CHAPTER 640
COMPOSITE PAVEMENTS

Topic 641 – Types of Composite Pavement

Index 641.1 Flexible Over Rigid Layer

This configuration consists of a flexible layer on top of a rigid surface layer (typically jointed plain concrete pavement or continuous reinforced concrete pavement) where the flexible layer is used to increase the performance of the rigid layer. (Flexible layers over lean concrete base or cement treated base are considered to be flexible pavements for the purposes of this manual.) The function of the flexible layer is to act as a thermal and moisture blanket to reduce the vertical temperature and moisture gradient within the rigid surface layer and decrease the deformation (curling and warping) of concrete slabs. In addition, the flexible layer acts as a wearing course to reduce wearing effect of wheel loads on the rigid surface layer.

Flexible over rigid composite pavements are found most often on older pavements that have had a flexible pavement overlay such as hot mix asphalt, open graded friction course, or rubberized hot mix asphalt, placed over previously built jointed plain concrete pavement (JPCP) or continuously reinforced concrete pavement (CRCP.) New or reconstructed flexible pavements over JPCP or CRCP typically have not been built in the past on State highways because they have been viewed as combining the disadvantages of rigid pavements (higher initial cost) and flexible pavements (more frequent maintenance).

Thin flexible layers (i.e. sacrificial wearing course) have sometimes been placed over JPCP or CRCP to improve ride quality or friction of the rigid layer. Because ride quality and friction can also be improved by grooving or diamond grinding the existing rigid layer, the engineer should perform a life-cycle cost analysis (LCCA) to determine if diamond grinding/grooving or a flexible sacrificial overlay is more cost effective before deciding which option to select.

In some cases such as matching the existing pavement structure when widening, adding truck lanes to an adjacent flexible pavement, or providing a new wearing surface to an old rigid surface layer that is still structurally sound, composite pavements may be an option.

641.2 Rigid Over Flexible Layer

Because of the minimum 205 mm thickness requirements for rigid surface layers, all pavements with a rigid surface are engineered according to the standards and procedures for rigid pavements in Chapter 620.

Topic 642 – Engineering Criteria

642.1 Engineering Properties

The engineering properties found in Index 622.1 for rigid pavement and Index 632.1 for flexible pavement apply to composite pavements. Care should be taken in selecting materials in the flexible layer to resist reflective crack propagation from the underlying rigid layer and facilitate construction of generally thin flexible layers.

642.2 Performance Factors

Flexible layers placed over rigid surface layers need to be engineered and use materials that will meet the following requirements:

(1) Reflective Cracking. Joints or cracks from the underlying rigid surface layer should not reflect through the flexible layer for the service life of the flexible layer.

(2) Smoothness. The flexible layer should be engineered to provide an initial IRI of 1.0 m/km and maintain an IRI that is less 2.68 m/km throughout its service life.

(3) Bonding. A major factor in the effectiveness and service life of the flexible layer is the condition of the bond between the flexible and rigid layers. For a good bonding condition between flexible and rigid layer, the thickness of the flexible layer does not play an important

role in its service life. Therefore, for practical purposes, if there is no thickness requirement from the structural/constructibility point of view, the minimum thickness of the flexible layer should be based on material factors such as, gradation and aggregate structure, type of binder, etc. To achieve the maximum bond consult the District Materials Engineer or Office of Flexible Pavement Materials and Office of Rigid Pavement Materials and Structural Concrete for options on effective bonding between rigid and flexible layers.

For performance factors of rigid pavement, see Index 622.2.

Topic 643 – Engineering Procedures for New Construction and Reconstruction

643.1 Empirical Method

Before deciding to construct a new composite pavement, a LCCA should be completed to determine whether the composite pavement is more cost effective over the long term than flexible or rigid pavement alternatives.

At present, there is no comprehensive procedure to engineer a structural layer of flexible pavement over a rigid surface layer of JPCP or CRCP. Research is under way to provide guidelines for engineering and construction of composite pavements. When engineering composite pavements using JPCP or CRCP, the rigid layer with base and subbase is engineered as a rigid pavement using the procedures in Index 623.1. No reduction is made to the thickness of the rigid layer on account of the flexible overlay. The flexible pavement is treated as a sacrificial wearing course, and thus has no structural value.

