concrete masonry wall, and Sunday did an air quality check and it was clear. So Monday morning we were right back in there. There was no down time because of the ease of clean up.”

Along with using concrete masonry to address mold issues, other health and safety issues under the “Kid’s First Approach” were solved by using concrete masonry design at Northern Lebanon Middle School.

Building security was handled using concrete masonry in the main entranceway. “We are conscious that we have to be public-oriented but also have to present some type of barrier for the children’s safety,” said Bell explaining that the school’s

main entrance is designed with two doorways. “You cannot go inside the interior doors without being buzzed in and those doors are set in concrete masonry.” A similar block interior doorway is in place where the middle school is connected to the high school.

With 425 active seventh and eighth graders the school’s interior concrete masonry walls provide a sound barrier for high noise areas such as the gym and lunchroom. They also provide secure anchoring for the school’s railings, partitions, water fountains, televisions and VCRs. “When you anchor them on something that is secure you do not have to worry about things being yanked off the wall,” said Bell.

“Vandalism is something to consider when you design a school,” said Darkey. “You are not going to be able to knock masonry walls down and if there is any vandalism, even if it is graffiti, you can paint over it or remove it with some type of cleaner.”

Cost is another factor that led to the decision to use concrete masonry at Northern Lebanon Middle School. Bell explains that because the design was focused on concrete masonry from the start, decisions were quick and designs did not have to be redrafted. “We saved about \$700,000 in the middle school project itself because we knew

NORTHERN LEBANON MIDDLE SCHOOL

Architect:

Jay Darkey, JPD Architects

General Contractor:

Lobar, Inc.—Carl Barker,
project manager

Masonry Contractor:

Caretti Masonry, Inc.

Project Size:

new addition: 50,000 square feet/
renovation of existing building:
155,000 square feet

General Contracting

Construction Cost:

\$7 million

Total Building Costs:

\$10.5 million

Cost of Masonry:

\$1.2 million (materials and labor)

Completion Date:

August 30, 2003



“We are fortunate in Pennsylvania in that most schools are made of masonry and if Dr. Bell has his way, even more schools will be using masonry.”

what we wanted so the response time was quick,” he said.

Energy efficiency was also a factor. “It is absolutely critical to get the building tight and super-insulated so you can maximize energy savings,” said Darkey. “Whatever wall system you use, every material is given an R-value. Concrete masonry has built in cores that can be left as air spaces or you can add insulation. So when you add that in to the other actual insulation and facing materials, you get a fairly well insulated wall.” The school construction included super-insulating the roof and using a polystyrene insulation in the walls to get a higher R-value. By reducing the cooling and heating loads, they were able to use smaller, less expensive HVAC units.

Darkey also says that concrete masonry is a key ingredient for fire safety. “You have a fire rated wall with an 8-inch (203 mm) block so you do not have to worry about covering it or putting up gypsum board for fire protection, it already has a natural rating.”

After 18 months of construction, Northern Lebanon Middle School opened its doors in August of 2003 and has preformed to everyone’s expectations. “In an educational career of about 18 years I have had a lot of building projects and I have seen the good and the bad and I am pleased to say I think we got this one right,” said Bell.

Boyer adds, “We are fortunate in Pennsylvania in that most schools are made of masonry and if Dr. Bell has his way, even more schools will be using masonry.” ■

A Burning Lesson in Fire Safety and Masonry

Dr. Bell knows first hand the protective properties of masonry in terms of fire safety. While principal of a high school, there was a fire on a Saturday when no one was in the school.

“The fire completely gutted the room itself but it was contained just to that classroom because of the concrete masonry construction,” said Bell. “It did not spread to any other rooms.”

Work to restore the school began that evening and through the weekend with the installation of temporary walls and doors. But because everything was isolated in one room, the school was open on Monday, except for the HVAC. “The only reason the high school kids were not in there Monday was that smoke and soot got into the HVAC system and that needed to be cleaned,” Bell said, adding that classes resumed on Tuesday, just three days after the fire. “You only have to live that once to realize what you want in the future. I was a witness to compartmentalizing with concrete masonry and how that reacts in a fire. It solidifies the fact that you want it in the future.”

