

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 3/4 " 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)
$$\text{Volume of concrete} = a \times t \times l \text{ (CY)}$$
- 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 plants: 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)
 - Tine 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