37TH INTERNATIONAL NO-DIG FLORENCE 2019

Fortezza da Basso • FLORENCE (Italy)

30th September • 2nd October 2019

A New FRP Solution for Reconstruction of Deterioratаed Pipes and Culverts

Mo Ehsani
PipeMedic by QuakeWrap

Introduction

- Tomorrow (12:30) presentation about FRP Wet-Layup
- A new type of fully-structural liner
  - Pre-manufactured pipe used in slip-lining
  - Applied directly on the host pipe

Genesis of Invention

- Wet-Layup:
  - Carbon FRP applied for hoop strength
  - Usually 1-3 layers is enough
  - Costs about \$300/m^2/layer >> \$300-\$900/m^2 of pipe surface
- Some clients are asking for fully structural liner
  - Buckling or ring stiffness controls the design
  - Increase thickness and moment of inertia of cross section
  - Adding many layers of carbon >> Cost prohibitive
- Develop a sandwich construction pipe

StifPipe™ By QuakeWrap, Inc.

Composite Sandwich Construction

Steel I-beam

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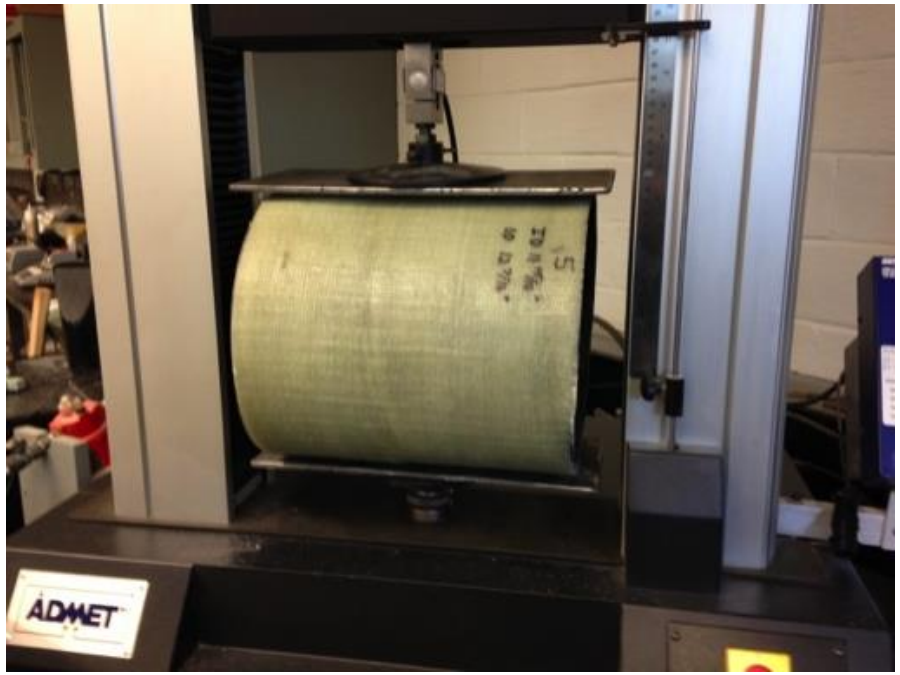
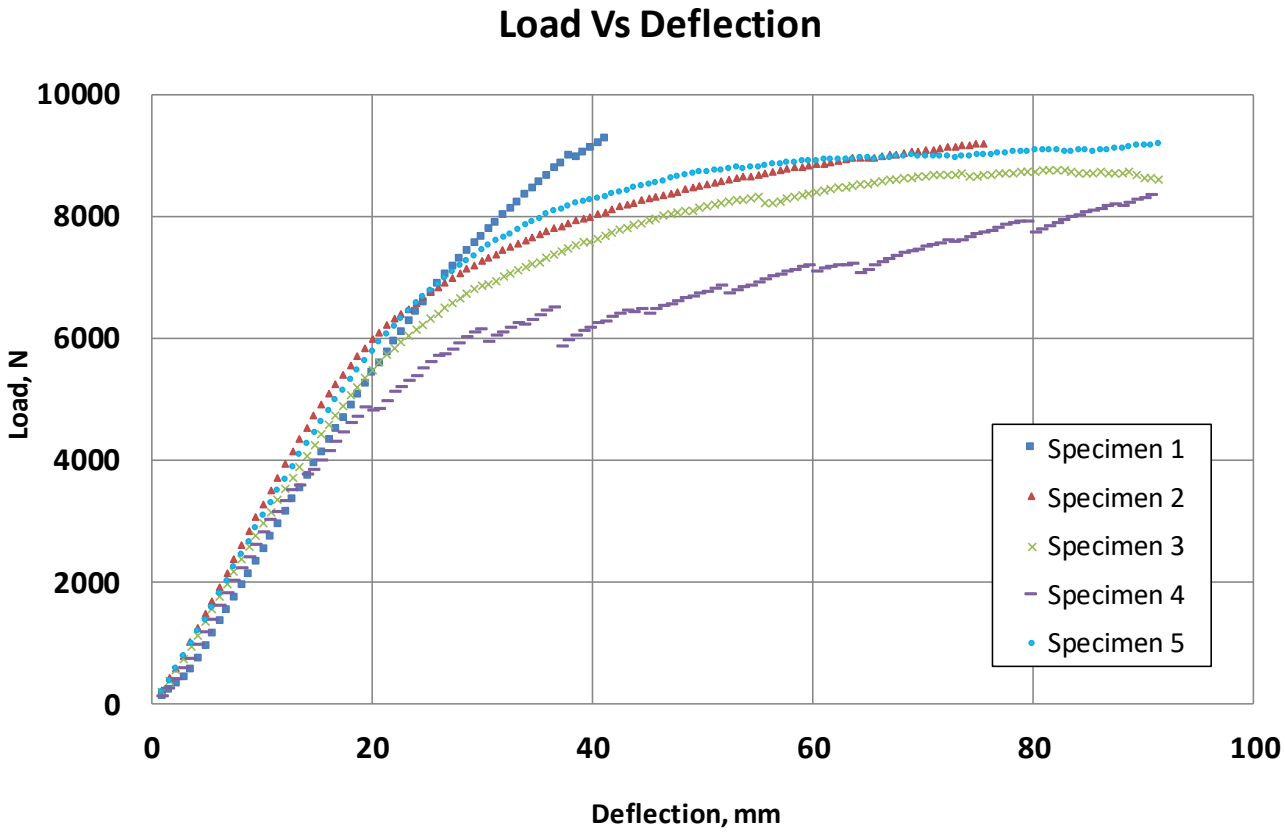
RELATIVE STIFFNESS	1
WEIGHT (Pounds/ft^2)	0.910

