URBAN FREEWAY RECONSTRUCTION WORKSHOP

March 16-17, 1999
Portland, Oregon

by

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16. Abstract

This report summarizes the recommendations of participants attending a workshop on March 16-17, 1999 in Portland Oregon, to consider options for preservation or reconstruction of Interstate 5 (I-5) in Portland. Participants from state Departments of Transportation in Georgia, Washington, Michigan and Oregon joined Federal Highway Administration, City of Portland and industry personnel to discuss this stretch of I-5, which is nearing the end of its 30-year design life.

The participants reviewed the project considerations and constraints, discussed similar project experiences, and brainstormed options for preservation/reconstruction and traffic management. Seven options were compared for five factors: 1) pavement related costs, 2) structure raising costs, 3) traffic control / detour costs, 4) other costs, and 5) user costs. Two promising options were analyzed in detail: Full reconstruction with concrete (full closure and partial closure) and Asphalt concrete overlay. A life-cycle cost analysis was done for both options.

The report includes project background, examples of similar projects from Georgia and Michigan, the list of brainstormed options, details of options discussed in more depth, and identified issues relating to contracting options.

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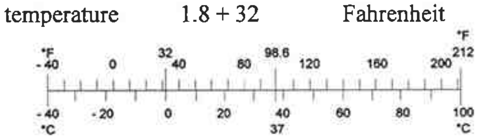
SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometers squared	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9	Celsius temperature	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
ha	hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celsius temperature	1.8 + 32	Fahrenheit	°F



* SI is the symbol for the International System of Measurement

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URBAN FREEWAY RECONSTRUCTION WORKSHOP

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1.0 INTRODUCTION

On March 16th and 17th, 1999, a workshop was held in Portland, Oregon to discuss options for preservation or reconstruction of Interstate 5 (I-5) pavement along the eastside of the Willamette River in Portland. The 6.8 km considered during the workshop is the first continuously reinforced concrete (CRC) section of the I-5 corridor projects that requires structural pavement preservation or reconstruction work. Participants included personnel from state Departments of Transportation in Georgia, Washington, Michigan, Nevada, and Oregon, Federal Highway Administration (FHWA) staff, City of Portland staff, and industry personnel. The attendance list and business cards are included in Appendix A.

I-5 through Portland is experiencing serious congestion problems as the population of Portland increases. Average weekday traffic (AWDT) volumes reach 77,000 vehicles. The I-5 corridor through Portland is also one of two major freight corridors with bridge connections to Washington over the Columbia River. Truck traffic is estimated at 13% of average weekday traffic.

Like the rest of the nation, the Oregon Department of Transportation (ODOT) is faced with identifying innovative methods and funding to address the needs of our aging infrastructure. Options must take into consideration clean water, clean air, wetlands, noise, greenspaces, and endangered species requirements. Oregon has also chosen to address congestion issues through intelligent transportation system applications, toll road investigations, congesting pricing considerations, and potential high occupancy/toll (HOT) lanes. ODOT needs to manage congestion as the cost of right of way makes it cost-prohibitive to add lanes.

This report includes project background, examples of similar projects from Georgia and Michigan, the list of brainstormed options, details for options discussed in more depth, and identified issues relating to contracting options.

2.0 PROJECT BACKGROUND

2.1 LOCATION

The section of I-5 under consideration starts in the vicinity of the Oregon Convention Center (Oregon St.) and continues north to the Columbia Slough Bridge for a total of 6.8 km. Figure 2.1 shows the vicinity and location. Other sections of the corridor were considered for preservation or reconstruction, but were deemed too expensive for now and/or not a critical need.

