

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

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**Table of Contents**

2.7.1	Geometric Design Standards	2.7 - 3
2.7.2	Vertical Alignment	2.7 - 4
2.7.3	Horizontal Alignment	2.7 - 5
2.7.3.1	Curb Returns	2.7 - 5
2.7.4	Road Structures	2.7 - 5
2.7.5	Earthworks	2.7 - 5
2.7.5.1	General	2.7 - 5
2.7.5.2	Granular Sub-base Course	2.7 - 6
2.7.5.3	Granular Base Course	2.7 - 6
2.7.5.4	Granular Surface Course	2.7 - 7
2.7.5.5	Material Quality	2.7 - 8
2.7.5.6	Compaction Testing	2.7 - 8
2.7.5.7	Finishing Tolerances	2.7 - 8
2.7.6	Hot Mix Asphalt	2.7 - 9
2.7.6.1	Gradation	2.7 - 9
2.7.6.2	Mineral Filler	2.7 - 10
2.7.6.3	Asphalt Cement	2.7 - 10
2.7.6.4	Design Mix	2.7 - 10
2.7.6.5	Weather Limitations	2.7 - 11
2.7.6.6	Joints	2.7 - 11
2.7.6.7	Compaction	2.7 - 12
2.7.6.8	Asphalt Thickness	2.7 - 12
2.7.6.9	Finished Pavement Tolerances	2.7 - 13
2.7.7	Prime Coats and Tack Coats	2.7 - 13
2.7.7.1	Description	2.7 - 13
2.7.7.2	Prime Coats	2.7 - 13
2.7.7.3	Tack Coats (Over Asphalt Base	2.7 - 13
2.7.8	Seal Coats and Fog Coats	2.7 - 14
2.7.8.1	Description	2.7 - 14
2.7.8.2	Materials	2.7 - 14
2.7.9	Bituminous Surface Treatment (BST)	2.7 - 14
2.7.9.1	Description	2.7 - 14
2.7.9.2	Materials	2.7 - 14
2.7.10	Curb, Gutter, and Sidewalk	2.7 - 16
2.7.10.1	Portland Cement	2.7 - 16
2.7.10.2	Aggregates	2.7 - 16
2.7.10.3	Membrane Curing Compound	2.7 - 16
2.7.10.4	Preformed Expansion Joint Filler	2.7 - 16
2.7.10.5	Levelling Course	2.7 - 16
2.7.10.6	Admixtures	2.7 - 17
2.7.10.7	Mix Design	2.7 - 17
2.7.10.8	Placing of Concrete	2.7 - 17
2.7.10.9	Concreting in Cold Weather	2.7 - 18
2.7.10.10	Concrete Testing and Inspection	2.7 - 18
2.7.11	Interlocking Concrete Block Paving	2.7 - 18
2.7.11.1	Bedding Sand	2.7 - 19
2.7.11.2	Joint Sand	2.7 - 19
2.7.11.3	Subgrade Preparation	2.7 - 19

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

---

2.7.11.4	Finished Pavement Tolerances	2.7 - 19
2.7.11.5	Edge Restraint	2.7 - 20
2.7.12	Street Signs	2.7 - 20

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL  
SECTION 2 - CONSTRUCTION DESIGN CRITERIA  
SUB-SECTION 2.7 - ROADS**

**2.7.1 GEOMETRIC DESIGN STANDARDS**

Road classification and designation shall be in accordance with the classification system outlined in the Roads and Transportation Association of Canada (TAC) manual, Geometric Design Standards for Canadian Roads and Streets.

Typical road cross-sections as per TAC Geometric Design Standards:

<b>ROAD CLASSIFICATION</b>	<b>ROAD CLASS</b>	<b>ROAD WIDTH (m)</b>	<b>R.O.W. WIDTH (m)</b>	<b>POSTED SPEED (km / h)</b>
<b>URBAN ROADWAYS</b>				
Local*	ULU 50	9.0	20.0	50
Local^	ULU 50	9.0	22.0	50
Minor Collector*	UCU 60	11.5	22.5	50
Minor Collector ^	UCU 60	11.5	24.5	50
Major Collector*	UCU 70	14.0	25.0	60
Major Collector ^	UCU 70	14.0	27.0	60
Industrial Local	UCU 50	10.0	20.0	50
Industrial Collector	UCU 60	12.5	22.5	50
Lane		4.0	6.0	
<b>RURAL ROADWAYS</b>				
Local	RLU 50	8.0	25.0	50
Collector	RCU 60	9.0	25.0	60
Industrial Local	RLU 50	9.0	25.0	50
Industrial Collector	RCU 60	10.0	25.0	60

\* Urban road structure with monolithic curb, gutter, and sidewalk.

