



THURBER ENGINEERING LTD.

**EQUIVALENT PAVEMENT DESIGNS FOR MUNICIPALITIES
RIGID AND FLEXIBLE PAVEMENTS**

PROVINCE OF BRITISH COLUMBIA

**Report to
Cement Association of Canada**

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EQUIVALENT PAVEMENT DESIGNS FOR MUNICIPALITIES RIGID AND FLEXIBLE PAVEMENTS

PROVINCE OF BRITISH COLUMBIA

EXECUTIVE SUMMARY

Most municipalities in the Province of British Columbia currently construct flexible pavements for their road network. Although suitable for lower volume roadways or areas with competent subgrade conditions, flexible pavements may not always be the correct pavement type when designing heavier travelled pavements, nor the most cost-effective alternative when comparing life cycle costs.

To provide assistance to municipalities in the Province of British Columbia, pavement design comparisons were developed for various traffic volumes, roadway classifications, and subgrade strengths. For each set of conditions, both flexible and rigid pavement designs were developed using the AASHTOWare *Pavement ME* software program, supplemented with the results of other commonly used programs such as AASHTO's (1993) DARWin and the American Concrete Pavement Association (ACPA) StreetPave 12.

Design inputs used in the analysis were compiled from a number of provincial and municipal documents, supplemented with information from the Cement Association of Canada (CAC) and local contractors. For comparison purposes, the equivalent pavement designs were evaluated with a Life Cycle Cost Analysis (LCCA) to determine the total cost to municipalities for each pavement section over a 50-year analysis period. Unit rates used in the LCCA were established taking into consideration typical rates from local industry.

Details on the pavement design analysis, resulting comparison design matrix, and LCCA are provided in this report. It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.



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EQUIVALENT PAVEMENT DESIGNS FOR MUNICIPALITIES RIGID AND FLEXIBLE PAVEMENTS

PROVINCE OF BRITISH COLUMBIA

1.0 INTRODUCTION

Most municipalities in the Province of British Columbia currently construct flexible pavements for their road network, while concrete pavements (if constructed) are typically reserved for bus lay-by areas. Although suitable for lower volume roadways or areas with competent subgrade conditions, flexible pavements may not always be the correct pavement type when designing heavier travelled roadways, nor the most cost-effective alternative when comparing life cycle costs.

Municipalities across Canada have been using rigid pavements as a viable pavement alternative for decades, particularly for roadways that support heavy truck traffic, or in areas with weak subgrade conditions. Although not very common in British Columbia, rigid pavements can provide municipalities with an alternative pavement type that could provide a more cost-effective solution to address some of their transportation infrastructure needs.

To provide assistance to municipalities in the Province of British Columbia, pavement design comparisons were developed for various traffic volumes, roadway classifications, and subgrade strengths for typical conditions throughout the province. For each set of conditions, both flexible and rigid pavement designs were developed using the AASHTOWare *Pavement ME* software program. This state-of-the-practice tool for the design of new and rehabilitated pavements is based on mechanistic-empirical principles. This design procedure empirically relates the cumulative damage for both flexible and rigid pavements to observed pavement distresses. Equivalent pavement designs presented in this document are based on the results of the *Pavement ME* analysis, supplemented with the results of other commonly used programs such as Association of American State Highway and Transportation Officials (AASHTO) 'DARWin' (1993) and the American Concrete Pavement Association (ACPA) 'StreetPave 12'.

Comparable pavement designs were evaluated using a Life Cycle Cost Analysis (LCCA), in terms of their Net Present Worth. The resulting costs represents the total cost to the municipality for each pavement type over a 50-year analysis period.

Details on the pavement design analysis, resulting comparison design matrix, and LCCA are provided in this report. It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.



2.0 BACKGROUND INFORMATION

The British Columbia Ministry of Transportation and Infrastructure (BCMoTI) recently revised a Technical Circular (T/01-15) that identifies the recommended pavement structure design process to determine various structure thicknesses for new construction and rehabilitation of roads and highways under provincial jurisdiction. The technical circular provides typical AASHTO 1993 pavement design input parameters, as well as typical flexible pavement designs for various types of roadways/highways. A summary of the typical flexible pavement for each vehicle class is provided in the table below.

Table 1. Typical Pavement Structures

Flexible Pavement Type	Roadway Designation	20-yr Design ESALs	Thickness (mm)		
			Asphalt	CBC	SGSB
A	High Volume Roads and Truck Lanes	> 20,000,000	≥ 150 mm	300 mm	300 mm (Soil)
B	Medium to High Volume Roads	100,000 to 20,000,000	75 to 150 mm	300 mm	150 mm (Rock)
C	Low Volume Subdivision Roads	< 100,000	50 to 75 mm	225 mm	150 mm (course Grained)
D	Low Volume Sealcoat or Gravel Roads	< 100,000	Graded Aggregate Sealcoat Layer(s)	225 mm	300 mm (Fine Grained)

3.0 PAVEMENT DESIGN INPUT PARAMETERS

The preparation of the pavement design comparison matrix required a number of input design parameters for the analysis. Design inputs used in the analysis were compiled from a number of provincial and municipal documents, supplemented with information from the local industry as well as municipal best practices in western Canada.

Pavement design inputs for the AASHTO 1993 (Darwin) analysis were in accordance with BCMoTI Technical Circular T-01/15, while soil and material input parameters for the AASHTOWare Pavement ME analysis were obtained from local consultants and contractors in the Province of British Columbia. Pavement design input parameters used to complete the AASHTOWare Pavement ME analysis are summarized in the ensuing sections.

3.1 Roadway Classifications

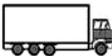
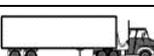
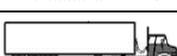
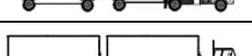
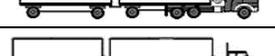
Upon a review of standard specifications for several municipalities in the Province of British Columbia, the roadway classifications used by these municipalities were consistent with similar municipalities across Canada. For this study, the roadway classifications have been grouped into four main categories: Industrial, Major Collector, Minor Arterial, and Major Arterial.

The two levels of Average Annual Daily Truck Traffic (AADTT) for each road classification were selected and included a typical average truck volume and the highest truck volume expected for each facility. The associated truck volumes and representative vehicle class distribution for each facility are provided in Table 2 and Table 3, respectively.

Table 2. Roadway Classification and Associated Truck Volumes

Roadway Classifications	AADTT
Industrial	250 & 500
Major Collector	750 & 1,600
Minor Arterial	2,500 & 5,000
Major Arterial	7,500 & 10,000

Table 3. Vehicle Class Distributions

FHWA Vehicle Classification			Industrial	Major Collector	Minor Arterial	Major Arterial
Class 4		2 or 3-Axle Busses	1.0%	20.5%	13.0%	9.4%
Class 5		2-Axle, 6-Tire, Single Unit Trucks	36.6%	33.8%	27.1%	22.6%
Class 6		3-Axle Single Units	6.8%	9.2%	6.0%	4.5%
Class 7		4 or more Axles, Single Unit Trucks	1.9%	1.5%	0.4%	0.4%
Class 8		4 or less Axles, Single Trailer Trucks	9.7%	8.9%	2.7%	1.5%
Class 9		5-Axle Single Trailer Trucks	16.4%	22.0%	19.1%	18.0%
Class 10		6 or more Axle Single Trailer Trucks	18.9%	1.8%	15.5%	25.0%
Class 11		5 or less Axle Multi-Trailer Trucks	0.3%	0.7%	0.5%	0.1%
Class 12		6-axle Multi-Trailer Trucks	0.5%	0.2%	0.5%	0.4%
Class 13		7 or more Axle Multi-Trailer Trucks	7.9%	1.4%	15.2%	18.1%

For the purpose of this analysis, a directional distribution factor of 50 percent was assumed. Furthermore, the roadways with an AADTT greater than 1,000 were assumed to have 2 lanes in each direction (four lane platform), with an 80 percent lane distribution for the design lane. Lower volume roadways (<1,000 AADTT) were assumed to be two-lane roadways. An average annual growth rate of 2.0 percent was applied to each roadway classification.



Although the *AASHTOWare Pavement ME* program used for the analysis does not convert the traffic into Equivalent Single Axle Loads (ESAL), the program does provide an output file with the calculated ESALs for the design inputs. The calculated Design ESALs by Pavement ME for each roadway classification and pavement type are provided in Table 4.

Table 4. Pavement ME Calculated Design ESALs

Roadway Classifications	AADTT	Flexible Design ESALs (Millions)	Rigid Design ESALs (Millions)
Industrial	250	0.9	1.3
	500	1.8	2.6
Major Collector	750	1.9	2.2
	1,600	4.0	4.8
Minor Arterial	2,500	8.5	12.4
	5,000	17.0	24.7
Major Arterial	7,500	29.7	45.0
	10,000	39.6	60.0

3.2 Design Reliability Levels:

Defining design reliability levels are important for pavement design purposes. For the purposes of this comparison study, the reliability levels from Table 3 of the BCMoTI Technical Circular T- 01/15 were applied. Applicable design reliability values are provided in Table 5.

Table 5. Design Reliability for Each Roadway Classification

Roadway Classifications	Reliability Level
Industrial	85 %
Major Collector	85 %
Minor Arterial	90 %
Major Arterial	90 %

3.3 Distress Prediction Target Values

For developing comparable pavement designs, a design life of 25 years was used for all roadway classifications. To evaluate the results of the pavement designs, the predicted distresses were required to meet a certain threshold value. The following target values were used for developing comparable pavement designs.

Table 6. Distress Prediction Target Values

Flexible Pavement – Performance Criteria	
Initial IRI	1.1 m/km
Predicted Terminal IRI	3.0 m/km
Permanent Deformation - AC only	10 mm
Permanent Deformation - Total Pavement	19 mm
AC Bottom-up Fatigue Cracking	20 %
AC Thermal Fracture	200 m/km
Rigid Pavement – Performance Criteria	
Initial IRI	1.3 m/km
Predicted Terminal IRI (m/km)	3.0 m/km
Transverse Cracking (Percent Slabs)	15 %
Mean Slab Faulting	6 mm

3.4 Climate Station Information

The Pavement ME software includes climate station information for 27 weather stations across the Province of British Columbia. As expected, climate station information throughout the province was found to be variable, with mean annual air temperatures ranging from as low as - 2.5°C in Smith River to 10.6°C in Vancouver. A sample of the climate properties from four climate stations are provided in Table 7.

Table 7. Climate File Comparison (TAC Pavement ME User Group)

Climate Properties	Vancouver	Fort St. John	Smith River
Mean Annual Air Temp. (°C)	10.6	2.6	-2.5
Mean Annual Precipitation (mm)	1,179	455	468
Number of Wet Days	167	118	147
Freezing Index (°C-days)	100	1,456	2,739
Average Annual No. Freeze-Thaw Cycles	37	83	94
Years of Climate Data	20	20	15

The selection of climate files for this study was limited to the provinces most populated areas. In comparison of the various climate properties, the climate file for the Vancouver area was selected to best represent municipalities in the southwestern-coastal part of the province.

3.5 Subgrade Soil Properties

Subgrade soil conditions are expected to change throughout the province, and often throughout a municipality’s jurisdiction. To capture the effects of changing subgrade soils, three different



subgrade soils were used for developing pavement designs. These soils included: Low Plastic Clay; Silty Sand; and Gravelly Sand. Instead of assuming a resilient modulus for each of these soils, the subgrade strengths for each group of soils were determined using Level 2 Inputs in Pavement ME. The gradation and other engineering properties for these soils were obtained from available geotechnical information throughout the province. The subgrade soil properties used for the Level 2 calculation are provided in the Table 8.

Table 8. Subgrade Soils – Input Parameters

Characteristic	Low Plastic Clay	Silty Sand	Gravelly Sand
Poisson's Ratio	0.2	0.325	0.3
Coefficient of Lateral Earth Pressure	0.6	0.73	0.68
Percent Passing 25 mm	100 %	91 %	97 %
Percent Passing 19 mm	86 %	89 %	94 %
Percent Passing 12.5 mm	84 %	85 %	85 %
Percent Passing 9.5 mm	83 %	83 %	77 %
Percent Passing 4.75 mm	81 %	80 %	67 %
Percent Passing 2.0 mm	79 %	75 %	60 %
Percent Passing 475 µm	76 %	63 %	44 %
Percent Passing 75 µm	64 %	40 %	21 %
Percent Passing 1 µm	13 %	10 %	4 %
Liquid Limit	30 %	22 %	18 %
Plasticity Index	16 %	10 %	4 %
Maximum Dry Unit Weight	1,858 kg/m ³	2,107 kg/m ³	1,996 kg/m ³
Optimum Moisture Content	14.4 %	9.0 %	11.9 %
Is Layer Compacted?	Yes	Yes	Yes
Resilient Modulus - Level 2 Calculation (at optimum moisture content)	71 MPa	117 MPa	206 MPa
<i>Approximate AASHTO '93 Resilient Modulus</i>	<i>30 MPa</i>	<i>40 MPa</i>	<i>50 MPa</i>

It is acknowledged that a common soil type in the Vancouver area comprises Fraser River Sand; however, the Pavement ME Level 2 Inputs for this soil do not reflect the strength values typically observed from load-deflection testing on roadways constructed with Fraser River Sand. For this reason, it is recommended that the preliminary pavement design for roadways constructed on Fraser River Sand use the Low Plastic Clay (30 MPa) pavement structures.

The resilient modulus for each soil type was calculated using the equations in Pavement ME, which represents the soil strength at optimum moisture content. The subgrade strengths determined by the Level 2 analysis varied from 71 MPa for the Low Plastic Clay, 117 MPa for the Silty Sand, to 206 MPa for the Gravelly Sand. It is noted that the resilient modulus used in the Pavement ME analysis (at optimum moisture content) is not the same value as typically used in



the AASHTO '93 design analysis (average strength). Further discussion on the difference between these two values can be found in the 2014 TAC proceedings, *Lessons Learned by Canadian Practitioners in Interpreting and Applying Pavement ME Design Results* (TAC 2014).

3.6 Hot Mix Asphalt Properties

The properties for the asphalt mixes used for the flexible design analysis were provided by the local industry. The asphalt mixes used in the analysis for all categories of flexible pavements met Master Municipal Construction Document (MMCD) material specifications for Lower Course #1 (binder) and Upper Course #1 (surface). A PG 64-22 was used as the asphalt cement grade for all roadway categories with an AADTT of 1,600 or less, while a PG70-22 was used in the analysis for Minor and Major Arterial roadways. A summary of the asphalt material properties are provided in Table 9.

Table 9. Hot Mix Asphalt – Input Parameters

Asphalt Material Type		Lower Course #1	Upper Course #1
Mixture Volumetric			
Unit Weight (kg/m ³)		2,456	2,446
Effective Binder Content - by Volume (%)		11.0	11.9
Air Voids (%)		5.0	5.0
Poisson's Ratio		0.35	
Mechanical Properties			
Dynamic Modulus		Calculated	
Aggregate Gradation	% Passing the 19 mm Sieve	99	100
	% Passing the 9.5 mm Sieve	70	86
	% Passing the 4.75 mm Sieve	47	53
	% Passing the 75 µm Sieve	4	5
G Star Predictive Model		"Use viscosity based model (nationally calibrated)"	
Reference Temperature		21.1 °C	
Asphalt Binder		PG 64-22	PG 64-22*
Indirect Tensile Strength – 10 deg.C (MPa)		Calculated	
Creep Compliance (1/GPa)		"Input level: 3" selected	
Thermal Properties			
Thermal Conductivity (watt/meter-Kelvin)		1.16	
Heat Capacity (joule/kg-Kelvin)		963	
Thermal Contraction		Calculated	

Note: Asphalt Binder Grade (PG) was increased to a PG 70-22 for both Minor and Major Arterial roadways, as well as for the Major Collector roads.



3.7 Concrete Properties

The material inputs for the Portland Cement Concrete material comes from the local industry in the Metro Vancouver area, and includes the following properties.

