# The Use of Simple Performance Tests in the Development of Rutting Resistant Criteria for Asphalt Mixes in Canada Stage 1

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## ABSTRACT

The use of Superpave mixes has become popular over the past several years in Canada. A joint research study was undertaken to develop rutting resistance criteria for Superpave and other asphalt mixes used in Canada. The study used the new Simple Performance Test (SPT) and an accelerated laboratory wheel rutting resistance test. The SPT is included in the American Association of State Highway and Transportation Officials (AASHTO) new Mechanistic-Empirical Pavement Design Guide (AASHTO 2002) as a means of asphalt mix characterization. Two surface course asphalt mixes and two binder course mixes from projects across Canada were selected for the study. These mixes span a wide range of applications from high traffic freeways to low volume municipal roads.

This paper presents the findings from Stage 1 of the study that included dynamic modulus testing of all four mixes, extensive AASHTO 2002 analysis, and accelerated rutting resistance testing in the Hamburg Wheel Rut Tester. The paper emphasizes the necessity for careful calibration of the models used in the new mechanistic-empirical method of pavement design and the need for accelerated performance testing at the mix design stage.


## 1.0 INTRODUCTION

There are five major asphalt pavement distresses that may lead to loss of performance: fatigue cracking; rutting; thermal cracking; friction; and moisture susceptibility. Asphalt pavement rutting is one of the most common and destructive pavement distresses observed on Canadian roads (Figure 1), particularly at intersections in the urban environment. Asphalt pavement rutting can be caused by insufficient pavement structural support allowing excessive stress to be transferred to the subgrade (structural rutting); however, the most common type of rutting is 'instability' rutting caused by the plastic movement of the asphalt mix under heavy, often slow moving loading. The cost of asphalt pavement rutting repairs can be very high and disruptive on traffic operations. A reliable, accelerated laboratory performance test to evaluate the rutting resistance of asphalt mixes is considered necessary. It would be beneficial for use in verifying mix designs, for pavement failure investigations and for evaluating new materials.

**Figure 1. Asphalt Pavement Rutting due to Plastic Movement of the Asphalt Mix under Heavy Loads**

The American Association of State Highway and Transportation Officials (AASHTO) new "Mechanistic-Empirical Pavement Design Guide" (AASHTO 2002) includes a procedure for predicting asphalt pavement permanent deformation (rutting). A joint research study was undertaken to develop rutting resistance criteria for Superpave™ (Superpave) and other asphalt mixes. The study used the new Simple Performance Test (SPT) and an accelerated laboratory wheel rutting resistance test. The SPT is included in AASHTO 2002 as a means of asphalt mix characterization. The SPT's were performed using the University of Waterloo's Interlaken asphalt and soil testing apparatus. The new mechanistic-empirical method requires careful calibration for Canadian conditions and materials.

There are three wheel rut testers that are used for asphalt mix testing: the Asphalt Pavement Analyzer; Hamburg Wheel Rut Tester; and the French Rutting Tester [1, 2]. All three wheel testers are in some use in Canada. Hot-mix asphalt rut resistance testing using the French Rutting Tester is required by the Quebec Ministre des Transports on high volume roads. Other provinces currently do not routinely require rut resistance testing, even for roads with very heavy traffic loading. In this study, the accelerated rut resistance testing was performed using a Hamburg Wheel Rut Tester (HWRT). However, the criteria currently used in the wheel rut testing are pass/fail with no clear link to mix type or traffic level.

The ultimate objective of this study is to develop rutting resistance criteria for accelerated laboratory testing. Besides the dynamic modulus testing and rutting resistance testing in the HWRT (Stage 1), the study will also include a creep test and determining the flow time, repeated load permanent deformation test and determining the flow number, and extensive hot-mix asphalt performance analysis (Stage 2). In addition, for comparison purposes, Marshall properties (stability and flow) were also determined in Stage 1. Based on the results of the entire study, recommendations will be developed for the rutting resistance criteria. This paper describes the equipment, procedures, existing criteria, findings, and provides initial recommendations for further testing. However, as the study has not been completed, it is too early to provide any recommendations for the criteria.

## 2.0 ASPHALT MIXES AND LABORATORY SPECIMENS

Three surface course asphalt mixes and one binder course mix were selected for the study. These mixes were selected to span a wide range of applications, from high traffic freeways to low volume municipal roads. Specifically, the surface course mixes were Stone Mastic Asphalt (SMA) and a Conventional Surface Course (CSC) Marshall mix. These mixes were anticipated to have excellent and fair resistance to rutting, respectively. The binder course mixes were two Superpave mixes, a coarse one, marked SP 19 E, designed to carry a high traffic volume, i.e. ≥30 million Equivalent Single Axle Loads (ESALs), which was anticipated to have excellent resistance to rutting and a fine one, marked SP 19 D, designed to carry medium to high traffic (3 to 30 million ESALs) and anticipated to have good resistance to rutting. The mixes incorporate different types of asphalt cements ranging from Performance Graded (PG) 58-28 to PG 70-28 grades.

All four mixes were obtained from paving projects in Canada and delivered to the Golder Laboratory in Whitby, Ontario. After determining the gradation, asphalt cement content, and maximum relative density the asphalt materials were then used to prepare specimens for the dynamic modulus testing in the Interlaken apparatus at the University of Waterloo. Table 1 shows the gradation, asphalt cement content, asphalt cement grade, and maximum theoretical specific gravity of all four mixes from mix designs and Figure 2 shows the gradation plots.

