News of Interest for and from the Connecticut Association of Home Inspectors, Inc.

CAHI MONTHLY NEWS

September 2016 Volume 9, Issue 9

Presidents Corner

I have been reflecting on my career past and future. I have been a home inspector a long time and I was contemplating how much longer I can do it and do it well. I realize that many changes have occurred during the 27 years I have been a home inspector. Some I had resisted and some I met head on.

One big change that has occurred over the past ten years or so is technology. It has changed the face of the home inspection profession. Report soft wares, smart phones, tablets, drones, and instant communications have revolutionized the inspection industry. My first reports were done on typewriters, now some inspectors prepare them on smart phones and tablets and are able to provide customers with a copy before they leave the inspection.

My latest intern turned licensed home inspector has been very busy. I have watched him as he builds his business. And he is doing it in a very different way than I did 27 years ago. He is deep into internet and social media marketing, and it is working. It has made me realize that is where CAHI should be.

Our website if used properly can generate a presence for our organization and work for our members if we have a professional use and maintain a blog, our Facebook page and our up and coming LinkedIn account. It will cost some bucks but I believe it will be well worth it. I will be getting back to this concept in future newsletters.

Here is an update on our website. The board decided to change web providers, as we were having problems working with the company who originally designed and implemented our current website.

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INSIDE THIS ISSUE

MONTHLY MEETINGS – Details & Info

CAHI's regular monthly meetings are held at the Best Western located at 201 Washington Ave (RT 5), North Haven. Meetings are free to members. Most meetings are on the fourth Wednesday of the month from 7-9pm. Guests are always welcome! Guests may attend 2 free monthly meetings to experience our presentations, meet our members, and receive a CE attendance certificate.

Joining CAHI may be done at anytime of the year through our Membership Page

Meeting Dates!

September 28th

Agenda TBD

For Updated Meeting Agenda

Please check the CAHI Website

Presidents Corner *continued*

The transfer took much longer than I believed it would and I thank you all for your patience. It has been transferred and is up and running. However, we are going through it to work out glitches that may have occurred during the transfer. I will be sending out an email with further instructions once we feel the site is at full potential.

So, let's plow into the last quarter of 2016. I hope everyone remains busy. Remember, holiday season is around the corner. Make plans to enjoy it!

The only way to make sense out of change is to plunge into it, move with it, and join the dance.
~ Alan Watts

Stan

2016 CAHI Scholarship

It is my pleasure to announce the two recipients of our 7th annual CAHI Scholarship, Christopher R. Bernier and William W. Haertel. The scholarship committee has decided to select two applicants to receive the scholarship award based on several criteria including grades, community service, relation to member, timeliness of application submission, and need.

Christopher will be attending Quinebaug Valley Community College where he will be pursuing his interest in Photography and Graphic Arts. Christopher is a graduate of Killingly High School in Dayville, CT. He graduated with a 3.72 GPA. in addition to his academic strengths, Christopher competed on the soccer, wrestling and track teams and also participated in theatre camps for the last 6 years. Christopher is motivated to be independent as he grows in his professional field.

William will be attending UMASS Boston. He is majoring in Archaeology. William graduated from Enfield High School with a GPA of 7.55. Will has participated as a team member and mentor of the school's "Buzz First Robotics" program. He also experienced civic service by volunteering for the voting registrar for state and local elections over the last two years. William has also worked with other program charities for the local food drive and an early education program for children during his high school years.

Both of the applicants have expressed their appreciation for their father's hard work and commitment to their home inspection businesses. That work ethic has influenced and enabled their career paths.
The board of directors is please to award both Christopher and William with scholarships based on their academic achievements and drive to pursue further education.

Congratulations and good luck to both Christopher Bernier and William Haertel!

Submitted by Dean Aliberti
CAHI Secretary, Chairman of the Scholarship Committee

History of Sewers, Yes Sewers

By Tom Feiza, Mr. Fix-It, Inc.

Most home inspectors have a basic knowledge of modern municipal sewer systems and an in-depth knowledge of modern residential drainage, waste and vent (DWV) systems. But how were those systems developed and what's the recent history of the ways communities dispose of human waste?

Big Problems, Strong Odors

Through history, human waste presented a big problem whenever people congregated in cities. From the early civilizations to about 1850, waste was put in chamber pots, outhouses and pits or used for fertilizer, or just dumped in the woods. Human waste was not treated. Larger cities in advanced societies built sewer systems to flush waste into rivers or other nearby bodies of water. Dilution was the solution – these relatively small amounts of waste were diluted with lots of water and dumped downstream.

Several ancient societies developed basic sewage removal systems but ultimately they all just flushed the human waste into natural sources of water. As cities grew larger, problems developed with the stench and unsightliness of sewage, as well as contamination of drinking water. Most cities took drinking water from the source they were polluting with their human waste or from wells next to their human waste dumps. In the U.S. during the 1850s, cities developed underground sewer piping to carry waste away. In combined sanitary and storm sewers, storm water helped flushed away the waste from humans and domesticated horses and other animals.

Because urban areas became so polluted and smelly, pumping systems were developed to add water to flush out the combined sewage dumped in rivers. In Milwaukee, Wis., a steam-powered flushing system built in 1888 used Lake Michigan water to flush out the Milwaukee River downtown. This system used a boiler, a steam turbine, and a 12-foot-diameter pipe to pump 500 million gallons of lake water per day to flush out the Milwaukee River (Figure 1).

Figure 1: Steam Powered Sewer Pump - 1888

In 1925, a modern electric motor replaced the steam engine and boilers (Figure 2). The photo shows the electric motor, gear box, thrust bearing, and seal. The pump impeller is behind the wall and the steam engine is long gone.

Figure 2: Modern Sewer Pump

Polluted Drinking Water

In the mid-1850s, there was much debate about whether serious illnesses like cholera were caused by polluted air or water in major cities such as London, Paris, New York and Chicago. During years of debate, epidemics killed thousands. Eventually, doctors and public health scientists became convinced that drinking water polluted with human waste was causing the problem.

London developed its now-famous sewer system in 1870 to flush human waste into the ocean. Chicago constructed a huge Sanitary and Ship Canal from the Chicago River to the Des Plaines River. This system of three canals, built between 1892 and 1922, reversed the flow of the Chicago River; instead of discharging into Lake Michigan, it now flowed to the Mississippi River – good luck, St. Louis and New Orleans. The canal-to-river system is still in use but today the sewage is partially treated. You may have read that this canal is a possible entry point for invasive Asian carp into the Great Lakes because it directly connects the Mississippi River with Lake Michigan.

(story continues below)

(story continues)

Drinking water could not be trusted in large cities anywhere. Europeans solved the problem by drinking beer and wine. Wealthy people, afraid to bathe in city water, left for “the country” with its clean water and air. Some think that fancy perfumes developed in Paris were an attempt to mask body odor from not bathing.

Treating Sewage or Drinking Water

In 1875, no U.S. city with a population of more than 100,000 provided any kind of sewage treatment. By 1900, only two cities had installed treatment facilities. By 1926, twenty cities had sewage treatment plants. As electricity, motors and pumps became widely available, many cities decided to treat sewage. Milwaukee started its activated sludge treatment system in 1925 – one of the earliest treatment systems in the world. Milwaukee still sells Milorganite, a fertilizer made from byproducts of sewage treatment.

