Lecture #3:

◎ Pavement Condition Index (PCI)
0 - 10 - 25 - 40 - 55 - 70 - 85 - 100
(Rating: Failed - Very Poor - Poor - Fair - Good - Very Good - Excellent)
Engineer's Rating

◎ Pavement Condition Survey: (Distresses)
Types, Severity Levels, Densities

Appendix A - Blank Field Survey Sheets
Appendix B, C - AC & PCC Roads
Appendix D, E - AC & PCC Airfields
(Distress Definitions and Deduct Value Curves)

Brief description of each distress type
LTPP Distress Identification Manual
(下學期「鋪面評估與維修」補充講義)

◎ ASTM D5340-93 (略)
"Standard Test Method for Airport Pavement Condition Index Surveys"

PCI PROCEDURE

CONDITION SURVEY AND RATING OF AIRFIELD PAVEMENTS*

1. Scope. This handout describes the procedures for performing airfield pavement condition surveys and outlines the methods and data requirements for preparing condition survey reports.

2. General

a. The airfield pavement condition survey as accomplished by the civil engineer is the primary means of obtaining and recording vital airfield pavement performance data.

b. The condition survey for both jointed concrete and asphalt- or tar-surfaced airfield pavements consists of the following steps (Figure A-1):

(1) Each pavement feature is inspected, and existing distress types, severity levels, and densities are recorded. Volume II of this report has been prepared for use by the pavement engineer as a reference for performing the inspection. It is imperative that the engineer follow the guidelines in the manual when recording the distress data.

(2) A deduct value is determined from the appropriate curve for each distress type, density, and severity level.

(3) The total deduct value (TDV) is determined by summing all deduct values from each distress condition observed.

(4) The corrected deduct value (CDV) is determined based on the TDV and the number of distress conditions observed with individual deduct values greater than five points.

(5) The pavement condition index (PCI) is calculated as follows:

$$PCI = 100 - CDV$$

(6) The pavement condition rating is determined based on the PCI value according to the scale in Figure A-1 (excellent, very good, ... or failed).

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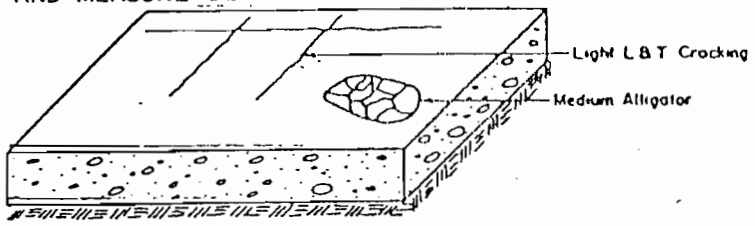
* References for PCI:

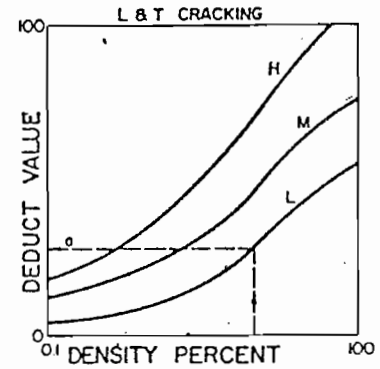
1. "Airfield Pavement Evaluation Program," Department of the Air Force, HQUSAF, AF Regulation 93-5, 18 May 1981, Washington, D.C.

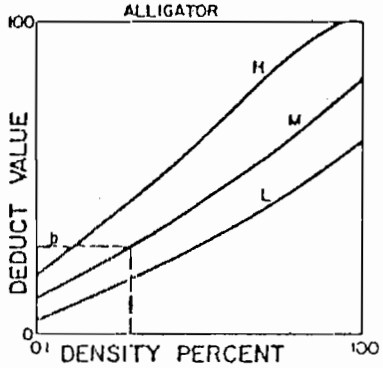
2. "Pavement Maintenance Management for Roads and Parking Lots,"

STEP 1. INSPECT PAVEMENT; DETERMINE DISTRESS TYPES AND SEVERITY LEVELS AND MEASURE DENSITY.



