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Development of Roughness Prediction Models Using Alberta Transportation's Pavement Management System

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Abstract: Alberta Transportation conducts annual automated International Roughness Index (IRI) surveys on the core highway network in the province. The measures are used to rate the physical condition of each pavement section in the Pavement Management System (PMS) to establish rehabilitation strategies for the year. Future rehabilitation needs are predicted based on highway sections' age, using the Highway Pavement Management Application (HPMA) sigmoidal IRI function, which does not consider the effect of climatic and pavement distresses or structural design. IRI prediction models incorporated in the Mechanistic Empirical Pavement Design Guide (MEPDG) and Highway Development and Management (HDM) require comprehensive and detailed distress records. Such data records are not fully available for Alberta yet, making it difficult to calibrate these models for local conditions. The present study focuses on identifying the significant climatic, structural and distress-related variables to IRI for Alberta's highway network. The data available in Alberta's PMS was used to develop two new IRI prediction models for New, and Straight Overlaid Asphalt Concrete (AC) sections with Granular Base Course (GBC). Regression analysis revealed that variables such as age, traffic, subgrade fines, rutting, transverse and miscellaneous cracking are most significant to IRI for new AC sections. Further, IRI for overlaid AC sections was found to be dependent upon age, traffic, Freezing Index (FI), GBC and AC overlay thickness, subgrade soil plasticity and rutting. The model for new AC sections was able to predict IRI for the General Pavement Sections (GPS)-1 of the Long Term Pavement Performance (LTPP) in Alberta, Manitoba and Saskatchewan.

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Introduction

Pavement surface roughness is one of the most commonly used measures to gage road users' level of satisfaction, while at the same time provides an assessment of roadway conditions to road owners. Many highway agencies, including Alberta Transportation, conduct automated and regular roughness measurements, mainly in terms of International Roughness Index (IRI). Measurements are made to assess the overall physical conditions of the highway network for preservation and rehabilitation purposes. In doing so, the highway sections are categorized into poor, fair and good condition groups, based on predetermined criteria for roughness adequacy. Poor and fair groups are considered in need of repair and rehabilitation immediately or in the near future, respectively [1, 2]. Alberta Transportation uses Highway Pavement Management Application (HPMA) to rank and plan corrective and preventative maintenance and rehabilitation strategies for the province [4]. HPMA, developed by Stantec Consulting Services, includes functions based on detailed highway database including geometry, pavement structure and performance data such as IRI. HPMA utilizes a default sigmoidal IRI prediction model (Eq. (1)) to predict IRI, and thus future preservation activities.

$$IRI = IRI_0 + e^{(A - B \times C^{\ln(Age)})} \quad (1)$$

where, IRI_0 is IRI at age zero, Age is the last rehabilitation or construction activity life in years and A, B, and C are coefficients defined based on treatment type [5]. The IRI model in Eq. (1) is utilized for pavement sections characterized within the same performance class in terms of thickness, environment, traffic, last rehabilitation and subgrade properties [6, 7]. However, local calibration based on IRI data has shown the need to refine and replace the HPMA's default IRI prediction model with new IRI models [5]. A similar approach as the one incorporated in HPMA was applied by El-Assaly et al. in 2002, where relations were developed to predict IRI progression as a function of age for different classes of road in Alberta Transportation's Pavement Management System (PMS) [8].

On the other hand, several evaluation studies conducted in recent years on roughness development for the Long-Term Pavement Performance (LTPP) sections revealed that, in addition to structural age, IRI is correlated to other variables. The evaluation of the General Pavement Studies (GPS)-1 (Asphalt Concrete [AC] over Granular Base Course [GBC]) revealed that base material passing Sieve No. 200, Freezing Index (FI), and Plasticity Index (PI) for the subgrade have a strong effect on roughness for all climatic zones [9]. A study on the Specific Pavement Studies (SPS)-1 (new AC pavements) in Iowa demonstrated that IRI development correlates with transverse and longitudinal cracking in the wheelpath. The same study revealed that, for SPS-5 (overlaid AC sections) IRI progression depends on the pre-overlay IRI for the section, as well as the overlay thickness [10].

