Disclaimer

This chapter is 1 of 8 included in the Caltrans Maintenance Technical Advisory Guide (TAG). The information presented in this chapter is for educational purposes only. It does not represent a policy or specification nor does it endorse any of the products and/or processes discussed.

CHAPTER 2 FRAMEWORK FOR TREATMENT SELECTION

1.0 INTRODUCTION

There are many factors that are considered in the process of selecting an appropriate treatment for a pavement. These include pavement age, condition, traffic levels, expected future plans, as well as available funding and agency policy. At the network level, a general relationship exists between pavement condition and pavement age. For a properly constructed new pavement, the only treatments that are required are preventive maintenance (maintenance performed to delay the onset of distress). Then, as the pavement ages, it may become a candidate for routine maintenance (crack sealing or chip sealing), rehabilitation and eventually reconstruction. The purpose of this chapter is to provide guidance on treatment selection. The first step in selecting the appropriate maintenance treatment is determining, based on the life cycle and pavement condition index of the existing pavement, the most appropriate maintenance strategy for a treatment applied to a relatively new pavement differs from the strategy. The most appropriate maintenance strategy for a treatment being applied to a pavement nearing the end of its life cycle. Figure 1 illustrates the treatment strategies employed based on the condition index of the existing pavement.

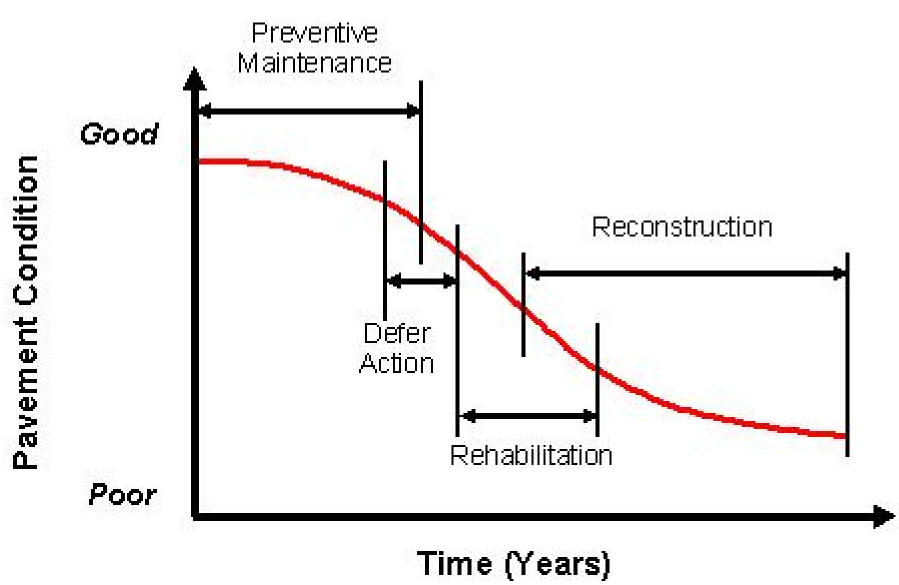

Figure 1: Treatment Strategy Based on Pavement Condition

Once an appropriate maintenance strategy has been chosen, a specific treatment is selected to address the specific distress mechanism for the pavement. The most important factors to consider when choosing a maintenance treatment include:

- Will the treatment address the distresses present? (i.e., Will it work?)
- Can the required preparation for the treatment be carried out?
- Is the treatment cost effective?
- Will the treatment be performed before the situation being addressed changes?

2.0 SELECTION PROCESS

There are three basic steps in the maintenance treatment selection process. These steps include:

- Assess the existing conditions.
- Determine the feasible treatment options.
- Analyze and compare the feasible options with each other.

2.1 ASSESS THE EXISTING CONDITIONS

The first step of the treatment selection process is to perform an evaluation of the existing conditions. This evaluation can be broken down into three processes, which include:

- Visual site inspection and/or inspection of project information from a database and/or records.
- Testing the existing pavement, as conditions require.
- Define the performance requirements for the treatment.