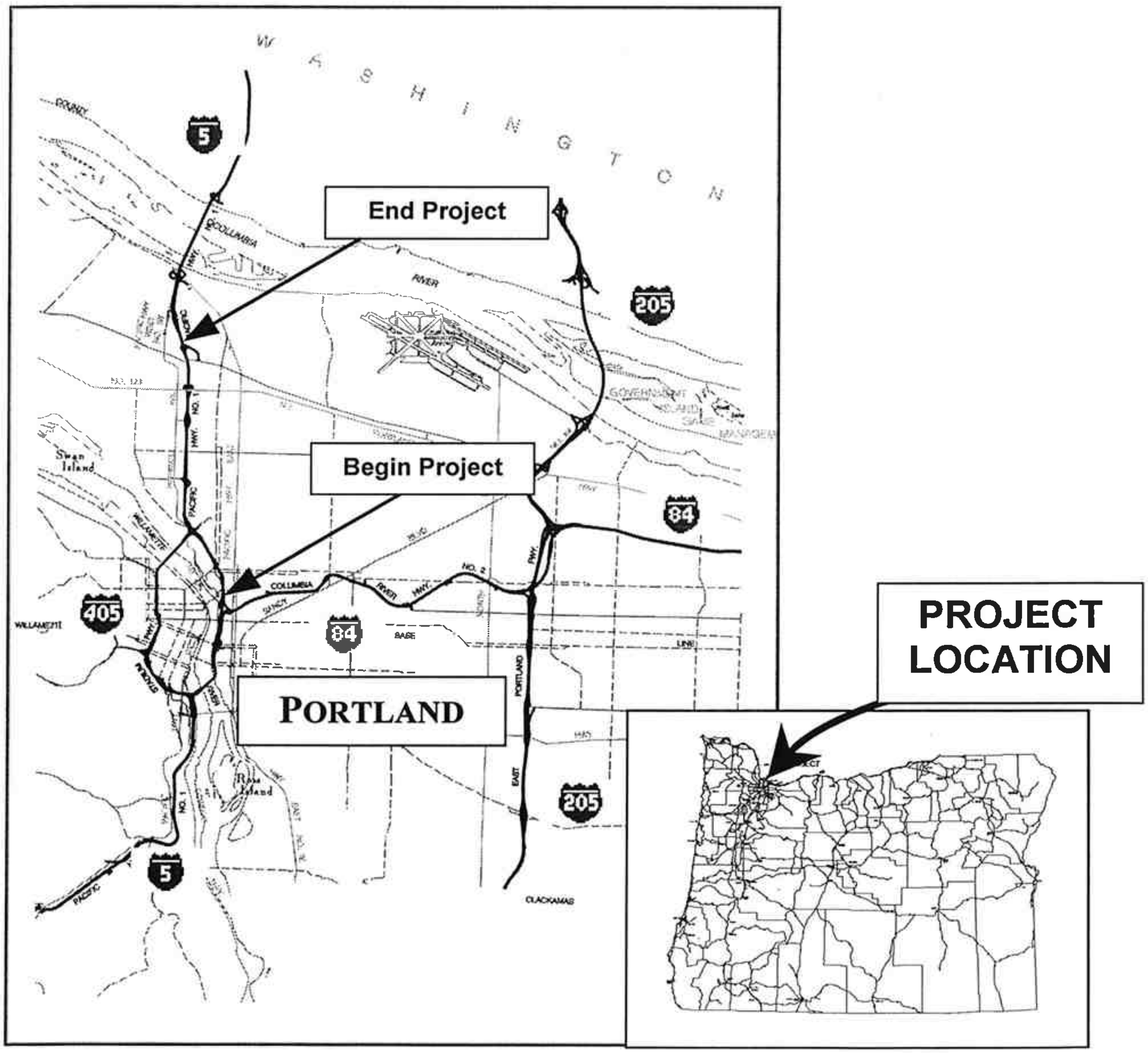


Figure 2.1: Project Location

2.2 PAVEMENT AND SECTION DESCRIPTION

The existing pavement consists of 200 mm of continuously reinforced concrete (CRC) and a 300 mm aggregate base for the first 2.06 km. The shoulders are 100 mm of asphalt concrete (AC) with a 400 mm aggregate base. The remainder of the section includes 200 mm of CRC with a 230 mm aggregate base; with 100 mm AC/230 mm aggregate base shoulders.

The existing surfacing along this stretch of I-5 is nearing the end of its 30-year design life. Some surface areas are cracked, alligator cracked or breaking away with areas of exposed rebar. When the "critical point" in the design life is reached complete failure of the pavement will be rapid. Some of the steel used for the CRC (#5 bars) is exposed. The existing pavement has about three punchouts per kilometer. Cracking through this section of concrete continues to increase.

Most of the pavement in question is three lanes wide for a total width of 11.0 m with some sections only two lanes wide for 7.3 m. Shoulder widths vary from 0.6 m to 2.4 m.

2.3 UTILITIES

For this portion of the I-5 corridor, there are no power line crossings. Water lines and gas lines cross both over and under the freeway. Both water and gas are located on some of the existing structures crossing over I-5. The City of Portland has a storm sewer system that passes under the freeway, but it is expected to be deep. There are no cable television lines in the corridor. ODOT fiber optic lines may or may not be impacted.

2.4 PROJECT CONSIDERATIONS

Several considerations were presented that could impact preservation or reconstruction of the freeway:

- Many bridges through the section have substandard vertical clearance. Four of the bridges have been damaged from impacts due to over-height loads. Options that would increase the height of the pavement like overlays would require raising the bridges. The target clearance height is 4.9 m.
- Construction of a north/south light rail line (LRT) is being discussed within the I-5 right of way, and also along a parallel route on Interstate Avenue. LRT within the I-5 right of way would impact the structures.
- Utilities such as water and gas cross over the freeway at the bridges.
- Options that require raising the structures must consider city traffic detouring and maintaining utilities.
- Several areas along the 6.8 km would require concrete digout and repairs for typical overlay options.
- The earliest a 100 mm overlay could be placed would be 1½ years because of the bridge-raising requirement.

- The existing shoulders and median width are substandard (predominately 2.4 m shoulders).

- The ramps through the section are asphalt concrete and in relatively good condition, with the exception of those onto I-405 which are CRC.

- A 1997 value engineering study recommended digging out under the structures to obtain vertical clearance with the overlay option, however, they did not have the subgrade utility information. The project development team is considering recommending digging out under the Killingsworth, Skidmore, and Going structures.

- The area may have a combined sewer/outfall system. Options that would lower the grade may need to include separating the storm sewer from the sanitary sewer, depending on how deep the section would be.

- All runoff from the impervious surface needs to be treated prior to discharge into the Willamette River and Columbia Slough.

- Noise levels have become an issue from Lombard to I-405. The project will include sound studies to determine noise impacts. An open graded friction course wearing surface could reduce the noise levels by 3-5 dBA. Plantings could also be considered in lieu of soundwalls in conjunction with an open graded wearing surface, if sound mitigation is needed.

