Concrete Pavements

ACCELERATED CONSTRUCTION OF URBAN INTERSECTIONS WITH PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

Pavements

- Asphalt pavement has long been a popular road construction material.
- In areas where traffic becomes concentrated, such as urban intersection, flexible pavement may be prone to rutting over time.
- In areas with seasonal extremes of both hot and cold weather, such as found in the Tri Cities, Washington, the ruts can quickly become severe.
- Several of the flexible pavement intersections in eastern region of Washington state had been suffering from severe rutting caused by slow moving heavy vehicles, exasperated by high temperatures during the summer months.
Portland Cement Concrete Pavements

- The frequent maintenance required on some asphalt concrete (AC) pavement sections has made reconstruction with Portland Cement Concrete Pavement (PCCP) a more feasible alternative.
- In Eastern Washington, three major AC intersections with severe rutting problems were reconstructed with PCCP in autumn 2000.
- The entire reconstruction of each intersection, including demolition of the AC pavement and its replacement with PCCP, took place over a period of three days - starting on Thursday evening and opening the intersection to the traffic on Sunday afternoon.

The Problem...

- 25,000 - 30,000 ADT (Average Daily Traffic) with 20 percent trucks
Rutting in Asphalt Concrete Pavements

- Replace the existing structure with 12 inches PCCP over the existing crushed stone base
- Thursday evening to Monday morning closures to construct the intersection square area
- Detour traffic over surrounding surface streets and state/interstate highway
- Construction September 12th to October 8th, 2000
  - Yelm Street
  - Clearwater Avenue
  - Kennewick Avenue
Prior to Design of this Project, Washington State Department of Transportation (WSDOT) communicated with contractors, and the city about strategies for avoiding some of the inconvenience caused by the previous Contracts.

City allowed full weekend closure, Friday evening to Monday morning, of one intersection at a time.

Contractors felt that the entire intersection with the exception of the radii could be completed in this timeframe.
Planning

- The contractor at a later meeting proposed completing the entire intersection including the radii, if a three day closure was possible.
- City of Kennewick agreed to a three-day, Thursday evening to Monday morning closure.
- Traffic issues were worked out between the City of Kennewick and WSDOT.

Traffic Detours

- Truck traffic detoured approximately 13 miles on interstate and state highways.
- Car traffic detoured on local streets.
- Flaggers placed at all key locations.
Public Relations

- Numerous public meetings were held during the design phase for public input and agreement
- WSDOT contacted business owners prior to the construction
  - One week before the closure
  - Day before the closure
  - Provided flyers

Public Relations

- Weekly meetings were held by the project engineer to update the local media
- WSDOT tried to make the closures as painless as possible:
  - Fully signed the detour routes
  - On site changes/refinements to allow traffic flow
  - Aggressive scheduling to ensure a minimum timeline for the closure
  - Variable message signs, flyers, and media notices
Construction Staging

Staging Concerns

- Traffic Flow and Traffic Control
- Access to Adjacent Business
- Access for Construction & Material Delivery
- Construction Time
- Safe Construction Area for Employees & Public
- Mix Designs
- Time to Cure & Opening to Traffic
SR-395 & Yelm, Clearwater, Kennewick Avenue:

- Close one Intersection at a Time
- Temporary Lane Closures Stages 1, 2, 3
- Complete Closure Stage 4, Thursday at 7:00 PM to Monday 6:00 AM.
- Late opening penalty of up to $2,400.00 per hour.
- 2,500 psi for opening to traffic.

