



Proceedings of

Pipelines Research Needs Symposium Sunday, August 13, 2023

*In conjunction with the ASCE/UESI 2023
Pipelines Conference*

San Antonio, Texas

Symposium Chair: Dr. Mo Najafi, P.E., F. ASCE

**Editor: Ehsan Rajaie, S.M. ASCE
CUIRE Research Associate**

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Foreword

A group of pipeline professionals including industry leaders, academics, and students came together to hold the fourth ASCE/UESI Pipelines Research Needs Symposium held on Saturday, August 13, 2023, in San Antonio, Texas in conjunction with the ASCE/UESI Pipelines Conference 2023. The Symposium provided a forum for presenting and discussing pipeline technologies, processes, and techniques that are in use or under development. The presented technologies came from research institutions, universities, consulting/engineering companies, government agencies, and associations.

The Symposium included presentations by fifteen speakers on pipeline technologies. Ten separate groups with eleven presentations were subsequently held to develop strategies to assist emerging technologies in becoming accepted in the marketplace. Each group addressed technologies and included facilitators, a panel leader, and a note-taker to capture information during presentations and group discussions.

The presentations included the following topics:

- Introduction
- New Standard/MOP Development at AWWA/WRF and NASSCO
- Developments and Future Pipeline Solutions
- Needs, Research, and Development for Condition Assessment of Pipe Materials
- Pipeline Resiliency Considerations
- Enhancements to Trenchless Technology Renewal Methods
- Pipeline Asset Management and Inspection
- Pipelines in Difficult Soil Conditions
- Structural Evaluation of Buried Pipe
- Renewal Technologies and Polymeric Spray Applied Pipe Lining
- CIPP Emissions

Following the conclusion of the presentations, attendees were organized into groups to engage in comprehensive discussions on each of the presented topics. These discussions progressed sequentially through the agenda. Subsequently, designated panel leaders from each group summarized the outcomes of their respective discussions along with proposed future recommendations.

Attendees included a strong cross-section of practitioners, suppliers, researchers, academia, and students. Each of these groups has an important role to play in the advancement of pipeline technologies.

Our industry needs a continuing friendly and objective forum where people from within and outside of the industry can showcase new technologies. It is our hope that this type of forum can continue to serve this role and support the advancement of the pipeline profession.

We are very appreciative of the many individuals who graciously contributed their time to make this Symposium a success.

Mohammad Najafi, P.E.
Chair, ASCE/UESI Pipeline Research Needs
Committee and Symposium

Agenda

ASCE/UESI Pipeline Research Needs Symposium

Marriott River Walk Hotel, San Antonio, Texas, Sunday, August 13, 2023

Group	Time	Topic	Group Leader/Presenter	Panel Leader	Note Taker
--	1:00 pm	Introduction and Expected Outcome	Mo Najafi (CUIRE/UTA) and Steven Kramer (COWI)	-	Ehsan Rajaie
1	1:15 pm	New Standard/MOP Development at AWWA/WRF and NASSCO	Frank Blaha (AWWA/WRF) and Sheila Joy (NASSCO)	Amir Tabesh	Frank Blaha
2	1:30 pm	Developments and Future Pipeline Solutions	John Norton (Great Lakes Water Authority)	-	-
3	1:45 pm	Needs, Research, and Development for Condition Assessment of Pipe Materials	Graham Bell (Structural Technologies)	John Mele	John Mele
4	2:00 pm	Pipeline Resiliency Considerations	Ahmad Habibian (CDM Smith, Inc.)	Jennifer Baldwin	Khalid Al-Juboori
5	2:15 pm	Enhancements to Trenchless Technology Renewal Methods	Firat Sever (Quake Wrap, Inc.)	Dan Koo	Diego R Calderon
6	2:30 pm	Pipeline Asset Management and Inspection	Kalyan Piratla (Clemson University)	Kalyan Piratla	Owen Yan
7	2:45 pm	Pipelines in Difficult Soil Conditions	Amster Howard (Consultant)	-	-
8	3:00 pm	Structural Evaluation of Buried Pipe	Hojat Jalali (UTA) and Amin Tehrani (Freese and Nichols)	Hojat Jalali	Zaid Momani
9	3:15 pm	Renewal Technologies and Polymeric Spray Applied Pipe Lining	Lynn Osborn (Consultant), Sanaz Ghalambor (Nukote) and Kawalpreet Kaur (CUIRE)	Evgeniy "Eugene" Torgashov	Paria Hamidzadeh
10	3:30 pm	CIPP Emissions	Dennis Pivin	Dennis Pivin	Salar Bavilinezhad
3:45 pm		Break			
4:00 pm		Small Group Discussions			
4:15 pm		Small Group Presentations			
4:45 pm		Conclusions and Future Plan			

Biography of Attendees



Jennifer Baldwin, Ph.D., PE
Digital OneWater Director
Jacobs
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Jennifer Baldwin, Ph.D., PE is currently the Digital OneWater Director at Jacobs, and she has over 21 years of experience in collection system management, working on several multi-million and billion dollar wastewater collection and treatment system programs. She has a Bachelor's Degree in Chemical Engineering and a Ph.D. in Civil (Environmental) Engineering from Purdue University.



Graham E.C. Bell, Ph.D., P.E., F. NACE, F. ASCE
Vice President
Structural Technologies
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Dr. Graham E.C. Bell is a Research Associate Professor in the Civil and Environmental Engineering Department at the University of Tennessee and a Vice President of Technical Services for Structural Technologies. Dr. Bell has more than 40 years of experience in Water Infrastructure. Dr. Bell is nationally and internationally known as an expert on Prestressed Concrete Cylinder Pipe. He is a Fellow of ASCE and the Past President of UESI. Dr. Bell is a registered professional engineer in Tennessee and a registered Corrosion Engineer in California.



Sanaz Ghalambor
Polymer Engineer, PhD Candidate
Nukote Coating Systems International, LLC
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Sanaz Ghalambor holds a B.S. in Polymer Engineering from Polytechnic University of Technology, a M.S. in MBA from CUI, and now she is a CEM Ph.D. candidate at UTA. Sanaz has spent about two decades in pipeline integrity, corrosion prevention, and rehabilitation and now she works as the technical head of Nukote Coating Systems International in Texas.



Ahmad Habibian, Ph.D., P.E., FASCE
Vice President/Global Practice Leader for Conveyance
CDM Smith
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Ahmad Habibian's accomplishments in water conveyance are driven by shaping the strategies to expand the boundaries of knowledge through innovative solutions. With over 30 years of experience, Ahmad specializes in infrastructure management, pipeline rehabilitation and trenchless technology. He has been involved in the planning, design, construction, evaluation, and rehabilitation of water and sewer systems. He serves as the Editor-In-Chief of the ASCE Journal of Pipeline Systems Engineering & Practice, and has also lent his expertise to several EPA WERF- and WaterRF-sponsored research projects.



Himan Hojat Jalali, Ph.D.
Assistant Professor, Department of Civil Engineering
University of Texas at Arlington
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Himan Jalali is an Assistant Professor at the Department of Civil Engineering of the University of Texas at Arlington. His PhD research work focused on the behavior of pipelines, as a vital part of the infrastructure, under large differential ground movement, to which he is holding a patent and several publications in prestigious journals and conferences (such as ASCE Journal of Pipeline Systems Engineering and Practice, Soil Dynamics and Earthquake Engineering, Journal of Earthquake Engineering, 15 WCEE among others).



Amster Howard
Phone: 303-949-5512
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While with the U.S. Bureau of Reclamation, Amster Howard developed a table of "E prime" values used in estimating the deflection of buried flexible pipe. Now retired, Amster presents seminars for the American Society of Civil Engineers on "Pipeline Installation" and has written a book, "Pipeline Installation."



Sheila Joy
Executive Director
NASSCO, Inc.
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Sheila began her career in the 1980s working for major advertising agencies in Los Angeles and Washington, D.C. where she managed national accounts including ARCO Gasoline, Pioneer Sound Systems, and Amtrak. In the late 1990s Sheila launched her own marketing agency with a roster that included trenchless suppliers and contractors MaxLinerUSA, Applied Felts, Duke's Root Control, Compliance EnviroSystems, Pro-Pipe, Visu-Sewer, and others. In 2007 NASSCO joined that roster when Sheila began providing technical writing and other marketing services to the Association. Sheila has served as NASSCO's Executive Director since 2018.



Kawalpreet Kaur, Ph.D
Post Doctoral Researcher
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Ms. Kawalpreet Kaur has recently graduated with a Ph.D. from the Civil Engineering department at the University of Texas at Arlington. Her research area is trenchless technology, pipeline rehabilitation, and asserts management. She is closely working on the designing, testing and evaluating spray applied pipe lining (SAPL) by performing different testing for gravity and pressure pipes.



Steven Kramer, PE, FASCE
Senior Vice President
COWI
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As COWI Senior Vice President, Steven Kramer, PE, FASCE oversees the growth and development of the transportation and water business. He has 40 years of experience in engineering firms serving the infrastructure industry. Steve led the design, management and construction of over 75 underground projects around the globe with construction values up to \$1 billion. A frequent speaker and active participant at industry conferences and in technical societies, Kramer has published more than 90 technical and management papers.



John Mele
National Business Development Manager
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John Mele Actively involved in the water and wastewater industry for over 42 years. For the last 35 years involved in Business Development for products and services to the municipal, private, and industrial sectors.

I continue to bring attention and actively participate in the Water and Wastewater Treatment and Conveyance. From advanced Treatment technologies to water reuse, to pipeline construction and reconstruction technologies.



Mo Najafi, Ph.D., P.E., F. ASCE.
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Dr. Najafi has more than 25 years of experience encompassing engineering, education, research, consulting, and management activities. Prior to starting his academic career, he spent more than 12 years working on various construction projects. As Director of the Center for Underground Infrastructure Research and Education (CUIRE) at the University of Texas at Arlington, Dr. Najafi has led research projects with funding agencies such as TxDOT, WRF, WERF, and NCHRP. He is the author of four trenchless technology books published by McGraw-Hill (the latest one published in 2022).



Lynn E. Osborn
Owner
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Since 2015 Lynn Osborn has been the Owner of LEO Consulting, LLC, a consulting firm specializing in the trenchless rehabilitation of pipelines. Lynn has over 45 years of experience in the water and sewer industry, including 9 years as a Project Manager for a civil engineering consulting firm and 31 years with a large technology provider and contractor principally in the business of pipeline trenchless technology. He is currently a member of NASSCO's Technical Advisory Council.



Kalyan Piratla , Ph.D.
Liles Associate Professor
Clemson University
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Dr. Kalyan Piratla is the Liles Distinguished Professor of Civil Engineering at Clemson University. His research and teaching interests lie in the area of sustainable and resilient infrastructures with a focus on buried pipeline and transportation systems. He published numerous peer-reviewed articles on these topics. He directs the Center for Research in Underground Infrastructure Systems Engineering (CRUISE) lab at Clemson

Photo Not
Available

Dennis Pivin
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Mr. Pivin has over 25 years of professional experience in safety, health, and environmental program development, implementation, and management. He has spent the past 19 years working for Aegion LLC and is a Certified Safety Professional (CSP) with the Board of Certified Safety Professionals. He currently serves as the President of the St. Louis Chapter of the American Society of Safety Professionals and is the Chair of the Health and Safety Committee for NASSCO.



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Ehsan Rajaie is a graduate research and teaching assistant at the Center for Underground Infrastructure Research and Education (CUIRE) at the University of Texas at Arlington (UTA) and a Ph.D. candidate. With 14 years of experience in the civil engineering industry, Ehsan has worked in various areas including research, design, inspection, and construction management. He is focused on trenchless technology methods for pipe rehabilitation and renewals. He has earned many scholarships and awards such as NASSCO, CMAA, APWA, NASTT, SME, and ASCE/UESI scholarships.



V. Firat Sever, Ph.D., PE.
Pipeline Division Manager
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Dr. Sever is the Pipeline Division Manager at QuakeWrap, Inc. His approximately 20 years of industry experience in the field spans a wide variety of projects including small/large conventional, design/build, and high-profile international research projects. His expertise in trenchless pipeline rehabilitation as well as new pipeline design has resulted in about 25 peer-reviewed publications, a book section, and a number of presentations at local, national, and international conferences. Dr. Sever currently spends majority of his time in the design, R&D, and marketing of QuakeWrap's pipeline solutions.



Amir Tabesh, Ph.D., P.E., P.M.P.
Project Manager
HDR Inc.
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Dr. Amir Tabesh is a highly accomplished professional engineer with 17 years of experience in water and wastewater pipeline design and construction. He holds a Ph.D. in Civil Engineering from the University of Texas at Arlington. One of Amir's standout achievements is his PMP certification, attesting to his proficiency in project management.



Amin Tehrani, PhD, PE, PACP
Project Manager
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Amin Tehrani, Ph.D., PE, is an award-winning project manager and pipeline specialist at Freese & Nichols Inc. Dr. Tehrani is an experienced engineer in pipe structural rehabilitation using SAPL systems, trenchless technology, pipe structural analysis, condition assessment, structural testing, and numerical simulation. He has provided technical assistance with engineering, specifications, and condition assessment of many pipe rehabilitation projects for Municipalities, the Department of Transportation (DOTs), Water District Authorities, etc.



Mehdi Torbat Esfahani, S.M. ASCE
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Mehdi Torbat Esfahani is currently a Ph.D. Student in the School of Civil & Environmental Engineering and Construction Management at The University of Texas at San Antonio (UTSA). His research focuses on construction safety management, technology, and automation in construction.



Evgeniy "Eugene" Torgashov, Ph.D.
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Currently work as a senior geophysicist in a consulting geotechnical firm, previously conducted applied research using geophysical methods in geological, geotechnical and infrastructure fields. Taught undergraduate and graduate level geophysical courses at Missouri University of Science and Technology, Rolla, Missouri.

