Social Science considerations in Civil Engineering

CE 4200
Professional Engineering Practice Issues
Fall 2021 Semester

William D. Lawson, PE, PhD

BASIS FOR THIS LECTURE

Social Science Considerations in Civil Engineering

CE 4200: Professional Engineering Practice Issues

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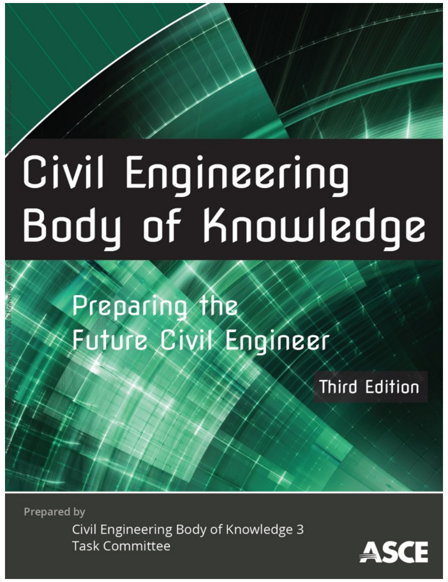
CIVIL ENGINEERING: A PEOPLE-SERVING PROFESSION

BOK3E Outcomes

1. Mathematics
2. Natural Sciences
3. **Social Sciences**
4. Humanities
5. Materials Science
6. Engineering Mechanics
7. Experimental Methods and Data Analysis
8. **Critical Thinking and Problem Solving**
9. **Project Management**
10. Engineering Economics
11. Risk and Uncertainty
12. Breadth in Civil Engr Areas
13. Design
14. Technical Depth
15. Sustainability
16. Communication
17. **Teamwork and Leadership**
18. **Professional Attitudes**
19. Lifelong Learning
20. Ethical Responsibility
21. **Professional Responsibilities**



Social Sciences

CE BOK 3rd Edition

Table ES-1. *Civil Engineering Body of Knowledge* Outcomes.

Foundational	**Engineering Fundamentals**
Mathematics	Materials Science
Natural Sciences	Engineering Mechanics
Social Sciences	Experiment Methods and Data Analysis
Humanities	Critical Thinking and Problem Solving
Technical	**Professional**
Project Management	Communication
Engineering Economics	Teamwork and Leadership
Risk and Uncertainty	Lifelong Learning
Breadth in Civil Engineering Areas	Professional Attitudes
Design	Professional Responsibilities
Depth in a Civil Engineering Area	Ethical Responsibilities
Sustainability	

APPENDIX K:
HUMANITIES AND SOCIAL SCIENCES
(ASCE BOK2E)

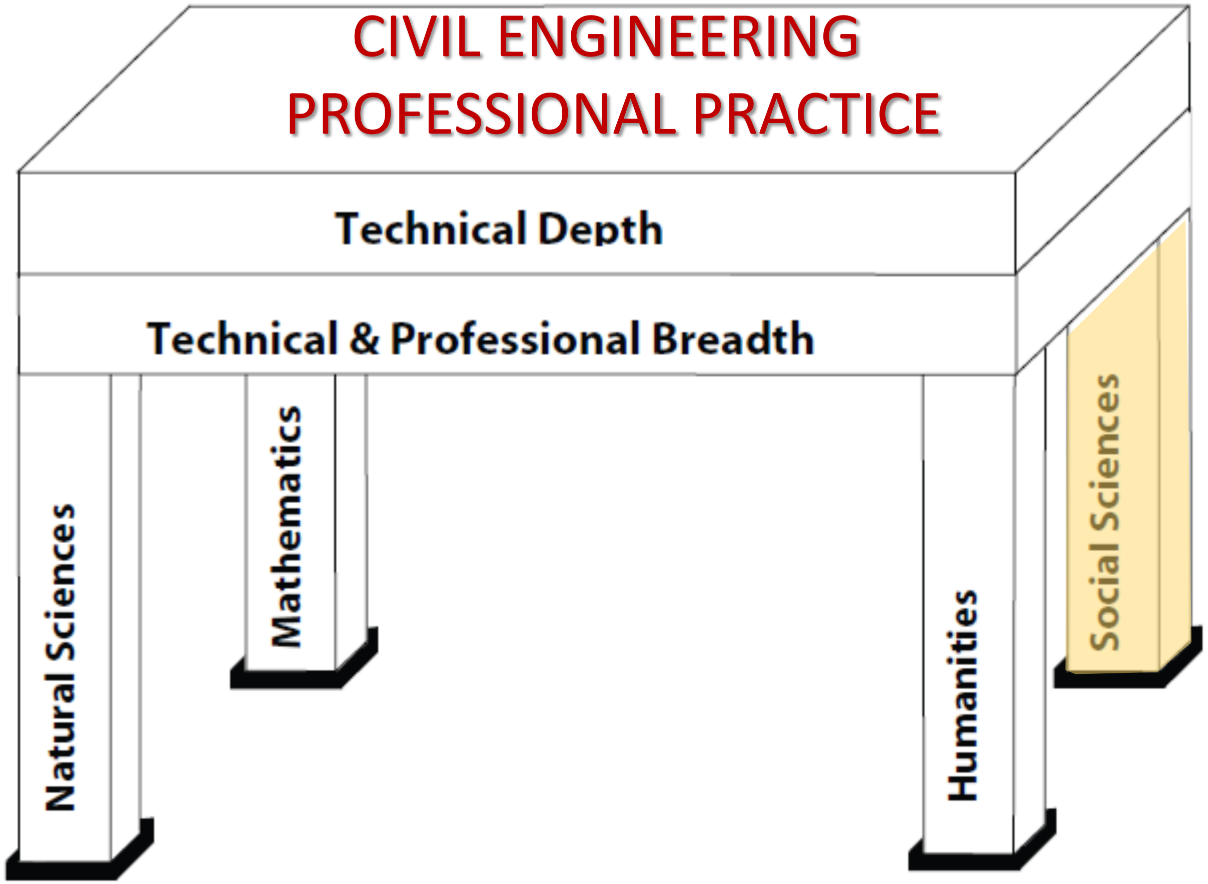


Figure K-1. The future technical and professional practice education of civil engineers is supported on four foundational legs.

Outcome Number and Title	*Level of Achievement*					
	1	*2*	*3*	*4*	*5*	*6*
	Knowledge	*Compre-hension*	*Application*	*Analysis*	*Synthesis*	*Evaluation*
Foundational						
1. Mathematics	B	B	B			
2. Natural sciences	B	B	B			
3. Humanities	B	B	B			
4. Social sciences	B	B	B			
Technical						
5. Materials science	B	B	B			
6. Mechanics	B	B	B	B		
7. Experiments	B	B	B	B	M/30	
8. Problem recognition and solving	B	B	B	M/30		
9. Design	B	B	B	B	B	E
10. Sustainability	B	B	B	E		
11. Contemp. issues & hist. perspectives	B	B	B	E		
12. Risk and uncertainty	B	B	B	E		
13. Project management	B	B	B	E		
14. Breadth in civil engineering areas	B	B	B	B		
15. Technical specialization	B	M/30	M/30	M/30	M/30	E
Professional						
16. Communication	B	B	B	B	E	
17. Public policy	B	B	E			
18. Business and public administration	B	B	E			
19. Globalization	B	B	B	E		
20. Leadership	B	B	B	E		
21. Teamwork	B	B	B	E		
22. Attitudes	B	B	E			
23. Lifelong learning	B	B	B	E	E	
24. Professional and ethical responsibility	B	B	B	B	E	E

Social Sciences

CE BOK 3rd Edition

Social Sciences

Table 2-3. Social Sciences (Cognitive Domain).

Cognitive Domain Level of Achievement	Demonstrated Ability	Typical Pathway
1 Remember (remember previously learned material)	**Identify** concepts and principles of social sciences.	Undergraduate education
2 Comprehend (grasp the meaning of learned material)	**Explain** concepts and principles of social sciences.	Undergraduate education
3 Apply (use learned material in new and concrete situations)	**Apply** concepts and principles of social sciences relevant to civil engineering.	Undergraduate education
4 Analyze (break down learned material into its component parts so that its organizational structure may be understood)	**Select** appropriate concepts and principles of social sciences to solve civil engineering problems.	
5 Synthesize (put learned material together to form a new whole)	**Integrate** appropriate concepts and principles of social sciences to solve civil engineering problems.	
6 Evaluate (judge the value of learned material for a given purpose)	**Evaluate** solutions to civil engineering problems involving concepts and principles of social sciences.	

SOME DEFINITIONS

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Social Sciences

Table 2-3. Social Sciences (Cognitive Domain).

Cognitive Domain Level of Achievement		Demonstrated Ability	Pathway
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4	Analyze (break down learned material into its component parts so that its organizational structure may be understood)	**Select** appropriate concepts and principles of social sciences to solve civil engineering problems.	
5	Synthesize (put learned material together to form a new whole)	**Integrate** appropriate concepts and principles of social sciences to solve civil engineering problems.	
6	Evaluate (judge the value of learned material for a given purpose)	**Evaluate** solutions to civil engineering problems involving concepts and principles of social sciences.	

Understanding the Outcome

The social sciences are the study of society and the manner in which people behave and influence the world around them (ESRC 2018). Social science disciplines include, but are not limited to, thropology, communication studies, economics, geography, law, linguistics, political science, ychology. Social sciences are scientific, analytical, and data-driven and use the both qualitative and quantitative methods. To be effective, civil work. This outcome is intended to guide civil engi- ducation and their education in the social on these connections. For into project

Social Sciences… Definition

- “Engineering services are delivered to society through social mechanisms and institutions. The **social sciences** are the systematic study of these social phenomena… Understanding [this] social framework is foundational to effective professionalism”

~ ASCE BOK2E

Social Sciences… Definition

“**Social science** is an academic discipline concerned with society and the relationships among individuals within a society, which often rely primarily on empirical approaches.”