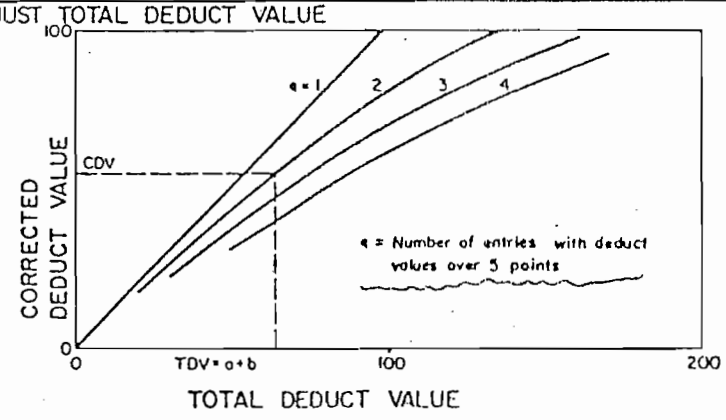
STEP 2. DETERMINE DEDUCT VALUES





STEP 3. COMPUTE TOTAL DEDUCT VALUE (TDV) = a + b

STEP 4. ADJUST TOTAL DEDUCT VALUE



STEP 5. COMPUTE PAVEMENT CONDITION INDEX (PCI) = 100 - CDV

STEP 6. DETERMINE PAVEMENT CONDITION RATING

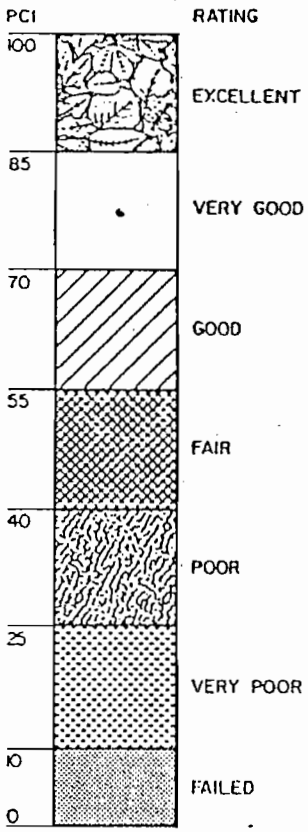


Figure A-1. Steps for Determining Airfield Pavement Condition Survey.

PCI PROCEDURE

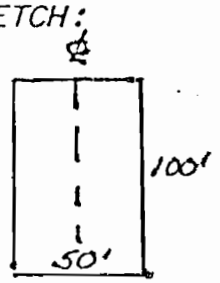
ASPHALT OR TAR SURFACED PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRFIELD A FEATURE T5
DATE 6/8/76 SAMPLE UNIT 1
SURVEYED BY MD/MS/SK AREA OF SAMPLE 5000 sq ft

Distress Types

1. Alligator Cracking
2. Bleeding
3. Block Cracking
4. Corrugation
5. Depression
6. Jet Blast
7. Jt. Reflection (PCC)
8. Long. & Trans. Cracking
9. Oil Spillage
10. Patching
11. Polished Aggregate
12. Raveling/Weathering
13. Rutting
14. Shoving from PCC
15. Slippage Cracking
16. Swell

SKETCH:



EXISTING DISTRESS TYPES

	1	5	8	12		
	4 x 4 M	6 x 4 L	10 L	3 x 10 M		
	2 x 3 L		5 L			
			15 L			
			5 M			
			10 L			
			5 M			
TOTAL SEVERITY L	6 sq ft	24 sq ft	40 ft			
TOTAL SEVERITY M	16 sq ft		10 ft	30 sq ft		
TOTAL SEVERITY H						

PCI CALCULATION

DISTRESS TYPE	DENSITY (%)	SEVERITY	DEDUCT VALUE
1	0.12	L	(7)
1	0.32	M	(19)
5	0.48	L	2
8	0.80	L	5
8	0.20	M	5
12	0.60	M	(7)
DEDUCT TOTAL			45
CORRECTED DEDUCT VALUE (CDV)			25

PCI = 100 − CDV = 75

RATING = Very Good

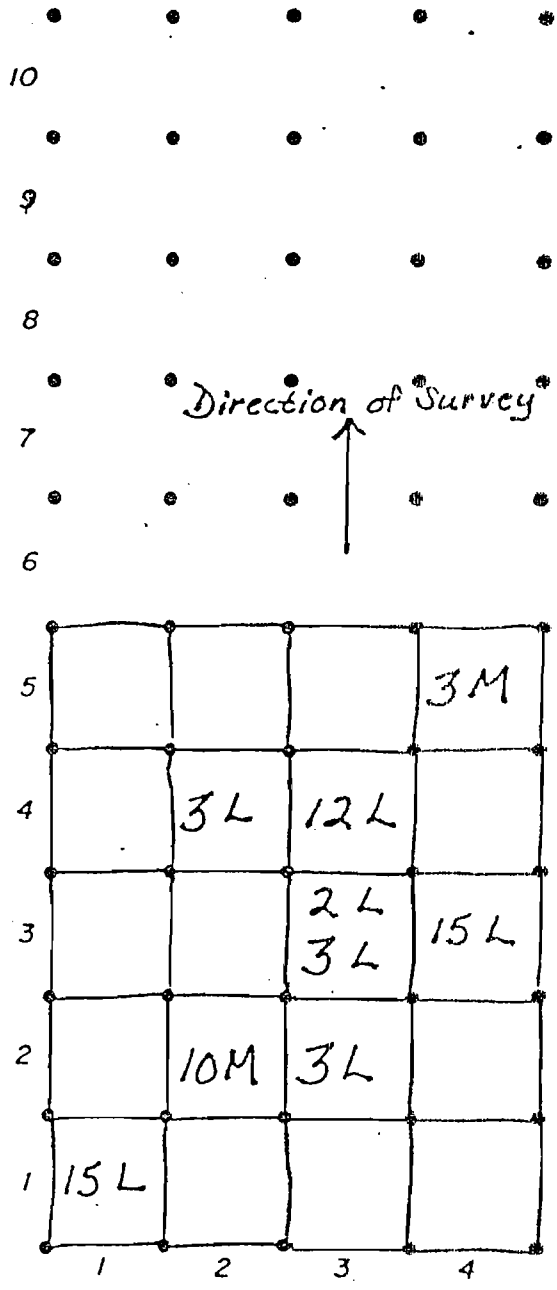
Figure A-8. Asphalt- or Tar-Surfaced Pavements - Condition Survey Data Sheet.