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Table 1. Summary of the Variables in the MEPDG and HDM IRI Prediction Models.

Category	Variables in MEPDG Models			Variables in HDM Model
	New AC (CSB)	New AC (GBC)	Overlaid (GBC)	New & Overlaid (Any Base)
Structure	IRI_0	IRI_0	IRI_0	IRI_0
		-	-	Pavement Modified Structural Number (SNC) Reduced for Cracks in AC
		-	-	Last AC Layer Thickness
		Age	*Age*	Age Since Last Major Treatment
		-	-	Thickness of old AC Layers
Subgrade		% Passing Sieve No. 200	-	-
		% Passing 0.02-mm Sieve	-	-
		PI	-	-
Climate		FI SD of Monthly Rainfall Average Annual Rainfall	-	Climatic Factor Based on Ambient Temp. & Moisture Index
Traffic		-	-	Annual ESAL
Distresses	Trans. Crack	Trans. Crack	Trans. Crack Spacing	Structural cracking
	Fatigue Crack	Fatigue Crack		Raveling
	Block Crack	Block Crack	Patches Area	Delamination
	None Wheelpath Long. Cracks	Sealed None wheelpath Long. Cracks	Sealed Wheelpath long. Cracks	Potholing
	SD of Rut Depth	COV of Rut Depth	Pothole Area	SD of Rut Depth

The new Mechanistic Empirical Pavement Design Guide (MEPDG) is embedded with individual IRI models for 1) new AC pavements with bound base materials, Cement Stabilized Base (CSB), 2) new AC sections with unbound GBC, and 3) overlaid pavement sections with GBC. The models, developed based on the data from the LTPP GPS-1 to 7, take into account the effect of different groups of variables, including structural design and properties, climate, distresses, and subgrade properties. A summary of the input variables in each category included in the three models is listed in Table 1. As seen in Table 1 the MEPDG IRI prediction models for new AC sections with CSB and overlays include only IRI_0, age and distresses, while the model for new sections with GBC includes the effect of climate through Standard Deviation (SD) of monthly rainfall, average annual rainfall and FI. The effect of subgrade type and properties on IRI is also considered in the model through gradation (percent fines) and PI. Distresses considered in the model for new AC sections are total area of all-severity fatigue and block cracking, Coefficient of Variation (COV) of rutting, total length of all-severity transverse cracking and total length of all-severity non-wheelpath longitudinal cracking [11].

Another IRI model that has gained popularity in several countries over the past few decades is the Highway Development and Management (HDM) model. Table 1 includes a list of the variables in different categories included in the HDM model. The HDM model can be used to predict pavement IRI progression by considering the effects of pavement structure, climatic and environmental conditions, traffic loading and different types of distresses [12].

Available IRI prediction models (Table 1) require an extensive record of distresses collected for the LTPP test sections. MEPDG models, calibration and implementation by highway agencies require extensive and regular distress survey records, collected in accordance with the LTPP Distress Manual along with records of many other variables such as climatic indices, material and structural properties [13]. While the need for comprehensive distress surveys and other pavement data records to fulfill the MEPDG implementation should be considered by highway agencies, the available PMS database is invaluable and can be investigated to identify relations between different variables and pavement performance. The present study will follow a similar methodology to that used in the development of the MEPDG and HDM models and will focus on identifying significant climatic, structural and distress-related variables to IRI for new and straight overlaid AC sections with GBC in Alberta. As a result of this study, the statistical significance of various influential variables on IRI, as well as their linear correlation with IRI, will be established for Alberta's highway network. This study can help Alberta Transportation and other highway agencies understand the pavement performance in cold climatic conditions, using current construction practices and materials. Further, the study can be useful in predicting future rehabilitation needs for exiting sections and also improve the design and construction practice for new sections in the future. The accuracy of the model developed for new AC sections will be evaluated using the data available for the LTPP sections in the three neighboring provinces of Alberta, Manitoba and Saskatchewan in western Canada.