The Caltrans Field Distress Manual (2) or Caltrans Pavement Survey (3) may be used to identify pavement distress mechanisms. Treatment methods for the distress mechanisms are discussed in the following chapters of this document.

It is helpful to assess pavements using a pavement assessment form of some kind. A well-developed form promotes uniformity in the assessment process. The District Maintenance Engineer or other reviewer should fill out the pavement assessment form, on site, for each pavement being considered for treatment. Figure 2 illustrates an example of a pavement assessment form (2) and the type of information that should be collected.

2.2 DETERMINE THE FEASIBLE TREATMENT OPTIONS

Once the pavement condition has been quantified, test results collected and analyzed, and other available data are reviewed, feasible treatments can be identified. In this context, "feasibility" is determined by a treatment's ability to address the functional and structural condition of the pavement while also meeting any future needs. Note that feasibility is not a function of affordability, because at this stage of the selection process the primary purpose is to determine what treatments might work. Figure 3 illustrates the Caltrans matrix for treatment options.

Distress Survey Date: ____________________ Air Temperature : Before: _____ After: _____

Surveyor: ____________________ Pavement Surface Temp: Before: _____ After: _____

Station PM/KP	Cracking																		Deformation				
	Longitudinal, a			Fatigue, b			Transverse, c			Reflective, c			Block, b			Edge, a			Rutting, d	Corrugation, b	Shoving, e	Depression, b	Overlay Bumps, c
	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H					

a = Length, meter; b = Area, square meter; c = Number and length, meter; d = Maximum depth, mm. Record plastic flow (Yes/No); e = Number and square meter

L = Low severity; M = Moderate severity; H = High severity

Figure 2: Typical Pavement Rating Form – Visual (2)

Treatment	Pavement Condition										Parameters																
				Rutting		Cracking					Climate				Traffic Volumes												
						Alligator B																					
	Raveling	Oxidation	Bleeding	<1/2"	>1/2"	0 to 10%	10 to 20%	20 to 30%	Longitudinal	Transverse	Desert	Valley	Coastal	Mountains	adt<5000	adt<5000<3000	adt<3000	Night/Cold	Stop Points	Urban	Rural	High Snow Plow Use	Cost Per Lane Mile	Life Expectancy (years)	Life Cycle Cost ($/year)
Crack/Joint Seal																										
Emulsion	N	N	N	N	N	F	P	N	F	F	G	G	G	G	G	G	G	N	G	G	G	G	2,500	1 to 2	1,700
Modified (Rubber)	N	N	N	N		G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	2,500	2 to 3	1,000
Low Modulus (Polymer & Asphalt)																									
Fog Seal (See note 1)	F	G	N	N	N	F	P	N	P	P	G	G	G	G	F	N	N	P	F	G	G	F	4,500	1	4,500
Rejuvenator (See note 1)	G	G	N	N	N	F	N	N	N	N	G	G	G	G	G	F	N	N	N	G	G	F	4,500	2 to 4	1,500
Slurry Seals																									
Type II (See note 2)	F	G	N	N	N	F	N	N	N	N	G	G	G	F	G	G	G	P	G	G	G	P	13,000	3 to 4	3,700
Type III	G	G	N	F	N	F	P	N	N	N	G	G	G	F	G	G	G	N	G	G	G	P	13,000	3 to 4	3,700
Microsurfacing																									
Type II (See note 2)	F	G	N	G	N	F	N	N	N	N	G	G	G	G	G	G	G	F	G	G	G	F	16,000	3 to 4	4,500
Type III	G	G	N	G	G	F	P	N	N	N	G	G	G	G	G	G	G	F	G	G	G	F	16,000	3 to 4	4,500
Chip Seal																									
PME – Med. Fine	G	G	N	F	N	G	F	N	P	P	G	G	F	F	G	G	N	N	P	P	G	P	6,500	3 to 5	1,600
PME – Medium	G	G	N	F	N	G	F	N	P	P	G	G	F	F	G	N	N	N	P	P	G	F	6,500	3 to 5	1,600
PMA – Medium	G	G	N	F	N	G	F	P	P	P	G	G	G	G	G	G	N	G	P	P	G	F	12,500	4 to 5	2,800
PMA – Coarse	G	G	N	F	N	G	F	P	P	P	G	G	G	G	G	N	N	G	P	P	G	G	12,500	4 to 5	2,800
AR – Medium	G	G	N	F	N	G	G	F	P	P	G	G	G	G	G	G	N	G	P	P	G	F	20,000	4 to 6	4,000
AR – Coarse	G	G	N	F	N	G	G	F	P	P	G	G	G	G	G	N	N	G	P	P	G	G	20,000	4 to 6	4,000
PM Alternative																									
Conventional OGAC	G	G	P	P	N	G	F	N	P	P	G	G	G	G	G	G	G	P	G	G	G	O	19,500	3 to 4	5,600
PBA OGAC4	G	G	P	P	N	G	F	N	P	P	G	G	G	G	G	G	G	F	G	G	G	P	25,000	4 to 5	5,600
AR (Type O)	G	G	P	F	N	G	G	F	P	P	G	G	G	G	G	G	G	P	G	G	G	P	28,000	4 to 6	5,600
Thin Blanket ACOL																									
Conventional	G	G	P	G	G	G	G	F	P	P	G	G	G	G	G	G	G	G	G	G	G	G	20,000	3 to 5	5,000
PBA	G	G	P	G	G	G	G	G	F	F	G	G	G	G	G	G	G	G	G	G	G	G	25,000	3 to 6	5,600
R (Type G)	G	G	P	G	F	G	G	G	G	G	G	G	G	G	G	G	G	F	G	G	G	G	30,000	5 to 8	4,600
Digouts	P	P	G	N	G	N	N	G	P	P	G	G	G	G	G	G	G	G	G	G	G	G	19,000	5 to 8	2,900