Photo Not
Available

Owen Yan, PhD
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Dr. Yan is a Civil Engineer with QuakeWrap, Inc. He has 10 years of academic and industry experience in a varied field including geotechnical exploration, mineral drilling, pile foundation design, pipeline cleaning and rehabilitation. He had two years of experience in the Spray-In-Place Pipeline (SIPP) and Land Development, and then in Nov 2018, joined the Pipeline Division at QuakeWrap. He completed tens of design projects of infrastructure rehabilitation with FRP.

Presentations

Group No. 1

New Standard/MOP Development at AWWA/WRF and NASSCO

Presentation No. 1

Water Research Foundation Infrastructure Research

Frank J. Blaha, P.E.

Water Research Foundation

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Water Research Foundation Infrastructure Research Overview, August 13, 2023

advancing the science of water®

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BY THE NUMBERS

AS OF 3/31/2023

SUBSCRIBERS



958 UTILITIES



63 CONSULTANTS



45 MANUFACTURERS

FUNDED RESEARCH



\$71 MILLION



48 STAFF



\$27 MILLION COST SHARE



\$44 MILLION CASH
Contractually Funded Research

RESEARCH PORTFOLIO



245 ACTIVE PROJECTS



73 CO-FUNDED PROJECTS
150 CO-FUNDERS



9 FEDERAL/STATE GRANTS



3 FEDERAL CONTRACTS



2 PRIVATE GRANTS

\$.78 OF EVERY DOLLAR SUPPORTS PROGRAM SERVICES

RESEARCH PRIORITY | TAILORED COLLABORATION | EMERGING OPPORTUNITIES | GRANTS/AWARDS | PAUL L. BUSCH AWARD | FACILITATED & UNSOLICITED RESEARCH

Infrastructure Work Relevant to Pipelines

- Categories of Infrastructure Work
 1. Condition Assessment of Pipelines
 2. Deterioration/Performance of Specific Pipe Types
 3. Pipe Rehabilitation Technologies/Techniques
 4. Costs of Failure & etc.
 5. New Projects/RFPs
- Infrastructure Resilience, climate change adaptation, general utility resilience, lead corrosion and lead service line management We have much work in these areas as well



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Ongoing/Recent Infrastructure Work Relevant to Pipelines— Condition Assessment

- Improved Risk Management from Condition Assessment Data, 5190, Ongoing
- Leveraging Big Data and Deep Learning for Economical Condition Assessment of Wastewater Pipelines 4902, 2020
- Advanced Condition Assessment and Failure Prediction Technologies for Optimal Management of Critical Water Supply Pipelines, 4326, 2018 (larger cast iron only)
- Practical Condition Assessment and Failure Probability Analysis of Small Diameter Ductile Iron Pipe, 4661, 2018
- Condition Assessment of Large Diameter Iron Pipe, 4391, 2014
- Condition Assessment for Wastewater Pipelines, 1423, 2013
- Best Practices Manual for Prestressed Concrete Cylinder Pipe Condition Assessment, 4233, 2012



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Ongoing/Recent Infrastructure Work Relevant to Pipelines— Deterioration/Performance of Pipe

- **Managing PCCP to Extend Asset Life, 5069, Ongoing**
- **Advanced Condition Assessment and Failure Prediction Technologies for Optimal Management of Critical Water Supply Pipelines, 4326, 2018 (larger cast iron only)**
- **Evaluation of the Value of Structurally Enhanced PVC Pipe, 4650, 2018**
- **Development of an Effective Asbestos Cement Distribution Pipe Management Strategy for Utilities, 4480, 2015**
- **Durability and Reliability of Large Diameter HDPE Pipe for Water Main Applications, 4485, 2015**
- **Long Term Performance of Asbestos Cement Pipe, 4093, 2013**
- **Fracture Failure of Large Diameter Cast Iron Water Mains, 4035, 2013**
- **Failure of PCCP, 4034, 2008**



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Ongoing/Recent Infrastructure Work Relevant to Pipelines— Pipe Rehabilitation

- **Cured-in-Place Pipe (CIPP) Rehabilitation Emissions Study, 5216, Ongoing**
- **Water-tight CFRP Liners for Renewal of PCCP, 4592, 2016**
- **The Assess-and-Fix Approach: Using Non-Destructive Evaluations to Help Select Pipe Renewal Methods, 4473, 2015**
- **Environmental Impact of Asbestos Cement Pipe Renewal Technologies, 4465, 2015**
- **Demonstration and Evaluation of Innovative Wastewater Main Rehabilitation Technologies, 1459, 2014**
- **CFRP Renewal of PCCP, 4352, 2013 & CFRP Renewal of PCCP, Part 2, 4510, 2014 (a supplement to 4352)**



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Ongoing/Recent Infrastructure Work Relevant to Pipelines— Cost of Failure & etc.

- **Retrofit & Management of Metallic Pipe with Cathodic Protection, 4618, 2018**
- **Managing Infrastructure Risk: The Consequence of Failure for Buried Assets, 4451, 2017**
- **Best Practices for Water Utility Legal Protection and Claims Management from Infrastructure Failure Events, 4369, 2014**
- **External Corrosion & Corrosion Control of Buried Water Mains, 2608, 2005**



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New Projects/RFPs September Release

- **Technology and Innovation for Assessing Operability and Full Closure of High Consequence Valves, 5241, \$200,000**
- **Enhancing Collection Systems Integrity and Capacity through Application of Emerging Assessment Methods, 5240, \$150,000**



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Thank You!
Questions?

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Group No. 1

New Standard/MOP Development at AWWA/WRF and NASSCO

Presentation No. 2

NASSCO UPDATE

Sheila Joy

NASSCO, Inc.

Email: director@nassco.org



UESI PIPELINES 2023 CONFERENCE
Pipeline Research Symposium

NASSCO UPDATE
 Presented by Sheila Joy,
 NASSCO Executive Director

August 13, 2023



About NASSCO


MISSION

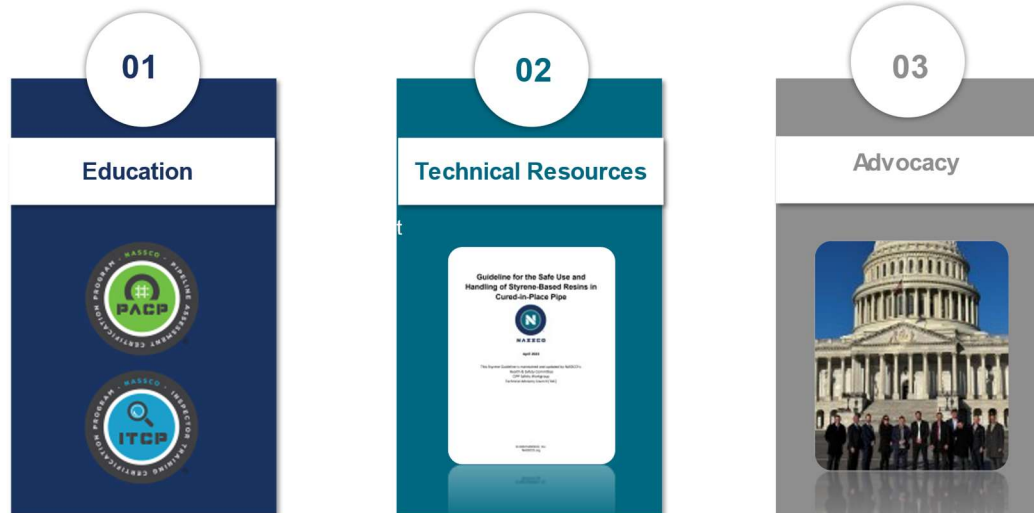
To set standards for the assessment, maintenance and rehabilitation of underground infrastructure and to assure the continued acceptance and growth of trenchless technologies.


VISION

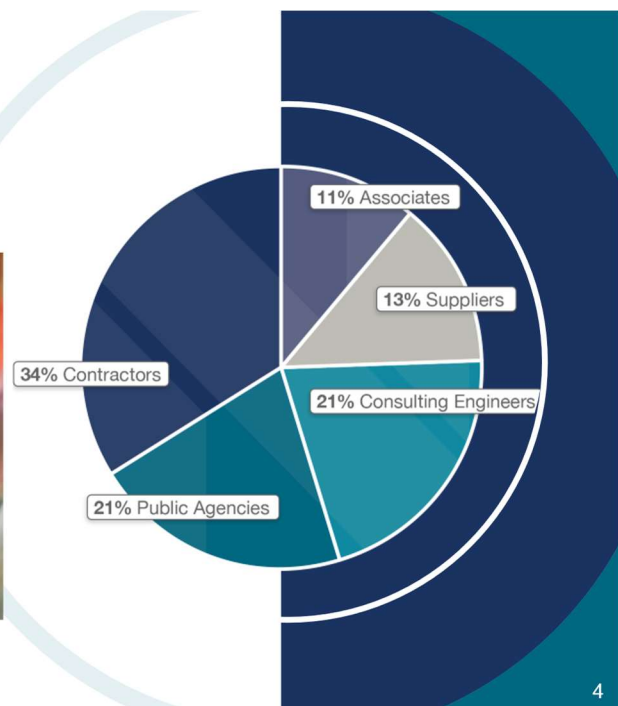
To increase the awareness of aging underground infrastructure and to provide viable solutions through education, technical resources and industry advocacy.

NASSCO.org

2



NASSCO Membership



PACP™ Version 8 Updates

- Coding Improvements Throughout
- NEW Pressure Pipe Codes
- Updated Stormwater Codes
- Perforated Pipe Codes
- Better Organization and Utilization



Styrene Safety Resources

STYRENE SAFETY

Since 2016, when concerns regarding styrene emissions used in the CIPP process first emerged, NASSCO and other industry organizations jumped into action to learn everything they could to keep our workers safe. Now, five years later, and after three phases of independent research, NASSCO has our best findings to continually and transparently update our industry on best practices in the safe use and handling of styrene-based resins. Full reports are available below. We encourage all contractors and public agencies to read, understand, and follow the critical safety recommendations found in this simple, one-page document and to utilize NASSCO guidelines and specifications on safe and effective CIPP installations.

BEST PRACTICES

TIC Recommendations | Styrene & CIPP Best Sheet

COMMUNITY OUTREACH

What's That Odor Video | What's That Odor Brochure

NASSCO RESEARCH

PHASE 1 CIPP EMISSION STUDY
PHASE 2 CIPP EMISSION STUDY
PHASE 3 CIPP EMISSION STUDY

SPECIFICATION GUIDELINES

CIPP Installation
Safe Use and Handling of Styrene-Based Resins



Machine Learning (AI) and PACP™

STEP 1: NASSCO's Position

- Excellent Training aid to improve PACP coding
- Improved workflows whereby AI algorithm is used first; followed by manual operator check
- Quick coding of legacy inspection video for benchmarking purposes
- Rapidly identifies cross bores

STEP 2: CAMERA MANUFACTURING TESTING (in progress)

- While using higher speeds in the field beyond the NASSCO PACP™ prescribed 30ft (or 9m) per minute, what is the quality of the video when it is slowed down for viewing/coding of defects in the office?
- Do changes in the speed or defined parameters increase the number of defects missed?



NASSCO Educational Events

NASSCO®



September 20, 2023– Boston Area



November 2, 2023– Detroit Area

One-Day Educational Event Earn 7 PDH / .7 CEU Credits

Curriculum:

- Trenchless Technology Overview
- State Funding Roadmap
- Trench and Confined Space Safety
- PACP™ Version 8 Updates and Overview
- AI and its Impact on Our Industry
- Routine Collections Systems O&M
- Styrene and CIPP Safety

Register at [NASSCO.org/Events](https://nassco.org/Events)

NASSCO®

Thank you!

NASSCO.Org

Group No. 2

Developments and Future Pipeline Solutions

Presentation No. 3

**GLWA's Pipeline Research Program:
Condition Assessment, Renewal, and Management**

John Norton, Ph.D., P.E.

Great Lakes Water Authority (GLWA)

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GLWA's pipeline research program: condition assessment, renewal, and management

John Norton, Wentao Wang, Graham E.C. Bell, Mike Higgins, Curt Wolf, and Jerome P. Lynch

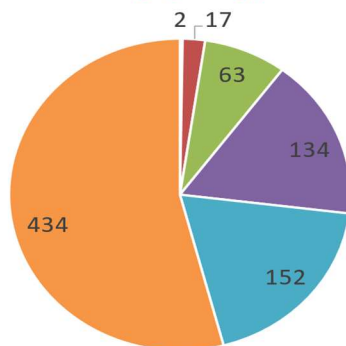
Presented by:

John Norton, PhD, PE

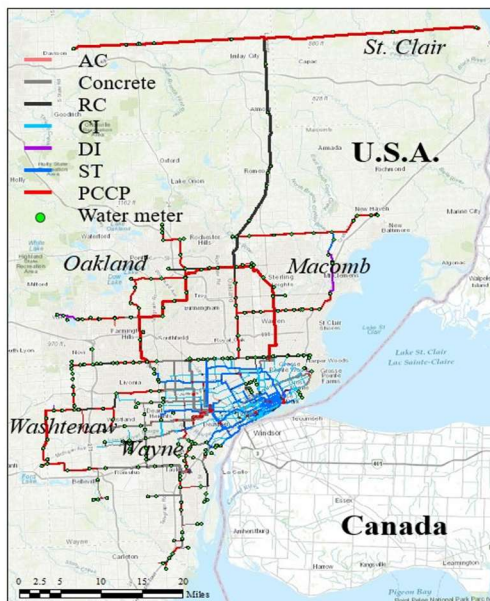
Director of Energy, Research, and Innovation, GLWA

GLWA's transmission mains

- GLWA's pipe types:

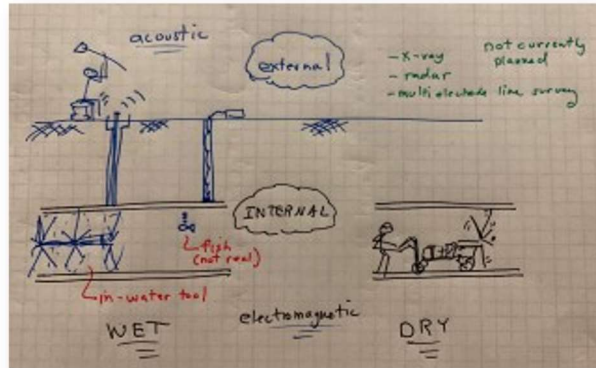


- Asbestos Cement
- Ductile Iron
- Reinforced Concrete
- Steel
- Cast Iron
- Prestressed Concrete Cylinder



GLWA's research focus

- **Assessment**
 - Ongoing
 - Internal: wet and dry
 - External: surface
 - Structural modelling
- **Renewal**
 - Ongoing: Strong pipe
 - Initiating: Steel relining
 - Initiating: Pipeline management program
- **Management**
 - Forthcoming
 - Pressure transient measurement and reduction



Summary of technologies assessed by GLWA

Pipe: empty or full	Internal or external	Technology	Name and Organization	Status
Full	Internal	Electromagnetic	Pipediver-Xylem	Completed
Empty	Internal	Electromagnetic	PICA	Completed
Full	External	Acoustic	"Marigold" – Xylem	Completed
Full	External	Acoustic	KenWave	In process
Full	External	Acoustic	HiFi	In process
Full	External	Acoustic	Echologics	In process
Full	External	Acoustic	UrbanoPlus – University of Michigan	Pending



Thank you to our collaborators

The efforts of Steven Jin, PE; Biren Saparia, PE; Joe Burchi, Bryan Wood, PE; Todd King, PE; Olivia Olsztyn -Budry, PE; Jerrod Wade, EIT, Mike Higgins, Susan Donnally, PE; Paul Acosta, and many other are greatly appreciated.