General Description of Alberta Transportation's PMS

Since the late 1990s, Alberta Transportation uses a laser-based system to measure IRI and rutting at 19-mm intervals. Later, the 19-mm interval data for the wheelpath is averaged over 50-m intervals, which is averaged over the entire length for each control section and reported annually in Alberta Transportation's PMS. In addition to the annual IRI measurements, the information available in the database for each control section includes: the highway name (number), control section number, start and end kilometers, length and width, subgrade soil type, base layer material's type, date of construction and thickness, last surface activity's type, date of construction and thickness, age since last surface activity, Average Annual Daily Traffic (AADT) and several distress records.

Alberta Transportation's PMS report in 2011 (the focus of the present study) contains a total number of 10,384 control sections, resulting in 31,333 km of highway. Of these, only 13 sections are Jointed Plain Concrete Pavements (JPCP), and the remaining are AC pavements. AC road sections in the database are in three categories, new (original), milled and overlaid, and straight overlaid sections. GBC is the most common base material used in Alberta, covering 76 percent of the entire sections in the network. Only seven and twelve percent of all the sections are comprised of Asphalt Stabilized Base (ASB) and Cement Stabilized Base (CSB), respectively. The remaining five percent include composite pavement sections and JPCP sections overlaid with AC. Also note that, the majority of the pavement sections (67 percent) include a clay-type subgrade soil.

Distress records available in the PMS for each control section include medium- and high-severity transverse cracking, longitudinal cracking in the wheelpath, miscellaneous cracking, and rut depth. Transverse cracking and miscellaneous cracking are measured manually and reported in the PMS as percentage of cracked area. For transverse cracking, the crack length is multiplied by a factor of 0.3 to account for the affected pavement area. This value is then divided by the total pavement area to arrive at percent cracked area. Longitudinal cracks, on the other hand, are reported as percent length cracked, since they are parallel to the direction of traffic [14]. The rut depth records in the PMS represent the 80th percentile rut depth in the wheelpath for each control section [15].

Database Preparation

Based on the number of control sections available in the PMS, two pavement groups were included in the analysis: 1) New; and 2) Straight Overlaid AC pavement sections with GBC. The number of new AC sections with a bound base material available in the PMS is limited, as are the milled-overlaid sections. Further, as these control sections are mostly young and do not cover a wide range of IRI, these types of pavements were not included in the study. To be able to identify the potential influential variables to IRI, a comprehensive review of existing roughness models was conducted. The MEPDG and HDM models, the two widely used and most inclusive models (as previously discussed), were mainly used in selecting the variables.

According to Table 1 both the MEPDG and HDM procedures comprise several input variables to predict pavement IRI, some of which are not readily available in Alberta's PMS and need to be defined based on available resources. According to Table 1 IRI_0 is part of both the MEPDG and HDM models. The effect of this variable was considered in the analysis by fitting an intercept through the entire IRI measurements available in the PMS, which includes a total of 40, one-year-old sections. The next variable within the structure category is structural age, which is common among all the models in Table 1. This variable is readily available in Alberta Transportation's PMS for every inventory. As opposed to the MEPDG, the HDM model includes other structural variables, such as pavement modified structural number (SNC) and old and new AC layer thicknesses. The latter variables are readily available in Alberta Transportation's PMS and were included in the analysis. For the subgrade category, the MEPDG model for new sections with GBC includes such variables as gradation and plasticity, while the HDM model includes no variables. Alberta Transportation's PMS includes the soil type in the form of the Unified Soil Classification (USC). In an attempt to include subgrade properties in the analysis, the default values available in the MEPDG Version 1.1 were used to define P200 and PI for each soil classification in the PMS.

Both design procedures in Table 1 consider the effect of climate and site conditions on IRI. The MEPDG model for original sections with GBC comprises the three environmental factors of standard deviation of monthly rainfall (SD RAIN), mean annual rainfall (MAP), and FI, while the HDM model recommends typical values for the environmental coefficient (m) for various ambient temperature and thornthwaite moisture index. Alberta Transportation's PMS does not include any climatic parameter; hence, in an attempt to establish FI, MAP and SD RAIN for each inventory section in the PMS, the climate program, ClimateAB (developed at the University of Alberta) was implemented. The program uses the historical data (minimum of 30 years) from weather stations across western Canada to establish major climatic indices for any geographical location in Alberta [16]. The one obstacle toward implementing the program for Alberta's network was missing coordinates for each inventory in the PMS. Only the coordinates for the start and end of each highway were obtainable from Alberta Transportation. Therefore, the climatic parameters could only be established for approximately 22 percent of all control sections.

