

## Green Renovations—Basements

Renovations are a popular way to update the interior and exterior of a house, add more liveable space, improve performance and address any problem areas. Renovations can also provide homeowners with an opportunity to improve the energy efficiency and indoor air quality of their homes, reduce their environmental impact, and make their homes more comfortable and affordable to live in, operate and maintain – or in other words, “green” your renovation project.

The challenge in adding green features to a renovation is to understand what value-added options are available, and how they can be undertaken at a relatively modest cost. For example, you can upgrade your house with one green feature or you can fold a number of green features into a larger project with an affordable incremental cost. You can also choose to green your entire house or just focus on making one room or area a little healthier to live in and more energy and water efficient as well.

With a little advance planning, allowances can also be made now that will make it easier to add green features in your home at some point in the future, as your budget permits or as your family’s needs change. In the end, it’s your interests, lifestyle and budget

that will determine how your renovation proceeds, and how many green features you choose to incorporate.

This guide offers tips, features and advice on how to green your basement renovation that can help you save time, energy and money.

### Healthy Housing™

While there are many different definitions of “green,” CMHC’s five principles of Healthy Housing™ offer a well-rounded interpretation. A Healthy House™ promotes:

1. **Occupant Health and a Healthy Indoor Environment** – superior quality of indoor air, water, lighting and comfort;
2. **Energy Efficiency and Renewable Energy Production** – efficient heating and ventilation systems and the use of renewable energy systems where appropriate, to reduce the consumption of energy and lower utility bills in every season;
3. **Resource Efficiency** – the efficient use of water, energy and other natural resources, including during the construction or renovation process, as well as throughout the life of the home;
4. **Environmental Impact** – reduced environmental impact of both individual homes and broader communities through more effective land-use planning and a decrease in the emission of pollutants; and
5. **Affordability** – a focus on creating homes and communities that are both appealing and financially affordable to Canadian homeowners.

## BASEMENT RENOVATIONS

People renovate their basements to increase or improve the livable space in their homes. Basement renovations also present homeowners with a number of different ways they can incorporate green features and technologies to improve the performance and energy-efficiency of their houses.

However, basements can also have significant moisture problems, which must be identified and addressed before starting any renovation project. If these problems are not fixed before you renovate, the moisture

could damage or even destroy your new materials and finishes and require costly demolitions and repairs.

### SITE CONSIDERATIONS: THE HOUSE-AS-A-SYSTEM

Before starting the renovation, it's important to understand whether your basement has any existing issues or problems related to structure, moisture, soil gases, ventilation, plumbing or durability. By identifying these problems in advance, you can fix them before you start construction or include them in the renovation work. This will help prevent them from recurring after your renovation is complete.

Potential problems to be on the lookout for, in your basement include:

#### 1. Structural considerations

- Carefully inspect the basement for moisture-damaged wooden beams, joists and wall framing.
- Check the foundation for cracks in the floor slab and walls that could allow water or soil gases into the basement. Hairline cracks may just need to be sealed if they aren't leaking, but larger or more severe cracks may need expert help to develop a solution tailored to the problem.

