

CEE 6651: Infrastructure Systems:

Infrastructure Asset Management: Resilient and Sustainable Infrastructure Systems

Fall 2020

3 Credit Hours

Location: Blue Jeans | Modality: Remote | F: 2:00 – 4:45 PM | School of Civil & Environ. Engr. | Georgia Institute of Technology

Main Instructor:

Dr. Adjo Amekudzi-Kennedy

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Office Hours: R: 2-4P and by appt.

Guest Instructors:

Rebecca Shelton, P.E., Assistant Director, Dept. of Water Resources, Gwinnett County Gov't. Chair, ASCE Georgia's 2019 Infrastructure Report Card

Robert Simon, Ph.D. Leadership Development Professional, School of Civil & Environmental Engineering, Georgia Tech

Peter Marshall, Rear Admiral, CEC, USN, Naval Facilities Engineering Command (Ret), NAC, NAPA

Alma Mujkanovic, Head, Office of Performance Based Mgmt. & Research, Georgia Dept. of Transportation

Susan Rutherford, Stormwater Program Director, City of Atlanta, Dept. of Watershed Management, Office of Watershed Protection

Perna Singh, Ph.D. Candidate, Transportation Systems Program, Georgia Tech

Brian Woodall, Ph.D., Professor, School of International Affairs, Georgia Tech. Director, Japan Study Abroad Program in Sustainable Development.

Russell Clark, Ph.D., Co-Director, Research Network Operations Center, School of Computer Science, Georgia Tech

Jamie Fischer, Ph.D., Director of Transportation Performance & Innovation, State Road & Tollway Authority, Georgia Regional Transportation Authority, Atlanta-Region Transit Link Authority



2009 Catastrophic Floods of Atlanta (Courtesy: Atlanta Journal Constitution)

Course Overview

"The climate is rapidly changing, bringing more frequent and extreme floods, droughts, and heat waves, along with stronger hurricanes and more intense wildfires. Each year brings record-breaking weather extremes; in the first six months of 2019, for example, a record number of US counties were flooded. July 2019 was the hottest month ever recorded for the world as a whole. Climate change is also melting glaciers, reducing the amount of sea ice, and raising sea levels, bringing devastation to coastal areas." (Arroyo, 2019 – Critical Issues in Transportation 2019 – Climate Change Resilience, TR News, Nov-Dec 2019, No. 324)

For many years, infrastructure agencies have applied risk-based Infrastructure Asset Management (IAM) principles, approaches, tools and technologies to manage large-scale public infrastructure in order to deliver superior condition, services and value to the public. What formal processes do agencies use in managing infrastructure as assets, and how should they adapt their processes to remain effective in the context of growing climate hazards and uncertainty? This course examines the Infrastructure Asset Management (IAM) body of knowledge, with a focus on climate change and system resilience - a major 21st Century grand challenge. We will examine transportation, building and stormwater infrastructure management, reviewing: institutions (i.e., laws, policies and regulations), funding and financing mechanisms, valuation approaches, data, performance models, project prioritization procedures, emerging technologies and major sources of vulnerability to the changing climate. We will assess the climate readiness of various infrastructure agencies and their IAM approaches/systems, and explore adaptations to enhance agency climate readiness and infrastructure system resilience. Through course instruction, in-class discussions, directed readings and analysis of hazards and infrastructure data, we will learn about what is required to adapt existing agencies, their IAMs, and infrastructure systems to become more climate resilient.

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Learning Objectives:

Upon completing the course, you will be able to:

1. Explain key challenges and opportunities for infrastructure provision and renewal posed by the changing climate and other threats
2. Discuss the relevant institutions (i.e., laws, policies and regulations) for IAM and evaluate their readiness for climate change
3. Discuss the basic data elements and model architecture of an Infrastructure Asset Management System and make recommendations for upgrades to address climate resiliency
4. Conduct a critical review of an Infrastructure Asset Management Plan and create a next-generation plan to address climate resiliency
5. Analyze climate risk exposure, infrastructure and demographic data to identify areas of high risk exposure and high vulnerability
6. Identify and prioritize adaptations to strengthen system resilience
7. Discuss the nuances of various long-term urban resilience risks and make stakeholder-appropriate recommendations to address them, and,
8. Apply the basics of team effectiveness and team health in executing team-based projects.

Web Page

The course webpages are located on Canvas. Handouts, lecture notes and other resources will be posted on Canvas.