As seen in Table 1 the HDM model considers the effect of traffic on IRI using ESAL, while none of the MEPDG models include any traffic-related parameters. Traffic data for each control segment in Alberta Transportation's PMS is available in the form of AADT and was used in the analysis. For the distress category, the MEPDG models include transverse, fatigue and block cracking, together with rutting, potholes and patches. The HDM model comprises structural cracking, delamination, ravelling and rutting. A record of distresses is available in the PMS for longitudinal, transverse and miscellaneous cracking, together with rutting, as discussed in the previous section.

Model Development

The data readily available in Alberta Transportation's PMS along with the data added to the database as described above was used to identify the statistically significant variables to IRI for original AC sections with GBC, as well as overlaid AC sections with GBC. A list of the variables included in the analysis includes:

- Pavement structure:
  - Structural age
  - AC layer or AC overlay thickness (AC-mm)
  - Base layer thickness (Base-mm)
  - AADT
- Subgrade properties:

   - P200
   - PI
- Climate:
   - FI
   - Mean Annual Precipitation (MAP)
   - Standard Deviation of mean monthly rainfall (SD RAIN)
- Distresses:
   - 80th percentile rut depth (Rutting)
   - Percent area with transverse cracking (Trans. Crk)
   - Percent length of wheelpath with longitudinal cracking (Long. Crk)
   - Percent area with miscellaneous crack (Misc. Crk)

Prior to the statistical analysis, the database for each pavement group (new AC and the straight overlaid sections) was carefully screened and examined for missing and erroneous data records. A total of 126 control sections in the PMS included unknown or missing subgrade soil types, thus were excluded from the analysis. Outliers of the data available for each variable were identified using the inner and outer fences from the relations below [17]. Where, observations falling between a pair of inner or outer fence are possible outliers, while observations lying outside the outer fence are probable outliers.

Inner fence: Upper: $Q_1 - 1.5(IQR)$

Lower: $Q_3 + 1.5(IQR)$

Outer fence: Upper: $Q_1 - 3.0(IQR)$

Lower: $Q_3 + 3.0(IQR)$

Q_1 and Q_3 in the above relations represent the first and third quartile of the observations, respectively and IQR is the interquartile range and is equal to Q_3 - Q_1. The inner and outer fences were established for each variable within each pavement group. The identified probable outliers were carefully examined for errors. For new AC sections with GBC, a total of 1,494 observations are available in the database. Variables such as AADT, transverse, and miscellaneous cracking did show values beyond the upper outer fence. Each of the probable outliers was examined; however, none of them showed an apparent mistake in data collection/recording, hence no elimination was made. A total of 14 observations showed a value of zero for IRI, thereby were excluded from the analysis, resulting in a total of 1,479 observations for new AC sections with GBC. For straight overlaid sections a total of 3,249 sections were available, of which seven sections were excluded, due to a zero IRI.

IRI Model for New AC Sections

As mentioned previously subsequent to screening the data for outliers and eliminating the observations with IRI of zero, a total number of 1,479 observations became available for new pavement sections with GBC. Of these observations, climatic variables were able to be assigned to 404 sections. A summary of all the variables used in the future statistical analysis together with their basic statistics is provided in Table 2.

A preliminary regression analysis was performed on the 404 observations to establish the significance of the climatic variables to IRI. The climatic variables showed P-values greater than $\alpha = 0.05$, implying their insignificance to IRI. Further, the Pearson correlation between IRI and climatic variables, including FI, MAP and SD RAIN, was found to be 0.02, 0.02 and 0.05, all with P-values greater than 0.05. Based on these observations it was concluded that the climatic variables do not affect IRI for new AC sections in Alberta significantly. Hence, another attempt was made to develop an IRI model for the entire observations (a total of 1,479).