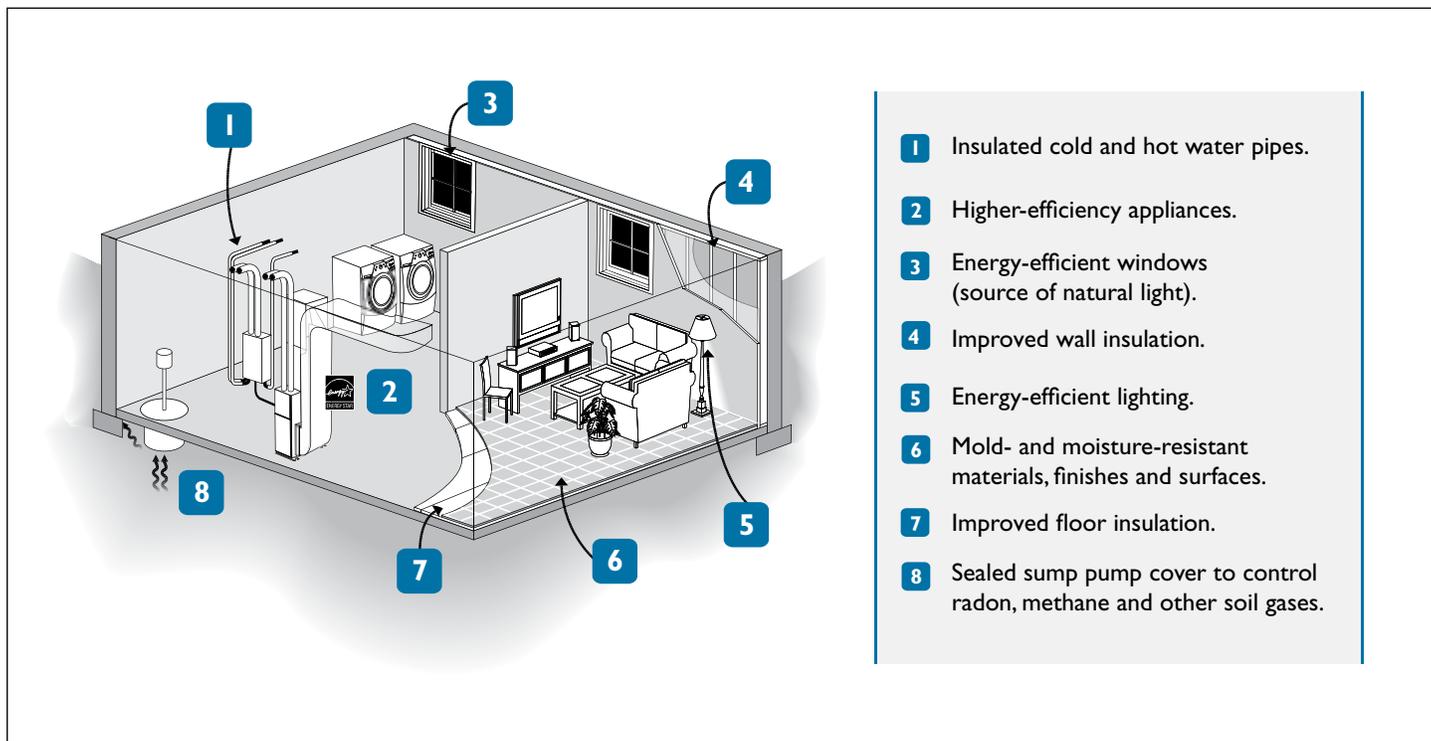


Figure 1 Healthy Basement

- Check the main floor above the foundation for insufficient bracing, beams that are too small or inadequately supported, or joists that have been overextended, spaced too far apart or cut to make room for ducts and pipes.
- Examine the concrete for spalling (concrete that has broken up, flaked or become pitted) or for a porous or powdery residue which could mean water is transferring through the floor or walls.

## 2. Soil gases

- If there is a leaking fuel tank or landfill near your house, you may have a problem with petroleum vapours, methane or other soil gases. Soil gases can cause chronic illnesses and may even explode. If you suspect that soil gases are coming into your basement, contact your municipal housing authorities immediately.
- Before renovating, test your basement for radon using a home test kit from your local home improvement store or online supplier. Radon gas comes from uranium deposits in the soil, and has been shown to be a factor in increased levels of lung cancer. If possible, conduct the radon test over a three-month period in late fall or winter for the best results. If the test confirms that radon is present

at levels that exceed Health Canada guidelines, include a radon mitigation system as part of the renovation.

## 3. Moisture

Look for signs of moisture coming from inside or around the foundation, including:

- Moisture stains on the foundation floors and walls;
- Wet insulation or condensation on wall-mounted air and vapour barriers;
- Moldy odours or visible mold on the wood framing, drywall and finishes;
- Gaps between the concrete floor slab and foundation walls;
- Evidence of previous flooding such as water marks on the walls and floors;
- Grading around the house that slopes towards (instead of away from) the foundation, or eavestroughs that deposit roof water at or around the foundation; and
- Poorly drained window wells.

## 4. Problems from water vapour (high humidity)

When the amount of water vapour in the air gets too high, it can condense on cool surfaces and then either damage the surface or surrounding materials. Mold growth may follow. Moisture can

also reduce the thermal resistance of some types of insulation and lead to mold growth, moisture-related damage and wood decay. Symptoms of high humidity include:

- Condensation on windows, cold water pipes and other fixtures;
- Condensation on or behind the wall and joist space vapour barrier, on exposed concrete surfaces or on structural steel members;
- Damp spots or mold on the walls and floors; and
- A moldy or musty smell.

