



Course Syllabus

Welcome to URBAN 589/IPM 514, Transportation Systems

This course explores transportation systems as critical infrastructure. We will study the transportation systems that move both people and freight on land, water, and in the air and that are critical to keep the economy of the United States functioning. We will explore the impact of both natural and human caused events on transportation. During much of our course, we will study transportation infrastructure as different modal systems with each mode composed of assets with varying level of importance and vulnerability to threats. We will look at the freight railroads, the national roadway system and vehicles on these roadways, the maritime system (including inland and ocean transportation and seaports), aviation and airports, different types of mass transit systems for people, and pipelines. For each of these systems, we will review the basic elements of the infrastructure, describe how the system functions, and provide statistics that give a sense of its importance, extent, and complexity as a part of the national transportation network. We will also identify databases and other sources of information that allow you further exploration of each system. We then evaluate the vulnerabilities specific to these infrastructures and examine best practices used to reduce these vulnerabilities to both natural and human threats. We will also discuss the role of customs and border protection in the transportation infrastructure.

We will review risk-based approaches to evaluating and protecting transportation infrastructure. We will discuss how the federal and state agencies are organized to both address security threats and climate change. We introduce the concepts of system resilience and provide several case studies related to resilience for particular infrastructures based on past incidents or attacks.

Course Preview

- 10 lessons with short reading quizzes
- 2 short written analysis
 - [Analytical Writing Assignment 1](#)
 - [Analytical Writing Assignment 2](#)
- 2 required discussion forums
 - [Discussion Assignment 1](#)
 - [Discussion Assignment 2](#)
- 1 major paper to be submitted at end of course.
 - [Major Project Paper](#)
- no exam

Learning Objectives

When you have completed this course, you will be able to

- define critical national transportation infrastructure;
- describe the extent of the national transportation network;
- describe how vehicles, vessels, and terminals function on this network;
- evaluate each system's vulnerability to human threats and climate change;
- describe the inherent conflict between the public and private sectors;
- explain the structure and goals of the National Infrastructure Protection Plan (NIPP);
- review the status of the U.S. Department of Transportation's (USDOT) climate change clearing house;
- describe the structure behind the Department of Homeland Security's transportation sector-specific plans and modal annexes;
- describe how the Department of Homeland Security (DHS) and the (USDOT) defines risk;
- describe climate change impacts from a transportation perspective;
- explain mitigation and adaptation to climate change; and
- explain the characteristics that make a transportation system resilient.

About the Course

There are no prerequisites for this course.

Two texts which we will reference frequently are:

- [Fifth National Climate Assessment \(NCA5\)](#), Read [Overview](#), the U.S. Global Change Research Program (USGCRP) links to an external site. USGCRP, 2023: *Fifth National Climate Assessment*. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. Full report is located [here](#).
- [Department of Homeland Security. Transportation Systems, Critical Infrastructures and Key Resources Sector Specific Plan as input to the National Infrastructure Protection Plan.](#)

Other required and recommended readings, as well as sources for additional information, are listed online and in relevant lessons.

Recommended Resources

- [US Department of Homeland Security, Transportation Security](#)
- Transportation Research Board [Climate Change website](#)
- [Executive Summary, Fourth National Climate Assessment \(NCA4\), the U.S. Global Change Research Program \(USGCRP\)](#)
- [Fourth National Climate Assessment](#) (see the previous [third edition](#) if interested)

- National Academies of Sciences, [Potential Impacts of Climate Change on U.S. Transportation](#), (2008, Transportation Research Board Special Report 290)

Technology Requirements and Skills

In addition to the resources and guidelines available in the [Help Center](#), for this course you will need [Adobe Reader](#).

About the Lessons

This course is organized into 10 lessons. Each includes readings from online sources. Some lessons also include an assignment such as a short analytical writing response, an online discussion, or work toward the major course project.

