Faculty of Engineering

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Thesis about:

Management of Superpave Asphalt Concrete Mixture in Jordan

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Authorization

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Dedication

I dedicate this thesis to my parents who were the cause of completing the study and the source of my insistence also they did not stop supporting me in all economic and moral aspects.

Also I dedicate it to my dear wife who stood with me in all my moments of study and she did not hesitate to support me psychologically and physically.

Finally, Thanks to all my relatives, friends, colleagues and all those who supported me at this stage, I would like to say to them:

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Anas Alshurayfeen

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List of Abbreviations

AASHTO	American Association Of State Highway And Transportation Officials
AGCS	Aggregate Gradation Control System
ANOVA	General Linear Model In Analysis Of Variance
ARZ	Above The Restricted Zone
BBR	Bending Beam Rheometer
BRZ	Below The Restricted Zone
DS	Dynamic Stability
DSR	Dynamic Shear Rheometer
ESALs	Equivalent Single-Axle Loads
FBR	Filler- Bitumen Ratio For HMA Designed By Marshall Method.
Gb	Specific Gravity Of Bitumen
Gmb	Total Density
Gmm	Specific Gravity
Gmm	Maximum Density
Gsb	Bulk Specific Gravity Of Combined Aggregate
Gse	Effective Specific Gravity Of Combined Aggregate,
HMA	Hot-Mix Asphalt
HMA#1	HMA Category Number One
HMA#2	HMA Category Number Two
HMA#3	HMA Category Number Three
HMA#3	HMA Category Designed Using Superpave Method Number Three
HMA#4	HMA Category Number Four
HMA#5	HMA Category Number Five
ITP	Illinois Test Procedures
JPR	Jordan Petroleum Refinery
K-S	Kolmogorov-Smirnov
LOS	Level Of Service
MAS	Maximum Aggregate Size
MDL	Maximum Density Line
NMAS	Nominal Maximum Aggregate Size
OBC	Optimum Bitumen Content
OLS	Ordinary Least-Square

PAV	Pressure Ageing Vessel
Pba	Absorbed Asphalt By Weight Of Aggregate
Pbe	Effective Bitumen Content
PG	Performance Grading
PG	Performance Grading
P-P	Normal Predicted Probability
R	Correlation Coefficients
R^2	Correlation Coefficient
RTFO	Rolling Thin-Film Oven
RZ	Restricted Zone
SG	Specific Gravity
SG	Bulk Oven Dry
SHMA#1	HMA Category Designed Using Superpave Method Number One
SHMA#2	HMA Category Designed Using Superpave Method Number Two
SHMA#4	HMA Category Designed Using Superpave Method Number Four
SHMA#5	HMA Category Designed Using Superpave Method Number Five
SHRP	Strategic Highway Research Program
SMA	Stone Matrix Asphalt
SSD	Bulk SG.
Superpave	Superior Performing Asphalt Pavements
S-W	Shapiro-Wilk
TGC	Texas Gyratory Compactor
TRZ	Through The Restricted Zone
US	United States
VMA	Voids In Mineral Aggregate
Va	Air Voids
VFA	The Voids Filled With Asphalt
VMA	Voids In Mineral Aggregate
WVDOH	West Virginia Division Of Highways
β value	Standardized Coefficients

Abstract

The main objective of this study is to determine the best formula, equation, or module between Marshall Method design and Superpave Method design of coarse aggregate types, which can be used in Superpave Performance Grading (PG) 64-16.

In order to achieve the study aim, five different alternatives of hot mix asphalt for each designed method (Marshall and Superpave design method) were designed, using two different types of commonly used coarse aggregate, which are limestone and Basalt.

A various ratio of coarse aggregate was used starting with 100% of the coarse aggregate being limestone as the first alternative, later 75% of the coarse aggregate is limestone and 25% is basalt for second alternative, this sequence develops until 100% of coarse aggregate is Basalt for the fifth alternative.

Each alternative was tested according to the national specifications and standards; these tests were Air voids, Specific Gravity, Stability, Voids in mineral aggregate, Flow, Filler-Bitumen ratio and Stiffness.

Each test results were analyzed and tested using Normality of the Data, Regression Analysis, t-Test and ANOVA-Test using SPSS version 25.0 software to define the equation between Superpave design method test as dependent variable and Marshall design method test as independent variable.

For Optimum Bitumen Content (OBC) test results, a model of Superpave methods (dependent variable) were designed from the above mentioned tests results of Marshall Method. After that error percentage was calculated for each model/equation, results show that all designed models/equations were within the specifications.

On the other hand, the economical modeling stages shows that using these models/equations will minimize the capital cost of testing cost up to 43%, the results of these modules are so important for Jordan highway projects, they will be introduced to provide optimal cost and optimal design for Asphalt Cement, such as raising the AC layer service lifecycle, flexibility, workability, etc. Finally, some recommendations were listed.

Key words: Marshall, Superpave, Performance Grading (PG), Air voids, Specific Gravity, Stability, Stiffness, Optimum Bitumen Content (OBC), ANOVA-Test.