Grading

You will earn the course grade by completing four homework assignments (20%), a midterm (30%), and a term project with a report and oral presentation (40%); and, by attending and actively participating in the course (10%). View this course as a learning community where each individual is responsible for their own learning as well as the learning of the whole group through viable and valuable contributions to the course. There is no final exam in this course.

Reading Materials

Reading materials are a compilation of selected publications on Canvas on infrastructure asset management for transportation, buildings and stormwater infrastructure, climate change, system resilience, strategic planning and performance management. The following texts contain several assigned readings in the course.

- Coffelt, D., and C. Hendrickson. Fundamentals of Infrastructure Management. 3rd Edition, 2019, <https://doi.org/10.1184/R1/5334379.v2>.
- Uddin, W.; Hudson, W. R., and R. Haas. Public Infrastructure Asset Management. 2nd Ed., 2013, McGraw Hill.
- IIMM International Infrastructure Management Manual. Fifth Edition, 2015.
- Moss, R. B. Move. Putting America's Infrastructure Back in the Lead. 2015, W. W. Norton and Company.
- The National Academies. Disaster Resilience – A National Imperative. The National Academies Press, 2012.
- AASHTO Transportation Asset Management Portal. www.tam-portal.com/



Academic Integrity/Special Accommodations

Academic Integrity: The standard of conduct for this course is the Georgia Tech Honor Code, which aims to cultivate a community based on trust, academic integrity and honor. Be sure to review the Honor Code at <http://osi.gatech.edu/content/honor-code>. Discussion is encouraged on homework assignments and team projects. However, you are responsible for completing assignments independently on individual assignments. Plagiarism is unacceptable. Take a few moments to review the following website produced by Indiana University on how to recognize plagiarism: <https://plagiarism.iu.edu/overview/index.html>. While not expected in this course, breaches of academic honesty will be dealt with in accordance with University policy.

Special Accommodations: Georgia Tech complies with the regulations of the Americans with Disabilities Act (ADA) of 1990 and offers accommodations to students with disabilities. If you need any kind of special accommodation, please visit the Office of Disability Services (<http://disabilityservices.gatech.edu/>) to find out about necessary procedures, and notify the instructor of any needed accommodations during the first week of class, or as soon as a new need arises.

Topical Outline

W e e k	Date	Lesson Activities/Topics	Assignments
MODULE 1: Infrastructure as a Sociotechnical System			
1	08/21	Overview Remarks: Course and Project Overview	Readings 1&2 Assigned
		Lecture: What is Infrastructure Asset Management? How is it executed at the Federal, State and Local Levels?	HW 1 Assigned
		Case Study: Development of the ASCE GA Infrastructure Report Card , Rebecca Shelton, P.E., Assistant Director, Gwinnett Dept. of Water Resources, Chair, 2019 ASCE GA Infrastructure Report Card	
2	08/28	Video Lecture: Climate Change: Engineering's Grand Challenge/Georgia Tech's Role , Dr. G. Wayne Clough	Reading 3 Assigned
		Discussion: What is System Resilience and why is it important?	Term Project #1 Assigned: Project Description
		Power Skills Development: Developing Effective Teams , Dr. Robert Simon, Leadership Development Professional	

3	09/04	Lecture: What is System Sustainability and Why is it Important?	Reading 4 Assigned
		Case Study: Federal Facilities Management , Peter Marshall, Rear Admiral, CEC, USN (Ret)	HW 1 Due HW 2 Assigned
MODULE 2: Infrastructure Management Tools			
4	09/11	Lecture: What Data, Analytic approaches, and Tools are used to manage infrastructure? (I) Inventory and attribute data, Asset Valuation approaches	Reading 5 Assigned
		Power Skills Development: Managing Team Health , Dr. Robert Simon, Leadership Development Professional	Term Project #1 Due Term Project #2 Assigned: Gap/Opportunity Analysis
5	09/18	Lecture: What Data, Analytic approaches, and Tools are used to manage infrastructure? (II) Performance Models, Project Priority Programming approaches	Reading 6 Assigned
		Case Study: Transportation Asset Management at Georgia Department of Transportation , Alma Mujkanovic, Head of Office of Performance-Based Management and Research	HW 2 Due HW 3 Assigned
6	09/25	Lecture: Vulnerability and Risk Analysis (Climate Hazards) (Resilience Planning & Management I)	Reading 7 Assigned
		Case Study: Stormwater Infrastructure Management in the City of Atlanta , Susan Rutherford, Stormwater Program Director	Term Project #2: Due Term Project #3 Draft Asset Management Plan
7	10/02	MIDTERM (Take-Home)	Reading 8 Assigned
8	10/09	Guest Lecture: Adapting Infrastructure to the Changing Climate, (Resilience Planning and Management II) , Perna Singh, M.S., Ph.D. Candidate	Reading 9 Assigned
		Team-Led Discussion	HW 3 Due HW 4 Assigned