JOINTED CONCRETE PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRFIELD Z FEATURE TW 1

DATE 3/28/76 SAMPLE UNIT #1

SURVEYED BY MS/MD SLAB SIZE 12.5 X 15 ft 6
20 slabs



Distress Types

1. Blow-Up
2. Corner Break
3. Long/Trans/ Diag. Crk
4. "D" Crk
5. Joint Seal Damage
6. Patching, <5ft²
7. Patching/Utility Cut
8. Popouts
9. Pumping
10. Scaling/Map Crk/Crazing
11. Settlement/ Fault
12. Shattered Slab
13. Shrinkage Crk
14. Spalling, Joints
15. Spalling, Corner

DIST. TYPE	SEV.	NO. SLABS	% SLABS	DEDUCT VALUE
2	L	1	5	5
3	L	3	15	(11)
3	M	1	5	(11)
10	M	1	5	(6)
12	L	1	5	(10)
15	L	2	10	3
DEDUCT TOTAL				46
CORRECTED DEDUCT VALUE (CDV) q=4				32

PCI = 100 − CDV = 68
RATING = Good

Figure A-3. Jointed Concrete Pavements - Condition Survey Data Sheet.

◎ PCI Procedure ("New" v.s. "Old")

1. Dividing Pavement into Sample Units
2. Determining Sample Units to be Surveyed

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

3. Performing the Condition Survey (distress types, severity levels, densities)
4. Calculating the PCI ("OLD")
   a. Determine Deduct Values
   b. Compute Total Deduct Value (TDV)
   c. Adjust TDV to Corrected Deduct Value (CDV)
   d. Compute PCI = 100 - CDV
4. Calculating the PCI ("NEW")
   a. Determine Deduct Values
   b. Determine the Max. Allowable Number of Deducts (m)

$$m = 1 + (9/95)(100 - HDV) \quad \text{for Airfields}$$

$$m = 1 + (9/98)(100 - HDV) \quad \text{for Roads}$$

   c. Determine the Max. Corrected Deduct Value (CDV)
   d. Compute PCI = 100 - Max. CDV

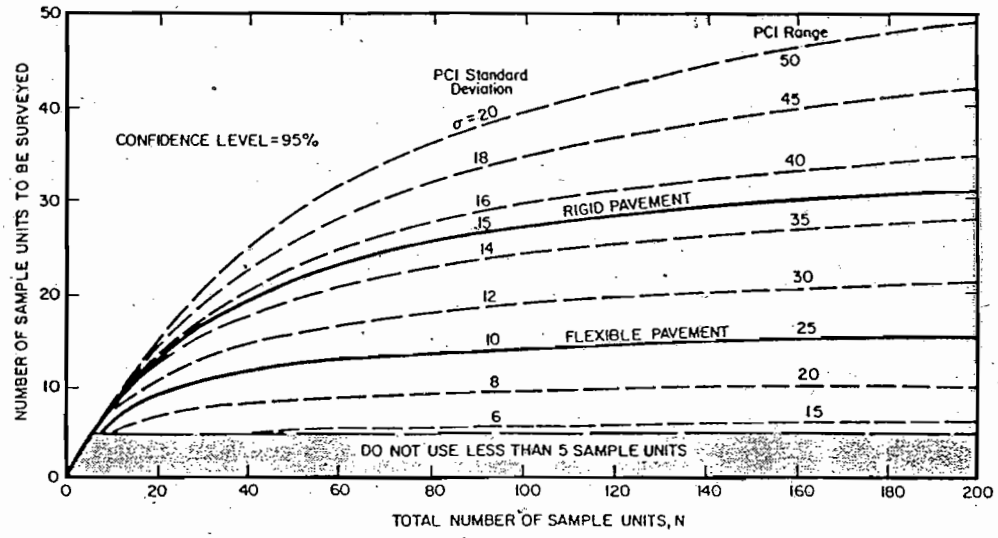


Figure 3-4. Selection of the minimum number of sample units. (From Shahin et al. 1976–1984).

determine the minimum number of sample units (n) that must be surveyed to obtain an adequate estimate of the section's PCI. This number is determined for a project-level evaluation by using the curves shown in Fig. 3-4. Using this number, a reasonable estimate of the true mean PCI of the section will be obtained. The estimate is within ±5 points of the true mean PCI 95% of the time. The curves in Figure 3-4 were constructed using Eq. 3.1:

$$n = [N \cdot s^2]/[(e^2/4)(N-1) + s^2] \qquad (3\text{-}1)$$

where

N = total number of sample units in the pavement section

e = allowable error in the estimate of the section PCI (e was set equal to 5 when constructing the curves of Figure 3-4)

s = standard deviation of the PCI between sample units in the section.

The curves in Figure 3-4 can be used based on the PCI standard deviation among sample units, or PCI range (i.e., lowest sample unit PCI subtracted from the highest sample unit PCI). When performing the initial inspection, the PCI standard deviation for a pavement section is assumed to be 10 for asphalt concrete (AC) surfaced pavements (or PCI range of 25) and 15 for Portland cement concrete (PCC) surfaced pavements (or PCI range of 35). These values are based on field data obtained from many surveys; however, if local experience is different, the average standard deviations reflecting local conditions should be used for the initial inspection. For subsequent inspections, the actual PCI standard deviation or range (determined from the previous inspection) should be used to determine the minimum number of sample units to be surveyed. As

