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Pavement Condition Index for Airports: A Case Study of Simara Airport

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Abstract

Airport Pavement Management System (APMS) is used worldwide for pavement management at airports for optimizing the timing and type of maintenance activities. Pavement Condition Index (PCI) is used as the indicator of pavement condition in APMS to track the pavement deterioration over the years. In Nepal, maintenance in airport pavements is carried out in piecemeal basis with major rehabilitation initiated only after serious operational issues without any systematic framework such as the APMS. This study, as a first step towards implementing APMS in the country, focuses on the various facets associated with determination of PCI for airports by considering a case study of Simara airport. The standard Deduct Value curves for 38 distress type and severity combinations used in PCI determination are transformed into polynomial functions of degree six relating deduct value and logarithmic of distress density, and validated by t-test for 114 readings. Distress survey is conducted for all 64 sample units at runway and all 7 sample units at taxiway and apron with the size of sample units ranging from 550 to 700 sq.m. Fourteen out of 38 total combinations are encountered amongst which longitudinal and transverse cracking, and ravelling are the most prevalent. The PCI for runway is 76, and that for taxiway and apron is 82 indicating that the pavement condition is satisfactory. The PCI values for all 64 sample units at runway fit normal distribution with 9.2 standard deviation. Finally, a 20% sampling rate is found to estimate PCI for the runway pavement within the widely accepted permissible error of 5 with 95% confidence level.

Keywords

APMS, PCI, Deduct Value Curves, Pavement Distress, Sample Units

1. Introduction

There are in total 54 airports in Nepal among which 35 airports are in operation currently. Amongst the 35 operational airports, there is one international airport, four domestic hub airports and 30 domestic airports. Moreover, several new domestic and three new international airports are currently in development and/or construction phase. 37 of the existing airports have paved runway while two more are undergoing pavement construction [1]. Majority of the airside pavement (pavement at Runway, Taxiway and Apron) in Nepalese airports consists of flexible pavement with only a small share of rigid pavement at apron of some of the airports. The current modality of pavement maintenance for Nepalese airports involves localized maintenance i.e., patching at small distress regions if and when recognized (in piecemeal basis), and full-scale maintenance i.e., rehabilitation or reconstruction only when it becomes an appreciably big problem posing threat to operational safety and/or resulting in loss of operational efficiency. This is also demonstrated by the first rehabilitation of Tribhuvan International Airport pavement in 2019 after 44 years of construction [2]. There is need for a systematic framework for routine pavement evaluation so as to allow timely maintenance to reduce maintenance cost and avoid any safety risks during flight operation. This kind of framework is known as Airport Pavement Management System (APMS) which has proven to be a vital tool for decision makers in maintaining acceptable level of pavement condition while also minimizing expenditures [3]. Introduction and determination of an objective and consistent indicator of pavement condition of airports across the country is the first requirement for implementation of such system. Pavement Condition Index (PCI) is the most prominently used indicator for APMS worldwide. It was developed by US Army Corps of Engineers and is currently used by FAA and other agencies as the primary indicator in their APMS [4]. PCI is a numerical index which provides a measure of the pavement condition based on the distresses visually observed on the pavement surface, and the standard Deduct Value curves for the particular pavement type. Deduct values are weighing factors that indicate the impact each distress has on pavement condition. PCI ranges from 0 for a failed pavement to 100 for a pavement in perfect condition [5].

2. Research Objectives

The general objective of this research is to explore various aspects associated with determination of PCI for airport pavement. The specific objectives of this research are:

(a) To derive mathematical functions of the standard Deduct Value Curves presented in ASTM D5340-98 [6] for expediting PCI calculation.

(b) To study the effect of the percentage of total pavement sample units surveyed on the expected error in PCI values and to recommend suitable percentage of sample units to be surveyed for PCI calculation within permissible error.