- The major cost of reconstructing with concrete will be removing the existing CRC; thus, the reconstruction option would be essentially a demolition job.

2.5 CONSTRAINTS

The project constraints were defined as follows:

- Maintain access to Swan Island as well as the Port of Portland terminals, a major shipping facility.

- Maintain access to Hayden Island.

- Consider timing of construction and potential impacts on local festivals like the Rose Festival, which runs during the month of June.

- Consider construction impacts on access to the Rose Garden and Convention Center which are located adjacent to the freeway. The Rose Garden provides sporting and special event seating for 22,700 people.

- Consider construction impacts on access to the Portland Expo Center, Delta Park, Portland International Raceway, Multnomah Meadows Race Track and other facilities near the freeway.

- Do not consider capacity increases at this time.

3.0 MICHIGAN AND GEORGIA DATA

Participants from Michigan and Georgia presented major interstate reconstruction examples involving concrete pavement. The descriptions of their projects are presented in Table 3.1.

Table 3.1: Michigan and Georgia Data.

	Michigan – I-75 through Detroit (1998)	Michigan—I-75 through Detroit (Phase I-1999 construction season)	Michigan—I-75 through Detroit (Phase II-1999 construction season)	Georgia—I-475 through Macon (1999 construction season)
Description	Full depth reconstruction of jointed reinforced concrete pavement (JRCP) three lanes each direction (including shoulders). Full closure, one direction at a time. Included reconstructing ramps, remove and replace median barriers, lighting, work at bridge abutments and some slope regrading.	Full depth reconstruction of JRCP (mainline section), three lanes each direction. Full closure, one direction at a time. Work on 24 bridges.	Full depth reconstruction of JRCP on collector distributor routes, some asphalt. Two lane routes. Full closure.	Widening the existing freeway from 2 lanes to three. The additional lane will be AC; existing jointed concrete will be overlaid with 190 mm of AC. Bridge work includes jacking and widening to accommodate the new lane. Partial closure.
ADT	100,000	100,000		50,000
Length/Cost	2 miles---/$20M	3 miles/$60M (includes Phase II)	1 mile/$60M (includes Phase I)	15 miles/$40M
Contracting Method	A+B: Bid 100 days; Incentive $50,000/day	A+B: Bid 100 days; Incentive $65,000/day	A+B: Bid 30 days; Incentive $20,000/day	A+B: estimated to take 30 months; incentive is $10,000 with $2M max.
Duration	24 hrs/day; 7 days/week. Total of 82 days (actual)	24 hrs/day; 7 days/week. Bid 100 days (engineer's estimate was two seasons!)	24 hrs/day; 7 days/week. Bid 30 days (engineer's estimate was 100 days)	Unknown — project will be let in April 1999

Table 3.1: Michigan and Georgia Data.

	Michigan – I-75 through Detroit (1998)	Michigan—I-75 through Detroit (Phase I-1999 construction season)	Michigan—I-75 through Detroit (Phase II-1999 construction season)	Georgia—I-475 through Macon (1999 construction season)
Staffing	12 to 14 people monitoring the bridge work and the following for the paving work: ❑ 8 inspectors ❑ 9 co-op students ❑ 5 rent-a-technicians ❑ 1 asst. resident engineer ❑ 1 roadway engineer The prime contractor worked 16 to 18 hour shifts.	Similar to column at left.		1 senior project engineer 2 subordinate project engineers 15 on inspection crews 4 lab technicians

4.0 LISTING OF OPTIONS

Following a field trip to the project site, the participants returned to the meeting room to brainstorm options. The list logically separated into two categories: preservation/reconstruction options and traffic management options. Note that *"do nothing"* was not considered an option since the Oregon Department of Transportation's maintenance forces are not equipped to continually maintain the CRC as it deteriorates. Contracted repair costs are estimated at $\$480/m^2$.

4.1 PRESERVATION/RECONSTRUCTION OPTIONS

- Reconstruct with jointed reinforced concrete pavement (JRCP) and use an asphalt concrete (AC) base for support and access.
- Reconstruct with JRCP and do not maintain existing traffic.
- Use existing pavement as base. Place stirrups into the pavement (reinforcement on top in the wheel path) and add 130-150 mm of high strength, bonded concrete like the Texas method.
- Preservation with AC.
- Overlay with bonded concrete.
- Rubblize the existing CRC and overlay with AC.
- Reconstruct the pavement under the bridges that need to be raised with concrete and overlay with a bonded concrete overlay or AC.

4.2 TRAFFIC MANAGEMENT OPTIONS

- Get the trucking industry, Swan Island, Port of Portland, and City of Portland involved.
- Reconstruct only one lane, overlay others and sign trucks to desired lane.
- For reconstruction options, stage a media blitz and maximize public involvement so the public will be aware and can plan accordingly. Encourage transit use and vanpooling. (The Michigan DOT representative provided examples of brochures they prepared for their project.)
- For reconstruction options, perform a traffic network study to determine how much traffic is through traffic and what is local; determine where additional capacity may be.
- For reconstruction options, detour traffic to local couplet north and south. Upgrade routes with striping and signal timing, if needed.

- Detour through traffic onto I-205 and I-405.

- Add additional capacity to 99E, 99W, I-205, and I-405. The I-205 shoulder was used as a high occupancy vehicle (HOV) lane for ODOT's Trunnion Project.