呎(約 232±93 平方公尺)的樣本路段；而當接縫長度不大於 25 英呎(約 7.6 公尺)的接縫式混凝土路面，則可選為 20±8 個版塊數。建議可在實務鋪面調查上，將目前國內已採用多時以每車道100公尺作為資料管理單元(約375平方公尺)做為樣本路段的長度。

根據統計學的原理，抽樣調查是從研究的母體中隨機抽取一部份樣本來進行調查，並以樣本統計量來推論未知的母體參數。假設母體為常態分配而且母體變異數(σ^2)已知，則根據下列公式可求出以樣本平均數($\overline{X}$)來推估母體平均數(μ)的估計誤差(e)。其中，$Z_{\alpha/2}$為標準常態變數；σ=母體標準差；n=抽樣個數；α=錯誤的機率[11]。

$$\overline{X}-\mu=Z_{\alpha/2}\frac{\sigma}{\sqrt{n}}\le e \tag{1}$$

一般而言，鋪面路段劃分為樣本單位的個數是有限的，其樣本空間應視為有限母體，因此需將上式乘以$\sqrt{N-n/N-1}$之修正因子。而且在常態母體、小樣本假設下(n<30)其機率分配應是自由度為 n-1 的 t 分配，表示為$t_{n-1,\alpha/2}$。再者，因為在母體變異數常是未知的情形下，需以樣本標準差(S)來代替母體標準差σ，因此可以下列公式來計算其估計誤差。其中，e =可容許之誤差或估計誤差，通常$e=\pm 5$；S=路段中樣本單位間的標準差；N=路段中樣本單位之總數。

$$\overline{X}-\mu=t_{n-1,\alpha/2}\frac{S}{\sqrt{n}}\frac{\sqrt{N-n}}{\sqrt{N-1}}\le e \tag{2}$$

將上述公式等號左右兩邊平方，在 95%信賴水準下常將$t_{n-1,\alpha/2}$假設為 2，再將所得公式重整，即可求得下列公式[7]：

$$n=\frac{NS^2}{(e^2/4)(N-1)+S^2} \tag{3}$$

其中，n 代表在有限母體、小樣本、母體為常態、而且母體變異數未知的情形下，當選定可容許誤差為 e 時所需抽樣的個數。此外，亦有某些鋪面主管單位以表二的建議來決定在路網階層的抽樣個數或抽樣。

表二 抽樣個數或抽樣率的建議[7]

樣本總數(N)	抽樣個數(n)
1-5	1
6-10	2
11-15	3
16-40	4
40 以上	10%

AIRFIELD ASPHALT PAVEMENT
CONDITION SURVEY DATA SHEET
FOR SAMPLE UNIT

SKETCH:

BRANCH _____ SECTION _____ SAMPLE UNIT _____
SURVEYED BY _____ DATE _____ SAMPLE AREA 5000 S.F.

1. Alligator Cracking
2. Bleeding
3. Block Cracking
4. Corrugation
5. Depression
6. Jet Blast
7. Jt. Reflection (PCC)
8. Long. & Trans. Cracking
9. Oil Spillage
10. Patching
11. Polished Aggregate
12. Raveling/Weathering
13. Rutting
14. Shoving from PCC
15. Slippage Cracking
16. Swell

DISTRESS SEVERITY	QUANTITY										TOTAL	DENSITY %	DEDUCT VALUE
8L	10	20	15								45	0.90	4.8
8M	9										9	0.18	4.9
1L	50										50	1.00	21.0
13L	200	175									375	7.50	27.0
13M	25										25	0.50	20.0
5L	15										15	0.30	2.0
5M	20										20	0.40	9.0
10L	50										50	1.00	4.0

FIG. 4 Example of a Flexible Pavement Condition Survey Data Sheet

#	Deduct Values										Total	q	CDV
1	27.0	21.0	20.0	9.0	4.9	4.8	4.0	1.8			92.5	4	50.0
2	27.0	21.0	20.0	5.0	4.9	4.8	4.0	1.8			88.5	3	56.0
3	27.0	21.0	5.0	5.0	4.9	4.8	4.0	1.8			73.5	2	51.0
4	27.0	5.0	5.0	5.0	4.9	4.8	4.0	1.9			57.5	1	57.5
5													
6													
7													
8													
9													
10													

Max CDV = 57.5

PCI = 100 - Max CDV = 42.5

RATING = FAIR

FIG. 6 Calculation of Corrected PCI Value—Flexible Pavement

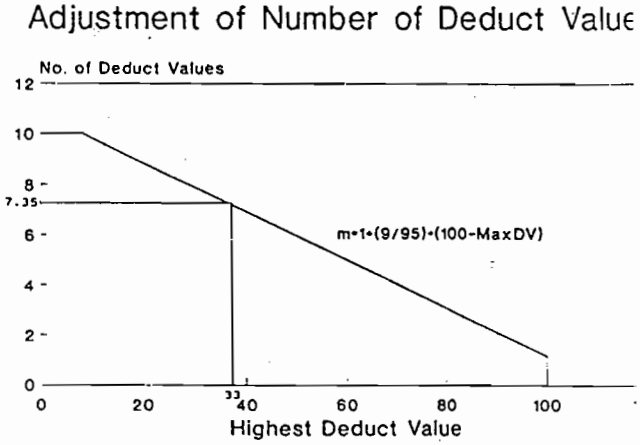


FIG. 5 Adjustment of Number of Deduct Values

HDV = highest individual deduct value.
For the example in Fig. 4:

$$m = 1 + (9/95)(100 - 27.0) = 7.92$$

10. Calculation of PCI for Portland Cement Concrete (PCC) Pavement

10.1 For each unique combination of distress type and severity level, add up the total number of slabs in which they occur. For example in Fig. 7, there are two slabs containing low-severity corner break.