3. Literature Review

Shahin and James (1984) summarized the development of an airfield pavement maintenance management system from year 1974 to 1983. This was the original research that formed as the foundation for use of PCI in pavement management along with appropriate prediction models by the use of the PAVERS software. Distress curves for distresses in asphalt concrete and cement concrete were also finalized in that original study. The three objectives to be met in the development of the PCI were that it was meant to provide (a) an index of present condition in terms of structural integrity and surface operational condition, (b) an objective, rational basis for determining Maintenance and Rehabilitation (M&R) needs and priorities, and (c) a warning system for the early identification or projection of major repair requirements or both [7].

The American Society of Testing and Materials (ASTM) standard D5340-98 dated 1998 covers the standard procedure for conducting distress surveys and determining PCI for airport pavements [6].

Pavement Management Program (PMP) under Federal Aviation Administration (FAA) has adopted PCI as the indicator of the structural integrity and surface operational condition of a pavement. It recommends FAA PAVEAIR software for database management of observed distresses at various pavements, projecting the rate of pavement deterioration based on PCI prediction models and life-cycle cost analysis for various M&R alternatives [8]. Pavement Management System used for airports in Canada also uses PCI as the main indicator of pavement condition [9]. FAA and ASTM adopt slightly different pavement rating i.e., verbal description of pavement condition as a function of the PCI as shown in Figure 1.

Figure 1: Verbal Rating of Pavement Condition based on PCI values

Sixteen different types of distresses with various severity levels totalling to 38 distress type-severity level combinations that can occur on asphalt concrete surfaces are listed in ASTM D5340-98 [6]. Distress Identification Manual is available with detailed descriptions of all the pavement distresses, measurement methods, information on judging the severity levels along with photographic examples of the distresses for aiding with objective and consistent identification of distresses on airport pavements [10].

For the distress survey for PCI determination, the entire pavement area to be surveyed is divided into a number of sample units in the range of 500 to 700 sq.m area for airports. The reported PCI for the entire pavement is calculated as the area-weighted average of the PCI values of all the individual sample units inspected (all sample units are not necessarily inspected) [5]. Shahin et al. (1996) studied the effect of sample unit size on PCI accuracy for asphalt roadways by conducting distress surveys for 24 pavement sections. A sample unit of area 2500 sq. ft was adopted as a regular size, and PCI was calculated by considering various other sample unit sizes from 10% to 80% of the regular size. The error in PCI was found to be limited to 2 as long as the sample unit size is within 40% of the regular size [11].

Equation 1 is generally adopted for determining the number of representative sample units to be selected for inspection [5]. However, this equation is applicable only when the PCI values of all the samples in the pavement branch are normally distributed [12], and their standard deviation is known from a prior distress survey and PCI evaluation study.

$$n = \frac{N \times s^2}{(\frac{e^2}{4}) \times (N-1) + s^2} \tag{1}$$

where, n = number of representative sample units to be inspected, N = total number of sample units in the pavement branch, e = allowable error in the estimate of the PCI for the branch, and s = standard deviation of the PCI between sample units in the branch

Furthermore, in case of airfield pavement, it is not unreasonable that 50% or even 100% of the total number of sample units are surveyed at central portion of runway, and likewise 25% to 33% sampling is conducted towards the edge of runway and on taxiways and aprons [5]. This would be understandable in cases where PCI evaluation is used as a tool for maintaining regular operational standard at the airport including that against the threat of Foreign Object Debris in the form of spalled material from pavement but it could be tedious and time-consuming when PCI is to be used in APMS for pavement management decisions. Also, sampling rate used by many agencies in network-level inspection [5], and that recommended by Florida Department of Transportation (FDOT) in its Statewide Airfield Pavement Management Program (SAPMP) [13] are shown in Table 1 and Table 2. Objective research behind adoption of these sampling rates by concerned agencies and departments is not available, and it can be speculated that some level of policy-level practical reasoning was involved.