Table 10. Portland Cement Concrete - Input Parameters

Portland Cement Concrete Properties	
Unit Weight	2,350 kg/m ³
Poisson's Ratio	0.2
Thermal Properties	
PCC Coefficient of Thermal Expansion (mm/mm °C x 10 ⁻⁶)	9.34
PCC Thermal Conductivity (watt/meter-Kelvin)	1.09
PCC Heat Capacity (joule/kg-Kelvin)	917
Concrete Mix Properties	
Cement Type	GU (Type 1)
Cementitious Material Content	332 kg/m ³
Water/Cement Ratio	0.45
Aggregate Type	Quartzite
PCC Set Temperature	Calculated (23.1)
Ultimate Shrinkage (Microstrain)	Calculated (654.1)
Reversible Shrinkage (% of Ultimate Shrinkage)	50 %
Time to Develop 50% of Ultimate Shrinkage	35 Days
Curing Method	Curing Compound
Material Strength	
PCC Strength and Modulus	"Level 3" selected
28 Day Modulus of Rupture (MPa)	4.2
Elastic Modulus (GPa)	28.3
JPCP Design Parameters	
PCC Surface Shortwave Absorptivity	0.85
PCC Joint Spacing (m)	4.5 m (AADTT = 10,000) 4.0 m (All Other Classes)
Sealant Type	Hot Pour Asphalt
Doweled Joints	32M @ 300mm Spacing (AADTT > 750) No Dowels (AADTT ≤ 750)
Widened slab	True
Tied Shoulders	Tied
Load efficiency (%)	70
Erodibility Index	Very Erodible (5)
PCC-base Contact Friction	Default (True)
Permanent Curl/Warp Temp. Difference (°C)	Default (-5.60)



A study completed by the FHWA, found that since the coarse aggregates make up the bulk of the volume of concrete, the most influential factor in the Coefficient of Thermal Expansions (CTE) of the concrete is the CTE of the coarse aggregates. The study further determined the quartzite aggregate has the highest CTE of the commonly used coarse aggregate types in concrete pavement construction. For this reason, the recommend CTE value of 9.34 was used in the concrete material properties, as Quartz aggregates are the likely type of coarse aggregates to be generally used in the Metro Vancouver area.

3.8 Granular Properties

The properties of the granular base and subbase were provided by the local industry in the Metro Vancouver Area. The specific granular material properties used in the analysis are provided in Table 11. Similar to the subgrade soils, a Level 2 analysis was used for determining the resilient modulus for the respective granular base and subbase.

Table 11. Granular Material Default Parameters

Unbound Material Properties		CBC	SGSB
Poisson's Ratio		0.35	
Coefficient of Lateral Pressure (k_0)		0.5	
Material Modulus			
<i>Resilient Modulus (Level 2 Calculation)</i>		<i>247 MPa</i>	<i>191 MPa</i>
Gradation and Other Engineering Properties			
Aggregate Gradation (percent passing)	75 μ m	5	4
	300 μ m	13	13
	1.18 mm	27	30
	4.75 mm	45	75
	9.5 mm	61	-
	13.2 mm	77	-
	19.0 mm	92	-
	25 mm	100	90
Liquid Limit		6	11
Plasticity Index		0	
Is layer compacted		Yes	
Maximum dry unit weight (kg/m^3)		Calculated	
Saturated hydraulic conductivity (m/hr)		Calculated	
Specific gravity of solids		Calculated	
Optimum gravimetric water content (T)		Calculated	

3.9 Software Calibration

Pavement distress prediction models, or transfer functions, are the key components of any M-E design analysis procedure. The accuracy of the performance prediction models in Pavement ME



depend on an effective process of calibration and subsequent validation with independent data sets. It is understood that all performance models in the Pavement ME software were calibrated on a global level to available field performance data throughout North America.

Local calibration of the performance models is a very involved and expensive exercise, which has not been completed by any Canadian agency to date. It is acknowledged that the pavement design analysis completed for this study relied on the default global calibration factors, supplemented by available material test results.

4.0 PAVEMENT DESIGN COMPARISONS

The development of the pavement designs for both flexible and rigid pavements considered the bound and unbound pavement materials typically used in roadway construction by municipalities in the Province of British Columbia. A range of subgrade soils were used to represent the various soil conditions present within the province. The subgrade soil properties used in the design analysis were obtained from actual laboratory test results completed on collected soil samples.

A pavement design matrix was developed, with rigid and flexible pavement designs for each combination of roadway classification, traffic volumes, and subgrade soils. Initial pavement designs were developed using typical municipal cross sections and provincial design parameters, adjusted for a 25-year design life. Preliminary pavement designs developed using standard design software including StreetPave 12 and the AASHTO Guide for the Design of Pavement Structures (1993). The preliminary designs were subsequently analyzed using the *AASHTOWare Pavement ME* software, to determine the predicted pavement distresses of the pavement for the local conditions.

The predicted distresses for each analysis were reviewed and adjusted to optimize the pavement structures required to meet the identified target thresholds. The resulting pavement design comparison matrix was then reviewed by practicing Engineers in the Province of British Columbia to ensure the results were appropriate to local conditions and practices.

A comparison of flexible and rigid pavement structures for the various roadway conditions is provided in Table 12. The designs presented in this table are considered typical for the varying conditions that exist across the province. However, it is important to note that conditions do change throughout the province, and designers may need to vary layer thicknesses to ensure that pavement structures address the needs of local conditions.



Table 12. Equivalent Pavement Designs for Municipalities: Province of British Columbia

Subgrade Strength*	Pavement Type	Average Annual Daily Truck Traffic							
		Industrial Roadway		Major Collector Roadway		Minor Arterial Roadway		Major Arterial Roadway	
		250	500	750	1,600	2,500	5,000	7,500	10,000
30 MPa	PCC	160 mm PCC 400 mm CBC	170 mm PCC 300 mm CBC	170 mm PCC 300 mm CBC	170 mm PCC 200 mm CBC	190 mm PCC 200 mm CBC	200 mm PCC 200 mm CBC	210 mm PCC 300 mm CBC	220 mm PCC 300 mm CBC
	HMA	125 mm ACP 150 mm CBC 350 mm SGSB	140 mm ACP 150 mm CBC 400 mm SGSB	140 mm ACP 200 mm CBC 350 mm SGSB	160 mm ACP 200 mm CBC 400 mm SGSB	190 mm ACP 200 mm CBC 500 mm SGSB	210 mm ACP 200 mm CBC 550 mm SGSB	240 mm ACP 300 mm CBC 450 mm SGSB	250 mm ACP 300 mm CBC 500 mm SGSB
40 MPa	PCC	160 mm PCC 300 mm CBC	170 mm PCC 300 mm CBC	170 mm PCC 300 mm CBC	170 mm PCC 200 mm CBC	190 mm PCC 200 mm CBC	200 mm PCC 200 mm CBC	210 mm PCC 300 mm CBC	220 mm PCC 300 mm CBC
	HMA	125 mm ACP 150 mm CBC 250 mm SGSB	140 mm ACP 150 mm CBC 300 mm SGSB	140 mm ACP 150 mm CBC 300 mm SGSB	160 mm ACP 150 mm CBC 350 mm SGSB	190 mm ACP 200 mm CBC 350 mm SGSB	210 mm ACP 200 mm CBC 400 mm SGSB	230 mm ACP 300 mm CBC 300 mm SGSB	240 mm ACP 300 mm CBC 350 mm SGSB
50 MPa	PCC	160 mm PCC 300 mm CBC	170 mm PCC 300 mm CBC	170 mm PCC 300 mm CBC	170 mm PCC 200 mm CBC	190 mm PCC 200 mm CBC	200 mm PCC 200 mm CBC	210 mm PCC 300 mm CBC	220 mm PCC 300 mm CBC
	HMA	125 mm ACP 150 mm CBC 150 mm SGSB	140 mm ACP 150 mm CBC 200 mm SGSB	140 mm ACP 150 mm CBC 200 mm SGSB	160 mm ACP 150 mm CBC 250 mm SGSB	190 mm ACP 200 mm CBC 250 mm SGSB	210 mm ACP 200 mm CBC 300 mm SGSB	230 mm ACP 200 mm CBC 350 mm SGSB	240 mm ACP 300 mm CBC 200 mm SGSB
Concrete Slab Properties		No Dowel Bars Slab Length < 4.0m Tied Curb/Shoulders			25M Dowel Bar Slab Length < 4.0m Tied Curb/Shoulders		32M Dowel Bar Slab Length < 4.0m Tied Curb/Shoulders		32M Dowel Bar Slab Length < 4.5m Tied Curb/Shoulders

Note: * - Subgrade Strength indicates the equivalent estimated AASHTO '93 Resilient Modulus design value. Subgrade Strength values do not consider any soil remediation treatments.



Furthermore, the pavement designs presented in the comparison matrix do not consider any soil remediation treatments that may be completed prior to the placement of the pavement layers, or the placement of additional material required for constructability purposes. Should the need for soil stabilization techniques for improving subgrade strength be required, then the resulting pavement structure should be selected that appropriately represents the combined strength of the treated and untreated subgrade soil.

5.0 LIFE CYCLE COST ANALYSIS

The equivalent pavement structures will be compared using a Life Cycle Cost Analysis (LCCA) in terms of their Net Present Worth (NPW). This LCCA approach calculates the initial construction costs for each pavement structure, and predicts future maintenance and rehabilitation costs, while discounting any salvage value that may remain at the end of the analysis period.

The LCCA assumed the construction and maintenance of a 1 km roadway length, over a 50-year analysis period. Roadways with an AADTT less than 1,000 are considered to contain a two-lane pavement platform, while pavements supporting more than 1,000 AADTT are four-lane roadways.

5.1 Initial Construction Costs

The initial construction costs used in the LCCA were estimated for each of the pavement comparisons in the design matrix. Cost estimates considered the roadway platform widths, construction materials and layer thickness required to construct each pavement type. It is important to note that platform width for rigid pavements with an AADTT of greater than 750 trucks was 1 m wider, to account for the widened lane required for design purposes at the pavement edge.

Construction costs assumed that a pavement platform will be constructed on grade; therefore, earth excavation will be required for the thickness of the new pavement structure. Furthermore, initial cost estimates did not consider items similar to both pavement types, such as the installation of subdrains, curb and gutters, or pavement markings.

5.2 Pavement Preservation Costs

To predict future maintenance and rehabilitation costs for each pavement alternative, a pavement preservation plan is required that reflects typical activities required by an agency to extend the service life of the roadway to meet the analysis period of the LCCA.

The LCCA for comparing equivalent pavement structures was completed over a 50-year analysis period, and used a typical discount rate of 4 percent. The pavement preservation plans (for both pavement types) were developed using information available from the provincial documents,



supplemented by information available from similar studies completed for other Canadian municipalities, modified for conditions and construction practices in British Columbia.

It is important to acknowledge that the application of pavement preservation treatments throughout the life of a pavement is a cost-effective approach for extending the intended design life, or the service life for a particular roadway. Although some municipalities may not complete certain maintenance activities (such as crack sealing and patching), it can be expected that not performing these tasks will reduce the intended pavement design life, increasing the frequency of costlier rehabilitation treatments. In these situations, it can be expected that the life cycle cost of these pavement would be higher than if the preservation treatments were completed.

The pavement preservation plans that were used for the LCCA in this study are provided in the ensuing tables.

Table 13. Flexible Pavement Preservation Plan – Industrial Roadways (AADTT 250 & 500)

Expected Year	Activity Description	Estimated Quantity
10	Rout and seal	250 m
10	Spot repairs (mill 40 mm/patch 40 mm)	8%
20	Mill HMA	40 mm
20	Resurface with new surface asphalt	40 mm
25	Rout and seal	500 m
30	Spot repairs (mill 40 mm/patch 40 mm)	10%
35	Mill HMA	40 mm
35	Full-depth asphalt base repairs	10%
35	Resurface with new surface asphalt	40 mm
40	Rout and seal	500 m
43	Spot repairs (mill 40 mm/patch 40 mm)	8%
48	Mill HMA	40 mm
48	Resurface with new surface asphalt	40 mm

Table 14. Flexible Pavement Preservation Plan – Major Collector (AADTT 750 & 1,600)

Expected Year	Activity Description	Estimated Quantity
10	Rout and seal	250 m
10	Spot repairs (mill 40 mm/patch 40 mm)	8%
15	Spot repairs (mill 40 mm/patch 40 mm)	10%
20	Mill HMA	40 mm
20	Resurface with new surface asphalt	40 mm
25	Rout and seal	500 m
30	Spot repairs (mill 40 mm/patch 40 mm)	10%
35	Mill HMA	40 mm
35	Full-depth asphalt base repairs	10%
35	Resurface with new surface asphalt	40 mm
40	Rout and seal	500 m
43	Spot repairs (mill 40 mm/patch 40 mm)	8%
48	Mill HMA	90 mm
48	Resurfacing with new base asphalt	50 mm
48	Resurface with new surface asphalt	40 mm

Table 15. Flexible Pavement Preservation Plan – Minor Arterial (AADTT 2,500 & 5,000)

Expected Year	Activity Description	Estimated Quantity
5	Rout and seal	250 m
10	Rout and seal	500 m
10	Spot repairs (mill 40 mm/patch 40 mm)	8%
20	Mill HMA	40 mm
20	Resurface with new surface asphalt	40 mm
25	Rout and seal	1,000 m
30	Spot repairs (mill 40 mm/patch 40 mm)	15%
35	Mill HMA	90 mm
35	Resurfacing with new base asphalt	50 mm
35	Resurface with new surface asphalt	40 mm
40	Rout and seal	1,500 m
43	Spot repairs (mill 40 mm/patch 40 mm)	10%
48	Mill HMA	40 mm
48	Full-depth asphalt base repairs	10%
48	Resurface with new surface asphalt	40 mm

Table 16. Flexible Pavement Preservation Plan – Major Arterial (AADTT 7,500 & 10,000)

Expected Year	Activity Description	Estimated Quantity
8	Rout and seal	200 m
8	Spot repairs (mill 40 mm/patch 40 mm)	5%
13	Rout and seal	1,000 m
13	Spot repairs (mill 40 mm/patch 40 mm)	15%
18	Mill HMA	50 mm
18	Full-depth asphalt base repairs	10%
18	Resurface with new surface asphalt	50 mm
23	Rout and seal	500 m
28	Rout and seal	1,500 m
28	Spot repairs (mill 40 mm/patch 40 mm)	10%
32	Mill HMA	90 mm
32	Resurfacing with new base asphalt	50 mm
32	Resurface with new surface asphalt	40 mm
37	Rout and seal	1,500 m
40	Spot repairs (mill 40 mm/patch 40 mm)	10%
45	Mill HMA	50 mm
45	Full-depth asphalt base repairs	10%
45	Resurface with new surface asphalt	50 mm
48	Rout and seal	1,500 m

Table 17. Rigid Pavement Preservation Plan – Industrial Roadways (AADTT 250 & 500)

Expected Year	Activity Description	Estimated Quantity
12	Reseal joints	10 %
25	Partial depth PCC repairs	2 %
25	Full depth PCC repairs	5 %
25	Reseal joints	20 %
40	Partial depth PCC repairs	5 %
40	Full depth PCC repairs	10 %
40	Reseal joints	20 %



Table 18. Rigid Pavement Preservation Plan – Major Collector (AADTT 750 & 1,600)

Expected Year	Activity Description	Estimated Quantity
12	Reseal joints	20 %
25	Partial depth PCC repairs	5 %
25	Full depth PCC repairs	10 %
25	Reseal joints	25 %
40	Partial depth PCC repairs	5 %
40	Full depth PCC repairs	15 %
40	Reseal joints	25 %

Table 19. Rigid Pavement Preservation Plan – Minor Arterial (AADTT 2,500 & 5,000)

Expected Year	Activity Description	Estimated Quantity
12	Reseal Joints	25 %
12	Partial depth PCC repairs	2 %
25	Partial depth PCC repairs	5 %
25	Full depth PCC repairs	10 %
25	Reseal joints	25 %
40	Partial depth PCC repairs	5 %
40	Full depth PCC repairs	15 %
40	Reseal joints	25 %

Table 20. Rigid Pavement Preservation Plan – Major Arterial (AADTT 7,500 & 10,000)

Expected Year	Activity Description	Estimated Quantity
12	Reseal Joints	25 %
12	Partial depth PCC repairs	2 %
25	Partial depth PCC repairs	5 %
25	Full depth PCC repairs	10 %
25	Reseal joints	50 %
25	Texturize Surface	25 %
40	Partial depth PCC repairs	5 %
40	Full depth PCC repairs	15 %
40	Reseal joints	50 %
40	Texturize Surface	50 %

5.3 Unit Rates for LCCA

Unit rates for the various construction, maintenance, and rehabilitation activities obtained from local contractors and material suppliers based in the Metro Vancouver area. The cost of asphalt



materials used in the LCCA were obtained from a local contractor and represent the unit rate for materials at the time this report was prepared.