Los Angeles developed sewage piping systems to deliver human waste to huge settling and drying ponds. The dried goods were sold as fertilizer for crops. Chicago's water was so polluted that cholera became a major issue. The planners of the Chicago World's Fair (which was called the Columbian Exposition) of 1893 worried that the spread of cholera would discourage visitors from attending the fair. It was held in downtown Chicago at the current site of the Museum of Science and Industry on Lake Michigan. The Chicago Director of Works and entrepreneurs attempted to build a 100-mile pipeline for natural spring water from Waukesha, Wis., to the fairgrounds for drinking water. Apparently, unions and Waukesha residents stopped the pipeline construction. Water was eventually brought in on railroad cars and piped from a spring south of Waukesha, and sold at the fair for a huge profit.

Combined Sewers

Many older cities still have combined sanitary and storm sewers (Figure 3) left over from the days before sewage treatment. Using rainwater to flush waste from the pipes was an important part of the system. Modern cities and new areas of older cities now install separated sewers: sanitary sewers to treat human waste and storm sewers to drain rainwater into rivers and streams. Separated sewers reduce the amount of water needing sanitary treatment. Cities that still use combined sewers suffer from sewage overflow into rivers or backups into basements whenever heavy rain falls. Some of these cities developed large deep-tunnel systems to store and hold overflow that would be treated over time or directed to separate sewers.

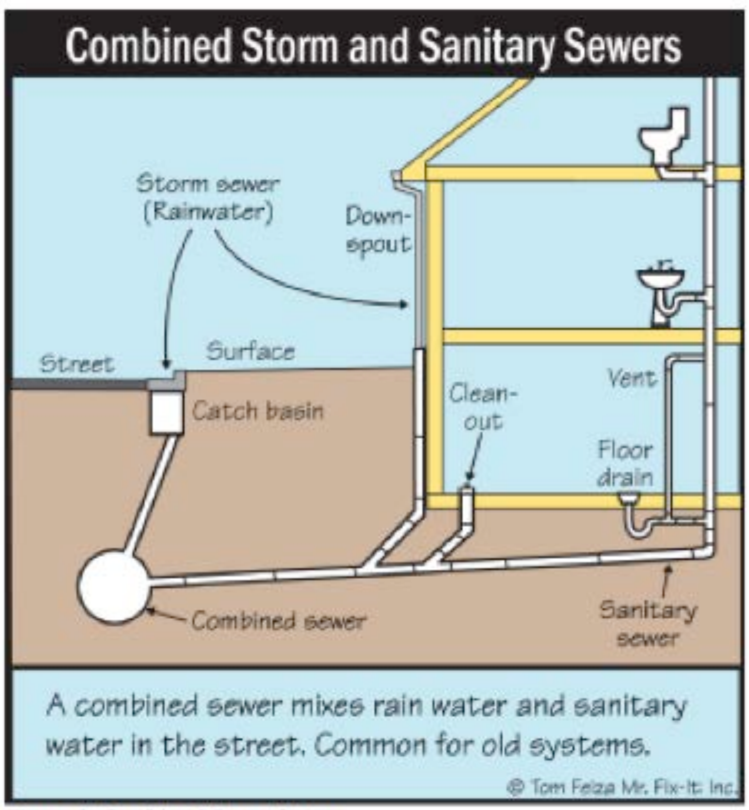

Figure 3: Combined Sewer System

Today’s Scientific Solutions

Scientists, federal laws and health officials now ensure adequate sewage treatment systems and safe drinking water. In response to the Federal Water Pollution Control Act of 1972 and the Clean Water Act of 1977, cities have worked hard to improve sewage treatment, minimize overflows and treat drinking water. But that is not true in Third World countries. According to a recent United.

Nations report, six billion of the world’s seven billion people have mobile phones, but only four and a half billion have access to a flush toilet. The real problem is where the human waste flows – into local rivers and other bodies of water.

There are open sewers in the city streets of many underdeveloped countries. Look for the Associated Press reports on the upcoming 2016 Summer Olympics in Rio de Janeiro. Two-thirds of the untreated human waste generated in that city is flushed into rivers, lakes and the Atlantic Ocean. These bodies of water are so polluted with human waste that there are major concerns about Olympic water sports. Watch out for the floaters. Yuck.

How the Plumber Saved Civilization

While government scientists improved municipal sewage treatment and water supplies, plumbers and engineers worked on systems found in homes. Indoor plumbing, including traps and drainage waste systems, was developed to flush away waste and prevent sewer smells and germs from entering homes (Figure 4). Europe was ahead of the U.S. in developing toilets and city sewer systems. Early toilets were designed to use lots of water to flush and clear pipes, but the polluted water still flowed to rivers. Traps often utilized mechanical wooden valves. And maybe you’ve heard the story (some say it’s an urban legend) about Thomas Crapper, a

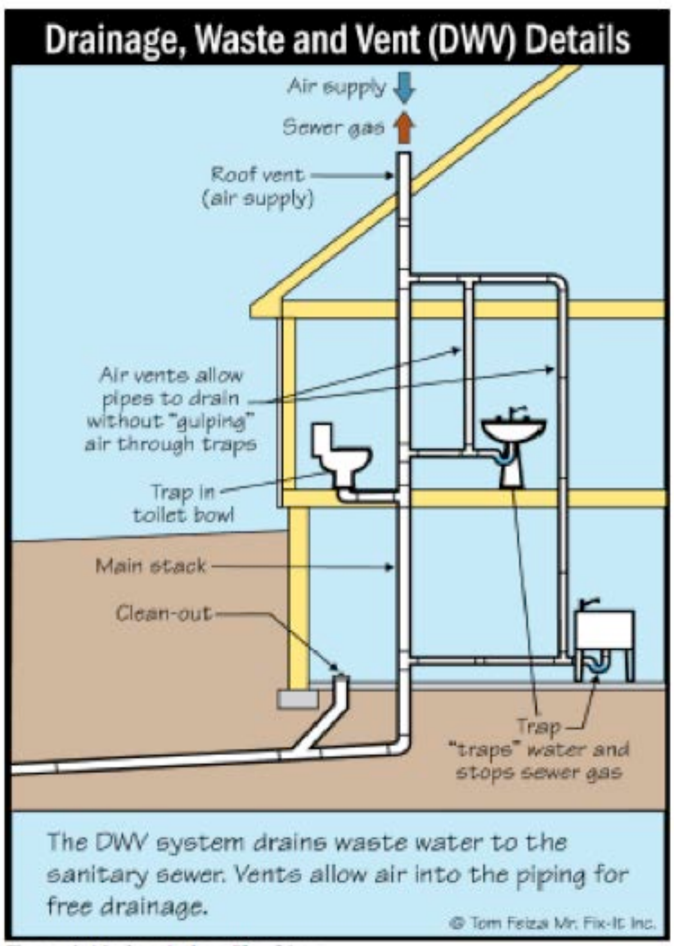

Figure 4: Modern Indoor Plumbing

popular English plumbing fixture manufacturer in the late 1800s. He's often credited with having invented the modern toilet. When our military boys went to Europe to fight in WWI, many of them saw toilets for the first time and these were labeled "Thomas Crapper." Hence the American slang for toilet – the crapper. If you're interested in learning more about the history of toilets and sewage systems, you may want to read Flushed: How the Plumber Saved Civilization by W. Hodding Carter.