Table 1: Sample Units to Inspect for Network-level Inspection [5]

Total No. of Sample Units (N)	No. of Units to Inspect (n)
1-5	1
6-10	2
11-15	3
16-40	4
41 or more	10%

Table 2: Sample Units to Inspect as per FDOT for airports [13]

Total No. of Sample Units (N)	No. of Units to Inspect at Runway (n)
1-4	1
5-10	2
11-15	3
16-30	5
31-40	7
41-50	8
51 or more	20% but <= 20

Several researches and studies are available focused on application of PCI in pavement management for roads and airports, and also on expedition of PCI determination through the application of computer tools in distress survey and subsequent data analysis. Wu (2015), in his Master's thesis on management of roads, transformed a total of 24 deduct value curves for flexible pavement at roads into polynomial functions of degree 3 relating deduct value and logarithmic of distress density using regression analysis with high coefficient of determination (R^2). An Excel$^{\text{TM}}$ template was also developed for automating PCI calculation for roads based on the ASTM procedure [14]. Similar study with polynomial functions of deduct value curves for airports is not available. Rahman and Tarefder (2015) determined PCI after distress survey following ASTM procedure for 19 New Mexico airports using MicroPAVER software. They also found a good correlation between the PCI and the Structural Condition Index (SCI) [15]. Ufuk and Gursoy (2010) explored the prospects of introducing pavement management system for roads in Besiktas district in Turkey by conducting distress survey in 20 road sections and determining the PCI values by using the PAVER software [16].

Only limited research or project-level study on PCI are available for either roads or airports in Nepal. US

Army Corps of Engineers (2012) conducted a pavement condition index survey in conjunction with structural evaluation at TIA, and rated TIA pavement between "Good" and "Satisfactory". Bleeding, patching and rutting were found to be the most common distresses. However, since the study was not detailed and only cursory in scope, PCI determination procedure recommended by ASTM was not followed and PCI value was not determined but only verbal rating was reported [17]. Devkota (2017) studied the effect of sample unit size on the determination of PCI for asphalt-surfaced roads along the Banepa-Bardibas highway in Nepal and recommended a 21% sampling rate for PCI with ± 5% permissible error [18].

The maximum gap between PCI survey is 5 years but it is common to determine runway PCI each year and that for other pavements in every 2 or 3 years. PCI prediction models built from years of PCI vs. Pavement Age data are used to predict pavement condition in the future using the prediction models also depending on the aircraft traffic, environmental conditions, construction history etc. for the pavement [9]. A pavement is considered for M&R activities before its PCI is forecasted to fall below a pre-decided critical PCI which is defined as the PCI value at which the rate of PCI loss increases with time or the cost of applying localized preventive maintenance increases significantly [4]. It is usually adopted between 55 and 70 (55 for smaller airports and 70 for major airports) by agencies and departments implementing APMS based on historic trends in pavement performance and their practical experience [13, 19, 20].

4. Methodology

Pavement distress survey was conducted at the Simara airport which is a domestic airport in Bara district in Province 2 of Nepal. There are near about 5000 annual aircraft movements at the airport with flexible airside pavement. The runway dimension is 1192 m x 30 m with 2 m shoulder on both sides. The dimension for the centrally located taxiway is 11 m x 18 m and that of apron is 108 m x 47 m. The distress survey was conducted on the runway, the taxiway and the apron by following the procedure laid out in ASTM D 5340-98 with the help of specifically prepared field reference guides excerpted from standard distress identification manual [6, 10]. The distress types were represented by numbers from 1 to 16 while the distress severity, where applicable, were represented by their initials such as "L" for low, "M" for medium and "H" for high. The symbols for distress type and distress severity were then concatenated for representing each of the 38 total possible distress type and severity combinations (hereafter referred to as distress codes). The whole airside pavement at Simara airport consisting of runway, taxiway and apron was divided into sample units. The pavement is divided into sample units of area in the range from 550 sq. m to 700 sq. m in line with literature [5, 11]. Since, this study is concerned with recommending appropriate percentage of sample units to be inspected as one of its findings, 100% of the sample units were inspected. Hand odometer and measuring tapes were used to measure the length and area of observed distress within a particular sample unit. Straight edge ruler was used to measure depression or rutting with measuring tape. Geotagged photographs of identified distresses were clicked for documentation along with hand sketches of each inspected sample unit included in the field sheet.

The procedure for calculating PCI as per ASTM D 5340-98 is reproduced here.