[Lesson 1: Introduction to Critical Transportation Infrastructure](#)

In this first lesson, we will introduce the transportation systems that we will study. We will explore the impact of both natural and human events on transportation. During much of our course, we will study transportation infrastructure as different modal systems (railroads, roads, etc.) with each mode composed of assets with varying level of importance and vulnerability to threats. We will introduce the concept of transportation as a critical national infrastructure that requires protection. As a result of this perspective, we will review risk-based approaches, borrowed from other disciplines, to evaluating and protecting transportation infrastructure. We discuss how the federal and state agencies are organized to both address security threats and climate change. A review of a weather-related disasters and their impacts on the transportation infrastructure will highlight the importance of climate change to transportation. Since much of the transportation system is owned and operated by the private sector, we will also note the complicated relationship between this sector and the government and look at some of challenges behind effectively reacting to threats. Since institutional and funding challenges complicate our ability to mitigate and to adapt to impacts on transportation, we will discuss those issues.

[Lesson 2: Roadway Transportation](#)

In the next two lessons we will discuss the national roadway transportation system. We will review some basic characteristics of road systems, including the road classification system, performance measurements, and the role of technology and intelligent transportation systems. We will then turn to the National Highway System. We will examine the regulatory framework pre- and post-9/11, with an emphasis on the regulation of the transportation of hazardous materials. The highway system has two vulnerable aspects that will be the focus of this lesson: the transportation of hazardous materials, and choke points in the National Highway System (bridges and tunnels). We will review the risk-based vulnerability-assessment approach recommended for bridges and tunnels, identify best practices, and briefly discuss the Department of Homeland Security's highway sector security plan. We will look at the impact of climate change on physical infrastructure of road and will focus on the possible impact of sea-level rise on roads. We will also examine the US Department Transportation's somewhat different risk-

based approach to adapting to climate change. And finally, we have included a recent webinar related to the emergency of artificial intelligence in transportation planning.

Lesson 3: Roadway Transportation, cont'd

This lesson continues the discussion of roadway transportation that we began in Lesson 2.

Lesson 4: Freight Railroads

In this lesson, we will examine the characteristics of freight railroads in the United States. We first will explore some statistics that will give a feel for extent of freight railroads and we will look at how freight railroads operate. We will discuss the vulnerabilities of freight rail to human and extreme weather threats and look at some of the approaches taken to reduce these threats. A case study concerning railroads, resiliency and hurricane Katrina will highlight railroad's response to disaster. Finally, we will look at possible climate change impacts on railroads.

Lesson 5: The Concept of Resilience for Transportation Systems

In this lesson, we will explore the concept of a resilient transportation system. We will examine, from several different perspectives, what attributes make an infrastructure system resilient. We will briefly discuss the concept of resilient as defined within in the DHS's National Infrastructure Protection Plan and as defined from a US Department of Transportation perspective. The Bay area's MacArthur maze freeway interchange fire will be explored to show how the response to this incident showed many indications of resiliency. Finally, we will bring up the issues related to the poor condition of much of the nation's infrastructure.

Lesson 6: Water-borne Freight

In Lesson 6, we explore the water transportation infrastructure as a diverse system that consists of a network of waterways, terminals, and navigation systems, and the vessels that operate on the network. We note that this system is extremely important to the American economy, since most of the nation's foreign trade arrives or leaves by water, and a considerable amount of national freight moves on domestic waterways.

We review how previous terrorist attacks on ships, as well as concerns that shipping containers from overseas could be used to smuggle weapons of mass destruction into the country indicate that this infrastructure needs to be secured. We discuss how the complexity of the water-borne freight system greatly complicates protection strategies, since an attack could involve many different scenarios. This makes it difficult to allocate and prioritize of protection resources effectively. We cover a number of federal programs designed to address the protection of this infrastructure by applying some level of security to each of its different point of vulnerability. We also explore how climate change may have lesser impacts on marine shipping than other modes we have reviewed and ostensibly some positive impact (such as more ice free shipping routes).

Lesson 7: Seaports

In the first part of this lesson, you'll get an overview of a port's role in the transportation system, as well as explanations of a port's physical infrastructure and how a port functions as a system of sub-systems. Later in the lesson, we'll review natural and human-caused disruption to a port's activities. Since most of the nation's freight activity passes through a handful of large gateway ports, we'll focus on these, which are mostly container ports. And since most ports load and unload freight, we will emphasize freight movements, with some references to passenger activity. We will explore climate impacts on ports and in particular their vulnerability to predicted sea level rise.