Group No. 3

**Needs, Research, and Development
for Condition Assessment of Pipe Materials**

Presentation No. 4

**Research Needs for Minimally Invasive Methods:
Distress Identification of PCCP**

Graham E.C. Bell, Ph.D., P.E., F. NACE, F. ASCE

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PIPELINES 2023 CONFERENCE

San Antonio, TX | Aug. 12–16

Presentation Title:
Research Needs for Minimally Invasive Methods
Distress Identification of PCCP

Authors: Graham Bell





Advancing Solutions for Resilient and Sustainable Infrastructure and Asset Management



The next step in condition assessment is to think outside the pipe to find bad pipe





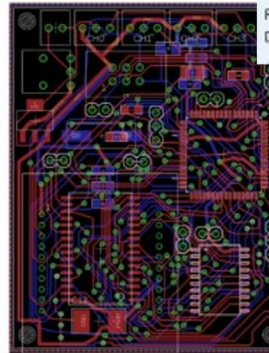
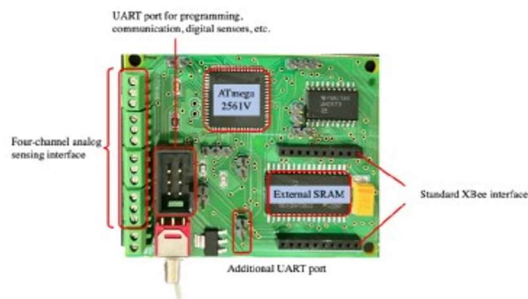
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UrbanoPlus may be able to use surface mounted sensors to detect wire breaks using external access points

- **More powerful microcontroller**
 - Higher sampling frequency
 - Time synchronized for triangulation
 - Trigger-based system



OPERATING SPECIFICATIONS

Dynamic

Peak Sensitivity, Ref V/(m/s)..... 101 dB

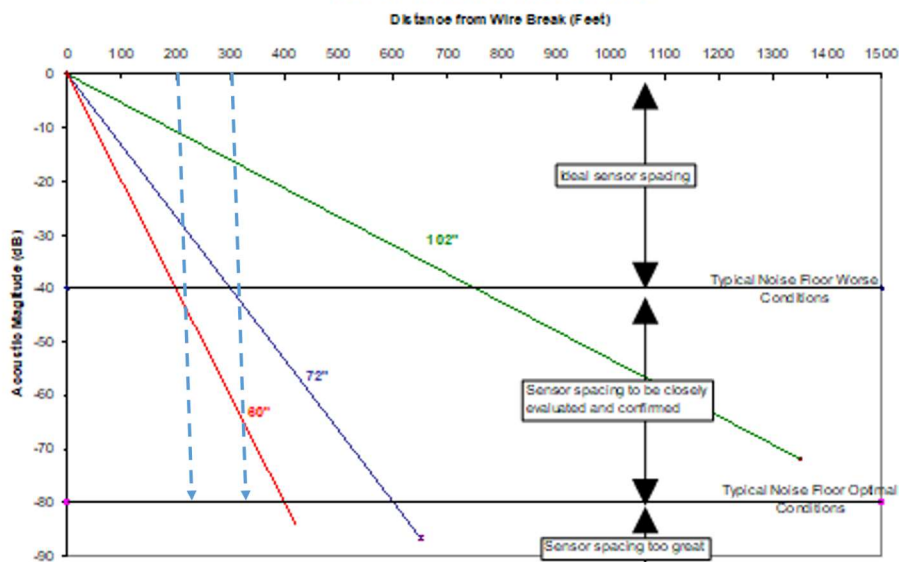
Operating Frequency Range..... 30-100 kHz

Resonant Frequency, Ref V/(m/s)..... 60 kHz

Directionality..... +/-1.5 dB



Expected Acoustic Magnitude at a Distance from a Wire Break with Surface Mounted Sensors



ASCI

agement



Applied Research near the 14 Mile & 101 Crossing Because of Variation in Damage along with recent CFRP Renew



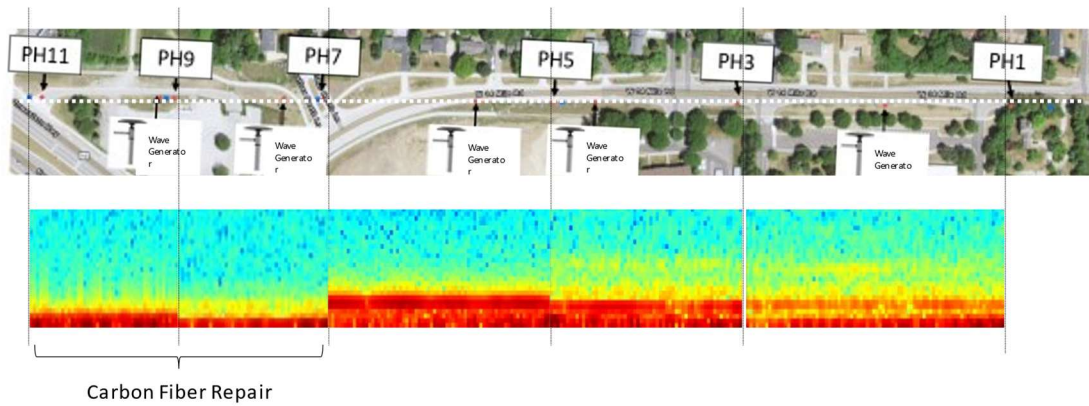
KenWave Technology uses external access points



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*Dynamic response of pipe to varying excitations
(wave generator) provides axial resolution of physical
pipe condition CFRP Extent*

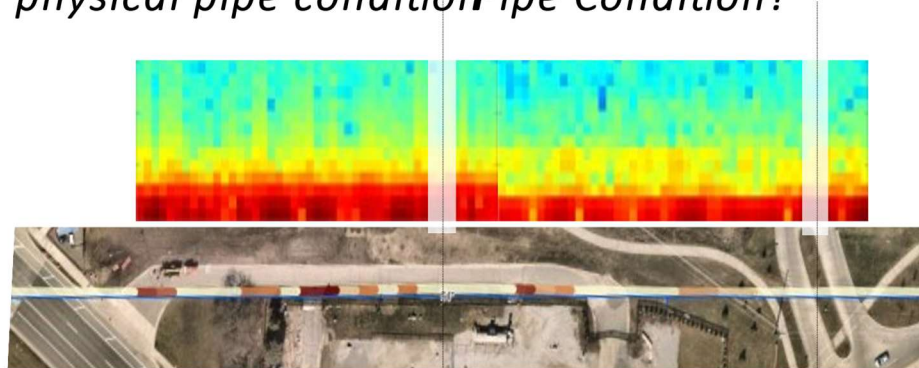


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*Dynamic response of pipe to varying excitations
(wave generator) provides axial resolution of
physical pipe condition Pipe Condition?*

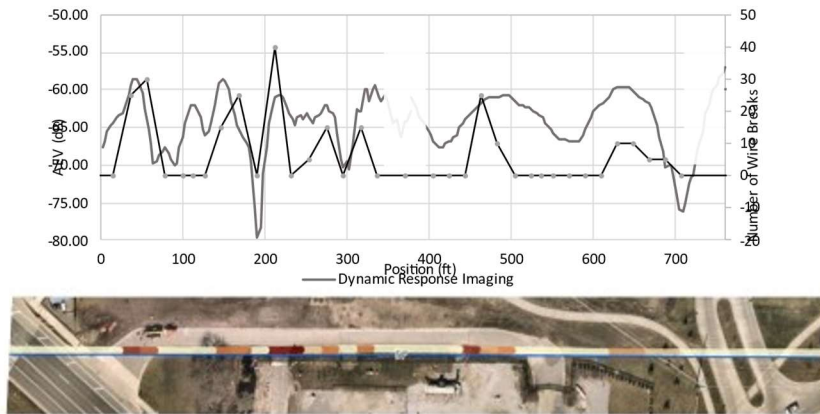


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Dynamic response of pipe to varying excitations (wave generator) provides axial resolution of physical pipe condition– Pipe Condition?



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We need to think outside the pipe

- Cost and disruption of shutdowns limits inspections and finding bad pipe
- Externally mounted acoustic sensors differentiate between levels of damage
- Focus should be on frequency rather than time domain.
- With some refinement, calibration and additional applied research, thinking outside the pipe is possible



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Group No. 4

Pipeline Resiliency Considerations

Presentation No. 5

Pipeline Resiliency Considerations

Ahmad Habibian, Ph.D., P.E., FASCE

CDM Smith

Email: habibiana@cdmsmith.com



PIPELINES 2023 CONFERENCE

San Antonio, TX | Aug. 12–16

Pipeline Resiliency Considerations

Ahmad Habibian, Ph.D., P.E., FASCE
Vice President/ Global Practice Leader for Conveyance




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Agenda

- 1) Defining resilience
- 2) Driving factors
- 3) Six dimensions of resiliency
- 4) Case Study
- 5) Areas of Research



Defining Resilience



[...] the ability to prepare for and adapt to changing conditions and to withstand and recover rapidly from disruptions [...]

-Presidential Policy Directive (PPD21-2013)



- Absorbing disturbance
- Managing disruptions
- Flexibility to return to function, not necessarily form
- Anticipating and planning for change



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Driving Factors

- Aging infrastructure
- Increased frequency and intensity of extreme events
 - ✓ Hurricanes
 - ✓ Floods
 - ✓ Drought
 - ✓ Fires
- Sea level rise
- Seismic activity
- Terrorism
- Cybersecurity concerns
- Regulatory action



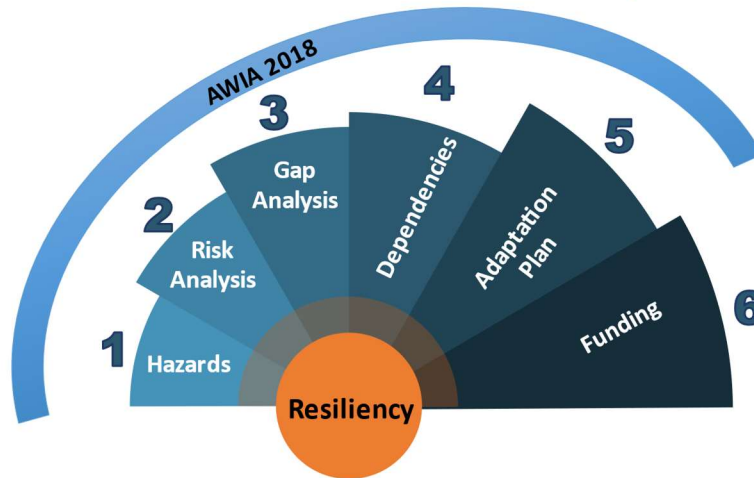
2011 Flood Photo Courtesy of FEMA



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Six Dimensions of Resiliency



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America Water Infrastructure Act (AWIA)

Risk & Resilience Assessment, Emergency Response Plan

- Amends the Safe Drinking Water Act (SDWA)
- Replaces Section 1433 (2002 Bioterrorism Act)



Covers terrorism or intentional acts

- ✓ Covers terrorism or intentional acts
- ✓ Conduct vulnerability assessment (VA)
- ✓ Submit VA to the EPA
- ✓ Create emergency response plan (ERP)

New



Addresses a broader spectrum of risk & resilience to include natural hazards

- ✓ Covers *all* hazards
- ✓ Conduct *risk & resilience* assessment
- ✓ Submit *certification* to EPA
- ✓ Create ERP/update and submit *certification* to the EPA
- ♦ Directs EPA to provide a baseline threat information
- ♦ Allows for use of voluntary standards/methods



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CALIFORNIA ACRES RAVAGED BY WILDFIRES

Acres burned

30 800 1,000 8,000 10,000 30,000 40,000+

SOURCE: ESRI, Calfire.ca.gov
 NOTE: Acres burned on active fires only, as of Sept. 21, Oct. 12

USA TODAY



Coming Together in Crisis

Great Santa Rosa

The Santa Rosa Story

In May 2005, Hurricane Wilma struck Santa Rosa, NM, leaving a trail of destruction. 600 homes were destroyed.