Modern Systems

Remnants of old sewer systems still exist in some cities. We see rain gutters connected underground to sanitary sewers; they were combined sewers when the city was built. There may be a "house trap" between the home and the city sewer to prevent sewer gas from backing up into the gutter system.

We see modern systems in homes with drainage waste and venting systems (Figure 5). The pipes are angled and sized to efficiently move waste and water together. Vents provide air to the system for proper drainage and traps prevent sewer gas from backing up into the home. Recent laws have required new construction to utilize low-flow toilets to save water and limit sewage treatment needs. This mandate resulted in a whole slew of toilets that just did not work very well. Toilet manufacturers eventually overcame the 1.6-gallon flush limit. Now we see pressure- activated toilets and dual-level-flush toilets. Supply systems are also changing due to limits on flow volume of shower fixtures and sink faucets. These are positive efforts to save water and energy. Some areas have systems that recycle gray water, others that reclaim heat from shower drain water, and circulating valves that quickly heat water on demand. Backflow preventers help prevent contamination of drinking water – and the list goes on.

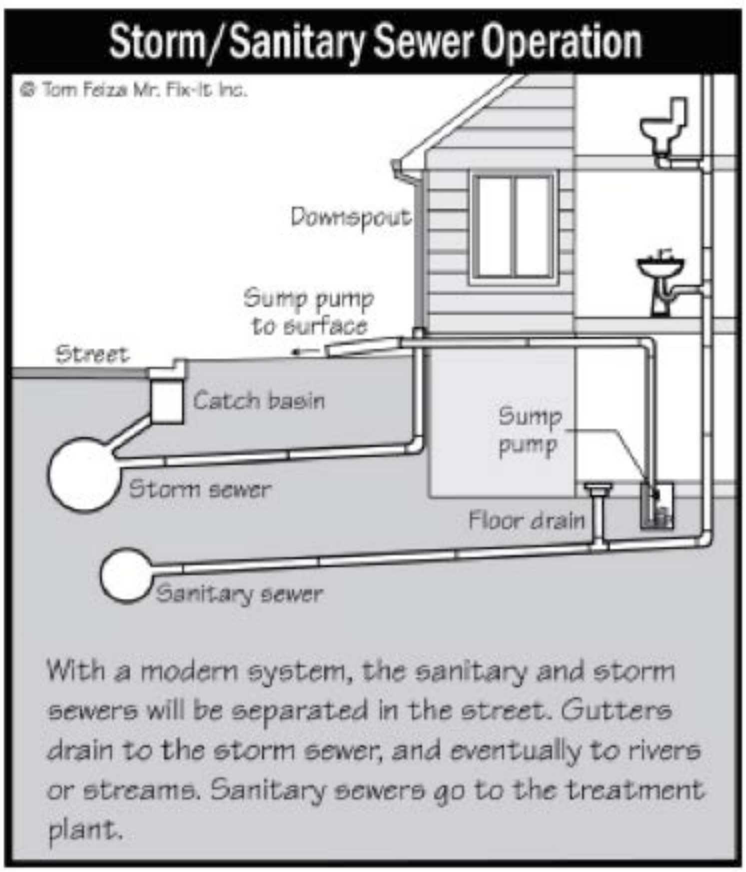

Figure 5: Modern Sewer Drain System

When you're doing an inspection, think about surrounding conditions: ditches, storm sewer or pumping station. Where does that water go? Might it back up into the home? Every city is different. Understand your local systems and how they affect your inspection.

Looking to the Past and Future

We will see continuous changes to water supply and sewer systems and they're all for the better. Think about how bad it was in 1915, when raw human waste was dumped into rivers and lakes, polluting our drinking water. That was only 100 years ago. We should be proud of how much we have improved conditions in the U.S. since then. We should also think about water problems in less developed countries and when we're there, remember – don't drink the water!

About the Author

Tom Feiza has been a professional home inspector since 1992 and has a degree in engineering. Through HowToOperateYourHome.com, he provides high-quality marketing materials that help professional home inspectors boost their businesses. Visit HowToOperateYourHome.com (or htoyh.com) for more information about building science, books, articles, marketing, and illustrations for home inspectors. Please e-mail Tom (Tom@misterfix-it.com) with questions and comments. Phone: 262-303-4884.

Photos by Doug Horgan/BOWA

Repairing Stone Patios Over Living Space

Thorough waterproofing is essential for a leak-free job

BY DOUG HORGAN

Low-slope roofs present a particular problem for drainage and waterproofing, especially when they intersect with an upper-story wall. If the roof is not just a roof, but also a walkable deck, the problems can be compounded. And a heavy stone or tile patio that is also the roof over an occupied space may be the trickiest problem of all.

In a previous issue, I discussed a case where we had to diagnose a leaking patio roof ("A Leaking Patio Above Living Space," Jun/16). But in that example, my company didn't have to repair or rebuild the patio; instead, the owners opted to cover the whole area with a new enclosed room covered by a conventional roof.

In this story, I'll look at a couple of other examples, where leaking rooftop patio surfaces had to be completely removed, re-waterproofed, and re-paved. The jobs included removing and replacing the masonry or stucco wall coverings at the bases of the adjacent walls. Along the way, our crews had to rebuild the waterproofing details at the intersections of the patios and the walls, replacing old, leaking systems with a more effective method.

In the example shown under repair in the photo above (and also on page 49), the original patio had flagstones set in a mortar bed on top of an 8-inch reinforced concrete slab, which in turn was supported by basement foundation walls at the ends, and steel I-beam girders in the middle. In the example shown on pages 45 through 48, the slab was supported by a steel structural frame and corrugated steel pan forms—again, topped by a mortar bed and flagstones.

In each case, the slab continued all the way to the home's framed walls, and the masonry cladding for the house walls rested on top of the slabs; then the mortar bed and flagstones were laid butting up against the masonry wall claddings.

At those complicated intersections, the waterproofing and flashing details require considerable thought, careful planning, and careful execution. The drawing on page 48 and the photo above show our preferred way to handle this condition, and reflect how we repaired each of these wall-to-roof intersections. But that's not what we originally found when we tore each example apart.

With the stone pavers removed, the crew conducts a test for leaks, focusing on the critical locations where the patio meets the house wall. They build a low dam using strips of foam caulked to the existing waterproofing, and flood the roof edge **(1)**. After observing leaks at the wall joint, the crew strips away a portion of stucco and the lowest course of concrete masonry to reveal the flashing and waterproofing, supporting the block wall with pieces of 2x4 **(2, 3)**. The joint where the rubber roofing met the masonry is seen to be compromised, and aluminum flashing behind the block is corroded and leaky **(4)**.


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INVESTIGATION

In both cases, the leaks weren't the only reason for us to be there: The homeowners wanted to replace their stone or concrete-paver patios anyway. But there was evidence of leaking in the rooms below each of the patios (in one case, a ground-level garden room, and in the other case, a garage and occupied room in the home's walk-out basement level). So we also had to figure out the cause of the leaks, and fix it.