~ ScienceDaily

Social Sciences… Definition

"**Social science** [is] any discipline or branch of science that deals with human behavior in its social and cultural aspects. The social sciences include cultural (or social) anthropology, sociology, social psychology, political science, and economics."

~ Encyclopedia Britannica

Social Sciences… Definition

“The social sciences study the common elements and collective dimensions of the human experience.”

~ Berkeley College of Letters & Science

A BRIEF QUIZ

Social Science Considerations in Civil Engineering

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QUIZ: Major Engineering Disasters

SCOPE

- **Relatively modern history, not necessarily the biggest failures**
- **Most (but not all) in the United States**
- **Most (but not all) related to Civil Engineering**

QUESTIONS

1. **How many people perished in these disasters?**
2. **Are you familiar… with the lessons learned?**

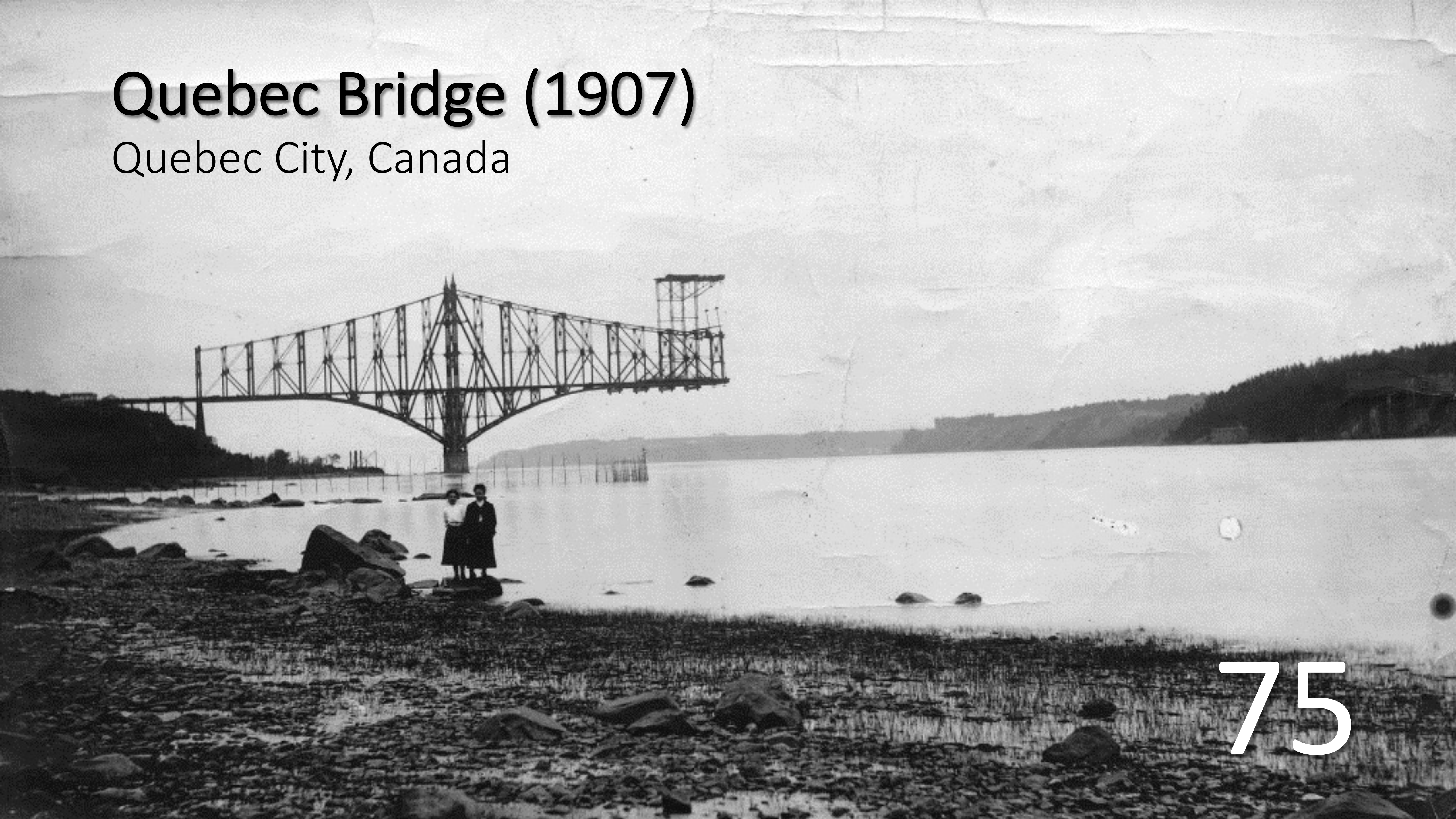
South Fork Dam (1889)

Johnstown, Pennsylvania

2,209

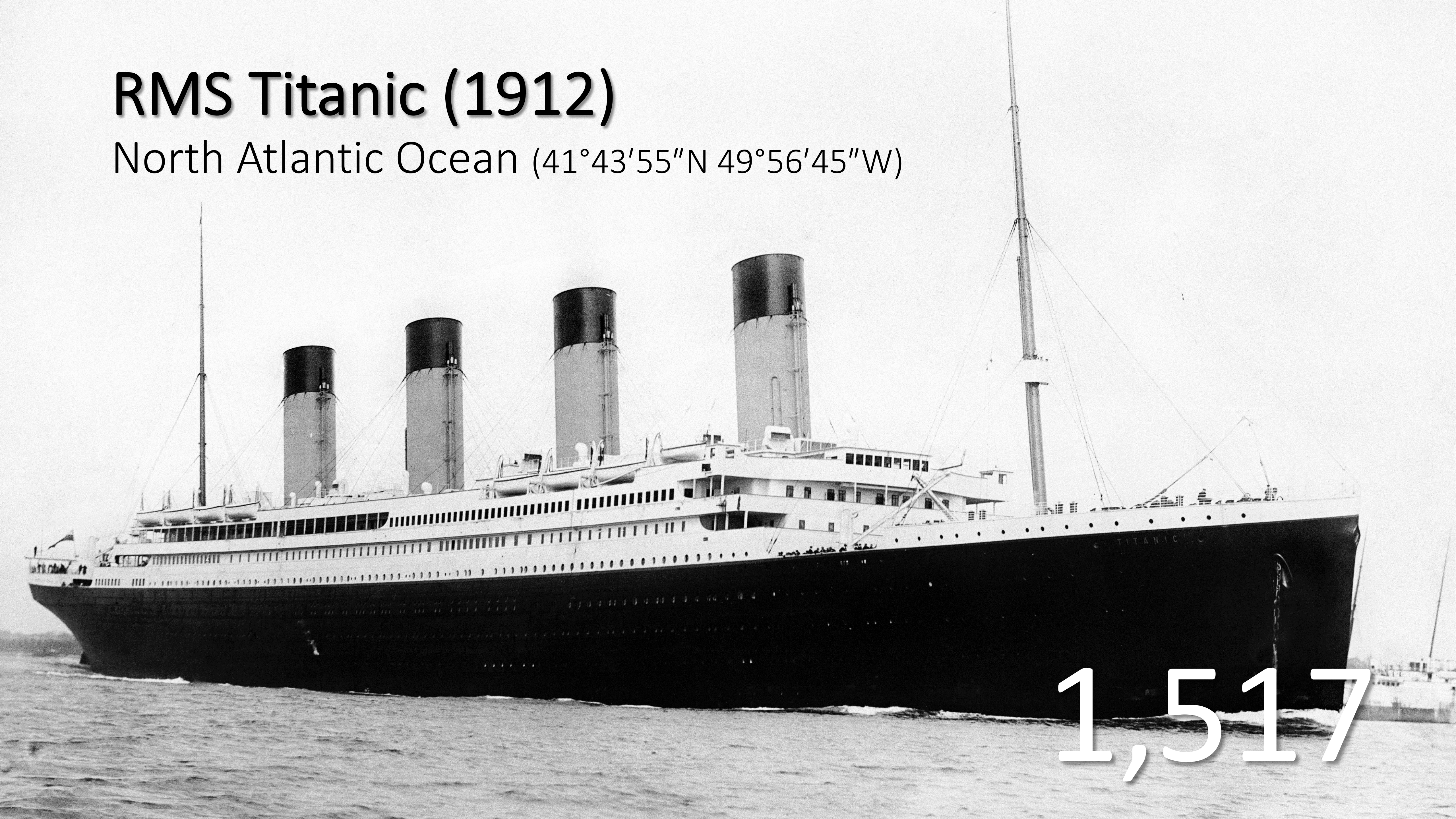
Quebec Bridge (1907)

Quebec City, Canada



RMS Titanic (1912)