When enough information is not available, the thickness requirement for placing a flexible pavement overlay over an old rigid pavement can be used as a conservative thickness for a new pavement.

643.2 Mechanistic-Empirical Method

For information on Mechanistic-Empirical Design application and requirements, see Index 606.3.

Topic 644 – Engineering Procedures for Pavement Preservation

644.1 Preventive Maintenance

Preventive Maintenance is used to maintain the surface of the flexible layer or to replace thin flexible layers (i.e., non-structural wearing courses) placed over a rigid surface layer. If work is needed to repair the underlying rigid layer, it should be developed as a CAPM (Index 644.2) or roadway rehabilitation (Topic 645) project. Additional information on preventive maintenance of the flexible layer can be found in the "Maintenance Technical Advisory Guide (MTAG)" available on the Department Pavement website.

644.2 Capital Preventive Maintenance (CAPM)

The procedures and designs for composite pavement CAPM projects are the same as those for flexible pavements (see Index 634.2). In the case of previously constructed crack, seat, and flexible overlay projects, it may be beneficial to mill a portion of the existing flexible layer prior to overlaying. Milling will reduce the thickness of the existing cracked pavement and therefore provide added life to the overlay.

The roadway rehabilitation requirements for overlays (see Index 645.1) and preparation of existing pavement surface (Index 645.1(3)) apply to CAPM projects. Additional details and information regarding CAPM policies and strategies can be found in Design Information Bulletin 81 "Capital Preventive Maintenance Guidelines."

Topic 645 – Engineering Procedures for Pavement and Roadway Rehabilitation

645.1 Empirical Method

On overlay projects, the entire traveled way and paved shoulder shall be overlaid. Not only does this help provide a smoother finished surface, it also benefits bicyclists and pedestrians when they are allowed to use the shoulder.

Procedures for engineering rehabilitation projects for composite pavement are as follows:

Because the flexible surface layer is considered to have no structural value, only reflective cracking and ride quality need to be considered.

(1) Reflective cracking. If the flexible layer is placed over an existing (old) rigid pavement, the thickness is calculated based on the procedure outlined for rigid pavement rehabilitation, mainly for reflective crack retardation. The thickness depends on the design life of the flexible non-structural wearing course, as well as mix gradation, type and percentage of the binder.

For additional information on rehabilitation of rigid pavements refer to "Rigid Pavement Preservation and Rehabilitation Guidelines" available on the Department Pavement website.

(2) Ride Quality. When the smoothness of the existing roadway is 2.68 m/km or greater as measured by the International Ride Index (IRI), a minimum 75 mm flexible layer (60 mm rubberized hot mix asphalt) should be placed. The overall thickness can be a single material or a combination of open graded, dense/gap graded, or SAMI-R material. Note that in some cases, existing pavement will need to be repaired to assure the roadway smoothness will remain below 2.68 m/km throughout the life of the overlay.

(3) Preparation of the Existing Pavement. Existing pavement distresses should be repaired before overlaying the pavement. Cracks wider than 5 mm should be sealed. Undesirable material such as bleeding seal coats or excessive crack sealant should be removed before paving. Existing thermoplastic traffic stripes and raised pavement markers should be removed. Spalls in rigid pavement should be repaired and broken slabs or punchouts replaced. Loose flexible pavement should be removed and replaced, and potholes and localized failures repaired. Ideally, existing non-structural wearing courses should be removed and, if needed, underlying pavement repaired prior to placing a new flexible wearing course. In some cases it may be more practical to overlay over the existing layer. (A LCCA of the two options will help determine which of these options is more cost effective. Note that when doing a LCCA, the need to ultimately remove all flexible layers in the future should be identified and included in the costs for the analysis.)

Routing cracks before applying crack sealant has been found to be beneficial. The width of the routing should be 5 mm wider than the crack width. The depth should be equal to the width of the routing plus 5 mm. In order to alleviate the potential bump in the overlay from the crack sealant, leave the crack sealant 5 mm below grade to allow for expansion (i.e., recess fill). The Materials Report should include a reminder of these preparations. Additional discussion of repairing existing pavement can be found on the Department Pavement website.

645.2 Mechanistic-Empirical Method

For information on Mechanistic-Empirical Design application and requirements, see Index 606.3.