Ring Stiffness *(ASTM D2412)*

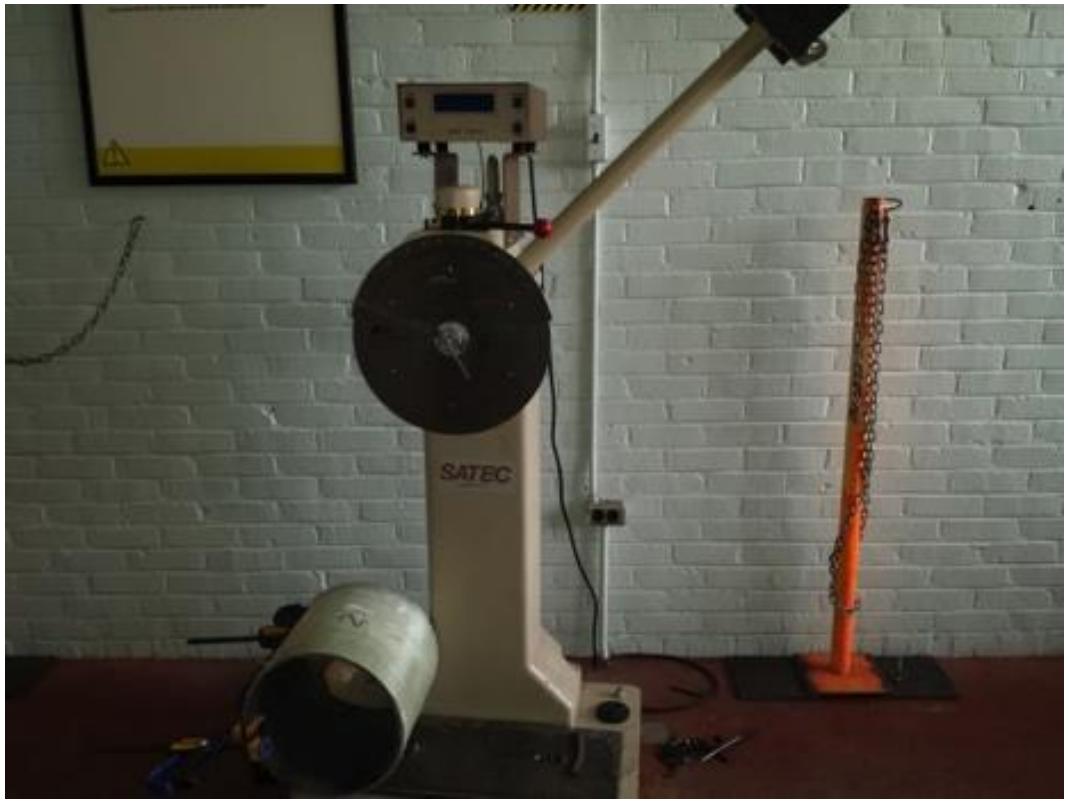




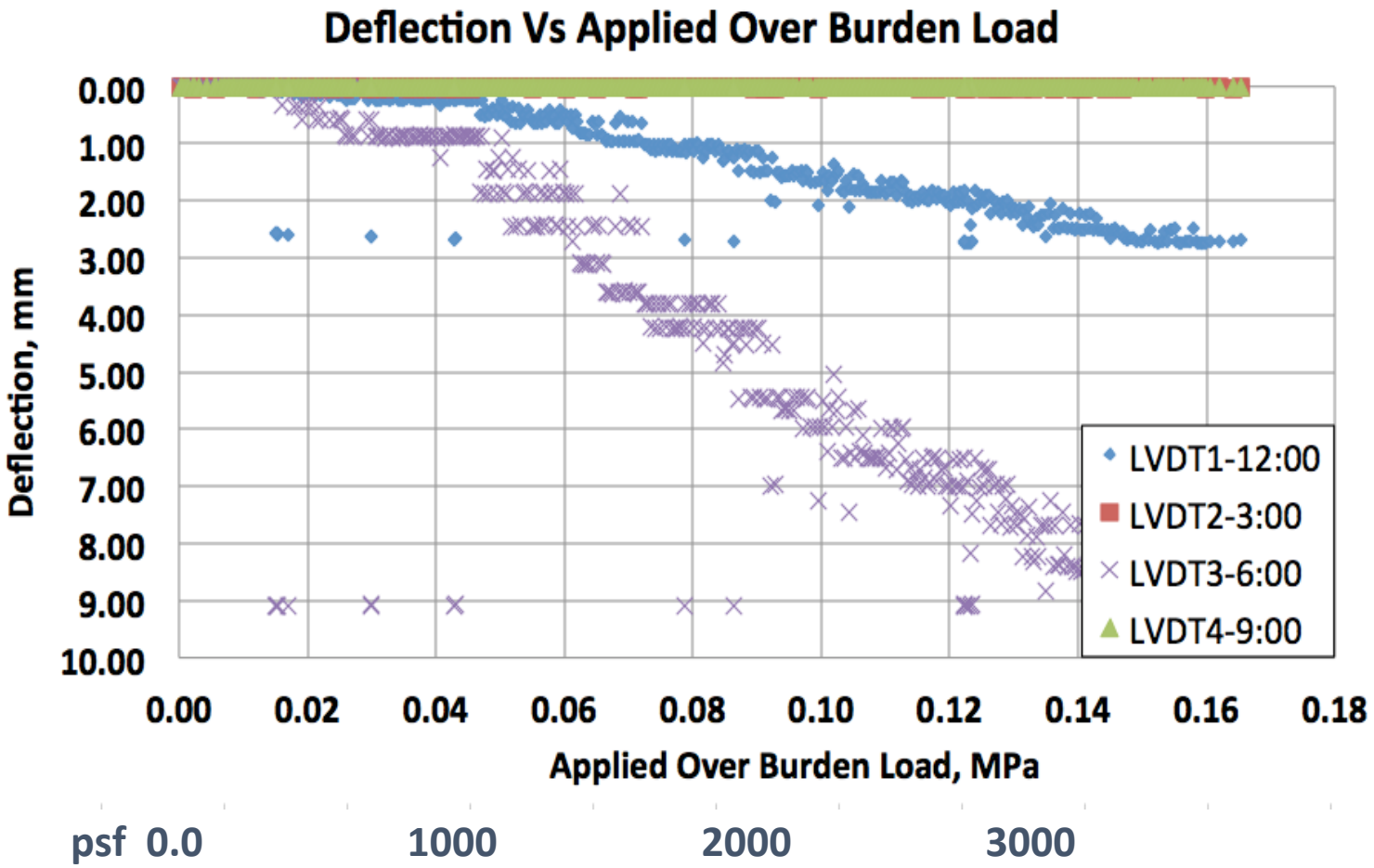
Charpy Impact Test *(ASTM D2444)*

Avg. absorbed energy = 162 N-m

(for annealed steel = 161.3 N-m)



Over Burden Pressure Test



Awards

ASCE 2016 Innovation Award

American Society of Civil Engineers

StifPipe® Construction

- walls of this pipe are made with a lightweight honeycomb core that is sandwiched between carbon or glass fabric
