



COUNT ON CONCRETE

72-HOUR INTERSECTION RECONSTRUCTION



Jim Powell
Executive Director

WSDOT Intersections

SR 27, Pines Rd.
and Broadway Ave.



Life Cycle Costs Analysis

40 YEAR ANNUALIZED COSTS

<u>SR</u>	<u>Intersection</u>	PCCP	ACP Rebuild		
		<u>Rebuild</u>	<u>4 yr Inlay</u>	<u>6 yr Inlay</u>	<u>8 yr Inlay</u>
27	Sprague Avenue	\$33,000	\$46,800	\$39,500	\$35,800
90	Thierman Street	\$54,300	\$66,400	\$57,600	\$53,100
2	Francis Avenue	\$73,500	\$100,900	\$87,000	\$79,900
291	Maple and Ash Street	\$33,900	\$50,800	\$42,100	\$37,600
27	Broadway Avenue	\$36,100	\$51,000	\$42,600	\$38,300
395	19 th Avenue	\$29,700	\$45,800	\$37,800	\$33,700
2	Third Avenue	\$15,200	\$18,700	\$16,500	\$15,400

SR 395
Kennewick,
WA



The Problem . . .



The Problem . . .

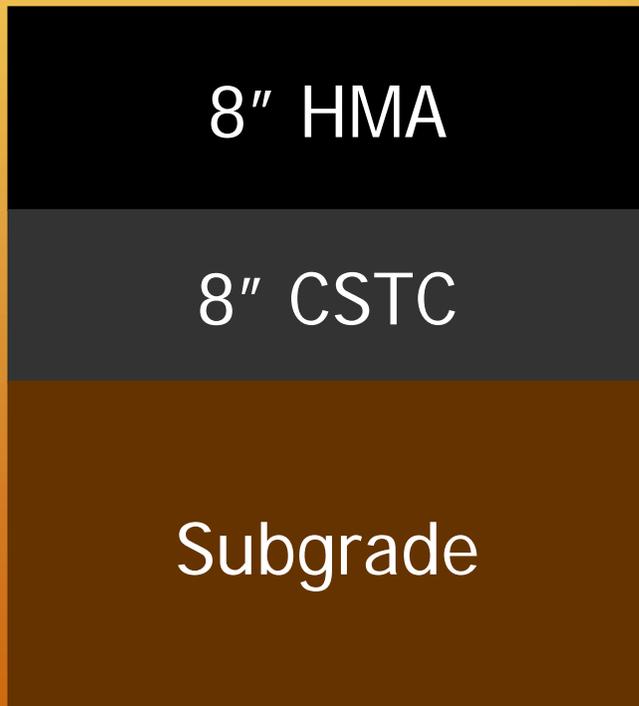


The Problem . . .

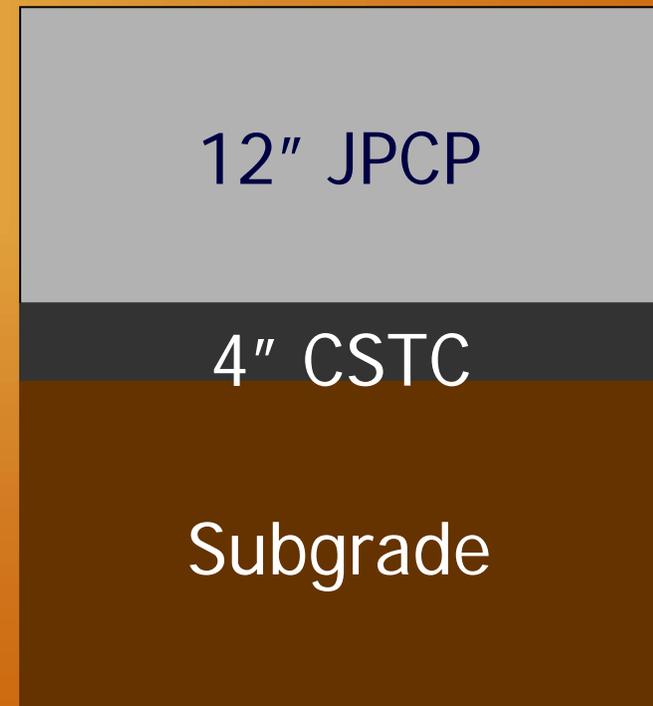


Pavement Sections

Existing



Design



SR 395 – Kennewick, WA

- Construction of four concrete intersections in 1998 resulted in strained community relations due to traffic problems.
- WSDOT/City of Kennewick desired to shorten the construction period.
- WSDOT contacted ACPA and contractors for input.
- WSDOT contacted public, business community, and city council to discuss options
- Ultimately, all parties agreed to complete closure of intersection core from Thursday evening to Monday morning, with approaches completed under traffic.

