Engineering Tech Tips

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Maintenance Issues and Repair Guidelines for Precast Concrete Toilets and Utility Buildings

Gary Kees, Project Leader

Cracked panels and peeling paint on some concrete Sweet Smelling Toilets (SSTs) have USDA Forest Service field personnel wondering how best to repair and maintain these toilets and other precast concrete buildings (figure 1). Though concrete SSTs are virtually indestructible, vandals, weather, and the nature of the concrete itself, can still take their toll. Small cracks in panels typically won't affect the building's structural stability. This report describes the best methods and materials for repairing cracks in concrete and coatings. The tech tip also documents field inspections we conducted, manufacturing information, safety and structural issues, and warranty and contract issues.

Field Inspections

The Missoula Technology and Development Center (MTDC) randomly inspected about 35 SSTs in Idaho, Montana, Wyoming, Colorado, and Nevada. The SSTs ranged from 1 to 7 years old. We typically found cracks in panels at sharp angles near doors and windows, and at panel connection joints (figure 2). A few panels had full-length, full-depth cracks across the roof and wall sections (figure 3). Only one SST had a visible crack in the floor panel. Coatings were commonly seen peeling under the eaves or in areas where concrete was cracking. The coating on one SST was peeling off in sheets on flat, open areas of the panels (figure 4).

Figure 1—Precast concrete toilets are tough, but still require some periodic maintenance. This Tioga special double-vault toilet is made by CXT, Inc., of Spokane, WA.

For additional information, contact: *Gary Kees, project leader; USDA Forest Service, MTDC; 5785 Hwy. 10 West; Missoula, MT 59808–9361. Phone: 406–829–6753; fax: 406–329–3719; e-mail: gkees@fs.fed.us*

Figure 2—Cracks in concrete typically begin at the sharp edges of doors and windows.

Figure 3—Full-length, full-depth cracks in panels may not be a serious structural concern.

Floor coatings seem to be holding up well, except for some peeling at the grouted joint along the wall.

Figure 4—Coatings that come off in sheets are not considered normal. Such problems probably are caused by poor surface preparation or unusual weather conditions.

Manufacturing

Two companies are currently under contract with the Forest Service to produce concrete SSTs: CXT, Inc., in Spokane, WA, and Missoula Concrete Construction in Missoula, MT. CXT manufactures various models of the SST. Special, high-strength concrete mixes and heating systems speed the curing process. Precast concrete panels must meet a specified strength before they are removed from the forms and assembled. Panels are connected by welding together metal clips embedded in the concrete. A heated paint booth bakes on the finish coating. Missoula Concrete Construction manufactures the "Aspen" style single vault-SST. Photos showing SSTs being manufactured at CXT, Inc., are available on the USDA Forest Service's Technology and Development Program Web site at *http://www.fs.fed.us/eng/t-d.php?link=pubs/ppt_html/htm04232P01*.

Structural Significance of Cracks

Questions about the structural integrity and quality of SSTs have surfaced because of full-depth cracks found in some concrete panels. Concrete is not a perfect building material. It shrinks as it cures, is exposed to thermal expansion and contraction, and can be stressed during shipping, all of which

can cause panels to crack. Water that freezes and thaws in the roof and wall cracks can cause further damage. Cracks that might be acceptable to an engineer concerned primarily about a panel's structural integrity might not be acceptable to the person responsible for maintaining the toilet.

So how do you determine whether cracks in SST panels present a structural concern or are just unattractive? The steel reinforcing bars (rebar) specified for each panel (figure 5) help hold the panel together, even if the concrete is cracked. A simple test recommended by CXT can help determine whether a crack might affect the structural integrity of a panel. If a credit card can be inserted deeper than $^{3}/_{16}$ of an inch into the crack, send a photo of the crack (with a ruler beside it for scale) to the manufacturer's engineering department or to a Forest Service facilities engineer. Rust stains found around cracks, or exposed reinforcing steel, are other causes for concern. Engineering analysis will help determine the severity of damage and whether repairs are required. MTDC did not find any SSTs in danger of failing structurally because of cracks.

