

The World Commission on Environment and Development has defined sustainability development as: *“Meeting the needs of the present without compromising the ability of future generations to meet their own needs”* (Report to the United Nations General Assembly, August 1987)

There is an increasing need for North America to replace transportation facilities that are fast becoming functionally obsolete. State Departments of Transportation (DOT) and municipalities are being asked to resolve these infrastructure issues with fewer and fewer resources. They are also receiving pressure from legislators, citizens and bonding companies to account for their resource allocation decisions. Therefore, it is imperative that we efficiently manage resources and infrastructure assets today so as not to compromise future needs.

When building transportation facilities, we must use materials and products that are the safest and highest quality, perform as intended for the design life of the project, and have the best overall value. Sustainable concrete pipe satisfies these criteria.

Concrete pipe is synonymous with longevity. Because of its long life, it is an economical, cost-effective drainage solution that consumes minimal materials and energy with reduced maintenance and rehabilitation requirements. Other features of concrete pipe that contribute to its sustainability include:

**Recyclable: Using industrial byproducts and recycled materials reduces the need for virgin material.**

Concrete pipe mixtures incorporate industrial by-products (such as fly ash and slag cement), which reduces the use of virgin materials, reduces the amount of cement needed, reduces the energy needed to manufacture the product and conserves natural resources. In addition, concrete made with fly ash is more durable and has a higher ultimate strength.

The steel that is used in reinforced concrete pipe is typically made of 90 to 100% recycled steel, which is infinitely recyclable.

Concrete pipe itself is renewable and 100% recyclable. Construction and demolition waste in the U.S. averages approximately 135 million tons annually. Materials that can be recycled at the end of their intended use reduce the amount of waste that is landfilled and reduces the need for virgin construction material. Due to reinforced concrete pipe’s durability and strength, it can be recycled and reused.

**Conserving Energy: Long life reduces energy needs.**

Concrete pipe’s long life reduces the necessity for replacement, thereby eliminating construction zones and associated traffic congestion. Energy savings are realized, vehicle pollutants are eliminated, and the public’s health and safety is improved.

Concrete pipe exhibits a lower energy footprint associated with production, delivery, and maintenance compared to other drainage pipe materials.

Properly installed concrete pipe reduces pavement subsidence because concrete pipe itself does not deflect, which saves maintenance costs and energy.

## **Environmentally Friendly: From mining aggregates to quarry mitigation.**

Concrete pipe is environmentally friendly, does not leach harmful VOCs into the soil, is non-combustible, and there is no off-gassing. Properly designed concrete pipe systems control flooding, and the spread of water born diseases.

Concrete pipe and its components (cement, water, aggregate) are extracted and manufactured locally, thereby reducing economic and environmental costs associated with transporting pipe to distant sites. Concrete pipe is usually backfilled with native soil and does not require imported material.

Old quarries used to mine aggregates for concrete pipe can be rehabilitated for community use, benefiting social progress.

Cement is one component of concrete pipe that is considered, by some, to have a negative impact on sustainability. Cement manufacturing plants account for roughly 1.5% of U.S. carbon dioxide (CO<sub>2</sub>) emission (Department of Energy 2006). Although cement is an energy intensive material to manufacture, most concrete is 90% sand, gravel, water, and industrial by-products, all of which require little energy to obtain.

Approximately 60% of the CO<sub>2</sub> emitted during the manufacturing of cement results from process known as calcination, a chemical reaction among the raw materials in the cement kiln. Later, when hardened concrete is exposed to air, the calcination reaction reverses in a process called carbonation. Carbonation occurs naturally in all concrete, including concrete pipe, and recaptures CO<sub>2</sub>. Eventually exposure of hardened concrete to the air will allow the recapture of all the CO<sub>2</sub> originally emitted from the cement during calcination (Recycled Materials Resource Center 2005).

A portion of portland cement in concrete pipe could be replaced by supplementary cementitious materials such as fly ash, a by-product from coal-burning in thermal power stations. The replacement can be done either directly at the concrete batch plant, or during the production of blended cements. Increased use of fly ash reduces greenhouse gas emissions. In addition to reducing CO<sub>2</sub> emissions, other potential benefits of using larger amounts of fly ash in concrete pipe include reduced landfill volumes and fly ash disposal costs, lower-cost concrete, manufacturing energy savings, and reduction of water needed to produce the concrete. Also, it is well established that the use of fly ash in concrete pipe improves its durability, translating into increased service life, resulting in considerable savings in repair and replacement costs.

## **Conclusion**

Concrete pipe is the best environmental, economical and sustainable drainage choice. Due to concrete's longevity, concrete pipe systems do not require rehabilitation or reconstruction as often as other drainage pipe materials and, therefore, consume fewer natural resources and energy, while decreasing traffic congestion and pollution.

Concrete pipe satisfies the three pillars of sustainable development, which include social progress, economic growth, and environmental balance.