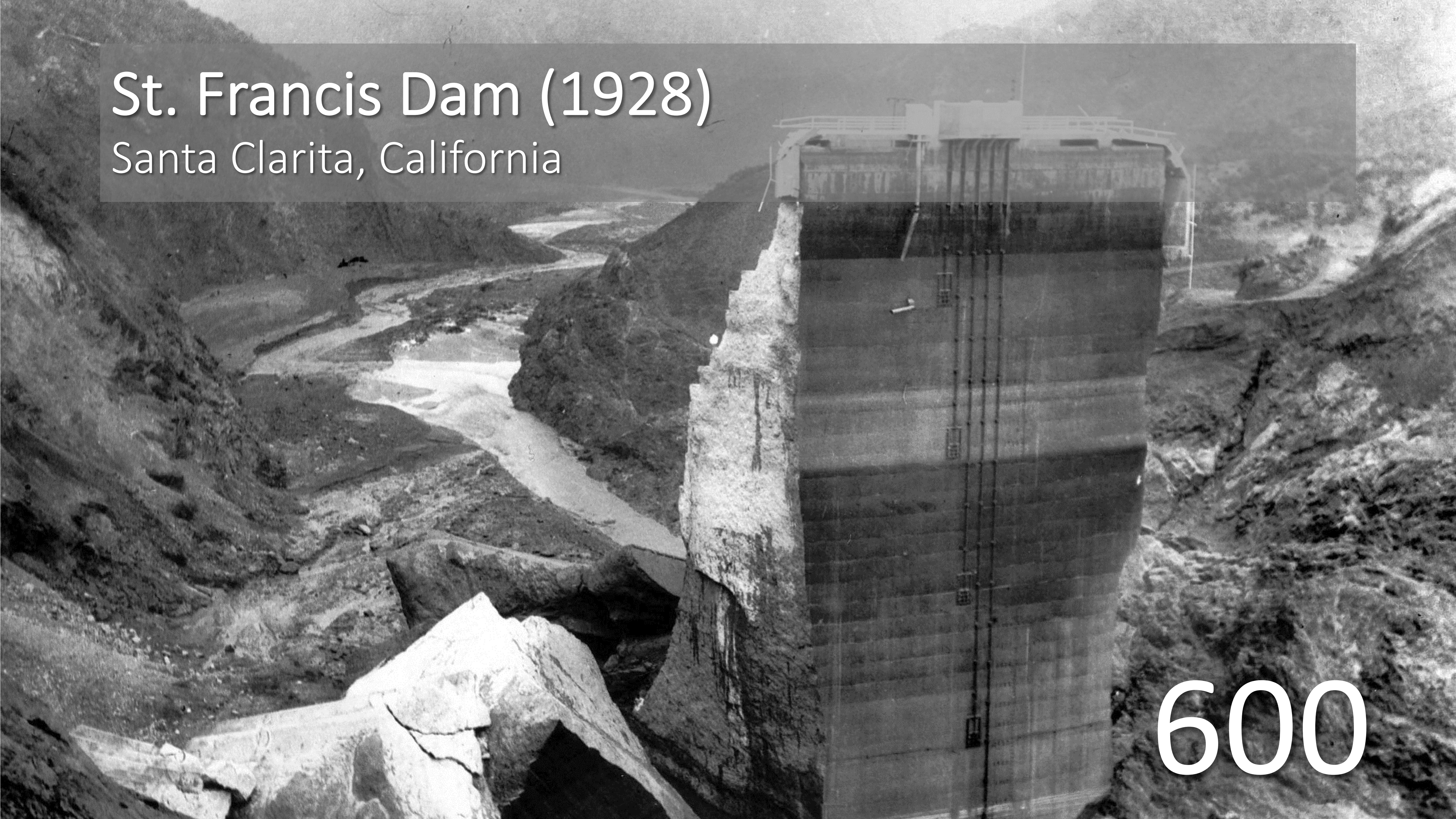
North Atlantic Ocean (41°43′55″N 49°56′45″W)



1,517

St. Francis Dam (1928)

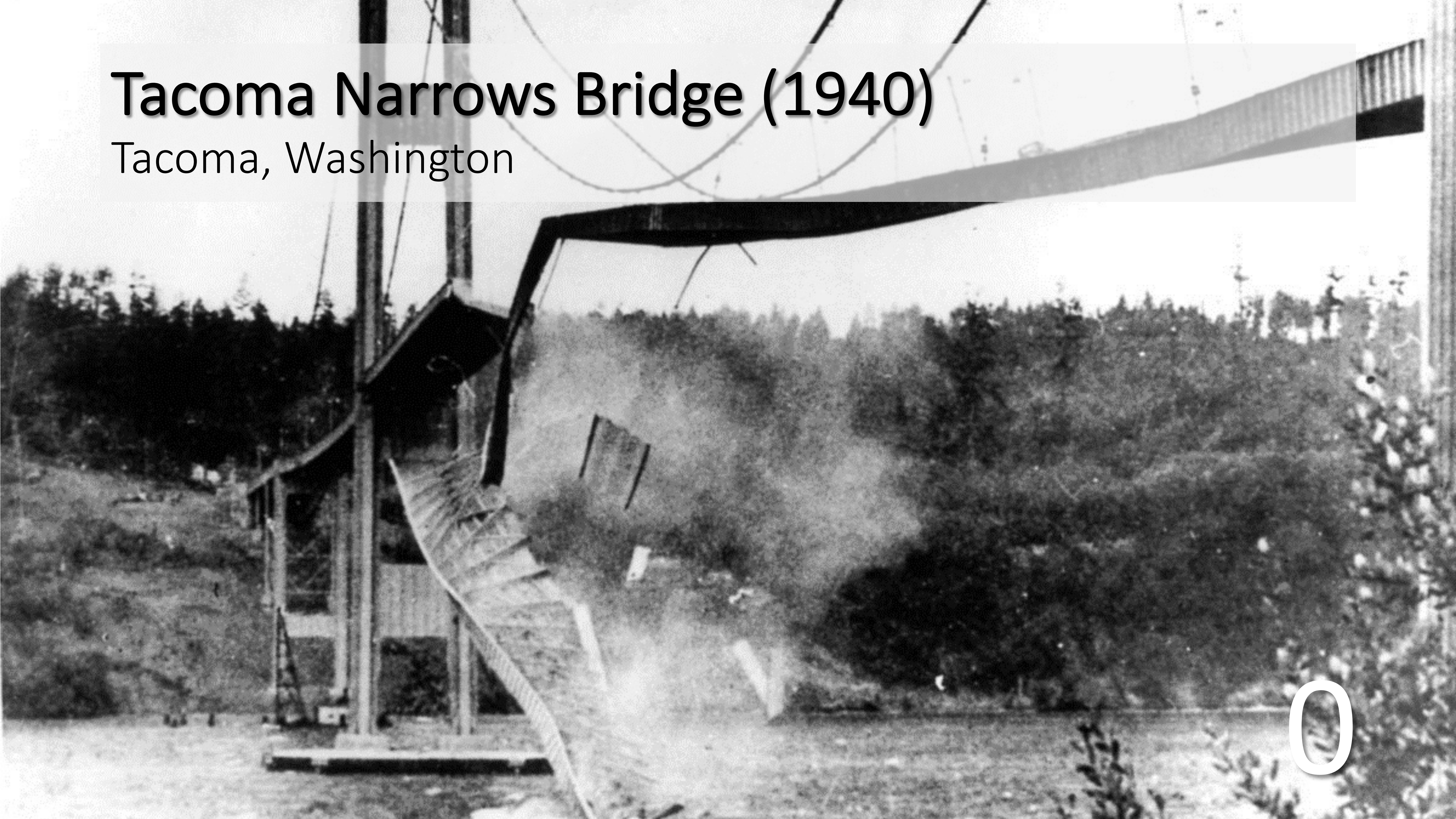
Santa Clarita, California



600

Tacoma Narrows Bridge (1940)

Tacoma, Washington



0

Hyatt Regency Hotel Walkway Collapse (1981)

Kansas City, Missouri


Chernobyl Nuclear Power Plant (1986)
Pripyat, Ukraine, Soviet Union
31

World Trade Center (2001)

New York City, New York

2,743

Space Shuttle Columbia Disaster (2003)

over Northeast Texas and Louisiana

7

I-35W Mississippi River Bridge (2007)

Minneapolis, Minnesota

Deepwater Horizon (2010)

Gulf of Mexico, USA

Tōhoku Earthquake and Tsunami (2011)

Oshika Peninsula, Japan

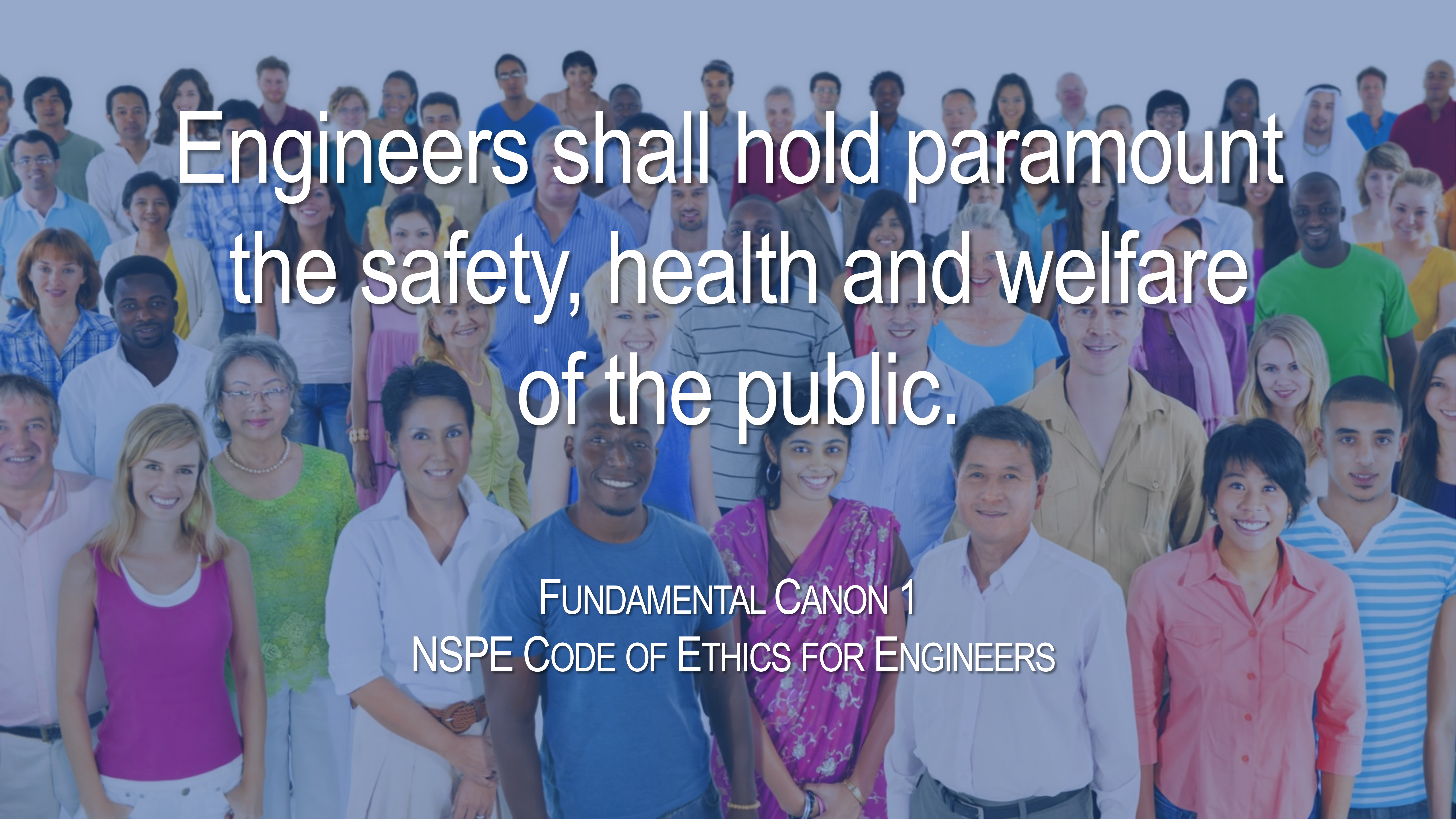
15,896

Florida International Pedestrian Bridge (2019)