10.2 Divide the number of slabs from 10.1 by the total number of slabs in the sample unit and multiply by 100 to obtain the percent density of each distress type and severity combination.

10.3 *PCI Calculation:*

10.3.1 If none or only one individual deduct value is greater than five, use the total deduct value in place of the maximum Corrected Deduct Value in determining PCI; otherwise use the following procedure to determine max CDV:

10.3.1.1 Determine m, the maximum allowable number of distresses, as follows:

$$m = 1 + (9/95)(100 - HDV) \leq 10$$
$$m = 1 + (9/95)(100 - 32.0) = 7.44$$

HDV = highest individual DV

10.3.1.2 Enter m largest DVs on Line 1 of the following table, including the fraction obtained by multiplying the last deduct value by the fractional portion of m. If less than m DVs are available, enter all of the DVs.

10.3.1.3 Sum the DVs and enter it under "Total". Count the number of DVs greater than 5.0 and enter it under "q".

10.3.1.4 Look up the appropriate correction curve (AC or PCC) with "Total" and "q" to determine CDV.

10.3.1.5 Copy DVs on current line to the next line, changing the smallest DV greater than 5 to 5. Repeat 10.3.1.3 and 10.3.1.4 until "q" = 1.

10.3.1.6 Maximum CDV is the largest value in the "CDV" column.

10.4 Determine the deduct values for each distress type severity level combination using the corresponding deduct curve in Appendix X4.

10.5 Determine PCI by following the procedures in 9.5 and 9.6, using the correction curve for PCC pavements (see Fig. X4.16) in place of the correction curve for AC pavements in 9.5.5.3.

10.6 Figure 8 shows a summary of PCI calculation for the example PCC pavement distress data in Fig. 7.

AIRFIELD CONCRETE PAVEMENTS
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

BRANCH_____ SECTION_____ SAMPLE UNIT_____
SURVEYED BY LMB DATE 18 JAN 92 SAMPLE AREA 12.5' x 25'

Distress Types

1. Blow up
2. Corner Break
3. Long/Trans/ Diagonal Crack
4. Durability Crack
5. Joint Seal Damage
6. Patching, S of
7. Patching/Utility Cut
8. Popouts
9. Pumping
10. Scaling/Map Crack/ Crazing
11. Settlement/Fault
12. Shattered Slab
13. Shrinkage Crack
14. Spalling–Joints
15. Spalling–Corner

DIST TYPE	SEV	NO. SLABS	DENSITY %	DEDUCT VALUE
5	H	20	100	12.0
1	L	2	10	8.0
2	M	1	5	9.0
3	L	3	15	11.0
3	M	5	25	32.0
15	L	3	15	6.0
14	L	2	10	3.0
12	L	1	5	10.0

SKETCH:

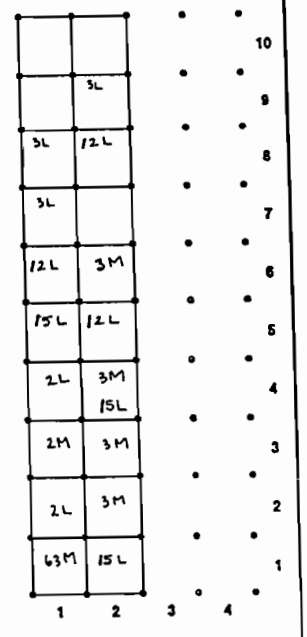


FIG. 7 Example of a Jointed Rigid Pavement Condition Survey Data Sheet

#	Deduct Values										Total	q	CD
1	32.0	12.0	11.0	10.0	9.0	8.0	6.0	1.3	1		89.3	7	56
2	32.0	12.0	11.0	10.0	9.0	8.0	5.0	1.3			88.3	6	58
3	32.0	12.0	11.0	10.0	9.0	5.0	5.0	1.3			85.3	5	58
4	32.0	12.0	11.0	10.0	5.0	5.0	5.0	1.3			81.3	4	58
5	32.0	12.0	11.0	5.0	5.0	5.0	5.0	1.3			76.3	3	57
6	32.0	12.0	5.0	5.0	5.0	5.0	5.0	1.3			70.3	2	61
7	32.0	5.0	5.0	5.0	5.0	5.0	5.0	1.3			63.3	1	63
8													
9													
10													

Max CDV = 63.3

PCI = 100 - Max CDV = 36.7

RATING = Poor

FIG. 8 Calculation of Corrected PCI Value—Jointed Rigid Pavement

maintenance zones.

Section Category — The section category is a letter which the agency may choose to represent different categories. Valid entries are: A-Z,0-9. (i.e., Y = Family Housing, N = Non-Family Housing.)

Pavement Rank — This is a required field. Valid entries are: A, B, C, D, E, N, P, S, T, X. The following table shows the significance of each of these entries.