## 5. Problems from capillary water

Water can also move through the capillaries (small tube-like pores) in any porous material such as masonry, stone and concrete. Symptoms of capillary water wicking into the foundation can be found on both the interior and exterior of the house, and include:

- Musty or damp walls, floors or carpets;
- Decaying window sills and bucks;
- Stuffy or damp smells;
- Wet or decaying wood that is in contact with the foundation walls or slab;
- White powdery stains on exposed concrete walls or floors; and
- The presence of mold.

### A simple test for capillary moisture problems

To find out if a foundation floor or wall is wicking moisture into your house, attach a 300 x 300 mm square of polyethylene film to a dry section of the wall or floor. Seal the edges with tape and leave it for a day or two. If moisture appears on the underside of the film, it's likely coming through the concrete.

It can be a good idea to perform this test before renovating your basement, even if there are no visible signs of moisture problems. Moisture can evaporate through the floor and walls without leaving any obvious signs. If left undetected, it can become a serious problem after you've covered the surfaces with new finishes that can trap the moisture and cause it accumulate to the point where it can damage your basement.

### 6. Problems from bulk water

“Bulk water” refers to rainwater, snow melt, groundwater or even a plumbing leak.

Bulk water leaking through basement walls or collecting in window wells is often due to poorly diverted rainwater and snow melt water, improper grading, coupled with the presence of a crack or hole in the foundation walls or floor. Some of the most common symptoms of bulk water problems include:

- Standing pools of water in the basement;
- Wet insulation;
- Mold;
- Stuffy or damp smells;
- Cracks with water leaks or staining in the concrete;
- Decayed or rotted frames or wall sill plates; and
- Visible water leaks.

### 7. Mold

- Mold is a sign that there are moisture problems that must be corrected before you renovate. If a significant amount of mold is present, hire a qualified professional to safely demolish and dispose of the affected materials and to deal with the moisture problem.

### 8. Ventilation and air circulation

- Adequate ventilation and air circulation will keep your basement comfortable and help control or prevent problems with moisture, humidity, temperature fluctuations, odours and contaminants.
- If your basement is connected to a forced-air heating system, good air circulation can be achieved fairly easily.
- For houses with baseboard heating, an air circulation system may need to be installed.

- If you're adding a new kitchen or bathroom in your basement, make sure they are equipped with an outside-vented exhaust fan.

### 9. Lead and asbestos

- Lead can be found in old house paint, solder, plumbing pipes and the service connections into homes (especially homes that were built before the 1950s) and can be a health hazard.
- Asbestos may be found in vinyl asbestos floor tiles and adhesive, appliance wiring, vermiculite insulation, as well as pipe and boiler coverings. Asbestos can become a health concern if it becomes airborne as demolition work is undertaken.
- If you think you may have lead or asbestos in your home, hire a qualified professional to assess and fix the problem. A qualified contractor will follow all applicable safety requirements, building codes, regulations and bylaws to protect their workers and your family.

## GREENING YOUR BASEMENT RENOVATION

After you've assessed your basement's current condition and addressed any problems before, or as a part of, the renovation project, it is time to consider how to add green features. There are a number

of green features, practices and options you can include in your basement renovation:

### Dealing with moisture problems

To keep water from getting into your basement, make sure your eavestroughs discharge water well away from the house. Ensure that the grading around your house, driveways, walkways and decks is sloped so that water runs away from the foundation and there are no low spots immediately next to the foundation walls. While a two per cent slope away from foundation walls is usually preferred, a 10 per cent slope for the first two metres is even better.

For more serious moisture problems, you may have to excavate the foundation walls to replace or repair the moisture protection system. Once the basement walls have been exposed, drainage tiles can be replaced or installed, cracks in the walls can be repaired, and the walls can be thoroughly moisture-proofed with a plastic or rubber waterproofing membrane or a surface bonding material.

Take advantage of the excavation to add more exterior insulation and install a vapour diffusion retarder and air barrier over the exterior foundation walls. Poorly installed air and vapour barriers can actually increase condensation and water damage, but insulation like polyurethane foam that is sprayed directly on the foundation wall can

provide an air and moisture seal while also keeping your basement comfortable and healthy.

On the inside, protect wood framing members from moisture by placing a moisture-impermeable material between the wood and concrete floors and walls.