- Internal fabric layers (usually carbon) are designed to take the internal pressure of pipe
- Honeycomb and outer glass fabric provide rigidity for pipe
- Can be easily made to any shape and size
- Used for:
  - slip-lining deteriorated pipes
  - As a wet layup system built directly on deteriorated pipes using the existing pipe as the mold

Gillies Road Culvert

Cairns, QLD

Gillies Road Culvert

Cairns, QLD

Gillies Road Culvert

Cairns, QLD

Non Circular Shapes

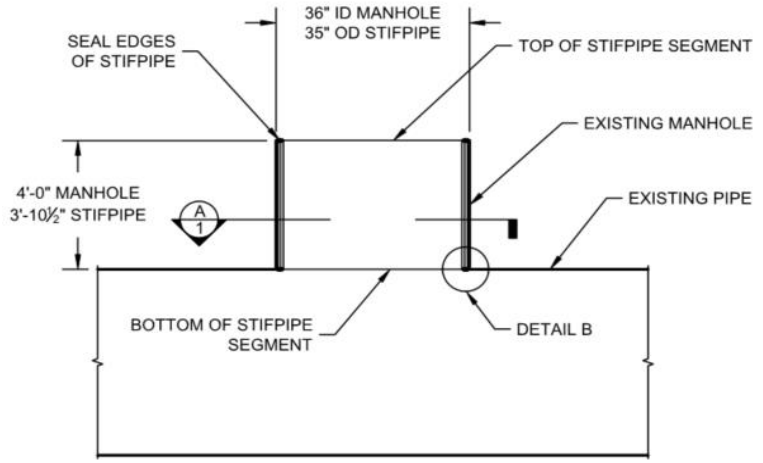
- Egg-Shaped
- Oval-Shaped
- ……..

