5-2008

Developing Subgrade Inputs for Mechanistic-Empirical Pavement Design

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Recommended Citation

Berlau, Meagan, "Developing Subgrade Inputs for Mechanistic-Empirical Pavement Design" (2008). *Computer Science and Computer Engineering Undergraduate Honors Theses*. 11.
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DEVELOPING SUBGRADE INPUTS FOR MECHANISTIC-EMPIRICAL PAVEMENT DESIGN

DEVELOPING SUBGRADE INPUTS FOR MECHANISTIC-EMPIRICAL PAVEMENT DESIGN

An Honors Thesis submitted in partial fulfillment
of the requirements for Honors Studies in
Civil Engineering

By
Meagan Berlau

May 2008
University of Arkansas

This thesis is approved for recommendation to the Honors College

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Acknowledgements

First, I would like to thank my thesis director Dr. Kevin Hall for his support and advice throughout this project. Without his guidance, this project would not be possible. Thanks are also extended to the members of my thesis committee, Dr. Robert Elliott and Dr. Norman Dennis. In addition, I could not have completed this project without the help that I have received from Trent Ellis. His support this past year has been invaluable. I would also like to thank my father, Chuck Berlau, for his constant encouragement and moral support.

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1. INTRODUCTION

The Resilient Modulus (M_R) of a subgrade soil is an essential input into the flexible pavement design models contained in the American Association of State Highway and Transportation Official's new pavement design guide, the Mechanistic-Empirical Pavement Design Guide (MEPDG). For most inputs required for pavement design, there are three levels of input that can be used within the MEPDG system. Level One requires the engineer to enter a value for subgrade Resilient Modulus based on the results of Resilient Modulus tests conducted in the laboratory. Level Two allows the user to input values for other soil property tests including California Bearing Ratio (CBR), and resistance value (R-Value). The program then converts these numbers to Resilient Modulus values using empirical correlations. When a pavement designer does not have access to detailed data about the subgrade soil, Level Three inputs can be used. These inputs are educated guesses for the Resilient Modulus of the subgrade soil based on the AASHTO soil type entered.

While Level Three inputs may not provide accurate data to allow an engineer to design pavements with a high reliability, the tests required to use Level One inputs are costly, time consuming, and are rarely run for a variety of reasons. Because soil environmental conditions can affect the results of a resilient modulus test; it is imperative that laboratory tests be performed on soil samples that replicate the moisture content, density, stress state, and degree of saturation of soil in the field. The expense and difficulty of mimicking in situ soil conditions for a subgrade soil makes running laboratory resilient modulus tests an uncommon practice.

This leaves Level Two as the likely method of determining resilient modulus for use in the MEPDG system. The correlations used in the MEPDG procedure, however, are based upon test data run on soil samples from across the country. Since soil properties vary greatly across the country, the default correlation equations contained in Level 2 models of the MEPDG are most likely a poor representation of soils commonly found throughout the state of Arkansas. The sheer volume of soils all over the country and the extreme variance in the properties between different soil types leads to a rather poor R-value correlation in the design guide for soils specifically found in the state of Arkansas.

If the Arkansas State Highway and Transportation Department continues favoring R-value correlations as the Level 2 soil property input in MEPDG, correlations that apply specifically to the soils found in the state of Arkansas should be developed. If no acceptable correlation can be developed, it may be in the best interest of the AHTD to abandon using R-value correlations and, either: (a) adopt a new method of determining resilient modulus, perhaps through backcalculation of Falling Weight Deflectometer data; or (b) expand the current resilient modulus testing program

2. LITERATURE REVIEW

2.1 Resilient Modulus

In 1986, the American Association of State Highway and Transportation Officials (AASHTO) updated its original design guide to begin using Resilient Modulus as a measure of subgrade soil strength instead of the soil support value that had previously been used. The subgrade support value was the first attempt to include subgrade soil properties in pavement design and ranged from 1 to 10. The 1986 AASHTO guide introduced the following relationship between resilient modulus and the subgrade support value:

$$S_i = 6.24 \times \log_{10} M_R - 18.72 \qquad \text{.......}\ldots\ldots\ldots\ldots\ldots\ldots\text{(1)}$$

Where: S_i= Subgrade Support Value

M_R=Resilient Modulus (psi)

The 1986 design guide also proposed that correlations should be developed between resilient modulus and either California Bearing Ratio values or R-value since, at that time, many state transportation agencies did not have the equipment necessary to run resilient modulus tests. The original correlations proposed in the design guide are extremely basic and are based on the bulk stress of the soil sample, but they represent the first step taken by the American Association of State Highway and Transportation Officials to incorporate resilient modulus into the pavement design equation.

The resilient modulus of subgrade soils has evolved from its less-than-perfect inclusion in the 1986 design guide into the required subgrade input to the MEPDG design system for flexible pavement. The resilient modulus estimates the elastic modulus of a subgrade soil; it is a measure of the stress to strain ratio for quickly applied loads. This loading is similar to the loading conditions that a subgrade soil will experience in the field. When a load is quickly applied and released, the strain is divided into resilient, or recoverable, strain and permanent, or plastic, strain (Woodbridge).

The most common way to measure the resilient modulus of a subgrade soil is using a repeated load triaxial test in which vertical load pulses are applied for 0.1 second durations with 0.9 second rest periods (NAPA). There is a marked difference in the stiffness exhibited by a subgrade soil in the conventional triaxial test compared the stiffness from the repeated load test. In the repeated load test, the soil sample is exposed to a cyclic vertical loading cycle and constant horizontal pressure (Farrar, et al.). From the test, the recoverable, or resilient, strain in the soil specimen is measured as "the rebound deformation resulting from removal of the the deviator stress divided by the original height of the sample (Woodbridge)." The Resilient Modulus is then calculated as

$$M_R = \frac{\sigma_d}{\varepsilon_R} \quad \text{.......................................(2)}$$

where: M_R= Resilient Modulus

σ_D=repeatedly applied deviator stress

ε_R=recoverable axial strain (NAPA)

The resilient modulus can also be described as the slope of the hysteresis loop developed in the stress vs. strain plot once there is no further significant increase in permanent strain due to cyclic loadings and elastic strain is the only type the specimen undergoes (Farrar, et al.). The importance of determining the resilient modulus of a subgrade soil lies in its ability to predict the rutting potential of a subgrade soil; the resilient modulus test most closely replicates the traffic loading conditions experienced by subgrade soils once used in highway construction.