Carpets, wood or laminate flooring, furnishings or other objects should not be installed in direct contact with unprotected concrete.

To reduce the risk of condensation, insulate cold water pipes, steel beams, walls, and if necessary, floors. Upgrade to more energy-efficient windows.

If water is leaking into the basement because of a high water table, put the renovation on hold, and contact a qualified professional to address the problem as soon as possible. If the moisture problem cannot be solved, it may be necessary to reconsider the renovation.

ENERGY STAR®-rated dehumidifiers can help control minor and seasonal moisture issues, but should not be relied upon to deal with persistent or bulk water leakage problems.

### Preventing mold

Be aware that disposing of moldy materials may raise a cloud of spores that may pose a health risk to anyone working or living in your home. Make sure your mold remediation professional seals off the basement from the rest of the house, uses a powerful

fan to vent the basement directly outdoors, and carefully bags and seals all moldy materials before removing them. Workers should also wear appropriate protection such as rubber gloves and a respirator.

If the mold is growing in carpets, they should be removed. For small mold problems, a thorough cleaning with an outdoor-vented vacuum, a vacuum with a high-efficiency particulate air (HEPA) filter or a dry steam cleaner may work, provided the carpet can be completely dried within a few hours. Be wary of some anti-fungal treatments, which can be as harmful as the mold. Moldy carpets and upholstered furniture should always be discarded.

### Soil gas and radon remediation

If you suspect soil gas entry into your basement, or a test confirms unacceptable levels of radon gas, the installation of a complete air barrier system is the first line of defence. This means providing a continuous air barrier from the first floor joist area, down the basement walls and across the floor. Any cracks or holes in the foundation must be sealed, including those around plumbing pipes and electrical wires where they enter the basement. Spray-applied foam insulation is one way to seal and insulate foundation walls. Sheet polyethylene installed over the basement wall framing can

also provide a good air and vapour barrier if it is properly installed and sealed.

Install a self-priming drain or gas trap to stop gases from coming up through the floor drain, and buy a sealable cover if you have a sump pump.

A sub-slab depressurization system may also be necessary. This typically involves installing a pipe through the basement floor into the gravel layer underneath. A fan is then connected to the pipe to draw air out from under the slab and vent it outdoors. Consult a soil gas expert or specialist radon remediation contractor to design and install the depressurization system.

If your home has a well and you detect radon gas in your basement, the gas may be coming from the water in the well. Have your well water tested, and install a treatment system if necessary. Regardless of how you resolve any gas issues, be sure to conduct a second, follow-up test before continuing with the renovation, to make sure the problem has been fixed.

### Adding wall insulation

If you need to excavate the basement walls (such as to fix a moisture problem), adding an extra layer of insulation to the exterior of the walls can be a great way to improve the energy-efficiency of your home. Otherwise, insulation can usually be added fairly easily and cost-effectively to the inside of the walls as long

as any moisture problems have been fixed.

Some common forms of exterior insulation include rigid or semi-rigid insulation panels, and spray-applied foam insulation. Semi-rigid board insulation can help direct any water around the foundation downward to the drainage tiles. However, it should only be used where there is a functioning drain tile, and should be installed over the full depth of the basement walls with no horizontal seams.

Spray-applied foam insulation can provide a continuous blanket of insulation and moisture protection, while also helping to prevent air leaks. Exterior insulation should be at least 51 mm (2 inches) thick, although 100 mm (4 inches) offers better performance. The sill plate and header joist can also be insulated from the outside if they are exposed during the renovation.

If you don't need to excavate the walls, insulating from the inside can be an effective and less disruptive way to reduce heat loss and increase comfort. There are several options available for insulating the interior of the walls, including building wood stud walls and adding batt insulation with a sealed polyethylene air barrier. Adding a moisture resistant sheet material between the wood framing and foundation walls can help protect the wood framing from moisture. Installing rigid board or spray foam insulation directly on the foundation walls are other

options. In either case, battens are installed over the insulation to provide space for electrical services and to support the gypsum board (drywall) finish.

Whatever method you choose, seal all cracks, penetrations, joints and electrical outlets, to make sure the insulation can work as effectively as possible.