In the case shown on this page, we removed the stone patio, mortar, and dimple-sheet drainage board (which left little circles all over the bitumen-sheet waterproofing). We could not see weeps or flashings in the masonry veneer on the walls, so we tested the intersection of the wall and terrace with water: We built a little dam near the wall, gluing strips of foam insulation to the roof membrane with adhesive caulking. Then we added water with a garden hose to create a shallow pool by the wall, and checked for leaks below the roof. Sure enough, water began to drip from the ceiling in the room below.

Next, masons removed the lowest 12 inches or so of masonry (4-inch block with a stucco veneer) and temporarily supported the block walls with short pieces of 2x4. The previous contractors had applied waterproofing to the flat concrete sub-deck,

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To create a waterproof seal, the crew applies Henry 790-11 Hot Rubberized Asphalt across the entire deck, continuing the asphalt coating up onto the wall. Before applying the coating, workers first make a fillet of flexible caulking at the joint to ease the corner and relieve strain **(1)**. Next, they roll the hot asphalt onto the wall and the deck edge **(2)**. A layer of reinforcing fabric is set over the hot material, then a second layer of coating is applied, embedding the fabric into the rubberized membrane **(3)**.

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then a piece of coil stock flashing was placed on top and bent up the wall. Housewrap on the wall was tucked behind this flashing instead of in front as it should have been, but that probably didn't matter—because water was free to run across the waterproofing and into the wall underneath the aluminum flashing. Also, aluminum flashing will corrode in contact with masonry. That process was well underway in exposed areas.

STARTING OVER

Our next task was to re-waterproof the concrete deck. We removed the old waterproofing and applied a "cant strip" of flexible sealant in the inside corner of the wall for strain relief.

Next, the crew applied Henry's recommended primer, then two coats of the hot rubber, with a layer of polyester reinforcing fabric laid down between coats. This product makes a thick, heavy coating. A couple of commercial contractors I know think it's the most reliable waterproofing on the market, and we haven't had any issues on the few jobs where we've used it.

Different waterproofing materials have different recommended methods for plane changes, corners, and other details; we always download the instructions and refer to them as we work. But generic details can't cover every situation that we may find in the field, particularly in a repair situation.

Railing post bases are a common source of leaks in a rooftop patio. One typical practice that can create a leak point is to drill holes and set anchor bolts after waterproofing is applied, penetrating the waterproofing. The author's preferred method is to set the bolt in the concrete before waterproofing **(8)**. Next, the metal-post base plate is connected to the bolts. **(9)**. A coat of primer is applied to the metal and the concrete, and finally the reinforced rubberized asphalt is applied over the post base for a robust waterproof seal **(10)**.


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So we usually have to make judgment calls on a case-by-case basis, relying on our experience and the expertise of our subs. For the jobs discussed here, a lot of the design and all the repair work was provided by Ev-Air Tight, Shoemaker Inc. (Riverdale, Md.), one of our trusted trade partners.

POST DETAIL

Railing mounts are a typical trouble spot on a masonry patio. For a patio on grade, railing companies often come to the job after pavers are installed and drill holes through the pavers into the concrete, then cement the rail-post bolts into the holes. That's not a problem if there's nothing under the patio but ground. But if they do that on a waterproof roof deck, it will make a hole in the waterproofing, and there will be a leak into the space below.

When you need to preserve effective waterproofing, one good approach is to mount the railing posts before doing the waterproofing, or at least set pins for mounting the posts. That's what we did in this case (see photos, right): The crew set stainless steel bolts into the concrete, then mounted the post bases in place, before applying Henry primer and two coats of rubber to the deck.

The rubberized asphalt membrane is applied hot, and splashes or drips will stick to anything and are a hassle to clean up. At left, the crew has protected the masonry rail posts with poly **(11)**. Over the reinforced membrane, the crew lays a dimpled plastic drainage sheet with filter faces, then builds up a mortar bed reinforced with galvanized wire mesh **(12)**. Finally, they set new stone pavers into the wet mortar **(13)**.

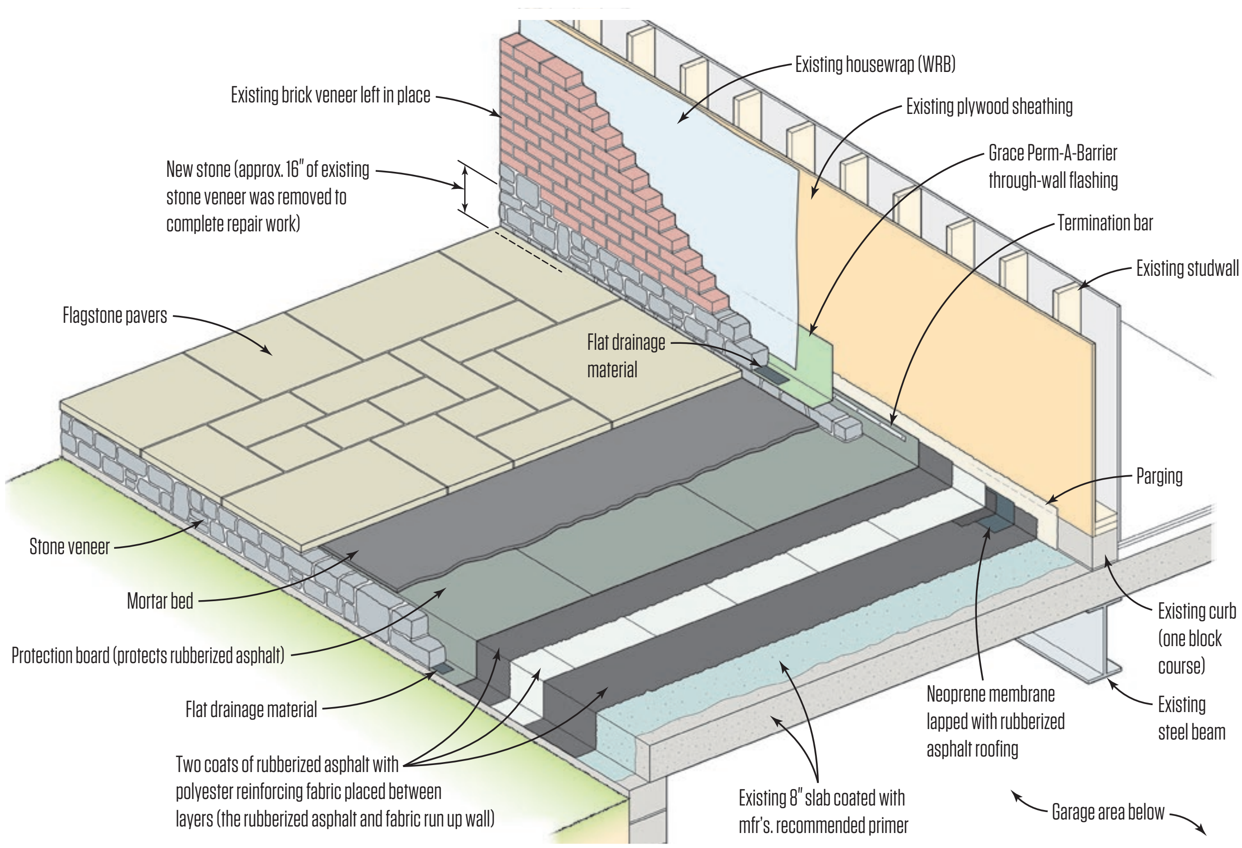
MORTAR BED AND PAVERS

Before setting the new limestone pavers in mortar, the crew rolled out a dimple-sheet drainboard with a filter facing. Many different vendors supply a suitable product for this application; we typically use MiraDrain from Carlisle Coatings and Waterproofing (carlisleccw.com), because it's easy to find in our area.