■ **Annotated Guide To Masonry Specification (TR-188)**, prepared by The Masonry Society (TMS), provides a detailed overview for the preparation of a unit masonry specification. Professional price: \$28

■ **Metric Design Guidelines for Concrete Masonry Construction (TR-172)**, developed in cooperation with the Construction Metrication Council, represents the industry's official recommendations for utilizing soft metric units in hard metric projects. Outlines how to cost effectively utilize soft metric units and minimize cutting. Available free online at www.ncma.org/online/metric.html
Professional price: \$2.85



■ **Annotated Design and Construction Details for Concrete Masonry (TR-90)** is a new 331-page manual of details and commentary addressing all aspects of concrete masonry design and construction. Users of this resource can access images in multiple file formats: AutoCAD (DWG format), DXF files, PowerPoint or word processing programs (WMF or GIF) as well as DXF and PDF for importing into graphics programs for brochures and other documents. Professional Price: Manual and CD is \$98.00. The CD may also be purchased separately at \$70.00 for professionals.

■ **Concrete Masonry Design Tables (TR-121)** presents axial and flexural design strengths and section properties for 6-, 8-, 10- and 12-inch (152-, 203-, 254- and 305 mm) reinforced and unreinforced concrete masonry walls. This edition includes diagrams and combined axial/flexural loading tables for easy solutions to multiple loading conditions. Professional price: \$74



■ **NCMA Masonry Design Software (CMS 10)** performs concrete masonry designs according to the 95, 99 and 02 Building Code for Masonry Structures (ACI 530/ASCE 5/TMS 402) and the 2000 International Building Code including allowable stress and strength design. It considers the effects of axial and lateral loads and generates a single moment/load interaction diagram or family of interaction diagrams as a function of steel spacing for easy design optimization. Includes design of concrete masonry and precast lintels. Professional Price: CMS 10 Upgrade from previous version CMS 12111 is \$80.00. CMS 10 software is \$200.00. The software and **Concrete Masonry Design Tables** (see above) can be purchased together for \$259.

■ e-TEK and e-Details

NCMA's TEK series and details are available online FREE to architects, engineers and specifiers. The TEKs include more than 150 technical bulletins on various topics related to concrete masonry with a new TEK published monthly. In addition, many others are revised and updated as necessary to reflect code or building design changes.

The Web site-accessible e-TEK and e-Details service can be reached through NCMA's member Web sites that sponsor the program. A listing of sponsors with hot-links to their sites can be found at www.ncma.org. Click on the "Select Your State" pulldown menu and then select your local concrete masonry producer. Click on "Technical Details" for e-Tek or "Technical Manual" for e-Details. e-Details has all drawings downloadable in various electronic formats including DWG for AutoCAD and DXF. This service allows viewers to be supplied with the latest up-to-date information on concrete masonry. For those who still prefer the hard copies, they are available from NCMA at www.ncma.org or by calling the publications department at 703.713.1900. ■

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CM

PROFILES



LEARNING OBJECTIVES:

After reading this article, you should understand:

1. design requirements for safe rooms or missile barriers.

Safe Room

Importance Grows

Near Schools

School districts are selecting concrete masonry for safe room construction because it is cost effective, reliable and ready to install.

Tornadoes have been known to strike every U.S. state, including Alaska and Hawaii. But most tornadoes form in a belt from Nebraska southward through Kansas and Oklahoma, into central Texas, infamously known as “Tornado Alley.” Tornadoes also frequently occur in the southeastern United States. Tornadoes often strike quickly and suddenly, causing a great deal of destruction. During one week in May 2003, a series of tornadoes swept across the country, resulting in disaster declarations for nine states and causing hundreds of millions of dollars in damage. Studies show that more than 80 percent of the total property damage from natural disasters in the United States is due to extreme wind.