Table 2. Basic Statistics for the Variables Used in IRI Regression for New AC Sections with GBC.

No.	Variable	Range		Mean	SD
		Min.	Max.		
1	AADT	130	45,850	3,726	5,676
2	Age (Years)	1	47	18.65	7.8
3	Misc. crack (% Area)	0	91	2.58	7.6
4	Trans. crack (% Area)	0	2.4	0.27	0.5
5	Long. Crack (%)	0	100	18.3	0.6
6	Rutting (mm)	1	15	4.71	2.5
7	AC Layer Thickness (mm)	60	360	146.4	36.9
8	GBC Thickness (mm)	50	500	259.3	77.6
9	FI (˚C-day)	710	2,546	1422.7	340.6
10	MAP (mm)	284	851	456	82.7
11	SD Rain (mm)	11.7	36.2	23.3	5.6
12	P200 (%)	3	75	69.5	16.2
13	PI	0	35	25	6

A split data method was used to validate the developed relation between IRI and the significant variables (20). Hence, 1,000 of the observations were used for model development (derivation data) and the remaining 479 were randomly screened and held out for validation. The most significant variables showing P-value < 0.05 were identified through a regression analysis. Equation 2 shows the final IRI prediction model. As seen in Equation 2, the IRI model has an intercept of 0.34 mm/m, which reflects the effect of IRI_0. Further, IRI has a direct relationship to a combination of age and AADT, percent fines in the subgrade and distresses such as rut depth, transverse and miscellaneous cracking. This agrees with the findings of Perera et al. (2002) that IRI measurements made by a profiler show jumps at the location of deep transverse cracks and ruts in the pavement (9). Using the average values from Table 2 for AADT and P200 and zero for all other variables IRI_0 is obtained at 0.99 m/km, which very well agrees with typical IRI_0 of new AC sections in Alberta.

$$IRI = 0.34 + 0.059 e^{Age/25} * Log(AADT) + 0.006 * P200 + 0.088 * TransCrk + 0.013 * MiscCrk + 0.07 * Rutting \quad (2)$$

Residuals, i.e. the difference between the predicted and observed IRI are plotted against the predicted (fitted) IRI in Fig. 1. According to Fig. 1 the residuals vary mainly between -1 and 1 m/km and expand in a horizontal band around the zero line. No specific pattern is observed in the distribution of the residuals, indicating a good fit for a linear model.

The regression model (Eq. (2)) has a coefficient of determination (R^2) of 39 percent and a standard error of estimate

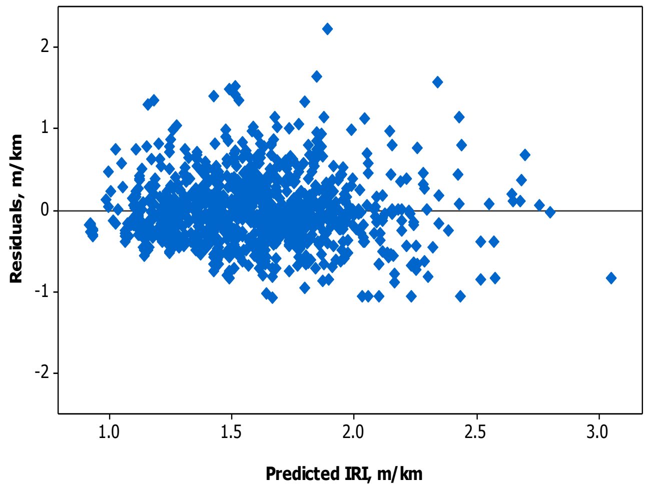

Fig. 1. Graph of Residuals versus Predicted IRI for New AC Pavements with GBC.

