Case Study for PCI Measurement at Airport

Introduction

In the modern world, airports play a significant role in the development of any region. They not only move people but also facilitate tourism, generate employment, increase revenue from taxation, and foster the conservation of protected areas.

Figure 1: Airport Considered for Pilot Study

In Asia, due to high population density, most of the airports have a single runway (barring major ones which have two). Bali airport in Indonesia is one of the busiest airports the South East Asia, having 600 landings in a day, runs operation on a single runway. In such a scenario, maintenance of the runways' pavement surfaces (Apron, Taxiway and Runway) becomes a challenging task as any failure leads to huge financial loss and also results in the halting of entire operations.

The Challenge

The challenge in working on airports in Asia is that they are operational 24x7, leading to small window for maintenance work. Need of the hour is to have a

system which is very effective in functioning and has less turnaround time (data should be collected and processed rapidly)

As per ASTM D 5340 standards, Pavement Condition Index (PCI) is one of the parameters which should be evaluated at frequent intervals which indicates the strength of the pavement. The key to pavement evaluation is to identify different types of pavement distress and link them together. This process helps in understanding the current condition holistically along with historic rate of deterioration which helps in developing appropriate maintenance and rehabilitation plans.

Table 1: index used for defining PCI

S.N	PCI Value	Colour Index	Remarks
1	86-100		Good
2	71-85		Satisfactory
3	56-70		Fair
4	41-55		Poor
5	26-40		Very Poor
6	11-25		Serious
7	0-10		Failed

The Solution

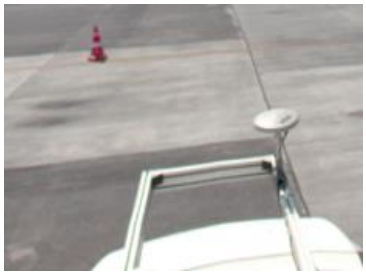
The airport considered for this study is one of the busiest in India, hence it was not possible to scan the entire area. Sample scanning was done on all the 3 pavement types viz. Apron (Parking bay), Runway (the surface on which aircraft takes off / land) and Taxi Way (surface connecting Apron to Runway). In this study for each type pf pavement, two samples were collected. Average sample size was 800m–1200m length x 4m width. Usually in Asian countries surface type for Apron is Concrete (rigid) whereas for Runway and Taxiway its Asphalt (flexible).

The entire process is described in brief below:

- Elements of airports were defined into network (airport), branches (apron, runway, and taxiway) and sections (samples taken) based on pavement types and functional category.
- Elementwise inventory was defined for details such as sample size, slab size (concrete), surface type, grade, date of construction etc.
- Scanning was carried out using ViaPPS system. Scanning includes data capture using different sensors viz. LiDAR, ViaIRI (IRI and MPD), 360 degrees photographs from ladybug and still photos from Basler placed in front of the car. This is all connected with Applanix GNSS and odometer (DMI).
- Post scanning different reports were generated (automated process) for parameters like
    - Homogeneity
    - IRI (Roughness index) and MPD (Mean Profile depth)
    - Photo structure (for aligning the photo's)
    - Crack / pothholes
    - Pavement Structure (contains Rutting, Longitudinal profile, cross fall, curve radius etc)
- Based on the reports generated, pavement distresses were marked at section level in Paver software. Sample distress as observed from the field / reports is as shown:

Cracks

Bad Joints



Patch Work

- By using combination of homogeneity / point cloud and photographs we were able to mark all surface distresses which are essential for calculating PCI

- The process with all related parameters and its weightage in evaluating PCI is detailed in https://en.wikipedia.org/wiki/Pavement_Condition_Index