- For reconstruction options, close the freeway in one direction and detour the remaining traffic onto MLK Boulevard or Interstate Avenue.

- For reconstruction options, use zipper barrier to move lanes. (This may be of limited use because of bridge abutment locations.)

4.3 OPTION COMPARISONS

In order to determine the most feasible options, a table of comparisons was created, as shown in Table 4.1. Seismic upgrades, fencing, soundwalls, illumination, bridge railing, and other bridge repair work were not included in the table. Total fixed costs for these items is estimated at $15M.

The options compared included:

1. **Full reconstruction with concrete**: 300 mm of plain jointed, doweled concrete over 100 mm of asphalt concrete, over a 150 mm aggregate base. Cost includes price for demolition of the existing concrete.
2. **Partial reconstruction**: reconstruction of the worst lane (the second lane from the left) with 300 mm concrete over 100 mm of asphalt concrete; with 100 mm asphalt concrete overlay for the remainder of the project.
3. **Concrete overlay**: 150 mm bonded concrete overlay.
4. **Full reconstruction with AC**: 75 mm of asphalt concrete over 300 mm of aggregate base.
5. **AC overlay**: 100 mm of asphalt concrete. Cost includes $1.5M for concrete repairs.
6. **Partial reconstruction at bridge crossings**: reconstructing the concrete under the bridges to accommodate the bridge clearance. The remainder of the project would include a 100 mm asphalt concrete overlay.
7. **Rubblize and overlay**: rubblizing the existing concrete pavement and overlaying with 250 mm of asphalt concrete. This option was not pursued because it was not considered cost effective, as it would not alleviate the need to raise the bridges to provide clearance.

For each option, the factors compared included:

(a) **Pavement related costs**: materials and construction;
(b) **Structure raising costs**: costs incurred for options that raise the pavement grade;
(c) **Traffic control, detour costs**: relative costs for flagging and detour upgrades. Costs for both full closure (no traffic allowed in the work zone) and partial traffic (maintain at least one lane of traffic through the work zone) were considered;
(d) **Other costs**: relative costs to relocate or adjust utilities. Options requiring bridge raisings would impact utilities and require some traffic signal adjustments. Full reconstruction options may impact existing drainage facilities;
(e) **User costs**: relative amount of time public would be impacted.

Table 4.1: Option Comparisons

Material	Strategy	Pavement Related Costs	Structure Raising Costs	Traffic Control, Detour Costs (Full Closure / Partial Closure)	Other Costs	User Costs	Risk	Rehab. Cycle, Years	Rehab. Costs	Resulting Score[a] (Full / Partial Closure)
Concrete	***1. Full reconstruction***	$10.9M (High)	-0-	M/H / H	$1.0M	H	L	40	L	***0.200 / 0.210***
	2. Partial reconstruction.	$6.2M (Med)	$2.0M	M / H	$2.0M	M	M	10	M	0.200 / 0.220
	3. Concrete overlay	$6.6M (Med)	$2.0M	M / H	$2.0M	M	H	20	L	0.205 / 0.225
Asphalt Concrete	4. Full reconstruction	$10.2M (High)	-0-	M / H	$1.0M	H	M/L	20	M	0.223 / 0.243
	5. AC Overlay	$5.0M (Low)	$2.0M	L / M	$2.0M	L	M/H	10	M	***0.158 / 0.178***
Other	6. Partial reconstruction. at bridge ends with concrete; overlay	$9.0M (High)	-0-	M/H / M/H	$1.0M	M/H	M	10	L/M	0.223 / 0.223
	7. Rubblize and overlay	Not considered cost effective.								

[a] See Table 4.2 for description.

To determine the most viable options, weights were assigned to each of the factors with the lowest weights assigned to the factors with most value. The weights were then used as multipliers for the low, medium, and high rankings assigned to each factor for a given option, as shown in Table 4.1. The weights are shown in Table 4.2.

Table 4.2: Weights Assigned to Factors

Factor	Weight
Pavement related costs combined with structure raising costs	0.10
Traffic control, detour costs	0.20
Other costs	No Factor
User costs	0.25
Risk	0.25
Rehabilitation cycle combined with rehabilitation costs	0.20

The relative ranking values used were:

Low = 0.10
Medium = 0.20
High = 0.30

The total score was then computed by multiplying the weights by the factor's relative value as shown in Table 4.3. The scores calculated for each option were then added together in order to identify the two most promising options to carry forward for further discussion. A lower score indicates more value.

Table 4.3: Calculation of the Total Weighted Factor

	Option	Pavement Costs with Structure Raising Costs	Traffic Control, Detour Costs (Full Closure Partial Closure	User Costs	Risk	Rehab. Cycle with Rehab. Costs	Total Factor (Full Partial Closure
Concrete	***Full Reconstruction***	(.1)X(.3)	(.2)X(.25) (.2)X(.3)	(.25)X(.3)	(.25)X(.1)	(.2)X(.1)	***0.200*** ***0.210***
	Partial Reconstruction	(.1)X(.2)	(.2)X(.2) (.2)X(.3)	(.25)X(.2)	(.25)X(.2)	(.2)X(.2)	0.200 0.220
	Concrete Overlay	(.1)X(.2)	(.2)X(.2) (.2)X(.3)	(.25)X(.2)	(.25)X(.3)	(.2)X(.1)	0.205 0.225
AC	Full Reconstruction.	(.1)X(.3)	(.2)X(.2) (.2)X(.3)	(.25)X(.3)	(.25)X(.15)	(.2)X(.2)	0.223 0.243
	AC Overlay	(.1)X(.1)	(.2)X(.1) (.2)X(.2)	(.25)X(.1)	(.25)X(.25)	(.2)X(.2)	***0.158*** ***0.178***
Other	Partial Reconstruction at Bridge Ends	(.1)X(.3)	(.2)X(.25) (.2)X(.25)	(.25)X(.25)	(.25)X(.2)	(.2)X(.15)	0.223 0.223

