BONDED CONCRETE OVERLAY OF ASPHALT PAVEMENTS MECHANISTIC-EMPIRICAL DESIGN GUIDE (BCOA-ME): USER'S GUIDE

USER'S GUIDE

University of Pittsburgh
Department of Civil and Environmental Engineering
Pittsburgh, Pennsylvania 15261

Prepared by:
Zichang Li
Nicole Dufalla
Julie M. Vandenbossche, Ph.D., P.E.

Prepared for:
FHWA Pooled Fund Project: TPF-5-165

August 2013

BCOA-ME User's Guide

This instruction manual is to be used along with the Bonded Concrete Overlay on Asphalt Mechanistic-Empirical Design Guide (BCOA-ME). A list of definitions for all abbreviations used is provided at the end of the instruction manual.

I. GENERAL INFORMATION

Geographic Information
Click on the "Geographic Information" button to be presented with two input options.

Level 1 Input – Exact location is known
The project geographical location information can be obtained from a smartphone, a GPS or by clicking on the "Open Webpage" button to be directed to http://veloroutes.org/elevation/ where latitude, longitude, and elevation can be given for any address. If the hyperlink is not working correctly, copy and paste the link into your web browser. Note that the latitude, longitude and elevation cannot be directly cut and pasted from this website into the design sheet but must be manually entered.
  a. *Latitude* - Manually enter the geographic latitude in degrees.
  b. *Longitude* - Manually enter the geographic longitude in degrees.
  c. *Elevation* - Manually enter the elevation above sea level in feet.

Level 2 Input – Nearest city is known
Choose the closest city to the project location from the drop-down menu that represents a similar elevation and climatic conditions as the project location. The latitude, longitude, elevation, AMDAT region, and sunshine zone will be automatically entered once the selection is made.

Design ESALs
Level 1 Input – ESALs are known
Enter design ESALs.

Level 2 Input – ADT is known
Click on the "ESALs Calculator" button to estimate the number of design ESALs. The one-way ADT must be entered along with the following information.

  a) *Design Life:*
     Enter the design life. The default value is 10 years.
  b) *Terminal Serviceability*
     Enter the terminal serviceability from the drop-down menu. The default value is 2.0.
  c) *Number of Lanes*
     Enter the number of traffic lanes in each direction. The default value is 1 lane in each direction.
  d) *Percent Trucks*
     Enter the percentage of the ADT that is classified as trucks without the percent sign. The default value is 6 (%).
  e) *ADTT Growth Rate*

Enter the projected growth rate in the volume of truck traffic as a percentage without the percent sign. The default value is 3 (%).

    f) *Traffic Growth Rate Type*
Select the ADTT growth rate type from the drop-down menu as either linear or non-linear. The default is non-linear.

    g) *Road Category*
Select the road classification from the drop-down menu. The default road type is collector.

Level 3 Input – ADT is unknown
All inputs from Level 2 are required except ADT. ADT will be estimated based on roadway classification.

Maximum Allowable Percent Slabs Cracked

Enter the Percent Slabs Cracked in percentage. A 25 percent cracking value is recommended for this procedure.

Desired Reliability against Slab Cracking

Enter the Reliability in percentage. A conservative reliability of 85 percent is recommended for this procedure.

II. CLIMATE

AMDAT Region

Enter the Annual Mean Daily Average Temperature region between 1 and 7. Clicking the hyperlink will show a map of these regions.

Sunshine Zone

Enter the Annual Concentrating Solar Resource zone between 1 and 6. Clicking the hyperlink will show a map of these zones.

III. EXISTING STRUCTURE

Post Milling HMA Thickness

Enter the post-milling HMA layer thickness in inches. It is limited to between 3 and 10 inches thick.

HMA Condition

Select the HMA condition from the drop-down menu as "Marginal" if the percent fatigue cracking in the existing HMA is between 0 to 8% or "Adequate" if the percent fatigue cracking is between 8 to 20%. This will produce a reduction in HMA stiffness of 5% and 13%, respectively. Clicking on the "Examples" button will show examples of fatigue cracking.