The first challenge of the study involved the specimen preparation for the SPT's. The procedure requires that the 150 mm diameter cylinders, prepared in the Superpave Gyratory Compactor (SGC), be cored to

obtain 100 mm diameter SPT specimens [3, 4]. Figure 3 shows cored specimens of all four mixes used in the study and Figure 4 shows the entire set of the SP 19 D specimens.

**Table No. 1. Gradation and Asphalt Cement Content**

| Properties | Mix Type | | | |
|---|---|---|---|---|
| | SMA | CSC | SP 19 D | SP 19 E |
| Gradation | | | | |
| Sieve Sizes (mm) | Percent Passing | | | |
| 25.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 19.0 | 100.0 | 100.0 | 97.2 | 97.0 |
| 12.5 | 98.8 | 96.0 | 77.9 | 80.2 |
| 9.5 | 71.1 | 86.0 | 68.2 | 63.2 |
| 4.75 | 25.4 | 60.0 | 60.2 | 38.0 |
| 2.36 | 21.3 | 50.7 | 44.6 | 33.4 |
| 1.18 | 17.5 | 40.9 | 29.7 | 22.5 |
| 0.600 | 14.8 | 28.8 | 18.8 | 14.4 |
| 0.300 | 13.0 | 13.3 | 9.9 | 8.7 |
| 0.150 | 10.8 | 5.7 | 5.3 | 5.2 |
| 0.075 | 9.1 | 3.7 | 4.2 | 3.8 |
| Asphalt Cement Content (%) | 5.70 | 5.30 | 4.35 | 4.60 |
| Asphalt Cement Grade (PG) | 70-28 | 58-28 | 64-28 | 70-28 |
| Theoretical Maximum Specific Gravity | 2.599 | 2.496 | 2.582 | 2.570 |

Note: SMA = Stone Mastic Asphalt
CSC = Conventional Surface Course Mix
SP 19D = Superpave 19 mm Fine Miz
SP 19E = Superpave 19 mm Course Mix
PG = Performance Grade