Based on the results of the analysis and engineering judgement, two options were carried forward for further discussion. The two options carried forward included options 1 and 5, shown in bold type on Tables 4.1 and 4.3:

1. **Full Reconstruction with Concrete**: 300 mm of plain jointed, doweled concrete over 100 mm of asphalt concrete, over a 150 mm aggregate base.

5. **AC Overlay**: 100 mm of asphalt concrete.

5.0 DETAILED ANALYSIS OF TWO OPTIONS

Following identification of the two promising options, workshop participants separated into two groups to determine the critical components. In addition, a life cycle cost analysis was performed to compare the impacts of different rehabilitation strategies over a projected 40-year life. Only agency costs were included.

5.1 OPTION DETAILS

For each option, the pavement design was fine-tuned; rough staging descriptions were discussed; construction time was estimated (including production rates); initial costs were detailed; and pros and cons were discussed.

5.1.1 Full Reconstruction with Concrete

Because of the unknowns associated with fully closing the freeway during construction, the work group evaluated both full and partial closures for the reconstruction. Table 5.1 provides details of the analysis for the full closure and Table 5.2 provides details for the partial closure. Segment 1 includes the section from about the Convention Center to the Fremont Bridge; Segment 2 refers to the section between the Fremont Bridge and the Columbia Slough. Additional concrete removal details are available in Appendix B.

Table 5.1: Full Reconstruction with Concrete (Full Closure)

Pavement Design	• 300 mm Concrete • 100 mm AC • Leave 100 mm aggregate base in at the north end; 25 mm aggregate base at the south end. May need to overexcavate into the subgrade to allow sufficient height for potential future overlays.
Construction Time	Total closure time estimated at 100 days based on Michigan's experience.
Staging	1. Close southbound (SB) segment 1; reconstruct median and SB lanes. 2. Close northbound (NB) segment 1; reconstruct NB lanes. 3. Close SB segment 2; reconstruct median and SB lanes. 4. Close NB segment 2; reconstruct NB lanes. Note: Order of segment construction listed is not necessarily optimum. Traffic control staging needs: • Truck plan for port access; trucking campaign to inform truckers of alternate routes. • St. John's Bridge closure consideration (anticipated in year 2001).

Table 5.1: Full Reconstruction with Concrete (Full Closure)

Staging (continued)	Traffic control staging needs (continued): • Signal timing plan. • Traffic plan for alternate routes (Interstate, MLK). Community outreach with Interstate and MLK residents, possibly arrange for offstreet parking; identify other incentives for residents. • Alternate route condition, maintenance needs. • Interchange optimization (large demand for access from interchange to interchange) (short term). Provide priority access for on-ramps on alternate routes like I-205. • Incentives for early completion through A+B contracting method. Maximum allowable calendar days would be 150. • Identification of or provision of? disposal site to facilitate demolition.
Advantages	• Permanent alternate emergency route available following detour route improvements. • One construction season. • Simple bridgework (would not need to raise bridges) as compared to AC. • Advantages in public relations (use public information before). • Safety -- no traffic construction zone fatals/accidents. • Reduced traffic control in construction zone. • Better unit prices / better production rates. • Better product quality. • Longer life of the pavement, increased durability as compared to AC.
Disadvantages	• Limited pool of contractors. • High user cost? Need to value figure this. • More neighborhood impacts. • Costly detours.
Actual User Impacts	• Known and definite user impacts for full closure (no expectation for traffic movement). *Calculate this closely.* • Under promise / over deliver. • Really pay attention to costs for delay (full vs partial). • Consider contractor impacts. • Identify county/city contracts which conflict.
Political Issues	• Full closure of I-5 has never been done before. • Perception of ODOT arrogance. • Legislative need for information. • ODOT must deliver to build credibility. • ODOT must generate advance political support. • Long range corridor future. • Capacity issues (in general, public is most willing to pay for capacity -- but project does not increase capacity). • Major impact to public. Perceptions that impacts would deliver increased capacity that will not be delivered.