This material creates a drainage space below the stone, giving water free-flowing access to leave the assembly. That reduces the risk of freeze-thaw damage in the stone and mortar, and reduces pressure on the waterproofing. With free drainage, only a tiny amount of water can accumulate on top of the waterproofing, so there is never much head pressure to push water through any flaw.

Next, the masons placed a setting bed of dry-pack mortar, embedding a galvanized wire reinforcing mesh in the center of the mortar bed. Then they mixed a batch of thin, more-fluid mortar, spread that thinly over the dry-pack, and set their pavers in place. Dry-pack forms a strong base, and the more-liquid mortar serves to bond the stone to the dry-pack bed.

Patio Waterproofing Over Basement Garage



Protection at the transition. In the author's preferred detail, fiber-reinforced rubberized asphalt membrane extends from the slab up onto the wall sheathing, with neoprene rubber flashing embedded in the hot asphalt at the corner. Protection board on the patio also extends up the wall and is secured with a mechanically fastened termination bar. After the base course of masonry is set, a through-wall flashing and weeps are applied to direct moisture from the wall masonry out to daylight.

A BEST-PRACTICE DETAIL

Our company has multiple crews working in the field on a wide range of building and remodeling projects. As a large company, one of our challenges is to create a common knowledge base across all of our crews, so that the whole company can benefit from the lessons each crew has learned on the job. Building and sharing that knowledge base is a big part of my job at BOWA.

The drawing above depicts the typical solution that we've developed over time for masonry paver decks over living space, based on the recommendations of materials suppliers combined with our own experience on site.

The joint between the wall and the concrete slab is the critical point. Ideally, we address that situation with the dual-flashed assembly shown above. The reinforced fluid-applied waterproofing adhered to the concrete slab extends all the way to the pre-primed wall and laps up onto the wall, secured with a termination bar that will hold the material even if adhesion fails. Dimpled drain board or a fiber protection board—or both—improves drainage and protects the waterproofing.

A base course of wall masonry is laid on the waterproofed slab. Next, a through-wall flashing membrane is applied to the top of that base course and lapped up onto the wall. The wall's weather-resistive barrier (WRB) is lapped down over the flashing. Then more courses of masonry are laid, with weeps provided for drainage above the through-wall flashing.

With this assembly, water in the wall cladding is directed out of the wall onto the surface of the patio. The waterproofing beneath the patio, extending up onto the wall, provides a second line of defense.

The photos above show the retrofit sequence for a grade-level patio over a basement and garage space. Hot-applied rubberized asphalt is applied to the concrete deck and lapped up onto the primed plywood wall sheathing **(14)**. A course of protection board is laid over the waterproofing **(15)**. Flashing membrane is applied to the wall as a backing for the new stonework **(16)**, then a base course of stone is set against the flashed wall (see photo, page 43). Another through-wall flashing is installed before upper courses of stone are laid (leaving weeps that allow the wall to drain). Finally, new pavers are set into a fresh mortar bed **(17)**.

PITCH AND PROTECTION

In the example shown above (and in the photo on page 43), the patio is located at grade, but it's not sitting on the ground—it's over occupied space. The room at the back of the patio is built over a basement-level garage, which extends past the room on both sides, so there is a 10-foot patio over the garage on either side. Like our earlier example, this patio was leaking into the space below because of ineffective waterproofing and flashing at the patio-to-wall juncture.

So our replacement of the flagstone patio, again, had to include a reworking of that intersection. In photo 14 above, the crew has taped back the housewrap, primed the plywood wall, and applied rubberized asphalt to the slab and up the wall. Next, they laid down sheets of fibrous protection board, which allowed the masons to rebuild the wall masonry without getting themselves covered in the soft, sticky asphalt, and then to pave the patio without damaging the waterproofing.

The masonry detail at the wall base includes two layers of fully adhered flashing. Before the base course of stone was set, masons applied a peel-and-stick membrane to the wall, lapping it onto the hot-applied asphalt. After setting the base course, they installed a through-flashing membrane over that course, lapping up under the WRB.

This relatively small patio had a good pitch, and so we decided it would be safe to omit the layer of dimpled drainage sheet. So in this case, the masons installed their mortar bed directly on the protection board.

Doug Horgan is vice president of best practices at BOWA, a design/build remodeling company in MacLean and Middlebury, Va.

Photos by Rick Luck

Hanging Pre-Hung Interior Doors

Stay organized and keep a production mind-set

BY JOHN SPIER

Interior doors are often taken for granted, but they are crucial to the overall quality of a home. Well-installed doors open and close smoothly and stay open when you want them to—and should be able to withstand the occasional teenage or matrimonial slam!

CHECK THE FRAMING

Interior door installation starts with the framing. Rough openings need to be the right size, in the right place, and framed with good stock. Each opening should be plumb, level, and in plane with itself and the surrounding wall. Trimmers need to be square in the opening and securely nailed, as well as exactly flush with the adjacent king studs to keep the wall thickness consistent. You can always hang a door in a bad opening, but it will take longer, and trimming the door neatly will be a challenge.

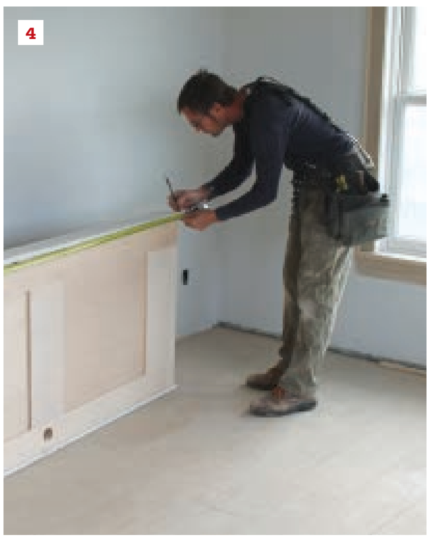
Good house plans call out the sizes of all interior doors, and some provide a schedule of rough openings. I always check the plans carefully, verifying that each door will fit with enough room left for trim, light switches, structural columns, and other details. I also verify that the opening height works with any special issues (such as the radiant subflooring heating used in the project shown here).

After the house is framed and all systems are roughed in—but before wall finishes are installed—I check every opening with a long level. Often, framing lumber will have bowed or twisted, or a plate will have shifted, or I'll find some other problem that I can fix now to save myself trouble later. While I'm doing this, I also label every opening with the door's nominal size and handing. For the benefit of the sub-tradespeople, I mark the hinge side and draw an arc on the floor to indicate swing direction.

ORDERING DOORS

The order for pre-hung doors starts with a master list. I give each door in the house a number or letter, and to avoid mix-ups, I also include its location in the house. I generally start by listing general specifications: slab type and finish, jamb material, style and thickness, hardware, and so on. Often, individual doors will have specific differences, so the general spec will be followed by "except where noted." Then each door is listed with information about it: size (height and width), handing, hardware prep, and any differences from the standard specs. Some suppliers will send a sales rep out to make the list for you, but I prefer to make my own.

