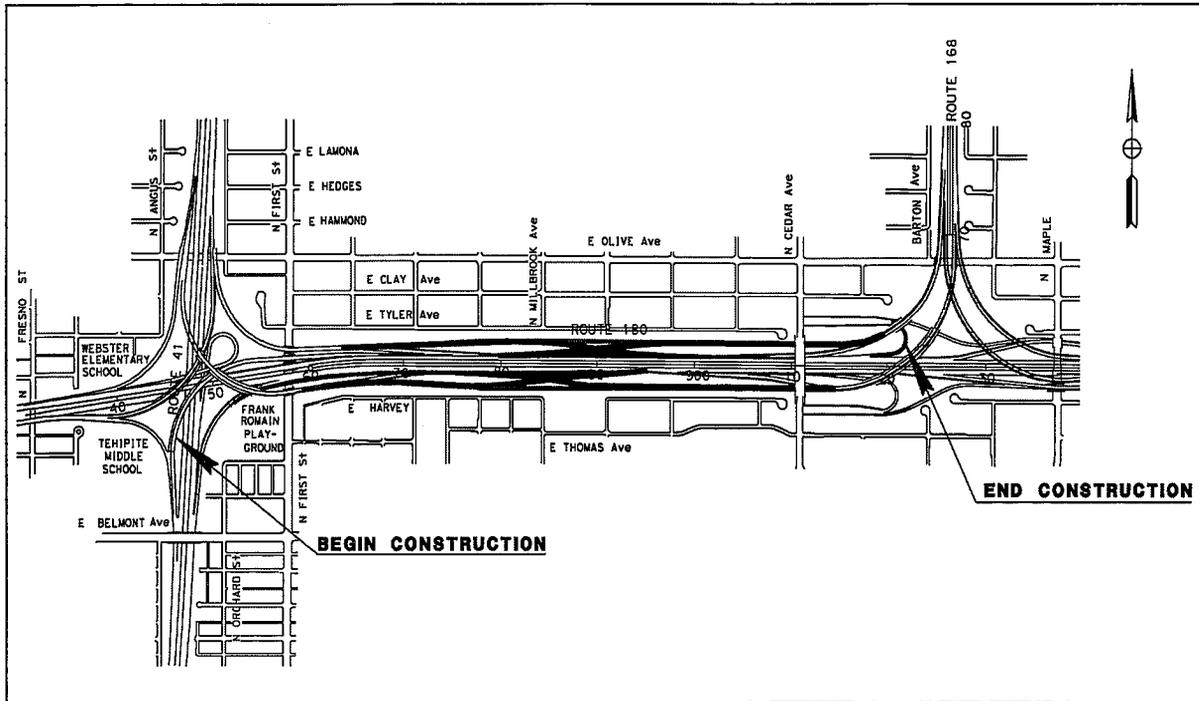


# PAVEMENT LIFE CYCLE COST ANALYSIS

## FREEWAY 180 BRAIDED RAMPS PROJECT



On Route 180, in Fresno County, from Route 41 to Route 168  
06-Fre-180-0C1100

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July 2010

## SUMMARY

It is proposed to improve traffic operations on Route 180 between Routes 41 and 168 in Fresno County (PM R58.4/R60.4) by constructing new braided branch connections within the interchanges of Routes 41, 180, and 168. The project would improve traffic operations, reduce congestion, and enhance traffic safety within the freeway-to-freeway interchanges. Along the proposed new branch connections, two new separation structures would be constructed and the existing First Street undercrossing would be widened. Also, the westbound Cedar Avenue on-ramp would be widened to two lanes in order to accommodate a proposed ramp-metering system. All work would be within the existing right-of-way.

The current total estimated construction capital cost for the project is as follows:

Roadway	\$29,000,000
Structures	<u>20,000,000</u>
Total	\$49,000,000

Two alternatives of pavement were compared in the pavement life cycle cost analysis in the project report phase. Following the Life Cycle Cost Analysis Procedures Manual, calculations were performed typically on the structural sections proposed by the District Material Engineering Branch for the BC1A2 (WB Route 168 to WB Route 180) branch connection, which is about 4,067 feet long.

Alternative 1: 0.65' HMA Type A / 0.80' Class 2 AB  
 Unit costs: \$80/ton for HMA and \$45/cy for AB)  
 Total initial cost: \$830,000

Alternative 2: 0.85' JPCP / 0.35' LCB  
 Unit costs: \$110/CY for JPCP and \$80/CY for LCB  
 Total initial cost: \$714,000

From the RealCost software outputs the equivalent uniform annual cost (EUAC) of the JPCP is estimated at \$5,034 or 24% lower than the estimated EUAC of the HMA of \$6,710.

It is recommended to select the JPCP to be proposed for structural sections on the new branch connections in this project.