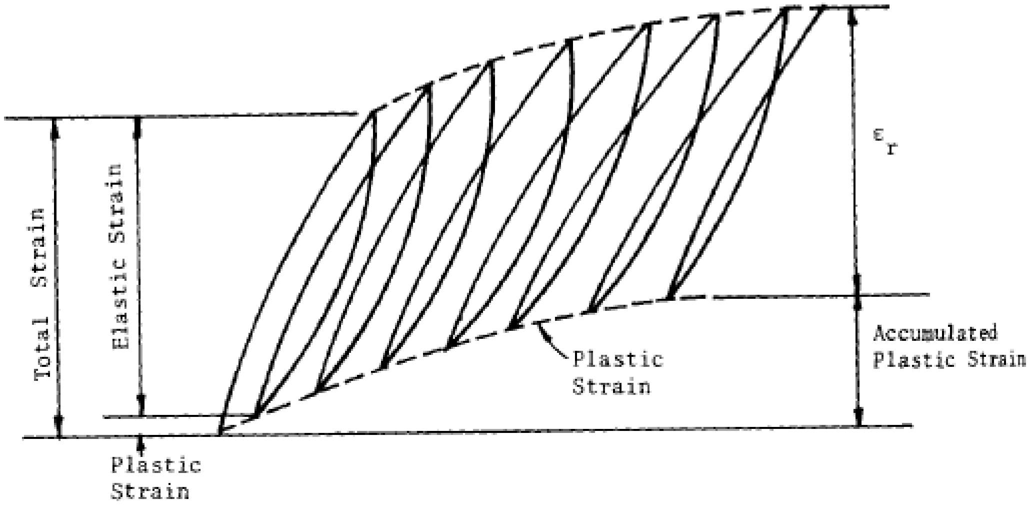

Figure 1. Resilient Strain Example (Huang)

The results of the resilient modulus test is dependent on a large number of factors including stress duration, frequency, grain size, void ratio, saturation, confining pressure, and stress level (Thornton). There is no significant correlation between any single soil property (grain size, plasticity, clay and silt content) and resilient modulus. However, according to research done by Su, et al., as moisture content increases, resilient modulus decreases. The degree of saturation, a property that combines the density and moisture content of a soil, exhibits the same effect on resilient modulus as moisture content. The deviator stress also affects the resilient modulus of a soil in both cohesive and cohesionless soils; as deviator stress increases, resilient modulus decreases (Su, et al.), particularly in cohesive soils.

It is imperative that deviator stress levels used during the resilient modulus test are determined based on the traffic loading anticipated (Su, et al.). It is also noted in the research, however, that once a confining pressure of approximately 6 psi is reached, the curve of the plot relating deviator stress to resilient modulus becomes flatter, so a confining stress of 6 psi is appropriate for almost all tests. Even though there is no true correlation between any single soil index property and resilient modulus, the effect that index properties can have on the results of a resilient modulus test needs to be considered.

2.2 Index Property Correlations

Since the Resilient Modulus test is not often run due to the cost and time necessary to get accurate results for soil samples that mimic the properties of the subgrade soil encountered in road construction, much research has been done on finding new ways to correlate various soil properties that are simple to obtain to the Resilient Modulus value of a soil.

Carmichael and Stuart attempted to derive a correlation for resilient modulus using soil index properties and measurements taken during a triaxial test. Their results, however, showed that a general equation could not be written for all soil types. Fine grained and coarse grained soils were separated and distinct correlations were developed for each soil type. The equations for both coarse (Equation 3) and fine grained soils (Equation 4) are based on the plasticity index, water content, percent passing the No. 200 sieve, confining stress, deviator stress, and bulk stress used during the triaxial test, and a correction for soil type (Carmichael, et al.).

$$\begin{aligned} M_R = {} & 37.431 - 0.4566(PI) - 0.6179(\%W) - 0.1424(s200) + 0.1791(CS) \ldots\ldots\ldots(3) \\ & - 0.3248(DS) + 36.422(CH) + 17.097(MH) \end{aligned}$$

$$\log(M_R) = 0.523 - 0.0225(\%W) + 0.544(\log T) + 0.173(SM) + 0.197(GR) \ \ldots\ldots\ldots..(4)$$

where:

MR= Resilient Modulus (ksi)

PI= Plasticity Index

%W= Water Content (%)

CS= Confining Stress (psi)

DS= Deviator Stress (psi)

T= Bulk Stress (psi) (DS+3CS)

DD= Dry Density (pcf)

S200=Percentage Passing No. 200 Sieve

SS= Soil Suction

CH=1 for CH Soil, 0 otherwise (MH, ML, or CL soil)

MH=1 for MH soil, 0 otherwise (CH, ML, or CL soil)

SM = 1 for SM Soil, 0 otherwise

GR = 1 for GR Soil, 0 otherwise

A study performed by Woodbridge found that plasticity index, clay content, and optimum moisture content contributed most to determining resilient modulus of cohesive soils. From her study, Woodbridge developed various correlations between soil index properties resilient modulus for cohesive soils throughout Arkansas. Her equations using only the inputs deemed significant, include:

For deviator stresses of 4 psi:

$$M_R = 10.71 + 0.1961PI + 0.1799CL - 0.7126W \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

For deviator stresses of 8 psi

$$M_R = 9.18 + 0.1601PI + 0.1393CL - 0.5860W \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

where:

MR= Resilient Modulus (psi)

PI = Plasticity Index (percent)

CL = Clay Content (percent)

W = Optimum Moisture Content (percent)

Woodbridge also developed additional equations that include various other soil properties, but proposed that including these additional properties in the correlations did not greatly improve the correlation.

According to Farrar, et al., the San Diego Road test provided the majority of data used in determining resilient modulus correlations for fine grained soils, specifically an A-7-6 clay. From the San Diego Road Test data, Jones and Witczak developed the following correlation:

$$\log M_R = -.111(w\%) + .0217(S\%) + 1.179 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$$

where:

M_R= Resilient Modulus (ksi)

S%=Degree of Saturation

w%= Water Content

According to Thompson and Robnett, degree of saturation was determined to be the most important soil property predictor of resilient modulus. They determined resilient modulus as a function of degree of saturation for fine grained soils based upon the following equations:

For soils at 95% AASHTO T99 maximum dry density:

$$M_R = 32.9 - .334(S\%) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

For soils at 100% AASHTO T99 maximum dry density:

$$M_R = 45.2 - .428(S\%) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(9)$$

where:

M_R= Resilient Modulus (ksi)