Modification to Traffic Control Plan

- Place Traffic in NB or SB lanes for several days. Once the traffic flow is modified leave them in the same configuration.
- Set up Temporary Signals
- Worked on Two Intersections at Once (Clearwater & Kennewick)
- No Left Turns to Facilitate Construction
Kennewick Intersection Staging

- Monday AM to Thursday 7:00 PM
  - Complete Approach & Departure Legs on Southbound Legs as Shown in Stage 1 & Stage 2 at both Kennewick & Clearwater
  - Set up Traffic Control for Closure at Clearwater
  - Move materials, (Tie Bars, Dowel Baskets, Forms, etc), into position for easy access
Kennewick Intersection Staging

- Complete Interior Portion of Clearwater Avenue over the weekend
- Monday through Friday Completed Northbound Approach and Departure Legs at Kennewick & Clearwater Avenue
Kennewick Intersection Staging

- 7:00 PM Thursday to 6:00 AM Monday
  - Close Kennewick Intersection 7:00 PM Thursday
  - Begin Milling at 8:00 PM
  - Start Finish Grading at 2:00 AM Friday Morning.
  - Set Forms 7:00 AM
  - Start Concrete Placement 11:00 AM
  - Complete Daily placement 11:00 PM Friday Evening.
  - Begin Green Sawing 4 to 6 hours after start of placement
Kennewick Intersection Staging

- Saturday
  - Check Maturity Meter
  - 7:00 AM Remove & Reset Forms, Place Baskets
  - 8:00 AM Begin Placing Concrete
  - Complete Concrete placement 4:00 PM
  - Start Cleanup.

• Stage 4a
• Stage 4b
Kennewick Intersection Staging

- Sunday
  - Check Maturity Meter for Required Strength
  - Clean and Seal Joints 7:00 AM to 2:00 PM
  - Set Up Traffic Control for opening
  - Place Traffic on Pavement 6:00 PM Sunday
• Intersection Complete

### Concrete Technology

#### Time for Completion

- In 15 days approximately 3384 cubic yards of concrete were placed at Kennewick Avenue and Cleawater.
- Kennewick Avenue and Clearwater were built concurrently.
- The concurrent construction saved a considerable amount of time. Crews were able to place concrete daily.
**Time Components**

- **Construction Activity**
  - 17% (No Activity)
  - 8% (Excavation)
  - 5% (Grading)
  - 1% (Excavation)
  - 27% (Form & Place Concrete)
  - 11% (Sawcutting)
  - 14% (Cure)
  - 5% (Clean Joints)
  - 5% (Joint Seal)
  - 11% (Cleaning)

**Components of typical turn-around time for a PCCP intersection reconstruction**

**Keys to this Projects Success**

- Good Communication between WSDOT project office and Acme.
- Key decision makers on site or available at all times.
- Involvement in the scheduling from subcontractors and suppliers.
- Hourly schedule for Weekend closures with clear milestones for daily production.
- Quality Control personnel onsite during all placements.
Contractor's CPM Schedule

Mix Design

- Bonus/Penalty for Air Content & Strength evaluated statistically
- Mix design required 650 flex in 14 days with 28 day cylinders for pay
- Ultimate 28 day field strengths required to exceed, 28 day lab cured compressive strength less 1000 psi, evaluated statistically.
- 2500 psi for opening to traffic in 12 to 16 hours
- Maturity Meter curves for early opening.
Mix Design

- **WSDOT One Day Mix**
  - 705 # Type III Cement
  - 940 # 1 1/2" Rock
  - 799 # 3/4" Rock
  - 140 # 3/8" Pea Gravel
  - 590 # Coarse Sand
  - 481# Fine Sand
  - 254 # Water
  - 11 oz/cy AEA
  - 30.3 oz/cy WRA
  - 17.6 oz/cy Delvo (Set Retarder)

Maturity Meter

- Maturity vs. Compressive Strength
- Maturity vs. Flexural Strength
- Flexural & Compressive vs. Time
Mix Design (Cont’d)

Maturity vs. Strength Relationship
Mix 3447, Conducted on 7-6-98

Maturity Meter
There are many different ways an agency can stage an intersection. The method presented is only one method that worked very well on this project.

None of the techniques used to place the concrete are highly specialized.

The mix design is very simple and easy to use.

High penalties for late openings will increase the initial cost of the intersections to cover contractor risk.