^ Urban road structure with separate sidewalk.

Modifications in right of way width may be reviewed on a project specific basis. Should the road right of way be reduced provisions must be made to accommodate all utility infrastructure such as easements on private property.

Design speed is to be 10 km / hr higher than posted speed unless otherwise noted by the City Engineer.

Roadway width is from lip of gutter to lip of gutter for urban roads and from shoulder to shoulder for rural roads.

As outlined in the National Building Code of Canada, turnaround facilities are required for any dead-end portion of the access route more than 90m long.

R.O.W. width in cul-de-sacs to be sufficient to provide the same separation from edge of shoulder or F.O.C. to property line as on straight roads.

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

---

Where Bike paths are applicable, they are to be a single 1.25m lane from the edge of the travelled lane to the lip of gutter.

Concrete curb and gutter shall be constructed on urban roads in accordance with the standard drawings in Section 4.

Monolithic sidewalks shall be 1.2m wide and separate sidewalks shall be 1.5m wide. All sidewalks shall be constructed in accordance with the standard drawings in Section 4.

All driveways shall be constructed to give a minimum of 1.5m clearance from structures such as hydrants, light standards and service pedestals, and shall be constructed in accordance with the standard drawings in Section 4. Maximum width of any driveway drop shall be 11.0m.

Rural roads that are constructed with a rural cross section (ditches no curb and gutter) will requirement BST or Asphalt surfacing as follows:

- Developments with less than 5 lots will be evaluated by the City Engineer who will determine what surfacing is required;
- Developments with more than 5 lots will require BST surfacing with Asphalt surfacing in the cul-de-sac bulbs and intersections.

**2.7.2 VERTICAL ALIGNMENT**

Minimum gutter grades around curves and along all tangents shall be not less than 0.5% for concrete structures and 1% for asphalt.

Maximum centreline roadway and gutter grades shall be in accordance with TAC geometric standards.

All roads shall be crowned or shall have a crossfall as shown on the applicable standard drawings in Section 4.

All vertical curves shall be designed to meet the following minimum requirements:

**K VALUE**

<b>DESIGN SPEED (km / h)</b>	<b>CREST (m)</b>	<b>SAG (m)</b>
50	7	6
60	15	10
70	22	15
80	35	20

$K = L/A$

L = length of vertical curve in metres

A = algebraic difference in grades percent

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

---

The minimum length of a vertical curve shall be as specified in the TAC Geometric Design Standard Manual for the given road design speed.

The degree of curvature is relative to the road classification and its design speed.

### **2.7.3 HORIZONTAL ALIGNMENT**

All horizontal curves shall be designed to meet the following minimum design requirements:

<b>STREET CLASSIFICATION</b>	<b>DESIGN SPEED (km / h)</b>	<b>MINIMUM RADIUS OF CURVE (m)</b>
LOCAL	50	100
MINOR COLLECTOR	60	150
MAJOR COLLECTOR	70	200
ARTERIAL	80	280

The minimum cul-de-sac radius is 18m for bus traffic and 14m for streets without bus traffic.

#### **2.7.3.1 CURB RETURNS**

Curb returns at residential street intersections shall be constructed to a radius of 10m and in accordance with the standard drawings in Section 4.

In industrial/commercial areas, the radius should be 15m to accommodate truck-turning movements.

### **2.7.4 ROAD STRUCTURES**

All road structures shall be designed as recommended by a geotechnical investigation and report.