S% = Degree of Saturation

Farrar and Turner studied various methods for determining resilient modulus from both R-value of Wyoming soils and index properties of the soils. However, their research included running modified R-value tests in addition to the standard Hveem test. The modified tests were run on samples that were not prepared in accordance with AASHTO T190. Instead, the samples were prepared from material passing the ¾" sieve and a given amount of water to create a certain moisture content (Farrar, et al). From their research, Farrar and Turner recommend the following equation for use with typical Wyoming subgrade soils:

$$M_R = 34280 - 359 * (S\%) - 325(\sigma_d) + 236(\sigma_3) + 86PI + 107(S200) \ldots\ldots(10)$$

where: M_R= Resilient Modulus (psi)

S%= Degree of Saturation

σ_d=deviator stress (psi)

σ_3=confining stress (psi)

PI= plasticity index

S_{200}= percent passing No. 200 sieve by weight

In addition to the recommended equation using soil index properties, Farrar and Turner also developed Equation 11 using R-value data:

$$LN(M_R) = 7.157 + .039R_{VM} - 0.049\sigma_d + 0.04\sigma_3 + 1.013X_C \ldots\ldots\ldots\ldots (11)$$

where: $LN(M_R)$= natural logarithm resilient modulus (psi)

R_{VM}=modified R-value

X_C= 1 for clay soils and 0 otherwise

σ_d=deviator stress (psi)

σ_3=confining stress (psi)

The equation including the R-value did not provide as tight of a correlation as the correlation corresponding to index properties. However, Farrar and Turner's analysis showed that the results of their prediction equation fit with previous attempts at correlating soil properties with resilient modulus; any difference was noted as the equations being written for Wyoming subgrade soils specifically.

The California Bearing Ratio test is a common test used for correlations. The CBR test measures "the percentage of the soil load required to produce a .1 inch deflection compared to a standard crushed stone (Thornton 6)." The test is run with a standard piston with an area of 3 in^2 penetrating the soil at a rate of .05 inches/minute. At each 0.1 inch interval up to 0.5 inches, pressure is measured. To determine the CBR value, the ratio of the recorded pressure to the pressure necessary to produce the same penetration in a high-quality crushed stone is calculated. The CBR value is most often calculated at 0.1 inch penetration is used unless the ratio at 0.2 inches is greater. The CBR Test is run in accordance with AASHTO T-193. Currently, MEPDG models Resilient Modulus as (NCHRP):

$$M_R = 2555(CBR)^{.64} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(12)$$

Where: M_R= Resilient Modulus (psi)

CBR= California Bearing Ratio (percent) as determined by AASHTO T-193

According to Woodbridge, Resilient Modulus has also been predicted as:

$$M_R = B * CBR \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(13)$$

Where: MR= Resilient Modulus (psi)

B= 1500 for CBR$\leq$ although value may vary from 750 to 3000

CBR= California Bearing Ratio (percent)

However, Woodbridge warns that the CBR test cannot accurately mimic the repeated load effects with which Resilient Modulus is associated. Additionally, she states that sometimes CBR can be so unreliable as to exhibit an inverse relationship with Resilient Modulus.

2.3 R-Value Test

Using the R-value test and subsequent correlations to estimate the Resilient Modulus is a source of contention amongst academics. In the early 1930s, F.N. Hveem used a modified triaxial test to attempt to develop a relationship between the vertical load applied to a soil specimen and the horizontal stresses that are induced if the material is horizontally confined. The device he constructed based on a triaxial test setup was originally used as a way to measure stability of bituminous paving specimens, thus his machine became known as the Stabiliometer. Hveem's original experiments involved subjecting a paving specimen to loads representing typical traffic loads that are frequently repeated over a period of time. In the stability test, horizontal stress is measured at every 1000 pounds of vertical load up to 6000 pounds (400 psi), which Hveem believed to be the ultimate stress developed from truck traffic (Farrar, et al.).

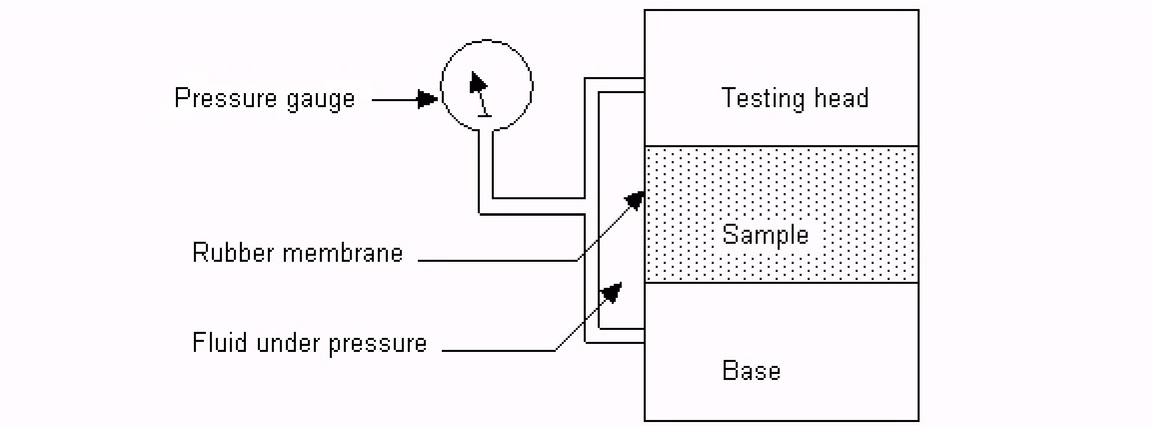

Figure 2. Stabiliometer Diagram

http://pavementinteractive.org/index.php?title=Image:Stabilometer.jpg

The stabiliometer was then used to measure the same properties in subgrade soils, a value Hveem coined as the "R-value." The R-value test measures the resistance a soil offers to transmitting vertical load in the horizontal direction (Thornton) and is specified by ASTM D2884 and AASHTO T190. When a passing wheel load exerts a downward vertical force on a subgrade soil, the soil resists the force through friction between soil particles. However, if the vertical force is greater than the frictional force offered by supporting soil particles, the soil moves in the only path available for movement, the lateral direction (Doyle). During the test, when the vertical stress on the soil specimen reaches 160 psi, horizontal stress is measured. The value of 160 psi holds significance as the "average value of vertical stress developed in a typical pavement subgrade (Farrar, et al. 8)." But, according to studies performed by Hveem, the number holds no influence on the output of the equation. Similar R-values were calculated with vertical pressure values ranging from 100 to 400 psi. Data from the test is converted to an R-value with the relationship:

$$R = \frac{100}{\frac{2.5}{D}(\frac{P_V}{P_H} - 1) + 1} \quad \text{.................................(14)}$$

where: R= Resistance Value

P_H=Horizontal Stress at P_V=160 psi

P_V= Vertical Stress (160 psi)