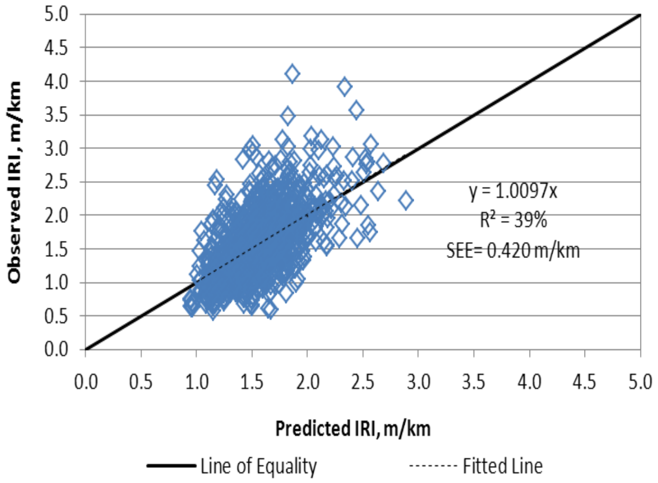

Fig. 2. Predicted IRI versus Observed IRI for 1,000 New AC Pavements with GBC.

(SEE) of 0.420 m/km. Fig. 2 provides a graphical presentation of the observed versus predicted IRI with respect to the line of equality. Overall, the model shows acceptable statistics and is able to reasonably predict IRI for the pavement sections in Alberta. The reason for the relatively low R^2 achieved for the model could be the possible inaccuracies in distress survey records, especially for the miscellaneous cracking category since this group includes a variety of crack types. The developed model was validated in the next section using the split data method.

The developed regression model (Eq. (2)) was used to predict IRI for the validation observations. The adjusted coefficient of determination (R^2_{adj}) was used for validation. Since R^2_{adj} for the validation model ($\hat{R}^2_{adj}$) is typically smaller than R^2_{adj} for the derivation model, it is critical to establish a valid criteria for the allowable drop in R^2_{adj}. The following criterion from Sobol (1991) was used to establish the allowable reduction in the R^2_{adj} (18).

$$\hat{R}^2_c = 1-(\frac{N-1}{N-K-1})(\frac{N+K+1}{N})(1-R^2_{adj}) \quad (3)$$

Table 3. Basic Statistics for the Variables Used in the Analysis for Straight Overlays.

No.	Variable	Range Min.	Range Max.	Mean	SD
1	AADT	100	66,090	5,286	8,045
2	Age (Years)	1	39	11.2	6.6
3	Misc. crack (%Area)	0	96	1.82	3.7
4	Trans. crack (%Area)	0	4.8	0.55	0.9
5	Long. crack (%)	0	100	21.6	35.7
6	Rutting (mm)	1	21	4.1	2.5
7	GBC Thickness (mm)	50	450	243.3	66.2
8	AC Overlay Thickness (mm)	135	470	263.45	66.6
9	MAP (mm)	326	882	452.7	65.9
10	FI (˚C-day)	697	2772	1519.6	345.7
11	SD Rain (mm)	14.5	34.9	23.5	5
12	P200	3	75	72	11
13	PI	0	35	26	6.5

Where, $\hat{R}^2_c$ is the acceptable drop in R^2_{adj}, N is the number of validation observations, and K is the number of variables including the intercept. Using 479, for N, 6 for K, and 39 percent for R^2_{adj}, $\hat{R}^2_c$ was established at 35 percent. $\hat{R}^2_{adj}$ was established at 37 percent for the validation observations, which is within the allowable drop limit for R^2_{adj}, implying that the derivation model meets the validation criterion.

IRI Model for Straight AC Overlay

A total number of 621 overlaid control sections with GBC with climatic variables were available in the PMS. A total of 501 observations were used for model derivation and the remaining 120 were randomly selected and held out for validation. Table 3 shows the range of variation for all of the variables used in the analysis, together with their mean and standard deviation.