### **2.7.5 EARTHWORKS**

#### **2.7.5.1 GENERAL**

All excavation shall be carried out within the limits of proposed works to depths, grades, and cross-sections as shown on the drawings. Selected approved borrow or native material shall be used for the embankment construction. Materials shall be placed in uniform layers of not more than 200 mm of loose thickness.

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

---

**2.7.5.2 GRANULAR SUB-BASE COURSE**

The following gradations shall apply to the crushed granular sub-base course.

<b>SIEVE SIZE (mm)</b>	<b>PASSING BY MASS (%)</b>
50.000	100
25.000	55-100
12.500	42-84
5.000	26-65
1.250	11-47
0.315	3-30
0.080	0-8

The following gradation shall apply to the pit run granular sub-base course.

<b>SIEVE SIZE (mm)</b>	<b>PASSING BY MASS (%)</b>
200.000	100
80.000	75-100
25.000	55-100
12.500	42-84
5.000	26-65
1.250	11-47
0.315	3-30
0.080	0-8

Aggregate with a length to thickness ratio of greater than five should be limited to 15% by mass. The depth of granular sub-base shall be as noted on the drawings. Alternate depths for granular sub-base will be used to replace unsuitable subgrade. Prior to placing granular sub-base material in such areas, it may be necessary to install a Geotextile fabric.

**2.7.5.3 GRANULAR BASE COURSE**

Granular base material shall consist of crushed rock and/or crushed gravel and sand consisting of hard, clean, durable material, free from coatings of silt, clay, or other deleterious materials, and containing no organic matter. The base course aggregate shall meet the following gradation requirements when tested to ASTM C136 and C117, (AASHTO T11 and T27):

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL  
SECTION 2 - CONSTRUCTION DESIGN CRITERIA  
SUB-SECTION 2.7 - ROADS**

---

<b>SIEVE NO. (mm)</b>	<b>PASSING BY MASS (%)</b>
20.00	100
12.500	64 -100
5.000	36 - 72
1.250	12 - 42
0.315	4 - 22
0.080	3 - 6

A tolerance of 3% in the amount passing the maximum screen size will be allowed if all the material passes a sieve with 6 mm larger opening. A minimum of 60% by weight of the material retained on the 5.000 sieve shall have at least one freshly crushed face. The material shall have a liquid limit not greater than 25 (ASTM D423-66) and a plastic limit not greater than six (ASTM D424-59).

Base course aggregate with a length to thickness ratio of greater than 5 should be limited to 15% by mass.

A minimum of 60% by weight of the material retained on the 5,000 sieve shall have at least two freshly crushed faces. Other properties shall be as follows:

Liquid limit	Maximum 25, ASTM D423-66
Plasticity Index	Maximum 6, ASTM D424-59
Los Angeles Abrasion	ASTM C131-76
Gradation "B"	35% maximum loss by mass
Sand Equivalent	Minimum of 35% ASTM D2419-74

A tolerance of 3% in the amount passing the maximum screen size will be allowed if all the material passes a sieve with 6 mm openings.

#### **2.7.5.4 GRANULAR SURFACE COURSE**

The material shall meet the following specifications:

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

---

<b>SIEVE NO. (mm)</b>	<b>PASSING BY MASS (%)</b>
20.000	100
12.500	70 - 100
10.000	62 - 94
5.000	45 - 82
2.000	28 - 62
1.000	18 - 43
0.400	12 - 32
0.160	7 - 18
0.063	5 - 12

The percentages passing the designated sieve sizes for any representative sample, when plotted on a semi log grading chart, shall show a free-flowing curve without sharp breaks within the limits specified. The material passing through the 0.400 mm sieve shall have a liquid limit not greater than 25 and a plastic limit not greater than six nor less than two.

#### **2.7.5.5 MATERIAL QUALITY**

Aggregates shall be hard, clean, durable, and free from clay and coatings of silt. Aggregates and embankment materials shall be free from clay or other deleterious materials and shall contain no organic material.

#### **2.7.5.6 COMPACTION TESTING**

Embankment material other than granular sub-base, base, granular surface course, the top 200 mm of the subgrade and the top metre of embankments shall be compacted to 95% of their Standard Proctor Density at optimum moisture content.

The granular sub-base, base, granular surface course, the top 200 mm of the subgrade and the top metre of embankments shall be compacted to 98% of their Standard Proctor Density at optimum moisture content.