As the construction of rigid of pavements is not common practice in the Province of BC, unit rates were estimated based on local cost of material and expected labour rates. This included the cost charged by local contractors/ producers for: concrete material (per m³); epoxy coated dowel bars; as well as transportation, equipment, and placement costs. Although not considered in this LCCA, it can be expected that the unit rates for the various construction materials and activities required for concrete pavements will decrease as more projects with this pavement type are tendered, and more local contractors gain experience.

The unit rates used for calculating initial construction costs are provided in Table 21, while typical costs for the various pavement preservation treatments are provided in Table 22.

Table 21. Unit Costs of Initial Construction Activities

Pavement Layer	Description of Pavement Layer	Units	Unit Rates
HMA	Upper Course #1	t	\$ 100
	Lower Course #1	t	\$ 90
	Tack Coat / Prime Coat	m ²	\$0.5
PCC	160 mm PCC pavement, no dowels	m ²	\$ 50
	170 mm PCC pavement, no dowels	m ²	\$ 52
	170 mm PCC pavement, 25M dowels	m ²	\$ 57
	190 mm PCC pavement, 25M dowels	m ²	\$ 61
	200 mm PCC pavement, 32M dowels	m ²	\$ 62
	210 mm PCC pavement, 32M dowels	m ²	\$ 63
	220 mm PCC pavement, 32M dowels	m ²	\$ 65
Base	Crushed Gravel Course	m ³	\$ 35
Subbase	Select Granular Sub-Base	m ³	\$ 26
Subgrade	Excavation and grading	m ³	\$ 16

Table 22. Unit Costs for Flexible Pavement Preservation Treatments

	Units	Unit Rates
Flexible Pavements		
Rout and seal	m	\$ 5.50
Spot repairs (mill/patch)	m ²	\$ 45
Full depth asphalt base repairs	m ²	\$ 105
Mill HMA	t	\$ 7.50



Table 23. Unit Costs for Rigid Pavement Preservation Treatments

	Units	Unit Rates
Resealing joints	m	\$ 11
Partial depth PCC repairs	m ²	\$ 200
Full depth PCC repairs	m ²	\$ 150
Surface texturize	m ²	\$ 15

5.4 LCCA Comparison

Based on the available information, a LCCA was completed to evaluate the overall cost a municipality could expect between the two pavement types over a 50-year analysis period. Estimated life cycle costs for rigid pavement were compared with the estimated costs to construct and maintain the comparable flexible pavement. The resulting difference is an indication of the cost savings that can be expected between the comparable pavements for each of the design categories.

It is noted that a negative cost difference in the summary tables below indicate that a rigid pavement has a lower life cycle cost than a comparable flexible pavement. A positive results indicates the reverse.

Table 24. LCCA Results for Major Arterial Roadways

Roadway Classification	Subgrade Strength	Pavement Type	Initial Construction Costs	M & R Costs	Life Cycle Cost	Cost Difference
Major Arterial (10,000 AADTT)	30 MPa	PCC	\$1,341,120	\$141,056	\$1,482,176	-23.60%
		Flexible	\$1,483,500	\$456,605	\$1,940,105	
	40 MPa	PCC	\$1,341,120	\$141,056	\$1,482,176	-17.78%
		Flexible	\$1,346,025	\$456,605	\$1,802,630	
	50 MPa	PCC	\$1,341,120	\$141,056	\$1,482,176	-13.23%
		Flexible	\$1,251,525	\$456,605	\$1,708,130	
Major Arterial (7,500 AADTT)	30 MPa	PCC	\$1,306,560	\$150,543	\$1,457,103	-21.90%
		Flexible	\$1,409,025	\$456,605	\$1,865,630	
	40 MPa	PCC	\$1,306,560	\$150,543	\$1,457,103	-16.05%
		Flexible	\$1,279,050	\$456,605	\$1,735,655	
	50 MPa	PCC	\$1,306,560	\$150,543	\$1,457,103	-13.81%
		Flexible	\$1,234,050	\$456,605	\$1,690,655	

The results of the LCCA for Major Arterial roadways indicate that roadways expected to support heavier truck traffic, rigid pavement would be more cost-effective over a 50-year analysis period.

Table 25. LCCA Results for Minor Arterial Roadways

Roadway Classification	Subgrade Strength	Pavement Type	Initial Construction Costs	M & R Costs	Life Cycle Cost	Cost Difference
Minor Arterial (5,000 AADTT)	30 MPa	PCC	\$1,206,400	\$101,418	\$1,307,818	-15.85%
		Flexible	\$1,289,100	\$265,038	\$1,554,138	
	40 MPa	PCC	\$1,206,400	\$101,418	\$1,307,818	-10.40%
		Flexible	\$1,194,600	\$265,038	\$1,459,638	
	50 MPa	PCC	\$1,206,400	\$101,418	\$1,307,818	-5.85%
		Flexible	\$1,124,100	\$265,038	\$1,389,138	
Minor Arterial (2,500 AADTT)	30 MPa	PCC	\$1,187,840	\$101,418	\$1,289,258	-11.19%
		Flexible	\$1,186,650	\$265,038	\$1,451,688	
	40 MPa	PCC	\$1,187,840	\$101,418	\$1,289,258	-4.48%
		Flexible	\$1,084,650	\$265,038	\$1,349,688	
	50 MPa	PCC	\$1,187,840	\$101,418	\$1,289,258	0.20%
		Flexible	\$1,021,650	\$265,038	\$1,286,688	

The results of the LCCA for Minor Arterial roadways indicate that rigid pavements offer a cost-effective solution in areas where weaker subgrade soils are expected. As subgrade strength increases, the LCCA for both pavement types are considered to be cost neutral.

Table 26. LCCA Results for Major Collector Roadways

Roadway Classification	Subgrade Strength	Pavement Type	Initial Construction Costs	M & R Costs	Life Cycle Cost	Cost Difference
Major Collector (1,600 AADTT)	30 MPa	PCC	\$594,320	\$44,316	\$638,636	-11.79%
		Flexible	\$582,825	\$141,187	\$724,012	
	40 MPa	PCC	\$594,320	\$44,316	\$638,636	-7.33%
		Flexible	\$547,950	\$141,187	\$689,137	
	50 MPa	PCC	\$594,320	\$44,316	\$638,636	-2.89%
		Flexible	\$516,450	\$141,187	\$657,637	
Major Collector (750 AADTT)	30 MPa	PCC	\$595,170	\$44,316	\$639,486	-2.90%
		Flexible	\$517,425	\$141,187	\$658,612	
	40 MPa	PCC	\$595,170	\$44,316	\$639,486	2.52%
		Flexible	\$482,550	\$141,187	\$623,737	
	50 MPa	PCC	\$595,170	\$44,316	\$639,486	7.98%
		Flexible	\$451,050	\$141,187	\$592,237	



Table 27. LCCA Results for Industrial Roadways

Roadway Classification	Subgrade Strength	Pavement Type	Initial Construction Costs	M & R Costs	Life Cycle Cost	Cost Difference
Industrial (500 AADTT)	30 MPa	PCC	\$595,170	\$25,869	\$621,039	-2.17%
		Flexible	\$514,050	\$120,778	\$634,828	
	40 MPa	PCC	\$595,170	\$25,869	\$621,039	2.94%
		Flexible	\$482,550	\$120,778	\$603,328	
	50 MPa	PCC	\$595,170	\$25,869	\$621,039	8.61%
		Flexible	\$451,050	\$120,778	\$571,828	
Industrial (250 AADTT)	30 MPa	PCC	\$620,160	\$25,869	\$646,029	11.75%
		Flexible	\$457,313	\$120,778	\$578,091	
	40 MPa	PCC	\$576,810	\$25,869	\$602,679	10.26%
		Flexible	\$425,813	\$120,778	\$546,591	
	50 MPa	PCC	\$576,810	\$25,869	\$602,679	17.00%
		Flexible	\$394,313	\$120,778	\$515,091	

As traffic volume reduces, rigid pavements become less cost-effective. However, in areas where soft soils or wet conditions exist, rigid pavements remain a comparable option. This is particularly true in areas where high ground water levels complicate the excavation of the required pavement structure.

6.0 CLOSURE

The primary purpose of this study is to provide municipalities in the Province of British Columbia with a resource for considering rigid pavements as a viable option in reconstruction of their road network. The reduced pavement thickness, and increased durability of the pavement surface make concrete pavements applicable in many urban areas, particularly for roadways experiencing heavy truck/bus movements.

The pavement design matrix provided in Appendix A has been developed to assist municipalities (within the Province of British Columbia) with an easy-to-use reference table. Flexible and rigid pavement designs in this table are considered to be equivalent pavement structures for the range of subgrade soils, roadway classifications, and traffic conditions considered as part of this study. The equivalent pavement designs were evaluated with a LCCA, over a 50-year analysis period. This costing exercise provided a reasonable comparison of the total costs that could be expected for each pavement type based on a 25-year design life. It can be expected that as conditions change, so will the cost to construct the selected pavement structure.



The pavement design matrix should be used for preliminary pavement design purposes. It is strongly recommended that municipalities carry out detailed design analysis to review the site conditions and determine the suitability of the preliminary designs for specific site conditions. Furthermore, the long-life performance associated with rigid pavements is largely dependent on proper design and construction practices. Detailed designs for concrete pavements should be completed by an experienced Pavement Engineer and include site specific details for the construction of this pavement, such as a joint layout plan, load transfer devices, and surface texture.

The analysis presented in this report is based on design inputs, provided by others, supplemented by Thurber's experience with pavement engineering projects throughout the Province of British Columbia. We note that any changes in soil conditions, traffic volumes, construction materials or procedures, may have a significant impact on design assumptions made for the purposes of developing the preliminary pavement designs.

Respectfully Submitted,
Thurber Engineering Ltd.

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Associate/ Senior Pavement Engineer



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Principal Engineer



7.0 REFERENCES

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APPENDIX A

COMPARABLE PAVEMENT DESIGN MATRIX



Equivalent Pavement Designs for Municipalities: Province of British Columbia

Subgrade Strength*	Pavement Type	Average Annual Daily Truck Traffic							
		Industrial Roadway		Major Collector Roadway		Minor Arterial Roadway		Major Arterial Roadway	
		250	500	750	1,600	2,500	5,000	7,500	10,000
30 MPa	PCC	160 mm PCC 400 mm CBC	170 mm PCC 300 mm CBC	170 mm PCC 300 mm CBC	180 mm PCC 200 mm CBC	190 mm PCC 200 mm CBC	200 mm PCC 200 mm CBC	210 mm PCC 300 mm CBC	220 mm PCC 300 mm CBC
	HMA	125 mm ACP 150 mm CBC 350 mm SGSB	140 mm ACP 150 mm CBC 400 mm SGSB	140 mm ACP 200 mm CBC 350 mm SGSB	160 mm ACP 200 mm CBC 400 mm SGSB	190 mm ACP 200 mm CBC 500 mm SGSB	210 mm ACP 200 mm CBC 550 mm SGSB	240 mm ACP 300 mm CBC 450 mm SGSB	250 mm ACP 300 mm CBC 500 mm SGSB
40 MPa	PCC	160 mm PCC 300 mm CBC	170 mm PCC 200 mm CBC	170 mm PCC 200 mm CBC	180 mm PCC 200 mm CBC	190 mm PCC 200 mm CBC	200 mm PCC 200 mm CBC	210 mm PCC 300 mm CBC	220 mm PCC 300 mm CBC
	HMA	125 mm ACP 150 mm CBC 250 mm SGSB	140 mm ACP 150 mm CBC 300 mm SGSB	140 mm ACP 150 mm CBC 300 mm SGSB	160 mm ACP 150 mm CBC 350 mm SGSB	190 mm ACP 200 mm CBC 350 mm SGSB	210 mm ACP 200 mm CBC 400 mm SGSB	230 mm ACP 300 mm CBC 300 mm SGSB	240 mm ACP 300 mm CBC 350 mm SGSB
50 MPa	PCC	160 mm PCC 300 mm CBC	170 mm PCC 200 mm CBC	170 mm PCC 200 mm CBC	180 mm PCC 200 mm CBC	190 mm PCC 200 mm CBC	200 mm PCC 200 mm CBC	210 mm PCC 300 mm CBC	220 mm PCC 300 mm CBC
	HMA	125 mm ACP 150 mm CBC 150 mm SGSB	140 mm ACP 150 mm CBC 200 mm SGSB	140 mm ACP 150 mm CBC 200 mm SGSB	160 mm ACP 150 mm CBC 250 mm SGSB	190 mm ACP 200 mm CBC 250 mm SGSB	210 mm ACP 200 mm CBC 300 mm SGSB	230 mm ACP 200 mm CBC 350 mm SGSB	240 mm ACP 300 mm CBC 200 mm SGSB
Concrete Slab Properties		No Dowel Bars Slab Length < 4.0m Tied Curb/shoulders			32M Dowel Bar Slab Length < 4.0m Tied Curb/shoulders				32M Dowel Bar Slab Length < 4.5m Tied Curb/shoulders

Note: * - Subgrade Strength indicates the equivalent estimated AASHTO '93 Resilient Modulus design value.
 - Subgrade Strength values do not consider any soil remediation treatments.



APPENDIX B

LIFE CYCLE COST ANALYSIS DETAILED WORK SHEETS



**EQUIVALENT PAVEMENT DESIGNS FOR MUNICIPALITIES
PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS RESULTS**

Roadway Classification	Subgrade Strength	Pavement Type	Initial Construction	M & R Costs	Life Cycle Cost	Cost Difference *
Major Arterial 10,000	30 MPa	PCC	\$1,341,120	\$141,056	\$1,482,176	-23.60%
		Flexible	\$1,483,500	\$456,605	\$1,940,105	
	40 MPa	PCC	\$1,341,120	\$141,056	\$1,482,176	-17.78%
		Flexible	\$1,346,025	\$456,605	\$1,802,630	
	50 MPa	PCC	\$1,341,120	\$141,056	\$1,482,176	-13.23%
		Flexible	\$1,251,525	\$456,605	\$1,708,130	
Major Arterial 7,500	30 MPa	PCC	\$1,306,560	\$150,543	\$1,457,103	-21.90%
		Flexible	\$1,409,025	\$456,605	\$1,865,630	
	40 MPa	PCC	\$1,306,560	\$150,543	\$1,457,103	-16.05%
		Flexible	\$1,279,050	\$456,605	\$1,735,655	
	50 MPa	PCC	\$1,306,560	\$150,543	\$1,457,103	-13.81%
		Flexible	\$1,234,050	\$456,605	\$1,690,655	
Minor Arterial 5,000	30 MPa	PCC	\$1,206,400	\$101,418	\$1,307,818	-15.85%
		Flexible	\$1,289,100	\$265,038	\$1,554,138	
	40 MPa	PCC	\$1,206,400	\$101,418	\$1,307,818	-10.40%
		Flexible	\$1,194,600	\$265,038	\$1,459,638	
	50 MPa	PCC	\$1,206,400	\$101,418	\$1,307,818	-5.85%
		Flexible	\$1,124,100	\$265,038	\$1,389,138	
Minor Arterial 2,500	30 MPa	PCC	\$1,187,840	\$101,418	\$1,289,258	-11.19%
		Flexible	\$1,186,650	\$265,038	\$1,451,688	
	40 MPa	PCC	\$1,187,840	\$101,418	\$1,289,258	-4.48%
		Flexible	\$1,084,650	\$265,038	\$1,349,688	
	50 MPa	PCC	\$1,187,840	\$101,418	\$1,289,258	0.20%
		Flexible	\$1,021,650	\$265,038	\$1,286,688	
Major Collector 1,600	30 MPa	PCC	\$594,320	\$44,316	\$638,636	-11.79%
		Flexible	\$582,825	\$141,187	\$724,012	
	40 MPa	PCC	\$594,320	\$44,316	\$638,636	-7.33%
		Flexible	\$547,950	\$141,187	\$689,137	
	50 MPa	PCC	\$594,320	\$44,316	\$638,636	-2.89%
		Flexible	\$516,450	\$141,187	\$657,637	
Major Collector 750	30 MPa	PCC	\$595,170	\$44,316	\$639,486	-2.90%
		Flexible	\$517,425	\$141,187	\$658,612	
	40 MPa	PCC	\$595,170	\$44,316	\$639,486	2.52%
		Flexible	\$482,550	\$141,187	\$623,737	
	50 MPa	PCC	\$595,170	\$44,316	\$639,486	7.98%
		Flexible	\$451,050	\$141,187	\$592,237	
Industrial 500	30 MPa	PCC	\$595,170	\$25,869	\$621,039	-2.17%
		Flexible	\$514,050	\$120,778	\$634,828	
	40 MPa	PCC	\$595,170	\$25,869	\$621,039	2.94%
		Flexible	\$482,550	\$120,778	\$603,328	
	50 MPa	PCC	\$595,170	\$25,869	\$621,039	8.61%
		Flexible	\$451,050	\$120,778	\$571,828	
Industrial 250	30 MPa	PCC	\$620,160	\$25,869	\$646,029	11.75%
		Flexible	\$457,313	\$120,778	\$578,091	
	40 MPa	PCC	\$576,810	\$25,869	\$602,679	10.26%
		Flexible	\$425,813	\$120,778	\$546,591	
	50 MPa	PCC	\$576,810	\$25,869	\$602,679	17.00%
		Flexible	\$394,313	\$120,778	\$515,091	

Note: * - Cost Difference calculation is the comparison of LCC of the Rigid pavement to the Flexible pavement. Negative values indicate that the Rigid pavements option is a more cost-effective alternative.



