Highways and Pavements

Week 6
Construction Estimation, Planning and Control

Pavements

- Flexible Pavements (allows flex due to loading)
  - Those which are surfaced with bituminous (or asphalt) materials.
    - Surface course
    - Base course
    - Sub-base course (optional)
    - Sub-grade (existing soil)
- Rigid Pavements
  - Those which are surfaced with Portland cement concrete (PCC).

Materials: Asphalt

- Hot Mix Asphalt (HMA)
  - Aggregate: Sand, gravel and crushed stone mineral materials
  - Asphalt: In 2001, the U.S. produced almost 35 million tons of asphalt at a rough value of around $6 billion.
- Maintenance
  - Fog Seals
  - Slurry Seals
  - Crack Seals
  - Chip Seals

Concrete Pavements

- Includes cost of:
  - Fine grading the sub-grade
  - Forms if necessary
  - Steel reinforcing
    - Dowel bars
      - Transverse: 1” dia, 24” long, spaced 12” OC
      - Longitudinal: 5/8 to ¾” dia, spaced 24” OC
  - Concrete mixing, placing, spreading, finishing and curing
  - Curing compounds
  - Expansion joint materials
    - Account for contraction and expansion stresses

Estimating Material

- Average thickness of material ($t$)
- Area of cross section ($a$)
- Length of pavement ($l$)
  
  Volume of concrete = $a \times t \times l$ (CY)
- Spacing between joints (Trans: 15-20’)
- Joint width (1/8-1/4”) and depth (1/4-1/3 of concrete thickness)
- Steel reinforcements

The Process: Clearing and Grubbing

- Land clearing operations
  - Clearing vegetation
  - Felling trees
  - Disposal of brush
  - Demolition
**Preparation of Sub-grade**
- Sub-grade stabilization
- Over-excavation of poor sub-grade
- Equipment:
  - Self propelled mechanical sub-grader lead by a stringline
  - Compaction equipment
  - Wetting with water if necessary

**Methods: Concrete pavements**
- Side-form method
  - City streets
  - Forms of steel about 10 ft long (multiple uses)
  - Left for about 8-10 hours
- Slip-form method
  - Slip form paving machine
- Concrete mixing:
  - Central batch (large volumes of concrete)
  - Batch plant: about 400cy of concrete per hour
  - Job-batch (low volumes of concrete)

**Concrete Placing**
- Constraint: Time between concrete mixing at batch plant and eventual pouring should not allow segregation of mix or setting
- Equipment:
  - Batch plant
  - Hauling units
  - Paving equipment: paving train! (upto 500 CY / hour)
    - Concrete placer spreader (2)
    - Slip form pavers (1)
    - Time and cure machine (2)

**Methods: Asphalt Pavements**
- Surface preparation for Asphalt Overlay:
  - Leveling course
  - Milling (milling machine)
  - Sweeping
- Asphalt mixing, transporting and laying
- Asphalt paving
- Compacting asphalt mixes

**Equipment**
- Milling Machine
  - Specs: Cut width: 1.5" -8'
    - Cut depth: Upto 10" per pass
    - Production rate: 100 – 200T / hour
- Asphalt paver (125 – 300ft/min)
- Compaction Rollers used
- Combination: Mix < Truck/material transfer vehicle < Paver < Rollers