WET CO.

18

Recommendation 18.A: The Water Department should document the benzene contamination incident and share this information with the American Water Works Association with the potential for updated standards, practices, and materials regarding water quality following intense fires.



ASCE Lifelines Conference 2021 2022

University of California, Los Angeles (UCLA)
California, USA



1. IL-WWS'S EFFECTS OF GROUND STRAIN AND PIPELINE ORIENTATION ON PIPELINE DAMAGE DURING EARTHQUAKES				
Date: Feb. 1, 2022 3:30 PM - 5:00 PM	Session: Analysis Methods for Soil-Pipeline Interaction	Track: Water and Wastewater Pipelines	Room: Auditorium	
ST24 Setrak Torpak, PhD Galen University	ES1 Ergin Kocoguz, PhD Galen University	ES2 Muhammed Ceylan Galen University	TS1 Thomas O'Riordan, PhD Water and Civil and Environmental Engineering, Cornell University	
2. IL-WWS'S Seismic-resistant Pipeline Design: Parametric Study of Axial Connection Force Capacity				
Date: Feb. 1, 2022 3:30 PM - 5:00 PM	Session: Analysis Methods for Soil-Pipeline Interaction	Track: Water and Wastewater Pipelines	Room: Auditorium	
H10 Hüseyin Baş, Assoc. University of Colorado Boulder	ES10 Isht Warden University of Colorado Boulder	ES11 Shihai Sique, PhD, M.ASCE University of Colorado Boulder	AS1 Heidi Le, PhD, PE University of Colorado Boulder	
3. IL-WWS'S Multiscale Pipe-Soil Interaction Analysis That Accounts for Liquefied Residual Soil Strength				
Date: Feb. 1, 2022 3:30 PM - 5:00 PM	Session: Analysis Methods for Soil-Pipeline Interaction	Track: Water and Wastewater Pipelines	Room: Auditorium	
TS24 Yuan-Liang PE Institute for Advanced Research	ES24 Geoffrey Cox, PE Institute for Advanced Research	ES25 Raj-Jay P. Eng Institute for Advanced Research		
4. IL-WWS'S Seismic Reliability Assessment of Buried Pipelines Subjected to Significant Permanent Ground Deformations in an M7 California Subduction Zone Earthquake				
Date: Feb. 1, 2022 3:30 PM - 5:00 PM	Session: Analysis Methods for Soil-Pipeline Interaction	Track: Water and Wastewater Pipelines	Room: Auditorium	
VC1 Mehmet Canak, Ph.D., PE Institute for Advanced Research	AN1 Arvind Natar Institute for Advanced Research	CS1 Christopher Hill-Cook, CEO Institute for Advanced Research	MC1 Michael Susskind, PhD, PE Institute for Advanced Research	
PN1 Peter Nelson, PE Institute for Advanced Research				
5. IL-WWS'S Seismic response of pipelines from multi-point shaking table tests				
Date: Feb. 1, 2022 3:30 PM - 5:00 PM	Session: Analysis Methods for Soil-Pipeline Interaction	Track: Water and Wastewater Pipelines	Room: Auditorium	
AS10 Julian Hill, PhD The Laboratory of Urban Security and Disaster Engineering of Ministry of Education	MC10 M. El Haggag, PhD The Laboratory of Urban Security and Disaster Engineering of Ministry of Education	TS10 Zihui Zuo, Master The Laboratory of Urban Security and Disaster Engineering of Ministry of Education	LL10 Li Li, PhD The Laboratory of Urban Security and Disaster Engineering of Ministry of Education	
ES10 Rezaul Karim, PhD The Laboratory of Urban Security and Disaster Engineering of Ministry of Education	ES11 Shihai Sique, PhD The Laboratory of Urban Security and Disaster Engineering of Ministry of Education			



Relevance to Pipelines

Hazard	Relevant to Pipelines
Fire	- Impact to plastic pipes - Need for water for firefighting
Seismic	- Need for pipeline integrity to ensure continuity of service - Need for developing seismioresistant solutions
Drought	- Need for moving water to drought areas - Need for water conservation (leak detection)
Floods	- Need for stormwater conveyance - Need for monitoring, maintenance & rehab of culverts
Hurricanes	- Need for post-hurricane assessment techniques - Need for post-hurricane cleaning techniques



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Areas of Research

- Hazard characterization & forecasting
- Risk analysis techniques
- Developing practice maturity framework
- Adaptation plans
 - ✓ Operational approaches
 - ✓ Risk avoidance approaches
 - ✓ Risk mitigation approaches
 - ✓ Use of monitoring technologies, AI/ML & digital twins to manage risk



Advancing Solutions for Resilient and Sustainable Infrastructure and Asset Management



Announcement: Call for Papers Deadline for Abstracts: Nov 1, 2023



Journal of Pipeline Systems Engineering and Practice

Guest Editors:

Emad Elwakil, Ph.D., P.E., CCE, PMP, Purdue University, eelwakil@purdue.edu

Bohong Wang, Ph.D., Zhejiang Ocean University, wangbh@zjou.edu.cn

Jianqin Zheng, China University of Petroleum-Beijing, 2018214074@student.cup.edu.cn



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Group No. 5

Enhancements to Trenchless Technology Renewal Methods

Presentation No. 6

Enhancements to Trenchless Technology Renewal Methods

V. First Sever, Ph.D., P.E., BCEE, FASCE

QuakeWrap, Inc.

Email: fsever@quakewrap.com



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Enhancements to Trenchless Renewal Methods

V. Fırat Sever, PhD, PE, BCEE, F. ASCE

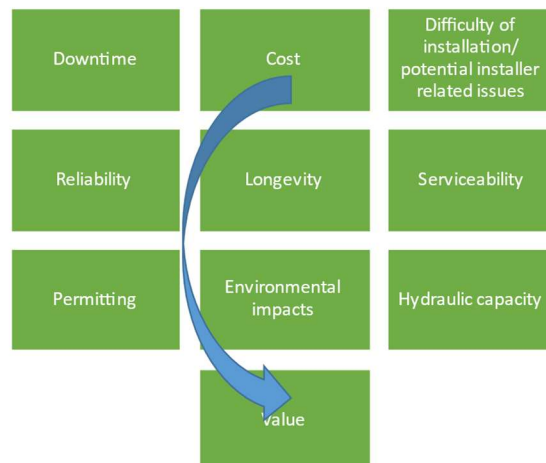
QuakeWrap, Inc.



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Pipe Rehabilitation - Factors to Consider



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Trenchless Technology



Coatings: Epoxy, Polyurethane, Polyurea

CIPP – Cured-In-Place Pipe

HDPE, PVC liners

Cementitious / Geopolymer Linings, Shotcrete

FRP – Fiber Reinforced Polymer

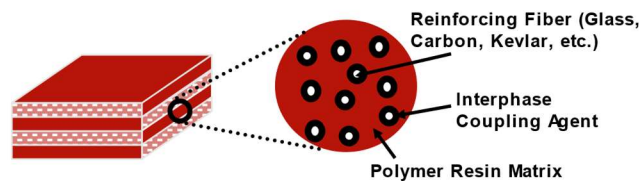


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Fiber Reinforced Polymer (FRP)

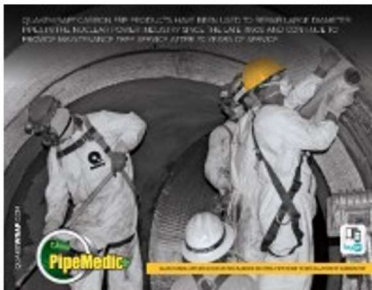
- A Polymer (i.e. epoxy, vinyl ester, etc.) that has been reinforced with a Fiber (e.g. carbon, glass, etc.)
- FRP is non-homogeneous.
- FRP does not have the same strength in all directions; these types of materials are called anisotropic



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Wet Layup Process



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Composite Sandwich Concept



Steel I-beam



T_c

RELATIVE STIFFNESS
WEIGHT (Pounds/R²)

1
0.910

0.0001
0.0001

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17.5-ft Diameter Sewer Interceptor (Detroit, MI) Installation

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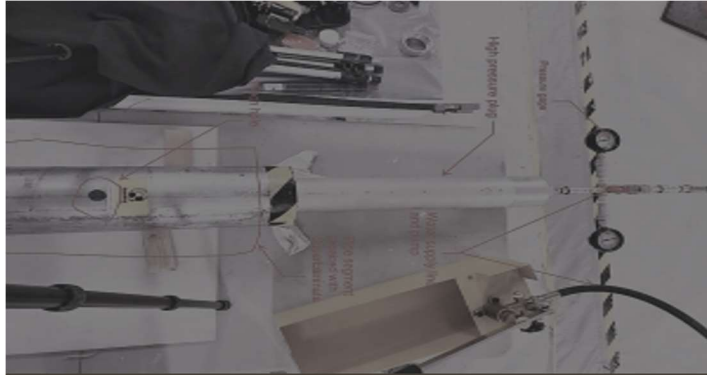
3D Composite FRP – Wet Layup



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USDOT PHMSA PROJECT FOR OIL & GAS PIPE REPAIRS



Outreach

- USDOT
- PHMSA
- Pipeline operators
- Integrity management professionals
- Other stake holders (e.g., Sprint Robotics, PRCI)



Testing

- Pressure tests
- Cyclic loading
- Dents, cracks, weld seam defects
- By third party (ADV Integrity)
- Chemical resistance



Installation Plan

- Long distance launching
- Working in tandem with pigging/ILI
- Test setup at QuakeWrap facility
- Troubleshooting

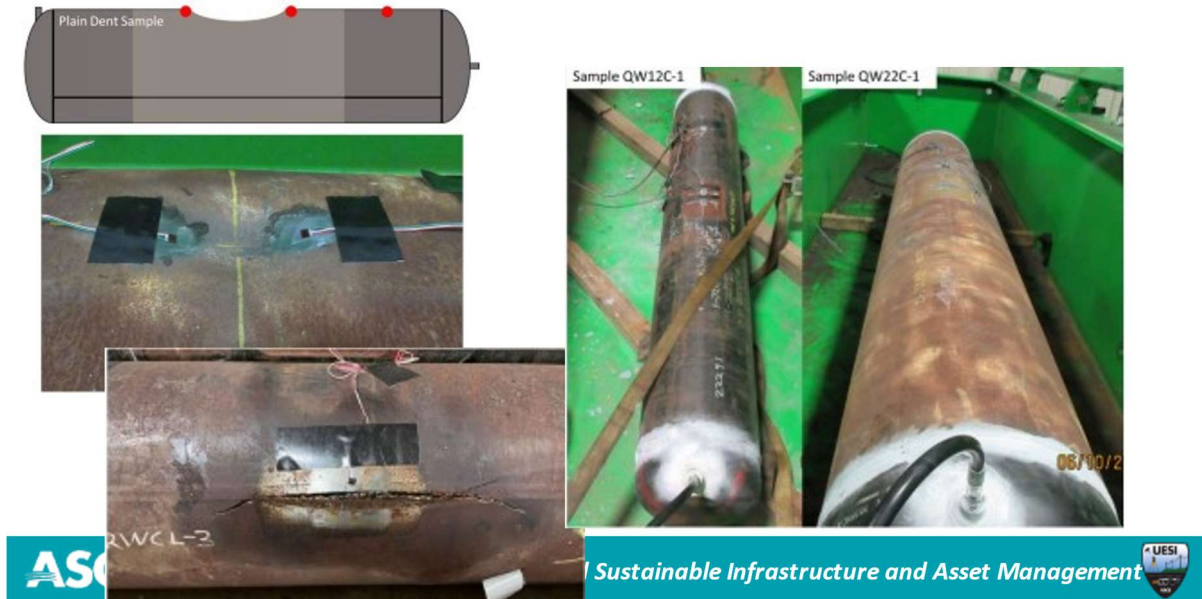
DEPLOYMENT CONTROL SYSTEM



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PRESSURE/CYCLIC LOAD TEST BY THIRD PARTY



Onsite-Manufactured FRP Pipe[®]

watch video at: <https://tinyurl.com/InfinitPipe>



Thank You!

Firat Sever

fsever@quakewrap.com

520-791-7000

www.pipemedic.com

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Group No. 6

Pipeline Asset Management and Inspection

Presentation No. 7

Condition Assessment in Smart Water Utilities Paradigm

Kalyan Piratla, Ph.D.