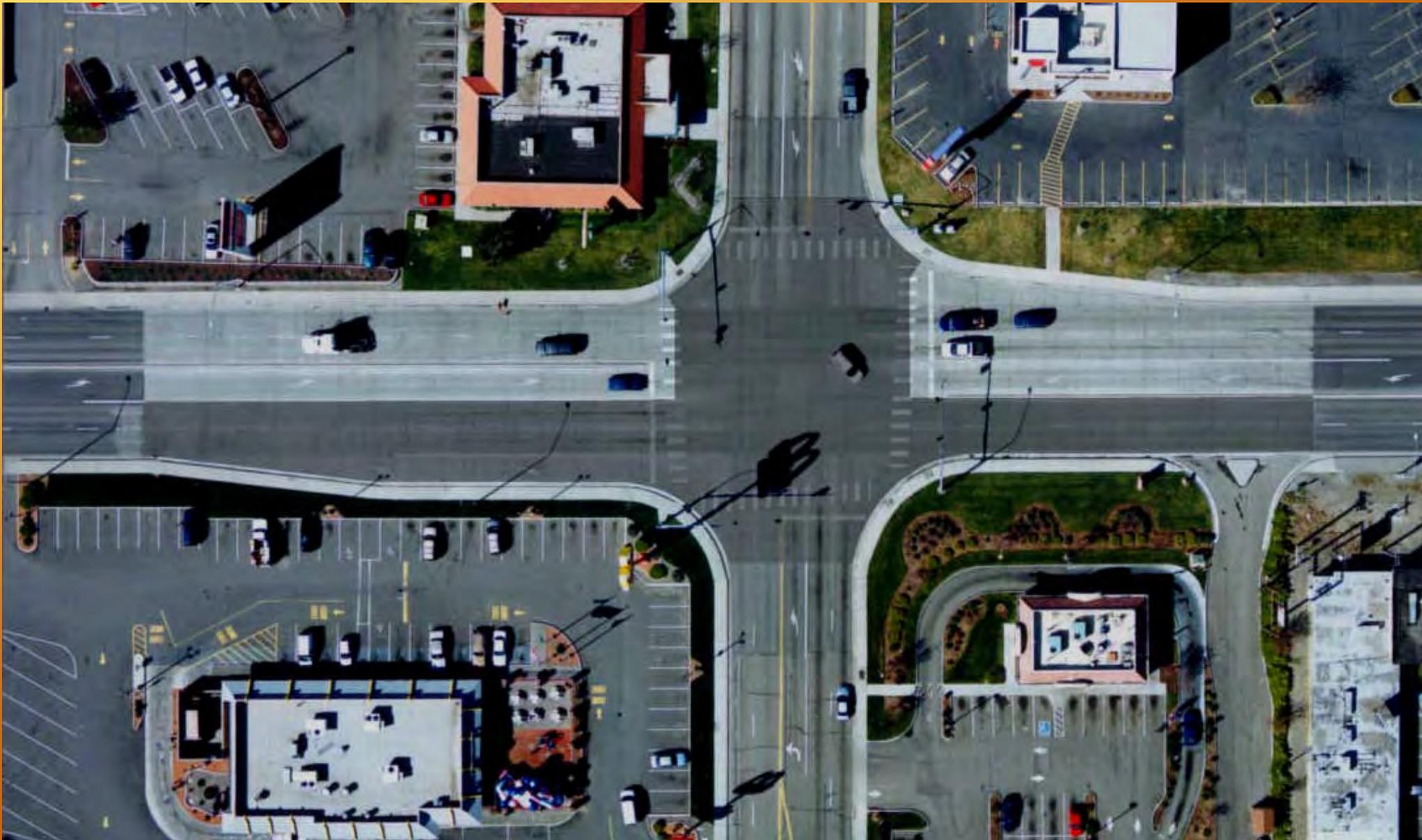
Prior to Construction



Stage 1



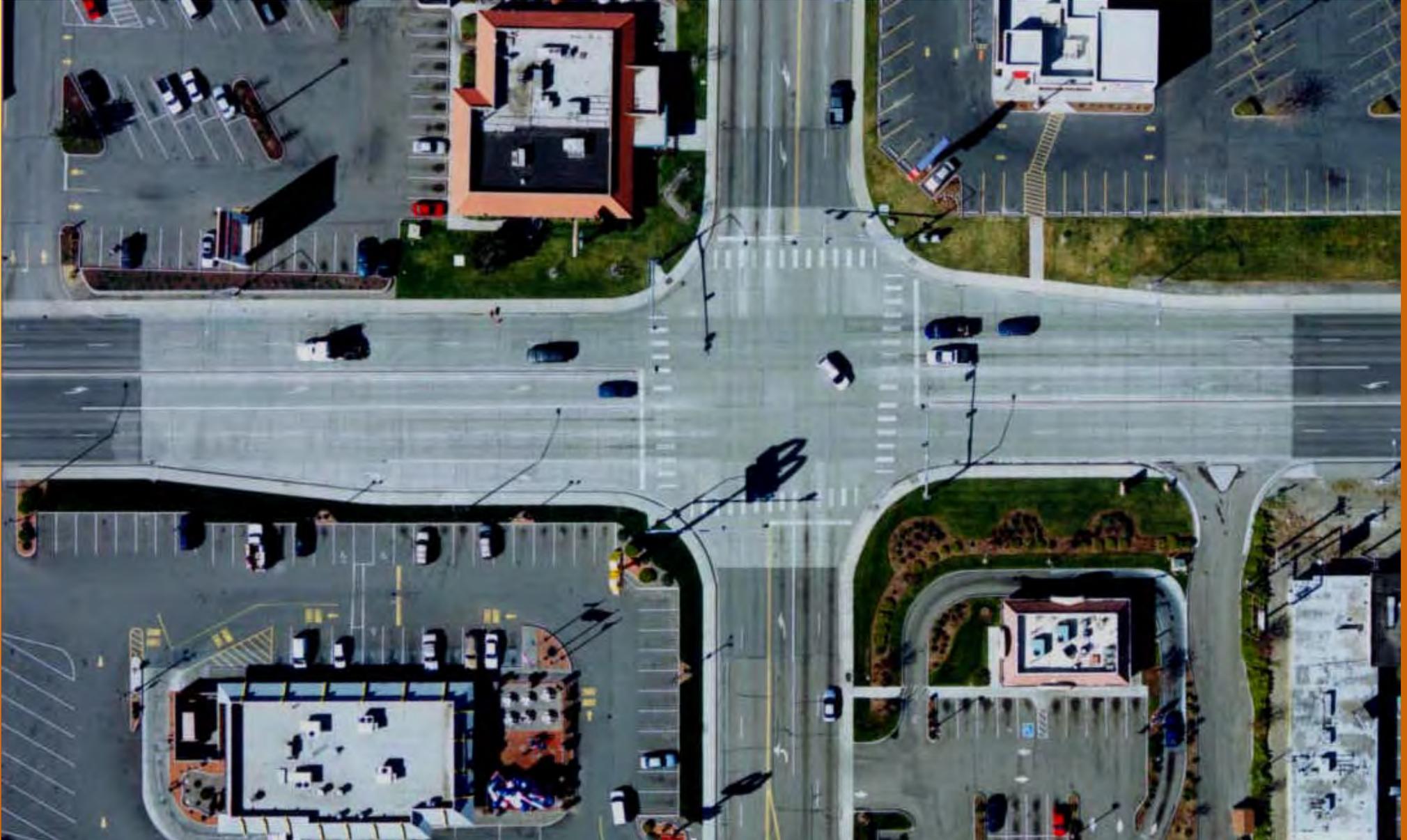
Stage 2



Stage 3



Construction Under Closure



Construction Schedule

–Thursday evening to Friday morning –

- 8:00 pm to 3:30 am - Remove existing surfacing
- 3:30 pm to 7:30 am – Grade, prep base

Construction Schedule

– Friday Morning to Friday Evening

- 7:30 am to 9:00 pm - Form and pour concrete
- 3:00 pm – Start joint sawing

– Saturday Morning to Saturday Evening

- 6:30 am – Finish joint sawing
- 8:00 am to 4:15 pm – Form and pour concrete
- 4:30 pm to 8:00 pm – Asphalt approaches
- 6:00 pm to 11:30 pm – Sawcut

Construction Schedule

–Sunday Morning to Sunday Afternoon Evening

- 5:00 am to 9:00 am – Clean joints/blow dry
- 9:00 am to 1:00 pm – Joint seal
- 1:00 pm to 2:00 pm – Clean roadway
- 2:00 pm to 4:45 pm – Prep roadway (striping)
- 4:45 pm – Open to traffic

Liquidated Damages

Opening beyond 6:00 am Monday
morning:

Yelm Street Intersection - **\$1,200/hr**

Clearwater and Kennewick Avenue
Intersections - **\$2,400/hr**

Kennewick Avenue – Thursday Evening



Kennewick Avenue – Thursday Evening



Kennewick Avenue – Thursday Evening



Kennewick Avenue – Friday Morning



Kennewick Avenue – Friday Morning

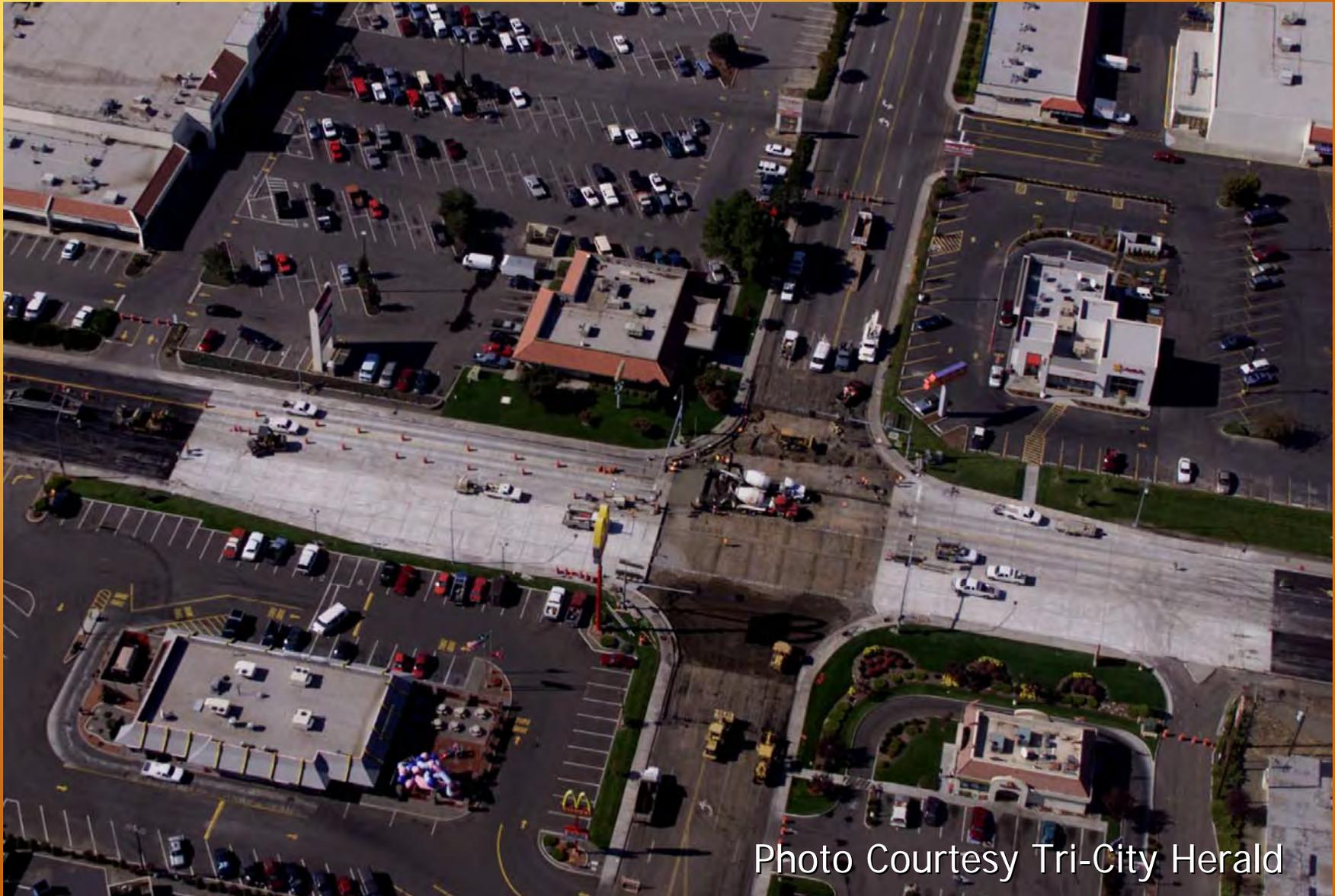


Photo Courtesy Tri-City Herald

Kennewick Avenue – Friday Morning



Kennewick Avenue – Friday Afternoon



Kennewick Avenue - Saturday Morning



Kennewick Avenue – Saturday Afternoon



Kennewick Avenue – Sunday Afternoon



Requirements for Rapid Reconstruction

- Staging
- Mix Design
- Strength Determination
- **PUBLIC RELATIONS!**

Phasing Concerns:

- Traffic Flow & Traffic Control
- Access to Adjacent Business
- Access for Construction & Material Delivery
- Construction Time
- Safe Construction Area for Employees & Equipment
- Mix Designs
- Curing & Opening to Traffic

Traffic Flow & Traffic Control:

Four Option:

- Restricted Traffic Movement - Francis & Division
- Partial Closures - Pines & Broadway
- Complete Closures - Broadway and University
- Combination of the Above - SR 395 - Yelm, Clearwater, and Kennewick Avenue

Francis & Division:

- 32,000 ADT
- Four lanes required to remain open along Division. Two in each direction.
- Left turns from Division required to remain open.
- One lane required to remain open along Francis Avenue.
- Business were located on all four corners of the intersection. Access to businesses required.

Time For Completion:

- The reconstruction took 35 working days of which 18 were concrete placing days to complete 3,047.3 cubic yard of concrete.
- Pavement removal began in September 8, 1997.
- Last pour day was October 22, 1997.

Partial Closure - Broadway & Pines:

- Original Intersection was to maintain traffic on all legs of the intersection.
- After evaluation of traffic control plan WSDOT allowed closure of Broadway. Therefore no left turns permitted.
- Broadway traffic used alternate routes.
- Pines traffic signals set on green for both north and south bound traffic. Traffic did not backup at intersection.
- Traffic along Pines was free flowing.

Time for Completion:

- The reconstruction took 19 calendar days of which 9 of those days involved concrete placing. A total of 1,681 cubic yard of concrete were placed.
- Pavement removal began in May 2, 1997.
- Last pour day was May 21, 1997.