Figure 5—Grids of steel reinforcing bars give strength to concrete panels, lessening the structural concerns that cracks in panels might represent.

Safety Issues

Before applying and handling any repair products, always review the application instructions, container labels, and the material safety data sheet (MSDS). If you have any questions relating to requirements specified on the MSDS, please contact the manufacturer of the product. All recommended safety requirements should be followed at all times.

Repairing Small Cracks in Interior or Exterior Walls and the Roof

Recommendations from CXT for repairing small cracks in the interior and exterior walls and the roof of precast concrete buildings include:

- Clean foreign material from the surface of the crack with a damp cloth and allow adequate time for the surface to dry.
- Rough up the area along the crack, including any paint edges and exposed concrete, with 100- to 125-grit sandpaper. Wire brushes are not recommended because they may remove too much paint .
- Use a dry paintbrush with stiff bristles to remove loose material inside the crack.
- Wipe the area around the crack with a damp cloth to remove fine particulate matter on the surface. Allow time for the surface to dry completely.
- Caulk the cracked area with an acrylic latex caulk plus silicone in brilliant white (DAP "Alex Plus" 35 Year Brilliant White is a good choice). Cut the tip of the tube of caulk so it has a $^{1}/_{16}$- to $^{1}/_{8}$-inch opening. A clean 45-degree angle cut will help ensure an even application of caulk. Begin caulking at the point that is the farthest from you. Gently squeeze the caulk gun's handle until caulk appears in the crack. Apply just enough caulk to fill the crack and move the tip of the caulk tube toward you until you have applied caulk along the entire length of the crack. Avoid applying more caulk than needed to fill the crack.
- As soon as you have filled the crack, smooth out the caulk. Place your thumb squarely on the caulk that is farthest from you and apply gentle pressure in a smooth, even motion down the entire length of the crack. Whenever your thumb has too much caulk on it or is pushing caulk outside the crack area, stop and clean your thumb with a damp rag. Clean excess caulk from the surface. If you use a damp rag, be careful not to let it touch the crack, because the rag will pull caulk out, leaving a depression.
- The caulk will dry (become tacky) in about 30 minutes, depending on the weather and the type of caulk. After the manufacturer's approved drying (tack up) time has passed, check to make sure that the entire crack has been filled to the surface. If so, the caulk may be painted. If not, fill areas that are not level with the surface. Allow any new applications of caulk to dry for at least 30 minutes before painting.

Repairing Coatings

Coatings commonly peel and crack around panel connection joints, under roof eaves, at sealed joints, and around areas of cracked concrete (figure 6). Failed coatings are most likely to have been caused by water migrating through cracks in the panels, poor surface preparation of the panels, or improper application of the coatings. A white, chalky substance found on many of the cracked paint surfaces (figure 7) is caused by efflorescence, crystalline salt that is deposited on the surface. Efflorescence is harmless, but unattractive.

Figure 6—Cracked and peeling paint is common under eaves and around panel connections and joints.

SSTs have a variety of coatings. These coatings have varied throughout the years because of changes in regulations that affect the manufacturing facilities. It's important to know the type of coating that you are trying to repair. Typically, wall and roof panels are coated with water-based, acrylic penetrating stains or sealers, while floors are coated with a two-part epoxy sealer.

Figure 7—A white, chalky substance called efflorescence found near cracked paint is ugly, but harmless.

Identifying the original coating will help you determine whether any special preparation and repair procedures are needed and select the proper personal protective equipment and repair materials. CXT and Missoula Concrete Construction can help you determine the original coating specification and color from the building's serial number.

On CXT products, the serial numbers are inside on a metal tag above the door. On Missoula Concrete Construction products, the serial number is scribed into the concrete between the vault access and back wall.

CXT and Missoula Concrete Construction sell materials to restore coatings, repair chips and cracks, and mask marks by vandals. You also may contact other vendors who supply these materials.