Clemson University

Email: kpiratl@clemson.edu



PIPELINES 2023 CONFERENCE

San Antonio, TX | Aug. 12–16

**Presentation Title: Condition Assessment in
Smart Water Utilities Paradigm**

Author: Kalyan R. Piratla, S. E. Liles
Distinguished Professor, Glenn Department
of Civil Engineering, Clemson University



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Presentation Outline

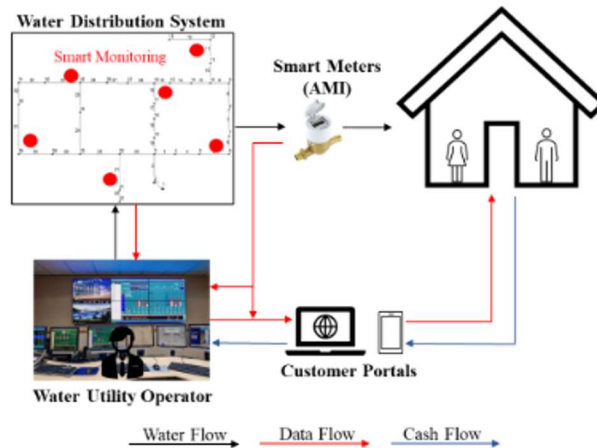
- Background on water infrastructure
- Smart leak monitoring techniques for water pipelines
 - Model-based (primitive)
- Future research directions



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Smart Water Utility Technologies



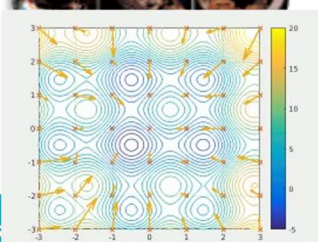
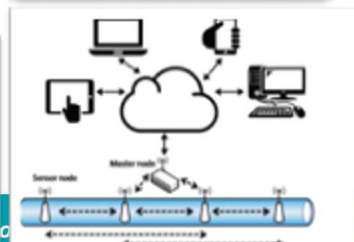
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Model-based Techniques

- AMI metering and smart near-real-time distribution system monitoring offer a great promise for pipeline condition assessment through model-based intelligence gathering techniques



A

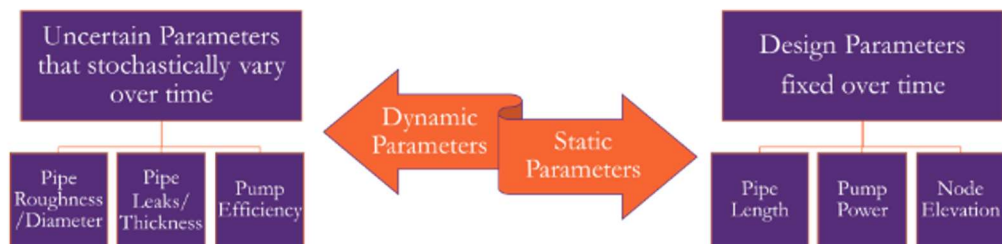
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infrast

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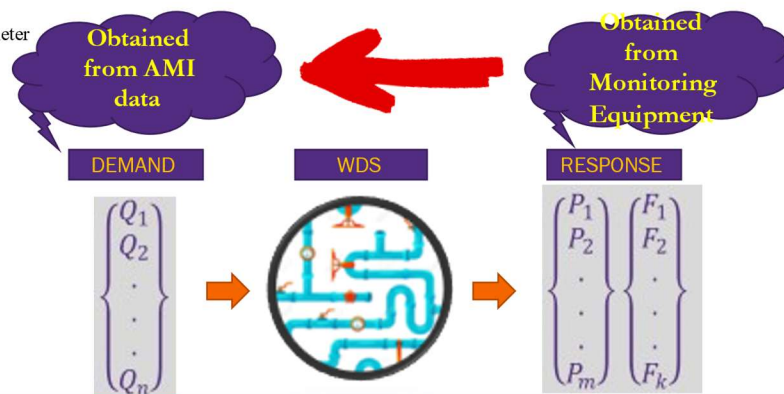


Dynamic vs. Static Condition Variables



Model-based Approach: Methodology

- A variety of learning techniques can be employed to predict the condition of water pipelines given the demands & the system responses
 - Dynamic system uncertainties may be predicted through sophisticated data-driven approaches
 - Pipe roughness values
 - Effective hydraulic diameter
 - Leakages



Stochastic Model-based Leakage Prediction

- How would the model behave when the uncertain parameters such as pipe roughness and hydraulic diameters are altered from static to dynamic (stochastic) values?

🌸 Roughness Coefficient (Walski et al, 1988):

$$C_k = 18.0 - 37.2 \log \left[\frac{a(T - T_0) + D_k (10^{\frac{18 - C_{k,0}}{37.2}})}{D_k} \right]$$

$$a = 10^{-(4.08 + 0.38 LSI)} \quad \text{for } LSI < 0$$

🌸 Quality-based approximation of Roughness Coefficient over time

🌸 Effective Hydraulic Diameter:

$$D_{20\text{-years-old}} = 80\% \text{ of } D_0$$

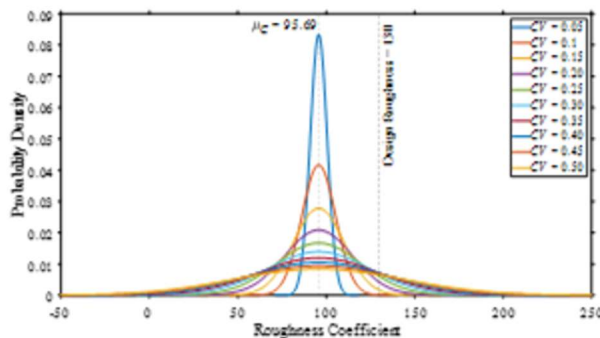


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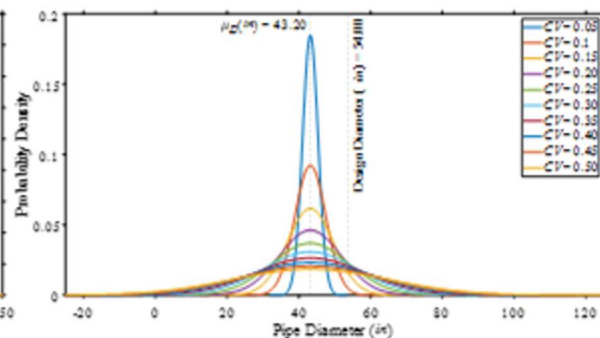


Uncertainty Propagation

- Roughness



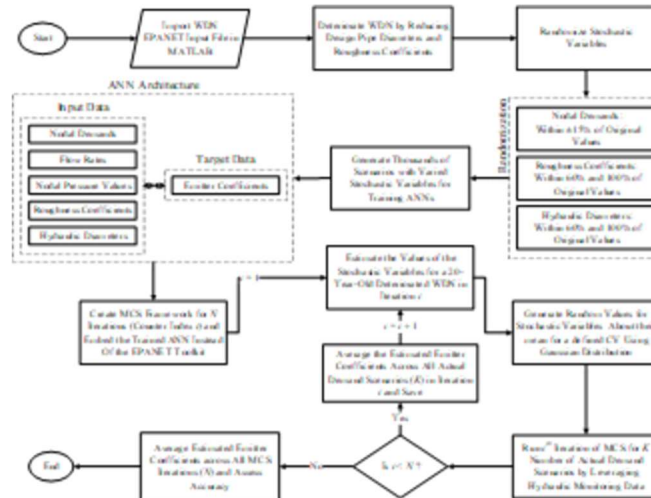
- Hydraulic Diameter



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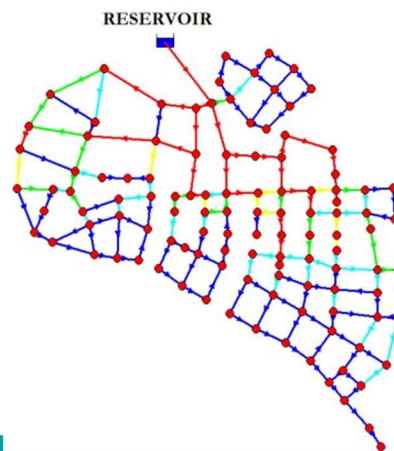


Stochastic Model-based Leakage Prediction

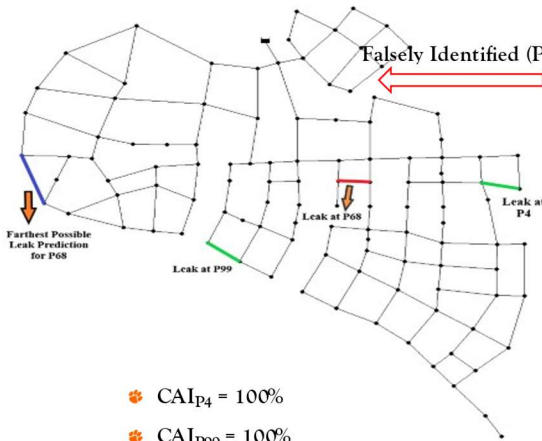


Test Network

- ZJ WDN:
 - 🌻 1 Reservoir (Total Head = 45m)
 - 🌻 164 Pipes (Average Diameter $\approx$ 672mm)
 - 🌻 113 Nodes (Average Demand $\approx$ 49 LPS)



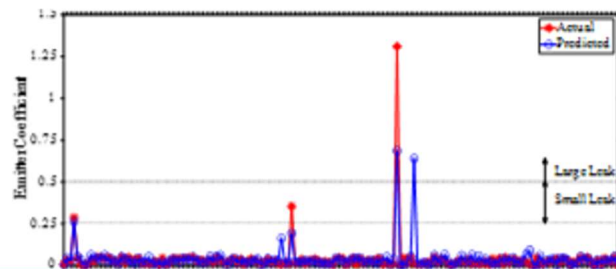
Closeness Accuracy Index (CAI)



- ✿ CAI_{P4} = 100%
- ✿ CAI_{P99} = 100%
- ✿ CAI_{P68} = 55.67%

CAI is leveraged to quantify the pipe-length proximity of an actual leak that the model has failed to identify to the closest, most significant predicted leak in the system

$$CAI (\%) = 100 * \sum_{x=1}^N (1 - \frac{D_x}{D_x^{Max}})$$

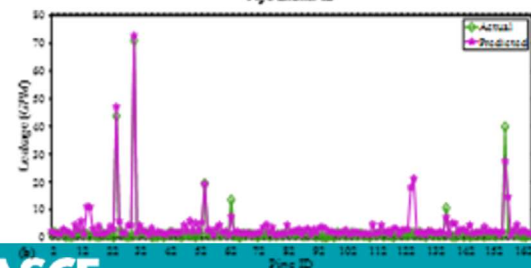
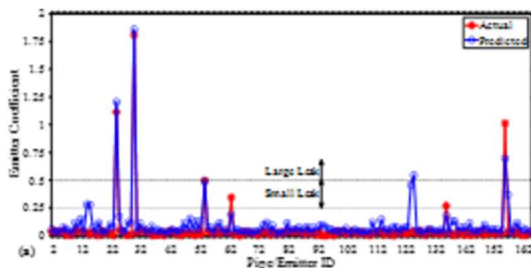


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Stochastic Model-based Leakage Prediction



Case #	# of Leaks	Average Network-wide Emmitter Coefficient MAE	Predictive Model Leak Localization Performance			
			Leak Localization on Average True Positive (%)	Leak Localization on Average False Positive (%)	CAI for False Negatives	Average Emmitter Coefficient MAE
1	Zero Leaks	0.023	N/A	0%	N/A	N/A
2	One Small Leak	0.023	49.3%	108.6%	49.3%	0.138
3	One Large Leak	0.028	49.3%	91.3%	98.6%	0.549
4	One Small & One Large Leaks	0.028	85.0%	54.9%	79.2%	0.332
5	Three Small Leaks	0.025	82.1%	67.3%	81.5%	0.143
6	Three Large Leaks	0.039	99.3%	73.1%	98.7%	0.515
7	Three Small & Three Large Leaks	0.03	72.5%	39%	63.4%	0.145
8	Five Small Leaks	0.044	86.0%	48.0%	83.3%	0.339
9	Five Large Leaks	0.068	96.9%	61.0%	92.3%	0.620

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Key Takeaways

- Larger leaks and multiple in number were predicted with **greater accuracy**
- When sensors are available at **all locations**, the model successfully identified leaks of different sizes and numbers within a range of **49% and 97%**, with a **CAI range of 50% and 99%**
- When **sensor numbers were reduced** and capped at 50% and 75% for random placement, the model accuracy suffered and yielded a true positive value range of roughly **13% and 80%**, with the **CAI range of roughly 4% and 89%**



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Future Research Directions

- Validation needed for large-scale systems
 - Computational challenges need to be addressed
- Need to make it work using only pressure monitoring at limited number of locations
 - Optimal sensor placement
 - Missing monitoring data prediction
- More representative hydraulic conditions need to be simulated considering valve and tank statuses
- Sustainability aspects of such monitoring systems need to be evaluated
 - Cost of sensors vs. resulting value?
- Unsupervised and transfer learning methods would be ideal



