Sustainability, Resilience, and Concrete Pipe

Riley Dvorak, P.E. - Forterra Jennifer Schaff, P.E. – County Materials



PRIMARY ELEMENTS OF DESIGN





Why are we here?



4. Discuss resilience and risk assessment Resilie nt Actions

THINK ABOUT IT:

What comes to mind when you hear the word "SUSTAINABILITY"?

Sustainability

"Meeting our own needs without compromising the ability of future generations to meet needs of their

own"

-International Institute for Sustainable Design

Environmental < planet Economic < profit





Infrastructure and Sustainability

Providing Social functionality and engagement to communities, being mindful of short-term and longterm environmental implications, and



ensuring that infrastructure is constructed and maintained with future economic impacts in mind.

THINK ABOUT IT:

What comes to mind when you hear the word "RESILIENCE"?

Resilience

"the ability of a system to resist, limit impacts, and rapidly return to service after a disruptive event."

> Robustness Redundancy Resourcefuln

ess Rapiditv

Resilient Infrastructure

Public systems having the ability to effectively resist and readily adapt to conditions above and beyond typical design conditions.

POLL:

How do sustainability and resilience relate to each other?

Sustainability



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Resilience

Resilience and Sustainabilit

- Less waste, limited impact on environment
- Significant long-term cost savings
- Reduced concern associated with loss of critical infrastructure functions

"Many LEED certified buildings in Superstorm Sandy were designed to have a low impact on the environment... but not for the environment to have a low impact on them" (U.S. Resiliency Council, 2016)

SMART INVESTING **MITIGATION SAVES** SPENT ON MITIGATION, SAVES \$6 ON FUTURE DISASTER LOSSES







Environment al Sustainability







"Environmental sustainability is about acting in a way that ensures future generations have the natural resources available to live an equal, if not better, way of life as current generations."

- United Nations (UN) World Commission on Environmen



Development



1. Life Cycle Analysis of drainage piping

systems







Data extracted from BSRIA Inventory of Carbon and Energy (ICE)



Sustainable Features of Concrete Pipe

Lowest material emissions per unit

Less than 1/10th the emissions of plastic



55% less required imported fill



~50% of cement emissions are recaptured



Shortest average transport distance

Hundreds of miles less than flexible pipes (avg.)

Lower freshwater demand than HDPE &

20-30% less water used (cradle-to-gate)



POLL:

Have you ever made a material selection based on environmentally sustainable criteria?



1. LCA of drainage piping systems

2. Re-use capabilities at end of service life







Economic Sustainability





"... practices that support <u>long-term</u> economic growth without negatively impacting social, environmental, and cultural aspects of the community."

- University of Mary Washington, Office of Sustainability





1. Life-Cycle Cost Analysis (LCCA)



POLL:

Does your agency incorporate some type of Life Cycle Cost Analysis (LCCA) for determining culvert material/type?

Life Cycle Cost Analysis of Drainage Systems

 Pipe Material
 Installation Materials/ Methods
 Pre/Post Installation Inspection

COST <u>PER</u> <u>YEAR</u> =

- - Product History
 - Local Experience
 - Residual Value





1. Life-Cycle Cost Analysis (LCCA)

2. Use of local resources/businesses

Green

Bureau

Rusiness

IUCALIS LUULEU AS LITE I to be environmentally friendly while supporting local communities at the same time. By purchasing food and other goods that are produced locally, consumers help stimulate their regional economy, help create and retain valuable jobs, support families and strength

Local Resources/Businesses



highest initial value

load-tested prior to shipment

sumulates

local

economy

lowest installatio n costs

residual value after longest expected service

Social Sustainability

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- "Social sustainability combines design of the physical realm with design of the social world – infrastructure to support social and cultural life, social amenities, systems for citizen engagement and space for people and places to evolve."
- Diversity for Social Impact





1. Community Interaction



2. System Safety/Reliability







Resilienc









Threats to Drainage Infrastructure

Natural Flooding

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Severe Rain

Tropical Cyclone

Wildfire

Extreme

Temperatures

Winter storms

Unnatural Litter/Debris Vehicle Accidents Poor Installation Other

Billion-Dollar Disasters BY THE NUMBERS (1980-2020)





FLOODING









For more info: www.ncdc.noaa.gov/billions/

DROUGHT

198

billion-dollar disasters

FREEZE

The year NOAA started tracking

TROPICAL CYCLONE

\$1.87

WILDFIRE

WINTER STORM

Number of billion-dollar events from 2010-2019

Average number of billion-dollar disasters per year since 1980

Total cost of the 285 billion-dollar disasters

Average number of billion-dollar disasters per year since 2015



Number of billion-dollar disasters that have impacted Texas since 1980—the most of any state



Number of U.S. billion-dollar disasters in 2020—the most on record

28

Number of billion-dollar disasters in the U.S. since 1980

Number of billion-dollar tropical cyclones that struck the U.S. in 2020

Number of states that have had at least one billion-dollar disaster

TOTAL COST OF BILLION \$ DISASTERS (1980-1999 vs. 2000-2020)



Vulnerabilities of Drainage Infrastructure

Slope stability/erosion

Buoyancy

Flammability

Infiltration

Poor installations



Consequences to Drainage Infrastation ture

- Washout
- Structural Failure
- Road Collapse
- Consequent
 Flooding









- 1. Design overland flow path
- 2. Inlet protection/headwalls in flood

prone areas

- 3. Post-installation Inspection
- 4. Non-flammable culverts/storm sev

5. Flotation resistant materials

Resilience of RCP

Primary structure is pipe itself, resistant to installation issues or loss of support material

Weight reduces risk of floatation

Proven performance: 100-yr service life

Inherently nonflammable Rigid, hightolerance joints ensure dependable seal



Sustainable and Resilient Action Summary



Concrete offers lowest environmental impact



Re-use of RCP sections limits waste Local plants support local economy



Provides safe, dependable

infrastructure Flame-proof

Heavy, flotation resistance

Manufactured primary structure





Thank you!

American Concrete Pipe Association

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REMAIN VIGILANT. CHOOSE TO NEVER COMPROMISE.

