Today’s Outline

- About Me
- About This Class
- Class Objectives (Why Transportation Engineering?)
- Grading/Administrivia
- Introduction
- Finally, About You
About myself..

- Ph.D. in Transportation Systems from UT Austin
- M.S. in Civil Engineering from Univ of Illinois
- B.Tech from IIT Madras
- Research Interests: Transportation Network Optimization for Planning and Operations, Transportation Security, Transportation Safety
- Hobbies: Music, Mathematics and Reading
Course Syllabus and Overview
About the Teaching Assistants

- Coral Torres: second year graduate student in transportation engineering (M.S.)
- Robyn Marquis: Undergraduate TA, expected to complete BS in May 09
Course Objectives

- Understand critical elements of Highway/Transportation Engineering
- Understand the basic definitions, tools and methods to plan, operate and design transportation systems
- Provide the required skills to pass the FE and PE exam (transportation component)
- Develop a critical, insightful thought process
- Skills to make big bucks in the transportation industry
Class Overview

- Meeting Times: Monday/Thursday: Noon – 1:50
- Office Hours: *(Please try to use them)*
  
  Course HomePage: 
  [http://www.rpi.edu/~ukkuss/classes/CIVL2030](http://www.rpi.edu/~ukkuss/classes/CIVL2030)
  
  I will try to post lecture notes before class

- Chapter dates are somewhat tentative
Course Details: Teaching approach

- Informal
- Learning is better if you participate
  I will call on you during class
- Non-analytical lectures using multimedia
- Analytical lectures using overhead slides
- No question is stupid
Philosophy of the class

“Theory without practice is an alienation. Practice without theory is empirism.”

B. Pascal
About the grading policy...

- Homework and Lab grades are a function of:
  - Correctness of the solution approach
  - Quality of the analysis
  - Clarity and neatness of written section
- Late Assignments: Will only be accepted under extraordinary circumstances
- Exam grades are a function of:
  - Correctness
  - Quality of analysis
Text Book

Class handouts (available at course website)

http://www.rpi.edu/~ukkuss/classes/CIVL2030/

Other references:

   - Garber and Hoel “Traffic and Highway Engineering”
   - Highway Capacity Manual (HCM)
   - Manual on Uniform Traffic Control Devices (MUTCD)
   - A Policy on Geometric Design of Highways and Streets (AASHTO “Green Book”)
Great Expectations

- I am expected to....
  - Teach
  - Be at my office hours
  - Give you feedback on how you are doing in a timely fashion

- You are expected to...
  - Learn
  - Attend lectures and participate
  - Do the problem sets
  - Not be rude if possible – sleeping, cell phones, using laptops for chatting, email etc.
Chapter 1: Introduction
Outline

- Transportation and traffic engineering
- The profession, in general
- Transportation and US history
- Institutional system and professional organizations
- Transportation modes
- Key transportation statistics
Traffic and Transportation Engineering

- Traffic: “.. The actual movement of vehicles or pedestrians on a facility...”
- Transportation engineering: “The application of technological and scientific principles to the planning, functional design, operation and management of facilities for any mode of transportation....”
Traffic Engineering

- Traffic engineering: “The phase of Transportation Engineering dealing with the planning, geometric design and traffic operations of roads, street and highways, their networks, terminals, abutting lands and relationships with other modes of transportation.

- “.. the science of measuring traffic and travel, the study of the basic laws relating to traffic flow and generation, and the application of knowledge to the professional practice of planning, designing and operating traffic systems to achieve safe and efficient movement of persons and goods.”
The profession of transportation engineering

Specialties in transportation:

- Planning
- Design
- Construction and maintenance
- Traffic Operations
Planning

Select projects for design and construction (not necessary). Planning involves:

- Forecast the impact of the project upon the system (e.g., transportation, environment)
- Setting up the specifications of the project
- Determining benefits and costs
- Interact with the decision makers to achieve final decisions
Planning
Design

Involves the specification of all the features of the project so that it can be built.