Procedures for Repairing Coatings

Follow the manufacturer's recommendations for repair or recoating and the manufacturer's specific safety precautions. United Coatings, Inc., a major supplier of coatings, offers this general advice for repairing or restoring water-based coatings on walls and roofs:

Surface preparation—

- Remove any loose coating, flaking concrete, or other foreign materials with a putty knife or scraper.
- Clean areas to be coated with a cleaner recommended by the coating manufacturer or another approved cleaner (such as Simple Green, 1–800–228–0709).
- Thoroughly rinse all cleansed areas with freshwater and allow them to dry to the touch (in most cases 2 to 4 hours).
- Repair damaged concrete with an approved patching material, such as QUIKRETE or United Coating's Uni-Crete. Follow the manufacturer's instructions and allow the product to cure at least 24 hours.
- Repair all cracked areas as described earlier.

Canyon Tone stain application (concrete stain)—

- Apply the first coat of Canyon Tone stain with a standard paint roller or brush at a rate of 1 gallon of stain per 100 square feet of surface. A thin coat that just covers the patch area is best.
- Allow the first coat to dry to the touch (in most cases 2 to 4 hours), then apply the second coat at the same rate as the first.

Acrysheen application (graffiti-resistant clear coat)—After the second coat of Canyon Tone stain is dry to the touch (in most cases 2 to 4 hours), apply one coat of Acrysheen at the same rate and using the same technique as the Canyon Tone stain.

Cleanup—Clean all tools with warm (if available) soapy water while materials are still wet. Dispose of any waste materials in accordance with the MSDS and conform to all local regulations.

Return to service—Allow a minimum of 24 hours for the completed repair to cure and set before returning the building to service. Cold, wet conditions can require extending the time needed before the building can be returned to service. Check the repairs after 24 hours and delay returning the building to service if the repair is still soft or tacky to the touch.

Contact CXT or Missoula Concrete Construction if you need to restore or repair epoxy floor coatings.

Warranty or Contract Issues

The current U.S. Government contract includes a 3-year warranty period on SST buildings, with a 10-year warranty on the watertightness of the vault. If repairs or adjustments are required while an SST is under warranty, contact your contracting officer to find out how to process the claim. Vendors have been good about repairing major cracks and coating problems while SSTs were under warranty.

Forest Service personnel should inspect new SSTs when they arrive onsite or before they leave the factory to ensure they meet the current contract specifications. Proper installation of the SST can help ensure a longer life, ease of maintenance, and good accessibility. The contract describes design requirements and specifications for constructing and installing SSTs.

The U.S. Government contract states that cracks in SSTs shall be cause for rejection by the Government if the cracks affect the serviceability or structural integrity of the components. Although the appearance of cracking panels isn't pleasing, most cracked panels will retain their serviceability or structural integrity for many years.

Contact Information

CXT and Missoula Concrete Construction have other useful information related to SSTs available on their Web pages. Both firms have employees available to answer questions on the maintenance and repair of SSTs and other precast buildings.

CXT, Inc.
3808 North Sullivan Road, Building 7
Spokane, WA 99216
Phone: 509–921–8766 or 800–696–5766
E-mail: See Web site below (search under Precast Products, Contacts/Locations)
Web site: *http://www.cxtinc.com*

Missoula Concrete Construction
7800 Deschamps Lane
Missoula, MT 59808
Phone: 406–549–9682
E-mail: *mslacon@missoulaconcrete.com*
Web site: *http://www.missoulaconcrete.com*

Forest Service Contracting Officer (CO)
William (Bill) Whitson
Phone: 425–744–3333
E-mail: *wwhitson@fs.fed.us*

Forest Service Contracting Officer's Representative (COR)
Bethany Barron
Phone: 303–275–5175
E-mail: *bbarron@fs.fed.us*

Products Recommended by CXT, Inc.