Concrete masonry has come through some of the most severe windstorms virtually unscathed—storms that in some cases leveled neighboring subdivisions. The inherent strength of concrete masonry can be used to withstand both



In an effort to protect the nation's public school students, several school districts in Tornado Alley are designing safe rooms that will withstand the tornado-force winds. These winds often reach speeds up to 250 mph (402 km/h). In 2001, Wichita, Kansas, public schools received more than \$1.7 million in federal funds for school safe room construction.

Part of the educational program in Arkansas public schools is teaching children how to take cover in school hallways when tornadoes strike the area. Arkansas gets hit with an average of 21 tornadoes a year. In February 2003, the Federal Emergency Management Agency (FEMA) awarded the State of Arkansas grants totaling more than \$25.5 million to construct 54 safe rooms throughout the state.

Studies from Texas Tech University indicate that a tor-



the high winds associated with tornadoes, as well as wind-born debris—the largest threat to occupants in these storms. With concrete masonry, designers and builders can offer a higher level of protection in buildings with outstanding beauty, security and durability.

As well as destroying property, tornadoes can hurt and even kill. Approximately 82 people are killed every year in the U.S. due to tornadoes. Tornadoes strike with incredible speed and little or no warning, carrying wind speeds up to 300 mph (483 km/h). As the wind picks up, any loose outdoor items, trees and even automobiles can be launched by the storm. This is by far the greatest threat to safety—the thousands of pieces of flying debris. It is, obviously, a threat to anyone caught outside, but it is also a significant threat to homes and buildings—once the envelope of the building is penetrated, few structures can survive. Keeping the building envelope intact becomes the first priority to protect occupants.

nado safe room is a solution that will keep occupants safe from extreme wind events. The materials selected to design safe rooms must meet the challenge of standing up to the strong winds and flying debris of the tornadoes. While FEMA gives some building material choices for these safe rooms, concrete masonry is a primary selection because of its cost, availability and installation time.

Research by the Texas Tech University Laboratory has demonstrated that both 6- and 8-inch-thick (152- and 203-mm) concrete masonry walls that are fully grouted with concrete and reinforced vertically with no. 4 (m# 13) reinforcing steel bars in every cell can withstand the impact of a nominal 2 x 4 inch (50 x 101 mm) wood stud weighing 15 pounds (6.8 kg) striking perpendicular to the wall with speed in excess of 100 mph (161 km/h) (Ref. 1).

NCMA has just recently completed a series of tests at Texas Tech University indicating that 8-inch (203 mm)

solid grouted concrete masonry with vertical no. 5 (m# 16) rebar's at 48 inches (1219 mm) on center and 6 inch (152 mm) solid grouted concrete masonry walls with vertical no. 4 (m#13) bars at 32 inches (813 mm) on center are more than adequate to met this test. Conventional fine grout was used instead of concrete. A full copy of the MR 21 report is available on the NCMA Web site at www.ncma.org/research/reports.html.

Cost Is Key

Safe room construction across the street from the Vilonia Elementary School in Arkansas is expected to begin in the summer of 2004. The school district received a \$400,000 FEMA grant to help build the safe room. The 4,500-ft² (418-m²) building will include a large multipurpose area, bathrooms, two large center corridors and a storage area. While the safe room will be designed to withstand wind gusts over 250 mph (402 km/h), it will be used regularly by local residents as a community center.

Meeting FEMA's guidelines, the Vilonia safe room walls are designed to withstand 250 mph (402 km/h) winds. They will be single-wythe, fully grouted with no. 4 (m# 13) steel reinforcement in every cell. The roof consists of a reinforced structural concrete slab.

According to Larry Dontenville, AIA, with Lewis, Elliott and Studer Architects of Little Rock, Arkansas, "FEMA pretty much regulates which building materials we can use for safe rooms. We chose concrete masonry because it is less expensive

to construct and faster than other materials. We estimate that at Vilonia, concrete masonry safe rooms cost about \$120/ft² (\$1,292/m²) finished."

