Calculation Book Report

Date: October 2, 2017

Technical Owner: Civil – Brett I. Kesterson, P.E.

Calculation Book No. 509 **Standard Drawing No.** P-509

Drawing Title: Borehole/Subsurface Investigation Pavement Restoration

REGISTERED PROFESSIONAL ENGINEER
9676PE
Brett I. Kesterson
OREGON
JULY 14, 1978
BRETT I. KESTERSON

Expires 06/30/2019

The following is the equivalent single axle load (ESAL) calculation for the 6 inches asphalt on 12 inches concrete. The program only has a cement treated base (CTB) for a pavement layer, which is not as strong as 4000psi concrete. However, the ESAL's using CTB are more than adequate for a typical city street.

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The following is the equivalent single axle load (ESAL) calculation for 12 inches of concrete. This calculation shows that the concrete by itself without the 6 inches of asphalt produces adequate ESAL loading.

20171003092148434
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The following is the flexural strength calculation for concrete that is designed for 4000psi compressive strength in 28 days using the ACPA recommended conversion.

20170901132018091
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Calculations made by:
Name: Brett I. Kesterson, P.E.
Title: Senior Engineer

WinPAS

Pavement Thickness Design According to

1993 AASHTO Guide for Design of Pavements Structures

American Concrete Pavement Association

Flexible Design Inputs

Project Name: Pothole Pavement Restoration-ACC
Route: Anywhere
Location: City of Portland
Owner/Agency: Transportation
Design Engineer: Assume sand backfill in trench

Flexible Pavement Design/Evaluation

Structural Number	4.43		**Subgrade Resilient Modulus**	5,000.00	psi
Total Flexible ESALs	1,585,900		**Initial Serviceability**	4.20	
Reliability	95.00	percent	**Terminal Serviceability**	2.25	
Overall Standard Deviation	0.45				

Layer Pavement Design/Evaluation

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
Asphalt Cement Concrete	0.42	0.90	6.00	2.27
Cement Treated Agg. Base	0.20	0.90	12.00	2.16
			ΣSN	4.43

WinPAS

Pavement Thickness Design According to

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American Concrete Pavement Association

Rigid Design Inputs

Project Name: Pothole Pavement Restoration-PCC
Route: Anywhere
Location: City of Portland
Owner/Agency: Transportation
Design Engineer: Assume sand backfill in trench

Rigid Pavement Design/Evaluation

Concrete Thickness	12.00	inches	Load Transfer Coefficient	4.30	
Total Rigid ESALs	16,731,200		Modulus of Subgrade Reaction	857	psi/in.
Reliability	80.00	percent	Drainage Coefficient	0.90	
Overall Standard Deviation	0.35		Initial Serviceability	4.50	
Flexural Strength	580	psi	Terminal Serviceability	2.00	
Modulus of Elasticity	3,940,000	psi			

Modulus of Subgrade Reaction (k-value) Determination

Resilient Modulus of the Subgrade	20,000.0	psi
Unadjusted Modulus of Subgrade Reaction	1	psi/in
Depth to Rigid Foundation	0.00	feet
Loss of Support Value (0,1,2,3)	0.0	

Modulus of Subgrade Reaction	857	psi/in.

/// STRENGTH CONVERTER ///

Strength (psi):	4,000.00	English / Metric
Convert From:	Compressive Strength	
Convert To:	Flexural Strength	

Calculate Save Inputs

CALCULATED RESULTS

English (psi)	Source
601	MEPDG
580	Mindess, Young, and Darwin; Raphael
474	ACI 318
580	ACI 330 *
506 to 632	Yoder and Witczak: Huang

** ACPA recommeded conversion.*

REFERENCES

MEPDG, 'Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavement Structures: Final Report - Part 2. Design Inputs – Part 2. Material Characterization,' NCHRP 1-37A, Mar 2004.

Mindess, S., Young, J.F., and Darwin, D., 'Concrete,' 2nd Ed., 2003.

ACI 318, 'Building Code Requirements for Structural Concrete and Commentary.'

ACI 330, 'Guide for the Design and Construction of Concrete Parking Lots.'

Yoder, E.J. and Witczak, M.W., 'Principles of Pavement Design,'2nd Ed., 1975.

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