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Major Arterial HMA	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	10,000	200 mm	Lower Course #1
Subgrade (MPa):	30 MPa	300 mm	Crushed Gravel Base
Lane Width (m):	3.75	500 mm	Crushed Gravel Subbase
Width of Road (m):	15		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	1,875	\$100.00	\$187,500
Base HMA	Lower Course #1	200 mm	t	7,350	\$90.00	\$661,500
Tack Coat	Tack Coat - 4 Lifts		m ²	60,000	\$0.50	\$30,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	4,500	\$35.00	\$157,500
Crushed Subbase	Crushed Gravel Subbase	500 mm	m ³	7,500	\$26.00	\$195,000
Excavation	Earth Excavation	1050 mm	m ³	15,750	\$16.00	\$252,000
Total Initial Pavement Construction Cost						\$1,483,500

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
8	Rout and Seal Cracks	200 m	\$5.50	\$1,100.00	\$804
	Spot Repairs - Mill 40 mm/ Patch 40 mm (5%)	750 m ²	\$45.00	\$33,750.00	\$24,661
13	Rout and Seal Cracks	1,000 m	\$5.50	\$5,500.00	\$3,303
	Spot Repairs - Mill 40 mm/ Patch 40 mm (15%)	2,250 m ²	\$45.00	\$101,250.00	\$60,808
18	Mill Asphalt Surface (50 mm)	1,800 t	\$7.50	\$13,500.00	\$6,664
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$77,746
	Resurface with New Surface Asphalt (50 mm)	1,875 t	\$100.00	\$187,500.00	\$92,555
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$3,702
23	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,116
28	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$2,751
	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$22,510
32	Mill Asphalt Surface (90 mm)	3,240 t	\$7.50	\$24,300.00	\$6,927
	Resurface with New Base Asphalt (50 mm)	1,838 t	\$90.00	\$165,375.00	\$47,141
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$42,759
	Tack Coat - 2 Layers	30,000 m ²	\$0.50	\$15,000.00	\$4,276
37	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$1,933
40	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$14,060
45	Mill Asphalt Surface (50 mm)	1,800 t	\$7.50	\$13,500.00	\$2,311
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$26,964
	Resurface with New Surface Asphalt (50 mm)	1,875 t	\$100.00	\$187,500.00	\$32,100
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,284
48	Rout and Seal Cracks	1,500 m	\$45.00	\$67,500.00	\$10,273
50	Salvage Value	7 year(s)	-\$30,500.00	-\$213,500.00	-\$30,042
Total Maintenance and Rehabilitation Cost					\$456,605



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Major Arterial HMA	Pavement Design	
Pavement Type:	Rigid Pavement	220 mm	Portland Cement Concrete
AADTT:	10,000	300 mm	Crushed Gravel Base
Subgrade (MPa):	30 MPa		
Lane Width (m):	3.75m Inner Lanes & 4.25m Outer Lanes		
Width of Road (m):	16		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	220 mm	m ²	16,000	\$65.00	\$1,040,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	4,800	\$35.00	\$168,000
Excavation	Earth Excavation	520 mm	m ³	8,320	\$16.00	\$133,120
Total Initial Pavement Construction Cost						\$1,341,120

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (25%)	1,389 m	\$11.00	\$15,277.78	\$9,542
	Partial Depth Joint Repairs (2%)	111 m ²	\$200.00	\$22,222.22	\$13,880
25	Partial Depth Joint Repairs (5%)	278 m ²	\$200.00	\$55,555.56	\$20,840
	Full Depth Joint Repairs (10%)	356 m ²	\$150.00	\$53,333.33	\$20,006
	Reseal Transverse/Longitudinal Joints (50%)	2,778 m	\$11.00	\$30,555.56	\$11,462
	Texturize Surface (25%)	4,000 m ²	\$15.00	\$60,000.00	\$22,507
40	Partial Depth Joint Repairs (5%)	278 m ²	\$200.00	\$55,555.56	\$11,572
	Full Depth Joint Repairs (15%)	533 m ²	\$150.00	\$80,000.00	\$16,663
	Reseal Transverse/Longitudinal Joints (50%)	2,778 m	\$11.00	\$30,555.56	\$6,364
	Texturize Surface (50%)	8,000 m ²	\$15.00	\$120,000.00	\$24,995
50	Salvage Value	5 year(s)	-\$23,842.59	-\$119,212.96	-\$16,775
Total Maintenance and Rehabilitation Cost					\$141,056



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Major Arterial HMA	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	10,000	190 mm	Lower Course #1
Subgrade (MPa):	40 MPa	300 mm	Crushed Gravel Base
Lane Width (m):	3.75	350 mm	Crushed Gravel Subbase
Width of Road (m):	15		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	1,875	\$100.00	\$187,500
Base HMA	Lower Course #1	190 mm	t	6,983	\$90.00	\$628,425
Tack Coat	Tack Coat - 3 Lifts		m ²	45,000	\$0.50	\$22,500
Crushed Base	Crushed Gravel Base	300 mm	m ³	4,500	\$35.00	\$157,500
Crushed Subbase	Crushed Gravel Subbase	350 mm	m ³	5,250	\$26.00	\$136,500
Excavation	Earth Excavation	890 mm	m ³	13,350	\$16.00	\$213,600
Total Initial Pavement Construction Cost						\$1,346,025

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
8	Rout and Seal Cracks	200 m	\$5.50	\$1,100.00	\$804
	Spot Repairs - Mill 40 mm/ Patch 40 mm (5%)	750 m ²	\$45.00	\$33,750.00	\$24,661
13	Rout and Seal Cracks	1,000 m	\$5.50	\$5,500.00	\$3,303
	Spot Repairs - Mill 40 mm/ Patch 40 mm (15%)	2,250 m ²	\$45.00	\$101,250.00	\$60,808
18	Mill Asphalt Surface (50 mm)	1,800 t	\$7.50	\$13,500.00	\$6,664
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$77,746
	Resurface with New Surface Asphalt (50 mm)	1,875 t	\$100.00	\$187,500.00	\$92,555
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$3,702
23	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,116
28	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$2,751
	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$22,510
32	Mill Asphalt Surface (90 mm)	3,240 t	\$7.50	\$24,300.00	\$6,927
	Resurface with New Base Asphalt (50 mm)	1,838 t	\$90.00	\$165,375.00	\$47,141
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$42,759
	Tack Coat - 2 Layers	30,000 m ²	\$0.50	\$15,000.00	\$4,276
37	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$1,933
40	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$14,060
45	Mill Asphalt Surface (50 mm)	1,800 t	\$7.50	\$13,500.00	\$2,311
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$26,964
	Resurface with New Surface Asphalt (50 mm)	1,875 t	\$100.00	\$187,500.00	\$32,100
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,284
48	Rout and Seal Cracks	1,500 m	\$45.00	\$67,500.00	\$10,273
50	Salvage Value	7 year(s)	-\$30,500.00	-\$213,500.00	-\$30,042
Total Maintenance and Rehabilitation Cost					\$456,605



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Major Arterial HMA	Pavement Design	
Pavement Type:	Rigid Pavement	220 mm	Portland Cement Concrete
AADTT:	10,000	300 mm	Crushed Gravel Base
Subgrade (MPa):	40 MPa		
Lane Width (m):	3.75m Inner Lanes & 4.25m Outer Lanes		
Width of Road (m):	16		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	220 mm	m ²	16,000	\$65.00	\$1,040,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	4,800	\$35.00	\$168,000
Excavation	Earth Excavation	520 mm	m ³	8,320	\$16.00	\$133,120
Total Initial Pavement Construction Cost						\$1,341,120

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (25%)	1,389 m	\$11.00	\$15,277.78	\$9,542
	Partial Depth Joint Repairs (2%)	111 m ²	\$200.00	\$22,222.22	\$13,880
25	Partial Depth Joint Repairs (5%)	278 m ²	\$200.00	\$55,555.56	\$20,840
	Full Depth Joint Repairs (10%)	356 m ²	\$150.00	\$53,333.33	\$20,006
	Reseal Transverse/Longitudinal Joints (50%)	2,778 m	\$11.00	\$30,555.56	\$11,462
	Texturize Surface (25%)	4,000 m ²	\$15.00	\$60,000.00	\$22,507
40	Partial Depth Joint Repairs (5%)	278 m ²	\$200.00	\$55,555.56	\$11,572
	Full Depth Joint Repairs (15%)	533 m ²	\$150.00	\$80,000.00	\$16,663
	Reseal Transverse/Longitudinal Joints (50%)	2,778 m	\$11.00	\$30,555.56	\$6,364
	Texturize Surface (50%)	8,000 m ²	\$15.00	\$120,000.00	\$24,995
50	Salvage Value	5 year(s)	-\$23,842.59	-\$119,212.96	-\$16,775
Total Maintenance and Rehabilitation Cost					\$141,056



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Major Arterial HMA	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	10,000	190 mm	Lower Course #1
Subgrade (MPa):	50 MPa	300 mm	Crushed Gravel Base
Lane Width (m):	3.75	200 mm	Crushed Gravel Subbase
Width of Road (m):	15		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	1,875	\$100.00	\$187,500
Base HMA	Lower Course #1	190 mm	t	6,983	\$90.00	\$628,425
Tack Coat	Tack Coat - 3 Lifts		m ²	45,000	\$0.50	\$22,500
Crushed Base	Crushed Gravel Base	300 mm	m ³	4,500	\$35.00	\$157,500
Crushed Subbase	Crushed Gravel Subbase	200 mm	m ³	3,000	\$26.00	\$78,000
Excavation	Earth Excavation	740 mm	m ³	11,100	\$16.00	\$177,600
Total Initial Pavement Construction Cost						\$1,251,525

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
8	Rout and Seal Cracks	200 m	\$5.50	\$1,100.00	\$804
	Spot Repairs - Mill 40 mm/ Patch 40 mm (5%)	750 m ²	\$45.00	\$33,750.00	\$24,661
13	Rout and Seal Cracks	1,000 m	\$5.50	\$5,500.00	\$3,303
	Spot Repairs - Mill 40 mm/ Patch 40 mm (15%)	2,250 m ²	\$45.00	\$101,250.00	\$60,808
18	Mill Asphalt Surface (50 mm)	1,800 t	\$7.50	\$13,500.00	\$6,664
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$77,746
	Resurface with New Surface Asphalt (50 mm)	1,875 t	\$100.00	\$187,500.00	\$92,555
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$3,702
23	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,116
28	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$2,751
	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$22,510
32	Mill Asphalt Surface (90 mm)	3,240 t	\$7.50	\$24,300.00	\$6,927
	Resurface with New Base Asphalt (50 mm)	1,838 t	\$90.00	\$165,375.00	\$47,141
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$42,759
	Tack Coat - 2 Layers	30,000 m ²	\$0.50	\$15,000.00	\$4,276
37	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$1,933
40	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$14,060
45	Mill Asphalt Surface (50 mm)	1,800 t	\$7.50	\$13,500.00	\$2,311
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$26,964
	Resurface with New Surface Asphalt (50 mm)	1,875 t	\$100.00	\$187,500.00	\$32,100
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,284
48	Rout and Seal Cracks	1,500 m	\$45.00	\$67,500.00	\$10,273
50	Salvage Value	7 year(s)	-\$30,500.00	-\$213,500.00	-\$30,042
Total Maintenance and Rehabilitation Cost					\$456,605



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Major Arterial HMA	Pavement Design	
Pavement Type:	Rigid Pavement	220 mm	Portland Cement Concrete
AADTT:	10,000	300 mm	Crushed Gravel Base
Subgrade (MPa):	50 MPa		
Lane Width (m):	3.75m Inner Lanes & 4.25m Outer Lanes		
Width of Road (m):	16		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	220 mm	m ²	16,000	\$65.00	\$1,040,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	4,800	\$35.00	\$168,000
Excavation	Earth Excavation	520 mm	m ³	8,320	\$16.00	\$133,120
Total Initial Pavement Construction Cost						\$1,341,120

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (25%)	1,389 m	\$11.00	\$15,277.78	\$9,542
	Partial Depth Joint Repairs (2%)	111 m ²	\$200.00	\$22,222.22	\$13,880
25	Partial Depth Joint Repairs (5%)	278 m ²	\$200.00	\$55,555.56	\$20,840
	Full Depth Joint Repairs (10%)	356 m ²	\$150.00	\$53,333.33	\$20,006
	Reseal Transverse/Longitudinal Joints (50%)	2,778 m	\$11.00	\$30,555.56	\$11,462
	Texturize Surface (25%)	4,000 m ²	\$15.00	\$60,000.00	\$22,507
40	Partial Depth Joint Repairs (5%)	278 m ²	\$200.00	\$55,555.56	\$11,572
	Full Depth Joint Repairs (15%)	533 m ²	\$150.00	\$80,000.00	\$16,663
	Reseal Transverse/Longitudinal Joints (50%)	2,778 m	\$11.00	\$30,555.56	\$6,364
	Texturize Surface (50%)	8,000 m ²	\$15.00	\$120,000.00	\$24,995
50	Salvage Value	5 year(s)	-\$23,842.59	-\$119,212.96	-\$16,775
Total Maintenance and Rehabilitation Cost					\$141,056



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Major Arterial HMA	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	7,500	190 mm	Lower Course #1
Subgrade (MPa):	30 MPa	300 mm	Crushed Gravel Base
Lane Width (m):	3.75	450 mm	Crushed Gravel Subbase
Width of Road (m):	15		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	1,875	\$100.00	\$187,500
Base HMA	Lower Course #1	190 mm	t	6,983	\$90.00	\$628,425
Tack Coat	Tack Coat - 3 Lifts		m ²	45,000	\$0.50	\$22,500
Crushed Base	Crushed Gravel Base	300 mm	m ³	4,500	\$35.00	\$157,500
Crushed Subbase	Crushed Gravel Subbase	450 mm	m ³	6,750	\$26.00	\$175,500
Excavation	Earth Excavation	990 mm	m ³	14,850	\$16.00	\$237,600
Total Initial Pavement Construction Cost						\$1,409,025