Table 5.2: Full Reconstruction with Concrete (Partial Closure)

Pavement Design	• 300 mm concrete • 100 mm AC • Leave 100 mm aggregate base in at the north end; 25 mm aggregate base at the south end. May need to overexcavate into the subgrade to allow sufficient height for potential future overlays.
Construction Time	Three seasons (three years).
Staging	1. Reconstruct shoulders north and southbound to allow temporary traffic. 2. Southbound—reconstruct median barrier; two inside lanes; split SB traffic (provide one lane in Northbound). 3. Reconstruct south shoulder (NB traffic split): N _ _ N S S _ 4. Close ramps to accommodate splits. Traffic control staging needs: • Truck plan for port access; trucking campaign to inform truckers of alternate routes. • St. John's Bridge closure consideration. • Signal timing plan. • Traffic plan for alternate routes (Interstate, MLK). Community outreach with Interstate and MLK residents, possibly arrange for offstreet parking; identify other incentives for residents. • Alternate route condition, maintenance needs. • Interchange optimization (large demand for access from interchange to interchange) (short term). Provide priority access for on-ramps on alternate routes like I-205. • Incentives for early completion. • Identification of or provision of? disposal site to facilitate demolition.
Advantages	• Simple bridge work (would not need to raise bridges) as compared to AC. • Reduced neighborhood impacts as compared to full closure. • More total capacity. • Longer construction window.
Disadvantages	• Longer construction time. • More stages than full closure. • Safety (driver, worker, exposure). • Traffic fatalities cost to department. • Greater traffic impacts because of increased project duration. • More temporary traffic control expense. • Potential for property damage in construction zone. • Traffic delays are not expected. If there are lanes open not enough traffic may choose alternate routes since they are expecting to be able to get through the construction zone. • ODOT credibility could be impacted (said there is access but it gets compromised) • Contract cost higher, production rates lower. • Lower quality product

Table 5.2: Full Reconstruction with Concrete (Partial Closure)

Actual User Impacts	• Time critical in user cost effects. • Partial closure will have longer time -- more delay. • Partial closure cannot include expectation of through traffic. • Freight/transit costs are long term problems
Political Issues	• Public expectations. • We know this option – public knows the option. • Have to let public know they are getting value for their money.

Table 5.3: Asphalt Concrete Overlay.

Pavement Design	• 100 mm AC: 50 mm open graded mix over 50 mm dense graded mix. • Use best materials available. • Level 4 mix design.
Construction Time	• 2 months concrete pavement repair (weekend closures). • 6 months bridge raisings. Assume soundwall construction is concurrent with bridge raisings. • 2 months AC paving—8 hours per night. Total of 43,500 Mg AC (1/2 base, 1/2 wearing). • May be able to complete by fall 2000.
Staging	• Maintain 3 lanes of traffic during daytime on weekdays for curb, inlet and shoulder work. • Concrete repair and bridge work at the ends will be a big impact. • Some lowering of grade at some bridges. • Allow 50 mm construction paving joints. • Match AC to existing bridges. • Closures for surface streets (4). • Instead of bridge raisings, look at lowering the grade and reconstructing with AC.
Advantages	• Lowest initial cost. • Lowest life cycle cost. • Lowest public inconvenience. • Quieter roadway surface. • Lowest traffic control cost. • Does not cause problems with possible north/south light rail like concrete. • Utilizes existing material; not hauling away a lot of material.
Disadvantages	• Some lowering grades at some bridges to provide clearance. • Higher risk with problems below surface (punchouts). • Would be back within 10 years. • At 20 years will need to reconstruct. Delaying the problem. • Have to raise bridges, inlets, curbs, and utilities. Neighborhood issues. • Less resistant to stud wear.
Political Issues	• Much less construction noise. • Failure is a large risk. • Back in 10 years. • Potential equipment breakdowns.

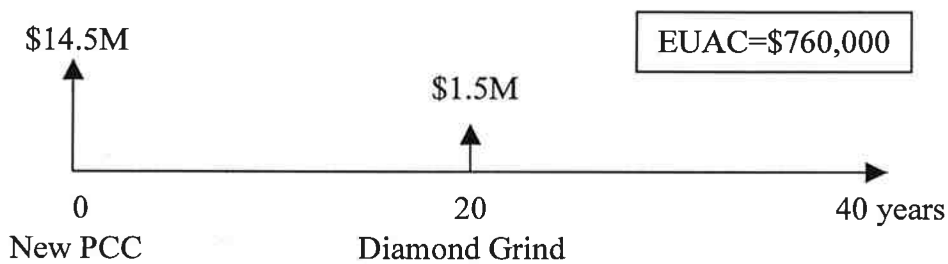
It was noted that alternative selection should not be prejudged as the estimates of time and cost are soft. It is important to determine the actual costs of users and traffic control. In the end it will be important to sell the public on the objectives of the project.

5.2 LIFE CYCLE COST ANALYSIS

Life cycle cost analysis was performed for the two principal options. A discount rate of 4% was used over a forty-year time period. The AC overlay option included four rehabilitation strategies that were evaluated separately in the following sections. Only agency costs were included in this analysis. There was not enough time to develop user costs to conduct a user cost life cycle cost analysis.

5.2.1 Reconstruction with Concrete

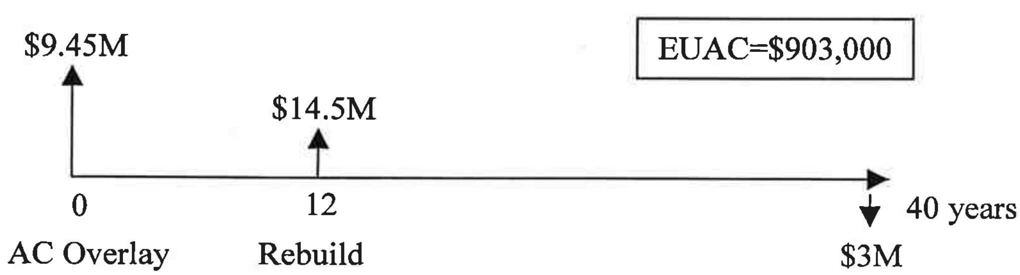
The concrete option includes removing the existing concrete and rebuilding the section with 300 mm of plain jointed, doweled concrete over 100 mm of asphalt concrete over approximately 150 mm of aggregate base. Traffic control costs are included in the initial costs. Due to anticipated studded tire wear in the wheel paths, diamond grinding is expected after 20 years. The pavement life is expected to be 40 years. As shown below, the equivalent uniform annual cost (EUAC) for this option is $760,000.