D= lateral displacement due to horizontal pressure measured as the displacement of the stabilometer fluid necessary to increase horizontal pressure from 5 to 100 psi measured as number of turns of stabiliomter pump handle

This relationship presents a soil's resistance to plastic flow as a ratio of vertical pressure to horizontal pressure on a scale of 0 to 100. A value of 0 indicates that the soil has no shear resistance, much like a liquid, and all applied vertical load is converted to a lateral pressure. A value of 100 indicates that the soil is able to resist all applied vertical loads without transmitting the loads to horizontal pressure (Doyle). This relationship, however, includes slight modification to account for the roughness of the soil specimen. If the correction for this roughness factor was ignored, the equation would simplify to:

$$R = (1 - \frac{P_H}{P_V}) * 100 \quad \text{.....................................} (15)$$

where: R= Resistance Value

P_H=Horizontal Stress at P_V=160 psi

P_V= Vertical Stress (160 psi)

which truly is a direct representation of R-value as simply applied vertical pressure and the horizontal pressure that results (Farrar, et al.).

Some stipulations must be followed before running the test, however. The test is only to be used on materials that pass the #4 sieve and is not valid for materials that possess high resistance to lateral deformation (Thornton). Additionally, soil specimens are compacted at moisture contents that will cause them to be nearly saturated at exudation pressures of approximately 300 psi. In order to make the test best mimic subgrade soil conditions, it is imperative that the soil be compacted with an apparatus that mimics the loading conditions and the kneading motion of rollers and tires. The compactor invented by Hveem to accomplish this condition is now known as the California kneading compactor.

Figure 3. California Kneading Compactor

http://www.asphaltwa.com/wapa_web/modules/05_mix_design/05_hveem.htm

The tamping foot of the compactor has an area of approximately 3 square inches and provides stresses similar to those a steel drum or rubber-tired pneumatic roller would exert on a subgrade soil (Farrar, et al.), however pressure can be adjusted to achieve the correct soil unit weight.

During testing, the exudation pressure in the sample must mimic the state of density and water content that the material may be subject to in the field (Thornton). This exudation pressure is defined as the pressure when moisture exudes from the soil sample with any additional increase in load, or when the soil specimen is loaded to saturation and any additional load is carried by pore water instead of soil particles (Farrar, et al.). An exudation pressure of 300 psi is seen as presenting the worst case moisture content and density that is experienced in the field (Farrar, et al.); however this exudation pressure causes moisture contents that are higher than are found in Colorado highways (Hines). Some studies show that A-7-6 soils compacted at 300 psi exudation pressure were 9.1% over optimum. When performing R-value tests to be used for correlations with Resilient

Modulus, it is important to consider what moisture content is used. Different highway departments use R-values that correspond to different moisture contents and densities.

2.4 R-Value Correlations

The relationship between R-value and resilient modulus is not as well studied as the relationship between Resilient Modulus and California Bearing Ratio (CBR). As a result, the correlation between R-value and Resilient Modulus has been adjusted to fit with the better known test (Woodbridge). The original correlation determined from data from the San Diego Road Test,

$$M_R = 772 + 369R \quad \text{……………………………..(16)}$$

was altered to

$$M_R = 1155 + 555R \quad \text{………………………………...(17)}$$

to better correlate with data from the CBR test (Farrar, et al.). Other states have developed correlations based upon the soils found locally. For instance, Idaho developed two correlations (Su, et al.):

$$M_R = 1455 + 57R \text{ for fine grained soils...............................(18)}$$

$$M_R = 1600 + 38R \text{ for coarse grained soils……………………(19)}$$

For fine-grained soils in Idaho, mainly low plasticity silts, the following correlation was developed for a deviator stress of 6 psi, bulk stress of 3 psi, and an R-value over 20 (Farrar, et al.):

$$M_R = 1.6 + .038 * R \quad \text{………………………………(20)}$$

According to tests run by the Colorado Department of Transportation, plotting resilient modulus against the average R-value from tests run on a sample both before and after the resilient modulus test presented a correlation of (Su, et al.):

$$M_R = 3500 + 125R \quad \text{.....................................(21)}$$

According to the report, this correlation is very similar to the current correlation used in design for fine grained soils when the R-value is less than 50. However, when the R-value is higher than 50, the modulus calculated from the equation is significantly lower than what is predicted with the current design standard.

3. EXPERIMENTAL DESIGN

Data was gathered from the Arkansas State Highway and Transportation Department representing various soils throughout the state of Arkansas. AHTD ran both R-value and resilient modulus tests on soil samples from various locations across the state. Soil types contained in the data are:

A-2-Silty or Clayey Gravel
A-4-Silt
A-6-Clay
A-7-6-Clay

"Ran" and "Reported" values for both R-value and Resilient Modulus tests were both provided reported. The "Reported" value for a test is the lowest Resilient Modulus value given (and therefore not appropriate for developing a correlation), so for determining a correlation, Resilient Modulus Ran and R-value Ran values were used. A new correlation between R-value and resilient modulus will be attempted by plotting resilient modulus against R-value. This approach was attempted for all soils, as well as splitting the data by soil type (fine grained vs. coarse grained). Additionally, the data was to be plotted against various combinations of the R-values and resilient modulus values as follows (plots can be found in Appendix A):

1. R-value^2
2. R-value^3
3. R-value^4
4. Mr^2
5. Square Root R-value

6. Square Root Resilient Modulus
7. log R-value
8. log Mr
9. ln R-value
10. ln Mr
11. Mr/R-Value
12. Mr^2/R-value

in an attempt to determine the most accurate correlation. Resilient modulus values calculated from any new correlations were compared to the reported values from the AHTD data and the correlation currently used by the MEPDG software (NCHRP),

$$M_R = 1155 + 555R \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (22)$$

Further analysis of the sensitivity of MEPDG to changes in R-value was also evaluated using two pavement designs as shown in Figures 4 and 5.