Combination Closures:

SR-395 & Yelm, Clearwater, Kennewick Avenue:

- Lane Closures Stages 1,2, 4
- Complete Closure Stage 3, Thursday at 7:00 PM to Monday 6:00 AM.
- Late opening penalty of up to \$2,400.00 per hour.

Time for Completion:

- Kennewick Avenue and Clearwater were built concurrently. This saved a considerable amount of time. Crews always had a place to work.
- In 15 days approximately 3384 cubic yards were placed in the two intersections.

Time Comparison:

Location	Days	Cubic Yards
Francis & Division	35	3050
Broadway & Pines	19	1681
Kennewick, Clearwater & SR-395	15	3384

Early Opening to Traffic



Mix Design

- 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)

PCCP Opening Strength

What Is Adequate Strength?

- Design Strength
- Strength at which applied stresses do not exceed concrete strength
- Strength level at which cumulative fatigue damage occurring at early ages is minor

Opening Strength

- Concrete gains strength with time
- Relatively few loads at early age
- Calculate cumulative fatigue damage for different time (strength) increments
- Determine acceptable opening strength

Opening Strength

- Acceptable opening strength dependent on slab thickness
 - 7" 370 psi = 2,040 psi compressive
 - 8" 335 psi = 1,760 psi compressive
 - 9" 275 psi = 1,310 psi compressive
 - 10" 200 psi = 820 psi compressive
- Based on FE analysis assuming 1000 trucks per day, k-value of 200 pci, no edge support.
- Beam strength typically lower than in-place strength by 50-150 psi

What Is Acceptable Strength?

- Dependent upon individual project designs
- 2,500 psi compressive (420 flexural) would be conservative for most pavements

Maturity?



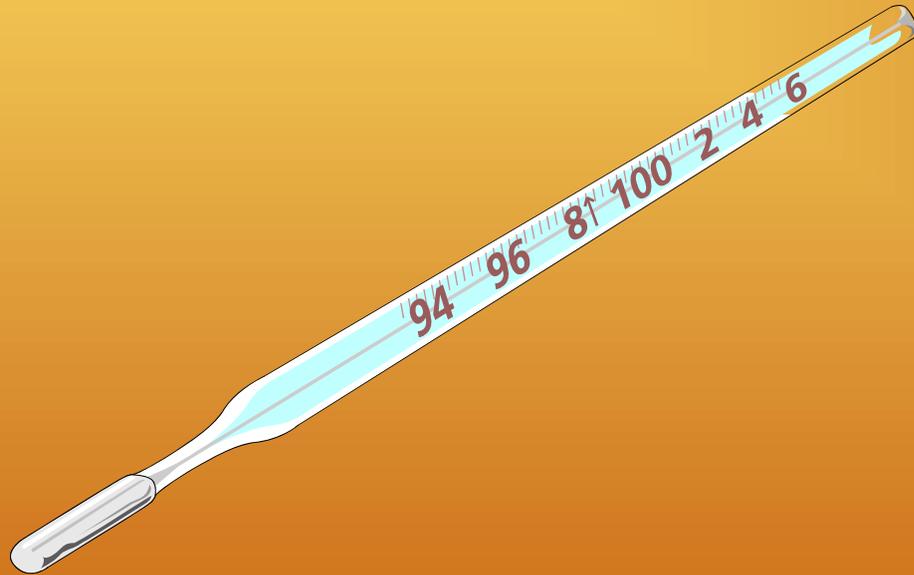
Maturity

Different samples of a given mixture will have equal strengths if they have equal maturities, regardless of their actual temperature histories.

Measurement



Required Equipment



Maturity Function

Nurse-Saul:

Temperature-time factor:

$$M(t) = \sum (T_a - T_0) \Delta t$$

ΔT = time interval

T_a = average concrete temperature

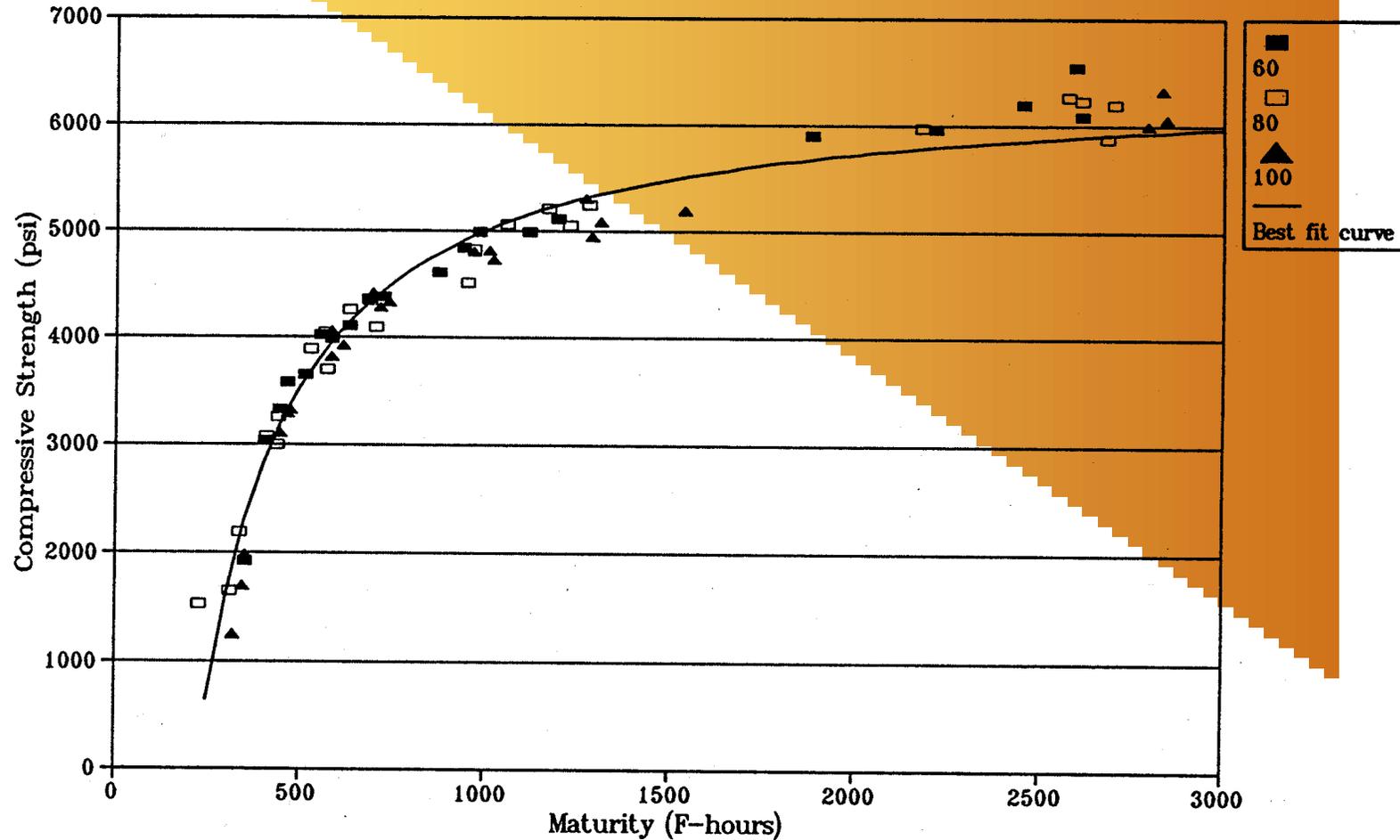
T_0 = datum temperature

Application

- Establish strength maturity relationship in laboratory
- Monitor maturity in field
- Determine concrete strength

Actual Strength/Maturity Curve

Figure 11: Strength vs. Maturity
Best Fit Curve



Maturity Meter:



Public Relations

Detour: More closures on 395 to come in Kennewick

Continued from A1

years ago, lanes were kept open so traffic could slowly crawl past the construction without detouring. However, the project took a couple of weeks to complete.

Closing the highway completely in areas requires a couple of miles of detouring but will allow the project to be finished more quickly, Davari said.

"There's also the issue of safety on the project," he said. Road crews don't have traffic whipping past at their elbows while they're working.

As it was, a flagger at the Edison Street ramp on Highway 240 was scraped up when she had to leap out of the way of a truck coming off Highway 240, Davari said.

Some cars were honking Friday afternoon near the interchange as flaggers worked to keep traffic from backing up much farther than the off-ramp from the highway, but most drivers halted at the interchange seemed resigned to the delay.

"We're on a road trip, so it's no big

deal," said Shane Corsetti of Moscow, Idaho, who was traveling with two other University of Idaho students on their way to watch the Vandals play in Oregon.

"Everywhere you go in the Tri-Cities, there's a detour," said Greg Bosch of Pasco. "It's par for the course."

"We just have to tolerate this," said Jerry Irwin of Kennewick.

Closing part of Highway 395 takes people out of their comfort zone, said Roni Teagle, a flagger at the interchange.

"There's a lot of people seem to take it personally when we stop them," she said. But "I think it's going great. I'm not the one in the car with road rage."

"There are always some grumpy people, but they're going to be grumpy no matter what," said Twyla Olney of Zillah, the second flagger at the interchange for the late-afternoon shift.

Although through traffic heading north was being diverted at 10th Avenue, Highway 395 remained open through much of the business section

until near the intersection with Yelm Street.