A	Principal	N	Not Applicable
B	Arterial	P	Primary
C	Collector	S	Secondary
D	IndustriaL	T	Tertiary
E	Residential	X	Other

Surface Type — This is a required field. The following table shows the valid surface type abbreviations:

AAC	Asphalt overlay over asphalt concrete
ABR	Asphalt over brick
AC	Asphalt concrete
ACT	Asphalt over cement treated base
APC	Asphalt overlay over portland cement concrete
APZ	Asphalt over pozzolanic base
BR	Brick
COB	Cobblestone
GR	Gravel
PCC	Portland cement concrete
PVB	Paving blocks
ST	Surface treatment
X	Other

Note: If PCC is selected as the surface type, four additional prompts will appear on your screen: Slab Length, Slab Width, Number of Slabs, and Joint Length. These will be discussed later in this section.

Section Length — Enter the length of the section in feet (meters). Section length can be a decimal not greater than 9,999,999.00.

Section Width — Enter the width of the section in feet (meters). Section width can be a decimal not greater than 9,999,999.00.

型態及嚴重程度組合之扣分值(DV)，並配合扣分修正曲線求出最大修正扣分值(CDV)以解決扣分值總和可能超過 100 之問題，再以 100 減去最大修正扣分值來計算 PCI，PCI = 100 – max CDV。

鋪面狀況指標(PCI)與其評定等級之範圍包括：0~10（失敗）、10~25（很差）、25~40（差）、40~55（普通）、55~70（好）、70~85（很好）、與 85~100（優良），不僅可以用來顯示鋪面現階段之狀況，亦可作爲決定養護順序之依據。由於 PCI 的鋪面損壞的定義、調查方法、以及計算的程序皆已列入美國材料標準試驗方法中（公路鋪面 ASTM D 6433-99,機場鋪面 D 5340-98），顯見其具有高度之可靠性，因此除了被美國國防部及美國公共工程協會所認可外，世界各國亦廣泛地將其應用在公路、停車場、及機場之鋪面管理工作上，我國中正機場之鋪面管理系統亦採用此綜合性指標【周家蓓等，2004】。

我國公路主管單位曾委託國內學術研究單位，進行一般公路之鋪面養護管理系統的研究，並針對本土鋪面狀況建立一種鋪面的結構性指標，此種指標主要是參考 PCI 之概念，並依鋪面破壞調查之結果，以破壞項目之權重、嚴重程度之權重、與破壞範圍權重之乘積，來決定路段之鋪面表面破壞指標(PSDI)值 【周家蓓等，1993】，如表一與下列公式所示：

PSDI = Σ（破壞項目權重*嚴重程度權重*範圍權重） (1)

表一 一般公路 PSDI 破壞項目及嚴重程度權重【周家蓓等，1993】

種類	破壞名稱		破壞項目權重	破壞等級權重		
				輕（L）	中（M）	重（H）
裂	A1	縱向車道裂縫	49	0.24	0.58	1.00
	A2	橫向裂縫	59	0.32	0.66	1.00
縫	A3	龜裂	59	0.34	0.63	1.00
變	B1	車轍	68	0.35	0.65	1.00
	B2	波浪形路面	89	0.35	0.63	1.00
	B3	隆起與凹陷	95	0.40	0.67	1.00
	B4	面層表面滑動	71	0.34	0.67	1.00
形	B5	車道與邊緣高差	66	0.35	0.64	1.00
表面	C1	坑洞	100	0.48	0.74	1.00
	C2	脫落及鬆散	64	0.42	0.70	1.00
破壞	C3	冒油	54	0.33	0.62	1.00
其	D1	修補面破壞	61	0.42	0.67	1.00
	D2	薄層剝離	58	0.36	0.65	1.00
它	D3	大孔高差	93	0.44	0.70	1.00

PSDI 爲零時，代表鋪面之最佳狀態，PSDI 值愈大時則表示鋪面狀況愈差。由於在早期針對一般公路發展 PSDI 時，並未選定明確之評分上限值，若是假設鋪面在最差之狀況下，路段中所有區域內均有所有類型的重度破壞時，則可將所有之破壞權重直接加總而得 PSDI 值，其可能之最高值爲 986（14 種破壞）。因此，在針對後續之中山高速公路路面養護管理系統的研究時，經過專家座談決定考慮加入評分上限爲 100 後，依高速公路公路鋪面的特性修正而得之破壞項目權重、嚴重程度權重、以及破壞項目之範圍權重計算方式，如表二與表三所示【侯羿、周家蓓、劉明仁等，1997】。

表二 高速公路 PSDI 破壞項目及嚴重程度權重 【侯羿、周家蓓、劉明仁等，1997】

種類	損壞名稱	破壞項目權重	破壞等級權重		
			輕（L）	中（M）	重（H）
裂縫	縱、橫向裂縫	10.56	0.24	0.58	1.00
	龜裂	13.44	0.34	0.63	1.00
變形	車轍	17.26	0.35	0.65	1.00
	表層滑動	13.44	0.34	0.67	1.00
表面破壞	坑洞	19.19	0.48	0.74	1.00
	冒油	11.52	0.33	0.62	1.00
其它	薄層剝離	10.56	0.36	0.65	1.00
	修補面	9.6	0.42	0.42	0.42