Lesson 8: Aviation

In this lesson, we will explore the aviation infrastructure with a focus on airports as major components of the air travel system. We will review some basic characteristics of commercial air travel and statistics for this sector and then examine its regulatory and protection framework. Specific areas of aviation vulnerability with emphasis on security and best practices are covered. We will briefly review the impacts of climate change on aviation.

Lesson 9: Mass Transit

In this lesson, we look at mass transit and will describe the characteristics of the American mass transit infrastructure, examine what make this system vulnerable, and discuss approaches used to reduce risk to mass transit. We will review how this mode is of particular interest in terms of critical infrastructure protection because the system's inherent vulnerability and a history of high profile terrorist attacks. We note how mass transit is vulnerable to climate change but also offers a travel choice which can reduce car generated greenhouse gas emissions.

Lesson 10: Border Protection and Customs / Pipelines

In this last lesson, we examine two separate areas relevant to transportation infrastructure. First will examine the protection of national borders, with an emphasis on the inspection process that involves goods and people on transportation modes that arrive internationally. We will examine the history of customs and discuss how Customs and Border Protections (CBP) fits with into today's Department of Homeland Security. We will mention a number of CBP border programs designed to facilitate border crossing and also address security concerns. We will briefly look airport and seaport ports of entries and then take a more detailed look at land ports of entry. We also cover how border protection involves layered security.

Secondly, we will briefly review the role of pipelines and review their critical but often underappreciated role in moving freight in our national transportation system.

About the Assignments

There are four types of assignments in this course:

- A reading review quiz with two multiple choice question for each of the 10 lessons;

- two short analytical written assignment;
- postings to two group discussion forums; and
- a major project, due at the end of the quarter.

Assignments are weighted as shown in Table 1, below.

Table 1: Assignments and Percentage of Grade

Component	Percent of Final Grade
Reading review quizzes	20
Written assignments	30
Participation in class and the two group discussion forums	20
Major project paper	30

Reading Review Quizzes

Each of the 10 lessons has two multiple choice questions related to that week's assigned reading. The questions are designed to ensure you have completed the readings. If you have done the reading the questions should be easy to answer.

Written Analytical Assignment

You will be responsible for two short analytical writing assignments. In the first assignment, you will address approaches to assess risk and vulnerability. In the second assignment you will explore the concept of resiliency. These assignments require a concise, but readable, evaluation of complicated transportation infrastructure issues. Each exercise will count toward 15 percent of your grade. Please submit the written analytical assignment to the class web site.

Discussion Forums

You are required to post to two discussions forums in this course (discussion assignments). The topics are noted on the assignments for these lessons. In each case, you will have two weeks to post comments in the forum. You will be required to make a substantive post responding to the topic question, and to read the postings of all your classmates and

- summarizing points where you agree and disagree with one posting; or submitting a revised posting,
- taking into account what you learned from the work of your classmates.

You will submit all work through the relevant discussion forums.

The discussion forums will not be graded individually but as part of your overall class participation.

There is also the general discussion forum where you can ask overall questions about the course, communicate with your classmates, and post anything that might be relevant to class.

Note: If you have questions that you don't want to discuss with the entire class, you may e-mail your instructor directly, using the e-mail address shown on the "About Your Instructor" page in your online syllabus.

Your instructor reserves the right to post your direct questions—anonously—on the discussion board if the questions seem important or representative enough that the entire class would benefit from them.

Final Project

This final project, based on the lessons and the readings throughout the course, is due at the end of the quarter. This project requires that you select, research, and evaluate a transportation system incident and document your finding as case study.

Unfortunately, each of the transportation infrastructures we have studied has numerous examples of incidents caused by natural disasters, accidents, and terrorist attacks. For this project, you will select one of these incidents and evaluate what went right and what went wrong. The incident can be of any severity, but larger incidents often are better documented. You can also look at one transportation infrastructure in a larger incident: for example, subways during Superstorm Sandy, the roadway impacts of Hurricane Harvey in Texas or the evacuations during the wildfires in California.

