Box Culverts in the Environment

Precast concrete box culverts are used for conveyance of fluids such as stormwater and sewage as well as for short span-bridges and access ways. Precast concrete three-sided culverts allow for natural streambeds to remain intact while providing for short-span bridge applications. Because precast box culverts are produced in a controlled environment, they will exhibit high degrees of quality and uniformity. They also offer a multitude of advantages such as superior strength and durability, reduced weather dependency for installation, design flexibility and reduced impact to the job site. Precast concrete is also an environmentally friendly material that will always be readily available. Box culverts are common products and many manufacturers maintain an inventory of several sizes of box culverts ready to be delivered in short notice.

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For additional information about using precast concrete within the LEED system, please visit www.precast.org
INSIDE THE BOX

Precast Concrete Box Culverts Have Many Advantages Over Competing Materials

**Built tough**
The strength of precast concrete gradually increases over time. Other materials can deteriorate, experience greater creep and stress relaxation, lose strength and/or deflect over time. The load-carrying capacity of precast concrete is derived from its own structural qualities and does not rely on the strength or quality of the surrounding backfill materials. Properly designed precast concrete box culverts can easily support vehicular, aircraft and railway loads meeting AASHTO, FAA and AREMA specifications.

**We’re talking quality here**
Because precast concrete products are manufactured in a controlled environment, they exhibit high quality and uniformity. Factors affecting quality typically found on a job site – temperature, improper curing, poor craftsmanship and material quality – are nearly eliminated in a plant environment. Precast concrete box culverts produced in a quality-controlled environment and installed with high-quality sealants offer a superior solution to watertightness requirements.

**Ready when you are**
Because precast concrete box culverts are manufactured well in advance of installation, they are ready for transportation to the job site at a moment’s notice. They are quickly installed in a matter of hours using a crane and a small crew. Backfilling can begin immediately rather than waiting several days or more for cast-in-place concrete to gain proper strength. Once backfilled, road construction can begin, greatly reducing the deviation of any associated lanes and congestion in the surrounding communities.

**Nasty weather? No problem**
Precast concrete increases efficiency because weather will not delay the manufacturing process in the precast plant. In addition, weather conditions at the job site do not significantly affect the schedule.

**Lookin’ good**
Precast concrete box culverts can also include spandrel and wingwall panels with a multitude of architectural finishes. Finishes commonly available are: colored, smooth-as-cast, textured form liner, exposed aggregate, acid etched, brick and sandblast. Each is distinctly different, providing specifiers and owners a broad choice in appearance. Architectural finishes complement the surrounding environment and comply with local aesthetic requirements.

**Good for the planet**
Precast concrete is nontoxic, environmentally safe and made from all natural materials, making it an ideal material for use below grade or for the conveyance of water. Concrete has no proven ill effects on groundwater and surface water quality, which helps preserve our natural water resources.

**A better bottom line**
Incorporating precast concrete box culverts into your next project can save you time and money. Fewer skilled laborers and fewer man-hours will be required for the project, making precast concrete box culverts ideal for meeting the needs of today’s fast-paced construction projects. Whether you are spanning a small creek, designing a combined sewer overflow system or housing telecommunications equipment below grade, precast concrete box culverts are the clear choice.
Credit Requirement  
Max. Points: 1

Site Development – Protect or Restore Habitat

Case 1 – Greenfield Sites
Limit all site disturbances to the following parameters:
• 40 feet beyond the building perimeter
• 10 feet beyond surface walkways, patios, surface parking and utilities less than 12 inches in diameter
• 15 feet beyond primary roadway curbs and main utility branch trenches
• 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities and playing fields) that require additional staging areas to limit compaction in the constructed area.

Case 2 – Previously Developed Areas
Restore or protect a minimum or 50% of the site (excluding the building footprint) or 20% of the total site area (including building footprint area), whichever is greater, with native or adapted vegetation.

Precast Contribution
Precast concrete products are cast and cured in the plant and delivered to the site ready to set so they reduce the staging area required, which can reduce the overall site disturbance.

The impact on the construction site is also reduced because there is no additional formwork, which often requires more construction area for above-ground products and larger excavation areas for underground products.

Less impact on sites can reduce construction waste, shorten the construction schedule and require fewer laborers on-site.
Credit Requirement

Site Development – Maximize Open Space

Requirements

Case 1: Sites with Local Zoning Open Space Requirements
Reduce the development footprint and/or provide vegetated open space within the project boundary such that the amount of open space exceeds local zoning requirements by 25%.