Miami, Florida

From the Historical Record…

Engineering Disaster	Deaths		Engineering Disaster	Deaths
South Fork Dam	2,209		Chernobyl Nuclear Plant	31
Quebec Bridge	75		World Trade Center	2,743
RMS Titanic	1,517		Space Shuttle Columbia	7
St. Francis Dam	600		I-35W Mississippi Bridge	13
Tacoma Narrows Bridge	0		Deepwater Horizon	11
Hyatt Regency Walkway	114		Tōhoku Quake & Tsunami	15,896
			Florida Pedestrian Bridge	6



Engineers shall hold paramount the safety, health and welfare of the public.

FUNDAMENTAL CANON 1
NSPE CODE OF ETHICS FOR ENGINEERS

Some Civil Engineering / Social Science Vignettes

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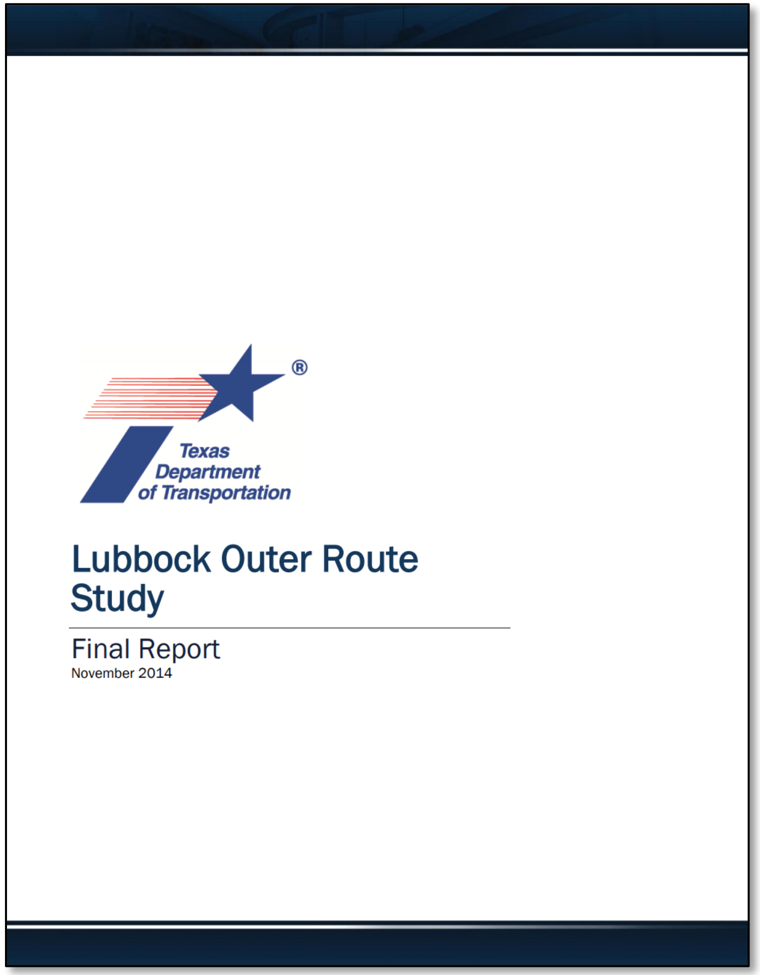
William D. Lawson, PE, PhD


Admiral William H. McRaven
Goalcast
If you wanna change the world,
start off by making your bed.
0:01 / 6:00



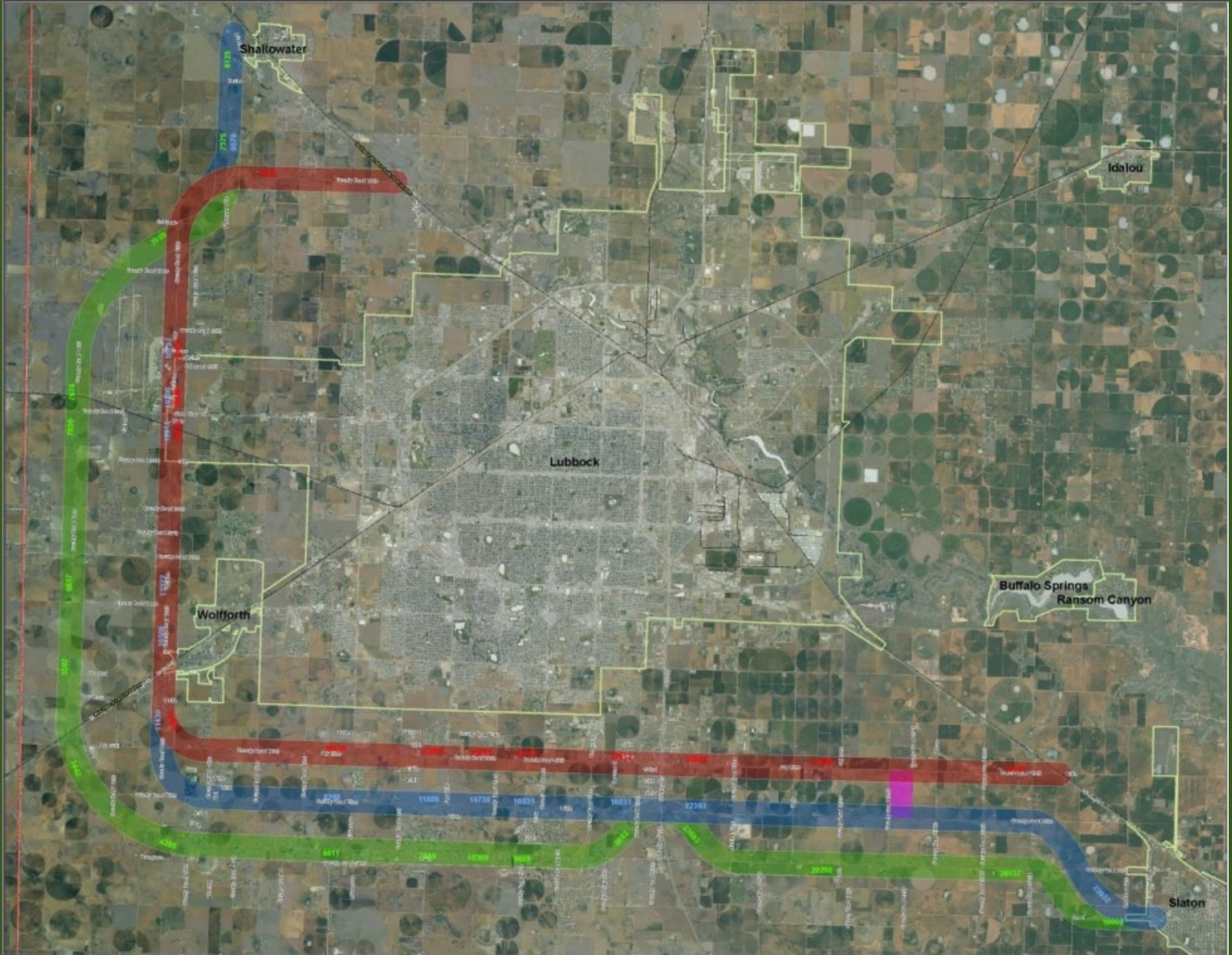
Guest Lecture

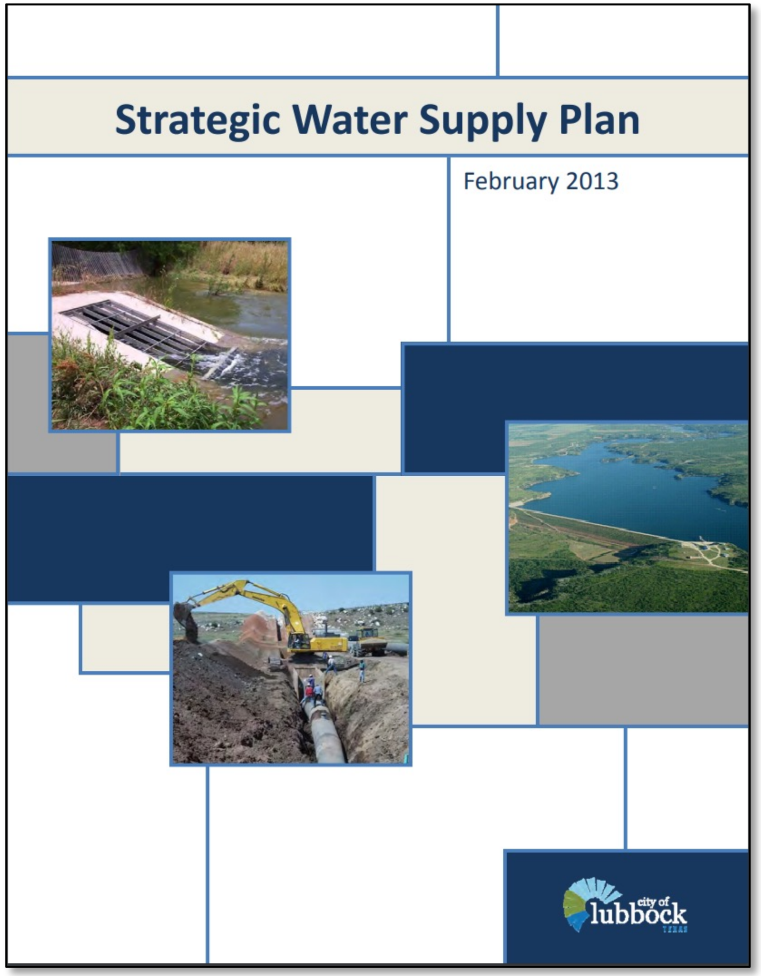
Kylan Francis, PE

Director, Transportation Planning & Development

TxDOT Lubbock

Texas Loop 88
Lubbock, TX





Technical Report

Aubrey A. Spear, PE, et al.