- geometric design (horizontal and vertical)
- pavement design
- determination of right of way, drainage structures, fencing, etc.
  (taking into consideration the users of the system)

- part of the design process is the production of construction plans (e.g., plans, profiles, details)
Traffic operations

Its objectives are related to using the facility in the most efficient way. It involves:

- the use of analytical models to determine the most efficient way to operate the facility
- the use of monitoring devices to determine actual conditions and level of service
- the use of devices to implement control strategies
Future Transportation Trends

- More “smart” highways and driverless trains

**Rapid response**
By continuously monitoring traffic data, the system can quickly detect and respond to incidents and keep traffic running smoothly.

Number of sensors in today’s cars?
Importance of transportation
Importance of transportation

a) necessary condition for economic growth, though not sufficient;
b) interacts with land use determining location and character of cities and regions;
c) national security
Forecasting is no easy task...

“The road system as a matter of national importance is a thing of the past. The system of internal water routes is a thing of the present in more senses than one.”

A. Hadley, Instructor of Political Sciences, Yale College. In “Railroad Transportation,” 1896
Components of the transportation system
Components of the transportation system

- Physical facilities: streets, highways, ports, railroads, etc.
- Fleets of vehicles: trucks, passenger cars, vessels....
- Operating bases and facilities: maintenance facilities, offices...
- Organizations:
  - Facility oriented: those involved in planning, design, construction, maintaining and operating fixed facilities
  - Operating organizations (carriers): railroads, airlines, shipping companies, private individuals
- Operating strategies: routing, scheduling, traffic control
Transportation modes
Transportation Modes

- A transportation mode is a specific way to travel, usually defined by either the physical system being used, by the technology used, or the organizational characteristics.

- Transportation modes include:
  - Walking
  - Auto
  - Transit
  - Water
  - Air
  - Rail

Picture taken by Dr. Holguin-Veras in the Darien Jungle in Panama. The pictures show Kuna Indians transporting produce in canoes in the Tuira river.
Highways, Transit

- **Highways:**
  - Over 6.25 million km (3.9 million miles)
  - 210 million vehicles, travel more than 4.1 trillion veh-km (2.5 trillion-miles)

- **Key issues:** traffic congestion, state of the infrastructure, urban sprawl

- **Urban Transit:**
  - Includes buses and rail systems (e.g., subways, light rail)
  - New York City accounts for 1/3 of USA transit demand; other American cities unable to effectively generate demand for transit

- **Key issues:** funding, land use
Air, Rail

- Air
  - General aviation represents 6.2 billion veh-km (3.8 billion veh-mi)
  - Air freight is less than 1% of total freight, though it is high valued cargo
- Key issue: airport expansion (more high speed rail is needed)

- Rail
  - Much of infrastructure removed in past 50 years
  - Amtrak: Passenger rail; other railroad companies: freight
- Key issues: Amtrak/other railroads’ financials
Water Travel, Pipelines

- **Water**
  - Includes ocean shipping and barge lines (inland waterways)
  - 42,000 km (26,000 mi) of navigable waterways

- **Key issues:**
  - The Jones Act requires that all vessels used for water domestic transportation be built in the US. Since US ships are more expensive, there are few entrants to coastal shipping. [About $250 million or more for one ship]

- **Pipelines:**
  - Mostly for transportation of liquid bulk cargoes
### Tables 1.2 and 1.3