#### **2.7.5.7 FINISHING TOLERANCES**

Maximum deviation from a specified grade for subgrade, granular sub-base, and base course shall be 20 mm, and 10 mm for a surface course.

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL  
SECTION 2 - CONSTRUCTION DESIGN CRITERIA  
SUB-SECTION 2.7 - ROADS**

---

**2.7.6 HOT MIX ASPHALT**

**2.7.6.1 GRADATION**

Coarse aggregate is aggregate retained on the 5.000 mm sieve. Fine aggregate is aggregate passing the 5.000 mm sieve. Fine aggregate shall contain manufactured or crushed fines at a percentage by mass of fine aggregate of minimum 70%. Aggregate shall be hard, clean, durable, free from coatings of silt, clay or other deleterious materials, and shall contain no organic matter. The combined aggregates shall meet the following gradation requirements when tested to ASTM C136 and C117.

<b>SIEVE SIZE (mm)</b>	<b>PASSING BY MASS (%)</b>
12.500	100
5.000	55-75
2.000	35-55
0.400	15-30
0.160	5-16
0.080	3- 8

Additional properties that shall be met are as follows:

Liquid Limit	Maximum 25, ASTM D423-66
Plasticity Index	Maximum 6, ASTM D424-59
Los Angeles Abrasion Gradation "B"	35% maximum loss by mass, ASTM C131- 76
Sand Equivalent	Minimum of 35% ASTM D2419-74
Magnesium Sulphate Soundness	
- Coarse Aggregate	Maximum 12%
- Fine Aggregate	Maximum 16%, ASTM C88-77
Absorption of Coarse Aggregate	Maximum 1.75%, ASTM C127-77
Lightweight Particles(Specific gravity less then 1.95)	Maximum 3% by mass, ASTM C123-69 (1975)
Flat Particles	Length to thickness ratio greater then 5, maximum of 15% by mass
Loss by Washing	1.5% maximum passing the 0.08 sieve, ASTM C117-80
Crushed Fragments	60% minimum material retained on the 5.000 mm with 1 crushed face

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

---

A minimum of 70% of material retained on the 5.000 mm sieve shall have at least two crushed faces.

Aggregate shall be hard, clean, durable, and free from clay and coatings of silt, clay, or other deleterious materials, and shall contain no organic matter.

**2.7.6.2 MINERAL FILLER**

Mineral filler shall be added in the mixing plant if the aggregate gradation is such that its addition is necessary to meet the above specifications. Mineral filler shall consist of Portland Cement, possolan, commercially ground stone dust or other mineral dust approved by the Consultant. Mineral filler shall have a plasticity index of zero and shall meet the following gradation requirements:

<b>SIEVE NO. (mm)</b>	<b>PASSING BY MASS (%)</b>
0.400	100
0.160	90 - 100
0.080	70-100
0.045	62 - 100

**2.7.6.3 ASPHALT CEMENT**

The asphalt cement shall be uniform in character, free of water and shall not foam when heated to 175 degrees Celsius. It shall meet the following specifications:

Viscosity	500+ poises, 60 degrees Celsius at 30 cm vacuum, ASTM D2171
Penetration	150A-200A, 100g in 5.0 sec. At 25 degrees Celsius, ASTM D5
Flash point	205+ degrees Celsius, ASTM D92
Thin film over test	ASTM D1754
Penetration	40+% of original, 100 g in 5 sec. At 25 degrees Celsius, ASTM D5
Ductility	100+ at 25 degrees Celsius, ASTM D113
Solubility in trichloro-ethylene	99.5% ASTM D2042

**2.7.6.4 DESIGN MIX**

A qualified testing laboratory shall be employed to prepare a mix design and job mix formula for the aggregate on which the tender is based. The mix design and job mix formula shall be submitted to the Engineer for approval a minimum of ten days prior to paving. No paving shall commence before the Engineer's approval is given for the mix design or job mix formula. The Engineer may also require a trial batch.