City of Lubbock Water Utilities
Lubbock, Texas

Meeting our increasing demand for water…

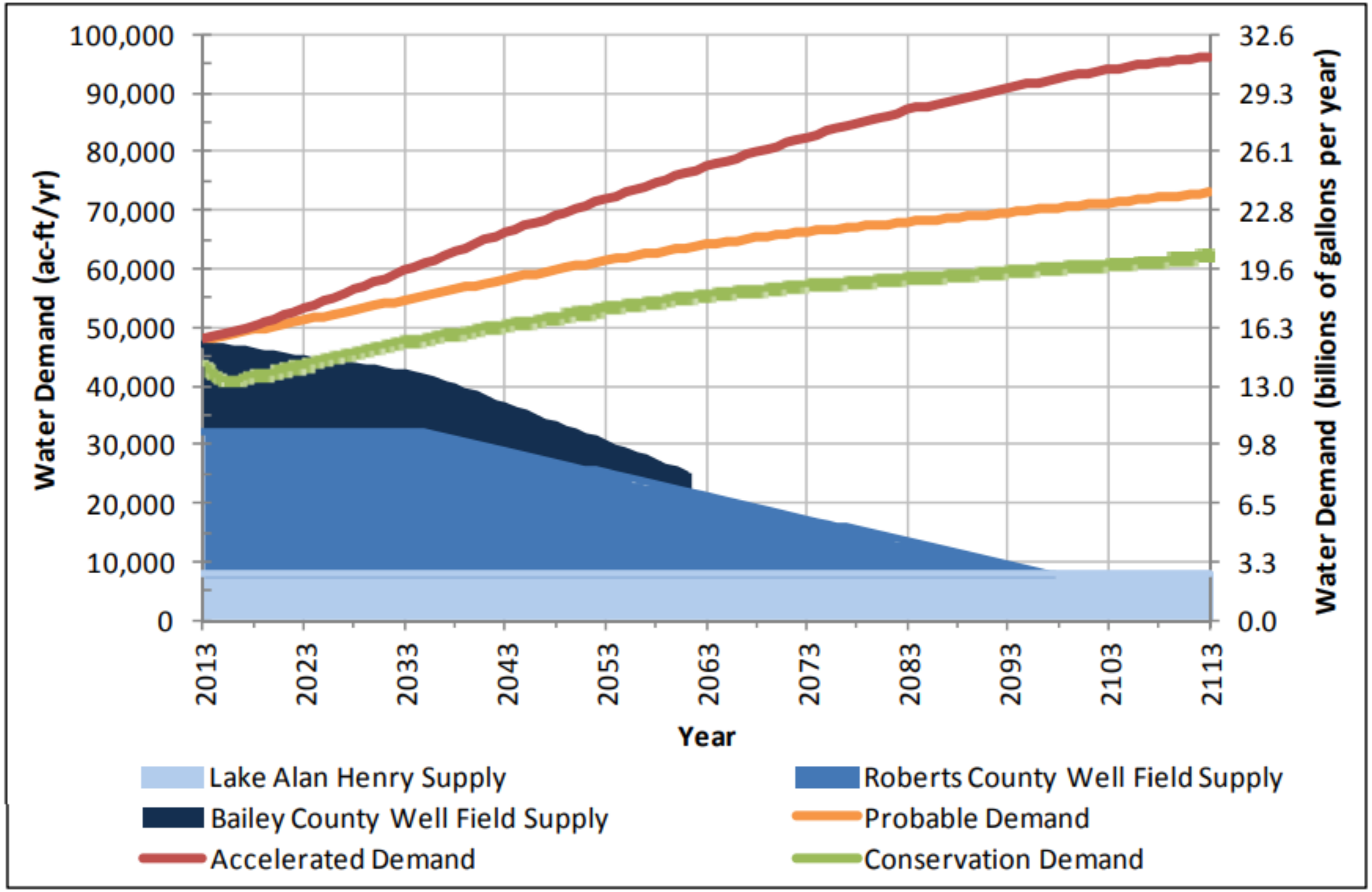
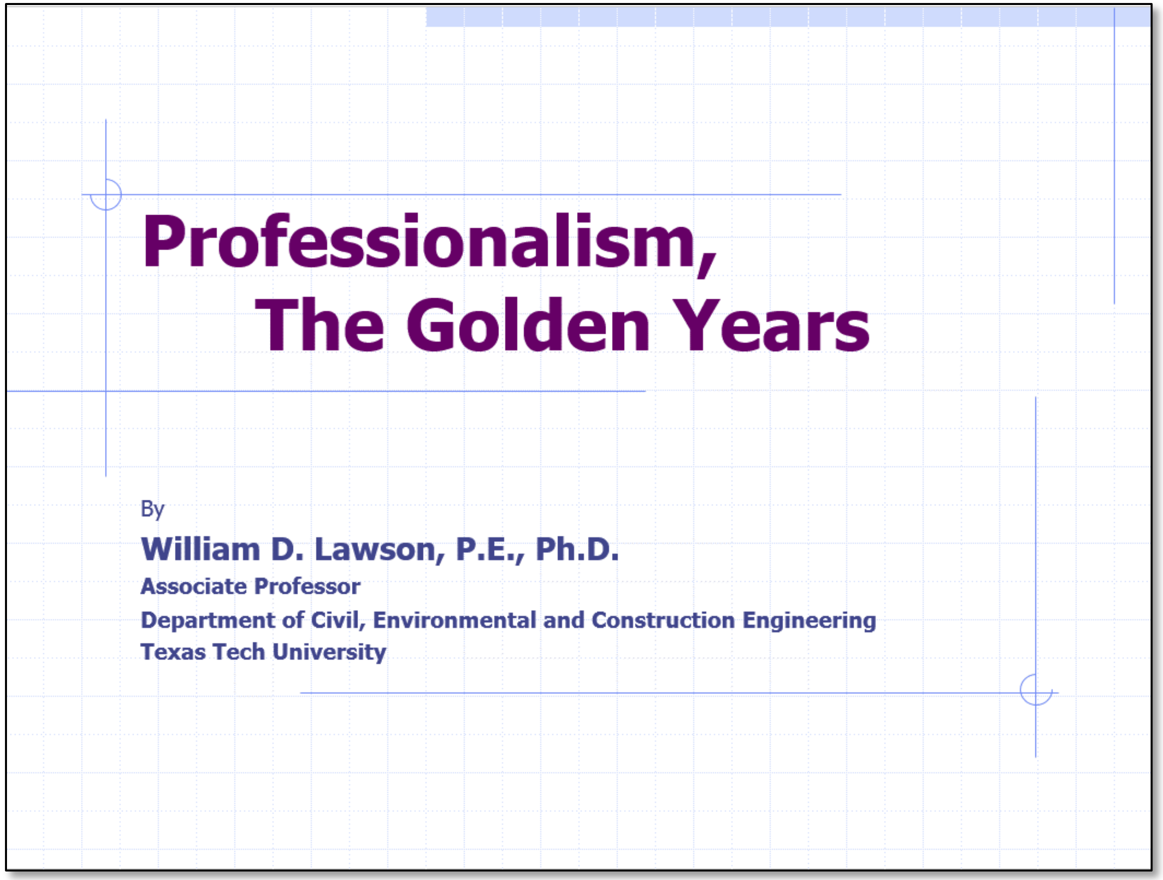


Figure ES.4 – 100-Year Annual Water Demand vs. Current Water Supply

Topic Lecture

William D. Lawson, PE, PhD

Associate Professor
Texas Tech University



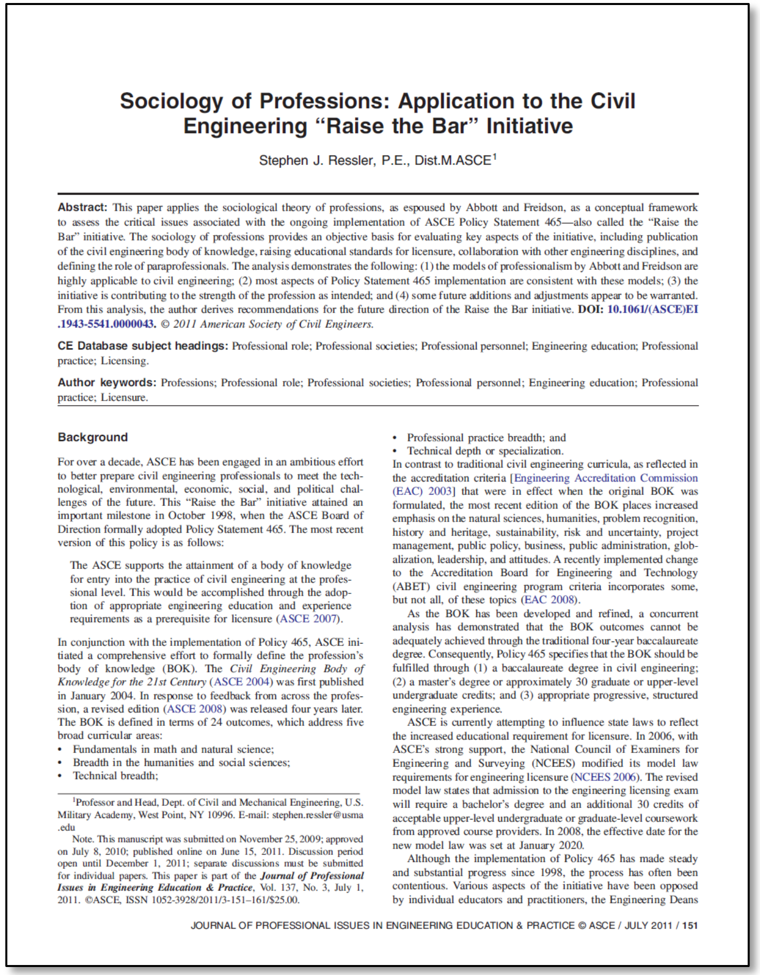
How Big is Your Lens?