Case 2: Sites with No Local Zoning Requirements
(example – some university campuses and military bases)
Provide a vegetated open space area adjacent to the building that is equal in area to the building footprint.

Case 3: Sites with Zoning Ordinances but No Open Space Requirements
Provide vegetated open space equal to 20% of the project site area.

ALL CASES
For projects in urban areas that earn SS Credit 2: Development Density and Community Connectivity, pedestrian-oriented hardscape areas can contribute to credit compliance. For such projects, a minimum of 25% of the open space counted must be vegetated. Wetlands or naturally designated ponds may count as open space and the side slope gradients average 1:4 (vertical:horizontal) or less and are vegetated.

Precast Contribution

Precast concrete box culverts can help maximize open space when utilized as underground detention/retention. These components can easily be located beneath paved parking, which reduces the need for an on-site water retention pond and reduces the site disturbance while maximizing vegetated open spaces.

Note: The precast products must be located within the site boundaries of a LEED rating system project type. Currently, infrastructure projects that are not part of a rating system would not contribute toward any LEED credits.
Credit Requirement

Max. Points: 1

Stormwater Design – Quality Control

Case 1 – Sites with existing imperviousness 50% or less

Option 1
Implement a stormwater management plan that prevents the postdevelopment peak discharge rate and quantity from exceeding the predevelopment peak discharge rate and quantity for the 1 and 2-year 24-hour design storms, or

Option 2
Implement a stormwater management plan that protects receiving stream channels from excessive erosion. The stormwater management plan must include a stream channel protection and quantity control strategies.

Case 2 – Sites with existing imperviousness greater than 50%
Implement a stormwater management plan that results in a 25% decrease in the volume of stormwater runoff from the 2-year 24-hour design storm.

Precast Contribution

Precast concrete is an excellent choice to help control the quantity of stormwater runoff with a wide variety of products that can contribute to a proper stormwater management plan.

Precast box culverts with headwalls and wingwalls help protect stream channels from excessive erosion by controlling the flow of water in and out of the box culverts to the open channel or ditch.

Precast concrete underground storm systems are sized to channel large discharges to nearby bodies of water during heavy rains. Precast concrete not only withstands the forces from fluids inside the pipe, but also handles extreme loading conditions outside the pipe.
Implementation of a stormwater management plan that reduces impervious cover, promotes infiltration and captures stormwater runoff from 90% of the average annual rainfall using acceptable best management practices (BMPs).

BMPs used to treat runoff must be capable of removing 80% of the average annual postdevelopment total suspended solids (TSS) load based on existing monitoring reports.

BMPs are considered to meet these criteria if:

- They are designed in accordance with standards and specifications from state or local program that has adopted these performance standards, or
- There exists infield performance monitoring data demonstrating compliance with the criteria. Data must conform to accepted protocol for BMP monitoring.

Precast concrete box culverts capture stormwater runoff in retention/detention systems. The outlets in these structures are sized to release the stored runoff at flow rates that serve to reduce the effects of pollutants leaving a site during peak flows.

Flow-through stormwater treatment structures can be utilized to separate sediments and other pollutants through a swirl flow pattern.

Precast concrete structures are often designed to fit stormwater treatment systems within them.
Credit Requirement

Max. Points: 2

Recycled Content

Requirements
Use materials with recycled content such that the sum of postconsumer recycled content plus 1/2 the preconsumer content constitutes at least 10% or 20% (based on cost) of the total value of the materials in the project. The minimum percentage materials recycled for each point threshold is:

<table>
<thead>
<tr>
<th>Recycled Content</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>1</td>
</tr>
<tr>
<td>20%</td>
<td>2</td>
</tr>
</tbody>
</table>

The recycled content value of a material assembly is determined by weight. The recycled fraction of the assembly is then multiplied by the cost of the assembly to determine the recycled content value.

Mechanical, electrical and plumbing components and specialty items such as elevators cannot be included in this calculation. Include only materials permanently installed in the project. Furniture may be included if it is included consistently in MR Credit 3: Materials Reuse through MR Credit 7: Certified Wood.

Precast Contribution

Precast concrete products may contain supplementary cementitious materials such as fly ash and blast furnace slag which will add to the project’s recycled content goals.

Precast products may also contain rebar and welded wire mesh which is often made from recycled steel.