Step 1: Determine deduct values

1a. Add the totals for each distress type at each severity level and record them under "Total" on the survey form. Quantities of distress are measured in square meters, linear meters, or number of occurrences, depending on the distress type.

1b. Divide the quantity of each distress type at each severity level by the total area of the sample unit, and then multiply by 100 to obtain the percentage of density per sample unit for each distress type and severity.

1c. Determine the deduct value for each distress type and severity level combination from the distress deduct value curves. Deduct value curves for all 16 distress types are available with separate curves for each severity level.

Step 2: Determine the maximum allowable number of deducts (represented as "m")

2a. If only one individual deduct value (or none) is >5, the total deduct value is used in place of the maximum corrected deduct value (CDV) in Step 4 and the PCI computation is completed; otherwise, the following steps should be followed.

2b. List the individual deduct values in descending order.

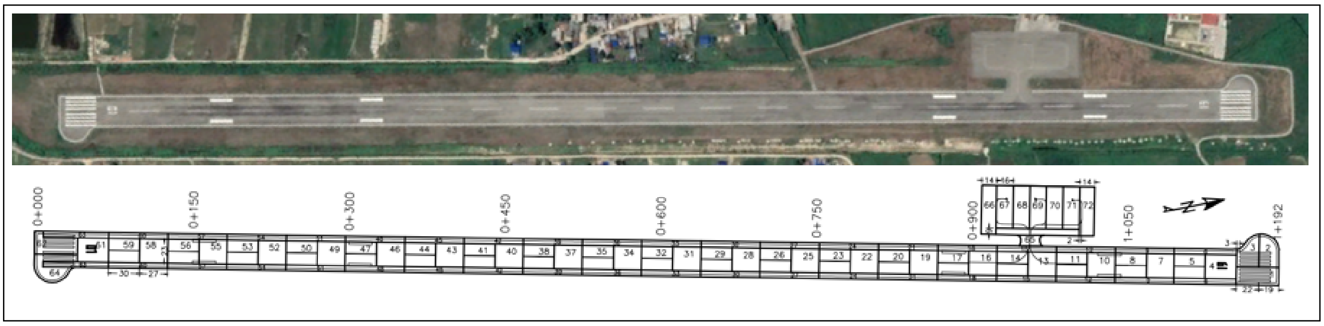

Figure 2: Satellite Image of Simara Airport (top), and Division of Sample Units (bottom)

2c. Determine the allowable number of deducts (m), using the following formula:

$$m_i = 1 + \frac{9}{95} \times (100 - HDV_i)$$

where, m_i : allowable number of deducts, including fractions, for sample unit i. HDV_i : highest individual deduct value for sample unit i.

2d. The number of individual deduct values is reduced to “m”, including the fractional part. If fewer than m deduct values are available, then all of the deduct values are used.

Step 3: Determine the maximum corrected deduct value (CDV)

The maximum CDV is determined iteratively as follows:

3a. Determine the number of deducts with a value >5.

3b. Determine total deduct value by adding all individual deduct values.

3c. Determine the CDV from q and total deduct value by looking up the appropriate correction curve. Five correction curves are available depending on the q which means the number of entries with deduct values greater than 5 points.

3d. Reduce to 5 the smallest individual deduct value that is >5. Repeat Steps 3a through 3c until q is equal to 1.

3e. The maximum CDV is the largest of the CDVs determined.

Step 4: Calculate PCI by subtracting the maximum CDV from 100.

Step 5: PCI of any particular pavement branch is determined by area weighted average of each inspected sample unit.