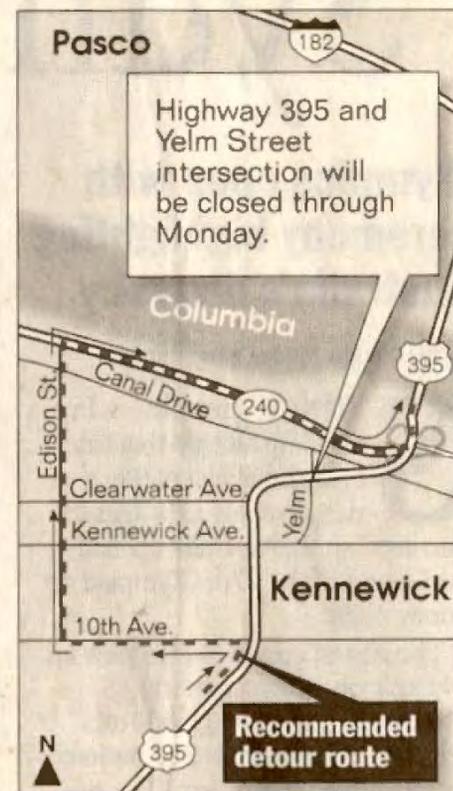
But traffic remained light.

"It's terrible," said Jacquie Fanciullo about business at Denny's Restaurant on Friday afternoon. She's the general manager there. Business was down about 25 percent, she estimated.

At the Country Gentleman restaurant, business was a little slower than usual but steady, said general manager Debbie Bennett. She did notice the absence of Hanford workers, however, who often drop by on Hanford's alternate work-free Fridays. They evidently chose to avoid the confusion of construction.

But this weekend won't be the worst for business at Denny's, Fanciullo said.

Waitresses who count on tips are dreading the weekend when Kennewick Avenue is closed as part of the \$3.6 million project on Highway 395. Clearwater Avenue is scheduled to close beginning Sept. 28, and Kennewick Avenue is scheduled



Herald/Sherry Emery

to close beginning Oct. 5.

■ Reporter Annette Cary can be reached at 582-1533 or via e-mail at acary@tri-cityherald.com.

Customer Focused Construction

- Was your business affected by the closure? Yes
 - Could not get across the intersection
 - It was a pain to get to the establishment
 - Trucks, who are a large part of our business could not get in
 - Two of three entrances were blocked off
 - Traffic from 395 was shut off
 - Business slowed
 - Local traffic found us OK
 - People avoided the area
 - It was a hassle to get here
 - People really wanted to eat here to go through all this

Customer Focused Construction

- Did you experience a loss in sales over the weekend closure? Yes

Estimated Percentage Loss in Business

30-40 – fast food restaurant

20-25 – ice cream shop

25 - restaurant

0 – car dealership

30 – pet store

50 – glass and silver collectable shop

25 – card shop

25 – cigarette store

15 percent increase - Goodwill

Customer Focused Construction

- Did you hear comments from customers about accessibility due to construction? Yes
 - It was a hassle to get to the business
 - You really want to eat here
 - People were not going to come in until the work is done
 - Night business was down 60% due to lighting
 - Out of town folks get lost
 - Took us extra time
 - At least 15 people came in asking for directions
 - Truck deliveries were difficult
 - Pain in the rear
 - What a mess, when will it be over

Customer Focused Construction

- Would you support a weekend closure in the future for reconstruction purposes rather than construction occurring over a longer period? Yes
 - Loss of business but it has to be done
 - We can endure one weekend as long as it is not constant
 - Weekend closure hurt but not too bad
 - Get it done with 24 hour a day work
 - WSDOT will not have to come back
 - Will not interfere with as many people
 - Less impact overall
 - Hurts now but less disruption in the long run
 - Get it over with – more clogged with doing it during the week

Customer Focused Construction

- Do you have any suggestions for the WSDOT regarding future closures?
 - Why not connect between the intersections with concrete?
 - Slow down message boards
 - WSDOT did everything they could. Locals knew how to get around
 - Use clear signage
 - Best way to do it. Need to detour trucks all the time
 - Good job

Success Factors

- WSDOT had several preliminary meetings with City of Kennewick to discuss impacts and City concerns.
- WSDOT invited businesses to pre-construction meeting.
- WSDOT met with contractors to discuss feasibility.
- WSDOT kept public informed via newspaper, radio, and television news broadcasts.
- WSDOT web page with up to date information.
- WSDOT gave flyers to businesses weekly.

Success Factors

- WSDOT/Acme partnered on the modifications to the traffic control plan allowing continuous work operation with increased safety for employees.
- Clearwater & Kennewick were constructed concurrently maximizing crew efficiency.
- Detailed schedule with known milestones.
- Meeting or beating schedule.
- Something going on all the time.
- Decision makers available to resolve issues.