Other less frequently used recycled content components include various fiber reinforcements, glass aggregates, silica fume, and recycled crushed concrete.

The NPCA LEED calculator helps members respond with the proper documentation required for this credit. Simply input the Zip Code/Postal Code and weight for each component to generate a pdf file that can be e-mailed directly to the LEED AP, contractor or architect.
Credit Requirement

Regional Materials
Use materials or products that have been extracted, harvested, and manufactured within 500 miles of the project site.
The calculation is based on the overall materials cost. Materials costs include all expenses to deliver the material to the project site. Materials costs should account for all taxes and transportation costs incurred by the contractor but exclude any cost for labor and equipment once the material has been delivered to the site.

Regional Materials of 10% = 1 point
Regional Materials of 20% = 2 points

See the NPCA LEED Calculator at www.precast.org/leed for help with this credit.
See the LEED Canada guide for information on Canada’s credit requirements.

Precast Contribution

Because concrete uses plentiful and natural raw materials, concrete components can be extracted, harvested and manufactured within 500 miles of the project site. Using locally obtained raw materials helps reduce transportation distances which reduces the environmental impact of carbon emissions.

If shipping is done by rail or water, LEED Canada allows up to 2,400 km (1,500 miles) from both the manufacturing site to the project site and the location where building materials are extracted, harvested, recovered and processed to the manufacturing site.

The NPCA LEED Calculator helps provide the proper documentation required for this credit. Simply input the Zip code or postal code where each raw material originates and the weight of each material to generate a printable file that can be e-mailed to the LEED AP, contractor or architect.
Credit Requirement

Minimized Site Disturbance in Design and Construction

Option 1 – Development Footprint on Previously Developed Land:
Locate 100% of the development footprint on areas previously developed, or

Option 2 – Undeveloped Portion of Project Left Undisturbed:
Limit disturbance to:
- 40 feet beyond the building perimeter
- 10 feet beyond surface walkways, patios, surface parking and utilities less than 12 inches in diameter
- 15 feet beyond street curbs and main utility branch trenches
- 25 feet beyond constructed areas with permeable surfaces that require additional staging areas to limit compaction in the constructed zone.

Note: This is a condensed version of the credit. The full credit may be downloaded from USGBG’s Neighborhood Development Guide.

Precast Contribution

Precast concrete products are plant cast and delivered to the site ready to set so they reduce the staging area required which can reduce the overall site disturbance.

The impact on the construction site is also reduced because there is no additional formwork, which often requires more construction area for above-ground products and larger excavation areas for underground products.

Less impact on sites can reduce construction waste, shorten the construction schedule and require fewer laborers on-site.
Credit Requirement

Max. Points 4

Stormwater Management

Implement a comprehensive stormwater management plan for the project that retains on-site, through infiltration, evapotranspiration, and/or reuse, the rainfall volumes listed below. Rainfall volume is based on the project’s development footprint, any other areas that have been graded so as to be effectively impervious, and any pollution-generating pervious surfaces, such as landscaping, that will receive treatments of fertilizers or pesticides.

<table>
<thead>
<tr>
<th>Percentile rainfall event</th>
<th>Total volume to be retained</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>80%</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>85%</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>90%</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>95%</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

Note: This is a condensed version of the credit. The full credit may be downloaded from USGBG’s Neighborhood Development Guide.
Credit Requirement

Max. Points: 1

Recycled Content in Infrastructure

Use materials for new infrastructure such that the sum of postconsumer recycled content, in-place reclaimed materials and one-half of the preconsumer recycled content constitutes at least 50% of the total mass of infrastructure materials.

Count materials in all of the following infrastructure items as applicable to the project:

- Roadways, parking lots, sidewalks, unit paving, and curbs
- Water retention tanks and vaults
- Base and subbase materials for the above
- Stormwater, sanitary sewer, energy distribution, and water piping

See the NPCA LEED Calculator at www.precast.org/leed for help with this credit.

See the LEED Canada guide for information on Canada’s credit requirements.

Precast Contribution

Precast concrete products may contain supplementary cementitious materials such as fly ash and blast furnace slag which will add to the project’s recycled content goals.

Precast products may also contain rebar and welded wire mesh which contains recycled steel.

Other less frequently used recycled content components include various fiber reinforcements, glass aggregates, silica fume, and recycled crushed concrete.

Beyond precast products themselves, recycled crushed concrete can also contribute to this credit when utilized as road fill base.