Vilonia had a choice between using concrete masonry units and Aerated Autoclaved Concrete (AAC) with poured concrete fills. "Since the concrete masonry units do not require a veneer, but only simple painting, they are a more economical choice," says Dontenville. "The AAC units need a brick veneer which requires additional labor and materials."

"The AAC units and the concrete masonry units are comparable in installation time, but the AAC units need the veneer which adds extra work days to the schedule," says Red Sisson, Vilonia School District construction superintendent.

There is a sense of relief in the Vilonia community now that the safe room is being constructed. In past years, students have gathered in the hallways and bathrooms during tornado threats. "This will be a tremendous place for the community because we will be able to offer them a place to go during storms in addition to protecting the kids here at the school," says Dr. Frank Mitchell, Vilonia School District superintendent.

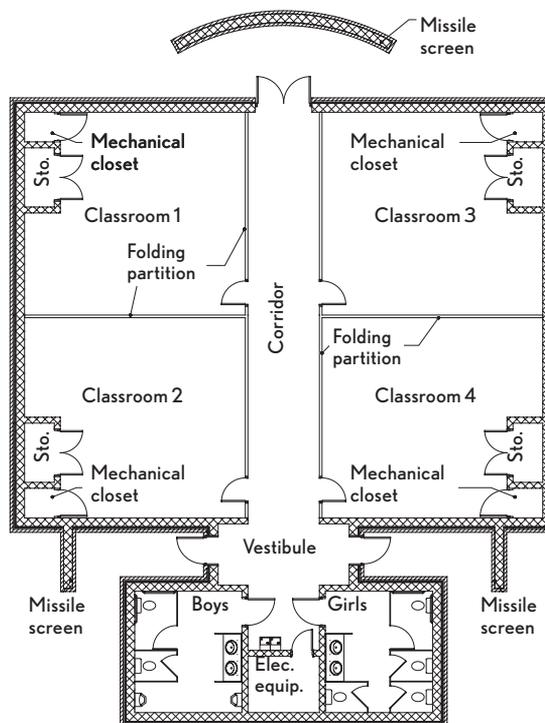
Speed Is Essential

Twin Rivers Architecture, P.A. in Arkadelphia, Arkansas, has designed four safe rooms for Arkansas school districts. The area typically experiences an average of four tornados per year. According to Mark Overturf, AIA, his firm utilizes concrete masonry for the design of safe rooms because "it can withstand the tornadic forces, it is a local trade and it is one of only two options."