Aguirre Power Plant, PR

- Pipe network 24-60 in. (600-1500mm)
- Operating P= 150-200 psi (1-1.4 MPa)
- Pipe risers throughout
- 2015: One lid dislodged – 100-ft (30 m) away

Structural Design Criteria

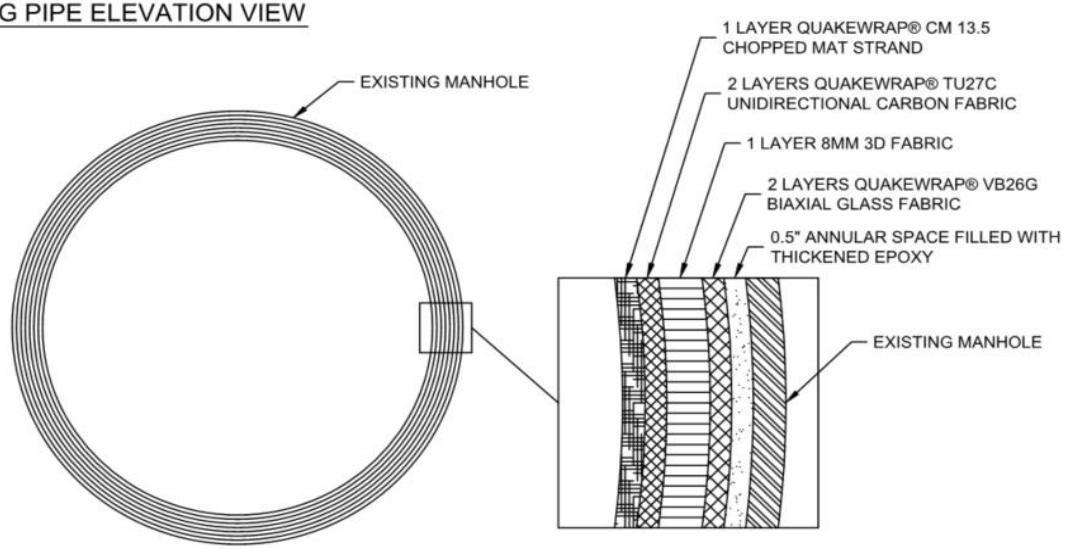
- Class IV Structural Liner
- External pressure from traffic & soil
- Internal design pressure of 400 psi (2.8 MPa)
- 35” OD pipes to fit into 36” ID host pipes
- 3’-10½” long to cover 4’-0” section
- 1 Layer of chopped strand mat
- 2 Layers of TU27C
- 1 0.31-inch spacer sheet
- 2 Layers of VB26G



EXISTING PIPE ELEVATION VIEW

INSTALLATION NOTES:

1. PLACE PREFABRICATED STIFPIPE SEGMENT INSIDE OF EXISTING MANHOLE
2. SEAL BOTTOM EDGES BETWEEN STIFPIPE SEGMENT AND EXISTING MANHOLE
3. INJECT THICKENED EPOXY CONSISTING OF QUAKEBOND™ 320LV LOW VISCOSITY RESIN MIXED WITH SAND INTO THE 0.5" ANNULAR SPACE BETWEEN THE STIFPIPE AND THE EXISTING MANHOLE



