十、Design of Overlays for Flexible Pavements

參考資料：

1. Darter, M. I. " Techniques for Pavement Rehabilitation," Training Course, FHWA, 1987. (Block 5, Module 5C)
2. AASHTO, "AASHTO Guide for Design of Pavement Structures," Volume I, 1993. (Chapter 5)

◎Approaches

1. Engineering Judgement
2. Structural Deficiency:
   AASHTO structural number approach, Corps of Engineers
3. Deflection approach:
   Asphalt Institute (AI), California, Texas
4. Mechanistic Fatigue Damage Approach:
   (a) characteristic of pavements, E's
   (b) past damage
   (c) remaining life
   (d) required overlay thickness
   ㄐ Not widely utilized

◎Types of Overlays over Rigid Pavements

AC, PCC (same as before)

◎Fundamentals of the AASHTO Overlay Design Procedure (Figure 2)

※Basic AASHTO Design Procedure:

Figure 1 Relationship of Serviceability, structural capacity, and traffic

$$SN_{OL} = SN_y - F_{RL}(SN_{xeff})$$

$$h_{OL} = SN_{OL} / a_{OL}$$

SN_{xeff} = effective structural capacity

F_{RL} = remaining life factor ≤ 1.0

◎AASHTO Flexible Overlay Design Over Flexible Pavements

Major Seven Steps:

1. Analysis unit delineation
2. Traffic analysis
3. Material and environmental study
4. Effective structural capacity analysis (SC_{xeff})
5. Future overlay structural capacity analysis (SC_y)
6. Remainling life factor deterimination (F_{RL})
7. Overlay design analysis

※Analysis Unit Delineation

1. determine boundaries along the project
2. accurate historic data available / unavailable

※Traffic Analysis (ESAL)

※Material and Environmental Study

1. existing pavement layer properties
   NDT 卄 backcalculation techniques
2. existing subgrade properties (stress sensitivity)

3. design properties of overlay layers

※Effective Structural Capacity Analysis (SC_{xeff})

1. Estimate drainage coefficients (m_i) (Figure 3)
2. Use the modulus values determined in step 3 to determine existing layer coefficients (Figure 4 - Figure 8)
3. Calculate SN_{xeff}

$$SN_{xeff} = a_1 D_1 + a_2 D_2 m_2 + a_3 D_3 m_3$$

※Future overlay structural capacity analysis (SN_y)

Simply a new pavement design

※Remaining life factor determination (F_{RL})

1. Remaining life of existing pavement:
   NDT (Figure 9), Traffic Approach, Time Approach (Figure 10), Serviceability Approach (Figure 11), Visual Condition Survey Approach (Figure 12)
2. Remaining life of overlaid pavement (Figure 2)
3. Use R_{Lx} and R_{Ly} to determine F_{RL} (Figure 13)
   The procedure is very confusing and was removed in the new AASHTO Guide (1993).

※AC overlay thickness determination

$h_{OL} = SN/a_{OL}$

◎AASHTO Rigid Overlays Over Flexible Pavements

1. Determine composite modulus of subgrade reaction (k_c)
2. Treat as a new rigid pavement design

◎Example Problems

※Major Steps

Step 1 – Collect basic information and design criteria

Step 2 – Determine the required structural capacity to support the future traffic

Step 3 – Determine the effective SC of the existing pavement

Step 4 – Determine the remaining life factor

Step 5 – Computation of final overlay design thickness

※Design of flexible overlays over flexible pavements (Figure 20 ~ Figure 22)

◎ Overlay design analysis

1993 年 AASHTO Guide 各類加鋪組合之加鋪厚度計算公式如下表所示：

表一 加鋪厚度計算公式

加鋪材料	現存鋪面	加鋪設計公式
AC	AC	$hol = SNol / a$ $=(Snf - SNeff)/a$
AC	Break/PCC	$hol = SNol / a$ $=(Snf - SNeff)/a$
AC	PCC	$Dol=A(Df - Deff)$
AC	AC/PCC	$Dol=A(Df - Deff)$
Bonded PCC	PCC	$Dol = Df-Deff$
Unbonded PCC	PCC	$D^2ol = D^2f-D^2eff$
PCC	AC	$Dol = Df$