- Interior cracks and joints—DAP "Alex Plus" 35-year caulk
  Phone: 888–327–8477
  Web site: *http://www.dap.comtechbulletins/00010002.pdf*
- Exterior joints—GE Silicone II
  Phone: 866–275–4372
  Web site: *http://www.gesealants.com/sealants/diy/portfolio/silicones/silicone2.shtml*
- Interior and exterior walls and the roof—Canyon Tone Stain "W"
  Web site: *http://www.canyontonestain.com/*
- Interior floors—Contact CXT for particular applications
- Sealer—Acrysheen Clear Coat
  Web site: *http://www.unitedcoatings.com/techpdf/acrysheen.pdf*
- Metal—DTM acrylic coating, semigloss, by Sherwin-Williams
  Phone: 800–321–8194
  Web site: *http://www.sherwin.com*
- United Coatings
  Phone: 800–541–4383
  Web site: *http://www.unitedcoatings.com*

Products Recommended by Missoula Concrete Construction

- Interior walls—Mirrorlac-WB DP84XX by Glidden/Devoe, white
  Phone: 888–681–6353
  Web site: *http://www.paint spec.com*
- Interior floors—2-part water base epoxy, AQUA Tile by INSL-X, gray
  Phone: 800–225–5554
  Web site: *http://www.insl-x.com*
- Metal—Mirrorlac DP85XX by Glidden/Devoe, color varies
  Web site: *http://www.paintspec.com*
- Exterior stain enhancement—Wondershield by Glidden/Devoe DR15XX, color varies
  Web site: *http://www.paint spec.com*)
- Interior caulk—DAP "Sidewinder"
  Phone: 888–327–8477
  Web site: *http://www.dap.com/techbulletins/00010015.pdf*
- Exterior joint caulk—Siliconized acrylic latex by General Electric
  Phone: 866–275–4372
  Web site: *http://www.gesealants.com/*
- Roof ridge—100 percent silicone caulk by General Electric
  Phone: 866–275–4372
  Web site: *http://www.gesealants.com/*

Other Products

- QUIKRETE
  Web site: *http://www.quickrete.com/*
- Romtec, Inc.—Risers and vents
  Web site: *http://www.romtec-inc.com/search.php?fmSearch=1&category=vaults*
- Contact CXT or Missoula Concrete Construction for information on materials for doors, windows, vents, signs, or hardware.

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- Dale Clouse from Missoula Concrete Construction

About the Author

Gary Kees is a project leader specializing in reforestation and nurseries, facilities, recreation, and GPS projects at MTDC. He received his bachelor's degree in mechanical engineering from the University of Idaho. Before coming to MTDC in 2002, Gary worked for the Monsanto Co. in Soda Springs, ID, as a mechanical/structural engineer and project manager.

Library Card

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Describes how to repair cracked panels and peeling coatings on Sweet Smelling Toilets. These toilets were developed by the USDA Forest Service with ventilation that carries odors out of the outhouse. Two firms have U.S. Government contracts to make the precast concrete outhouses: CXT, Inc., in Spokane, WA, and Missoula Concrete Construction in Missoula, MT. Although cracks may appear to compromise the structural integrity of the concrete panels, steel bars (rebar) that reinforce the panels prevent small cracks from causing serious problems. A simple guideline from CXT can be used to determine whether a crack is cause for concern. If a credit card can be inserted more than $^{3}/_{16}$ of an inch deep into a crack, send a photo of the crack (with a ruler alongside it for scale) to the manufacturer's engineering department or to a Forest Service facilities engineer. Rust stains around cracks or exposed steel reinforcing bars also would be a cause for concern.

Keywords: coatings, concrete, cracks, facilities, outhouses, rebar, reinforcement, restrooms, SSTs, Sweet Smelling Toilets.

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5785 Hwy. 10 West
Missoula, MT 59808–9361
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Phone: 406–829–6753
Fax: 406–329–3719
E-mail: gkees@fs.fed.us

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http://fsweb.mtdc.wo.fs.fed.us/search