A/1 CROSS SECTION NTS

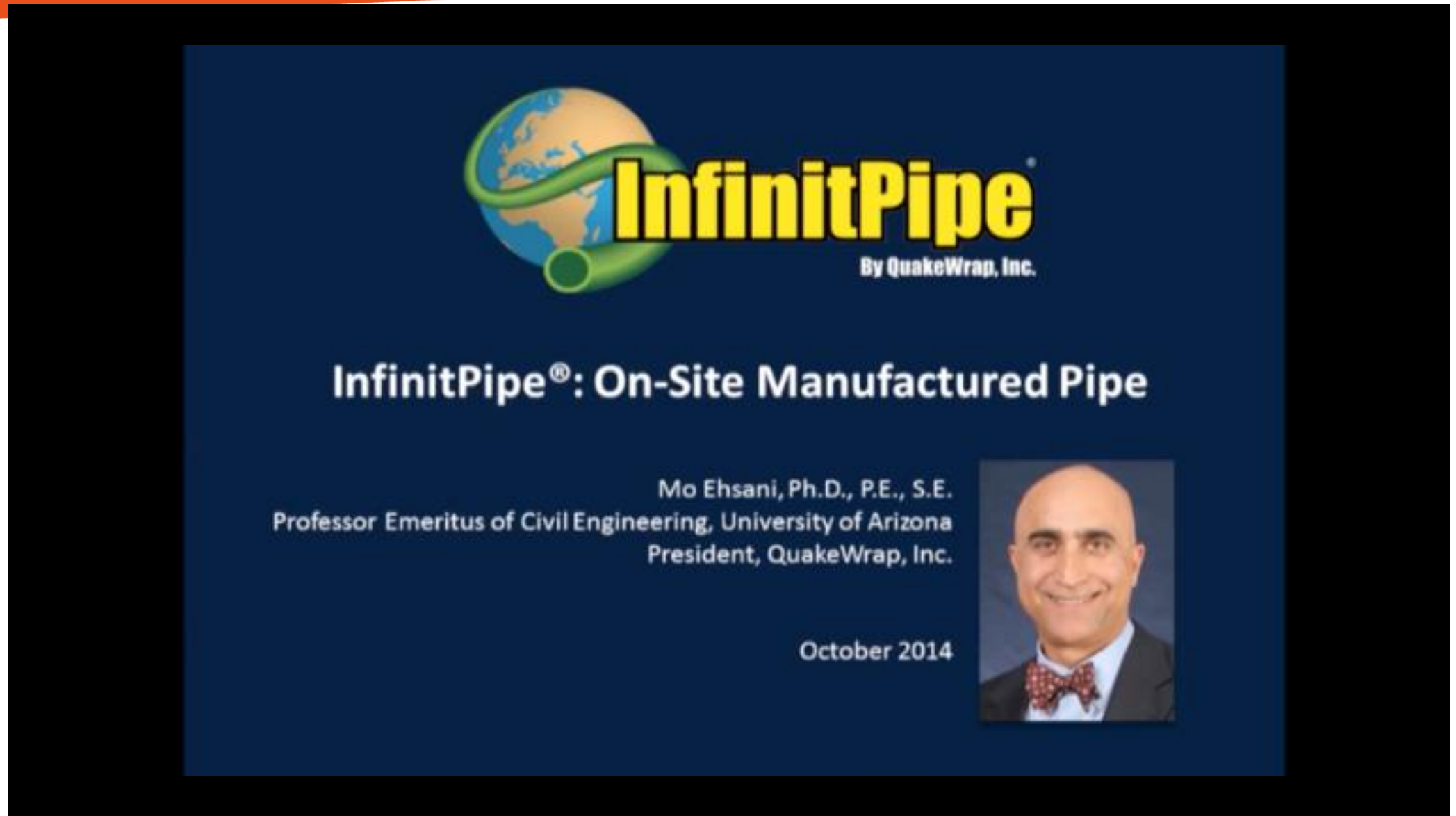
Aguirre Power Plant, PR

Field-Applied StifPipe®

Recent Project in Minneapolis:

- Tunnel Dia. 3.6 m (12-ft)
- Buried 46 m (150-ft)
- Access through shaft
- 1200 m (4000-ft) Distance
  - 2 layers of glass
  - 20mm core
  - 4 layers of CFRP

Onsite-Manufactured InfinitPipe®



Grazie!

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Questions?

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