ASPHALT PAVEMENT FRICTION ANALYSIS:

A CPATT TEST TRACK CASE STUDY

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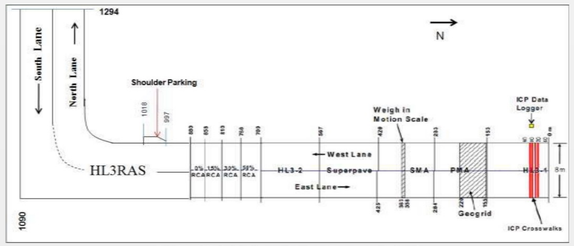
INTRODUCTION

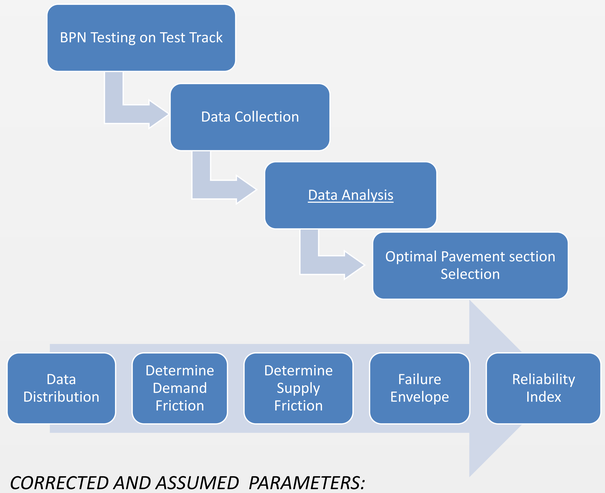
- Centre for Pavement and Transportation Technology (CPATT) Test Track was constructed at the Region of Waterloo's landfill facility in Waterloo, Ontario, in 2002.
  - 700m long test strip, with various asphalt mix designs.
- Originally added PCP Sections in 2007 and RAS sections in 2009: tested for friction supply using a British Pendulum Test (BPT) to obtain British Pendulum Numbers (BPN).
- Risk and reliability analysis involved to determine if the friction supply from each of the sections was adequate for an application on a generic urban freeway.



OBJECTIVE

- High friction pavement surfaces are desirable, particularly for intersections and other stopping areas. Friction coefficient satisfies geometric design standards for roads and allows for adequate safe stopping sight distance.
- Understanding different friction properties of different pavement types over time could help achieve this.

METHODOLOGY



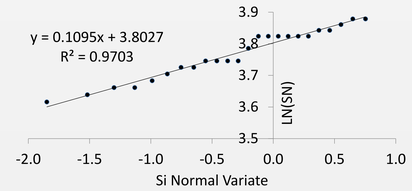
CORRECTED AND ASSUMED PARAMETERS:

- For the assessment of the BPN number, the BPN value was corrected.
  - Compensate for the effect of temperature
  - Wide range of BPN values and temperatures of the pavement.
  - Lack of maintenance and the heavy truck loads carried on the test track, the pavement is assumed to have degraded with time reducing the available friction of the pavement surface.
- Temperature of the pavement used for the data in this report was between 35˚C and 40˚C. Test should be performed with temperatures lower than 30˚C.
  - Contributed to a decrease in the BPN values. A threshold value of 10 was added to the calculated SN value to account for the correction.
- Design speed of the demand curve was assumed to be 100 kmph. Distribution of speed range assumed to follow normal probability distribution.
- Coefficient of variance for the design speed distribution assumed to be 0.10 to maintain consistency in mean and standard deviation ratio.

ANALYSIS

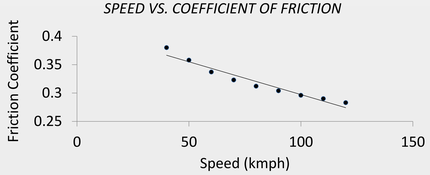
- Probability plots were carried out for SN values calculated for each of the pavement test sections. Fit the log-normal distribution.

LOG NORMAL DISTRIBUTION – RAS SECTION



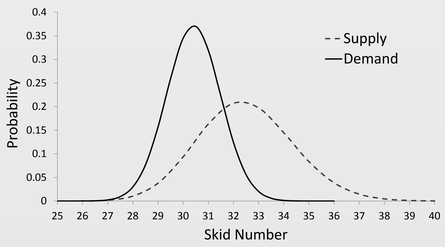
- 85% of the people driving on the highway drive under or at the speed limit, while 15% of the drivers exceed the speed limit. Thus, the distribution of speed was obtained by using 100 kmph as the 85th percentile of the distribution.
- Monte-Carlo simulation was carried out for 500 trials, resulting in a mean and standard deviation of approximately 30.4 and 1.1, respectively, for the SN values required for a pavement.

SPEED VS. COEFFICIENT OF FRICTION



- Probability curves were developed. These curves were considered the supply curves of the system.

DEMAND VS. HL3-1 SUPPLY



RELIABILITY INDEX

- Probable points of failure were calculated for each set of supply and demand curves. Using these points, the reliability index and the probability of failure for each test section were calculated against and compared against the given demand. Table 3-1 shows the resulting probabilities of failure and the reliability indices.

	Observations	
Pavement Type	Reliability Index	Prob. Of Failure
HL3-1	1.93	2.66E-02
PMA	6.37	9.44E-11
SMA	9.90	2.13E-23
SPP	4.43	4.65E-06
HL3-2	1.00	1.63E-01
RAS	4.18	1.47E-05

- Failure envelopes were very low and the reliability indices were all greater than a value of 1.0. Thus, each section indicates an adequate supply of friction in the pavement for a design speed of 100 kmph.

CONCLUSION

- From the tested sections, it can be concluded that stone mastic asphalt portrayed the best frictional properties giving the least probability of failure.
- Other sections were comparative; however, the HL3-2 section had the highest probability of failure.

RECOMMENDATIONS

- Using SMA as the top layer of asphalt pavement for an urban freeway with design speed 100 kmph is ideal in comparison to the other test sections
- When carrying out the BPT, the pavement surface temperature should be below 30°C to get accurate test results
- Further experimentation should be done to yield a more accurate relationship between the SN and BPN values
- Proper maintenance of the test track should be carried out to decrease the amount of degradation of the test track in order for more reliable data to be collected.

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