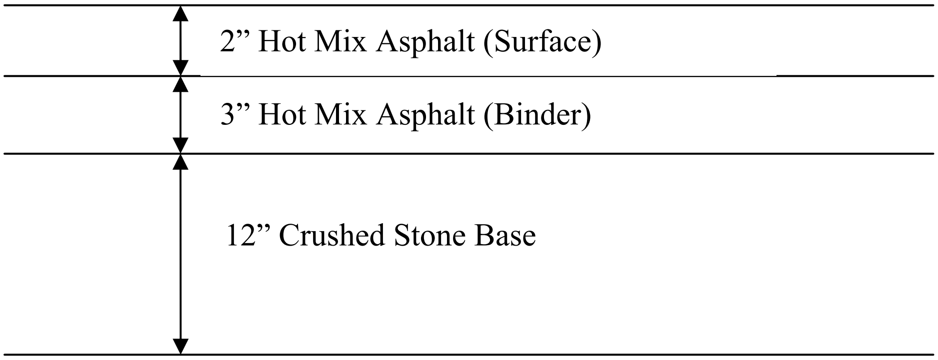

Figure 4. Thinner Pavement Cross Section

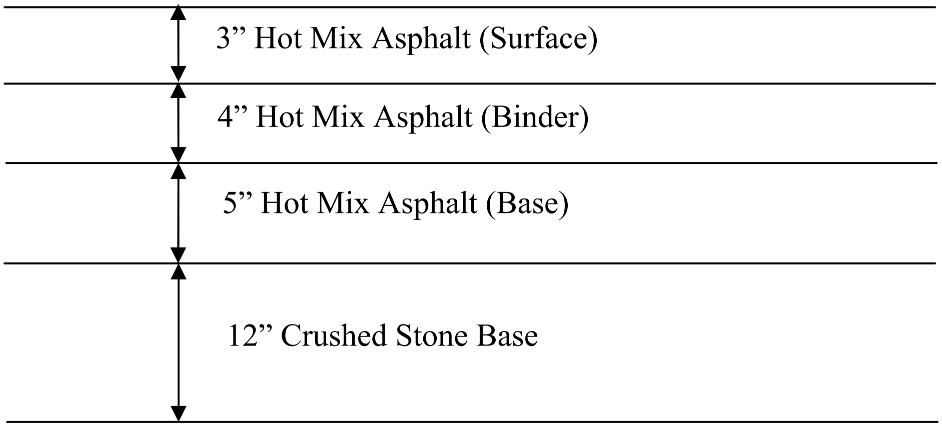

Figure 5. Thicker Pavement Cross Section

Additional information on inputs into MEPDG can be found in Appendix B.

R-values of 5, 10, 15, 20, 25, 30, 35, 40, and 45 were input into the program as Level 2 correlations for resilient modulus. The pavement distresses of bottom-up fatigue cracking, IRI, and total rutting that result from the varying R-values were plotted versus time for both the thicker and thinner pavement sections. Then, the same pavement sections were used, but Resilient Modulus was input as a Level 3 correlation calculated from R-values of 5, 10, 15, 20, 25, 30, 35, 40, and 45 using the correlation developed from the AHTD data. Bottom-up fatigue cracking, IRI, and total rutting were plotted vs. time. Using these plots, the sensitivity of MEPDG to variance in Level 2 R-value inputs were analyzed. Furthermore, the variance in fatigues using the correlation developed from the AHTD data to calculate Level 3 resilient modulus inputs were studied.

4. RESULTS

4.1 Correlations Involving R-Value

Plotting Resilient Modulus against R-value does not lead to very promising results. Even separating the data by soil type does not lead to any significant correlation. Furthermore, the various geometric combinations of R-value and Resilient Modulus also seem to move towards a dead end in terms of developing a usable correlation. However, once the ratio (Resilient Modulus to R)-value versus R-value for all soil types is plotted, a more significant relationship begins to develop, illustrated in Figure 6.

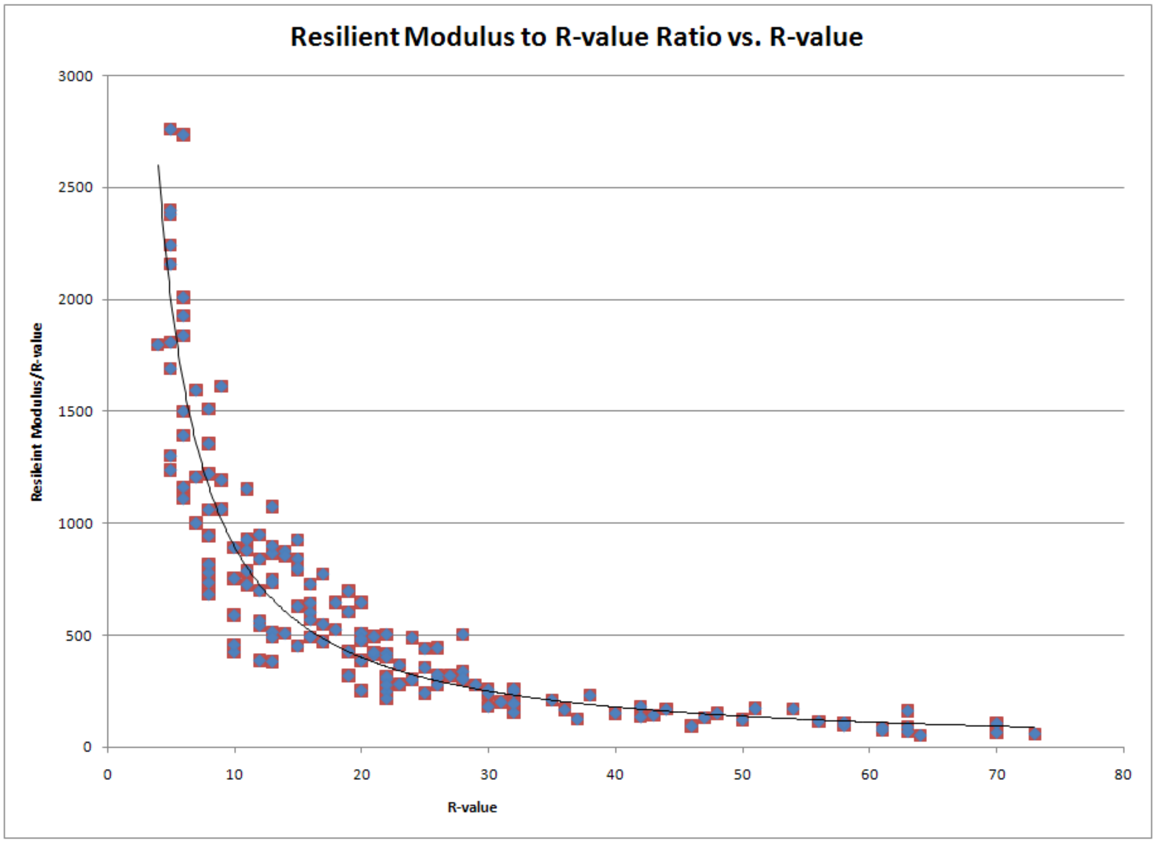

Figure 6. Relationship Between the (Resilient Modulus to R-Value) ratio and the R-value of Arkansas Soils

A power-function regression equation can be developed from this plot as follows:

$$\frac{M_R}{R} = 12998 * R^{-1.163} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (23)$$

$$R^2 = .8973$$

Where: M_R=Resilient Modulus (psi)

R=R-value

The R-squared value of this correlation seems to suggest that plotting the ratio of Resilient Modulus to R-value vs. R-value could lead to a usable correlation for Arkansas soils. In an attempt to further refine the correlation, the ratio of the square of Resilient Modulus to R-value vs. R-value is plotted (Figure 7). Contrary to what is expected, the tightness of this of this correlation seems to diminish as evidenced by the lower R-squared value.