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Group No. 7

Pipelines in Difficult Soil Conditions

Presentation No. 8

Pipelines in Poor Soil Conditions

Amster Howard

Email: amsterk@comcast.net

POOR SOIL CONDITIONS

Rocks

Expansive Clays

Collapsing Soils

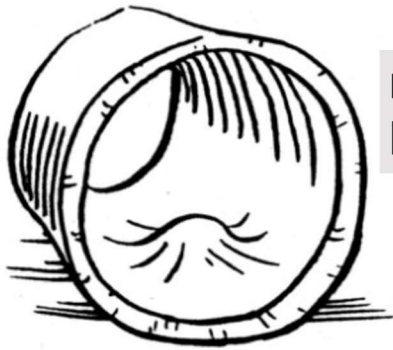
Weak Trench Walls

how to read logs

**Laying pipe on trench bottom
covered in rocks**



2



results of point loads on pipe



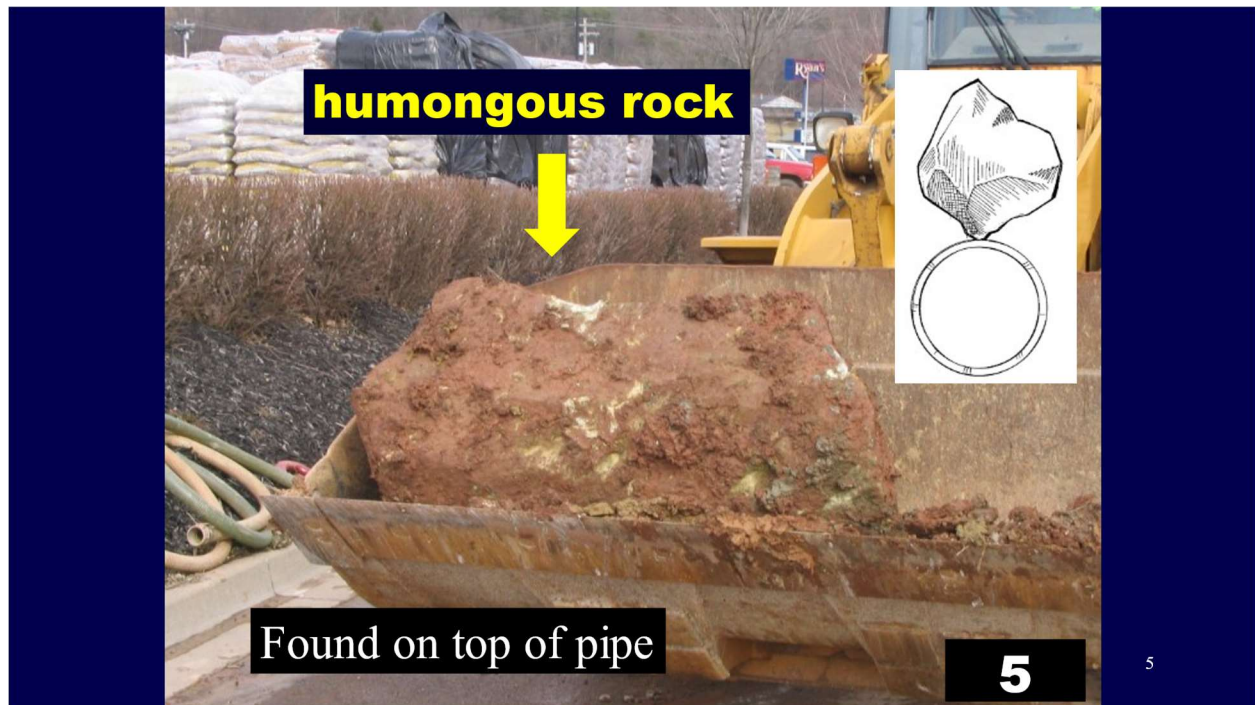
3

Third Party Inspection



4

4

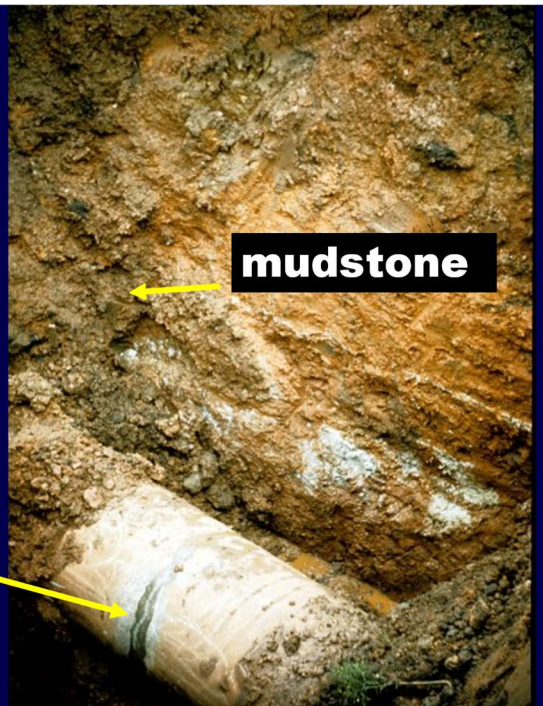


**Broken
Back
leak**



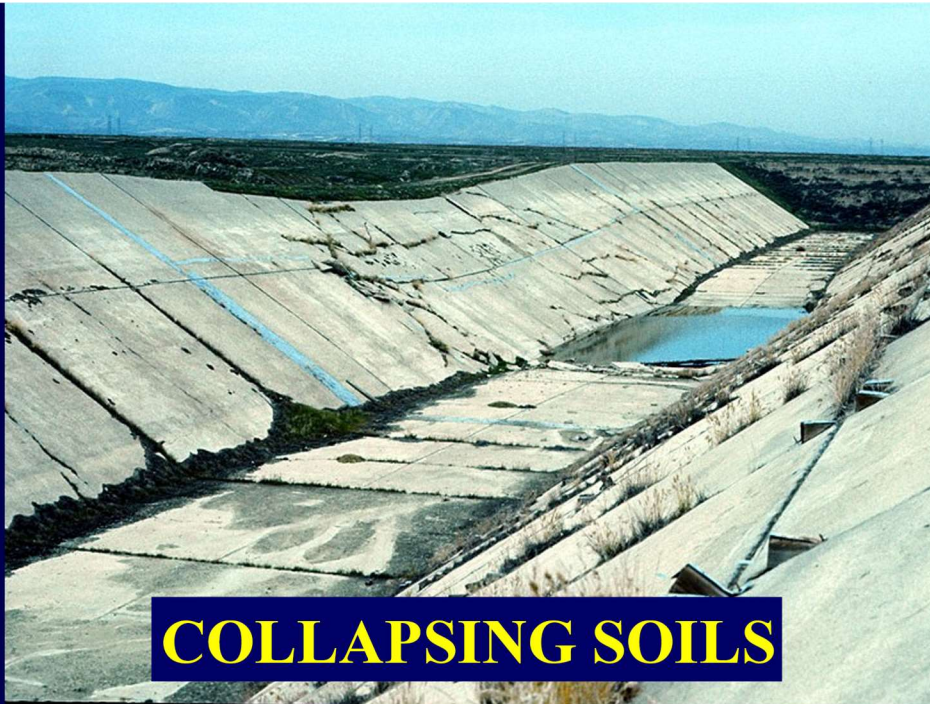
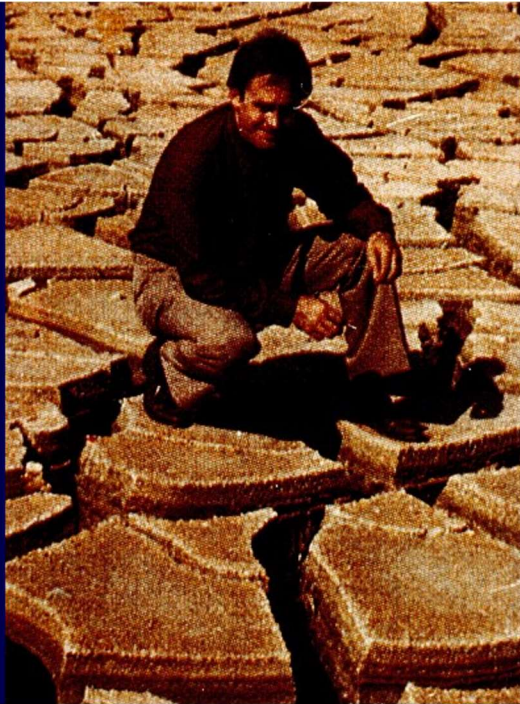
**repaired
leak**

mudstone



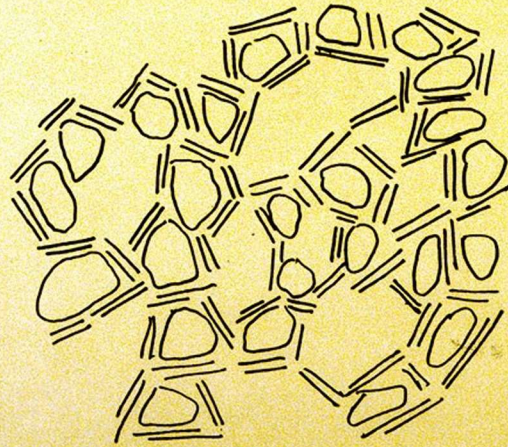
EXPANSIVE CLAY

**shrinks
and
swells**

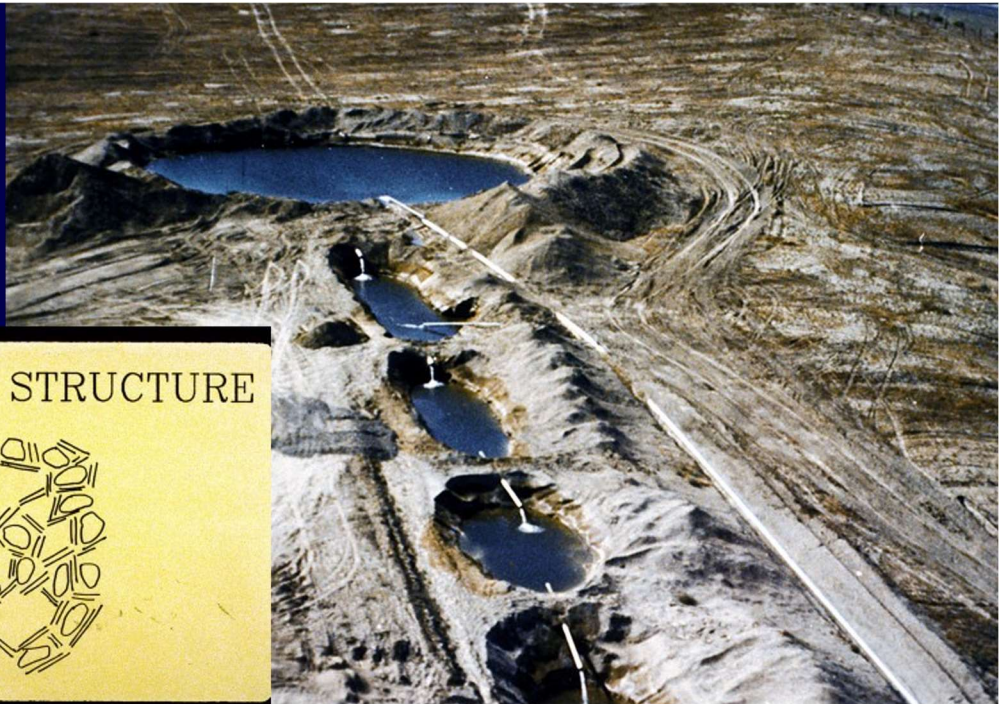
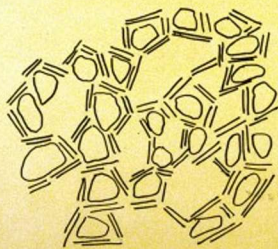


COLLAPSING SOILS

COLLAPSE STRUCTURE

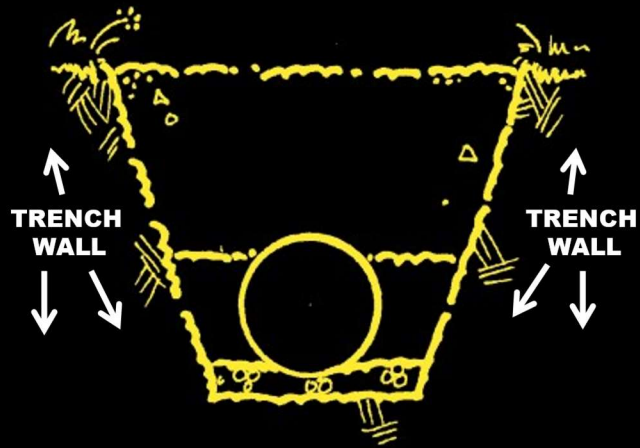


COLLAPSE STRUCTURE





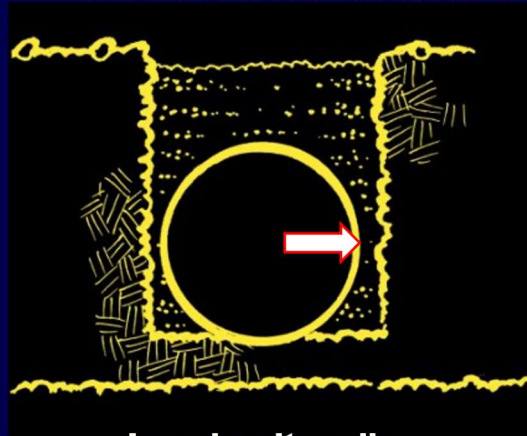
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15

p324

POOR TRENCH WALLS

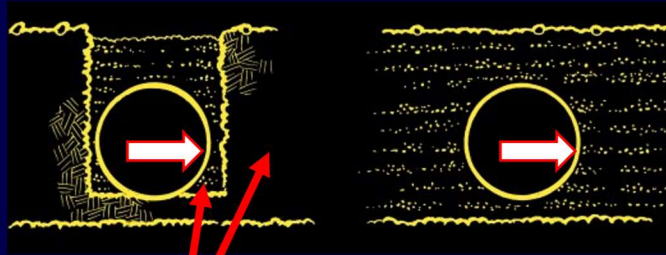


Low density soils
Soft soils
Organic soils, peat

16

p325

COMPOSITE E PRIME

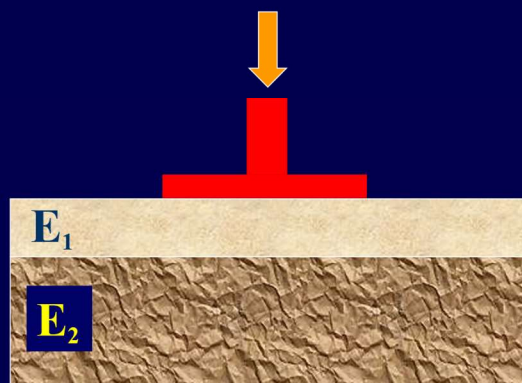


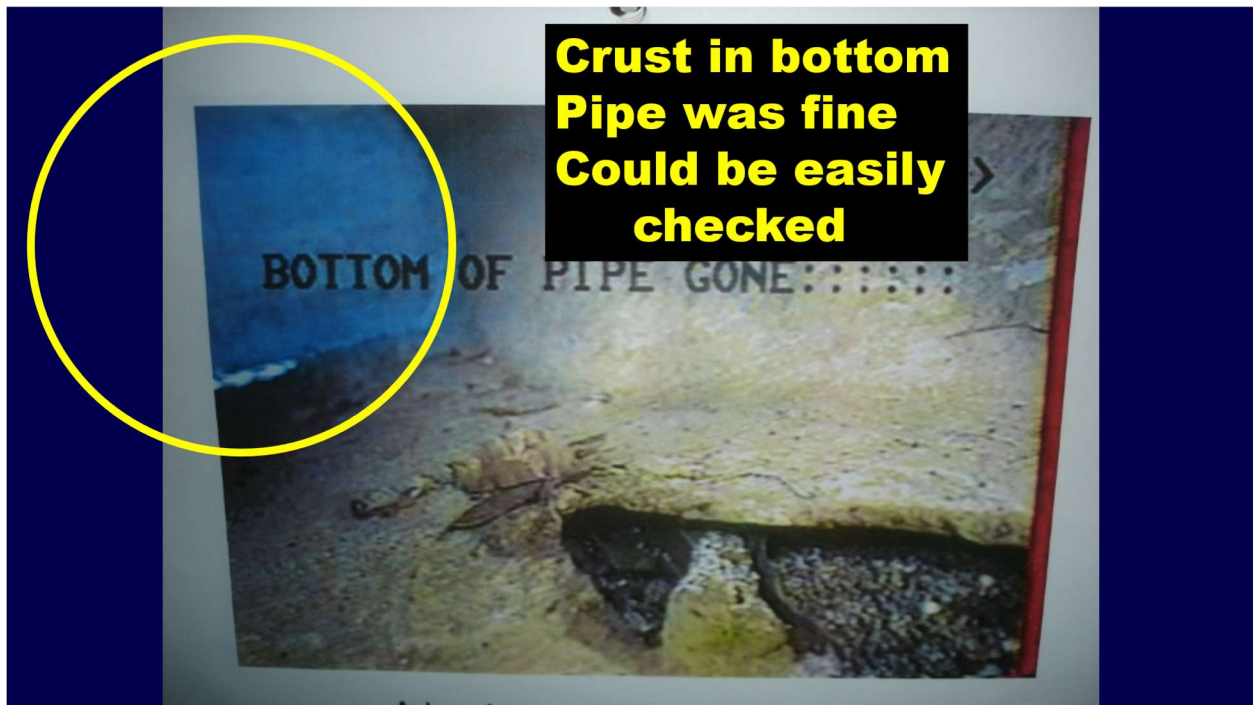
Combine
Embedment
Stiffness with
Trench wall
stiffness