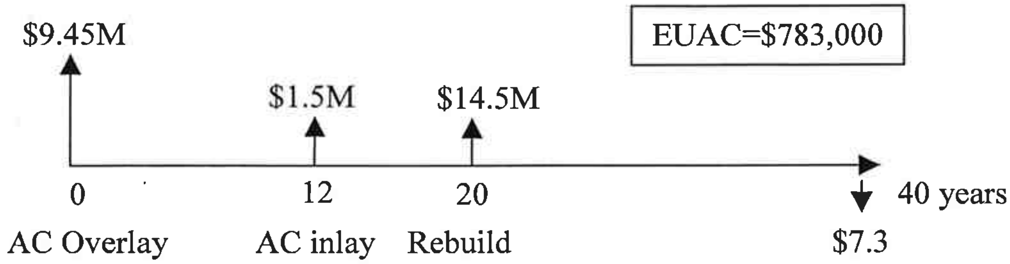
5.2.2 Asphalt Concrete Overlay

The asphalt concrete overlay option includes repairing the existing concrete pavement, raising the bridges and overlaying the pavement with 100 mm of asphalt concrete. The initial cost includes the concrete pavement repair costs, bridge raising costs, traffic control costs and material costs. The mill and inlay strategies include removing and replacing 50 mm of AC. The four rehabilitation strategies include:

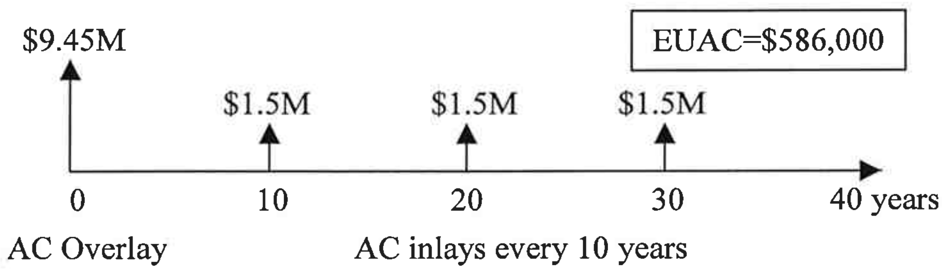
1. Overlay with AC and rebuild the pavement with concrete. The salvage value for the pavement is estimated to be $3M at year 40. The EUAC for this option is $903,000 as shown below.



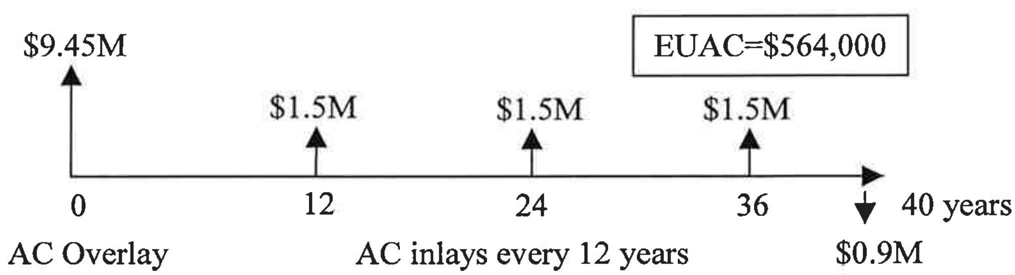
2. Overlay with AC; mill and inlay with AC at year 12 and rebuild the pavement with concrete at year 20. The salvage value for the pavement is estimated to be \$7.3M at year 40. As shown below, the EUAC for this option is \$783,000.



3. Overlay with AC; mill and inlay with AC every 10 years. The EUAC for this option is \$586,000 as shown below.



4. Overlay with AC; mill and inlay with AC every 12 years. The EUAC for this option is \$564,000 as shown below.



6.0 CONTRACTING METHODS

Contracting methods were discussed to consider alternatives for reconstruction of the urban freeway. The comments included:

- A+B bidding may not be an option due to the Oregon Department of Administrative Services (DAS) constraints. DAS currently allows ODOT one exception per year to the low bidder selection criteria. Another project (I-5/Kruse Way) is already scheduled to be bid as an A+B contract this fiscal year.

- Even if the contract were not an A+B, consider including incentives and disincentives. ODOT recently completed a contract (I-5 Interstate Bridge Trunnion Project) with early completion incentives of $100,000/day. The contractor finished 14 days early from the specified 21-day completion time limit established under the contract.

- Provide intermediate completion dates to minimize risk to contractor. If problems arise, ODOT could readjust the contract and continue.

- Early completion incentives for the AC option are only justified if the project is scheduled to be done in one season.