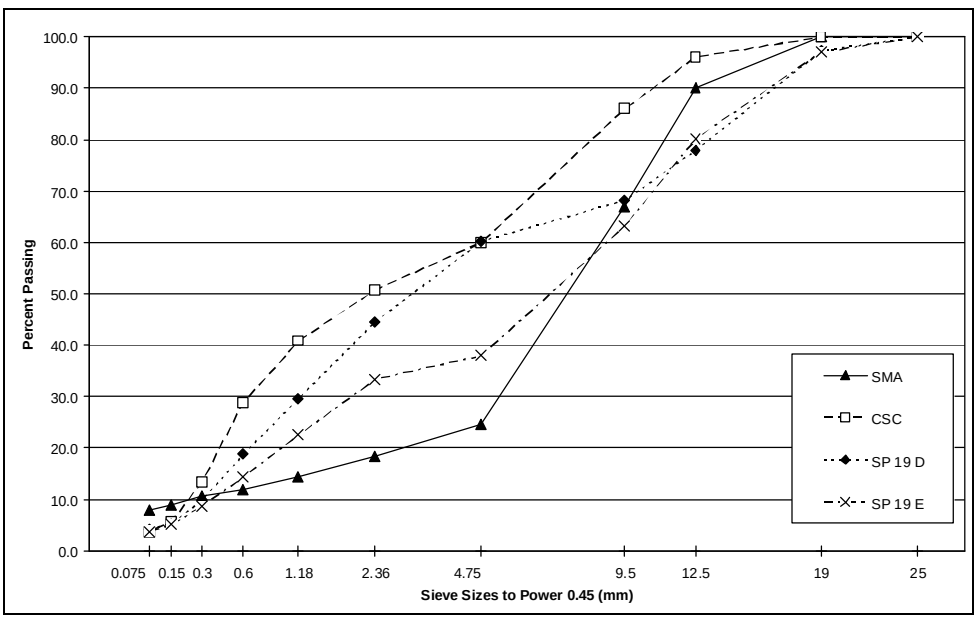


**Figure 2. Mix Gradations**

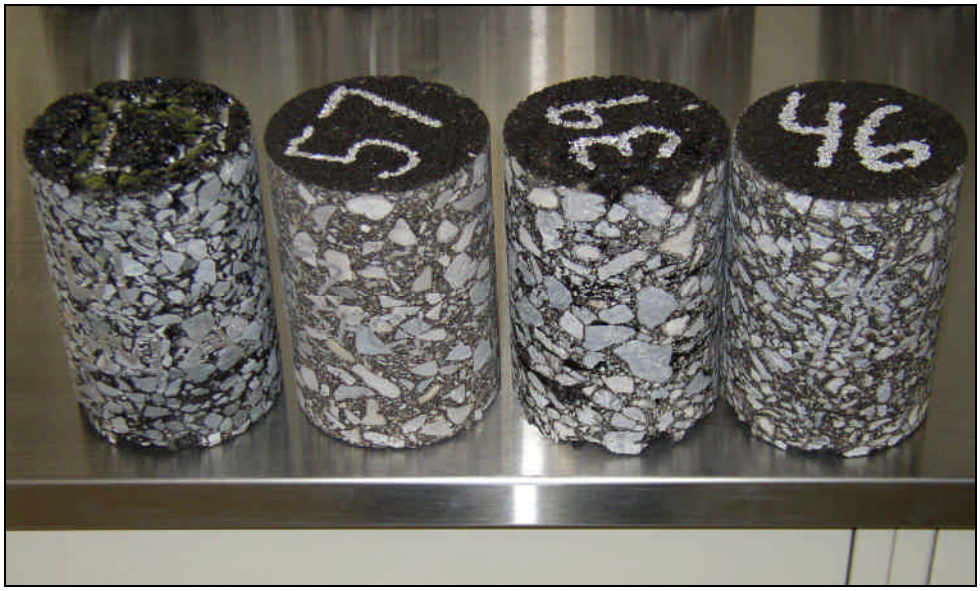


**Figure 3. Cored Specimens of SMA (#D1), SP 19 D (#57), SP 19 E (#39) and Conventional Surface Course (#46) used in the Study**


**Figure 4. A Set of SP 19 D Mix Cored Specimens Prepared for the Study**

As the air voids of the core taken from the center of the cylinder are typically significantly lower (about 0.2 to 1.5 percent, depending on the type of mix) than those of the entire cylinder, obtaining the specimens with the target air voids level of 6.5 percent was a relatively difficult task. Table 2 shows the air voids of the SGC specimens, the air voids of the cores, and the difference between the two for the specimens used in the dynamic modulus test. The lowest difference was that of the CSC mix (mean of 0.4 percent) and the highest one was that of the SP 19 E mix (mean 1.0 percent).

**Table No. 2. Summary of Superpave Gyratory Compactor (SGC) and Simple Performance Test (SPT) Air Voids**

| Mix Type | Specimen No. | Air Voids (%) | | |
|---|---|---|---|---|
| | | SGC | Core | Difference |
| SMA | 5 | 6.9 | 5.9 | 1.0 |
| | 6 | 6.8 | 6.1 | 0.7 |
| | 20 | 5.6 | 5.4 | 0.2 |
| | Mean | 6.4 | 5.8 | 0.6 |
| | SD | 0.7 | 0.4 | 0.4 |
| CSC | 34 | 6.6 | 6.2 | 0.4 |
| | 35 | 6.3 | 5.9 | 0.4 |
| | 36 | 6.5 | 6.2 | 0.3 |
| | Mean | 6.5 | 6.1 | 0.4 |
| | SD | 0.2 | 0.2 | 0.1 |
| SP 19 D | 3 | 7.4 | 6.5 | 0.9 |
| | 4 | 7.3 | 6.3 | 1.0 |
| | 51 | 7.6 | 6.8 | 0.8 |
| | Mean | 7.4 | 6.5 | 0.9 |
| | SD | 0.2 | 0.3 | 0.1 |
| SP 19 E | 8 | 6.7 | 5.5 | 1.2 |
| | 22 | 7.0 | 6.2 | 0.8 |
| | 25 | 6.8 | 5.7 | 1.1 |
| | Mean | 6.8 | 5.8 | 1.0 |
| | SD | 0.2 | 0.4 | 0.2 |

The asphalt cement testing included the Rolling Thin Film Oven (RTFO) residue Complex Shear Modulus (G*) and Phase Angle (δ) [5] determination for each type of asphalt cement used. The results are summarized in Table 3.

**Table No. 3. Summary of Asphalt Cement Testing Results**

| Mix Type | Asphalt Cement Grade | RTFO Residue G*/sinδ (kPa) | |
|---|---|---|---|
| | | Determined | Specified Minimum |
| SMA | 70-28 | 2.6 | 2.2 @ 70°C |
| CSC | 58-28 | 3.4 | 2.2 @ 58°C |
| SP 19 D | 64-28 | 4.3 | 2.2 @ 58°C |
| SP 19 E | 70-28 | 7.6 | 2.2 @ 70°C |

Note: RTFO = Rolling Thin Film Oven
G* = Complex Shear Modulus,
sinδ = sine of the Phase Angle,

In addition, for comparison purposes, Marshall properties (stability and flow) were also determined for all four asphalt mixes. A summary is given in Table 4.

**Table No. 4. Summary of Marshall Properties**

| Mix Type | Marshall Stability (Newtons) | Flow (0.25 mm) |
|---|---|---|
| SMA | 8,679 | 12.2 |
| CSC | 15,400 | 8.5 |
| SP 19 D | 19,300 | 11.5 |
| SP 19 E | 19,400 | 11.9 |

## 3.0 DYNAMIC MODULUS TESTING AND AASHTO 2002 ANALYSIS

The new mechanistic-empirical method of pavement design requires that for hot-mix asphalt materials a time-temperature dependent Dynamic Modulus (E*) and Poisson's ratio be determined [6]. Additional tests include tensile strength, creep compliance, and coefficient of thermal expansion. The procedure for the dynamic modulus testing is covered by the AASHTO TP62-03 standard [7]. The testing is run at five different temperatures (-10, 4.4, 21.1, 37.8, and 54.4ºC) and six loading frequencies (0.1, 0.5, 1.0, 5.0, 10.0, and 25.0 Hz). The test is typically run at axial strains ranging from 50 and 150 microstrains.