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL  
SECTION 2 - CONSTRUCTION DESIGN CRITERIA  
SUB-SECTION 2.7 - ROADS**

---

The laboratory mix design shall be based on the Marshall Method. Absorption of asphalt into the aggregate shall be taken into account using the ASTM bulk specific gravity of the aggregate in calculating optimum asphalt content.

The mix design shall meet the following specifications

	<b>RANGE</b>
Max size of aggregate (mm)	12.5
Number of compaction blow each end of specimen	50
Stability (kN) at 60 degrees Celsius	4.5
Minimum Retained Stability (%)	75
Flow (0.254 mm unit)	8-16
% Voids total mix	4.0 ± 1.0
% Aggregate voids filled with asphalt	73-85
Minimum film thickness <sup>2</sup> (µm)	7.0

#### **2.7.6.5 WEATHER LIMITATIONS**

The mixture shall not be placed when the outside air temperature is colder than two degrees Celsius, when there is frost present on the surface, when there is water present on the surface and during periods of rain or when there is an imminent threat of rain.

#### **2.7.6.6 JOINTS**

The mixture shall be laid so that all longitudinal joints are made while the first mat is still hot.

In order to ensure that the surface shall not become cooled prior to laying the adjacent mat, the spreader shall not advance beyond the limits shown in the table below unless directed by the Engineer i.e. on collector or arterial roads:

<b>Air Temperature Degrees Celsius</b>	<b>Maximum Length of Advancement (m)</b>
Above 27	250
15-27	190
7-15	125
Below 7	90

When the air temperature is below seven degrees Celsius, an infrared generator shall be used in front of the spreader in order to heat the abutting joint.

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

---

**2.7.6.7 COMPACTION**

Densities shall be based on core samples, each of which shall represent no more than 1000 square metres per constructed lift. Asphalt densities are specified as 98% of the standard laboratory Marshall. A minimum of one Marshall per day shall be performed with one core sample taken at a designated Marshall location.

If any core fails to meet the density specified, two additional cores shall be taken within one metre of the first core sample, and the average density of the three cores shall represent the area. No additional rolling, to achieve a more favourable density, shall be allowed without the written approval of the Engineer.

If the densities are less than specified, a deficiency penalty shall be assessed according to the following:

$$\text{Deficiency penalty} = [0.041[X-98]^2] \text{U.P.} * Q$$

Where:       U.P. = Unit Price  
              X    = Actual Asphalt Density (%)  
              Q    = Quantity

All asphalt below 95% standard Marshall density shall be removed and replaced.

The Developer shall fill all core holes within a maximum period of 72 hours.

**2.7.6.8 ASPHALT THICKNESS**

The pavement shall have the thickness specified on the Consultant's drawings. Areas suspected to be deficient shall be cored, as directed by the City.

If asphalt thickness is less than specified, a deficiency penalty shall be assessed according to the following:

<b>Asphalt Thickness Tolerances</b>	<b>Deficiency Penalty</b>
50 mm – 3 to 15 mm	= [ C - [ A <sup>2</sup> / B <sup>2</sup> ] * C ] * Q
50 mm – over 15 mm	= Replacement by Contractor
75 mm – 4 to 22 mm	= [ C - [ A <sup>2</sup> / B <sup>2</sup> ] * C ] * Q
75 mm – over 22 mm	= Replacement by Contractor
100 mm – 5 to 30 mm	= [ C - [ A <sup>2</sup> / B <sup>2</sup> ] * C ] * Q
100 mm – over 30 mm	= Replacement by Contractor

Where:       A = Average core thickness  
              B = Specified core thickness  
              C = Contract unit price  
              Q = Quantity of deficient HMA

For any cores of a thickness greater than specified, the specified thickness shall be used for the purpose of all calculations and averages.

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

---

No additional payment will be made to the Developer for thickness greater than specified.

**2.7.6.9 FINISHED PAVEMENT TOLERANCES**

Maximum deviation from specified grade: 10 mm

Maximum deviation under a 3 m straight edge: 3 mm

**2.7.7 PRIME COATS AND TACK COATS**

**2.7.7.1 DESCRIPTION**

Prime coat is the application of bituminous material to previously prepared granular base course prior to placing asphalt surfacing.