Your project should:

- Describe the system or the infrastructure. Note its extent, and discuss who was responsible for maintaining, operating, regulating, and securing the system;
- Describe the incident. Describe the impacts to the transportation infrastructure;
- Detail both the vulnerabilities of the infrastructure as seen during the incident and the aspects that make the system resilient;
- Recommend practices or programs that could prevent similar incident from happen again; and Summarize your overall findings.

Document all your sources. The case study should be 8 to 12 pages. Please post the incident you have selected by the end of week 8 of the course. Please submit your major project paper to the class website.

Grading and Assessment

You will receive a numeric grade for this course. The numeric grading system used by the University of Washington relies on a decimal scale between 1.7 (low) and 4.0 (high).

For graduate courses, grades below 1.7 are recorded as 0.0 and no credit is earned. A minimum of 2.7 is required in each course that is counted toward a graduate degree. A 3.0 cumulative average in graduate work is required to receive a graduate degree.

Grading Criteria

Grades on the assignments will be based on

- addressing all parts of each assignment
- providing adequate treatment of each part of the assignment (for example, if an item calls for an explanation of factors involved, an answer that lists factors without explaining them will be inadequate)
- relating your work on the assignments to course readings, lessons, discussions, or supplementary readings as appropriate; and
- documenting your sources (that is, providing citations to published material, government documents, personal interviews). You can use any citation method you feel comfortable with, but please be consistent. Failure to cite your sources will result in lower grades. Plagiarism will be reported to the University.
- The use of AI tools to complete your assignment is not allowed. Tools like Grammarly are useful to polish language, but do not replace your own research and synthesis with those generated by AI. Using a tool to replace your own work does not comply wit the student code of ethics and must be reported to the University.

Assignments that are partially completed will not receive full credit. Late assignments will be penalized 4% per hour.

Table 2 provides descriptions of the criteria for your performance in this class. If you meet these criteria for all your work, you will be graded appropriately. Instructors may "interpolate" grades between these standards as they see fit.

Table 2: Grading Criteria

Value	Criteria
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4.0	Excellent and exceptional work for a graduate student. Work at this level is consistently creative (where appropriate), thorough, well-reasoned, insightful, well written and shows clear recognition and incisive understanding of the important materials and issues. All assignments submitted are of good professional quality. The value of individual contributions to this course is considerable and positively affects the learning of all participants.
3.7	Strong work for a graduate student. Work at this level sometimes shows signs of creativity, is thorough and well reasoned, and demonstrates clear recognition and good understanding of the important materials and issues. Assignments submitted lack professional quality but demonstrate effort and concern for quality. The value of individual contributions to the course is strong and occasionally significant.
3.3	Competent and sound work for a graduate student. Work is well reasoned and thorough but not especially creative or insightful. The student shows adequate understanding of the important materials and issues although that understanding may be somewhat incomplete. Work submitted is competent but not remarkable. The value of individual contributions to the course is such that they do not influence the quality of the course one way or the other. This grade indicates neither exceptional strengths nor exceptional weaknesses, but is the grade for "average" graduate performance.
3.0	Adequate work for a graduate student. Work is moderately thorough and well reasoned, but with some indications that some of the important materials and issues is less than complete and perhaps inadequate for graduate study. The value of individual contributions to the course is minimal. However, the work is above the minimal expectations for the course.
2.7	Borderline work for a graduate student. Work barely meets the minimal expectations for the course and may occasionally fall below them. Understanding of the important materials and issues is incomplete or has not been demonstrated. There is little positive value in the individual contributions to the course and there may even be negative effects on the overall learning. Consistent overall performance at this level would be below that of adequate graduate student performance.

Study Tips

Exercises in this class are open book, so no memorization is involved. The course is designed for you to learn from readings and from completing the assignments.

Some hints:

- Pace yourself.
- Set aside time each week that is dedicated exclusively to the course.
- Do the readings and explore the topic using the link(s) in the lesson.
- Begin assignments as soon as possible after completing the readings. Use all available resources, including your fellow classmates.

For the final project, select an infrastructure system that you have a real interest in or have some familiarity.

About the Course Developer

This course was originally developed by Dr. Ed McCormack at the University of Washington. [Tom Maxner](#) is now teaching the course. While some material will be re-developed over time, you may see videos or materials that still refer to Dr. McCormack.