The Interlaken asphalt and soil testing apparatus was used for the dynamic modulus testing. Figure 5 shows the general view of the Interlaken and Figure 6 shows the testing configuration. The Interlaken apparatus can also be used for uniaxial and triaxial creep test to determine the flow time, uniaxial and triaxial repeated loading permanent deformation test to determine flow number, fatigue resistance test on beam asphalt specimens, creep compliance test, indirect tensile resilient modulus test, and other tests [8]. Three Linear Variable Differential Transducers (LVDT's) were used on each sample to determine the deformations.

The dynamic modulus and phase angle were determined for a minimum of three specimens of each mix. Table 5 shows a summary of the dynamic modulus testing results for the SP 19 D mix. The deformation of the CSC mix at a temperature of 54.4ºC was outside the range of the LVDT's. Therefore, the dynamic modulus of these two mixes was determined only at -10, 4.4 21.1, and 37.8ºC. The specimens of this mix exhibited a significant unrecoverable deformation (2 to 4 mm) and some cracks at 54.4ºC.

**Figure 5. General View of the Interlaken Asphalt and Soil Testing Apparatus**

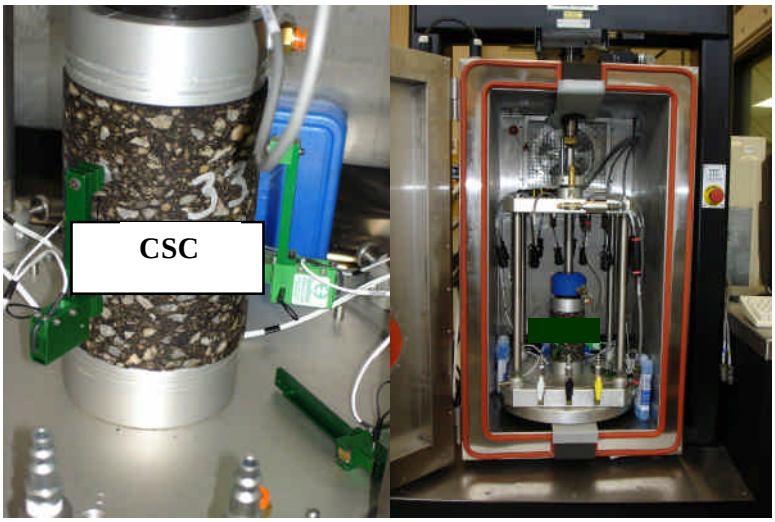


**Figure 6. Dynamic Modulus Testing Set-up in the Interlaken Apparatus**

**Table No. 5. Summary of SP 19 D Dynamic Modulus Testing Results**

| Specimen/Mix | Frequency (Hz) | Dynamic Modulus (GPa) | | | | |
|---|---|---|---|---|---|---|
| | | -10ºC | 4.4ºC | 21.1ºC | 37.8ºC | 54.4ºC |
| 3 SP 19 D | 25 | 29.7 | 21.7 | 10.7 | 5.7 | 2.7 |
| | 10 | 26.6 | 19.4 | 8.9 | 4.5 | 1.9 |
| | 5 | 24.5 | 17.9 | 7.8 | 3.7 | 1.6 |
| | 1 | 20.6 | 14.6 | 5.4 | 2.4 | 1.2 |
| | 0.5 | 18.5 | 13.2 | 4.6 | 2.0 | 1.1 |
| | 0.1 | 14.2 | 10.3 | 3.1 | 1.4 | 0.9 |
| 4 SP 19 D | 25 | 30.0 | 21.8 | 11.4 | 6.5 | 3.3 |
| | 10 | 26.9 | 19.3 | 9.6 | 5.1 | 2.4 |
| | 5 | 24.6 | 17.8 | 8.4 | 4.3 | 2.0 |
| | 1 | 20.6 | 14.3 | 6.0 | 2.9 | 1.5 |
| | 0.5 | 18.5 | 12.9 | 5.1 | 2.5 | 1.4 |
| | 0.1 | 14.1 | 9.8 | 3.6 | 1.8 | 1.2 |
| 5 SP 19 D | 25 | 31.6 | 20.1 | 11.1 | 5.5 | 2.9 |
| | 10 | 28.4 | 17.9 | 9.1 | 4.0 | 2.1 |
| | 5 | 26.3 | 16.5 | 8.0 | 3.3 | 1.8 |
| | 1 | 22.2 | 13.2 | 5.5 | 2.2 | 1.3 |
| | 0.5 | 19.9 | 11.8 | 4.6 | 1.9 | 1.2 |
| | 0.1 | 15.4 | 8.8 | 3.2 | 1.4 | 1.0 |
| Average | 25 | 30.4 | 21.2 | 11.1 | 5.9 | 3.0 |
| | 10 | 27.3 | 18.9 | 9.2 | 4.5 | 2.2 |
| | 5 | 25.1 | 17.4 | 8.1 | 3.8 | 1.8 |
| | 1 | 21.1 | 14.1 | 5.7 | 2.5 | 1.3 |
| | 0.5 | 18.9 | 12.6 | 4.8 | 2.1 | 1.2 |
| | 0.1 | 14.5 | 9.6 | 3.3 | 1.5 | 1.0 |

Note: SP 19 D = Superpave 19 mm Fine Mix

The behaviour of viscoelastic asphalt materials depends on temperature and time of loading in the test. In order to compare test results of different mixes, a single master curve is formed for each mix. A master curve for the SP 19 D mix is shown in Figure 7. The data collected at different temperatures was shifted relative to the time of loading to form a single curve. The shift factor is shown in Figure 8. Figure 9 shows master curves for all four mixes.