Composite Modulus of Subgrade Reaction, k-value

The composite k-value represents the composite stiffness of all layers below the asphalt. If the existing pavement structure consists of a concrete pavement that was overlaid with asphalt and the asphalt layer is not bonded to the old concrete pavement, then the concrete layer should be

considered when defining the stiffness of the composite k-value. If the asphalt overlay is still bonded to the old concrete pavement then the stiffness of the concrete layers should be considered when defining the stiffness of the HMA layer.

Click on the hyperlink to the ACPA app for estimating the composite k-value for pavements with multiple layers below the asphalt or if the asphalt layer was constructed directly on top of a subgrade with a known resilient modulus: http://apps.acpa.org/apps/kValue.aspx (If the hyperlink is not working correctly, copy and paste the link into your web browser.) A default value of 150 psi/in is given.

Does the existing HMA pavement have nondeteriorated transverse cracks?
Select "Yes" or "No" from the drop-down menu to indicate if nondeteriorated temperature cracks are present in the existing HMA pavement. Nondeteriorated transverse cracks must have a width less than the maximum aggregate top size in the concrete mix of the overlay. The design process includes a check to determine if there is the potential for reflective cracking to occur. This does not affect the design thickness but indicates whether preemptive measures should be taken prior to placing the overlay to prevent reflective cracking into the overlay. See the technical note Steps to Take to Get from Project Selection through the Construction of BCOAs [1] for guidance on how to address both deteriorated transverse cracks as well as nondeteriorated transverse cracks that are indicated to have the potential to induce reflective cracking in the overlay.

IV. PCC OVERLAY

Concrete Strength
Select and enter either the *average* 28-day flexural (third point) strength (as determined by ASTM C 78) or the *average* 28-day compressive strength from the drop down menu.

Estimated Elastic Modulus
Level 1 Input – PCC Elastic Modulus is known
Enter the elastic modulus of the concrete layer in psi. The default value is 4,000,000 psi.

Level 2 Input – PCC Elastic Modulus is unknown
Click the "E_{PCC} Calculator" button and the PCC elastic modulus will be estimated using the concrete strength input.

Coefficient of Thermal Expansion
Level 1 Input – CTE is known
Enter the coefficient of thermal expansion in units of inch/inch/F.

Level 2 Input – CTE is unknown
Click on the "CTE Calculator" button to enter a type of coarse aggregate from the drop-down menu. The default value is 5.5×10^{-6} inch/inch/F.

Fiber Type
Select the type of fiber from the drop-down menu. If no fiber is to be used, select "No fibers".

Fiber Content
Enter the volume of fibers to be added to the concrete in lb/yd^3.

Joint Spacing
Select the joint spacing dimensions from the given drop down menu presented as transverse by longitudinal joint spacing dimensions. For rectangular slabs with joint spacing less than 7 ft, select square slab size with the same dimension as the largest side. Guidance on selecting the joint spacing can be found in reference 1.

NOTE: Performance from MnROAD indicated that using a ¼ inch reservoir and sealing with an asphalt sealant performs better than not sealing for ultra-thin whitetopping (< 4.5 in). The MnROAD data showed, the difference in the performance between of the sealed and unsealed sections with a 5-in bonded whitetopping was not significantly different. This BCOA-ME assumes the bonded whitetopping sections are sealed as described above.

Reference:

1. Sachs S. and J.M Vandenbossche, Technical Note: Steps to Take to Get from Project Selection through the Construction of BCOAs, University of Pittsburgh, Pittsburgh, PA, August 2013.

Abbreviation Definitions

ADT: Average Daily Traffic
ADTT: Average Daily Truck Traffic
AMDAT: Annual Mean Daily Average Temperature
CTE: Coefficient of Thermal Expansion
ESALs: Equivalent Single Axle Loads
HMA: Hot Mix Asphalt
PCC: Portland Cement Concrete