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
8	Rout and Seal Cracks	200 m	\$5.50	\$1,100.00	\$804
	Spot Repairs - Mill 40 mm/ Patch 40 mm (5%)	750 m ²	\$45.00	\$33,750.00	\$24,661
13	Rout and Seal Cracks	1,000 m	\$5.50	\$5,500.00	\$3,303
	Spot Repairs - Mill 40 mm/ Patch 40 mm (15%)	2,250 m ²	\$45.00	\$101,250.00	\$60,808
18	Mill Asphalt Surface (50 mm)	1,800 t	\$7.50	\$13,500.00	\$6,664
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$77,746
	Resurface with New Surface Asphalt (50 mm)	1,875 t	\$100.00	\$187,500.00	\$92,555
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$3,702
23	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,116
28	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$2,751
	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$22,510
32	Mill Asphalt Surface (90 mm)	3,240 t	\$7.50	\$24,300.00	\$6,927
	Resurface with New Base Asphalt (50 mm)	1,838 t	\$90.00	\$165,375.00	\$47,141
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$42,759
	Tack Coat - 2 Layers	30,000 m ²	\$0.50	\$15,000.00	\$4,276
37	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$1,933
40	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$14,060
45	Mill Asphalt Surface (50 mm)	1,800 t	\$7.50	\$13,500.00	\$2,311
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$26,964
	Resurface with New Surface Asphalt (50 mm)	1,875 t	\$100.00	\$187,500.00	\$32,100
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,284
48	Rout and Seal Cracks	1,500 m	\$45.00	\$67,500.00	\$10,273
50	Salvage Value	7 year(s)	-\$30,500.00	-\$213,500.00	-\$30,042
Total Maintenance and Rehabilitation Cost					\$456,605



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Major Arterial HMA	Pavement Design	
Pavement Type:	Rigid Pavement	210 mm	Portland Cement Concrete
AADTT:	7,500	300 mm	Crushed Gravel Base
Subgrade (MPa):	30 MPa		
Lane Width (m):	3.75m Inner Lanes & 4.25m Outer Lanes		
Width of Road (m):	16		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	210 mm	m ²	16,000	\$63.00	\$1,008,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	4,800	\$35.00	\$168,000
Excavation	Earth Excavation	510 mm	m ³	8,160	\$16.00	\$130,560
Total Initial Pavement Construction Cost						\$1,306,560

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$10,306
	Partial Depth Joint Repairs (2%)	120 m ²	\$200.00	\$24,000.00	\$14,990
25	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$22,507
	Full Depth Joint Repairs (10%)	400 m ²	\$150.00	\$60,000.00	\$22,507
	Reseal Transverse/Longitudinal Joints (50%)	3,000 m	\$11.00	\$33,000.00	\$12,379
	Texturize Surface (25%)	4,000 m ²	\$15.00	\$60,000.00	\$22,507
40	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$12,497
	Full Depth Joint Repairs (15%)	600 m ²	\$150.00	\$90,000.00	\$18,746
	Reseal Transverse/Longitudinal Joints (50%)	3,000 m	\$11.00	\$33,000.00	\$6,874
	Texturize Surface (50%)	8,000 m ²	\$15.00	\$120,000.00	\$24,995
50	Salvage Value	5 year(s)	-\$25,250.00	-\$126,250.00	-\$17,765
Total Maintenance and Rehabilitation Cost					\$150,543



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Major Arterial HMA	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	7,500	180 mm	Lower Course #1
Subgrade (MPa):	40 MPa	300 mm	Crushed Gravel Base
Lane Width (m):	3.75	300 mm	Crushed Gravel Subbase
Width of Road (m):	15		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	1,875	\$100.00	\$187,500
Base HMA	Lower Course #1	180 mm	t	6,615	\$90.00	\$595,350
Tack Coat	Tack Coat - 3 Lifts		m ²	45,000	\$0.50	\$22,500
Crushed Base	Crushed Gravel Base	300 mm	m ³	4,500	\$35.00	\$157,500
Crushed Subbase	Crushed Gravel Subbase	300 mm	m ³	4,500	\$26.00	\$117,000
Excavation	Earth Excavation	830 mm	m ³	12,450	\$16.00	\$199,200
Total Initial Pavement Construction Cost						\$1,279,050

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
8	Rout and Seal Cracks	200 m	\$5.50	\$1,100.00	\$804
	Spot Repairs - Mill 40 mm/ Patch 40 mm (5%)	750 m ²	\$45.00	\$33,750.00	\$24,661
13	Rout and Seal Cracks	1,000 m	\$5.50	\$5,500.00	\$3,303
	Spot Repairs - Mill 40 mm/ Patch 40 mm (15%)	2,250 m ²	\$45.00	\$101,250.00	\$60,808
18	Mill Asphalt Surface (50 mm)	1,800 t	\$7.50	\$13,500.00	\$6,664
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$77,746
	Resurface with New Surface Asphalt (50 mm)	1,875 t	\$100.00	\$187,500.00	\$92,555
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$3,702
23	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,116
28	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$2,751
	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$22,510
32	Mill Asphalt Surface (90 mm)	3,240 t	\$7.50	\$24,300.00	\$6,927
	Resurface with New Base Asphalt (50 mm)	1,838 t	\$90.00	\$165,375.00	\$47,141
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$42,759
	Tack Coat - 2 Layers	30,000 m ²	\$0.50	\$15,000.00	\$4,276
37	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$1,933
40	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$14,060
45	Mill Asphalt Surface (50 mm)	1,800 t	\$7.50	\$13,500.00	\$2,311
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$26,964
	Resurface with New Surface Asphalt (50 mm)	1,875 t	\$100.00	\$187,500.00	\$32,100
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,284
48	Rout and Seal Cracks	1,500 m	\$45.00	\$67,500.00	\$10,273
50	Salvage Value	7 year(s)	-\$30,500.00	-\$213,500.00	-\$30,042
Total Maintenance and Rehabilitation Cost					\$456,605



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Major Arterial HMA	Pavement Design	
Pavement Type:	Rigid Pavement	210 mm	Portland Cement Concrete
AADTT:	7,500	300 mm	Crushed Gravel Base
Subgrade (MPa):	40 MPa		
Lane Width (m):	3.75m Inner Lanes & 4.25m Outer Lanes		
Width of Road (m):	16		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	210 mm	m ²	16,000	\$63	\$1,008,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	4,800	\$35	\$168,000
Excavation	Earth Excavation	510 mm	m ³	8,160	\$16	\$130,560
Total Initial Pavement Construction Cost						\$1,306,560

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$10,306
	Partial Depth Joint Repairs (2%)	120 m ²	\$200.00	\$24,000.00	\$14,990
25	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$22,507
	Full Depth Joint Repairs (10%)	400 m ²	\$150.00	\$60,000.00	\$22,507
	Reseal Transverse/Longitudinal Joints (50%)	3,000 m	\$11.00	\$33,000.00	\$12,379
	Texturize Surface (25%)	4,000 m ²	\$15.00	\$60,000.00	\$22,507
40	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$12,497
	Full Depth Joint Repairs (15%)	600 m ²	\$150.00	\$90,000.00	\$18,746
	Reseal Transverse/Longitudinal Joints (50%)	3,000 m	\$11.00	\$33,000.00	\$6,874
	Texturize Surface (50%)	8,000 m ²	\$15.00	\$120,000.00	\$24,995
50	Salvage Value	5 year(s)	-\$25,250.00	-\$126,250.00	-\$17,765
Total Maintenance and Rehabilitation Cost					\$150,543



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Major Arterial HMA	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	7,500	180 mm	Lower Course #1
Subgrade (MPa):	50 MPa	200 mm	Crushed Gravel Base
Lane Width (m):	3.75	350 mm	Crushed Gravel Subbase
Width of Road (m):	15		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	1,875	\$100	\$187,500
Base HMA	Lower Course #1	180 mm	t	6,615	\$90	\$595,350
Tack Coat	Tack Coat - 3 Lifts		m ²	45,000	\$0.50	\$22,500
Crushed Base	Crushed Gravel Base	200 mm	m ³	3,000	\$35	\$105,000
Crushed Subbase	Crushed Gravel Subbase	350 mm	m ³	5,250	\$26	\$136,500
Excavation	Earth Excavation	780 mm	m ³	11,700	\$16	\$187,200
Total Initial Pavement Construction Cost						\$1,234,050

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
8	Rout and Seal Cracks	200 m	\$5.50	\$1,100.00	\$804
	Spot Repairs - Mill 40 mm/ Patch 40 mm (5%)	750 m ²	\$45.00	\$33,750.00	\$24,661
13	Rout and Seal Cracks	1,000 m	\$5.50	\$5,500.00	\$3,303
	Spot Repairs - Mill 40 mm/ Patch 40 mm (15%)	2,250 m ²	\$45.00	\$101,250.00	\$60,808
18	Mill Asphalt Surface (50 mm)	1,800 t	\$7.50	\$13,500.00	\$6,664
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$77,746
	Resurface with New Surface Asphalt (50 mm)	1,875 t	\$100.00	\$187,500.00	\$92,555
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$3,702
23	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,116
28	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$2,751
	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$22,510
32	Mill Asphalt Surface (90 mm)	3,240 t	\$7.50	\$24,300.00	\$6,927
	Resurface with New Base Asphalt (50 mm)	1,838 t	\$90.00	\$165,375.00	\$47,141
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$42,759
	Tack Coat - 2 Layers	30,000 m ²	\$0.50	\$15,000.00	\$4,276
37	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$1,933
40	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$14,060
45	Mill Asphalt Surface (50 mm)	1,800 t	\$7.50	\$13,500.00	\$2,311
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$26,964
	Resurface with New Surface Asphalt (50 mm)	1,875 t	\$100.00	\$187,500.00	\$32,100
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,284
48	Rout and Seal Cracks	1,500 m	\$45.00	\$67,500.00	\$10,273
50	Salvage Value	7 year(s)	-\$30,500.00	-\$213,500.00	-\$30,042
Total Maintenance and Rehabilitation Cost					\$456,605



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Major Arterial HMA	Pavement Design	
Pavement Type:	Rigid Pavement	210 mm	Portland Cement Concrete
AADTT:	7,500	300 mm	Crushed Gravel Base
Subgrade (MPa):	50 MPa		
Lane Width (m):	3.75m Inner Lanes & 4.25m Outer Lanes		
Width of Road (m):	16		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	210 mm	m ²	16,000	\$63	\$1,008,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	4,800	\$35	\$168,000
Excavation	Earth Excavation	510 mm	m ³	8,160	\$16	\$130,560
Total Initial Pavement Construction Cost						\$1,306,560

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$10,306
	Partial Depth Joint Repairs (2%)	120 m ²	\$200.00	\$24,000.00	\$14,990
25	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$22,507
	Full Depth Joint Repairs (10%)	400 m ²	\$150.00	\$60,000.00	\$22,507
	Reseal Transverse/Longitudinal Joints (50%)	3,000 m	\$11.00	\$33,000.00	\$12,379
	Texturize Surface (25%)	4,000 m ²	\$15.00	\$60,000.00	\$22,507
40	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$12,497
	Full Depth Joint Repairs (15%)	600 m ²	\$150.00	\$90,000.00	\$18,746
	Reseal Transverse/Longitudinal Joints (50%)	3,000 m	\$11.00	\$33,000.00	\$6,874
	Texturize Surface (50%)	8,000 m ²	\$15.00	\$120,000.00	\$24,995
50	Salvage Value	5 year(s)	-\$25,250.00	-\$126,250.00	-\$17,765
Total Maintenance and Rehabilitation Cost					\$150,543



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Minor Arterial HMA	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	5,000	160 mm	Lower Course #1
Subgrade (MPa):	30 MPa	200 mm	Crushed Gravel Base
Lane Width (m):	3.75	550 mm	Crushed Gravel Subbase
Width of Road (m):	15		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	1,875	\$100	\$187,500
Base HMA	Lower Course #1	160 mm	t	5,880	\$90	\$529,200
Tack Coat	Tack Coat - 3 Lifts		m ²	45,000	\$0.50	\$22,500
Crushed Base	Crushed Gravel Base	200 mm	m ³	3,000	\$35	\$105,000
Crushed Subbase	Crushed Gravel Subbase	550 mm	m ³	8,250	\$26	\$214,500
Excavation	Earth Excavation	960 mm	m ³	14,400	\$16	\$230,400
Total Initial Pavement Construction Cost						\$1,289,100

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
5	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$1,130
10	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,858
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	1,200 m ²	\$45.00	\$54,000.00	\$36,480
20	Mill Asphalt Surface (40 mm)	1,440 t	\$7.50	\$10,800.00	\$4,929
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$68,458
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$3,423
25	Rout and Seal Cracks	1,000 m	\$5.50	\$5,500.00	\$2,063
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (15%)	2,250 m ²	\$45.00	\$101,250.00	\$31,217
35	Mill Asphalt Surface (90 mm)	3,240 t	\$7.50	\$24,300.00	\$6,158
	Resurface with New Base Asphalt (50 mm)	1,838 t	\$90.00	\$165,375.00	\$41,909
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$38,012
	Tack Coat - 2 Layers	30,000 m ²	\$0.50	\$15,000.00	\$3,801
40	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$1,718
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$12,499
48	Mill Asphalt Surface (40 mm)	1,440 t	\$7.50	\$10,800.00	\$1,644
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$23,971
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$22,829
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,141
50	Salvage Value	10 year(s)	-\$27,150.00	-\$271,500.00	-\$38,203
Total Maintenance and Rehabilitation Cost					\$265,038



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Minor Arterial HMA	Pavement Design	
Pavement Type:	Rigid Pavement	200 mm	Portland Cement Concrete
AADTT:	5,000	200 mm	Crushed Gravel Base
Subgrade (MPa):	30 MPa		
Lane Width (m):	3.75m Inner Lanes & 4.25m Outer Lanes		
Width of Road (m):	16		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	200 mm	m ²	16,000	\$62	\$992,000
Crushed Base	Crushed Gravel Base	200 mm	m ³	3,200	\$35	\$112,000
Excavation	Earth Excavation	400 mm	m ³	6,400	\$16	\$102,400
Total Initial Pavement Construction Cost						\$1,206,400

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$10,306
	Partial Depth Joint Repairs (2%)	120 m ²	\$200.00	\$24,000.00	\$14,990
25	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$22,507
	Full Depth Joint Repairs (10%)	400 m ²	\$150.00	\$60,000.00	\$22,507
	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$6,189
40	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$12,497
	Full Depth Joint Repairs (15%)	600 m ²	\$150.00	\$90,000.00	\$18,746
	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$3,437
50	Salvage Value	5 year(s)	-\$13,875.00	-\$69,375.00	-\$9,762
Total Maintenance and Rehabilitation Cost					\$101,418



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Minor Arterial HMA	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	5,000	160 mm	Lower Course #1
Subgrade (MPa):	40 MPa	200 mm	Crushed Gravel Base
Lane Width (m):	3.75	400 mm	Crushed Gravel Subbase
Width of Road (m):	15		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	1,875	\$100	\$187,500
Base HMA	Lower Course #1	160 mm	t	5,880	\$90	\$529,200
Tack Coat	Tack Coat - 3 Lifts		m ²	45,000	\$0.50	\$22,500
Crushed Base	Crushed Gravel Base	200 mm	m ³	3,000	\$35	\$105,000
Crushed Subbase	Crushed Gravel Subbase	400 mm	m ³	6,000	\$26	\$156,000
Excavation	Earth Excavation	810 mm	m ³	12,150	\$16	\$194,400
Total Initial Pavement Construction Cost						\$1,194,600