## RealCost Input Data

<b>1. Economic Variables</b>	
Value of Time for Passenger Cars (\$/hour)	\$10.46
Value of Time for Single Unit Trucks (\$/hour)	\$27.83
Value of Time for Combination Trucks (\$/hour)	\$27.83

<b>2. Analysis Options</b>	
Include User Costs in Analysis	No
Include User Cost Remaining Service Life Value	No
Use Differential User Costs	No
User Cost Computation Method	Calculated
Include Agency Cost Remaining Service Life Value	Yes
Traffic Direction	Both
Analysis Period (Years)	35
Beginning of Analysis Period	2015
Discount Rate (%)	5.0

<b>3. Project Details and Quantity Calculations</b>	
State Route	180
Project Name	Braided Ramps Between Route 168/41
Region	District -6
County	Fresno
Analyzed By	Ohannes Bedrossian
Mileposts	
Begin	58.40
End	60.40
Length of Project (miles)	2.00
Comments	

<b>4. Traffic Data</b>	
AADT Construction Year (total for both directions)	31,294
Cars as Percentage of AADT (%)	96.0
Single Unit Trucks as Percentage of AADT (%)	2.8
Combination Trucks as Percentage of AADT (%)	1.2
Annual Growth Rate of Traffic (%)	2.4

Speed Limit Under Normal Operating Conditions (mph)	50
No of Lanes in Each Direction During Normal Conditions	2
Free Flow Capacity (vphpl)	
Rural or Urban Hourly Traffic Distribution	Urban
Queue Dissipation Capacity (vphpl)	
Maximum AADT (total for both directions)	108,000
Maximum Queue Length (miles)	

**Alternative 1**

<b>Initial Construction</b>	<b>20 YEAR HMA PAVEMENT</b>	
Agency Construction Cost (\$1000)	\$830.00	
User Work Zone Costs (\$1000)		
Work Zone Duration (days)	30	
No of Lanes Open in Each Direction During Work Zone	2	
Activity Service Life (years)	18.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost (\$1000)	4.8	
Work Zone Length (miles)	0.57	
Work Zone Speed Limit (mph)	50	
Work Zone Capacity (vphpl)	1500	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

<b>Rehabilitation #1</b>	<b>5 YEAR CAPM</b>	
Agency Construction Cost (\$1000)	\$136.00	
User Work Zone Costs (\$1000)		

Work Zone Duration (days)	30	
No of Lanes Open in Each Direction During Work Zone	2	
Activity Service Life (years)	5.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost (\$1000)	1.51	
Work Zone Length (miles)	0.57	
Work Zone Speed Limit (mph)	50	
Work Zone Capacity (vphpl)	1500	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

<b>Rehabilitation #2</b>	<b>10 YEARS HMA REHAB</b>	
Agency Construction Cost (\$1000)	\$409.00	
User Work Zone Costs (\$1000)		
Work Zone Duration (days)	30	
No of Lanes Open in Each Direction During Work Zone	2	
Activity Service Life (years)	10.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost (\$1000)	4.32	
Work Zone Length (miles)	0.57	
Work Zone Speed Limit (mph)	50	
Work Zone Capacity (vphpl)	1500	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure		

Second period of lane closure		
Third period of lane closure		

Rehabilitation #3	5 YEAR CAPM HMA	
Agency Construction Cost (\$1000)	\$136.00	
User Work Zone Costs (\$1000)		
Work Zone Duration (days)	30	
No of Lanes Open in Each Direction During Work Zone	2	
Activity Service Life (years)	5.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost (\$1000)	1.5	
Work Zone Length (miles)	0.57	
Work Zone Speed Limit (mph)	50	
Work Zone Capacity (vphpl)	1500	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

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Rehabilitation #4		
Agency Construction Cost (\$1000)		
User Work Zone Costs (\$1000)		
Work Zone Duration (days)		
No of Lanes Open in Each Direction During Work Zone		
Activity Service Life (years)		
Maintenance Frequency (years)		
Agency Maintenance Cost (\$1000)		
Work Zone Length (miles)		
Work Zone Speed Limit (mph)	45	
Work Zone Capacity (vphpl)		
Time of Day of Lane Closures (use whole numbers		

based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

<b>Rehabilitation #5</b>		
Agency Construction Cost (\$1000)		
User Work Zone Costs (\$1000)		
Work Zone Duration (days)		
No of Lanes Open in Each Direction During Work Zone		
Activity Service Life (years)		
Maintenance Frequency (years)		
Agency Maintenance Cost (\$1000)		
Work Zone Length (miles)		
Work Zone Speed Limit (mph)	45	
Work Zone Capacity (vphpl)		
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

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<b>Rehabilitation #6</b>		
Agency Construction Cost (\$1000)		
User Work Zone Costs (\$1000)		
Work Zone Duration (days)		