The detailed procedure mentioned above entails that deduct value curves need to be referred for each distress code encountered followed by number of iterations until q is equal to one. In this study, a computer tool was written in Visual Basic for Applications (VBA) for automating all of PCI calculation procedures. Furthermore, all 38 of the deduct value curves were transformed into polynomial functions. A minimum of 100 points were generated from each curve using WebPlot Digitizer™. Following which a polynomial function of degree 6 was plotted between deduct value and logarithmic of density percent with coefficient of determination (R^2) higher than 0.99. The general function is shown here in Equation 2 and the coefficients for all the distress codes are given in Section 5. Similarly, the five curves for Corrected Deduct Values (CDV) were also transformed into polynomial functions of degree 2. For validation of the polynomial functions, deduct values were determined for each of the 38 distress codes for three distress densities (0.5%, 10% and 50%) both my manually referring the curve, and by using the polynomial functions. Following which, t-test was conducted to test the null hypothesis that there is no statistically significant difference between the two sets of deduct values thus obtained.

$$Y = A_1x^6 + A_2x^5 + A_3x^4 + A_4x^3 + A_5x^2 + A_6x + B \quad (2)$$

Where, Y: deduct value; and x: logarithmic of distress density %; and $A1$, $A2$,…, B are coefficients of the polynomial function depending on the distress code.

PCI was calculated for each sample unit. The PCI calculation is based on the deduct values which are weighing factors from 0 to 100 that indicate the impact each distress has on pavement condition. A deduct value of 0 indicates that a distress has no effect on pavement structural integrity and/or surface operational condition, whereas a value of 100 indicates an extremely serious distress. The deduct value is obtained by the computer program written in VBA which uses the mathematical functions derived from all the Deduct Value curves. Area-weighted average of calculated PCI for each sample unit in a pavement branch (i.e., runway, taxiway or apron) is the PCI for that branch.

$$PCI_{branch} = \frac{\sum_{i=1}^{n}(PCI_i \times A_i)}{\sum_{i=1}^{n}(A_i)} \tag{3}$$

where, PCI_{branch}: adopted PCI of any pavement branch (runway, taxiway, or apron); n: number of sample units inspected; PCI_i: calculated PCI of any inspected sample unit; and A_i: area of that particular sample unit

Equation 1 is applicable only when the PCI values of all the samples in the branch are normally distributed and their standard deviation is known from a prior distress survey and PCI evaluation study. In this research study, 100% of the sample units were inspected with the objective to explore the effect of the number of representative sample units inspected on the expected error in PCI estimate, specially considering that the standard deviation of the PCI values was not known and it was also not known if the PCI values follow normal distribution owing to no prior PCI study at the airport. Chi-squared test was conducted on the PCI values of all the sample units at the runway in addition to observing their skewness and kurtosis for testing for normality. Following which, Equation 1 was used to determine required number of sample units to be inspected for the error in PCI estimate ranging from 0 to 10.

5. Analysis and Results

5.1 Polynomial Functions for Deduct Value Curves

Polynomial functions with degree 6 equating Deduct Values and logarithmic of Distress Densities had the best fit with the points generated from standard curves with R^2 greater than 0.99 compared to functions with lower degrees. The coefficients for polynomial functions thus obtained are presented in Table 3.