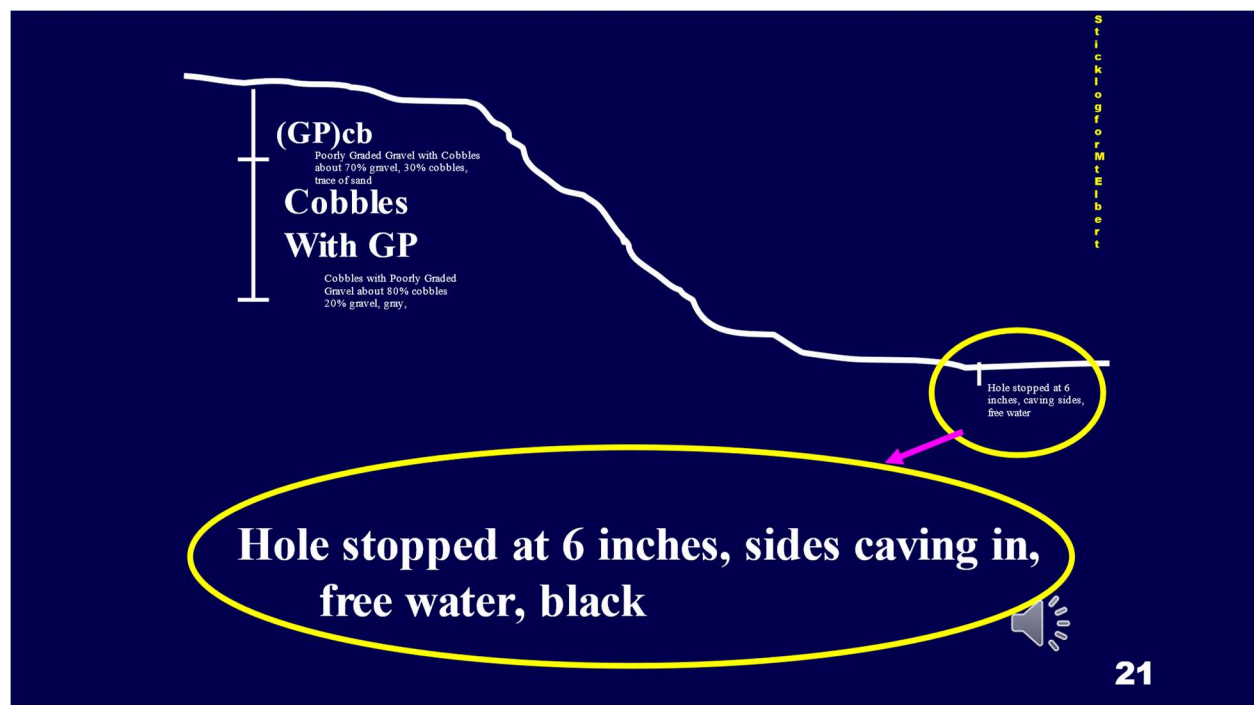
=

One stiffness

17







Group No. 8

Structural Evaluation of Buried Pipe

Presentation No. 9

Structural Evaluation of Buried Pipes

Himan Hojat Jalali, Ph.D., PE, M. ASCE

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Amin Tehrani, Ph.D., PE, M. ASCE

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PIPELINES 2023 CONFERENCE

San Antonio, TX | Aug. 12-16

Research Symposium

Structural Evaluation of Buried Pipes

Speakers:

Dr. Himan Hojat Jalali, PE, M.ASCE – UT Arlington,
Dr. Amin Tehrani, PE, M.ASCE – Freese & Nichols Inc.

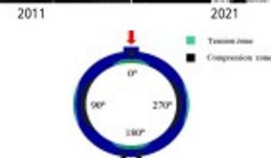
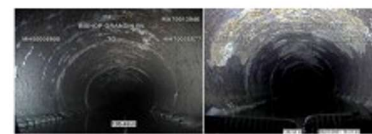


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Condition Assessment vs. Structural Evaluation

- **Condition Assessment:** evaluates the current condition of the pipe with regards to the overall health that includes:
 - Visible defects and damages.
 - Deterioration of the pipe surface.
 - Anomalies and Blockages, etc.
 - Primary Objective: To distinguish the present state of the pipe from its intended design condition.
- **Structural Evaluation:** Analyzes the pipe's structural behavior and performance.
 - Considers factors such as material strength, structure supports, etc.
 - Primary Objective: Assess the current load carrying capacity and to predict pipe behavior and its durability over time.
- **Outcome:** Decision Making.



		Impact				
		Negligible	Minor	Moderate	Significant	Severe
Likelihood	Very Likely	Low Med	Medium	Med H	High	High
	Likely	Low	Low Med	Medium	Med H	High
	Possible	Low	Low Med	Medium	Med H	Med H
	Unlikely	Low	Low Med	Low Med	Medium	Med H
	Very Unlikely	Low	Low	Low Med	Medium	Medium



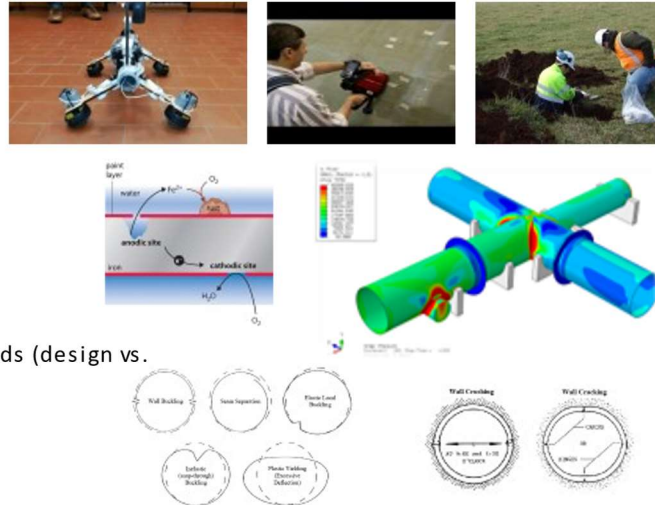
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Structural Evaluation of Buried Pipes

- Key Components:

- Condition Assessment:
 - Visual Inspection
 - Pipe Profile Acquisition
 - Material Assessment
 - Non-Destructive Testing
 - Corrosion Assessment
- Geotechnical Assessment
- Project Related Data
 - Pipe geometry, burial depth, loads (design vs. seismic), age,...
- Modeling and Simulations
 - Stress Analysis
 - Deflection Estimation

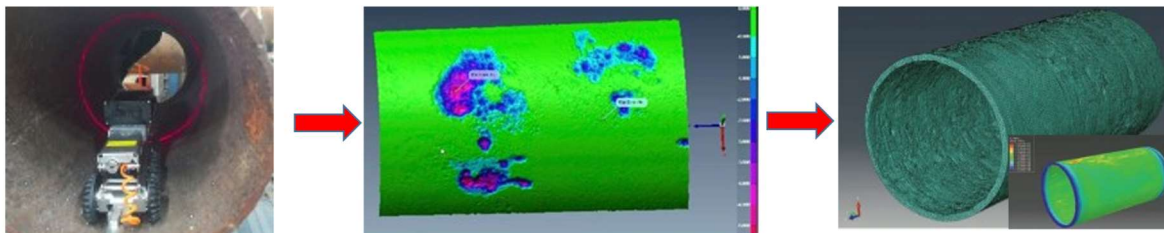


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Challenges and Gaps

- Typically, numerical simulation (FEA, CFD,...) but with simplifying engineering assumptions
- Incorporating condition assessment into structural evaluation (continuous vs. segmented)
- Computational cost: requires high performance computing (HPC)

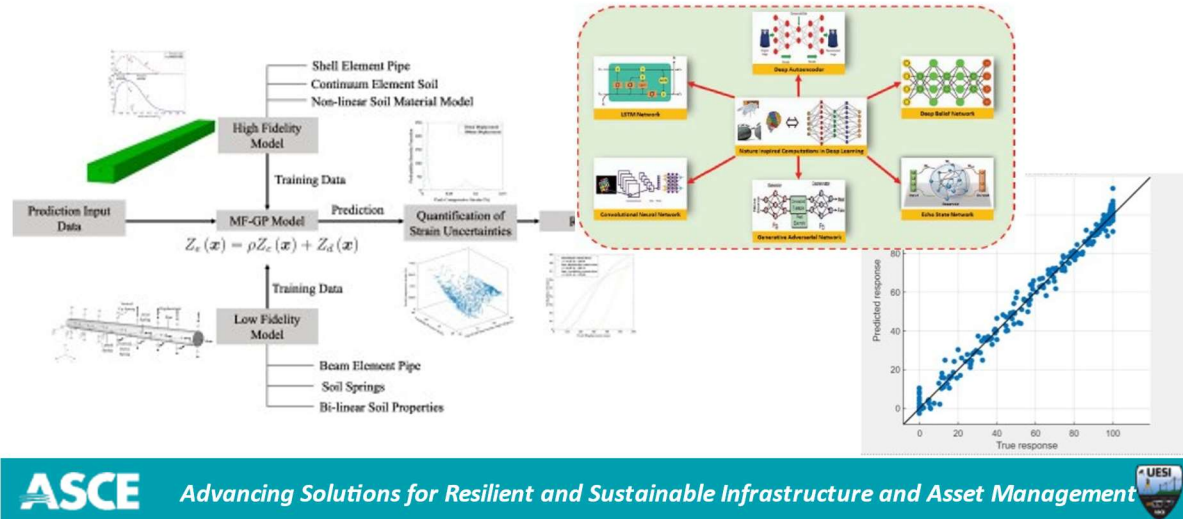


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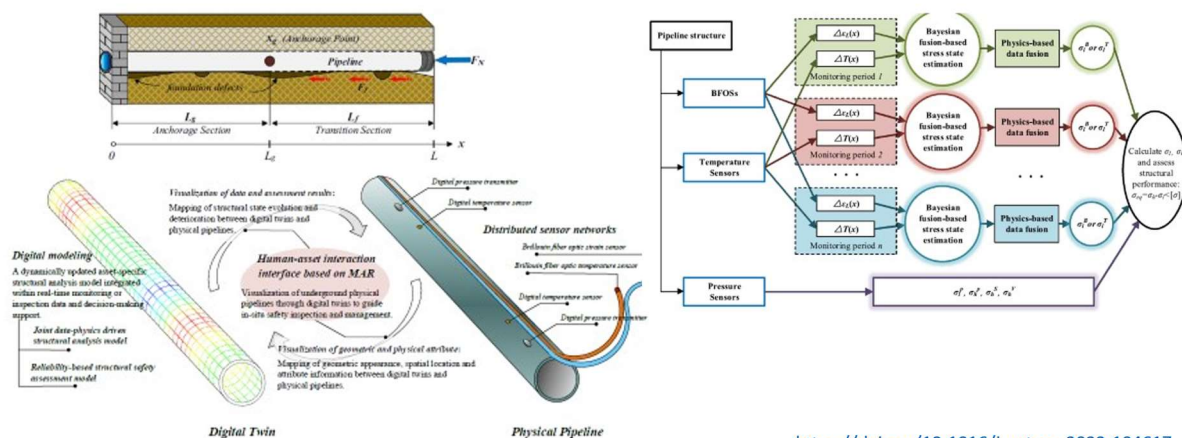
Research Needs

- AI and ML-based structural evaluation incorporating condition assessment



Research Needs

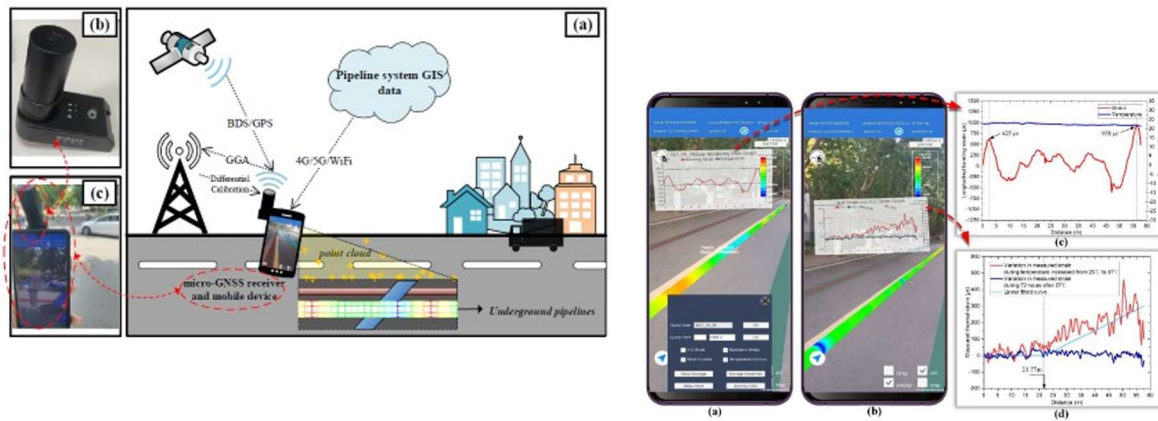
- Digital Twin



<https://doi.org/10.1016/j.autcon.2022.104617>

Research Needs

- Digital Twin-based Augmented Reality (AR) structural evaluation



<https://doi.org/10.1016/j.autcon.2022.104617>

ASCE

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Group No. 9

Renewal Technologies and Polymeric Spray Applied Pipe Lining

Presentation No. 10

Trenchless Renewal Methods

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NO PowerPoint Presentation Was Provided.