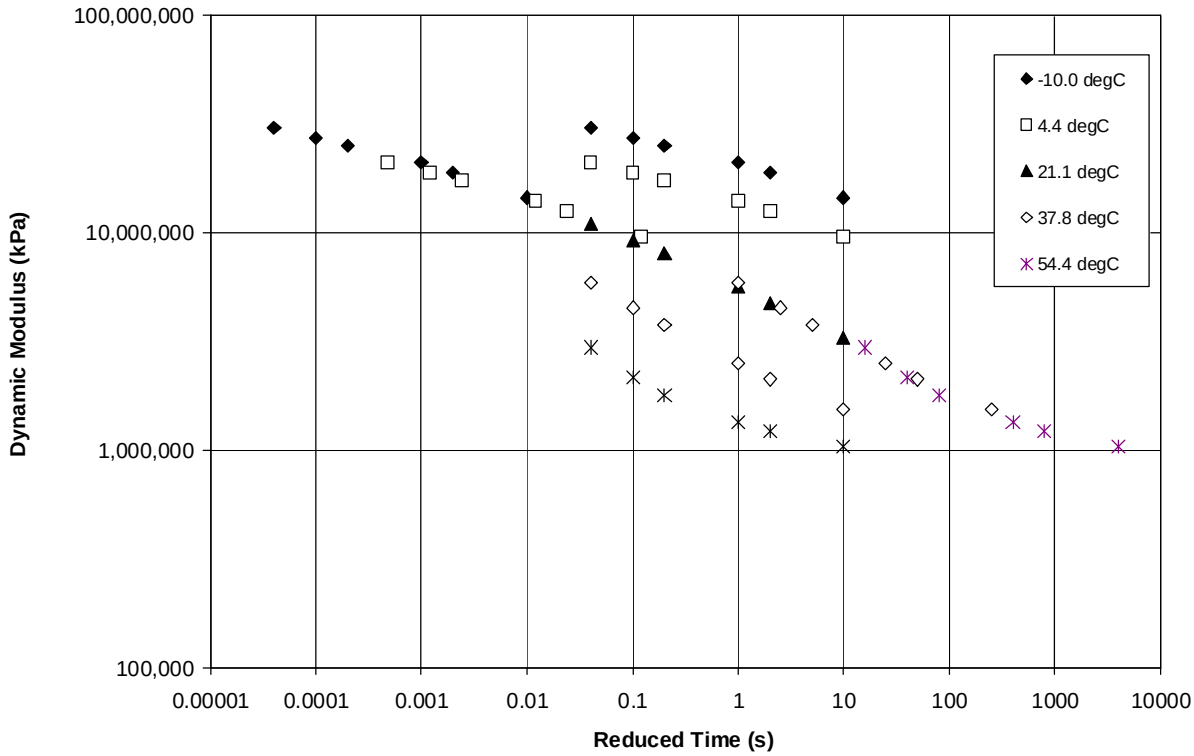


**Figure 7. Master Curve for SP 19 D Mix**

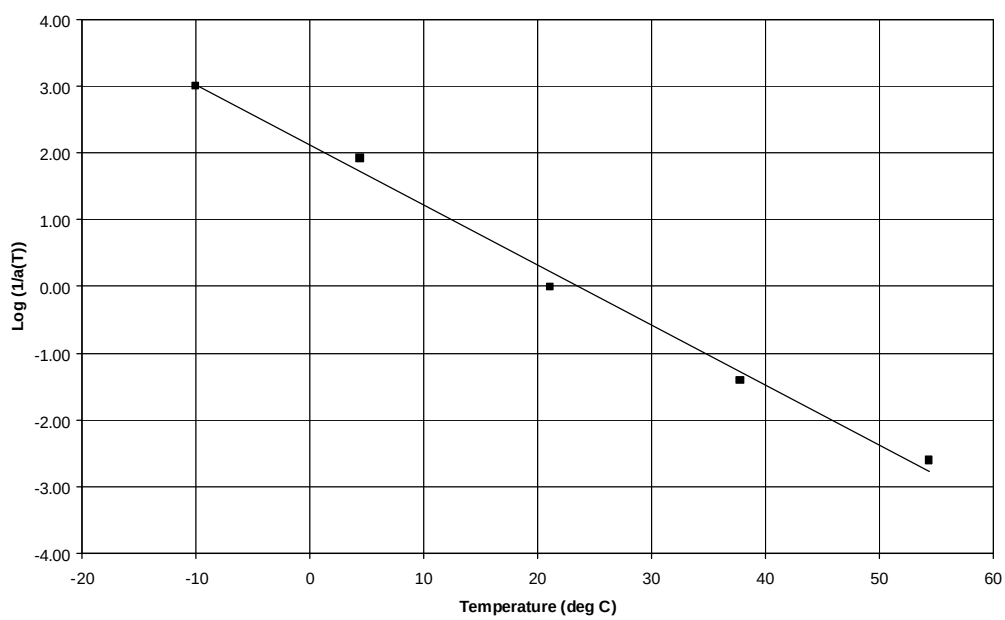


**Figure 8. Shift Factor for SP 19 D Mix**

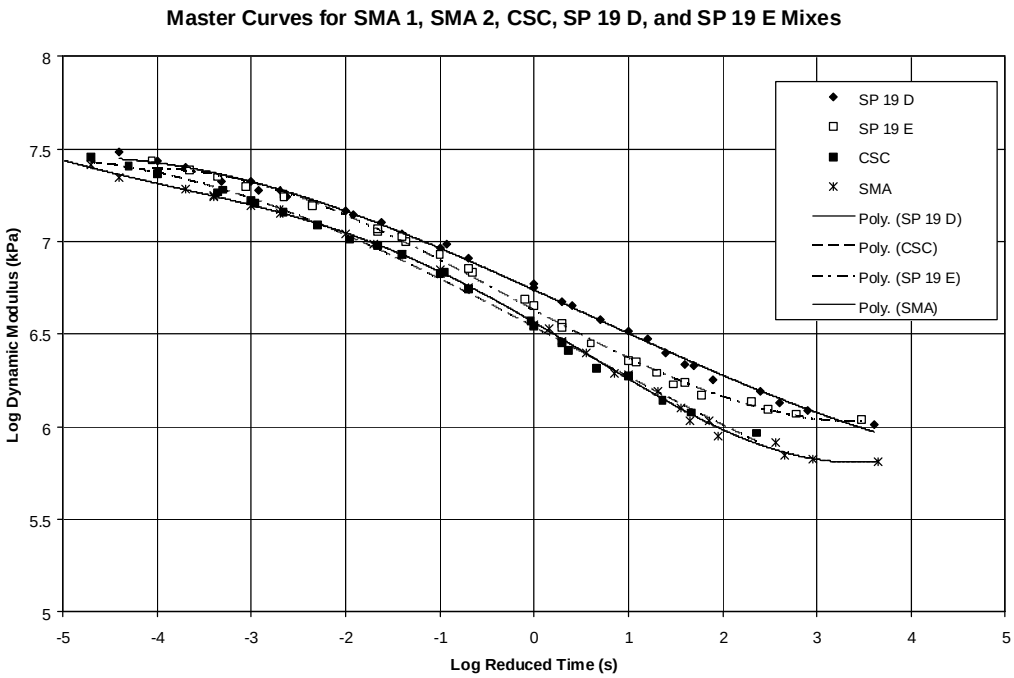


**Figure 9. Master Curves for SMA, CSC, SP 19 D, and SP 19 E Mixes**

The data from the dynamic modulus testing, asphalt cement testing, and asphalt mixture volumetrics was input into the AASHTO 2002 program for the pavement rutting prediction analysis. A composite pavement structure consisting of 63 mm of hot-mix asphalt over 250 mm of Portland cement concrete was assumed for the analysis, as shown in Table 6. A similar pavement structure was used by White, Hua and Galal [9] in their analysis of asphalt concrete rutting. The analysis was completed for a period of 20 years assuming a traffic spectra that gave a total traffic loading of about 60 million ESALs. For comparison purposes, the same traffic loading and design life were used for all four mixes analyses. As there is no climatic model in the program for any of Canadian provinces, a model for New York - Upper State was used in the study.

**Table No. 6. Assumed Pavement Structure in AASHTO 2002 Analysis**

| Layer Type | Thickness (mm) |
|---|---|
| Hot-Mix Asphalt | 63 |
| PC Concrete | 250 |
| Granular Base | 150 |
| Subgrade | - |

Note: AASHTO = American Association of State Highway and Transportation Officials
PC = Portland Cement