The best fit model is presented below in Equation 4. According to Equation 4, IRI increases with an increase in age, rut depth, FI and PI, while thicker overlay and base layers result in less IRI. Also, when age and rut depth are considered as zero, and average values of 5,286, 1,416 ˚C-day, 243 mm and 263 mm are used for AADT, FI, overlay, and base thickness, respectively, IRI_0 of 0.92 m/km is obtained using Eq. (4). This observation implies that although no milling is performed prior to overlay, a low IRI_0 of 0.92 m/km is still attained for the overlaid sections.

$$\begin{aligned} IRI = 0.786 + .0.099 * e^{Age/25} * AADT + 0.2 * (FI/1000) \\ - 1.55 * Base(m) - 1.5 * AC(m) + 0.074 * Rutting + 0.01 * PI \end{aligned} \quad (4)$$

Study of the residuals with respect to the predicted IRI showed that the residuals scatter around the zero line without a specific pattern, meaning that the assumption of normal variances is valid. The relationship between the measured and predicted IRI is shown in Fig. 3. The model has a R^2 of 39 percent and SSE of 0.452 m/km.

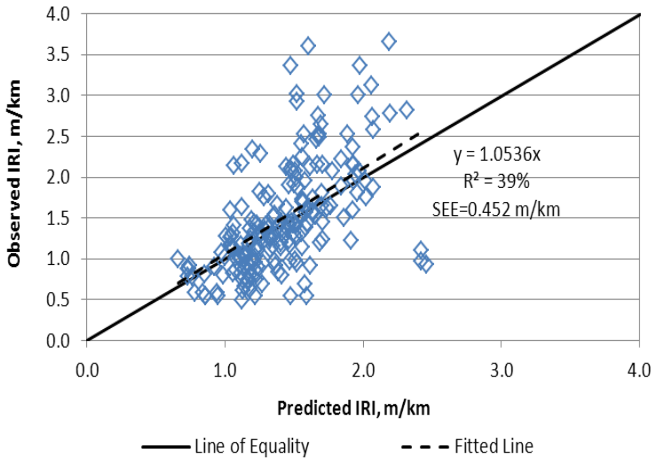

Fig. 3. Observed Versus Predicted IRI for Straight Overlays (Derivation Data).

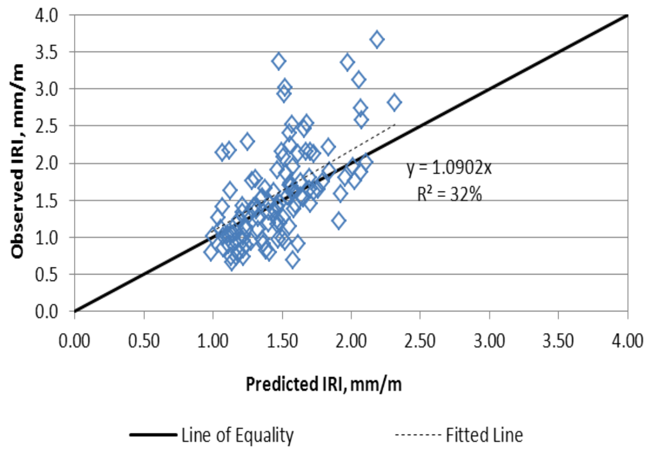

Fig. 5. Observed Versus Predicted IRI for Straight Overlays (Validation Data).

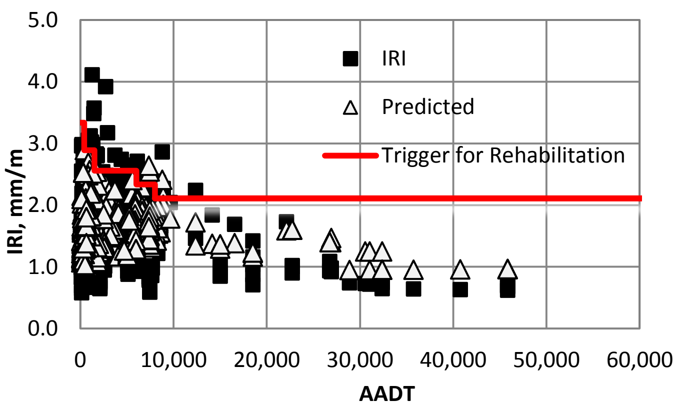

Fig. 4. Predicted and Observed IRI for Straight Overlays as a Function of AADT.