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
5	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$1,130
10	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,858
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	1,200 m ²	\$45.00	\$54,000.00	\$36,480
20	Mill Asphalt Surface (40 mm)	1,440 t	\$7.50	\$10,800.00	\$4,929
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$68,458
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$3,423
25	Rout and Seal Cracks	1,000 m	\$5.50	\$5,500.00	\$2,063
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (15%)	2,250 m ²	\$45.00	\$101,250.00	\$31,217
35	Mill Asphalt Surface (90 mm)	3,240 t	\$7.50	\$24,300.00	\$6,158
	Resurface with New Base Asphalt (50 mm)	1,838 t	\$90.00	\$165,375.00	\$41,909
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$38,012
	Tack Coat - 2 Layers	30,000 m ²	\$0.50	\$15,000.00	\$3,801
40	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$1,718
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$12,499
48	Mill Asphalt Surface (40 mm)	1,440 t	\$7.50	\$10,800.00	\$1,644
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$23,971
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$22,829
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,141
50	Salvage Value	10 year(s)	-\$27,150.00	-\$271,500.00	-\$38,203
Total Maintenance and Rehabilitation Cost					\$265,038



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Minor Arterial HMA	Pavement Design	
Pavement Type:	Rigid Pavement	200 mm	Portland Cement Concrete
AADTT:	5,000	200 mm	Crushed Gravel Base
Subgrade (MPa):	40 MPa		
Lane Width (m):	3.75m Inner Lanes & 4.25m Outer Lanes		
Width of Road (m):	16		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	200 mm	m ²	16,000	\$62	\$992,000
Crushed Base	Crushed Gravel Base	200 mm	m ³	3,200	\$35	\$112,000
Excavation	Earth Excavation	400 mm	m ³	6,400	\$16	\$102,400
Total Initial Pavement Construction Cost						\$1,206,400

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$10,306
	Partial Depth Joint Repairs (2%)	120 m ²	\$200.00	\$24,000.00	\$14,990
25	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$22,507
	Full Depth Joint Repairs (10%)	400 m ²	\$150.00	\$60,000.00	\$22,507
	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$6,189
40	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$12,497
	Full Depth Joint Repairs (15%)	600 m ²	\$150.00	\$90,000.00	\$18,746
	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$3,437
50	Salvage Value	5 year(s)	-\$13,875.00	-\$69,375.00	-\$9,762
Total Maintenance and Rehabilitation Cost					\$101,418



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Minor Arterial HMA	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	5,000	160 mm	Lower Course #1
Subgrade (MPa):	50 MPa	200 mm	Crushed Gravel Base
Lane Width (m):	3.75	300 mm	Crushed Gravel Subbase
Width of Road (m):	15		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	1,875	\$100	\$187,500
Base HMA	Lower Course #1	160 mm	t	5,880	\$90	\$529,200
Tack Coat	Tack Coat - 2 Lifts		m ²	30,000	\$0.50	\$15,000
Crushed Base	Crushed Gravel Base	200 mm	m ³	3,000	\$35	\$105,000
Crushed Subbase	Crushed Gravel Subbase	300 mm	m ³	4,500	\$26	\$117,000
Excavation	Earth Excavation	710 mm	m ³	10,650	\$16	\$170,400
Total Initial Pavement Construction Cost						\$1,124,100

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
5	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$1,130
10	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,858
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	1,200 m ²	\$45.00	\$54,000.00	\$36,480
20	Mill Asphalt Surface (40 mm)	1,440 t	\$7.50	\$10,800.00	\$4,929
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$68,458
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$3,423
25	Rout and Seal Cracks	1,000 m	\$5.50	\$5,500.00	\$2,063
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (15%)	2,250 m ²	\$45.00	\$101,250.00	\$31,217
35	Mill Asphalt Surface (90 mm)	3,240 t	\$7.50	\$24,300.00	\$6,158
	Resurface with New Base Asphalt (50 mm)	1,838 t	\$90.00	\$165,375.00	\$41,909
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$38,012
	Tack Coat - 2 Layers	30,000 m ²	\$0.50	\$15,000.00	\$3,801
40	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$1,718
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$12,499
48	Mill Asphalt Surface (40 mm)	1,440 t	\$7.50	\$10,800.00	\$1,644
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$23,971
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$22,829
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,141
50	Salvage Value	10 year(s)	-\$27,150.00	-\$271,500.00	-\$38,203
Total Maintenance and Rehabilitation Cost					\$265,038



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Minor Arterial HMA	Pavement Design	
Pavement Type:	Rigid Pavement	200 mm	Portland Cement Concrete
AADTT:	5,000	200 mm	Crushed Gravel Base
Subgrade (MPa):	50 MPa		
Lane Width (m):	3.75m Inner Lanes & 4.25m Outer Lanes		
Width of Road (m):	16		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	200 mm	m ²	16,000	\$62	\$992,000
Crushed Base	Crushed Gravel Base	200 mm	m ³	3,200	\$35	\$112,000
Excavation	Earth Excavation	400 mm	m ³	6,400	\$16	\$102,400
Total Initial Pavement Construction Cost						\$1,206,400

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$10,306
	Partial Depth Joint Repairs (2%)	120 m ²	\$200.00	\$24,000.00	\$14,990
25	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$22,507
	Full Depth Joint Repairs (10%)	400 m ²	\$150.00	\$60,000.00	\$22,507
	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$6,189
40	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$12,497
	Full Depth Joint Repairs (15%)	600 m ²	\$150.00	\$90,000.00	\$18,746
	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$3,437
50	Salvage Value	5 year(s)	-\$13,875.00	-\$69,375.00	-\$9,762
Total Maintenance and Rehabilitation Cost					\$101,418



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Minor Arterial HMA	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	2,500	140 mm	Lower Course #1
Subgrade (MPa):	30 MPa	200 mm	Crushed Gravel Base
Lane Width (m):	3.75	500 mm	Crushed Gravel Subbase
Width of Road (m):	15		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	1,875	\$100	\$187,500
Base HMA	Lower Course #1	140 mm	t	5,145	\$90	\$463,050
Tack Coat	Tack Coat - 3 Lifts		m ²	45,000	\$0.50	\$22,500
Crushed Base	Crushed Gravel Base	200 mm	m ³	3,000	\$35	\$105,000
Crushed Subbase	Crushed Gravel Subbase	500 mm	m ³	7,500	\$26	\$195,000
Excavation	Earth Excavation	890 mm	m ³	13,350	\$16	\$213,600
Total Initial Pavement Construction Cost						\$1,186,650

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
5	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$1,130
10	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,858
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	1,200 m ²	\$45.00	\$54,000.00	\$36,480
20	Mill Asphalt Surface (40 mm)	1,440 t	\$7.50	\$10,800.00	\$4,929
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$68,458
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$3,423
25	Rout and Seal Cracks	1,000 m	\$5.50	\$5,500.00	\$2,063
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (15%)	2,250 m ²	\$45.00	\$101,250.00	\$31,217
35	Mill Asphalt Surface (90 mm)	3,240 t	\$7.50	\$24,300.00	\$6,158
	Resurface with New Base Asphalt (50 mm)	1,838 t	\$90.00	\$165,375.00	\$41,909
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$38,012
	Tack Coat - 2 Layers	30,000 m ²	\$0.50	\$15,000.00	\$3,801
40	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$1,718
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$12,499
48	Mill Asphalt Surface (40 mm)	1,440 t	\$7.50	\$10,800.00	\$1,644
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$23,971
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$22,829
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,141
50	Salvage Value	10 year(s)	-\$27,150.00	-\$271,500.00	-\$38,203
Total Maintenance and Rehabilitation Cost					\$265,038



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Minor Arterial HMA	Pavement Design	
Pavement Type:	Rigid Pavement	190 mm	Portland Cement Concrete
AADTT:	2,500	200 mm	Crushed Gravel Base
Subgrade (MPa):	30 MPa		
Lane Width (m):	3.75m Inner Lanes & 4.25m Outer Lanes		
Width of Road (m):	16		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	190 mm	m ²	16,000	\$61	\$976,000
Crushed Base	Crushed Gravel Base	200 mm	m ³	3,200	\$35	\$112,000
Excavation	Earth Excavation	390 mm	m ³	6,240	\$16	\$99,840
Total Initial Pavement Construction Cost						\$1,187,840

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$10,306
	Partial Depth Joint Repairs (2%)	120 m ²	\$200.00	\$24,000.00	\$14,990
25	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$22,507
	Full Depth Joint Repairs (10%)	400 m ²	\$150.00	\$60,000.00	\$22,507
	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$6,189
40	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$12,497
	Full Depth Joint Repairs (15%)	600 m ²	\$150.00	\$90,000.00	\$18,746
	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$3,437
50	Salvage Value	5 year(s)	-\$13,875.00	-\$69,375.00	-\$9,762
Total Maintenance and Rehabilitation Cost					\$101,418



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Minor Arterial HMA	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	2,500	140 mm	Lower Course #1
Subgrade (MPa):	40 MPa	200 mm	Crushed Gravel Base
Lane Width (m):	3.75	350 mm	Crushed Gravel Subbase
Width of Road (m):	15		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	1,875	\$100	\$187,500
Base HMA	Lower Course #1	140 mm	t	5,145	\$90	\$463,050
Tack Coat	Tack Coat - 2 Lifts		m ²	30,000	\$0.50	\$15,000
Crushed Base	Crushed Gravel Base	200 mm	m ³	3,000	\$35	\$105,000
Crushed Subbase	Crushed Gravel Subbase	350 mm	m ³	5,250	\$26	\$136,500
Excavation	Earth Excavation	740 mm	m ³	11,100	\$16	\$177,600
Total Initial Pavement Construction Cost						\$1,084,650

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
5	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$1,130
10	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,858
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	1,200 m ²	\$45.00	\$54,000.00	\$36,480
20	Mill Asphalt Surface (40 mm)	1,440 t	\$7.50	\$10,800.00	\$4,929
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$68,458
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$3,423
25	Rout and Seal Cracks	1,000 m	\$5.50	\$5,500.00	\$2,063
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (15%)	2,250 m ²	\$45.00	\$101,250.00	\$31,217
35	Mill Asphalt Surface (90 mm)	3,240 t	\$7.50	\$24,300.00	\$6,158
	Resurface with New Base Asphalt (50 mm)	1,838 t	\$90.00	\$165,375.00	\$41,909
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$38,012
	Tack Coat - 2 Layers	30,000 m ²	\$0.50	\$15,000.00	\$3,801
40	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$1,718
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$12,499
48	Mill Asphalt Surface (40 mm)	1,440 t	\$7.50	\$10,800.00	\$1,644
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$23,971
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$22,829
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,141
50	Salvage Value	10 year(s)	-\$27,150.00	-\$271,500.00	-\$38,203
Total Maintenance and Rehabilitation Cost					\$265,038



EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS
25 Year Pavement Design and 50 Year LCCA
 All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Minor Arterial HMA	Pavement Design	
Pavement Type:	Rigid Pavement	190 mm	Portland Cement Concrete
AADTT:	2,500	200 mm	Crushed Gravel Base
Subgrade (MPa):	40 MPa		
Lane Width (m):	3.75m Inner Lanes & 4.25m Outer Lanes		
Width of Road (m):	16		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	190 mm	m ²	16,000	\$61	\$976,000
Crushed Base	Crushed Gravel Base	200 mm	m ³	3,200	\$35	\$112,000
Excavation	Earth Excavation	390 mm	m ³	6,240	\$16	\$99,840
Total Initial Pavement Construction Cost						\$1,187,840

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$10,306
	Partial Depth Joint Repairs (2%)	120 m ²	\$200.00	\$24,000.00	\$14,990
25	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$22,507
	Full Depth Joint Repairs (10%)	400 m ²	\$150.00	\$60,000.00	\$22,507
	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$6,189
40	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$12,497
	Full Depth Joint Repairs (15%)	600 m ²	\$150.00	\$90,000.00	\$18,746
	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$3,437
50	Salvage Value	5 year(s)	-\$13,875.00	-\$69,375.00	-\$9,762
Total Maintenance and Rehabilitation Cost					\$101,418



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Minor Arterial HMA	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	2,500	140 mm	Lower Course #1
Subgrade (MPa):	50 MPa	200 mm	Crushed Gravel Base
Lane Width (m):	3.75	250 mm	Crushed Gravel Subbase
Width of Road (m):	15		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	1,875	\$100	\$187,500
Base HMA	Lower Course #1	140 mm	t	5,145	\$90	\$463,050
Tack Coat	Tack Coat - 2 Lifts		m ²	30,000	\$0.50	\$15,000
Crushed Base	Crushed Gravel Base	200 mm	m ³	3,000	\$35	\$105,000
Crushed Subbase	Crushed Gravel Subbase	250 mm	m ³	3,750	\$26	\$97,500
Excavation	Earth Excavation	640 mm	m ³	9,600	\$16	\$153,600
Total Initial Pavement Construction Cost						\$1,021,650

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
5	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$1,130
10	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,858
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	1,200 m ²	\$45.00	\$54,000.00	\$36,480
20	Mill Asphalt Surface (40 mm)	1,440 t	\$7.50	\$10,800.00	\$4,929
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$68,458
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$3,423
25	Rout and Seal Cracks	1,000 m	\$5.50	\$5,500.00	\$2,063
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (15%)	2,250 m ²	\$45.00	\$101,250.00	\$31,217
35	Mill Asphalt Surface (90 mm)	3,240 t	\$7.50	\$24,300.00	\$6,158
	Resurface with New Base Asphalt (50 mm)	1,838 t	\$90.00	\$165,375.00	\$41,909
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$38,012
	Tack Coat - 2 Layers	30,000 m ²	\$0.50	\$15,000.00	\$3,801
40	Rout and Seal Cracks	1,500 m	\$5.50	\$8,250.00	\$1,718
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	1,500 m ²	\$45.00	\$67,500.00	\$12,499
48	Mill Asphalt Surface (40 mm)	1,440 t	\$7.50	\$10,800.00	\$1,644
	Full Depth Asphalt Base Repairs (10%)	1,500 m ²	\$105.00	\$157,500.00	\$23,971
	Resurface with New Surface Asphalt (40 mm)	1,500 t	\$100.00	\$150,000.00	\$22,829
	Tack Coat - 1 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,141
50	Salvage Value	10 year(s)	-\$27,150.00	-\$271,500.00	-\$38,203
Total Maintenance and Rehabilitation Cost					\$265,038



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 4-Lane Roadway

Roadway:	Minor Arterial HMA	Pavement Design	
Pavement Type:	Rigid Pavement	190 mm	Portland Cement Concrete
AADTT:	2,500	200 mm	Crushed Gravel Base
Subgrade (MPa):	50 MPa		
Lane Width (m):	3.75m Inner Lanes & 4.25m Outer Lanes		
Width of Road (m):	16		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	190 mm	m ²	16,000	\$61	\$976,000
Crushed Base	Crushed Gravel Base	200 mm	m ³	3,200	\$35	\$112,000
Excavation	Earth Excavation	390 mm	m ³	6,240	\$16	\$99,840
Total Initial Pavement Construction Cost						\$1,187,840

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$10,306
	Partial Depth Joint Repairs (2%)	120 m ²	\$200.00	\$24,000.00	\$14,990
25	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$22,507
	Full Depth Joint Repairs (10%)	400 m ²	\$150.00	\$60,000.00	\$22,507
	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$6,189
40	Partial Depth Joint Repairs (5%)	300 m ²	\$200.00	\$60,000.00	\$12,497
	Full Depth Joint Repairs (15%)	600 m ²	\$150.00	\$90,000.00	\$18,746
	Reseal Transverse/Longitudinal Joints (25%)	1,500 m	\$11.00	\$16,500.00	\$3,437
50	Salvage Value	5 year(s)	-\$13,875.00	-\$69,375.00	-\$9,762
Total Maintenance and Rehabilitation Cost					\$101,418



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Major Collector	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	1,600	110 mm	Lower Course #1
Subgrade (MPa):	30 MPa	200 mm	Crushed Gravel Base
Lane Width (m):	3.75	400 mm	Crushed Gravel Subbase
Width of Road (m):	7.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	938	\$100	\$93,750
Base HMA	Lower Course #1	110 mm	t	2,888	\$90	\$259,875
Tack Coat	Tack Coat - 2 Lifts		m ²	15,000	\$0.50	\$7,500
Crushed Base	Crushed Gravel Base	200 mm	m ³	1,500	\$35	\$52,500
Crushed Subbase	Crushed Gravel Subbase	400 mm	m ³	3,000	\$26	\$78,000
Excavation	Earth Excavation	760 mm	m ³	5,700	\$16	\$91,200
Total Initial Pavement Construction Cost						\$582,825