The rutting prediction analyses were completed at all three hierarchical levels of the AASHTO 2002 system. In Level 1, the Dynamic Modulus (E*) data from laboratory testing at loading frequencies and temperature for all mixes was input into the program, as well as the binder Complex Shear Modulus (G*) and Phase Angle (δ). No laboratory testing is required for Level 2 and the program uses a predictive equation to calculate E*; binder complex modulus and phase angle, and mix gradations were input in Level 2. Similarly, in Level 3, the program uses a predictive equation to calculate E*; and only the PG

grades were input for the asphalt cements. Table 7 summarizes rutting prediction for all four mixes from Level 1 and Level 3 analyses.

**Table No. 7. Summary of AASHTO 2002 Analysis**

| Mix Type | Predicted Rutting * | | | |
|---|---|---|---|---|
| | Level 1 | | Level 3 | |
| | Months | Rutting (mm) | Months | Rutting (mm) |
| SMA | 240 | 3.5 | 179 | 12.0 |
| CSC | 240 | 4.5 | 154 | 12.5 |
| SP 19 D | 240 | 3.2 | 240 | 11.6 |
| SP 19 E | 240 | 3.3 | 240 | 11.7 |

* Based on the default calibration factors in the program.

In AASHTO 2002 rutting is predicted using the following model [6]:

$$\frac{\varepsilon_p}{\varepsilon_r} = \beta_{r1} 10^{k_1} T^{k_2 \beta_{r2}} N^{k_3 \beta_{r3}}$$

where: $\varepsilon_p$ is accumulated plastic strain at N repetitions.
$\varepsilon_r$ is resilient strain of the asphalt material as a function of mix.
N is number of load repetitions.
T is temperature (ºF).
$k_i$ are non-linear regression coefficients.
$\beta_{ri}$ are calibration factors.