John Spier owns Spier Construction, a building and remodeling company on Block Island, R.I.



Check the rough openings

Start each door with a final check of the opening, making sure that the door will fit and that there's nothing unusual to contend with. If door location within the opening is critical—to center it in a space, for example, or to align it with another component—note what its exact position needs to be. If there are other doors nearby, check the overall level of the floor to make sure the head jambs all line up **(1)**. Next, check the floor across the doorway for level **(2)** and under each jamb to make sure the opening is perpendicular to the floor **(3)**. If the floor is sloped or stepped, adjust the jamb cuts for the best fit.

Measure and cut the jambs

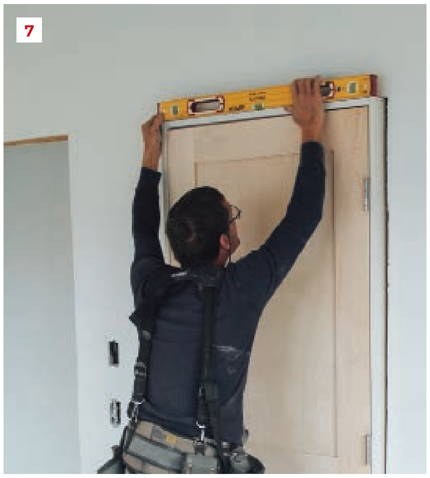
Jamb-leg length is strictly a function of the door-slab height and the clearance that's needed above the floor or threshold. In most houses, the height of the jambs rarely varies. Ideally, leave $1/2$ to 1 inch of clearance between the top jamb and the header framing to allow for settling and to let the casing bridge slight differences between the jamb and wall finish.

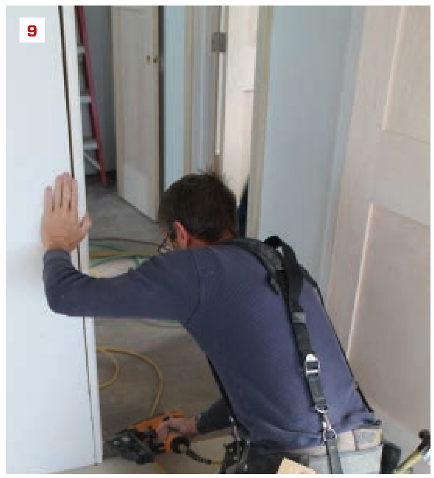
During the initial steps of cutting and fitting, keep in place the temporary fasteners that hold the door slab in its jamb. To cut the jamb legs, roll the unit onto one edge. Then measure the jamb leg **(4)**, mark it **(5)**, and cut it to length **(6)**. Flip the unit onto its other edge and repeat the process. Check to be sure that the hinge screws haven't come through the back of the jamb; they can quickly ruin a finished floor.

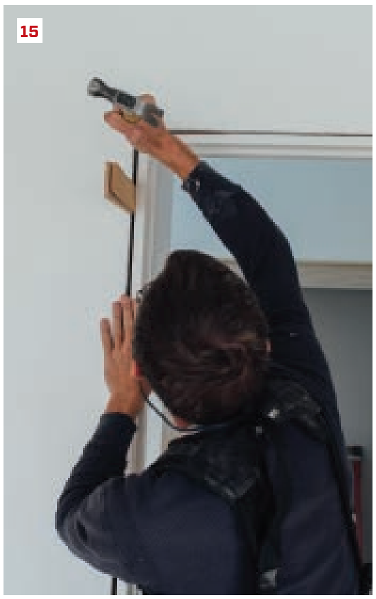
Level the door slab in the jamb

With the door slab still secured in its jamb, stand the unit up in the opening and make sure the head jamb is perfectly level **(7)**. If it's not level, set the door down again and trim the appropriate jamb. When the bubble is dead center, release the temporary fasteners holding the door in its jamb, and set the unit in the rough opening. Unless you've noted differently, center the door in the opening and secure the hinge jamb just above the top hinge with a couple of shims and nails **(8)**.

To anchor the assembly in the opening, shoot a single nail through the jamb at each of the other three corners **(9)**. Then shim and nail the rest of the hinge jamb. Rather than using a level to plumb the slab, insert shims behind the bottom of the hinge jamb just below the hinge **(10)**. Adjust the shims until the margin between the door slab and head jamb is perfect across the top **(11)**. If the head jamb is level, then the door should be plumb, but double-check it with a long level. When you're happy with the fit, drive a couple of additional nails to secure the bottom of the hinge jamb. Then shim and nail just above the middle hinge to make sure the jamb stays straight.







Fine-tune the rest of the fit

When the hinge jamb is straight and secure, turn your attention to the strike jamb. Starting at the bottom, adjust the jamb in or out to keep an even space between the door slab and the jamb **(12)**. Once that space is even, insert shims between the jamb and the framing close to the floor, and snug them in place before nailing through them. At the top of the strike jamb, insert shims just below the head jamb **(13)**.

Next, check to make sure the door is hitting the stop evenly **(14)**. If it's not, give the jamb a gentle tap until it's perfectly even **(15)** before securing the top with additional nails. Finally, shim and secure the middle of the latch jam just above the striker location. When finished, the door should open and close smoothly, show a perfect margin all the way around, and hit the stop evenly with a satisfying solid clunk.

To make shims, rip stacks of shingles into 2-inch to 3-inch widths. Insert the same number of shims from each side, except to make up for twisted framing. When each door is hung, cut the shims flush with a utility knife or multi-tool **(16)**.