G – Good Performance
F – Fair Performance
P – Poor Performance
N – Not Recommended

Note: 1. Generally used on shoulders, low volume roads, and parking areas. Should not be placed on traveled way by contract until further notice.
2. Generally used on shoulders, parking areas, and locations where a less aggressive surface texture is desired.

Figure 3: Caltrans Maintenance Treatment Matrix (5)

Once the feasible options have been determined, the limitations of each of the options should be taken into account in relation to its suitability vs. the other feasible options. Treatment limitations are imposed by such factors as deflection, pavement, curvature, roughness and permeability. The most inexpensive option that satisfies the maintenance requirements within its limitations should be considered first. At this point, a life cycle analysis or other cost effectiveness measure should be made as discussed in the next section.

2.3 ANALYZE AND COMPARE THE FEASIBLE TREATMENT OPTIONS

It is likely that there will be several treatments that are identified as feasible. In comparing these different treatments, thought should be given to the treatment placement cost, the life of the treatment and whether or not the treatment extends the life of the pavement. Additional factors to consider when analyzing and comparing treatment options are: the cost effectiveness, traffic level, construction limitations, and any factors, such as weather, curing times or local issues that affect a specific treatment. The most desirable treatment is the one that provides the greatest benefit (whether that benefit is measured in terms of improvement in condition, extension of pavement life, or even, more simply, the life of the treatment) for the lowest life cycle costs. At this point a life cycle or other cost effectiveness measure should be made.

Reconstruction and maintenance costs rise as a pavement ages. However, if maintenance and/ or rehabilitation (M&R) is carried out too early the costs are prohibitively high. There is an optimum time at which maintenance can be performed to provide the maximum cost effectiveness. Figure 4 shows a typical cost effectiveness relationship with respect to timing of treatment applications.