The default k values are:

$k_1$ = -3.4488
$k_2$ = 1.5605
$k_3$ = 0.4791

The predicted rutting values shown in Table 7 appear to be very low, particularly for the Level 1 analysis. It was observed that the calculated modulus in Levels 2 and 3 was a few times lower than that calculated in Level 1. However, it should be noted that the predicted values were calculated using the default calibration factors. These factors were developed for the conditions and mixes in the United States. An extensive and careful calibration is required for Canadian conditions and asphalt mixes.

## 4.0 TESTING IN HAMBURG WHEEL RUT TESTER (HWRT)

The HWRT (Figure 10) is used for evaluation of rutting and moisture resistance of asphalt mixes [1, 2, 10-14]. In a conventional HWRT test, a slab of hot-mix asphalt is submerged in hot water and a steel wheel is rolled across its surface. Two samples can be tested simultaneously in one HWRT run. The wheels can be either steel (47 mm wide) or rubber (50 mm wide). The load applied to the wheels is 710 ± 1 Newtons (N). The customary temperature for the HWRT test is 50ºC, which was developed in Europe for a climate close to a Superpave high temperature PG of 58. The test path is 230 ± 10 mm long and the average speed of each wheel is approximately 1.1 km/h (53 ± 2 wheel passes per minute). Samples can be either: 260 x 300 mm and 40, 80, or 120 mm thick slabs; or three cores or laboratory prepared SGC briquettes of 150

mm diameter. The number of wheel passes being used in the United States (Texas, Washington, and Colorado), for instance is 20,000 although up to 100,000 passes can be applied. Susceptibility to rutting (and moisture susceptibility) is based on pass/fail criteria. The Colorado Department of Transportation recommends a maximum allowable rut depth (Figure 11) of 4.0 mm at 10,000 wheel passes and 10 mm at 20,000 wheel passes while the Texas Department of Transportation specification requires that the rut depth be less than 12.0 mm at 20,000 passes (in a wet test using a steel wheel) [10]. The analysis of HWRT testing results can include post-compaction consolidation, creep slope, stripping inflection point, and stripping slope. In Europe, standard EU prEN 12697-22 [15] is used, although some countries have developed their own standards (United Kingdom - ISO 5725, Germany - Hamburg RST 4/90, and Czech Republic -TP 109/A1, for instance). Some of the European standards specify the dry test using the rubber wheel. An example is given in Table 8. Some researchers in Europe consider that the use of the steel wheel is too severe and may cause excessive damage to asphalt samples. A dry test with a rubber wheel was used in this study. The test was run at a temperature of 50ºC.

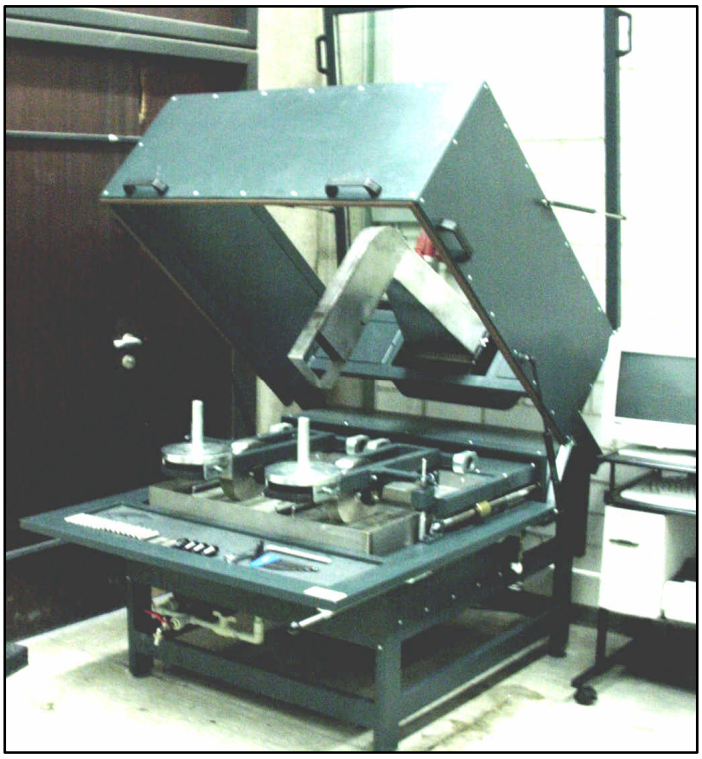

**Figure 10. Hamburg Wheel Rut Tester**

**Figure 11. Asphalt Cylindrical Samples after Application of 20,000 Wheel Passes**

**Table 8. Example of Hamburg Wheel Rut Tester (HWRT) Maximum Allowable Rutting in a Dry Test Using Rubber Wheel**

| Class of Traffic Loading | Rut Depth after 10,000 passes, $y_3$ (mm) | | Increase of rut depth between 10,000 and 15,000 passes, $p_2$ (mm) | | Increase of rut depth between 10,000 and 20,000 passes $p_3$ (mm) | |
|---|---|---|---|---|---|---|
| | Wearing Course | Binder Course | Wearing Course | Binder Course | Wearing Course | Binder Course |
| Class I with extreme heavy, slow, and stopping traffic | 1.60 | 1.50 | 0.20 | 0.15 | 0.30 | 0.22 |
| Class II and III with slow and stopping traffic | 2.00 | 1.60 | 0.25 | 0.20 | 0.40 | 0.32 |
| Class II and III | 2.40 | 1.80 | 0.36 | 0.28 | 0.55 | 0.45 |

| Class of Traffic Loading | Number of Heavy Trucks per Day |
|---|---|
| I | > 3500 |
| II | 1501 - 3500 |
| III | 501 - 1500 |
| IV | 101 - 500 |
| V | 15 - 100 |
| VI | < 15 |

Figure 12 shows the permanent deformation plot of the SP 19 D mix in the HWRT and Table 9 shows the rutting in the HWRT of all four mixes.