表三 高速公路 PSDI 鋪面表面破壞範圍權重定義【侯羿、周家蓓、劉明仁等，1997】

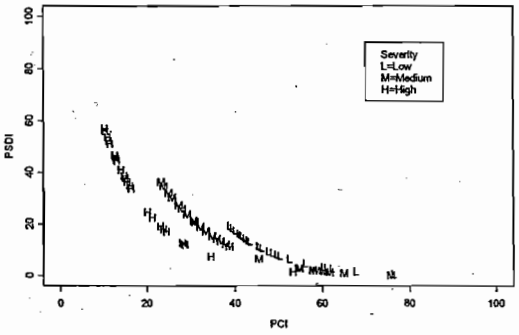
損壞項目	範圍權重定義方式
縱、橫向裂縫	（裂縫長度*0.7）/資料單元面積
龜裂	龜裂面積/資料單元面積
車轍	車轍長度/資料單元長度
表層滑動	表層滑動長度/資料單元長度
坑洞	（坑洞個數*5）/資料單元長度
冒油	冒油面積/資料單元面積
薄層剝離	薄層剝離長度/資料單元長度
修補面	修補面長度/資料單元長度

三、 綜合性指標之分析與比較

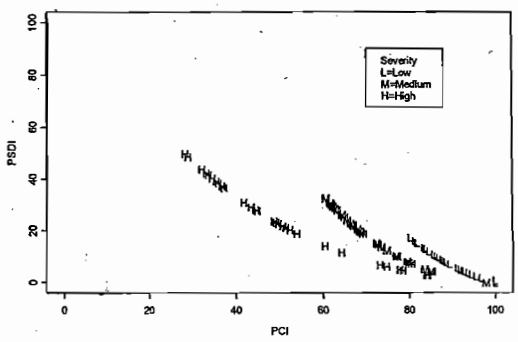
簡言之，在國際上鋪面綜合性指標（功能性與結構性）之原則與發展趨勢不外乎簡化、客觀化、標準化、及自動化，目的是希望在最短時間內以最精簡之資料與最經濟的方式有效地評估鋪面的狀況。因此對於不同之管理需求，所採用之指標也不盡相同，慎選擇合適之綜合性指標以評估鋪面之狀況，方能充分發揮鋪面管理之功能與效益。以路網階層之鋪面管理而言，較適合以簡單之功能性指標來評估鋪面之狀況，以避免資料過多造成資料分析與管理之困難。然而，在個案階層之鋪面評估與維修工作時，則需要較詳細的資料以決定要採行之細部維修方法，因此較適合採用結構性指標。

鑑於結構性指標需要較爲詳細之破壞資料，因此對於調查內容及計算程序之標準化便格外地重要。由於鋪面狀況指標(PCI)對於可量測性、重複性、及一致性均可達到一定的要求，而其調查內容與計算程序亦已列入美國材料標準試驗方法中，在客觀性、標準性、與國際接受度上似乎亦較鋪面表面破壞指標(PSDI)爲佳。因此，本研究將以隨機產生之一般公路與高速公路柔性鋪面資料，透過資料分析的方式來探討鋪面狀況指標(PCI)與本土化的鋪面表面破壞指標(PSDI)之特性差異，藉以比較其優缺點及國內之適用性。

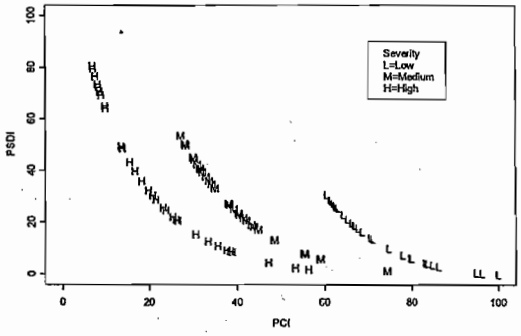
因此，研究中僅對龜裂、冒油、波浪形路面、修補、及滑動裂縫（表面滑動）等五種破壞項目進行後續分析比較。在破壞範圍方面，由於 PCI 對於此五種破壞範圍之定義爲破壞面積佔樣本路段面積之百分比，而 PSDI 則無明確定義，爲便於進行比較，本研究亦將之視爲面積百分比。