MODULE 3: Integration			
9	10/16	<p>Guest Lecture: Institutional Resilience & Flood Risk Management (Resilience Planning and Management III), Dr. Brian Woodall, Professor, School of International Affairs</p> <p>Virtual Field Trip Assigned: Kendeda Building for Innovative Sustainable Design (GT), Jimmy Mitchell, LEED, BD+C, Skanska USA</p>	<p>Reading 10 Assigned</p> <p>Term Project #3: Due Term Project #4 Assigned: <i>Final Asset Management Plan plus Visuals</i></p>
10	10/23	<p>Project Day: Lightening Round Project Descriptions</p> <p>Case Study: Smart Sea Level Sensors in Savannah/Chatham: Leveraging Technology to Improve Resiliency on the Georgia Coast, Dr. Russell Clark, Co-Director, Research Network Operations Center, School of Computer Science</p>	Reading 11 Assigned
11	10/30	<p>Panel: Intergovernmental Partnerships in Transportation Planning and Program Delivery in the Atlanta Metro Area, Led by Dr. Jamie Fischer, Director of Transportation Performance and Innovation, GRTA, SRTA, and The ATL</p> <p><i>Discussion: How is intergovernmental decision making used to deliver transportation system performance in the Atlanta Region? How do transportation officials and political decision makers use TAM information in making decisions? How is system resilience being developed in the Atlanta Region?</i></p>	Reading 12 Assigned
MODULE 4: Project Presentations/Course Reflection			
12	11/06	<p>Emerging Technologies and Innovation</p> <p><i>Individual Presentations Gallery Walk</i></p>	HW 4 Due
13	11/13	<p>Term Project Presentations</p> <p><i>Team Presentations Gallery Walk</i></p>	Term Project #4 Due
14	11/20	Course Reflections and Debrief	
15	11/27	No Class Meeting Thanksgiving Holiday	
16	12/04	No Class Meeting No Final Exam	

Additional Considerations

The fall 2020 semester is unusual because of the COVID-19 pandemic and a growing awareness of racial inequities. Let's aim to work together as a learning community to accomplish the course goals. This will entail being adaptable as different situations may arise and require us to adapt. I trust you will do your best to be engaged and adaptable. My goal is to provide a wonderful online learning environment for you. This will happen with your help. Give me feedback on what works better as we move forward and let's aim to have a high quality learning environment that's engaging, supportive, collaborative and fun.

Course Modality: The course will occur through live synchronous broadcast with specific assignments to be completed asynchronously. The course design weaves theory with practice using lectures and videos for concepts and theory with case studies bringing in practice to supplement the conceptual/theoretical material.

Digital Etiquette: The format of the class will be a series of activities with short breaks in between them. Each class will begin with me checking up on you to see how everyone is doing. Although there will be some deviations, we will generally then move into a lecture or video, followed by a short break, followed by a case study with a question and answer or discussion session. I expect you to turn your cameras on at the beginning of the class, and during Q&A and discussions sessions. In the event that I, or any of the other instructors, lose connection to the Internet, we will work to regain connection quickly and continue with the class.

Learning Management System: The course website is up on Canvas. I will post all class materials on the course website as well as links to appropriate material online.

Class Participation Expectations: I expect you to attend and participate in class synchronously. This is particularly important because we also have several high-level officials who are taking the time to come and talk with us in this course. I do however understand that circumstances may arise in which you may not be able to participate synchronously. In such cases, email to let me know. There will be provisions for you to complete the particular class or classes asynchronously. Actively participating in the course will contribute to an enhanced learning experience for you and the entire class.

Graded Elements: I expect you to do your best to submit assignments as per the syllabus. However, situations may arise where you may need more time to submit assignments because of health or other issues. Again, simply email me in those situations and accommodations will be made appropriate to your particular situation. The midterm will be a take-home exam. All course assignments will be submitted electronically via Canvas.