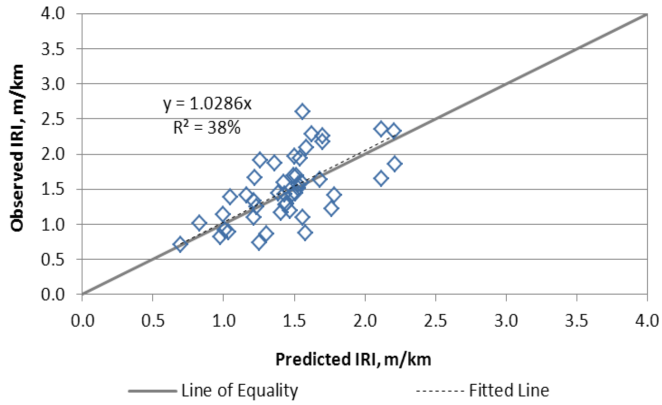

Fig. 6. Observed Versus Predicted IRI for LTPP GPS-1 in Western Canada.

It is noted in Fig. 3 that the prediction model underestimates IRI for mostly all the sections with IRI greater than 2.5 m/km. This behavior is better noted in Fig. 4, where both the predicted and observed IRI values are presented with respect to AADT. Alberta Transportation's trigger values for rehabilitation are also presented in FIGURE 4 for different traffic levels. It is noted in Fig. 4 that the majority of the sections whose IRI is underestimated by the model are those with IRI values beyond the trigger limits.

The model in Equation 3 was used to predict IRI for the validation observations (120 observations total). The allowable drop in the R^2_{adj} for the validation model ($\hat{R}_c^2$) was established at 25 percent using Equation 3. Additionally, $\hat{R}_{adj}^2$ for the validation model was established at 28 percent in comparison to R^2 of 39 percent for the derivation model, which is well within the allowable limit. The scatter of the predicted versus observed IRI around the one-to-one line is presented in Fig. 5 for the validation observations.

Model Validation using LTPP Data

The model developed for new AC pavements with GBC was validated using the data from eight GPS-1 LTPP sections with similar climatic conditions, located in western Canada. The eight sections included in the analysis are Sections 1803 and 1804 in Alberta, 1801, 6450, 6451 in Manitoba, and 645 and 6410 in Saskatchewan.

The data required to define each variable in the model, including transverse cracking, rutting depth, AADT, base thickness and P200 for the subgrade, were collected for each section from the LTPP online database in June 2012. Several simplifying assumptions for each variable became necessary, depending on the available data. For instance, the yearly traffic data available for each section did not match with the years in which the distress and IRI records were available. To overcome this limitation, the available traffic data were used to establish the average annual growth rate and consequently predict AADT for the required years. In addition, the months when the IRI measurements were made for each section did not match with the months when the rutting measurements and transverse cracking surveys were made. Hence, for each section and in each year the distress data which corresponded to the months in a similar season were used together, resulting in a total of 47 observations. The scatter of the predicted versus the observed IRI around the one-to-one line is presented in Fig. 6. As seen in Fig. 6, the model is very well able to predict IRI for the LTPP with a R^2 of 39 percent (R^2_{adj}.= 27 percent).

Conclusions

The data available in Alberta Transportation's Pavement Management System (PMS) was utilized in this study to develop two IRI prediction models for Alberta's highway network. The regression models developed were for: 1) New and 2) Straight Overlaid Asphalt Concrete (AC) sections with Granular Base Course (GBS). A total of 1,000 and 621 highway sections were used to develop the two models, respectively and another 479 and 120 highway sections were used to validate each model, respectively. Regression analysis revealed that, for the new AC sections in Alberta, age, Annual Average Daily Traffic (AADT), subgrade fines, rutting, transverse and miscellaneous cracking are linearly correlated with IRI. Variables such as age, AADT, FI, PI, rutting, base and overlay thickness were found to be significantly correlated with IRI for the overlaid sections. The models showed reasonable statistics and can be used to predict IRI for the pavement sections in Alberta. The models' predictions agreed best with IRI measurements for those sections with IRI values lower than Alberta Transportation's trigger value for rehabilitation. The accuracy of both models is expected to increase with more accurate records of various types of cracking. The model developed for the new AC sections provided reasonable IRI predictions for the LTPP GPS-1 sections in western Canada.

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