Double doors: Cut and set up

Double doors are trickier to hang than single doors, but the basic process is the same. With the double door shown here, the floor was out of level. Placing a shim under the level showed how much had to be added to the jamb leg to make the head jamb level **(17)**. That amount was added to the measurement of the longer leg **(18)** and then both jamb legs were cut **(19)**. As with a single door, the unit was set in the opening—this time with the temporary fasteners removed—and the head jamb checked to make sure it was level **(20)**.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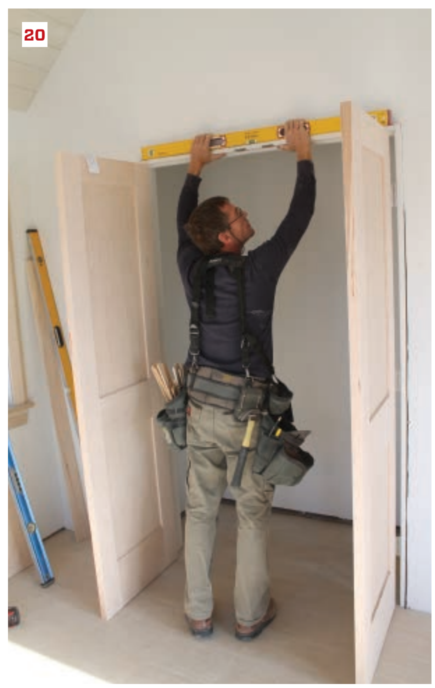
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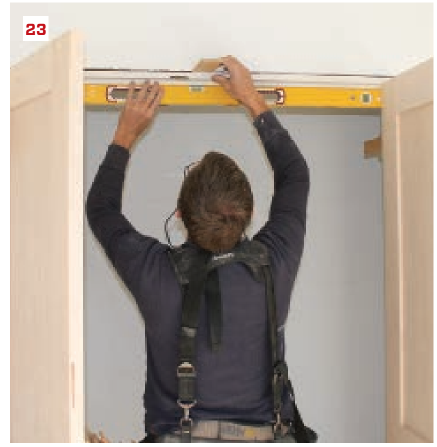
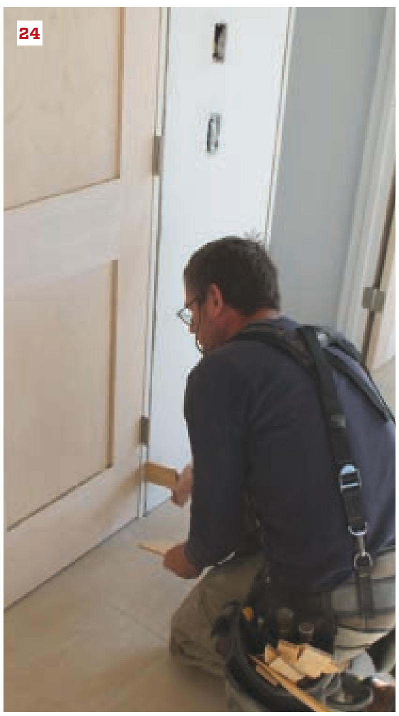
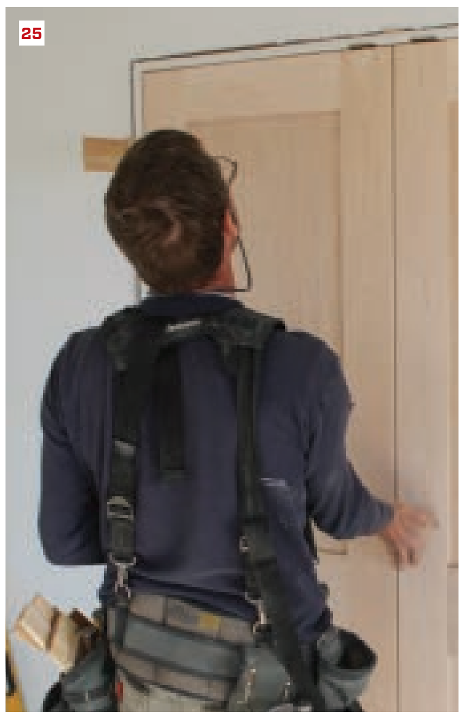






Double doors: Tweaking the fit

To hang double doors, instead of starting with a set of shims on one side, swing the doors open and shoot a single 2 1/2-inch 15-gauge finish nail through the jambs at each of the four corners **(21)**. These nails hold everything loosely in place and let you adjust the jambs as needed. Next, shim the top of each side jamb, centering it in the opening **(22)**. Shoot only one nail through the shims—it's important to be able to shift the jambs slightly to align the door. At this point, shim and nail the top jamb, using the edge of a level to get the jamb perfectly straight **(23)**. Don't nail through the head-jamb shims though; those shims will be removed later after casing is installed on one side. Then, the header framing can't push on the door jamb if it settles in the future.

With the top of the frame secure, shim and adjust the side jambs **(24)**, making sure that the gap between the doors and head jamb is even; the top corners of the doors are level with each other; the center gap between the doors is even **(25)**; and the door slabs are in the same plane when fully closed. This last part is done by tapping all four corners in or out slightly with a block **(26)**. Once everything is aligned properly, shim and nail the rest of the jamb securely.

A Path to Safer Balconies

These tricky cantilevered structures demand careful framing and waterproofing details

BY CHARLES BICKFORD

Photo: Lenny Gillis

On June 15, 2015, a group of 13 students in Berkeley, Calif., fell five stories when the balcony they were standing on suddenly collapsed. Six were killed, seven were critically injured, and the incident became the latest example of the often-fatal consequences of poor building practices. The 4-foot-5-inch by 8-foot-10-inch balcony wasn't overloaded; it was designed to support combined live and dead loads of more than 100 lb. per square foot (the code requirement at the time it was built). Subsequent investigations revealed a number of problems, however, including a leaky walking surface and a non-ventilated deck soffit that trapped water inside the deck frame, causing the engineered (but not pressure-treated) wood framing to rot.

It's a sobering lesson for any builder who thinks a balcony is basically a cantilevered deck. Unlike a deck, which is supported by a ledger and a system of posts, beams, and footings, a framed balcony's sole support derives from joists or beams that cantilever from the exterior wall. Its stability and longevity rely on the strength of the cantilever and a careful detailing of the exterior to protect the house and deck framing from water damage.

CODE PROBLEM

As building-code educator Glenn Mathewson notes, codes specify requirements for balcony framing and railings, but they don't address the precise and often unique combinations of potential problems that balconies pose. "For example, when a balcony is designed to be waterproof and the joists are enclosed by a soffit below," he explains, "it is considered by code to be a roof assembly, and because roofs are not meant to leak, there is no code requirement to use pressure-treated lumber."

According to city officials who investigated the Berkeley tragedy, that was one of the factors that led to the collapse. Plans for the balcony called for a 2-inch concrete topping slab over waterproofing and a double layer of OSB sheathing supported by cantilevered 1¾-inch by 11⅞-inch LVL joists, which were untreated. Investigators say that when the Library Gardens apartment complex was built in 2006, the balcony design met all of the requirements of the California Building Code. Of particular note, the balcony joists didn't have to be made of a "durable or preservative-treated material," because they were separated from the walking surface by an impervious moisture barrier (an exemption that has since been removed from the current Berkeley Housing Code).