Technical Paper

Stephen J. Ressler, PE, PhD

Professor

US Military Academy at West Point



Sociology of Professions: Application to the Civil Engineering "Raise the Bar" Initiative

Stephen J. Ressler, P.E., Dist.M.ASCE[1]

Abstract: This paper applies the sociological theory of professions, as espoused by Abbott and Freidson, as a conceptual framework to assess the critical issues associated with the ongoing implementation of ASCE Policy Statement 465—also called the "Raise the Bar" initiative. The sociology of professions provides an objective basis for evaluating key aspects of the initiative, including publication of the civil engineering body of knowledge, raising educational standards for licensure, collaboration with other engineering disciplines, and defining the role of paraprofessionals. The analysis demonstrates the following: (1) the models of professionalism by Abbott and Freidson are highly applicable to civil engineering; (2) most aspects of Policy Statement 465 implementation are consistent with these models; (3) the initiative is contributing to the strength of the profession as intended; and (4) some future additions and adjustments appear to be warranted. From this analysis, the author derives recommendations for the future direction of the Raise the Bar initiative. **DOI: 10.1061/(ASCE)EI.1943-5541.0000043.** *© 2011 American Society of Civil Engineers.*

CE Database subject headings: Professional role; Professional societies; Professional personnel; Engineering education; Professional practice; Licensing.

Author keywords: Professions; Professional role; Professional societies; Professional personnel; Engineering education; Professional practice; Licensure.

Background

For over a decade, ASCE has been engaged in an ambitious effort to better prepare civil engineering professionals to meet the technological, environmental, economic, social, and political challenges of the future. This "Raise the Bar" initiative attained an important milestone in October 1998, when the ASCE Board of Direction formally adopted Policy Statement 465. The most recent version of this policy is as follows:

> The ASCE supports the attainment of a body of knowledge for entry into the practice of civil engineering at the professional level. This would be accomplished through the adoption of appropriate engineering education and experience requirements as a prerequisite for licensure (ASCE 2007).

In conjunction with the implementation of Policy 465, ASCE initiated a comprehensive effort to formally define the profession's body of knowledge (BOK). The *Civil Engineering Body of Knowledge for the 21st Century* (ASCE 2004) was first published in January 2004. In response to feedback from across the profession, a revised edition (ASCE 2008) was released four years later. The BOK is defined in terms of 24 outcomes, which address five broad curricular areas:

- Fundamentals in math and natural science;
- Breadth in the humanities and social sciences;
- Technical breadth;
- Professional practice breadth; and
- Technical depth or specialization.

In contrast to traditional civil engineering curricula, as reflected in the accreditation criteria [Engineering Accreditation Commission (EAC) 2003] that were in effect when the original BOK was formulated, the most recent edition of the BOK places increased emphasis on the natural sciences, humanities, problem recognition, history and heritage, sustainability, risk and uncertainty, project management, public policy, business, public administration, globalization, leadership, and attitudes. A recently implemented change to the Accreditation Board for Engineering and Technology (ABET) civil engineering program criteria incorporates some, but not all, of these topics (EAC 2008).

As the BOK has been developed and refined, a concurrent analysis has demonstrated that the BOK outcomes cannot be adequately achieved through the traditional four-year baccalaureate degree. Consequently, Policy 465 specifies that the BOK should be fulfilled through (1) a baccalaureate degree in civil engineering; (2) a master's degree or approximately 30 graduate or upper-level undergraduate credits; and (3) appropriate progressive, structured engineering experience.

ASCE is currently attempting to influence state laws to reflect the increased educational requirement for licensure. In 2006, with ASCE's strong support, the National Council of Examiners for Engineering and Surveying (NCEES) modified its model law requirements for engineering licensure (NCEES 2006). The revised model law states that admission to the engineering licensing exam will require a bachelor's degree and an additional 30 credits of acceptable upper-level undergraduate or graduate-level coursework from approved course providers. In 2008, the effective date for the new model law was set at January 2020.

Although the implementation of Policy 465 has made steady and substantial progress since 1998, the process has often been contentious. Various aspects of the initiative have been opposed by individual educators and practitioners, the Engineering Deans

[1]Professor and Head, Dept. of Civil and Mechanical Engineering, U.S. Military Academy, West Point, NY 10996. E-mail: stephen.ressler@usma.edu

Note. This manuscript was submitted on November 25, 2009; approved on July 8, 2010; published online on June 15, 2011. Discussion period open until December 1, 2011; separate discussions must be submitted for individual papers. This paper is part of the ***Journal of Professional Issues in Engineering Education & Practice***, Vol. 137, No. 3, July 1, 2011. ©ASCE, ISSN 1052-3928/2011/3-151–161/$25.00.

ASCE
Policy Statement 465

ASCE AMERICAN SOCIETY® OF CIVIL ENGINEERS

MEMBERSHIP & COMMUNITIES | EDUCATION & CAREERS | CONFERENCES & EVENTS | ISSUES & ADVOCACY

Issues & Advocacy > Public Policy Statements >

KEY PROGRAMS

Infrastructure
- 2017 Report Card
- Failure to Act Reports
- Infrastructure Policy Reports
  - Life Cycle Cost Analysis Report
- State and Regional Report Cards

Raise the Bar
- Raise the Bar Articles and Publications

Sustainability
- Sustainability at ASCE
- Sustainability Resources

POLICY STATEMENT 465 - ACADEMIC PREREQUISITES FOR LICENSURE AND PROFESSIONAL PRACTICE

Approved by the Raise the Bar Committee on January 9, 2017
Approved by the Public Policy Committee on January 27, 2017
Adopted by the Board of Direction on March 17, 2017

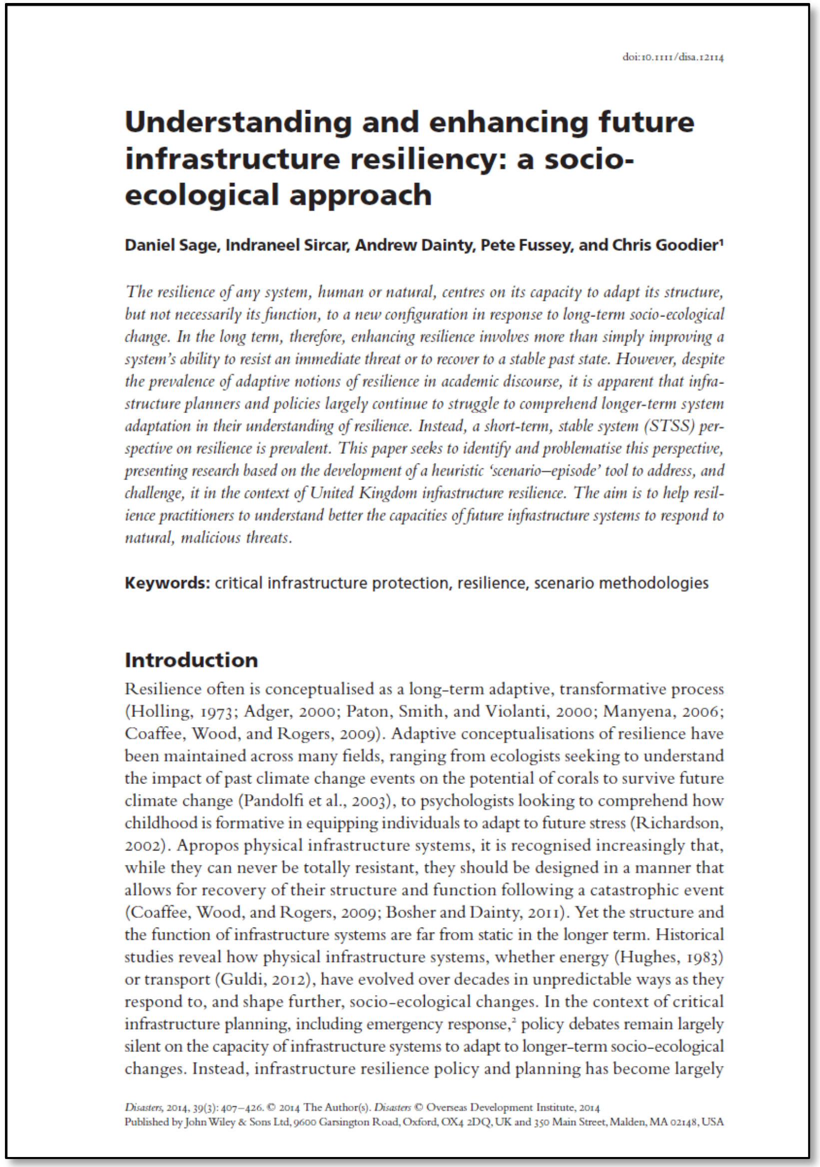
POLICY

The American Society of Civil Engineers (ASCE) supports the attainment of the Civil Engineering Body of Knowledge for entry into the practice of civil engineering at the professional level, i.e., practicing professional engineer, through appropriate engineering education and experience, and validation by passing the licensure examinations. To that end, ASCE supports an increase in the amount of engineering education, such that the requirements for licensure would comprise a combination of:

Technical Paper

Daniel Sage, et al.

