CE100
Introduction to Civil Engineering
Transportation Engineering

Lecture 6

Quiz Tuesday April 8th 2003

Q1 – List the different branches of Civil Engineering @ KFUPM

Q2 -- What does a Geotechnical Engineer do? List 5 Jobs.

Q3 – What types of loads the Structural Engineer should design for when building in Japan? List 5 Types.

Please Write your name and Student #

What is Transportation Engineering?

- Is the field of engineering that deals with the planning, design, construction, and operation of transportation networks and facilities
- It includes: railways; airports; waterways; roadways; transit; pedestrians; bicycles...
The Transportation Engineer Job

- Transportation Engineers design and analyze Highways, Railways, Airports, Urban and Suburban Road Networks, Parking Lots, and Traffic Control Signal Systems.

Specializations

Transportation Engineers also work with different modes of travel:
- Road
- Rail
- Air
- Water

Developing Facilities

- Planning
- Preliminary design
- Detailed design
- Construction
- Operations
- Planning....
Planning

- Short Range (0-5 yrs)
- Long Range (5-20 yrs)
- Devise facilities to meet immediate and future transportation needs
- Facility type, operation, size, location, network links

Road Classification System

- Why classify roads?
  - design and safety
  - service function(s)
  - operational level of service
  - maintenance
  - jurisdiction

What do roadways do for us?

- Land Service - provide access to private property
- Traffic Service - allow us to move from point A to point B

Road Classification System

- How does it work?
  - cross-section type
  - service function(s)
  - median type
  - design speed
Road Classification

<table>
<thead>
<tr>
<th>Cross Section Type</th>
<th>Service Function(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c</td>
<td>for Urban</td>
</tr>
<tr>
<td>e</td>
<td>for Rural</td>
</tr>
<tr>
<td>1</td>
<td>for Freeways</td>
</tr>
<tr>
<td>0</td>
<td>for Arterials</td>
</tr>
<tr>
<td>0</td>
<td>for Collectors</td>
</tr>
<tr>
<td>0</td>
<td>for Locals</td>
</tr>
</tbody>
</table>

Preliminary Design

- First attempt at designing a transportation facility
- Identifies type of facility, number of lanes, land needs, operation, costs, network links, etc.

Planning

Type of Facility: Geometric Representation

Number of lanes

Road Classification

<table>
<thead>
<tr>
<th>Median Type</th>
<th>Design Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>c</td>
<td>for 30 km/h</td>
</tr>
<tr>
<td>e</td>
<td>for 40 km/h</td>
</tr>
<tr>
<td>1</td>
<td>for 110</td>
</tr>
<tr>
<td>0</td>
<td>for 120</td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
**Detailed Design**

- Confirms type of facility, number of lanes, operation...
- Plans, profiles, quantities, specifications
- Staging, penalties, restrictions, contracts, costs, environmental...

**Pavement Types**

- Flexible - pavements with a bitumen bonded surfacing and roadbase.
- Rigid - Pavements with a concrete surface slab which can be un-reinforced, joint reinforced or continuously reinforced.
- Rigid Composite - continuously reinforced concrete slab with a bituminous overlay.

**Pavement Design**

- **Foundation Design** - That is the design of the Subgrade and sub-base
- **Thickness Design** - That is the design of the actual road surface

**Construction**

- Estimating, bidding, tendering contracts
- Actual construction of facility
- Traffic management, materials testing, inspection
- Signs, signals, pavement markings
**Operations**

- Traffic control devices
- Capacity and safety analysis
- Level of Service
- Legislation and enforcement
- Maintenance and rehabilitation

**Intersection Control**

- Basic Right-of-Way Rule
- Yield Signs
- Stop Signs
- Traffic Control Signals

**Traffic Control Device**

- A sign, signal, marking, or barrier;
- placed upon, above, or adjacent to the roadway;
- by person(s) having jurisdiction for the roadway;
- to regulate, warn, and guide the road user.

**What links?**

- Land development generates traffic
- Property needs access to a public right-of-way
- Land values depend on accessibility
What links?

Urban Planning
Transportation
Civil Construction
Architectural

Traffic Studies

“If you build it, they will come.”
- building roads and developing land generates traffic
- studying traffic requires data collection

Traffic Counts

Traffic volume counts
Vehicle classification studies
Pedestrian volume counts
Traffic speed studies
Transit ridership studies
Parking inventory and usage studies
Origin-destination studies...
Intersection Turning Movement Count
- Count all vehicles by approach and movement
- Count pedestrians by crosswalk

Vehicle Classification Count
- Recording the different types of vehicles using the roadway
- Cars, trucks, tractor-trailers, buses, bicycles...

Spot Speed Study
- Use radar to record the speed of vehicles at a point on road
- Minimum sample of 100 vehicles
- Calculate the mean speed, 85th percentile speed...

Transportation Core & Elective
- CE 260 Surveying [3-3-3]
- CE 341 Transportation Engineering Laboratory [3-3-3]
- CE 341 Transportation Engineering [3-3-3]
- CE 440 Highway & Airport Materials [3-0-3]
- CE 442 Design of Pavement [3-0-3]
- CE 442 Construction & Maintenance of Highways & Airports [3-0-3]
- CE 442 Highway Planning & Design [3-3-3]
- CE 444 Traffic Engineering & Roadway Safety [2-3-3]
Topics

- Accidents, Injuries and Fatalities (1418 & 1419).
- Major and minor accidents (1418 & 1419).
- Fatalities & Injuries for the last 4 years.
- Causes
- Other Findings.
- Pictures.

## Accidents & Injuries in 1418/1419

<table>
<thead>
<tr>
<th>Year</th>
<th>Accidents</th>
<th>Injuries</th>
<th>Total Inj.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1418</td>
<td>153,727</td>
<td>28,114</td>
<td>181,841</td>
</tr>
<tr>
<td>1419</td>
<td>264,326</td>
<td>31,059</td>
<td>295,385</td>
</tr>
</tbody>
</table>

% Increase:
- Accidents: 72%
- Injuries: 10%
- Total Inj.: 12%

## Major & Minor Accidents in 1418/1419

<table>
<thead>
<tr>
<th>Year</th>
<th>Major</th>
<th>Minor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1418</td>
<td>133,649</td>
<td>20,078</td>
<td>153,727</td>
</tr>
<tr>
<td>1419</td>
<td>241,810</td>
<td>22,516</td>
<td>264,326</td>
</tr>
</tbody>
</table>

% Increase:
- Major: 81%
- Minor: 12%
- Total: 72%
Fatalities

Year 1416 1417 1418 1419
Fatalities 3,152 3,108 3,474 4,290

Other Findings and Notes

- 392,577 Drivers involved in accidents.
  - 40% are non-Saudi (157,031).
  - 14% are below 18 years (54,688).
- 2,782,556 Violations
  - 360,194 “No Driving License”
  - 269,094 “Speeding”
- 6% of injured people ended with a permanent disability (1,864).

Causes

- Speed 35.09%
- Red-light 13.31%
- Turns 11.50%
- Parking 10.90%
- Passing 9.68%
- Others 19.52%
Reach Home Safely