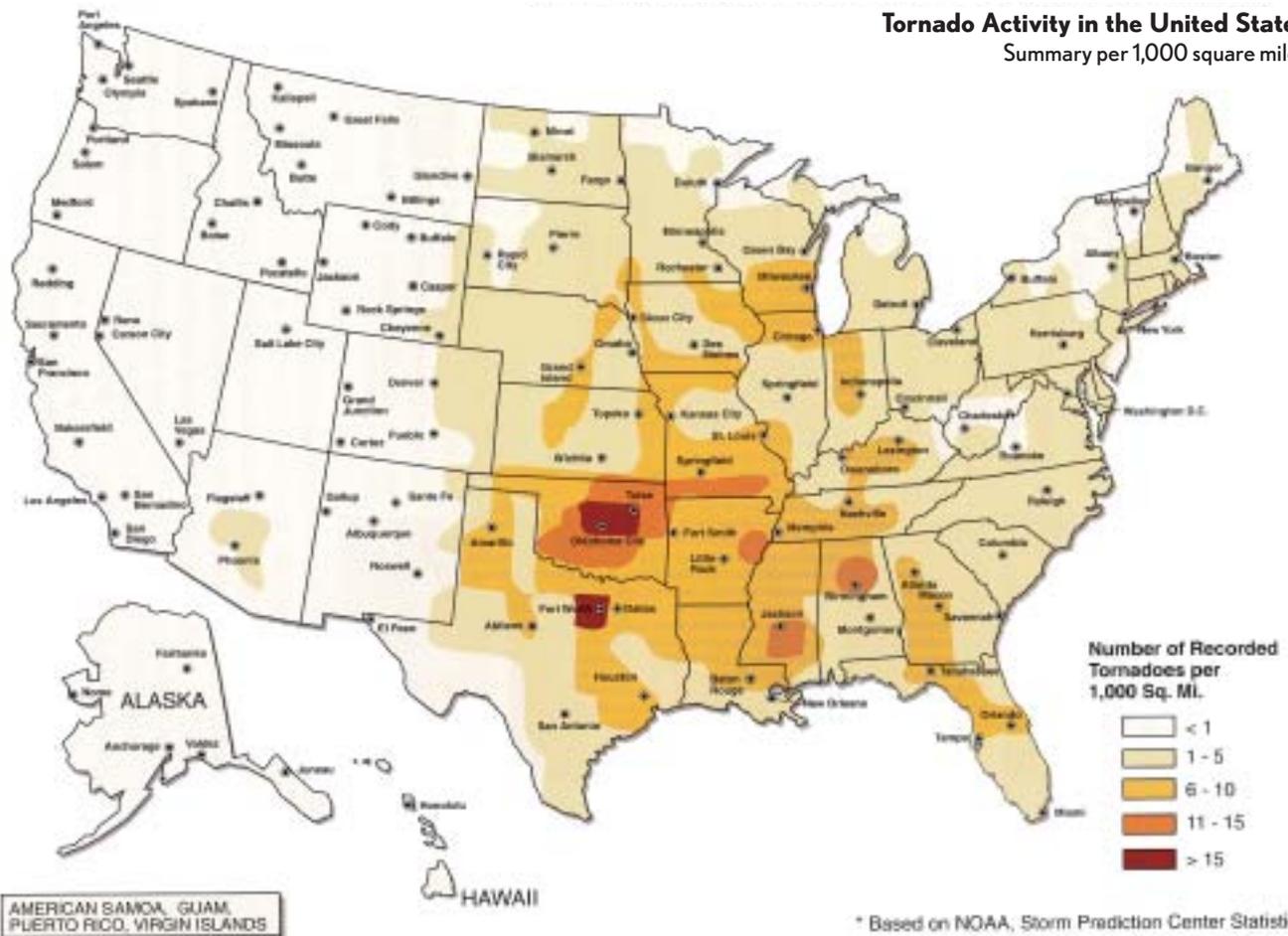
Overturf explains that precast concrete was originally considered for these safe rooms but the lead-time is very lengthy and cost is slightly higher. "While installation time varies with contractors, precast is typically installed faster. However, you just can't get started right away because of the lead-time for the precast. Lead-time is approximately three months and that is considerable enough to select another building material," says Overturf.

The Glen Rose School District has constructed two safe rooms in Malvern, Arkansas. One safe room is approximately 4,500-ft² (418-m²) and the other safe room is 3,200 ft² (297-m²). The design of the safe rooms consists of a corridor in the middle of the building which separates classrooms.

The construction of the Glen Rose safe rooms are cavity walls comprised of 12-inch (305 mm) wide concrete masonry units fully grouted with reinforcing in every cell vertically and horizontally, a cavity with two-inch rigid insulation and 4 x 8 x 16-inch (101 x 203 x 406-mm) split-face concrete masonry



Tornado Activity in the United States
Summary per 1,000 square miles



units for the veneer. Interior partition walls throughout the safe room are painted 8 x 8 x 16-inch (203 x 203 x 406-mm) concrete masonry units. FEMA contributed \$735,000 with the state and local governments supplying an additional \$245,000 to complete the two safe rooms. The construction of the Peake safe room's cavity walls is the same design as Glen Rose, but utilize a clay brick veneer.