For Further Info:
www.wsdot.wa.gov

CROWN

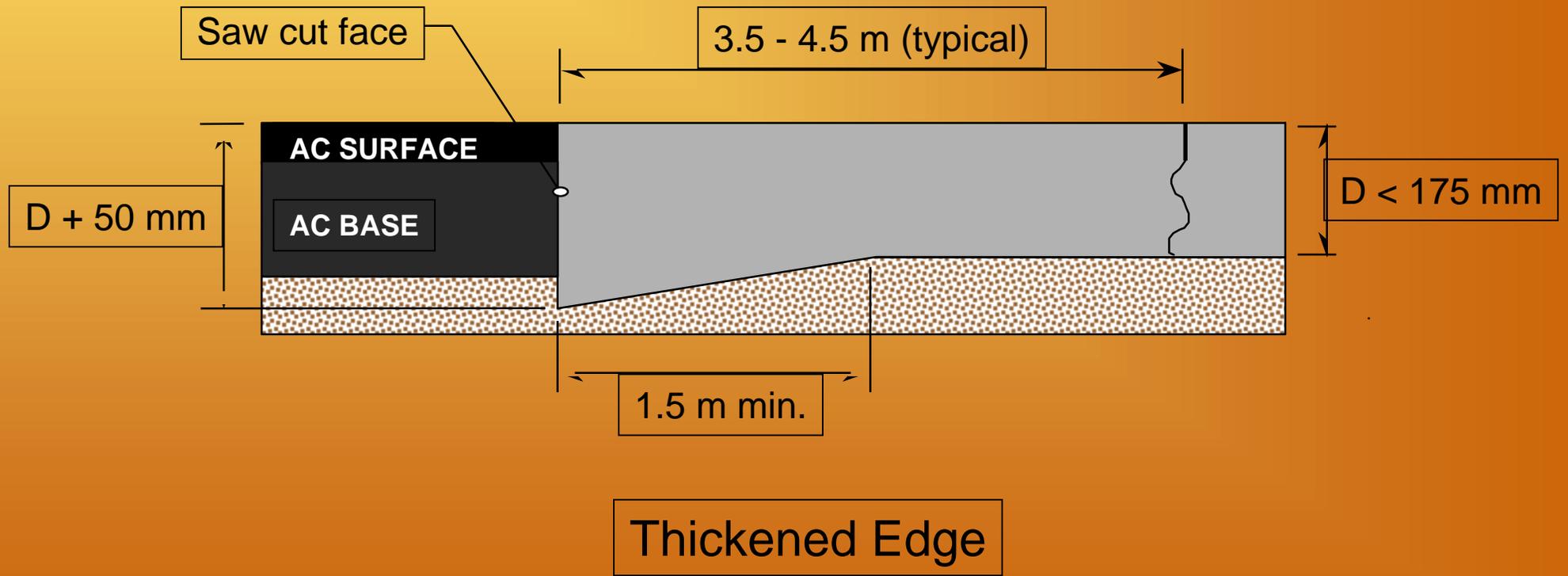
1.5% min.
1% in intersection

?



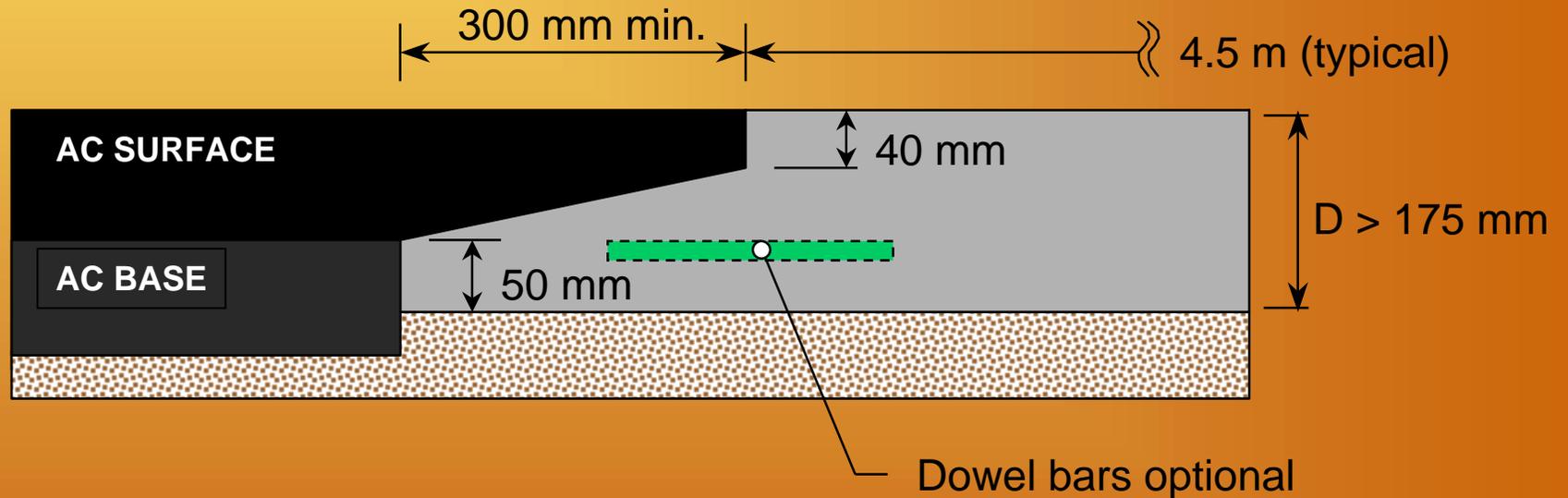
Concrete to Asphalt Transition

$D < 175 \text{ mm}$



Concrete to Asphalt Transition

$D > 175 \text{ mm}$



Impact Slab