7.0 CONCLUSIONS

A secret ballot was done to solicit the general comments of the workshop participants. Of 22 votes, 11 favored the concrete reconstruction with a full traffic closure in one direction; ten favored the AC overlay; and one favored the concrete reconstruction with partial traffic closure. The comment on the concrete option with partial traffic closure was that "we know method/results". Comments on the other options are included in Tables 7.1 and 7.2.

Table 7.1: Comments on Concrete Reconstruction with Full Traffic Closure.

- Would be my first choice, it makes no sense to spend $30 million then come in 12 years later. The public wants us to stay out. Would agree for State DOT's to stay out!
- Better engineering solution will provide a longer more durable pavement. More of a challenge to complete – better feeling of accomplishment, security once done. Less risk to ODOT overall, if public is adequately informed. Just do it.
- Least performance risk for not that much more dollars. Least hassle to public over the long haul.
- Less risk in performance. Ability to get in – get out and stay out (40+ year performance period).
- The best choice.
- Never done before; innovative contracting; show your stuff. Long term solution if studs are eliminated.
- Condensed time impact to users (public will understand if properly informed). Better quality lower prices. If done right, well on time, should result in better public image. In and out, gone for years. Can let bridgework now? And concrete work later? Let it continue to deteriorate.
- Better product life. Not back to fix base.
- Greater impact; less time, safety.
- Lets do it right; get in, get out and stay out.

Table 7.2: Comments on AC Overlay with Partial Closure.

- Impact of PCC would be too great for the road system. AC would work for 10 years plus maybe 15 years. By the year 2015 Oregon will be forced to start building more routes, which would help in the total rebuild.
- Lower overall costs. Avoids impacts to the neighborhoods as far as cut-through traffic is concerned. Minimum risks because of limited lane restrictions and lane closures.
- Overall best price (short term). Least affect on traffic. Public acceptance of this method will be better. Overall impact to area business will be less.

Table 7.2: Comments on AC Overlay with Partial Closure.

- Easy reconstruct, less traffic impact, cheaper, lowest public inconvenience, one construction season, utilize existing material, easy to renew the surface i.e., mill and inlay.
- Traffic management concerns.
- I vote for AC overlay based on the lowest annual cost.
- Minimum impact to traffic, least initial cost and life cycle cost. Utilize existing material.
- Until the I-5 corridor issue and light rail routes are finalized should not spend money to completely reconstruct the section. Also if we have full closure and inconvenience public and do not give them anything additional (lanes capacity) to what they have now ODOT would be looked upon unfavorably by public. Should minimize costs to maintain existing structure of pavement also minimize expense with dealing with the structure clearances.
- Lower life cycle costs, lowest public inconvenience.
- Consider digging out under all structures because of uncertain future of I-5. Should not consider the AC or PCC reconstruct with partial closures. If ODOT is not willing to go to Metro to add capacity and additional lanes, plus delay the project then should not consider PCC reconstruct. If ODOT is willing to get buy in for added lanes and capacity and delay project for a year, then I would consider PCC with total closure.

8.0 CLOSEOUT

The closeout comments were favorable, as noted below:

- Good turnout/participation.
- Good to get better handle of time and costs.
- Appreciate participation from out of state.
- Worthwhile from Region 1 perspective.
- Good basis of information to make decision—glad he came (Georgia).
- Good to have contractor participation.
- Process impressive.
- Learned a lot to take back; facing problems similar to Nevada.
- WsDOT now has more power to justify lane closures; will have paving activities in Tacoma; PCC in Seattle.
- Documentation will be helpful.
- Energy, enthusiasm; and utilization of industry representatives was appreciated.
- Perception that contractors are partners is good.
- Good cooperation; open environment for discussion.
- Good to get diverse—learned things to take back.
- Eye opener—different problems faced by different states are similar.
- Learned more details about the project. Project development team will utilize the information.
- Ability to concentrate on a single subject without interference was effective.
- Will have better product as result of the workshop.
- Most valuable part was the project costing. Confirmed that all the facts are in line.
- Outside ODOT folks were helpful.
- Good information from groups.
- Interaction between industry, owners; agencies is important and necessary to keep going.
- Group worked well together; good participation.

9.0 RECOMMENDATIONS

Following the workshop, the ODOT Region 1 Management Team made the decision to pursue the overlay options. The decision was based on the lower initial cost, lower life cycle cost, and fewer unknowns associated with the construction. Consideration was also given to the tight time frame associated with getting the project designed and under contract. The short time frame did not allow for a large public outreach effort.

The information generated from the workshop and report will be used to develop strategies to deal with future Interstate 5 and Interstate 405 projects in the Portland area.

APPENDIX A

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APPENDIX B

CONCRETE REMOVAL DETAILS

CONCRETE REMOVAL DETAILS

The numbers used to determine the concrete removal costs were:

1. Saw cut the existing concrete panels into sections 30 ft long by 9 ft wide. Drill holes and use a crane on the straightaway to remove the panels and place them on a flat bed truck. A fork lift could be used under bridges.
2. The cost for saw cutting would be about $7.50/lf, full depth. This work would be done about the same time as the median barrier was being replaced.
3. Removal would be $282,000 (9' x 30'panels @ $100/ea).
4. Disposal would be 17,600 cy PCC @ $15/ton = $600,000.
5. Over excavation costs – remove 7" x 72' x $6/ton = $240,000.