Tack coat is the application of asphalt material to a previously constructed paving surface of any type in preparation for placing asphalt surfacing, and against curb gutter faces, manholes, valves and other appurtenances in the street to be paved.

**2.7.7.2 PRIME COAT**

The bituminous material for priming the granular base course shall be liquid asphalt. The asphalt types may vary from M.C. 30 to M.C. 250; from SS-1 to SS-1H or an emulsified asphalt primer to suit the conditions of the base. The rate of application may vary from 0.50 to 1.00L/sq.m. Temperature of application shall fall within the following limits:

**- Medium Curing Asphalt:**

M.C. 30 - 51 to 70 degrees Celsius

M.C. 70 - 75 to 90 degrees Celsius

M.C. 250 - 100 to 110 degrees Celsius

**- Emulsified Asphalt:**

SS-1 - 25 to 55 degrees Celsius

SS-1H - 24 to 54 degrees Celsius

**-Emulsified Asphalt**

Primer: - 15 to 50 degrees Celsius

**2.7.7.3 TACK COATS (OVER ASPHALT BASE)**

The asphalt for the tack coat may vary from SS-1 to SS-1H and from R.C. 30 to R.C. 250, depending on conditions to suit the base. The rate of application shall be 0.25 to 0.90L/sq.m. Temperature of application shall fall within the following limits:

**- Rapid Curing Asphalt:**

R.C. 30 - 50 to 70 degrees Celsius

R.C. 70 - 75 to 90 degrees Celsius

R.C. 250 - 100 to 110 degrees Celsius

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

---

**- Emulsified Asphalt:**

SS-1 - 24 to 54 degrees Celsius

SS-1H - 24 to 54 degrees Celsius

**2.7.8 SEAL COATS AND FOG COATS**

**2.7.8.1 DESCRIPTION**

Seal coats shall consist of a surface treatment composed of a single application of bituminous material on an existing bituminous surface, immediately followed by covering with aggregate.

When seal coat is applied without cover then it shall be referred to as "Fog Coat".

**2.7.8.2 MATERIALS**

The liquid asphalt used for seal coating shall be rapid curing or emulsified asphalt; the actual grade and type shall be determined to suit the surface condition and shall be approved by the Engineer.

Temperature of application shall fall within the following:

**- Rapid Curing Asphalt:**

R.C. 30 - 50 to 70 degrees Celsius

R.C. 70 - 75 to 90 degrees Celsius

R.C. 250 - 100 to 110 degrees Celsius

**- Emulsified Asphalt:**

R.S. 1k - 15 to 50 degrees Celsius

R.S. 2k - 15 to 50 degrees Celsius

**2.7.9 BITUMINOUS SURFACE TREATMENT (BST)**

**2.7.9.1 DESCRIPTION**

BST shall consist of a surface treatment composed of a single application of bituminous material on a prepared surface, immediately followed by covering with approved aggregate.

**2.7.9.2 MATERIALS**

B.S.T. Aggregate shall satisfy all requirements of this specification and unless otherwise specified shall be:

- Crushed rock composed of hard, uncoated, cubical fragments, produced from rock formations or boulders of uniform quality; or
- Crushed gravel composed of hard, durable, uncoated particles, produced from naturally formed deposits.

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL  
SECTION 2 - CONSTRUCTION DESIGN CRITERIA  
SUB-SECTION 2.7 - ROADS**

---

SIEVE SIZE (mm)	PASSING BY MASS (%)		
	12.5 mm BST Aggregate	16 mm BST Aggregate	20 mm BST Aggregate
20.000	----	----	100
16.000	----	100	----
12.500	100	----	63 - 89
10.000	82 - 100	70 - 90	----
5.000	42 - 72	32 - 60	36 - 56
2.500	27 - 52	22 - 46	18 - 38
1.250	19 - 36	15 - 34	12 - 30
0.315	9 - 23	7 - 15	4 - 18
0.080	0 - 5	0 - 5	0 - 5

PHYSICAL TEST	12.5 mm BST Aggregate	16 mm BST Aggregate	20 mm BST Aggregate
Los Angeles Abrasion ASTM C131 Gradation "B" Percent Max Loss	25	25	25
Percent Crushed Minimum*	60%	60%	60%
Flat & Elongated Particles Ration 5:1 Percent Maximum	8	8	8

\* The percent of crushed material will be determined by examining the fraction retained on the 5.000 mm sieve and dividing the mass of the crushed particles by the total mass retained on the 5.000 mm sieve.