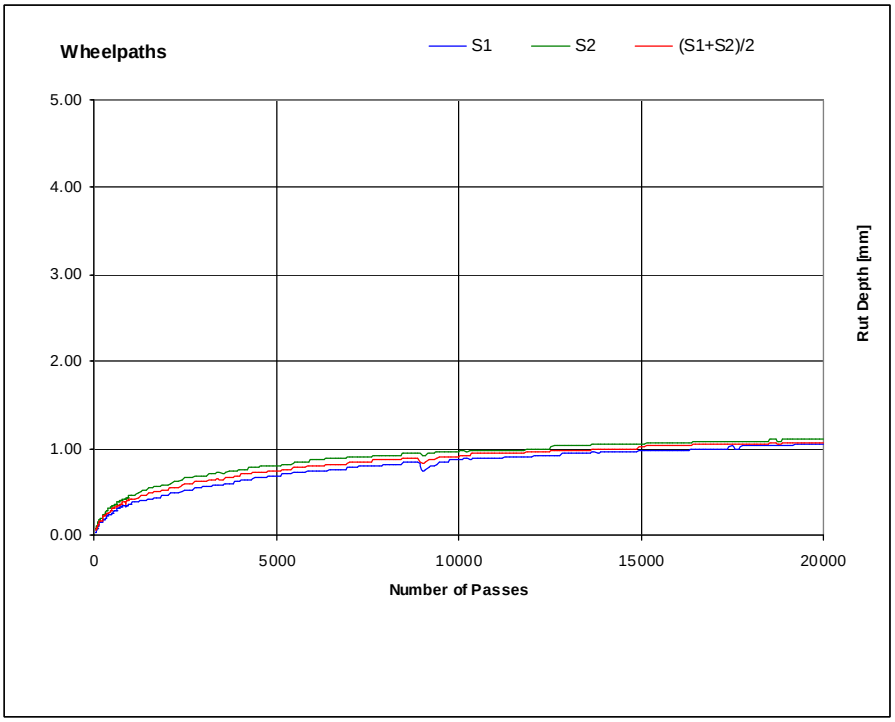


**Figure 12. Plot of Rutting in Hamburg Wheel Rut Tester (HWRT) of SP 19 D Mix**

**Table No. 9. Summary of Hamburg Wheel Rut Tester (HWRT) Testing Results**

| Mix Type | Temperature (°C) | Rut Depth (mm)* | | |
|---|---|---|---|---|
| | | Number of Passes | | |
| | | After 10,000 | Increase between | |
| | | | 10,000 to 15,000 | 10,000 to 20,000 |
| SMA | 50 | 1.33 | 0.06 | 0.14 |
| CSC | 50 | 1.66 | 0.19 | 0.34 |
| SP 19 D | 50 | 0.91 | 0.10 | 0.16 |
| SP 19 E | 50 | 1.51 | 0.15 | 0.21 |

## 5.0 FINDINGS AND RECOMMENDATIONS

The results of the dynamic modulus testing were used for predicting pavement performance in terms of asphalt rutting. The rutting resistance results from the HWRT testing were then compared with the pavement performance prediction. Overall, the results presented will be used as a basis for the development of rutting resistance criteria for specific mix types and traffic loading levels. The findings from Stage 1 of the study can be summarized as follows:

- The four mixes used in the study can be ranked in the following order in terms of their rutting resistance based on the dynamic modulus testing and AASHTO 2002 analysis: CSC was the worst; SMA, SP 19 D and SP 19 E mixes were similar and showed very good resistance to rutting.

- The ranking in the HWRT testing is as follows: the CSC mix was the worst; SP 19 E was better than the CSC but significantly worse than SMA and SP 19D mixes; the SP 19 D mix showed the best resistance to rutting.
- The coarser SP 19 E mix incorporating a PG 70-28 asphalt cement rutted more in the HWRT than the finer SP 19 D mix incorporating PG 64-28 asphalt cement. Some researchers report that finer mixes perform better in wheel rut testing than the coarser ones. More testing is required to verify this observation.
- Significant differences were observed between AASHTO 2002 Level 1, Level 2, and Level 3 results. A careful calibration is required for all three levels to reflect Canadian conditions and asphalt mixes.
- A reliable, accelerated laboratory performance testing is considered necessary. It should be used by the industry to routinely check rutting resistance at the mix design stage. The test should correlate well with SPT testing and field performance.
- Although the results of the testing completed to date are promising, it is too early to draw conclusions on the effectiveness of the test equipment in predicting asphalt concrete rutting, ranking the mixes in terms of their resistance to rutting and recommending rutting resistance criteria.

Rutting criteria for Superpave and other asphalt mixes used in Canada will be developed in Stage 2 of the study.

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