Table 3: Coefficients for Polynomial Functions of Deduct Value Curves

Code	A1	A2	A3	A4	A5	A6	B
1H	1.0	-4.3	0.1	7.8	5.4	23.4	37.1
1M	0.3	-1.6	0.8	2.7	2.4	21.7	29.8
1L	0.0	-0.2	2.0	-2.6	2.4	20.7	20.9
2.0	3.7	-9.4	-6.6	17.9	16.8	10.7	5.7
3H	0.3	-0.3	-0.7	0.6	7.1	15.6	18.9
3M	0.9	-1.9	0.0	2.3	3.5	7.3	11.3
3L	0.2	-0.3	0.0	0.6	3.0	5.6	7.3
4H	1.0	-0.9	-1.2	2.0	7.0	27.0	32.5
4M	0.8	-1.3	-0.3	1.2	8.0	21.4	18.8
4L	0.3	-0.3	-0.3	0.7	6.5	13.5	9.3
5H	0.3	-0.2	-0.9	1.6	6.8	18.6	25.6
5M	0.2	-0.1	0.3	-0.9	7.1	18.7	15.1
5L	-0.2	0.9	-0.5	-1.9	8.2	14.6	5.9
6	2.3	-7.8	0.2	12.5	5.4	7.3	5.4
7H	0.1	-0.2	-2.2	-0.5	14.8	27.3	15.3
7M	0.4	-0.2	-3.6	0.0	13.3	19.1	9.0
7L	-0.1	0.3	-0.7	-0.3	6.4	8,0	2.4
8H	0.7	-3.2	0.8	6.1	9.5	20.1	20.0
8M	1.1	-5.0	1.5	9.0	6.8	11.9	11.0
8L	1.7	-5.6	-0.5	10.9	7.2	4.8	4.9
9	1.9	-6.3	-0.1	10.9	4.1	2.4	4.0
10H	0.0	-0.1	-0.9	4.6	10.3	9.2	19.0
10M	0.5	-1.9	0.6	5.2	6.5	7.2	9.5
10L	0.5	-1.3	-0.4	3.4	4.4	4.2	3.6
11	0.4	-1.3	0.0	3.6	5.9	5.2	3.0
12H	-0.2	3.5	-8.1	-5.9	20.3	25.9	16.8
12M	-0.8	1.9	1.5	-1.4	3.3	7.7	8.4
12L	0.1	-0.4	0.1	1.4	2.6	3.2	2.9
13H	0.2	-0.3	0.6	1.6	5.3	19.5	34.5
13M	0.2	0.0	-0.3	0.5	3.9	14.9	24.4
13L	0.1	-0.4	0.2	1.2	2.8	9.1	15.3
14H	0.1	-0.6	0.6	0.8	4.4	19.6	24.9
14M	0.0	0.5	-0.4	-1.3	5.2	14.6	14.8
14L	0.1	-0.6	0.2	1.2	3.5	7.5	6.6
15	3.1	-7.9	-6.3	14.1	19.5	16.5	11.8
16H	-0.3	0.7	-0.7	2.6	9.4	10.8	33.6
16M	0.2	-0.6	-1.1	4.3	8.5	8.2	14.1
16L	0.1	-0.3	-0.4	2.5	5.9	5.4	3.3

The 114 deduct values obtained manually from the curves for all the 38 distress codes and the 114 corresponding deduct values obtained from the polynomial functions for distress densities of 0.5%, 10% and 50% were subjected to paired sample t-test. Paired sample t-test was used since the same entity i.e., deduct values were obtained twice for the two data sets once by using the curves and then by using the polynomial functions. The null hypothesis is that there is no statistically significant difference between the two data sets. From Table 4, the t-Stat does not fall in the rejection area since it is between the negative and the positive values of Critical t for two-tail test at significance level of 0.05 and also, the P-value is more than the significance level of 0.05. Therefore, we cannot reject the null hypothesis meaning that using polynomial functions instead of manually referring to the curves does not influence the deduct values in a statistically significant level [21, 22].

Table 4: t-test Results

t-Stat	-1.028
P(T <= t) two-tail	0.306
t Critical two-tail	1.981

5.2 PCI Calculation

A total of 64 sample units were inspected at the runway and 7 sample units were inspected at the taxiway and apron combined. The branches taxiway and apron were combined into one single branch owing to relatively low pavement area at the taxiway (200 sq.m compared to 500 to 700 sq.m area required for one sample unit). In the distress survey, only the following distresses from amongst the sixteen distress types and several severities were encountered. This totals to 14 combinations of distress type and severity from amongst the 38 possible combinations. Distress codes 8L, 8M, 11, 12L and 12M were found to be most prevalent while some other distress codes such as 1L, 9, 16L and 16M were only rarely encountered.

(a) Alligator Cracking of Low severity (1L)

(b) Block Cracking of Low severity (3L)

(c) Depression of Low severity (5L)

(d) Longitudinal and Transverse Cracking of Low, Medium and High severity (8L, 8M and 8H)

(e) Oil Spillage (9)

(f) Patching of Low severity (10L)

(g) Polished Aggregate (11)

(h) Raveling of Low, Medium and High severity (12L, 12M and 12H)

(i) Swell of Low and Medium severity (16L and 16M)

Figure 3: Some Photographs from Distress Survey at Simara Airport, clockwise from top left: 8H, 10L, 11 and 12H

Equation 3 was used to determine PCI for each pavement branch using the calculated PCI of sample units. FAA standard scale was used for verbal rating based on PCI instead of the standard scale suggested by ASTM since the FAA scale is more stringent in line with the higher standards expected for airports. The PCI results for Simara Airport is presented in Table 5.