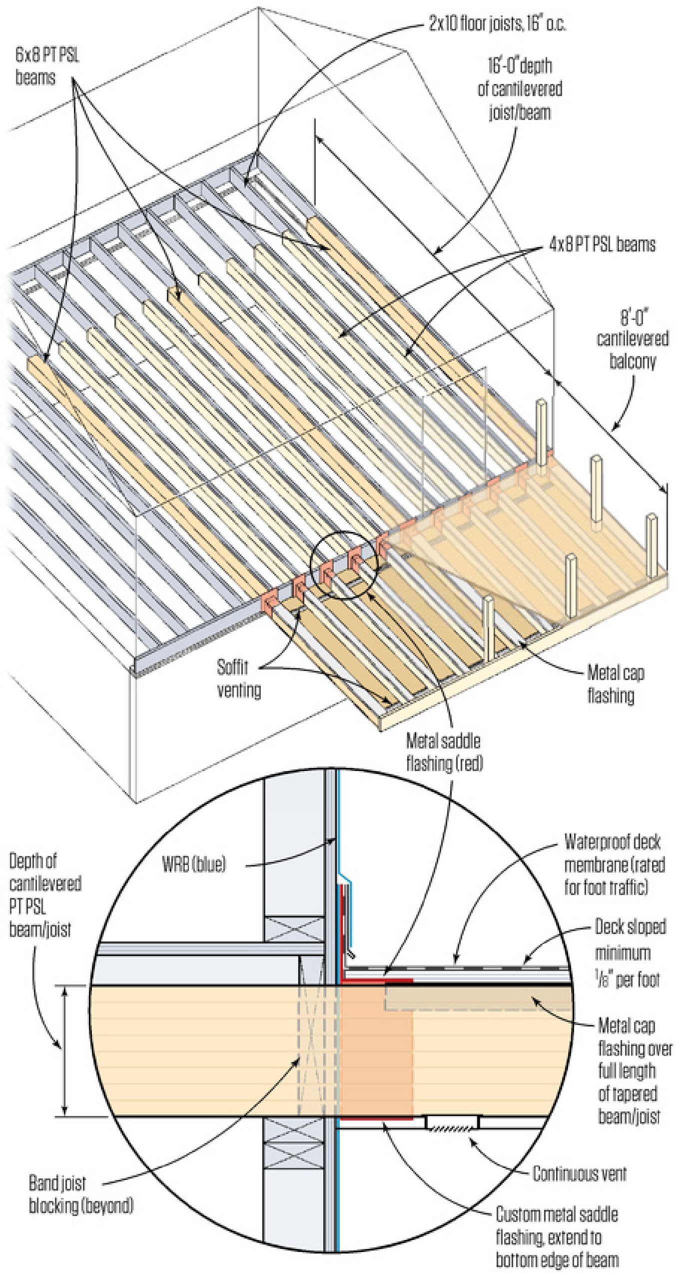
ENGINEERED CONNECTION

Most balcony designs originate with architects or engineers, and one of their rules of thumb for cantilevered balcony joists is that the exterior length of the joist must be supported by a double length inside the building envelope. This 2:1 backspan to cantilever ratio is incorporated in Table R502.3.3(2) in the 2015 IRC, which specifies joist sizing based on the desired cantilever span, ground snow loads, and joist spacing. Following this prescriptive path, 12-foot-long 2x10s spaced 16 inches on-center would be needed to frame a 48-inch-wide balcony built in an area with 50-psf ground snow loads. Not addressed by the code are connection, insulation, and flashing details.

To achieve wider balconies, Patrick Jean-Phillip Burger, a licensed architect, builder, and building inspector, in Hayward, Calif., suggests incorporating 6x8 beams of PT Douglas fir or Wolmanized Parallel-Strand Lumber (PSL) at the perimeter and mid-span of the design. Burger says using the wider beams along with 4x8 PT joists 16 inches on-center and sistered to the interior floor system allows for an 8-foot-wide balcony. To prevent water damage to the framing, he emphasizes careful flashing at the beam-wall intersection, and if the framing is enclosed, he makes sure that the assembly is well ventilated (see "Flashing a Cantilevered Balcony," right).

Flashing and drainage. In multifamily construction, balconies are often stacked vertically and built with an enclosed waterproof deck so that the upper balconies shelter

Flashing a Cantilevered Balcony



Careful flashing is a critical component in any balcony design. Here, each beam is protected with metal saddle and cap flashing, which in turn is integrated with the WRB on the wall and the floor's waterproofing membrane. Continuous soffit vents underneath allow air to flow through the assembly, and promote drying if the waterproof deck should ever leak.

Illustration: Tim Healey

Structural steel can be used to frame wider balconies **(1)**. On this project, four MC-10-22 steel beams were bolted to the interior joists on 8-foot centers **(2)**. Pressure-treated 2x12s were used for the perimeter and infill joists, as well as for the ledger bolted to the house's rim joist. Adjacent joists and the rim beam were bolted to the steel **(3)**. Note: Unlike a deck's 36-inch-minimum railing height, a balcony's railing is required by code to be a minimum of 42 inches high **(4)**.

Photos: Lenny Gillis

the balconies on the floors beneath them. The joist bays are typically enclosed with an exterior grade of plywood that's painted or covered with stucco to act as a finished ceiling for the balcony beneath. The problem with this type of assembly is that if the walking surface leaks, there's no way for the framing to dry out.

In the Berkeley collapse, this proved to be a critical flaw. Reports indicate that although the balcony joists were covered with a waterproof membrane, the builders apparently neglected to include the necessary drainage board above the backerboard, which made the joists vulnerable to water that seeped through perforations in the membrane caused by fasteners. Making matters worse, the concrete walking surface was apparently not sloped away from the building as specified, which allowed water to collect and find its way through the concrete and the backerboard to the joists. Had the balcony deck not been enclosed, or had there been ventilation, it's possible that the framing would not have rotted. And had there been a way to inspect the framing, the problem may have been discovered prior to the fatal accident.

"The failure to adequately ventilate an enclosed deck can create a breeding ground for fungal growth," says Burger. So he recommends a belt-and-suspenders approach, which is to install continuous strip vents to ventilate each of the framed cavities, as shown in the illustration on the facing page.

On residential balconies that aren't enclosed, simply installing gapped water-resistant decking boards is an effective way to shed water, as long as the structure is adequately detailed and flashed at the exterior wall. The framing should also be sloped away from the house to maintain proper drainage. This can be done by adding tapered rips to the tops of the joists to create a 1/4-inch-per-foot slope. An alternative sloping technique used by some builders is to start with wider stock and rip tapers along the length of the joists.

STEEL REINFORCEMENTS

Cantilevered wood framing can be reinforced with steel, an approach used by Lenny Gillis, of Colony Home Improvements, while building a cantilevered balcony as part of an extensive remodel in Wellesley, Mass. While the project's architect had initially specified pressure-treated 2x12s as the cantilever support, Gillis thought that was a bad idea. "The 2x12s were supposed to be sistered to the interior engineered I-joists, but in my experience, PT tends to twist when it's used inside a structure," Gillis explains. "In addition, we couldn't get the lengths we needed to satisfy the required amount of cantilever."

At the time of the build (2009), pressure-treated LVLs were hard to find, so Gillis decided to use steel C-channel beams. After packing out the webs of the 14-inch-deep I-joists, he and his crew bolted four MC-10-22 steel beams to the interior joists **(1, 2, 3, 4)**. Cantilevered at the 2:1 ratio specified by his engineer, the beams were installed on 8-foot centers. Gillis then ran pressure-treated 2x12s as perimeter and infill joists from a ledger bolted to the house's rim joist. Adjacent joists and the rim beam were bolted to the steel. As to the cost, Gillis says, "I can see the cost-saving advantages of using PT LVLs, but they would fail long before the MC10s would fail."

INNOVATIVE SOLUTIONS

To prevent moisture problems, some companies offer prefabricated aluminum balconies and balcony components. American Structures and Designs' innovative system (americanstructures.com) also incorporates a pair of support or sag rods that run between the deck's outer rim and the structure wall just above the railing **(5)**. The rods and a sub-fascia ledger can be lag-bolted or through-bolted into the interior framing. Though each balcony is engineered, all designs are based on standardized frame components that are bolted together on site, and include aluminum decking and railing posts. Owner Mark Weissenbuhler says

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Other options. This prefabricated aluminum balcony from American Structures and Designs has integral diagonal support rods that connect to brackets that are through-bolted to the house framing **(5)**. Another choice is a component system from Wahoo Decks. This option begins with a balcony that's framed with pairs of cantilevered LVL beams, as shown above **(6)**.

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