### Floor finishing options

In general, hard surface finishes like ceramic tile, pre-finished wood, laminate flooring and linoleum can be healthier choices for flooring. This is because they are generally more water-resistant and have little or no off-gassing. Vinyl flooring can gradually release pollutants, though hard vinyl tiles may emit fewer gases than flexible sheet vinyl flooring. Look for adhesives, sealers and grouts that are low-polluting and low-toxicity.

To further prevent bulk or capillary water from damaging your floor, consider installing a water- or moisture-resistant subfloor. If your ceiling-to-floor clearance is high enough, you can also install a whole new floor structure, complete with a moisture barrier, air barrier and insulation.

Unless the foundation is very dry, carpeting is usually not a good choice for basements, as it tends to trap moisture and provides a good place for mold to grow. Area rugs can be used, as they can be removed more easily for cleaning.

## Wall and ceiling finishes

Drywall provides the simplest and most versatile surface for most walls and ceilings, but consider using sealed wood paneling or paperless drywall as more moisture-resistant alternatives. Use pressure-treated wood for wall base plates, and be sure to provide a moisture break, such as strips of polyethylene sheet material, between the wood and concrete floor for extra protection.

Acoustic tiles and panels can also be good options for basement ceilings. If you use drywall in the ceiling, include hatches to allow access to plumbing valves, duct dampers and other elements that may require periodic inspection and adjustment.

## Healthier finishes and sealants

Wherever possible, choose finishes, cement, caulking and sealants that are low-odour and low in chemical emissions. This includes low-VOC paints and water-based urethane coatings for wood. Plant- or mineral-based paints and coatings can also be good options if you or anyone in your family is particularly sensitive to emissions.

## Cabinetry and shelving

Solid hardwood is a low pollutant emitting, durable option for most cabinets and shelves. The particleboard and medium-density fibreboard (MDF) used to make modular cabinets may contain urea formaldehyde glue, which can adversely affect the air quality in your house. If you choose to use

these materials, make sure the material is sealed with a plastic skin, and coat all surfaces (including edges and the holes for adjustable shelving) with a suitable sealer, such as waterborne urethane or a low-toxicity acrylic sealer.

Formaldehyde-free MDF, exterior-grade plywood and formaldehyde-free hardwood plywood can also help minimize off-gassing. If possible, look for wood products that are Forest Stewardship Council (FSC), Canadian Standards Association (CSA) or Sustainable Forestry Initiative (SFI) certified. This ensures that the wood you choose comes from sustainably managed forests.

## Plumbing

To save energy and prevent condensation and mold from forming, insulate cold and hot water pipes that become accessible during the renovation work.

As the trap in a basement floor drain can dry out over time, consider the installation of an automatic trap seal primer. This device delivers a small amount of water to the drain each time a basement faucet is used. This helps to ensure that sewer gases do not find their way into your basement.

To protect against current, or future, sewer backups into your newly renovated basement, install a backwater valve in the main drain line. The valve allows waste water to drain out of your house but closes automatically if sewer water tries to back up in the drain line.

To save water and cut down on your energy bills, choose a dual-flush or low flush toilet (6 litres of water or less per flush) and low-flow faucets and showerheads. Check for a WaterSense® label, which certifies fixtures that are both water-efficient and high-performance.

Add shut-off valves to all fixtures to make future repair and replacement work easier and less expensive to do.

Adding a drain water heat recovery unit to a drain line serving a shower on a floor above the basement can help reduce your family's water heating costs.

## Lighting

One of the simplest and easiest ways to improve energy-efficiency in your basement is by installing ENERGY STAR®-rated energy-efficient lighting, and making effective use of whatever natural light is available.

A good lighting design will make sure your basement provides enough light for your family's needs, without wasting money or energy. Dimmers with suitable fluorescent or light emitting diode (LED) bulbs can create a more intimate sitting area while also saving electricity.

Adding or enlarging windows, enlarging window wells and using light-coloured paint on the walls and ceilings can all help increase the amount of natural light and make your basement more inviting and useable. An "all-off" switch placed at the top of the basement stairs can be installed to shut off all lights and

electrical outlets to reduce the amount of energy wasted by phantom loads.

### Ventilation and air circulation

The indoor air quality of all rooms can be improved through ventilation and air circulation. If your house uses a forced-air furnace system, good air circulation can be provided by locating new supply and return air diffusers throughout the basement. While the ducts are exposed, it is a good time to seal all the joints in the supply and return air ductwork with foil tape or mastic.