Table 5: Calculated PCI for Simara Airport

Branch	PCI	Rating
Runway	76	Satisfactory
Taxiway & Apron	82	Satisfactory

5.3 Sample Units to Inspect

The PCI obtained for the 64 sample units at the runway were tested for normality. Skewness which is a measure of the symmetry in a distribution was near about zero which agrees with that of a normal distribution. Likewise, the Excess Kurtosis (measure of peakedness of a distribution) for the PCI values was within ±0.5 of the Excess Kurtosis of normal distribution [23]. Furthermore, the PCI values were also subjected to Chi-Squared test with the null hypothesis that the PCI values fit the normal distribution. From Table 6, the calculated Chi-Square value is lower than the Critical Chi-Square for the degree of freedom of 3 and 95% probability. Therefore, the null hypothesis cannot be rejected entailing that the PCI values for the 64 sample units fit the normal distribution [22].

Table 6: Results for Normality test in PCI values for all sample units at Runway

Skewness	-0.02
Excess Kurtosis	-0.46
Calculated Chi-Square	3.94
Degree of Freedom	3
Critical Chi-Square	7.81

The standard deviation of the PCI values of all the sample units at runway is 9.2. The normal distribution of PCI values of the sample units allows use of the Equation 1 to explore the relationship between the percentage of total sample units inspected and the expected error in PCI estimate for the pavement branch. Figure 4 shows that 17% of total sample units selected for inspection will ensure expected error within 5 with a confidence level of 95%. This amounts to 11 sample units out of the total 64 sample units at the runway of Simara airport. An attempt at keeping the error down to 1 would mean that the number of sample units to be inspected would be almost 5 times (84% of total sample units) than that for error of 5 as shown in Figure 4. Rounding up the 17% to 20% as the sampling rate at runway agrees with the current practice by FDOT as shown in Table 2.

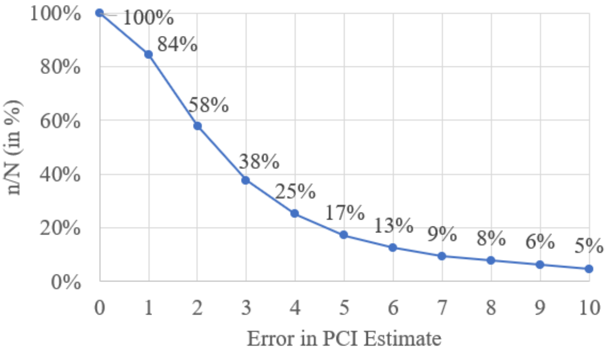

Figure 4: Effect of percentage of sample units inspected on the expected error in PCI estimate

6. Conclusion and Recommendations

Efficient and accurate determination of PCI using consistent methods is the first step towards implementation of APMS in the country. The use of polynomial functions instead of manually referring to the deduct value curves for the 38 distress codes expediates the PCI determination without introducing any error into the calculations. Also, in terms of conducting the distress survey, it was found from the case study at Simara Airport that a sampling rate of 20% (rounded from calculated 17%) would ensure a PCI estimate within the widely accepted permissible error of 5. Selecting only 20% of the total pavement area for distress inspection for obtaining an acceptable PCI estimate will help save time during distress survey which is especially notable considering operational risks during pavement inspection at an airport with regular flights.

However, the findings regarding sampling rate can be conclusively determined to hold true only for runway at Simara Airport, and it may vary for any other airport depending on its environmental and site conditions, aircraft traffic, and construction history. It is recommended that similar research studies also be conducted for other airports in the country especially if the aforementioned factors for any airport varies greatly from those for Simara Airport. Furthermore, it is recommended to Civil Aviation Authority of Nepal that policy decisions regarding implementation of APMS in Nepal be prioritized, and a critical PCI triggering M & R activities between PCI value from 55 to 70 be established in line with international practice.

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