Similar design and construction is nearly complete on the safe room at Peake Elementary School in Arkadelphia, Arkansas. Expected to open in September 2004, the 3,200-ft² (297-m²) safe room will be used as a classroom. The building was designed to be capable of holding all the Peake Elementary students if a storm strikes during school hours. In addition, Peake's safe room will be able to shelter up to 500 people during a severe storm or tornado. Restrooms and water fountains are included in the safe room design in the event that the building needs to serve as a rescue shelter for people whose homes are destroyed or severely damaged by a storm.

The Arkadelphia School District received \$418,000 in grants for the construction of a safe room from FEMA. The Arkadelphia School District

received an additional \$140,000 from the state and the city of Arkadelphia to complete the safe room.

Shelter from the Winds

Often called "missile barriers," the safe rooms are expected to resist the penetration of flying debris as well as tornado-force winds. To be considered a safe room, the building must be designed to meet certain safety regulations based on guidelines established by FEMA. FEMA recognizes few building materials as capable of meeting these requirements. However, cost and installation time for these materials can be significant enough that one building material is selected over another. Concrete masonry has been successfully used for safe room construction and has proven to be a reliable building material for keeping school children and communities safe from destructive storms.

Reference:

Design and Construction Guidance for Community Shelters, FEMA 361, Federal Emergency Management Agency.

FEMA 320—Taking Shelter From the Storm: Building A Safe Room Inside Your House. ■



Concrete Masonry Designs' AIA Continuing Education Learning Program

Learning Units Reporting Form

To receive one learning unit, read "Forgive & Forget" (page 4), and "Safe Room Importance Grows Near Schools" (page 14) and complete the following questions on both articles. Return this form to the National Concrete Masonry Association. Only original forms will be accepted for learning unit credit.

Forms received after August 2005 will not be accepted for learning unit credit.

I am a non-AIA architect or design professional. Please send me a certificate stating the learning units earned that I can use for documentation to fulfill other continuing education requirements.

Send completed Report Form to: AIA CES, National Concrete Masonry Association, 13750 Sunrise Valley Drive, Herndon, VA 20171-4662. If you have questions, please contact NCMA at 703.713.1900.

August 2004

AIA Questions:

1. What are the two main components of the building structure that keeps moisture out?

2. What are factors that contribute towards wall leaks?

3. How does mold grow in a building?

4. What are the two most important factors contributing to a long-lived, sustainable, cost-effective school?

5. What are safe rooms designed to do?

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I certify that the above information is true and accurate to the best of my knowledge. I have complied with the AIA Continuing Education Guidelines.

SIGNATURE _____

DATE _____

Check here to request a catalog of concrete masonry technical literature.