**NOTE:** To avoid backdrafting problems, air returns should not be located in or near any closed

rooms that have furnaces, hot water tanks or other unsealed combustion appliances.

Sometimes air circulation may not be sufficient to provide good indoor air quality. Mechanical ventilation systems such as exhaust fans or energy efficient heat recovery ventilation systems are much better at providing indoor-outdoor air exchange.

In addition, if you install a kitchen or bathroom in your basement, be sure to include an exhaust fan that vents directly to the outdoors. Clothes dryers must also be vented outdoors unless they are condensing-type appliances.

### EnerGuide and ENERGY STAR®

Natural Resources Canada's EnerGuide rating system allows consumers to compare the energy performance of different models of common household products, including windows, appliances, and heating and cooling equipment. The United States Environmental Protection Agency's ENERGY STAR® system identifies products that meet or exceed premium levels of energy efficiency. To choose the most energy-efficient products available, read the EnerGuide label, or look for the ENERGY STAR® symbol on the product, its packaging, or in the product literature.

### Green Product Claims

There's a lot of misinformation and confusion about "green" products. Homeowners should beware of unsubstantiated or overstated claims. Manufacturers or suppliers should be able to produce independent test results to back up their claims, as well as a material safety data sheet (MSDS) to address any safety concerns.

To identify specific green products, you can also rely on independent third-party certification programs like Natural Resources Canada's EnerGuide, the Environmental Protection Agency's ENERGY STAR® ratings, the International Standards Organization (ISO) and the Canadian Standards Association (CSA). The following are a few other green product-labelling programs that can help you make an informed decision:

- **GreenSpec™ Product Guide:** an independent website that helps building-industry professionals and policy makers improve the environmental performance, and reduce the adverse impacts, of buildings. <http://www.buildinggreen.com/menus/>
- **GREENGUARD™ Environmental Institute:** an ISO-accredited third-party organization that certifies products and materials for low chemical emissions. <http://www.greenguard.org/en/QuickSearch.aspx>
- **EcoLogo™:** a program founded by the Government of Canada (now managed by TerraChoice) that certifies products and services based on their compliance with environmental criteria established by industry, environmental groups and independent experts. <http://www.ecologo.org/en/index.asp>
- **Green Seal™:** a non-profit organization that develops and certifies sustainability standards for products, services and companies. <http://www.greenseal.org/>
- **WaterSense®:** a U.S. Environmental Protection Agency-sponsored rating program that promotes water-efficient products, programs and practices that also offer consumers exceptional performance. <http://www.epa.gov/WaterSense/>

## Checklist: Green Basement Renovations

### Occupant health/healthy indoor environments

- Prevent moisture and mold problems with moisture control strategies and moisture-resistant materials, finishes and surfaces.
- Test for soil gas (radon, methane, etc.) and mitigate if necessary.
- Reduce pollutant emissions by using low-emission flooring (ceramic tile, natural stone), cabinets (hardwood, low-emission or sealed particleboard), countertops (solid surface, laminates, sealed particleboard), paint, cement, grouts, sealants and caulking.
- Provide good air circulation and ventilation throughout the space.
- Insulate cold water lines to prevent condensation.

### Energy efficiency

- Improve wall and floor insulation.
- Install effective air barriers.
- Insulate hot water pipes.
- Install energy-efficient appliances, windows and equipment.
- Use low-energy lighting and take advantage of available natural light.
- Inspect, adjust, seal and adapt forced-air system ducts for the new basement space.

### Resource conservation

- Select certified forest products for flooring, cabinetry and millwork; recycled content for tiles and drywall; and materials that are locally sourced and lightly processed.
- Choose materials and products that are durable, resilient and easy to maintain.
- Plan for future retrofits of additional green features.

### Reduced environmental impact

- Create a plan for how you will dispose of waste from the renovation and recycle or reuse old fixtures, cabinets and materials.
- Choose products and materials with low pollutant emissions.
- Choose water efficient fixtures and appliances that reduce loads on the sewer system.

### Affordability

- Avoid expensive rework by identifying and addressing any concerns that may arise at the beginning of the job.
- Control maintenance and replacement costs by using high-quality, durable materials.
- Include energy- and water-saving features to reduce monthly operating costs.
- Design for accessibility to maximize the amount of time you and your family will be able to access and enjoy your basement as you age.
- Choose a good, timeless design that will extend the life of your new basement and the time between demolitions.

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