Emulsified Asphalt to be CGSB CAN 2-16.5, type HF-250S Emulsified Asphalt.

Apply emulsified asphalt at minimum rate of 2.2 litres per square metre on granular base and minimum rate of 1.8 litres per square metre on overlay unless approved in writing by the Engineer. Application rate shall be designed to achieve 70% embedment of coarse aggregate.

The materials for sand cover shall consist of clean, granular material approved by the Consultant. All sand cover shall pass a 5000 sieve.

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

---

**2.7.10 CURB, GUTTER AND SIDEWALK**

**2.7.10.1 PORTLAND CEMENT**

Portland Cement shall meet the requirements of CSA Standard A5-M Portland Cement and shall be Type 10 normal or Type 50, sulphate resistant as determined by a Geotechnical Engineer.

**2.7.10.2 AGGREGATES**

Fine aggregate shall meet the requirements of CSA Standard CAN3-A24.1-M77, Clause 5.3.

Coarse aggregate shall meet the requirements of CSA Standard CAN3-A23.1-M77, Clause 5.4.

Aggregate size shall conform to nominal size 28,000 to 5,000 sieve grading in Group 1 of Table 3 of this standard.

<b>SIEVE NO. (mm)</b>	<b>PASSING BY MASS (%)</b>
40.000	100
28.000	95-100
14.000	30- 65
5.000	0- 10
2.500	0 - 5

**2.7.10.3 MEMBRANE CURING COMPOUND**

Resin-base impervious curing compound shall conform to ASTM Standard Specification C309 Type 1D - Type B. The curing compound shall contain white fugitive dye.

**2.7.10.4 PREFORMED EXPANSION JOINT FILLER**

Prefomed expansion joint filler shall conform to ASTM Standard Specification D-1752.

**2.7.10.5 LEVELLING COURSE**

The levelling course material shall be a maximum of 25 mm in depth and shall consist of sand, crusher screenings, or other approved material meeting the following requirements.

<b>SIEVE SIZE (mm)</b>	<b>PASSING BY MASS (%)</b>
20.000	100
12.500	64-100
5.000	36-72
1.250	12-42
0.315	4-22
0.080	3- 8

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

---

A minimum of 60% by weight of the material retained on the 5.000 sieve shall have at least two freshly crushed faces.

Additional properties that shall be met are as follows:

Liquid Limit	Maximum 25, ASTM D423-66
Plasticity Index	Maximum 6, ASTM D424-59
Los Angeles Abrasion Gradation "B"	35% maximum loss by mass, ASTM C131-76
Sand Equivalent	Minimum of 35%, ASTM D2419-74

**2.7.10.6 ADMIXTURES**

Air-entraining admixtures shall conform to CSA Standard CAN 3-A266.1-M78.

Chemical admixtures, if used, shall conform to CSA Standard CAN 3-A266.2-M78.

Calcium chloride shall conform to the requirements of CSA Standard CAN 3-A266.2-M78.

The use of pozzolans in concrete is not permitted.

**2.7.10.7 MIX DESIGN**

The concrete for curb, gutter, and sidewalk shall meet the following requirements:

- Minimum compressive strength in 28 days: 25 MPa
- Slump: 25 mm-75 mm
- Entrained air content: 5-7%

Unless otherwise approved, ready-mix concrete shall be used for the work.

The 7-day test should give approximately 70% of the 28-day strength.

The mix design shall be carried out by an accredited testing agency and shall be submitted to the Consultant for approval at least 10 days prior to commencement of the work.

**2.7.10.8 PLACING OF CONCRETE**

The subgrade, subbase or levelling course shall be compacted to a minimum of 98% Standard Proctor Density.

Concrete shall be placed and vibrated to form curbs, gutters and sidewalks in accordance with the standard drawings in Section 4.