Senior Lecturer in Organizational Behavior
Loughborough University, UK



doi:10.1111/disa.12114

Understanding and enhancing future infrastructure resiliency: a socio-ecological approach

Daniel Sage, Indraneel Sircar, Andrew Dainty, Pete Fussey, and Chris Goodier[1]

The resilience of any system, human or natural, centres on its capacity to adapt its structure, but not necessarily its function, to a new configuration in response to long-term socio-ecological change. In the long term, therefore, enhancing resilience involves more than simply improving a system's ability to resist an immediate threat or to recover to a stable past state. However, despite the prevalence of adaptive notions of resilience in academic discourse, it is apparent that infrastructure planners and policies largely continue to struggle to comprehend longer-term system adaptation in their understanding of resilience. Instead, a short-term, stable system (STSS) perspective on resilience is prevalent. This paper seeks to identify and problematise this perspective, presenting research based on the development of a heuristic 'scenario–episode' tool to address, and challenge, it in the context of United Kingdom infrastructure resilience. The aim is to help resilience practitioners to understand better the capacities of future infrastructure systems to respond to natural, malicious threats.

Keywords: critical infrastructure protection, resilience, scenario methodologies

Introduction

Resilience often is conceptualised as a long-term adaptive, transformative process (Holling, 1973; Adger, 2000; Paton, Smith, and Violanti, 2000; Manyena, 2006; Coaffee, Wood, and Rogers, 2009). Adaptive conceptualisations of resilience have been maintained across many fields, ranging from ecologists seeking to understand the impact of past climate change events on the potential of corals to survive future climate change (Pandolfi et al., 2003), to psychologists looking to comprehend how childhood is formative in equipping individuals to adapt to future stress (Richardson, 2002). Apropos physical infrastructure systems, it is recognised increasingly that, while they can never be totally resistant, they should be designed in a manner that allows for recovery of their structure and function following a catastrophic event (Coaffee, Wood, and Rogers, 2009; Bosher and Dainty, 2011). Yet the structure and the function of infrastructure systems are far from static in the longer term. Historical studies reveal how physical infrastructure systems, whether energy (Hughes, 1983) or transport (Guldi, 2012), have evolved over decades in unpredictable ways as they respond to, and shape further, socio-ecological changes. In the context of critical infrastructure planning, including emergency response,[2] policy debates remain largely silent on the capacity of infrastructure systems to adapt to longer-term socio-ecological changes. Instead, infrastructure resilience policy and planning has become largely

Disasters, 2014, 39(3): 407–426. © 2014 The Author(s). *Disasters* © Overseas Development Institute, 2014
Published by John Wiley & Sons Ltd, 9600 Garsington Road, Oxford, OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA

Enhancing Resilience…

CRITICAL
INFRASTRUCTURE
RESILIENCE
2018

Technical Paper

Nils Sørensen, et al.

Danish Building Research Institute
Aalborg University, Denmark


Available online at www.sciencedirect.com
ScienceDirect
Procedia Economics and Finance 21 (2015) 239 – 246
Procedia
Economics and Finance
www.elsevier.com/locate/procedia

8th Nordic Conference on Construction Economics and Organization

Architectural competitions and BIM

Nils Lykke Sørensen[a], Anne Kathrine Frandsen[a], Turid Borgestrand Øien[a,*]

[a] *Danish Building Research Institute, Aalborg University, 2450, Copenhagen, Denmark*

Abstract

New technological and societal developments have entailed changes within the building sector; including building trades becoming academically based, and the introduction of new building materials, new concepts and ICT-based designs and communication, traditional methods and organizations are being put under pressure. Thus, the two central actors involved in architectural competitions, architects and building clients, are continually influenced by such developments, interpreting and adapting to changes according to their interests and horizons. During a project reviewing Nordic research literature on architectural competitions, a series of interviews was conducted with building clients as well as architects, focusing on the impact of the above-mentioned changes within the building sector on architectural competitions as an institution. In the interviews, ICT and not least BIM was a recurring theme that both parties saw as having a positive impact on competitions. But when looking closely into the answers, these revealed diverse understandings of how and why the impact of BIM on competitions could be said to be positive. The paper sheds light on the interaction between the actors (building clients, architects and client consultants) and the applied technologies (competition forms, ICT tools, directives) in architectural competitions in a theoretical actor-network perspective. The diverging understandings of the role of BIM are demonstrating one of many negotiations in progress in the network of architectural competitions. BIM is transformed from an inscription device visually representing the competition proposals to form an actant that challenges the very concept of architectural competition.

The objective of the paper is to contribute to the understanding of BIM used in the kind of network that an architectural competition constitutes, and thereby give professional actors a possibility to act on the basis of a wider understanding of interrelations mediated by BIM.

Selection and/ peer-review under responsibility of Tampere University of Technology, Department of Civil Engineering

Keywords: Architectural competitions; architects; actor-network theory; BIM; building clients.

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E-mail address: tbo@sbi.aau.dk

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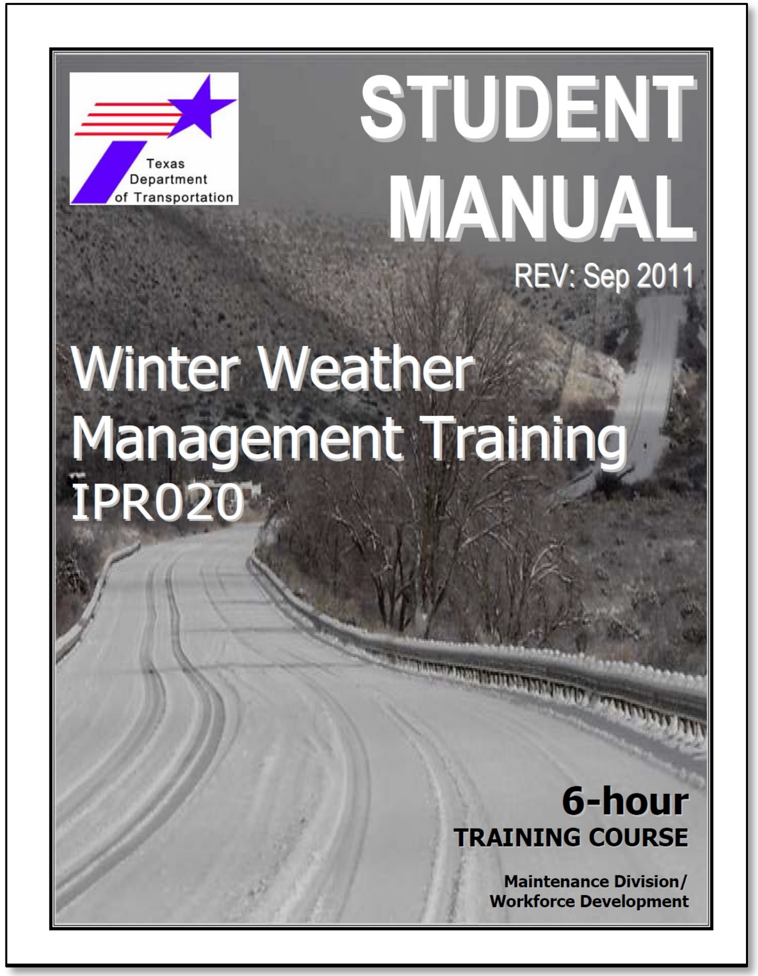
Selection and/ peer-review under responsibility of Tampere University of Technology, Department of Civil Engineering
doi:10.1016/S2212-5671(15)00173-2


BIM is 10% technology
and 90% sociology…



Transportation Training

William D. Lawson, et al.

Multidisciplinary Research in Transportation
Texas Tech University

Who Establishes Level of Service (LOS)?

RELATIONSHIP BETWEEN LOS AND RESOURCES

FINANCIAL

- Funding is established through legislative appropriation

TECHNICAL

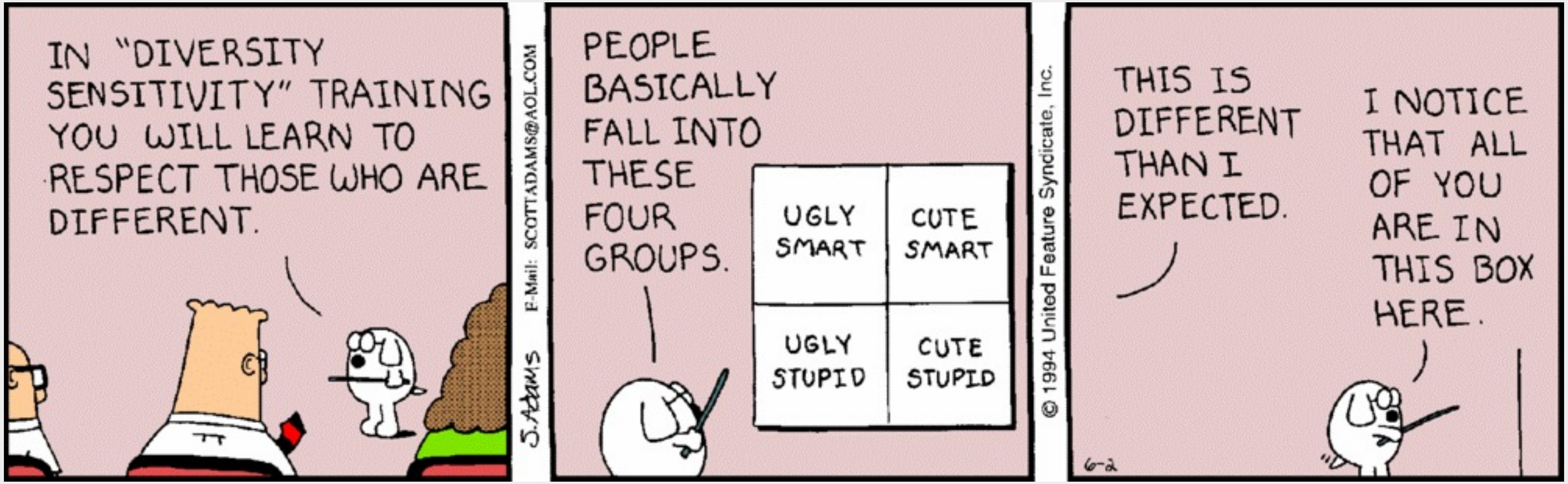
- Capabilities are established through technical knowledge