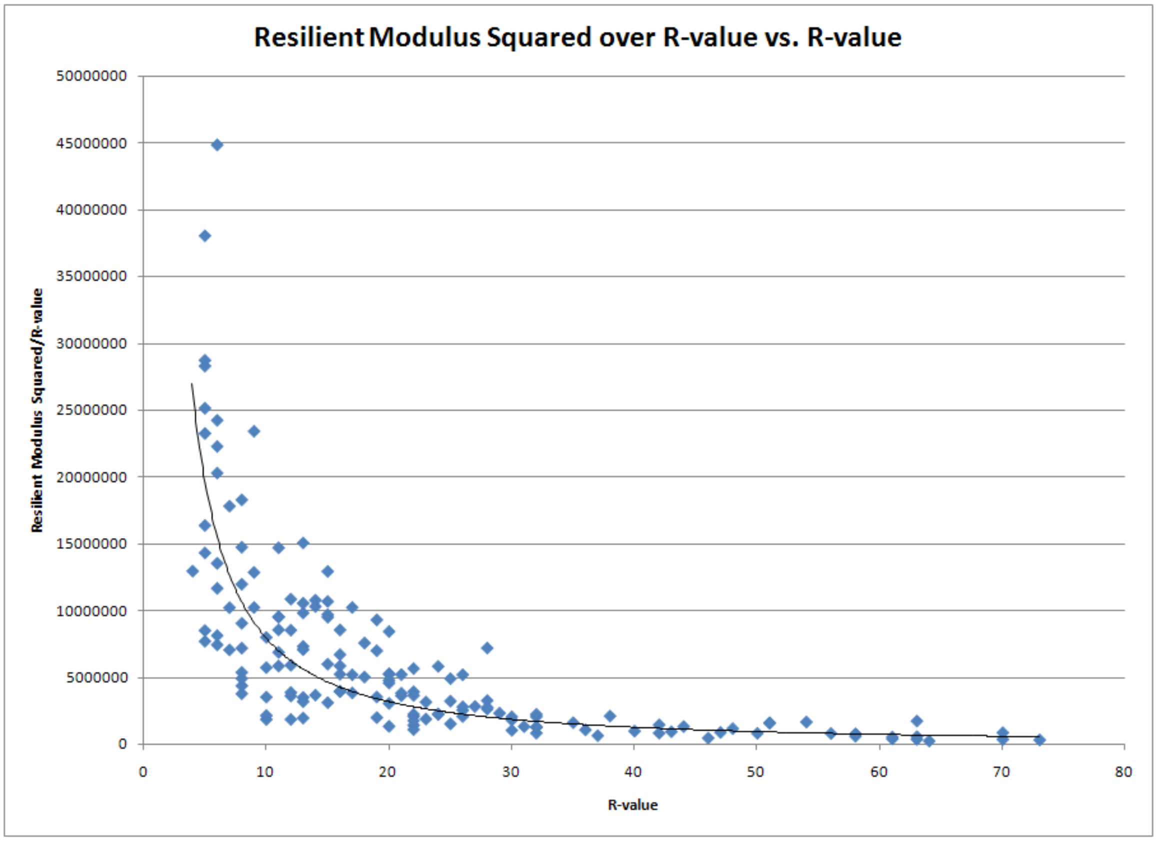

Figure 7. Mr^2/R Plot

A power-function regression was developed as follows:

$$\frac{M_R^2}{R} = 200000000R^{-1.3226} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(24)$$

$$R^2 = .7391$$

Where: M_R=Resilient Modulus (psi)

R=R-value

Subdividing the data by soil type did not result in a more refined correlation, as shown in Figures 23-34 in Appendix B.

To try to further refine the correlation, the data was split into soils with R-values below 25 and those with R-values above 25. Different plots were developed for each soil group. Figure 8 shows the plots of Resilient Modulus/R-value vs. R-value split by soil group.