Backfilling behind the curb, gutter and sidewalk shall be carried out 7 days after form removal and shall be compacted to a minimum of 95% Standard Proctor Density.

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

---

**2.7.10.9 CONCRETING IN COLD WEATHER**

If the temperature at any time of day or night is below 2 degrees Celsius, suitable means such as hording and heating shall be provided for maintaining the concrete at a temperature of at least 10 degrees Celsius for 3 days after placing of concrete.

**2.7.10.10 CONCRETE TESTING AND INSPECTION**

Compressive strength, slump test, and air test shall be performed for each 150 cubic metres of concrete placed, and there shall be at least one test for each day of placing operation.

Sampling and testing shall be carried out in accordance with the following:

- Compression Test Specimens: Standard method of making and curing concrete test specimens in the field in accordance with ASTM C31.
- Compression Test: Standard method of testing for compression strength of cylindrical concrete specimens in accordance with ASTM C39.
- Air Content: Standard method of testing for air-content of freshly mixed concrete by the pressure method in accordance with ASTM C231.
- Slump: Standard method of testing slump of Portland Cement concrete in accordance with ASTM C143 and CSA A23.2-5c.
- Sampling Fresh Concrete: Standard method of sampling fresh concrete in accordance with ASTM C172.

**2.7.11 INTERLOCKING CONCRETE BLOCK PAVING**

Concrete Paving Blocks: conforming to ASTM C936, solid concrete interlocking paving units and with particular requirements as follows:

- Cement: Type 10 Portland Cement conforming to CAN3-A5-M77.
- Aggregates: Normal density aggregates, conforming to CAN3-A23.1-M77. Source and gradation shall be submitted to the Consultant for approval prior to casting.
- Air-entraining Agent: Conforming to CAN3-A23.1 -M77.
- Dimensional Tolerance: Manufactured blocks shall be true to shape and shall not differ from manufacturer's standard dimensions by more than +/-2 mm in length and width and +/-2 mm in thickness.
- Shape: Type A, dentated and interlocking on all four faces, resists joint spreading in either direction, and can be laid in herringbone pattern. According to manufacturer's specific shape, subject to Engineer's approval. The Engineer may also specify or accept shapes other than type A.
- Colour: Subject to Engineer's approval.
- Size: According to manufacturer's standard size, subject to Engineer's approval.

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.7 - ROADS**

---

**2.7.11.1 BEDDING SAND**

Bedding sand shall be clean, sharp sand that is suitable for concrete making, free of deleterious soluble salts and other contaminants likely to cause efflorescence, and graded within the following limits:

<b>SIEVE NO (mm)</b>	<b>PASSING BY MASS (%)</b>
10.000	100
5.000	95-100
2.500	80-100
1.250	50-85
0.630	25-60
0.315	10-30
0.160	5-15
0.063	0-10

**2.7.11.2 JOINT SAND**

Joint sand shall be sharp sand free of deleterious soluble salts and other contaminants likely to cause efflorescence and reduced skid resistance, graded within the following limits:

<b>SIEVE NO (mm)</b>	<b>PASSING BY MASS (%)</b>
2.500	100
1.250	85-100
0.630	50-90
0.315	25-90
0.160	12-30
0.063	10-15

**2.7.11.3 SUBGRADE PREPARATION**

The finished subgrade surface shall not deviate by more than 15 mm from the bottom edge of a 3m straight edge laid in any direction, and shall be on correct grade or not more than 10 mm below grade. Subgrade below concrete shall be compacted to not less than 98% Standard Proctor Density.

**2.7.11.4 FINISHED TOLERANCES**

Maximum deviation from specified grade: +/- 10 mm

Maximum deviation from under a 3m straight edge: 8 mm

Maximum differential level between two adjacent mats: 2 mm

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL  
SECTION 2 - CONSTRUCTION DESIGN CRITERIA  
SUB-SECTION 2.7 - ROADS**

---

**2.7.11.5 EDGE RESTRAINT**

All paving stones shall be contained within concrete headers.

**2.7.12 STREET SIGNS**

All street signs are to be designed and installed as per TAC standards with Diamond Grade visibility. The Developer shall sign a work order for the purchase and installation of all street signs by the Public Works Sign Shop.