Flashings to Maintain Structural Continuity

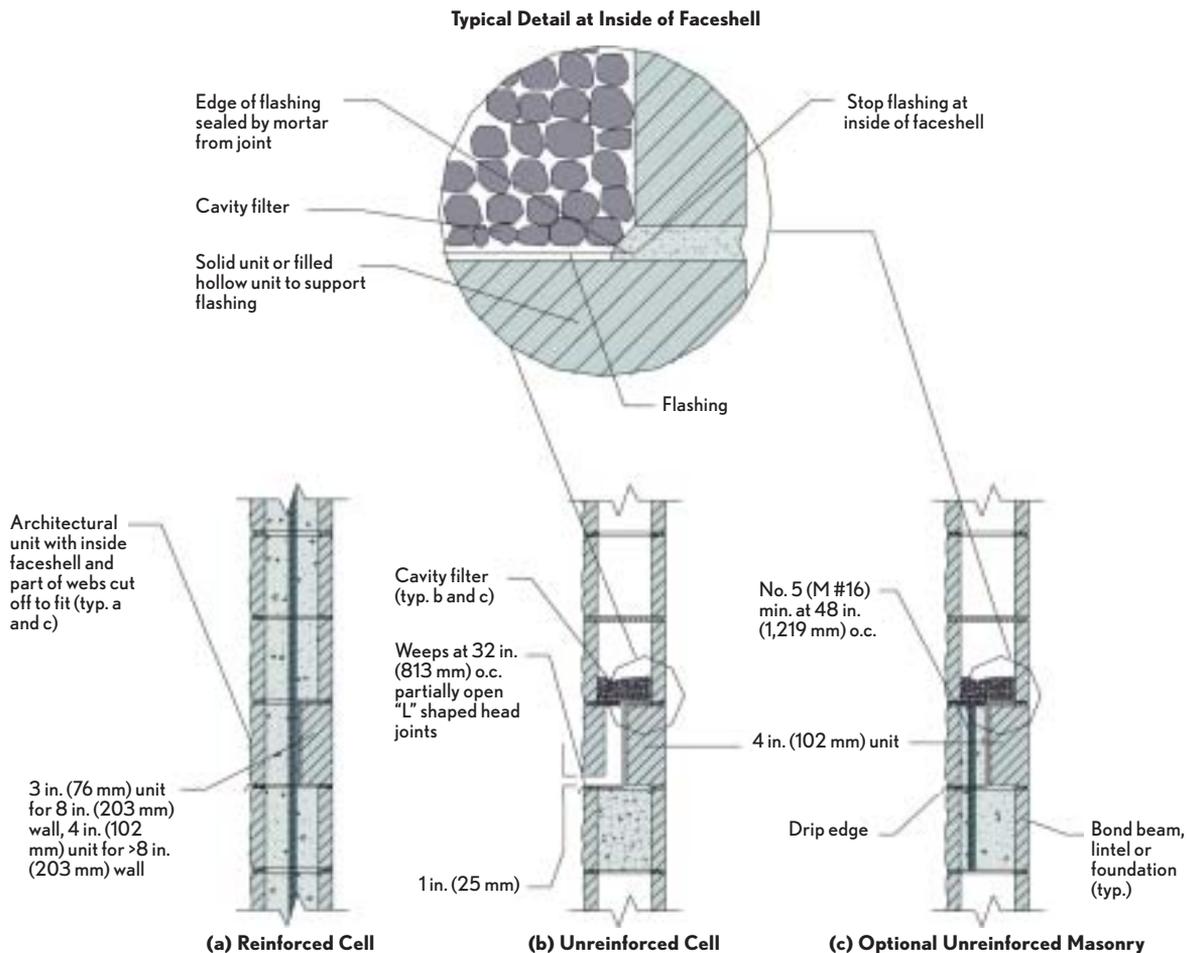
Through-wall flashing in single wythe walls creates a bond break. The potential impact on the wall's structural capacity should be evaluated in these cases. In reinforced walls, this is not much of a concern since shear resistance is provided by the reinforcement. Proper grouting effectively seals where the vertical reinforcement penetrates the flashing. The absence of this doweling in unreinforced masonry may be more of a concern, but loads tend to be relatively low in these applications.

Flashing can be stopped short of the inside faceshell of the wall, as shown in the detail, to retain some shear and flexural capabilities across the mortar joint. If needed for structural capacity, a short reinforcing bar through the flashing with cells grouted directly above and below the flashing can be provided as shown in detail (c). A cavity filter such as washed pea stone is needed to prevent mortar droppings from clogging the weeps.

This should be accompanied

by a means of intercepting or dispersing mortar droppings, such as using mortar nets or filling the cells with nonabsorbent, loose fill insulation a few courses at a time as the wall is laid up. As an alternate, every other reduced thickness facing unit can be left out on top of the flashing to serve as cleanouts until the wall is completed.

Using solid 4 inch (102 mm) units or filled hollow units on the interior side of the flashing supports the cavity filter material and the flashing. ■





Ahhh... a feast is being prepared for me!

Mold growth requires moisture, oxygen and an organic food source such as found in paper and wood building materials. Concrete masonry, however, is not a food source for mold. That's just one of the many advantages of using concrete masonry in construction projects of all types.

Mold Prevention requires proper design and climate control in buildings.

Concrete masonry is the right choice!

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