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
10	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$929
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$18,240
15	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$18,740
20	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$2,464
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$34,229
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$1,711
25	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,032
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$10,406
35	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$1,368
	Full Depth Asphalt Base Repairs (10%)	750 m ²	\$105.00	\$78,750.00	\$19,956
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$19,006
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$950
40	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$573
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$5,000
48	Mill Asphalt Surface (90 mm)	1,620 t	\$7.50	\$12,150.00	\$1,849
	Resurface with New Surface Asphalt (90 mm)	1,688 t	\$100.00	\$168,750.00	\$25,683
	Tack Coat - 2 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,141
50	Salvage Value	10 year(s)	-\$15,700.00	-\$157,000.00	-\$22,092
Total Maintenance and Rehabilitation Cost					\$141,187



EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS
25 Year Pavement Design and 50 Year LCCA
 All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Major Collector	Pavement Design
Pavement Type:	Rigid Pavement	170 mm Portland Cement Concrete
AADTT:	1,600	200 mm Crushed Gravel Base
Subgrade (MPa):	30 MPa	
Lane Width (m):	4.25	
Width of Road (m):	8.5	

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	170 mm	m ²	8,500	\$57	\$484,500
Crushed Base	Crushed Gravel Base	200 mm	m ³	1,700	\$35	\$59,500
Excavation	Earth Excavation	370 mm	m ³	3,145	\$16	\$50,320
Total Initial Pavement Construction Cost						\$594,320

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$4,294
25	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$11,722
	Full Depth Joint Repairs (10%)	213 m ²	\$150.00	\$31,875.00	\$11,957
	Reseal Transverse/Longitudinal Joints (25%)	781 m	\$11.00	\$8,593.75	\$3,224
40	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$6,509
	Full Depth Joint Repairs (15%)	319 m ²	\$150.00	\$47,812.50	\$9,959
	Reseal Transverse/Longitudinal Joints (25%)	781 m	\$11.00	\$8,593.75	\$1,790
50	Salvage Value	5 year(s)	-\$7,304.69	-\$36,523.44	-\$5,139
Total Maintenance and Rehabilitation Cost					\$44,316



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Major Collector	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	1,600	110 mm	Lower Course #1
Subgrade (MPa):	40 MPa	150 mm	Crushed Gravel Base
Lane Width (m):	3.75	350 mm	Crushed Gravel Subbase
Width of Road (m):	7.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	938	\$100	\$93,750
Base HMA	Lower Course #1	110 mm	t	2,888	\$90	\$259,875
Tack Coat	Tack Coat - 2 Lifts		m ²	15,000	\$0.50	\$7,500
Crushed Base	Crushed Gravel Base	150 mm	m ³	1,125	\$35	\$39,375
Crushed Subbase	Crushed Gravel Subbase	350 mm	m ³	2,625	\$26	\$68,250
Excavation	Earth Excavation	660 mm	m ³	4,950	\$16	\$79,200
Total Initial Pavement Construction Cost						\$547,950

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
10	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$929
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$18,240
15	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$18,740
20	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$2,464
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$34,229
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$1,711
25	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,032
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$10,406
35	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$1,368
	Full Depth Asphalt Base Repairs (10%)	750 m ²	\$105.00	\$78,750.00	\$19,956
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$19,006
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$950
40	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$573
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$5,000
48	Mill Asphalt Surface (90 mm)	1,620 t	\$7.50	\$12,150.00	\$1,849
	Resurface with New Surface Asphalt (90 mm)	1,688 t	\$100.00	\$168,750.00	\$25,683
	Tack Coat - 2 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,141
50	Salvage Value	10 year(s)	-\$15,700.00	-\$157,000.00	-\$22,092
Total Maintenance and Rehabilitation Cost					\$141,187



EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS
25 Year Pavement Design and 50 Year LCCA
 All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Major Collector	Pavement Design
Pavement Type:	Rigid Pavement	170 mm Portland Cement Concrete
AADTT:	1,600	200 mm Crushed Gravel Base
Subgrade (MPa):	40 MPa	
Lane Width (m):	4.25	
Width of Road (m):	8.5	

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	170 mm	m ²	8,500	\$57	\$484,500
Crushed Base	Crushed Gravel Base	200 mm	m ³	1,700	\$35	\$59,500
Excavation	Earth Excavation	370 mm	m ³	3,145	\$16	\$50,320
Total Initial Pavement Construction Cost						\$594,320

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$4,294
25	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$11,722
	Full Depth Joint Repairs (10%)	213 m ²	\$150.00	\$31,875.00	\$11,957
	Reseal Transverse/Longitudinal Joints (25%)	781 m	\$11.00	\$8,593.75	\$3,224
40	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$6,509
	Full Depth Joint Repairs (15%)	319 m ²	\$150.00	\$47,812.50	\$9,959
	Reseal Transverse/Longitudinal Joints (25%)	781 m	\$11.00	\$8,593.75	\$1,790
50	Salvage Value	5 year(s)	-\$7,304.69	-\$36,523.44	-\$5,139
Total Maintenance and Rehabilitation Cost					\$44,316



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Major Collector	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	1,600	110 mm	Lower Course #1
Subgrade (MPa):	50 MPa	150 mm	Crushed Gravel Base
Lane Width (m):	3.75	250 mm	Crushed Gravel Subbase
Width of Road (m):	7.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	938	\$100	\$93,750
Base HMA	Lower Course #1	110 mm	t	2,888	\$90	\$259,875
Tack Coat	Tack Coat - 2 Lifts		m ²	15,000	\$0.50	\$7,500
Crushed Base	Crushed Gravel Base	150 mm	m ³	1,125	\$35	\$39,375
Crushed Subbase	Crushed Gravel Subbase	250 mm	m ³	1,875	\$26	\$48,750
Excavation	Earth Excavation	560 mm	m ³	4,200	\$16	\$67,200
Total Initial Pavement Construction Cost						\$516,450

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
10	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$929
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$18,240
15	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$18,740
20	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$2,464
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$34,229
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$1,711
25	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,032
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$10,406
35	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$1,368
	Full Depth Asphalt Base Repairs (10%)	750 m ²	\$105.00	\$78,750.00	\$19,956
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$19,006
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$950
40	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$573
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$5,000
48	Mill Asphalt Surface (90 mm)	1,620 t	\$7.50	\$12,150.00	\$1,849
	Resurface with New Surface Asphalt (90 mm)	1,688 t	\$100.00	\$168,750.00	\$25,683
	Tack Coat - 2 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,141
50	Salvage Value	10 year(s)	-\$15,700.00	-\$157,000.00	-\$22,092
Total Maintenance and Rehabilitation Cost					\$141,187



EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS
25 Year Pavement Design and 50 Year LCCA
 All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Major Collector	Pavement Design
Pavement Type:	Rigid Pavement	170 mm Portland Cement Concrete
AADTT:	1,600	200 mm Crushed Gravel Base
Subgrade (MPa):	50 MPa	
Lane Width (m):	4.25	
Width of Road (m):	8.5	

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	170 mm	m ²	8,500	\$57	\$484,500
Crushed Base	Crushed Gravel Base	200 mm	m ³	1,700	\$35	\$59,500
Excavation	Earth Excavation	370 mm	m ³	3,145	\$16	\$50,320
Total Initial Pavement Construction Cost						\$594,320

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$4,294
25	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$11,722
	Full Depth Joint Repairs (10%)	213 m ²	\$150.00	\$31,875.00	\$11,957
	Reseal Transverse/Longitudinal Joints (25%)	781 m	\$11.00	\$8,593.75	\$3,224
40	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$6,509
	Full Depth Joint Repairs (15%)	319 m ²	\$150.00	\$47,812.50	\$9,959
	Reseal Transverse/Longitudinal Joints (25%)	781 m	\$11.00	\$8,593.75	\$1,790
50	Salvage Value	5 year(s)	-\$7,304.69	-\$36,523.44	-\$5,139
Total Maintenance and Rehabilitation Cost					\$44,316



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Major Collector	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	750	90 mm	Lower Course #1
Subgrade (MPa):	30 MPa	200 mm	Crushed Gravel Base
Lane Width (m):	3.75	350 mm	Crushed Gravel Subbase
Width of Road (m):	7.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	938	\$100	\$93,750
Base HMA	Lower Course #1	90 mm	t	2,363	\$90	\$212,625
Tack Coat	Tack Coat - 2 Lifts		m ²	15,000	\$0.50	\$7,500
Crushed Base	Crushed Gravel Base	200 mm	m ³	1,500	\$35	\$52,500
Crushed Subbase	Crushed Gravel Subbase	350 mm	m ³	2,625	\$26	\$68,250
Excavation	Earth Excavation	690 mm	m ³	5,175	\$16	\$82,800
Total Initial Pavement Construction Cost						\$517,425

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
10	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$929
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$18,240
15	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$18,740
20	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$2,464
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$34,229
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$1,711
25	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,032
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$10,406
35	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$1,368
	Full Depth Asphalt Base Repairs (10%)	750 m ²	\$105.00	\$78,750.00	\$19,956
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$19,006
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$950
40	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$573
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$5,000
48	Mill Asphalt Surface (90 mm)	1,620 t	\$7.50	\$12,150.00	\$1,849
	Resurface with New Surface Asphalt (90 mm)	1,688 t	\$100.00	\$168,750.00	\$25,683
	Tack Coat - 2 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,141
50	Salvage Value	10 year(s)	-\$15,700.00	-\$157,000.00	-\$22,092
Total Maintenance and Rehabilitation Cost					\$141,187



EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS
25 Year Pavement Design and 50 Year LCCA
 All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Major Collector	Pavement Design
Pavement Type:	Rigid Pavement	170 mm Portland Cement Concrete
AADTT:	750	300 mm Crushed Gravel Base
Subgrade (MPa):	30 MPa	
Lane Width (m):	4.25	
Width of Road (m):	8.5	

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	170 mm	m ²	8,500	\$52	\$442,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	2,550	\$35	\$89,250
Excavation	Earth Excavation	470 mm	m ³	3,995	\$16	\$63,920
Total Initial Pavement Construction Cost						\$595,170

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$4,294
25	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$11,722
	Full Depth Joint Repairs (10%)	213 m ²	\$150.00	\$31,875.00	\$11,957
	Reseal Transverse/Longitudinal Joints (25%)	781 m	\$11.00	\$8,593.75	\$3,224
40	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$6,509
	Full Depth Joint Repairs (15%)	319 m ²	\$150.00	\$47,812.50	\$9,959
	Reseal Transverse/Longitudinal Joints (25%)	781 m	\$11.00	\$8,593.75	\$1,790
50	Salvage Value	5 year(s)	-\$7,304.69	-\$36,523.44	-\$5,139
Total Maintenance and Rehabilitation Cost					\$44,316



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Major Collector	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	750	90 mm	Lower Course #1
Subgrade (MPa):	40 MPa	150 mm	Crushed Gravel Base
Lane Width (m):	3.75	300 mm	Crushed Gravel Subbase
Width of Road (m):	7.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	938	\$100	\$93,750
Base HMA	Lower Course #1	90 mm	t	2,363	\$90	\$212,625
Tack Coat	Tack Coat - 2 Lift		m ²	15,000	\$0.50	\$7,500
Crushed Base	Crushed Gravel Base	150 mm	m ³	1,125	\$35	\$39,375
Crushed Subbase	Crushed Gravel Subbase	300 mm	m ³	2,250	\$26	\$58,500
Excavation	Earth Excavation	590 mm	m ³	4,425	\$16	\$70,800
Total Initial Pavement Construction Cost						\$482,550

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
10	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$929
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$18,240
15	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$18,740
20	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$2,464
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$34,229
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$1,711
25	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,032
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$10,406
35	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$1,368
	Full Depth Asphalt Base Repairs (10%)	750 m ²	\$105.00	\$78,750.00	\$19,956
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$19,006
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$950
40	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$573
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$5,000
48	Mill Asphalt Surface (90 mm)	1,620 t	\$7.50	\$12,150.00	\$1,849
	Resurface with New Surface Asphalt (90 mm)	1,688 t	\$100.00	\$168,750.00	\$25,683
	Tack Coat - 2 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,141
50	Salvage Value	10 year(s)	-\$15,700.00	-\$157,000.00	-\$22,092
Total Maintenance and Rehabilitation Cost					\$141,187



EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS
25 Year Pavement Design and 50 Year LCCA
 All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Major Collector	Pavement Design
Pavement Type:	Rigid Pavement	170 mm Portland Cement Concrete
AADTT:	750	300 mm Crushed Gravel Base
Subgrade (MPa):	40 MPa	
Lane Width (m):	4.25	
Width of Road (m):	8.5	

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	170 mm	m ²	8,500	\$52	\$442,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	2,550	\$35	\$89,250
Excavation	Earth Excavation	470 mm	m ³	3,995	\$16	\$63,920
Total Initial Pavement Construction Cost						\$595,170

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$4,294
25	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$11,722
	Full Depth Joint Repairs (10%)	213 m ²	\$150.00	\$31,875.00	\$11,957
	Reseal Transverse/Longitudinal Joints (25%)	781 m	\$11.00	\$8,593.75	\$3,224
40	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$6,509
	Full Depth Joint Repairs (15%)	319 m ²	\$150.00	\$47,812.50	\$9,959
	Reseal Transverse/Longitudinal Joints (25%)	781 m	\$11.00	\$8,593.75	\$1,790
50	Salvage Value	5 year(s)	-\$7,304.69	-\$36,523.44	-\$5,139
Total Maintenance and Rehabilitation Cost					\$44,316



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Major Collector	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	750	90 mm	Lower Course #1
Subgrade (MPa):	50 MPa	150 mm	Crushed Gravel Base
Lane Width (m):	3.75	200 mm	Crushed Gravel Subbase
Width of Road (m):	7.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	938	\$100	\$93,750
Base HMA	Lower Course #1	90 mm	t	2,363	\$90	\$212,625
Tack Coat	Tack Coat - 2 Lift		m ²	15,000	\$0.50	\$7,500
Crushed Base	Crushed Gravel Base	150 mm	m ³	1,125	\$35	\$39,375
Crushed Subbase	Crushed Gravel Subbase	200 mm	m ³	1,500	\$26	\$39,000
Excavation	Earth Excavation	490 mm	m ³	3,675	\$16	\$58,800
Total Initial Pavement Construction Cost						\$451,050

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
10	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$929
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$18,240
15	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$18,740
20	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$2,464
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$34,229
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$1,711
25	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,032
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$10,406
35	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$1,368
	Full Depth Asphalt Base Repairs (10%)	750 m ²	\$105.00	\$78,750.00	\$19,956
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$19,006
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$950
40	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$573
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$5,000
48	Mill Asphalt Surface (90 mm)	1,620 t	\$7.50	\$12,150.00	\$1,849
	Resurface with New Surface Asphalt (90 mm)	1,688 t	\$100.00	\$168,750.00	\$25,683
	Tack Coat - 2 Layers	15,000 m ²	\$0.50	\$7,500.00	\$1,141
50	Salvage Value	10 year(s)	-\$15,700.00	-\$157,000.00	-\$22,092
Total Maintenance and Rehabilitation Cost					\$141,187



EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS
25 Year Pavement Design and 50 Year LCCA
 All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Major Collector	Pavement Design
Pavement Type:	Rigid Pavement	170 mm Portland Cement Concrete
AADTT:	750	300 mm Crushed Gravel Base
Subgrade (MPa):	50 MPa	
Lane Width (m):	4.25	
Width of Road (m):	8.5	

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	170 mm	m ²	8,500	\$52	\$442,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	2,550	\$35	\$89,250
Excavation	Earth Excavation	470 mm	m ³	3,995	\$16	\$63,920
Total Initial Pavement Construction Cost						\$595,170

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$4,294
25	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$11,722
	Full Depth Joint Repairs (10%)	213 m ²	\$150.00	\$31,875.00	\$11,957
	Reseal Transverse/Longitudinal Joints (25%)	781 m	\$11.00	\$8,593.75	\$3,224
40	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$6,509
	Full Depth Joint Repairs (15%)	319 m ²	\$150.00	\$47,812.50	\$9,959
	Reseal Transverse/Longitudinal Joints (25%)	781 m	\$11.00	\$8,593.75	\$1,790
50	Salvage Value	5 year(s)	-\$7,304.69	-\$36,523.44	-\$5,139
Total Maintenance and Rehabilitation Cost					\$44,316