POLITICAL

- Expectations exist for the traveling public

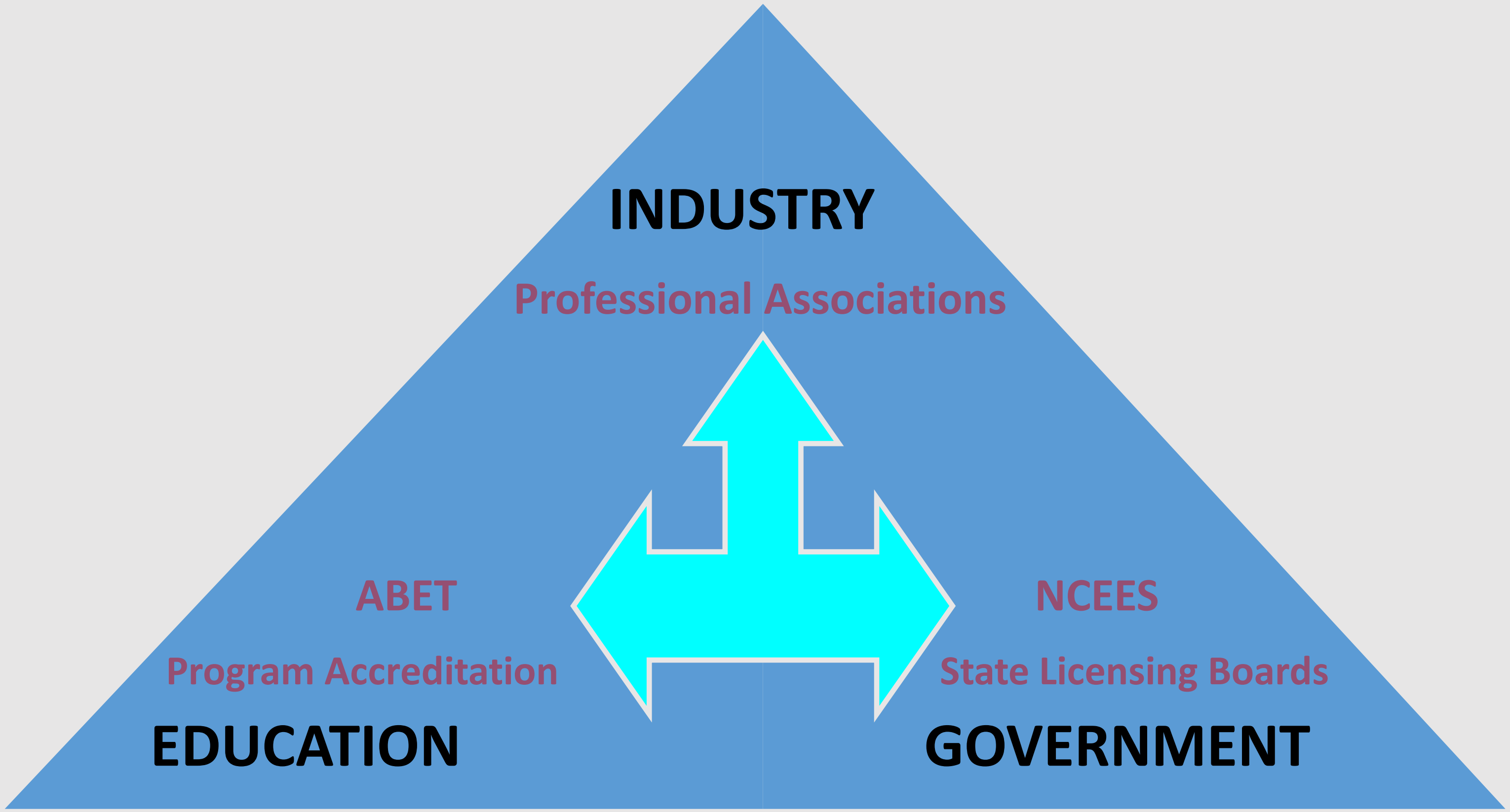
And we have discussed many more…

DIVERSITY & INCLUSION…



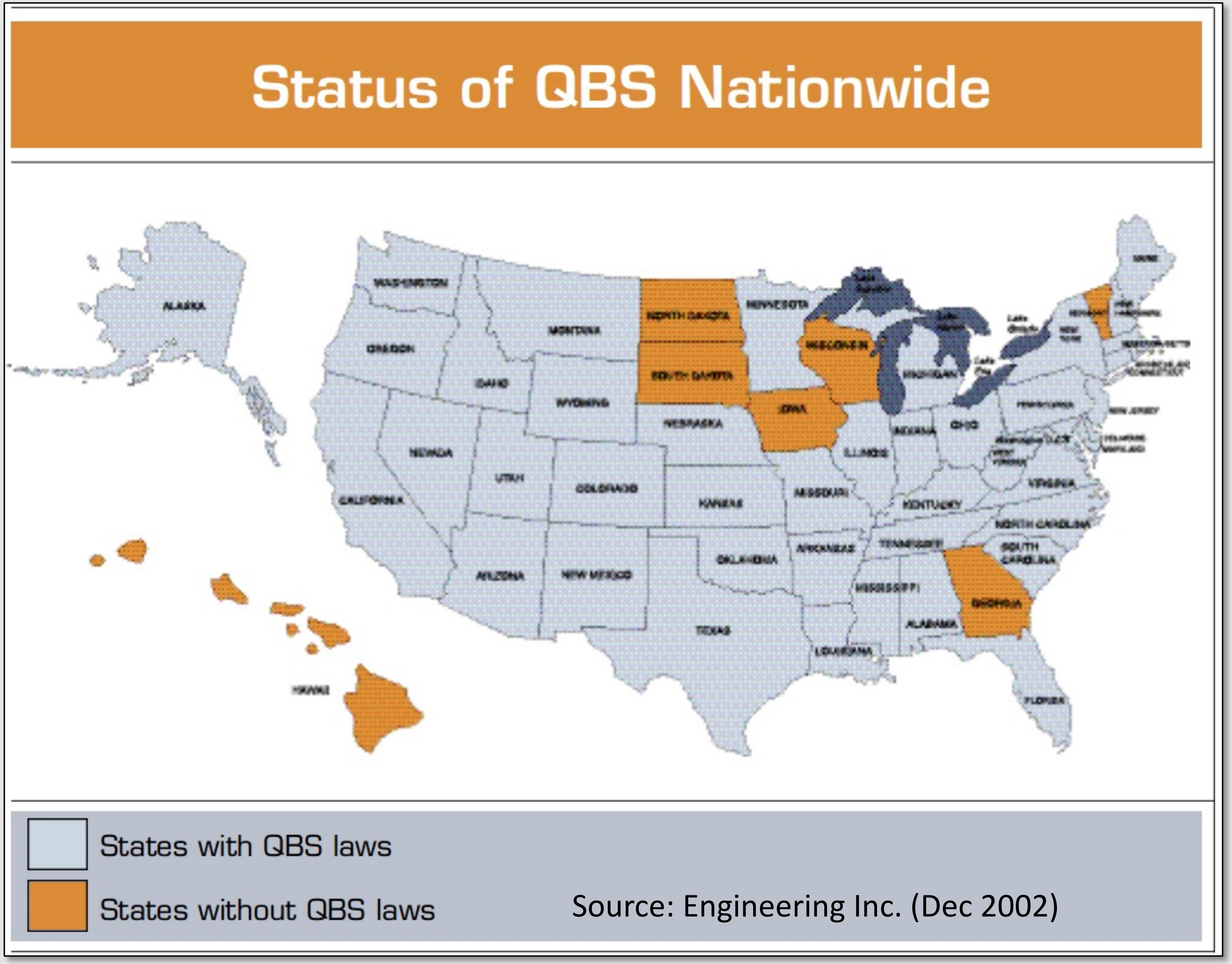
LICENSING:

the product of collaboration between Industry, Government & Education



ABET - Accreditation Board for Engineering and Technology
NCEES - National Council of Examiners for Engineering and Surveying

QUALIFICATIONS BASED SELECTION…



COMMODITIZATION OF ENGINEERING WORK…

Breaking the Mold

Commoditization: How to overcome a major threat to a firm's success

By Samuel Greengard

In this era of rapid change, from globalization to emerging technologies, delivering value to customers and clients is more complicated than ever. A/E firms find themselves facing an increasingly competitive and cutthroat marketplace—with clients who don't always recognize or want to recognize differing values in products and services. The result is that as pricing pressures increase, so does the risk of engineering services becoming commoditized. >>

Source: ENGINEERING, INC. March/April 2015

LEADERSHIP…

"An engineer is hired for his or her technical skills, fired for poor people skills, and promoted for leadership and management skills."

-Jeffery S. Russell

"Trustworthiness is the first virtue of professional life."

Social Science… the scientific study of human society and social relationships