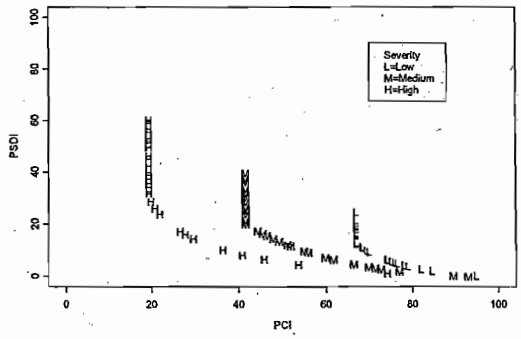
(a) 龜裂



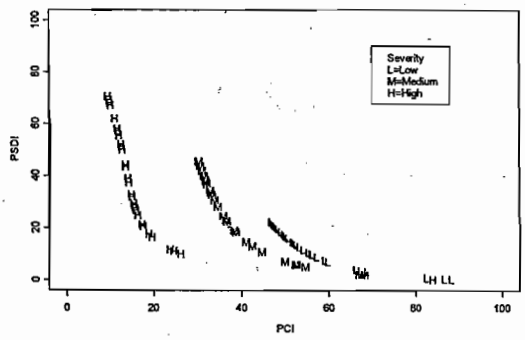
(b) 冒油



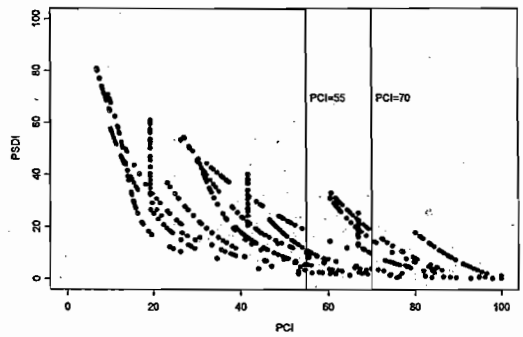
(c) 波浪形路面



(d) 修補



(e) 滑動裂縫



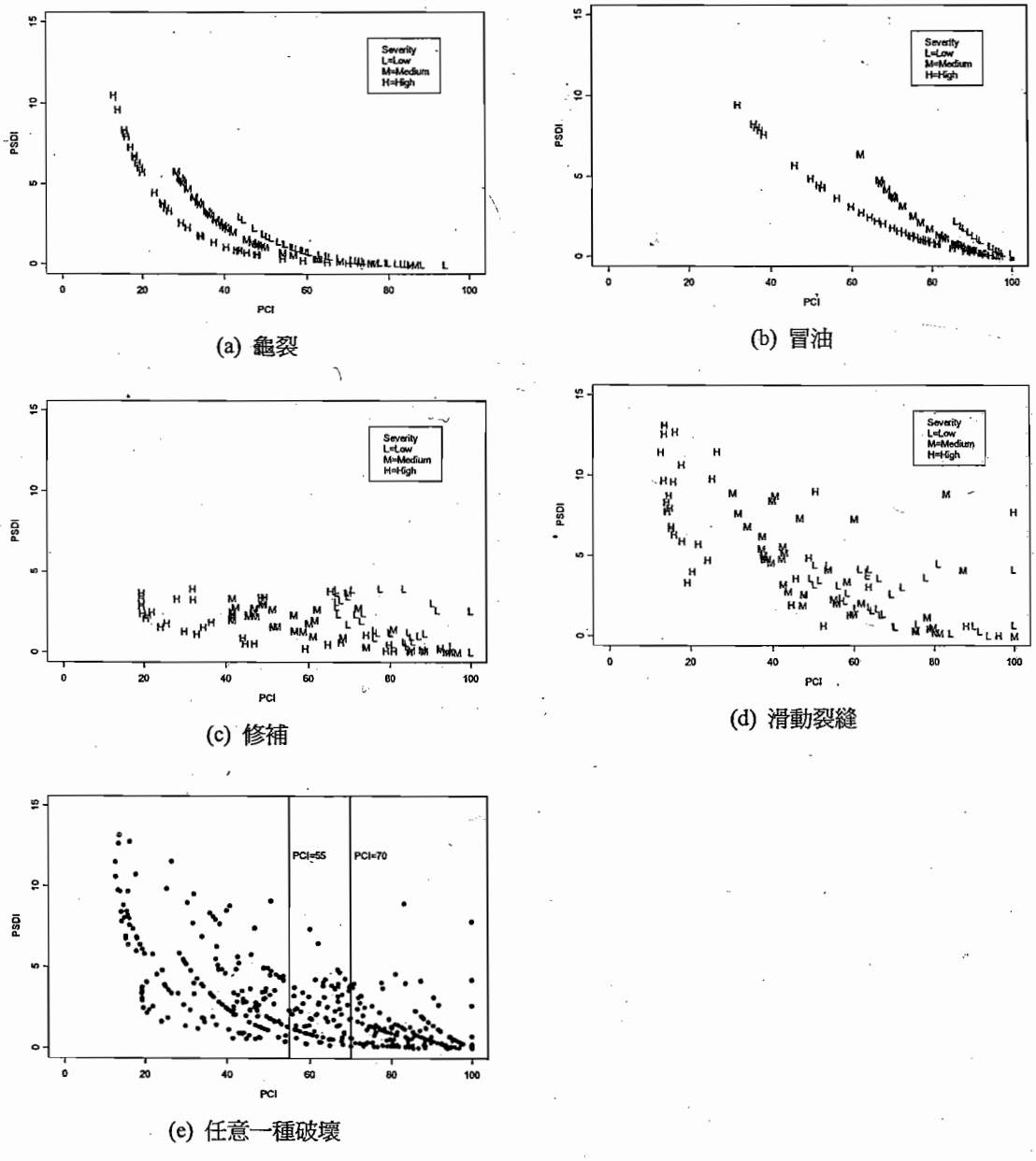
(f) 任意一種破壞

圖一 一般公路柔性鋪面之綜合性指標比較

接著，再以隨機產生之方式，建立一般公路柔性鋪面資料，並分別針對各單一破壞項目、嚴重程度、及破壞範圍來計算其 PCI 值與 PSDI 值，並繪出此計算結果之散佈圖，如圖一所示。圖一(a)代表輕度、中度、

則爲破壞長度佔資料單元長度之百分比。因此，在隨機產生資料時，必須假設固定之樣本路段（資料單元）之長度與寬度，並隨機產生破壞之長度與寬度等破壞範圍資料，再分別以此資料來進行分析比較。

接著，再根據前述產生之高速公路柔性鋪面資料，並分別針對各單一破壞項目、嚴重程度、及破壞範圍來計算其 PCI 值與 PSDI 值，並繪出此計算結果之散佈圖，如圖二所示。



(a) 龜裂　(b) 冒油

(c) 修補　(d) 滑動裂縫

(e) 任意一種破壞

圖二 高速公路柔性鋪面之綜合性指標比較