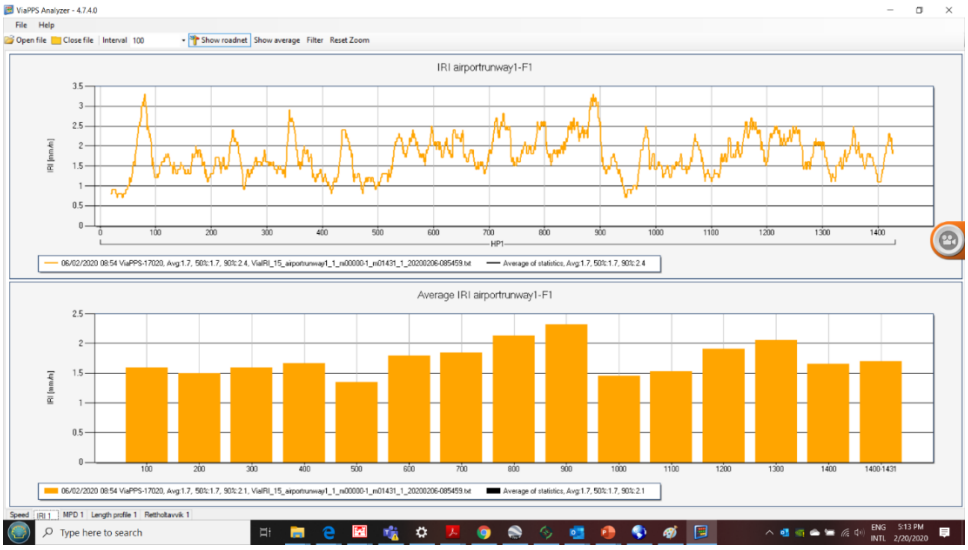


Figure 1: Sample report generated for IRI (roughness index)

- Based on all the results and reports generated by the system, distress codes are marked mentioning date of inspection (to maintain a calendar) with distress sizes and location (which can be evaluated from co-ordinates) as well as grid numbers
- Based on the parameters entered, PCI is calculated based on sections / branches and date of inspection. The report is generated and presented in different (textual / graphical) formats

The best part of entire process is the speed at which data capture and processing is done. If all sections are made available, the entire airport can be scanned in two hours with processing and reporting taking another two hours. For the pilot airport, we completed six sections in less than an hour.

The Result

The PCI values calculated from the study are as indicated below.

Network Name : Airport

S.N	Branch	Section	Surface Type	*Date of Construction	Date of Inspection	PCI
1	Apron	Apron 1	Concrete	03-01-2019	06-02-2020	92
2	Apron	Apron 2	Concrete	16-01-2019	06-02-2020	83
3	Taxiway	Taxiway 1	Asphalt	02-01-2020	06-02-2020	91
4	Taxiway	Taxiway 2	Asphalt	06-01-2020	06-02-2020	94
5	Runway	Runway 1	Asphalt	10-01-2020	06-02-2020	90
6	Runway	Runway 2	Asphalt	15-01-2020	06-02-2020	90

The samples were taken from a newly laid surface in the airport; hence the PCI was in the good category overall. However, to monitor the surface and carry out preventive maintenance, its required that airport should be scanned once a week to identify the grey area's and to carry out monitoring at the finest level as possible.

Tools Used

ViaPPS (Pavement Scanner)

This is inhouse technology developed by ViaTech AS, Norway (www.viatech.no) The main application of ViaPPS is for pavement maintenance and safety. ViaPPS has multiple sensors that captures various parameters like cracking, rutting, raveling, bleeding etc., which defines the surface distress. The entire pavement maintenance schedule can be planned based on this data. Using this equipment, any sort of distress can be captured at even the most initial levels. Norwegian road authority has been using this system for the last 12 years for maintaining their highway.

For more information check on http://viatech.no/products.aspx?lang=en&id=6

Paver

Paver is software developed by US Army Corps of Engineers and Federal Aviation Administration. This software is developed on ASTM standard ASTM D6433 for highways and ASTM D5340 for airports.

For more information check on http://www.paver.colostate.edu/