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Industrial	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	500	90 mm	Lower Course #1
Subgrade (MPa):	30 MPa	150 mm	Crushed Gravel Base
Lane Width (m):	3.75	400 mm	Crushed Gravel Subbase
Width of Road (m):	7.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	938	\$100	\$93,750
Base HMA	Lower Course #1	90 mm	t	2,363	\$90	\$212,625
Tack Coat	Tack Coat - 2 Lifts		m ²	15,000	\$0.50	\$7,500
Crushed Base	Crushed Gravel Base	150 mm	m ³	1,125	\$35	\$39,375
Crushed Subbase	Crushed Gravel Subbase	400 mm	m ³	3,000	\$26	\$78,000
Excavation	Earth Excavation	690 mm	m ³	5,175	\$16	\$82,800
Total Initial Pavement Construction Cost						\$514,050

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
10	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$929
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$18,240
20	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$2,464
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$34,229
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$1,711
25	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,032
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$10,406
35	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$1,368
	Full Depth Asphalt Base Repairs (10%)	750 m ²	\$105.00	\$78,750.00	\$19,956
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$19,006
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$950
40	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$573
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$5,000
48	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$822
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$11,415
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$571
50	Salvage Value	8 year(s)	-\$7,012.50	-\$56,100.00	-\$7,894
Total Maintenance and Rehabilitation Cost					\$120,778



EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS
25 Year Pavement Design and 50 Year LCCA
 All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Industrial	Pavement Design	
Pavement Type:	Rigid Pavement	170 mm	Portland Cement Concrete
AADTT:	500	300 mm	Crushed Gravel Base
Subgrade (MPa):	30 MPa		
Lane Width (m):	4.25		
Width of Road (m):	8.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	170 mm	m ²	8,500	\$52	\$442,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	2,550	\$35	\$89,250
Excavation	Earth Excavation	470 mm	m ³	3,995	\$16	\$63,920
Total Initial Pavement Construction Cost						\$595,170

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (10%)	313 m	\$11.00	\$3,437.50	\$2,147
25	Partial Depth Joint Repairs (2%)	63 m ²	\$200.00	\$12,500.00	\$4,689
	Full Depth Joint Repairs (5%)	106 m ²	\$150.00	\$15,937.50	\$5,978
	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$2,579
40	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$6,509
	Full Depth Joint Repairs (10%)	213 m ²	\$150.00	\$31,875.00	\$6,639
	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$1,432
50	Salvage Value	5 year(s)	-\$5,833.33	-\$29,166.67	-\$4,104
Total Maintenance and Rehabilitation Cost					\$25,869



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Industrial	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	500	90 mm	Lower Course #1
Subgrade (MPa):	40 MPa	150 mm	Crushed Gravel Base
Lane Width (m):	3.75	300 mm	Crushed Gravel Subbase
Width of Road (m):	7.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	938	\$100	\$93,750
Base HMA	Lower Course #1	90 mm	t	2,363	\$90	\$212,625
Tack Coat	Tack Coat - 2 Lifts		m ²	15,000	\$0.50	\$7,500
Crushed Base	Crushed Gravel Base	150 mm	m ³	1,125	\$35	\$39,375
Crushed Subbase	Crushed Gravel Subbase	300 mm	m ³	2,250	\$26	\$58,500
Excavation	Earth Excavation	590 mm	m ³	4,425	\$16	\$70,800
Total Initial Pavement Construction Cost						\$482,550

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
10	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$929
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$18,240
20	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$2,464
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$34,229
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$1,711
25	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,032
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$10,406
35	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$1,368
	Full Depth Asphalt Base Repairs (10%)	750 m ²	\$105.00	\$78,750.00	\$19,956
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$19,006
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$950
40	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$573
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$5,000
48	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$822
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$11,415
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$571
50	Salvage Value	8 year(s)	-\$7,012.50	-\$56,100.00	-\$7,894
Total Maintenance and Rehabilitation Cost					\$120,778



EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS
25 Year Pavement Design and 50 Year LCCA
 All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Industrial	Pavement Design	
Pavement Type:	Rigid Pavement	170 mm	Portland Cement Concrete
AADTT:	500	300 mm	Crushed Gravel Base
Subgrade (MPa):	40 MPa		
Lane Width (m):	4.25		
Width of Road (m):	8.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	170 mm	m ²	8,500	\$52	\$442,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	2,550	\$35	\$89,250
Excavation	Earth Excavation	470 mm	m ³	3,995	\$16	\$63,920
Total Initial Pavement Construction Cost						\$595,170

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (10%)	313 m	\$11.00	\$3,437.50	\$2,147
25	Partial Depth Joint Repairs (2%)	63 m ²	\$200.00	\$12,500.00	\$4,689
	Full Depth Joint Repairs (5%)	106 m ²	\$150.00	\$15,937.50	\$5,978
	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$2,579
40	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$6,509
	Full Depth Joint Repairs (10%)	213 m ²	\$150.00	\$31,875.00	\$6,639
	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$1,432
50	Salvage Value	5 year(s)	-\$5,833.33	-\$29,166.67	-\$4,104
Total Maintenance and Rehabilitation Cost					\$25,869



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Industrial	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	500	90 mm	Lower Course #1
Subgrade (MPa):	50 MPa	150 mm	Crushed Gravel Base
Lane Width (m):	3.75	200 mm	Crushed Gravel Subbase
Width of Road (m):	7.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	938	\$100	\$93,750
Base HMA	Lower Course #1	90 mm	t	2,363	\$90	\$212,625
Tack Coat	Tack Coat - 2 Lifts		m ²	15,000	\$0.50	\$7,500
Crushed Base	Crushed Gravel Base	150 mm	m ³	1,125	\$35	\$39,375
Crushed Subbase	Crushed Gravel Subbase	200 mm	m ³	1,500	\$26	\$39,000
Excavation	Earth Excavation	490 mm	m ³	3,675	\$16	\$58,800
Total Initial Pavement Construction Cost						\$451,050

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
10	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$929
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$18,240
20	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$2,464
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$34,229
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$1,711
25	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,032
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$10,406
35	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$1,368
	Full Depth Asphalt Base Repairs (10%)	750 m ²	\$105.00	\$78,750.00	\$19,956
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$19,006
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$950
40	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$573
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$5,000
48	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$822
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$11,415
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$571
50	Salvage Value	8 year(s)	-\$7,012.50	-\$56,100.00	-\$7,894
Total Maintenance and Rehabilitation Cost					\$120,778



EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS
25 Year Pavement Design and 50 Year LCCA
 All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Industrial	Pavement Design	
Pavement Type:	Rigid Pavement	170 mm	Portland Cement Concrete
AADTT:	500	300 mm	Crushed Gravel Base
Subgrade (MPa):	50 MPa		
Lane Width (m):	4.25		
Width of Road (m):	8.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	170 mm	m ²	8,500	\$52	\$442,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	2,550	\$35	\$89,250
Excavation	Earth Excavation	470 mm	m ³	3,995	\$16	\$63,920
Total Initial Pavement Construction Cost						\$595,170

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (10%)	313 m	\$11.00	\$3,437.50	\$2,147
25	Partial Depth Joint Repairs (2%)	63 m ²	\$200.00	\$12,500.00	\$4,689
	Full Depth Joint Repairs (5%)	106 m ²	\$150.00	\$15,937.50	\$5,978
	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$2,579
40	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$6,509
	Full Depth Joint Repairs (10%)	213 m ²	\$150.00	\$31,875.00	\$6,639
	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$1,432
50	Salvage Value	5 year(s)	-\$5,833.33	-\$29,166.67	-\$4,104
Total Maintenance and Rehabilitation Cost					\$25,869



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Industrial	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	250	75 mm	Lower Course #1
Subgrade (MPa):	30 MPa	150 mm	Crushed Gravel Base
Lane Width (m):	3.75	350 mm	Crushed Gravel Subbase
Width of Road (m):	7.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	938	\$100	\$93,750
Base HMA	Lower Course #1	75 mm	t	1,969	\$90	\$177,188
Tack Coat	Tack Coat - 1 Lifts		m ²	7,500	\$0.50	\$3,750
Crushed Base	Crushed Gravel Base	150 mm	m ³	1,125	\$35	\$39,375
Crushed Subbase	Crushed Gravel Subbase	350 mm	m ³	2,625	\$26	\$68,250
Excavation	Earth Excavation	625 mm	m ³	4,688	\$16	\$75,000
Total Initial Pavement Construction Cost						\$457,313

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
10	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$929
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$18,240
20	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$2,464
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$34,229
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$1,711
25	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,032
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$10,406
35	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$1,368
	Full Depth Asphalt Base Repairs (10%)	750 m ²	\$105.00	\$78,750.00	\$19,956
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$19,006
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$950
40	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$573
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$5,000
48	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$822
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$11,415
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$571
50	Salvage Value	8 year(s)	-\$7,012.50	-\$56,100.00	-\$7,894
Total Maintenance and Rehabilitation Cost					\$120,778



EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS
25 Year Pavement Design and 50 Year LCCA
 All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Industrial	Pavement Design	
Pavement Type:	Rigid Pavement	160 mm	Portland Cement Concrete
AADTT:	250	400 mm	Crushed Gravel Base
Subgrade (MPa):	30 MPa		
Lane Width (m):	4.25		
Width of Road (m):	8.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	160 mm	m ²	8,500	\$50	\$425,000
Crushed Base	Crushed Gravel Base	400 mm	m ³	3,400	\$35	\$119,000
Excavation	Earth Excavation	560 mm	m ³	4,760	\$16	\$76,160
Total Initial Pavement Construction Cost						\$620,160

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (10%)	313 m	\$11.00	\$3,437.50	\$2,147
25	Partial Depth Joint Repairs (2%)	63 m ²	\$200.00	\$12,500.00	\$4,689
	Full Depth Joint Repairs (5%)	106 m ²	\$150.00	\$15,937.50	\$5,978
	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$2,579
40	Partial Depth Joint Repairs (5%)	156 m ²	\$200.00	\$31,250.00	\$6,509
	Full Depth Joint Repairs (10%)	213 m ²	\$150.00	\$31,875.00	\$6,639
	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$1,432
50	Salvage Value	5 year(s)	-\$5,833.33	-\$29,166.67	-\$4,104
Total Maintenance and Rehabilitation Cost					\$25,869



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Industrial	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	250	75 mm	Lower Course #1
Subgrade (MPa):	40 MPa	150 mm	Crushed Gravel Base
Lane Width (m):	3.75	250 mm	Crushed Gravel Subbase
Width of Road (m):	7.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface HMA	Upper Course #1	50 mm	t	938	\$100	\$93,750
Base HMA	Lower Course #1	75 mm	t	1,969	\$90	\$177,188
Tack Coat	Tack Coat - 1 Lifts		m ²	7,500	\$0.50	\$3,750
Crushed Base	Crushed Gravel Base	150 mm	m ³	1,125	\$35	\$39,375
Crushed Subbase	Crushed Gravel Subbase	250 mm	m ³	1,875	\$26	\$48,750
Excavation	Earth Excavation	525 mm	m ³	3,938	\$16	\$63,000
Total Initial Pavement Construction Cost						\$425,813

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
10	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$929
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$18,240
20	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$2,464
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$34,229
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$1,711
25	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,032
30	Spot Repairs - Mill 40 mm/ Patch 40 mm (10%)	750 m ²	\$45.00	\$33,750.00	\$10,406
35	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$1,368
	Full Depth Asphalt Base Repairs (10%)	750 m ²	\$105.00	\$78,750.00	\$19,956
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$19,006
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$950
40	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$573
43	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$5,000
48	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$822
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$11,415
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$571
50	Salvage Value	8 year(s)	-\$7,012.50	-\$56,100.00	-\$7,894
Total Maintenance and Rehabilitation Cost					\$120,778



EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS
25 Year Pavement Design and 50 Year LCCA
 All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Industrial	Pavement Design	
Pavement Type:	Rigid Pavement	160 mm	Portland Cement Concrete
AADTT:	250	300 mm	Crushed Gravel Base
Subgrade (MPa):	40 MPa		
Lane Width (m):	4.25		
Width of Road (m):	8.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
Surface PCC	Portland Cement Concrete	160 mm	m ²	8,500	\$50	\$425,000
Crushed Base	Crushed Gravel Base	300 mm	m ³	2,550	\$35	\$89,250
Excavation	Earth Excavation	460 mm	m ³	3,910	\$16	\$62,560
Total Initial Pavement Construction Cost						\$576,810

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
12	Reseal Transverse/Longitudinal Joints (10%)	313 m	\$11.00	\$3,437.50	\$2,147
25	Partial Depth Joint Repairs (2%)	63 m ²	\$200.00	\$12,500.00	\$4,689
	Full Depth Joint Repairs (5%)	106 m ²	\$150.00	\$15,937.50	\$5,978
	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$2,579
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	Full Depth Joint Repairs (10%)	213 m ²	\$150.00	\$31,875.00	\$6,639
	Reseal Transverse/Longitudinal Joints (20%)	625 m	\$11.00	\$6,875.00	\$1,432
50	Salvage Value	5 year(s)	-\$5,833.33	-\$29,166.67	-\$4,104
Total Maintenance and Rehabilitation Cost					\$25,869



**EQUIVALENT PAVEMENT DESIGNS - PROVINCE OF BRITISH COLUMBIA
LIFE CYCLE COST ANALYSIS**

25 Year Pavement Design and 50 Year LCCA

All Quantities and Costs are for 1km of 2-Lane Roadway

Roadway:	Industrial	Pavement Design	
Pavement Type:	Flexible Pavement	50 mm	Upper Course #1
AADTT:	250	75 mm	Lower Course #1
Subgrade (MPa):	50 MPa	150 mm	Crushed Gravel Base
Lane Width (m):	3.75	150 mm	Crushed Gravel Subbase
Width of Road (m):	7.5		

Initial Pavement Construction Costs

Pavement Layer	Layer Description	Layer Thickness	Units	Quantity per km	Unit Price	Total Cost
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Base HMA	Lower Course #1	75 mm	t	1,969	\$90	\$177,188
Tack Coat	Tack Coat - 1 Lifts		m ²	7,500	\$0.50	\$3,750
Crushed Base	Crushed Gravel Base	150 mm	m ³	1,125	\$35	\$39,375
Crushed Subbase	Crushed Gravel Subbase	150 mm	m ³	1,125	\$26	\$29,250
Excavation	Earth Excavation	425 mm	m ³	3,188	\$16	\$51,000
Total Initial Pavement Construction Cost						\$394,313

Flexible Pavement Maintenance and Rehabilitation Costs

Scheduled Maint./Rehab. Year	Maintenance/ Rehabilitation Activity	Quantities	Pay Item Price \$	Cost/km \$	Present Worth
10	Rout and Seal Cracks	250 m	\$5.50	\$1,375.00	\$929
	Spot Repairs - Mill 40 mm/ Patch 40 mm (8%)	600 m ²	\$45.00	\$27,000.00	\$18,240
20	Mill Asphalt Surface (40 mm)	720 t	\$7.50	\$5,400.00	\$2,464
	Resurface with New Surface Asphalt (40 mm)	750 t	\$100.00	\$75,000.00	\$34,229
	Tack Coat - 1 Layers	7,500 m ²	\$0.50	\$3,750.00	\$1,711
25	Rout and Seal Cracks	500 m	\$5.50	\$2,750.00	\$1,032
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50	Salvage Value	8 year(s)	-\$7,012.50	-\$56,100.00	-\$7,894
Total Maintenance and Rehabilitation Cost					\$120,778



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Crushed Base	Crushed Gravel Base	300 mm	m ³	2,550	\$35	\$89,250
Excavation	Earth Excavation	460 mm	m ³	3,910	\$16	\$62,560
Total Initial Pavement Construction Cost						\$576,810

Flexible Pavement Maintenance and Rehabilitation Costs

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Total Maintenance and Rehabilitation Cost					\$25,869