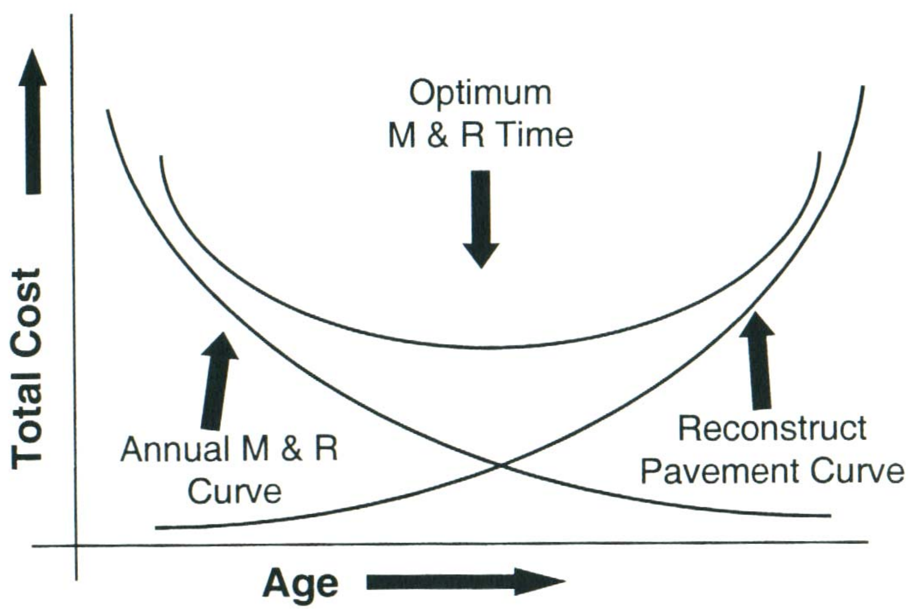

Figure 4: Treatment Timing versus Costs (6)

2.3.1 Cost Effectiveness

Caltrans calculates cost effectiveness using the Caltrans Pavement Condition Report (3) system. However, for an initial assessment a more simplified approach may be employed (5). This simplified approach is useful as costs and actual bid prices fluctuate. One simplified approach that can be used is the equivalent annual cost (EAC). In this method an equivalent annual cost is calculated using the following equation (5):

EAC = Unit Cost of Treatment / Expected Life of Treatment……………………..(9.1)

At this stage the treatment that meets the performance requirements with the lowest EAC may be selected. Other, more complex, methods exist (7) and may be used to calculate whole of life costing.

2.3.2 Choosing from the Maintenance Treatment Matrix

The main issues to consider when selecting between accepted treatments listed in the Caltrans treatment selection matrix are:

- Performance and Constructability
- Customer Satisfaction

Performance and constructability factors include the expected life of a treatment, seasonal effects on a treatment, existing pavement conditions, the existing pavement structure and the EAC calculated for the treatment. The contractor's experience, materials availability and weather limitations should also be taken into account. Each of these items is rated on a scale of 1 to 5. The District Maintenance Engineer or local supervisor should assign the ratings based on their individual experience. The ratings are based on the fact that a treatment is suitable when it is properly applied; however, project limitations such as climate conditions and material limitations may prohibit proper procedures from being followed. In situations where new products or material sources are being introduced, a risk factor should be considered, and a lower rating given to these materials. Similarly, if a contractor is unfamiliar with the new product or new material a lower rating should be given, despite the technical properties of a new product.

Customer satisfaction factors are social factors and include: traffic disruption, skid resistance achieved and noise level. Aesthetic factors such as dust and general appearance are also included. This allows a feasible option to be evaluated on factors other than cost and performance. The most cost effective and long lasting treatment may not be the right treatment for the right pavement at the right time under some conditions.

The rating factor is the weight, based on overall importance to the job success, assigned to a specific treatment's attribute; the higher the rating the more significant the attribute's impact on the job's success. The sum of all rating factors must equal 1.0. Figure 5 illustrates a blank ratings evaluation worksheet while Figure 6 shows an example of a worksheet comparing a chip seal and a microsurfacing for a particular job. Based on the results of the worksheet (Figure 6), a microsurfacing treatment (Total Score of 3.55) would be chosen over the chip seal (Total Score of 2.90) for this job. This process should be repeated for all potential treatments that meet the feasibility requirements.