No of Lanes Open in Each Direction During Work Zone		
Activity Service Life (years)		
Maintenance Frequency (years)		
Agency Maintenance Cost (\$1000)		
Work Zone Length (miles)		
Work Zone Speed Limit (mph)	45	
Work Zone Capacity (vphpl)		
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

**Alternative 2**

Initial Construction	20 YEAR RIGID JPCP PAVEMENT	
Agency Construction Cost (\$1000)	\$714.00	
User Work Zone Costs (\$1000)		
Work Zone Duration (days)	30	
No of Lanes Open in Each Direction During Work Zone	2	
Activity Service Life (years)	25.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost (\$1000)	0.96	
Work Zone Length (miles)	0.57	
Work Zone Speed Limit (mph)	50	
Work Zone Capacity (vphpl)	1500	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		

Third period of lane closure		
Outbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

Rehabilitation #1	5 YEAR CAPM	
Agency Construction Cost (\$1000)	\$168.00	
User Work Zone Costs (\$1000)		
Work Zone Duration (days)	30	
No of Lanes Open in Each Direction During Work Zone	2	
Activity Service Life (years)	5.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost (\$1000)	4.1	
Work Zone Length (miles)	0.57	
Work Zone Speed Limit (mph)	50	
Work Zone Capacity (vphpl)	1500	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

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Rehabilitation #2	10 YEAR REHAB	
Agency Construction Cost (\$1000)	\$294.00	
User Work Zone Costs (\$1000)		
Work Zone Duration (days)	30	
No of Lanes Open in Each Direction During Work Zone	2	
Activity Service Life (years)	10.0	
Maintenance Frequency (years)	1	
Agency Maintenance Cost (\$1000)	2.1	

Work Zone Length (miles)	0.57	
Work Zone Speed Limit (mph)	50	
Work Zone Capacity (vphpl)	1500	
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

<b>Rehabilitation #3</b>		
Agency Construction Cost (\$1000)		
User Work Zone Costs (\$1000)		
Work Zone Duration (days)		
No of Lanes Open in Each Direction During Work Zone		
Activity Service Life (years)		
Maintenance Frequency (years)		
Agency Maintenance Cost (\$1000)		
Work Zone Length (miles)		
Work Zone Speed Limit (mph)	45	
Work Zone Capacity (vphpl)		
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

<b>Rehabilitation #4</b>		
Agency Construction Cost (\$1000)		
User Work Zone Costs (\$1000)		
Work Zone Duration (days)		
No of Lanes Open in Each Direction During Work Zone		
Activity Service Life (years)		
Maintenance Frequency (years)		
Agency Maintenance Cost (\$1000)		
Work Zone Length (miles)		
Work Zone Speed Limit (mph)	45	
Work Zone Capacity (vphpl)		
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

<b>Rehabilitation #5</b>		
Agency Construction Cost (\$1000)		
User Work Zone Costs (\$1000)		
Work Zone Duration (days)		
No of Lanes Open in Each Direction During Work Zone		
Activity Service Life (years)		
Maintenance Frequency (years)		
Agency Maintenance Cost (\$1000)		
Work Zone Length (miles)		
Work Zone Speed Limit (mph)	45	
Work Zone Capacity (vphpl)		
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure		

Second period of lane closure		
Third period of lane closure		

<b>Rehabilitation #6</b>		
Agency Construction Cost (\$1000)		
User Work Zone Costs (\$1000)		
Work Zone Duration (days)		
No of Lanes Open in Each Direction During Work Zone		
Activity Service Life (years)		
Maintenance Frequency (years)		
Agency Maintenance Cost (\$1000)		
Work Zone Length (miles)		
Work Zone Speed Limit (mph)	45	
Work Zone Capacity (vphpl)		
Time of Day of Lane Closures (use whole numbers based on a 24-hour clock)		
Inbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		
Outbound	Start	End
First period of lane closure		
Second period of lane closure		
Third period of lane closure		

**Deterministic Results**

Total Cost	Alternative 1: 20 YEAR HMA PAVEMENT		Alternative 2: 20 YEAR RIGID JPCP PAVEMENT	
	Agency Cost (\$1000)	User Cost (\$1000)	Agency Cost (\$1000)	User Cost (\$1000)
Undiscounted Sum	\$1,557.42	\$0.00	\$1,076.84	\$0.00
Present Value	\$1,098.68	\$0.00	\$824.25	\$0.00

EUAC	\$67.10	\$0.00	\$50.34	\$0.00
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**Probabilistic Results**

Total Cost (Present Value)	Alternative 1: 20 YEAR HMA PAVEMENT		Alternative 2: 20 YEAR RIGID JPCP PAVEMENT	
	Agency Cost (\$1000)	User Cost (\$1000)	Agency Cost (\$1000)	User Cost (\$1000)
Mean				
Standard Deviation				
Minimum				
Maximum				

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**Tornado Graphs**