<table>
<thead>
<tr>
<th>Mode</th>
<th>Vehicle-Miles (Millions)</th>
<th>Percent</th>
<th>Passenger-Miles (Millions)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Carriers</td>
<td>4,911</td>
<td>0.19%</td>
<td>450,600</td>
<td>9.75%</td>
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<td>General Aviation</td>
<td>3,877</td>
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<td>12,500</td>
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<td><strong>Passenger Cars</strong></td>
<td><strong>1,502,000</strong></td>
<td><strong>57.71%</strong></td>
<td><strong>2,388,000</strong></td>
<td><strong>51.67%</strong></td>
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<td>Motorcycles</td>
<td>10,100</td>
<td>0.39%</td>
<td>12,000</td>
<td>0.26%</td>
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<tr>
<td>Other 2-Axle, 4-Tire Vehicles</td>
<td>850,000</td>
<td>32.66%</td>
<td>1,394,000</td>
<td>30.16%</td>
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<td><strong>Truck</strong></td>
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<tr>
<td>Single Unit</td>
<td>66,800</td>
<td>2.57%</td>
<td>66,800</td>
<td>1.45%</td>
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<tr>
<td>Combination</td>
<td>124,500</td>
<td>4.78%</td>
<td>124,500</td>
<td>2.69%</td>
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<tr>
<td><strong>Buses</strong></td>
<td><strong>6,800</strong></td>
<td><strong>0.26%</strong></td>
<td><strong>144,900</strong></td>
<td><strong>3.14%</strong></td>
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<tr>
<td><strong>Other</strong></td>
<td><strong>670</strong></td>
<td><strong>0.03%</strong></td>
<td><strong>1,627</strong></td>
<td><strong>0.04%</strong></td>
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<td><strong>Rail</strong></td>
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<td>Transit</td>
<td>599</td>
<td>0.02%</td>
<td>13,139</td>
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<td>Commuter</td>
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<td>Class I Freight</td>
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<td>1.22%</td>
<td>5,200</td>
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<tr>
<td>Amtrak</td>
<td>288</td>
<td>0.01%</td>
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Think!

Why is private auto use high in the U.S. as compared to other countries?
The transportation system is hierarchical

- For instance:
  - Interstate highways provide the backbone for long distance travel
  - State highways provide connectivity at the State level
  - Local streets provide access to local destinations

- Our job as transportation engineers is to put together these hierarchies
Hierarchical Nature of Highway Systems
Introductions
The institutional setting is also important...
Institutional structure

National level: US Department of Transportation

- Federal Highway Administration
- National Highway Traffic Safety Administration
- Urban Mass Transportation Administration
- Federal Aviation Administration
- Federal Railroad Administration
- Maritime Administration, Coast Guard

Local level:

- State Department of Transportations (e.g., NYSDOT, Caltrans)
- Municipal Planning Organizations – also known as Metropolitan Planning Organizations – MPO’s (e.g., NYMTC)
- Special purpose agencies (e.g., NYS Thruway Authority, Port Authority of New York and New Jersey)
Case Study – New York City Congestion Pricing

- Traffic congestion is one of the major issues facing New York City planners (not only on a traffic engineering level, but also on a much more ‘macro’ scale (e.g., politicians, economists))
- Latest proposal from Mayor Michael Bloomberg is to implement a congestion pricing plan
- While congestion pricing could solve many or all of the traffic engineering issues, political, social, and economic concerns present major obstacles
- Proposal Overview: $8 for cars, $21 for trucks to enter Manhattan below 86th Street
NYC Congestion Pricing – Engineering

- 800,000 vehicles currently enter Manhattan below 60th Street on weekdays – pricing scheme would lead to approximately a 10% reduction (note: Transportation Planners for MPO’s and/or consultants typically make these projections)

- Most transportation professionals recognize that seemingly small 10% reduction in vehicles would eliminate most congestion issues in New York City (again, part of the transportation planning process)
Political Issues

- Proposal requires state support in form of funding or state application for federal funding – cooperation required from politicians at both the state and regional (NYC) level

- Request for state support occurred during the largest political squabble in New York State in decades (Governor Spitzer vs. Senator Bruno vs. Aty Gen. Cuomo)

- Democratic Governor and Republican Senate Majority Leader supported plan, but were stymied by Democratic Assembly Leader who wanted to “trade-off” support for other issues
NYC Congestion Pricing - Social Impacts

- Neighborhoods surrounding the “congestion zone” concerned that they will become parking lots for users of mass transit
- One major goal of the plan is to reduce incidences of asthma (especially in children)
- Opponents feel that the plan helps the wealthy Manhattanites at the expense of the lower-class Bronx neighborhoods
NYC Congestion Pricing - Summary

- Even a seemingly flawless engineering scheme is not always easily implemented
- Politics and social issues are often mitigating factors that derail even the soundest of engineering plans
- Coordination between decision-makers (i.e., politicians, government officials) and planners/engineers is essential
- Planners/engineers must be effective at conveying ideas to politicians
Where to get more information

- Next Time: Chapter 1: Highway Engineering and Traffic Analysis Introduction