RATING FACTOR		SCORING FACTOR CHIP	SCORING FACTOR MICRO		RATING FACTOR		TOTAL SCORE CHIP	TOTAL SCORE MICRO
PERFORMANCE EVALUATION ATTRIBUTES								
____ %	Expected Life			×		=		
____ %	Seasonal Effects			×		=		
____ %	Pavement Structure Influence			×		=		
____ %	Influence of Existing Pavement Condition			×		=		
CONSTRUCTABILITY ATTRIBUTES								
____ %	Cost Effectiveness (EAC)			×		=		
____ %	Availability of Quality Contractors			×		=		
____ %	Availability of Quality Materials			×		=		
____ %	Weather Limits			×		=		
CUSTOMER SATISFACTION ATTRIBUTES								
____ %	Traffic Disruption			×		=		
____ %	Noise			×		=		
____ %	Surface Friction			×		=		
100 %					*Total*			

RATING FACTOR: PERCENT OF IMPACT ON TREATMENT DECISION (total must = 100%)
SCORING FACTOR:
5 = Very important
4 = Important
3 = Some importance
2 = Little importance
1 = Not important

Figure 5: Rating Evaluation Work Sheet (6)

NOTE: Ratings may vary from one district to another.

RATING FACTOR		SCORING FACTOR CHIP	SCORING FACTOR MICRO		RATING FACTOR		TOTAL SCORE CHIP	TOTAL SCORE MICRO
PERFORMANCE EVALUATION ATTRIBUTES								
15 %	Expected Life	3	4	×	0.15	=	0.45	0.60
10 %	Seasonal Effects	2	3	×	0.10	=	0.20	0.30
5 %	Pavement Structure Influence	3	3	×	0.05	=	0.15	0.15
5 %	Influence of Existing Pavement Condition	4	2	×	0.05	=	0.20	0.10
CONSTRUCTABILITY ATTRIBUTES								
10 %	Cost Effectiveness (EAC)	5	4	×	0.10	=	0.50	0.40
5 %	Availability of Quality Contractors	4	3	×	0.05	=	0.20	0.15
10 %	Availability of Quality Materials	3	2	×	0.10	=	0.30	0.20
5 %	Weather Limits	3	4	×	0.05	=	0.15	0.20
CUSTOMER SATISFACTION ATTRIBUTES								
20 %	Traffic Disruption	1	5	×	0.20	=	0.20	1.00
5 %	Noise	1	4	×	0.05	=	0.05	0.15
10 %	Surface Friction	5	3	×	0.10	=	0.50	0.30
100 %					*Total*		*2.90*	*3.55*

RATING FACTOR: PERCENT OF IMPACT ON TREATMENT DECISION (total must = 100%)
SCORING FACTOR:
5 = Very important
4 = Important
3 = Some importance
2 = Little importance
1 = Not important

Figure 6: Example Ratings Evaluation Worksheet

Chip Seal Vs. Microsurfacing (6)

3.0 REFERENCES

1. Cornell Local Roads Program, “Hot and Cold Mixing Paving”, Principles and Practices Report, 95-4, 1995.

2. California Department of Transportation, “Guide to the Investigation and Remediation of Distress in Flexible Pavements: Field Manual”, Sacramento, California, July, 2002.

3. California Department of Transportation, “Caltrans Pavement Survey”, Sacramento, California, January, 2000.

4. Koch Pavement Solutions, “A Pocket Guide to Pavement Preservation”, Form for Field Surveys, 2001.

5. Hicks, R.G, Seeds, S.B., Peshkin, D.G., “Selecting a Preventative Maintenance Treatment for Flexible Pavements”, FHWA Report, FHWA-IF-00-027, 2000.

6. Hicks, R.G., Jackson D., “Benefits of Pavement Maintenance- an Update”, Western Pavement Maintenance Forum, Sacramento, California, 1998.

7. O’Brien, L.G., “Evolution and Benefits of Preventative Maintenance Strategies”, NCHRP Synthesis 153, Transportation Research Board, Washington, DC, 1989.

8. Moulthrup, J., Thomas, T., Ballou, W., King, H., “Choose the Right Tool for the Right Distress”, Asphalt Contractor, September Issue, 1999.