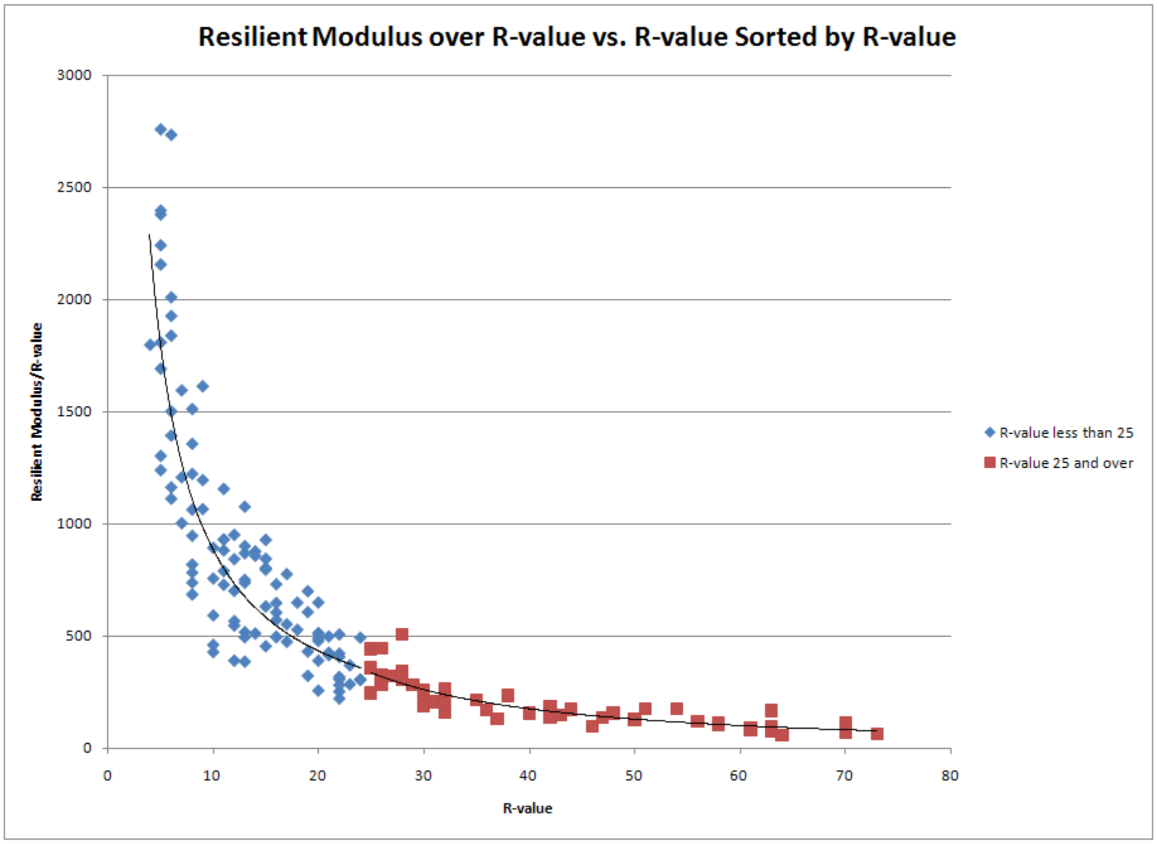

Figure 8. Resilient Modulus over R-value vs. R-value Sorted by R-value

The correlations developed from these plots include:

For R<25:

$$\frac{M_R}{R} = 9605.9R^{-1.033} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(25)$$

$$R^2 = .7536$$

For R$\geq$ 25:

$$\frac{M_R}{R} = 30522R^{-1.401} \qquad \text{……………………………………..(26)}$$
$$R^2 = .7991$$

Contrary to what is expected, splitting up the data does not further refine the correlation. In fact, the attempt at refinement seemed to make the correlation worse.

4.2 Analyzing Correlations

The Mr/R correlation seems to have the tightest fit of the data. A regression line fit through the origin yields a slope of .9298, which is relatively close to a unity equation that would be expected in the predicted and actual M_R/R values were equivalent. However, when the predicted (M_R/R) is plotted against actual (M_R/R) depending on R-value, the correlation appears to become less robust when the ratio exceeds 1000 (Figure 9).

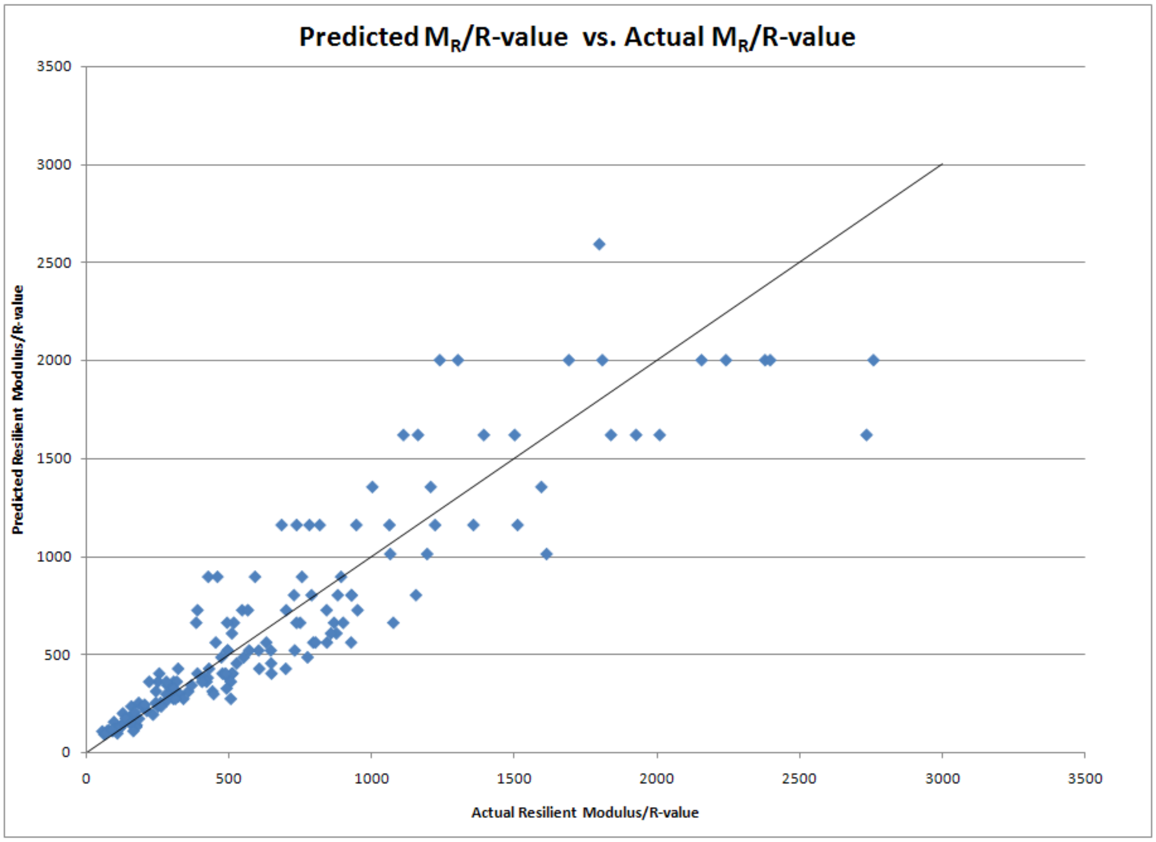

Figure 9. Comparrison of Predicted Mr/R and Actual Mr/R

The Resilient Modulus generated from the correlation currently in use in MEPDG (Equation 22) was compared to the Mr /R correlation developed using Arkansas data (Equation 23). Figure 10 shows how incorrectly the MEPDG correlation predicts Resilient Modulus using R-value for soils commonly seen in Arkansas. The Mr/R correlation is a much tighter fit for soils in Arkansas.