Group No. 9

Renewal Technologies and Polymeric Spray Applied Pipe Lining

Presentation No. 11

Polymeric Spray Applied Pipe Lining Renewal Technology

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Polymeric SAPL Pipe Renewal Technology

- Sanaz Ghalambor, *Nukote Coating Systems*
- Kawalpreet (Preet) Kaur, *CUIRE/UTA*



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SPRAY APPLIED PIPE LINER (SAPL)

- Also Known as: Spray-in-Place-Pipe (SIPP)
- Today, high-tech polymer coatings and composite lining methods are used to restore, protect, repair, and renew a wide range of concrete, masonry, and steel structures.
- SAPL applies layers of liner on the interior surface of the host pipe to provide corrosion protection and structural capacity enhancement.
- SAPL is one continuous length of liner without joints or weak points.



Robotic Installation
Nukote Coating Systems



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POLYMERIC SAPL ADVANTAGES

- Quick return-to-service attributes
- Solvent-free. VOC free.
- Less construction space/ construction cost.
- Minimum access requirements and the length of time that the pipe is out of service.
- In most cases faster, cheaper, and better than various options.



Robotic Installation
Nukote Coating Systems



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POLYMERIC SAPL ADVANTAGES

- It can enhance the structural strength of host pipe and acts as a stand alone pipe within a pipe. It can be used to span missing sections of pipe.
- Hydraulic capacity of the pipe can be maintained or improved with its smooth and uniform surface.
- Prevents Pipeline Internal Corrosion, Erosion, Abrasion Problems, further deterioration



Internal Pressure - Burst Test
Parallel Plate Test

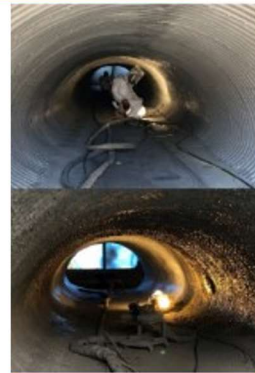


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POLYMERIC SAPL – POLYUREA/ POLYURETHANE

- Compatible with complex geometries.
- It does not leave annular gaps and conforms the host culvert geometry.
- Laterals do not need reconnection.
- Can be used in potable water, sewer, wastewater pipes, culverts, transmission lines, reservoirs...



CSP culvert rehabilitation
Nukote Coating Systems



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POLYMERIC SAPL INSTALLATION

Manual spraying



360 Ringtech Robot
Nukote Coating Systems

Lithium Powered Crawler – Spin-cast Unit



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Polymeric SAPL in Pipe Rehabilitation/ Renewal

System Class	Non Structural I	Semi-Structural		Structural IV
		II	III	
Corrosion Protection	Yes	Yes	Yes	Yes
Gap Spanning Capability	No	Yes	Yes	Yes
Inherent Ring Stiffness	No (Depends on Adhesion)	No (Depends on Adhesion)	Yes (Self Support)	Yes (Self Support)
Survives Burst failure of old pipe	No	No	No	Yes



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WHY RESEARCH ON POLYMERIC SAPL NEEDED

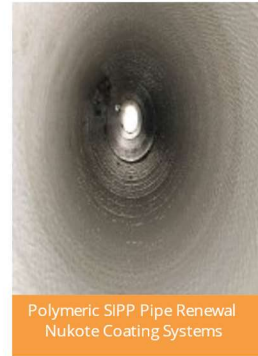


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WHAT IS THE CURRENT STATE OF INDUSTRY?

- Under-funded, mostly focused on simple, expensive solutions like pipe replacement, due to inadequate knowledge of mechanics and functionality of pipe rehabilitation.
- Changing fast with new standards for SIPP pending, and many managers having heard of or experienced some type of SIPP project and embracing the option to get more for less.



WHAT ARE THE GAPS AND CHALLENGES?

- Data gaps in specific knowledge of the existing pipe condition, and capability gaps in terms of the available renewal and rehabilitation technologies.
- Accurate data of the host pipe condition and matching the design procedures to the actual loading conditions are necessary for the successful selection and design of Polymeric SAPL.
- The performance of the technology has not been studied over time. Understanding of the longterm performance, expected life cycle and deterioration rates are needed.



WHAT ARE THE GAPS AND CHALLENGES?

- Host pipe stability and resiliency combined with the rehabilitation method selected are either not completely understood or not fully appreciated.
- Each rehabilitation method has benefits and weaknesses that must be matched to the specific unique condition of each project considered.
- Gaps exist between available technologies in the marketplace and technological developments that would offer significant improvements in practice.
- No complete standard/ design procedure for the polymeric SIPP.



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R&D TO ADDRESS THE CHALLENGES?

- Innovative rehabilitation technologies be demonstrated in field conditions and measured against a clearly defined set of performance criteria.
- Design considerations and standards for SIPP.
- Emergency repair procedures for lining systems.



Polymeric SIPP Pipe Renewal
Nukote Coating Systems



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HOW TO BE ACCEPTED IN THE MARKETPLACE?

- Education of clients and engineers
- Develop a positive track record of use
- Consult the vendors before using any of the identified technologies
- publish the findings of demonstration projects and case studies. Promoting the increased use of decision support systems (DSS)
- Standardizing to ensure the end user of the quality and ability to get what they were sold and seeking. Technology needs to be repeatable.



Polymeric SIPP Pipe Renewal
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THANK YOU.

- Sanaz Ghalambor, *Nukote Coating Systems*
- Kawalpreet (Preet) Kaur, *CUIRE/UTA*



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Group Discussion Reports

Group 1 Report: New Standard/MOP Development at AWWA/WRF and NASSCO

Group Leader: Amir Tabesh, Ph.D., P.E.

Note Taker: Frank Blaha

Group Presenter: Frank Blaha

Attendees:

Frank Blaha

Tom Iseley, Ph.D., P.E.

Zahra Kohankar Kouchesfehni, Ph.D.

Mahnaz Rouhi

Amir Tabesh, Ph.D., P.E.

Research Needs and Discussions:

- 1- Increasing the utilization and understanding of asset management is a driver of pipe rehabilitation management, as an increasing number of agencies require asset management programs.
- 2- Expanding educational opportunities in asset management and pipe evaluations.
- 3- Increasing the understanding of scientific methodologies for predicting and comprehending the remaining lifespan of pipes.
- 4- Establishing a standard coding for addressing the various types of pipe liners. This would eventually lead to an expanded PACP program. It would provide a selection mechanism for liners used in both gravity and pressure-based pipes.

**Group 2 Report:
Developments and Future Pipeline Solutions**

No Small Group Discussion Was Conducted.

Group 3 Report: Needs, Research, and Development for Condition Assessment of Pipe Materials

Group Leader: John Mele

Note Taker: John Mele

Group Presenter: John Mele

Attendees:

Amster Haward

Ayoub Mohammadi

Sri Rajah, Ph.D., P.E.

John Mele

Vinayak Kaushal, Ph.D.

Smith F. Rangel

Research Needs and Discussions:

- 1- Analyzing the implications of the outspread use of artificial intelligence in drinking water and wastewater systems.
- 2- Investigating the implications of improper construction practices across various pipe materials and developing strategies to predict pipeline conditions and remaining useful life (RUL) based on pre-acceptance surveys.
- 3- Determining maximum allowable pressure ratings for various pipe materials and evaluating the safety margins and reliability of pipes under different pressure conditions.
- 4- Evaluating the use of artificial intelligence for the prediction of sewer inflow and infiltration sources.

Group 4 Report: Pipeline Resiliency Considerations

Group Leader: Jennifer Baldwin, Ph.D., P.E.

Note Taker: Khalid Al-Juboori

Group Presenter: Khalid Al-Juboori

Attendees:

Khalid Al-Juboori

Jennifer Baldwin, Ph.D., P.E.

Ahmad Habibian, Ph.D., P.E.

Steven Kramer, P.E.

Bill Brick, P.E.

Research Needs and Discussions:

- 1- Hazard Characterization & forecasting
- 2- Risk analysis techniques
- 3- Developing practice maturity framework
- 4- Adaptation plans

Group 5 Report: Enhancements to Trenchless Technology Renewal Methods

Group Leader: Dan Koo, Ph.D.

Note Taker: Diego Calderon, P.E.

Group Presenter: Diego Calderon, P.E.

Attendees:

Mo Ehsani, Ph.D., P.E.

Dan Koo, Ph.D.

First Sever, Ph.D., P.E.

Vanaja Rajah, Ph.D., P.E.

Diego Calderon, P.E.

Research Needs and Discussions:

- 1- Exploring new or enhanced renewal technologies for renewal small size asbestos concrete pipes.
- 2- Advancing the prediction of condition assessment for new pipe installation
- 3- Increasing the understanding of scientific methodologies for predicting and comprehending the remaining lifespan of pipes.
- 4- Addressing the insufficiency in condition assessment for small-sized drinking water pipelines.

Group 6 Report: Pipeline Asset Management and Inspection

Group Leader: Kalyan Piratla, Ph.D.

Note Taker: Owen Yan, Ph.D.

Group Presenter: Kalyan Piratla, Ph.D.

Attendees:

Kalyan Piratla, Ph.D.

Mehdi Torbat Esfahani

Madhuri Arjun, Ph.D.

Owen Yan, Ph.D.

Ibukun Gabriel Awolusi

Research Needs and Discussions:

- 1- Explore AI, machine learning, and sensor for accurate pipeline condition assessment, focusing on flow leakage detection via model-based approaches.
- 2- Investigate the practicality and efficiency of unmanned aerial vehicles (UAVs) in pipeline inspection.
- 3- Assess the feasibility of using vibration testing to evaluate the condition of plastic pipelines.
- 4- Enhance wire break detection methods for prestressed concrete cylinder pipes (PCCP) within pressure pipelines.
- 5- Research and develop the application of electrical magnets for non-destructive testing of steel pipes.
- 6- Explore the potential applications and benefits of 3D modeling in sewer pipeline condition assessment.

**Group 7 Report:
Pipelines in Difficult Soil Conditions**

No Small Group Discussion Was Conducted.

Group 8 Report: Structural Evaluation of Buried Pipe

Group Leader: Himan Hojat Jalali, Ph.D.

Note Taker: Zaid Momani, Ph.D.

Group Presenter: Himan Hojat Jalali, Ph.D.

Attendees:

Himan Hojat Jalali, Ph.D.

Shahriar Abed, Ph.D.

Amin Tehrani, Ph.D., P.E.

Zaid Momani, Ph.D.

Adel Abou Jaoude, Ph.D.

Research Needs and Discussions:

- 1- How FEM can be used in field assessment of pipelines?
- 2- How can the database management help in conducting assessment of future cases?

Group 9 Report: Renewal Technologies and Polymeric Spray Applied Pipe Lining

Group Leader: Evgeniy "Eugene" Torgashov, Ph.D.

Note Taker: Paria Hamidzadeh

Group Presenter: Kawalpreet Kaur, Ph.D.

Attendees:

Evgeniy "Eugene" Torgashov, Ph.D.

Paria Hamidzadeh

Zahra Kohankar Kouchesfehni, Ph.D.

Kawalpreet Kaur, Ph.D.

Sanaz Ghalambor

Shah Rahman

Research Needs and Discussions:

- 1- The absence of a standard for certain trenchless technology methods, such as Spray Apply Pipe Lining (SAPL) poses a significant challenge.
- 2- A lack of comprehensive data hinders the complete understanding of SAPL's performance and potential challenges.
- 3- The efficacy of SAPL needs validation through extensive testing in real-world pilot projects.
- 4- Testing under various conditions is essential, including different liner materials, soil types, depths, pipe variations, and temperature conditions.

Group 10 Report: CIPP Emissions

Group Leader: Dennis Pivin

Note Taker: Salar Beigvand

Group Presenter: Dennis Pivin

Attendees:

Dennis Pivin

Salar Beigvand

Parisa Beigvand

Sevda Jannatdoust

Research Needs and Discussions:

1. Research the measurement of worker exposures during CIPP installation through real-time monitoring of hazardous substances and long-term exposure assessment.
2. Conduct a comprehensive analysis of VOCs using sensitive techniques including PID, GC-MS, and water sampling.
3. Explore air sampling methods to track the dissemination of styrene during CIPP processes.
4. Investigate the diverse challenges presented by various CIPP methods, encompassing installation techniques, materials, and their impact on hazardous substance emissions.

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