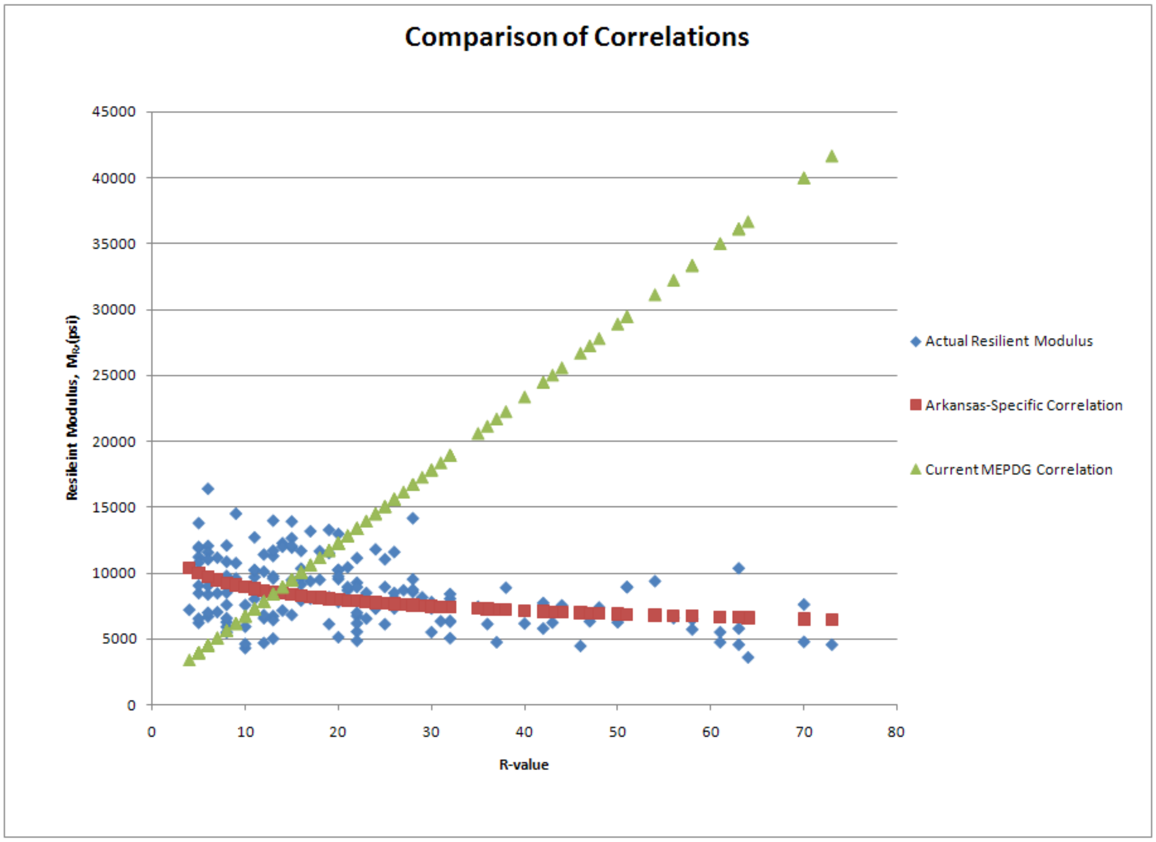

Figure 10. Comparison of Correlations

4.3 MEPDG Tests

The potential importance of the new subgrade soil correlation is highlighted by running MEPDG trials. The sections which follow describe the results of an MEPDG-based study.

4.3.1 Current MEPDG Correlation

4.3.1.1 Thicker Cross Section

Figure 11 shows the MEPDG estimate of total rutting with varying levels of R-value for the subgrade soil (Level 2 input). Inspection of the curves shown in Figure 11 leads to the following observations:

- Total rutting is significantly affected by the R-value
- Total rutting decreases with an increase in R-value
- As R-value increases, the difference in total rutting (the effect of varying R-value) decreases.

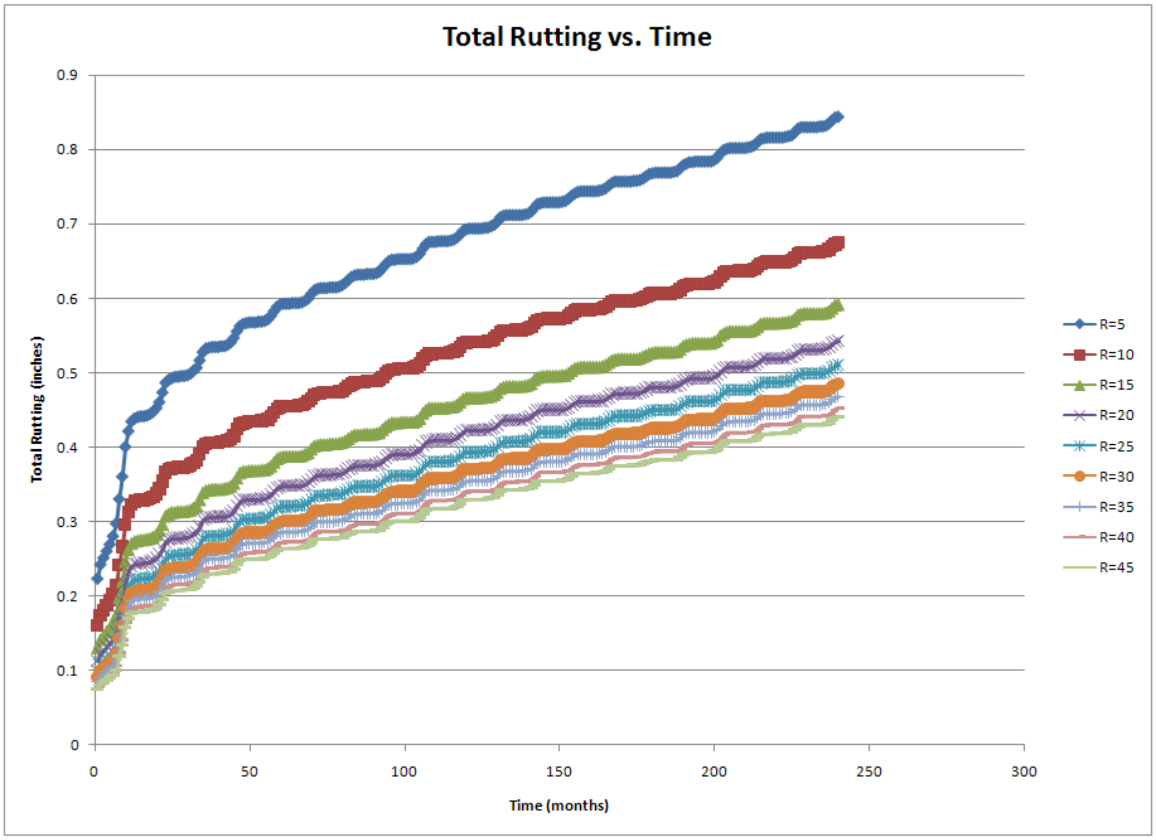

Figure 11. Total Rutting vs. Time, Thicker Cross Section, Current Correlation

Figure 12 shows the MEPDG estimate of bottom up cracking with varying levels of R-value for the subgrade soil (Level 2 input). Inspection of the curves shown in Figure 12 leads to the following observations:

- Bottom up cracking is significantly affected by the R-value
- Bottom up cracking decreases with an increase in R-value
- As R-value increases, the difference in bottom up cracking (the effect of varying R-value) decreases.

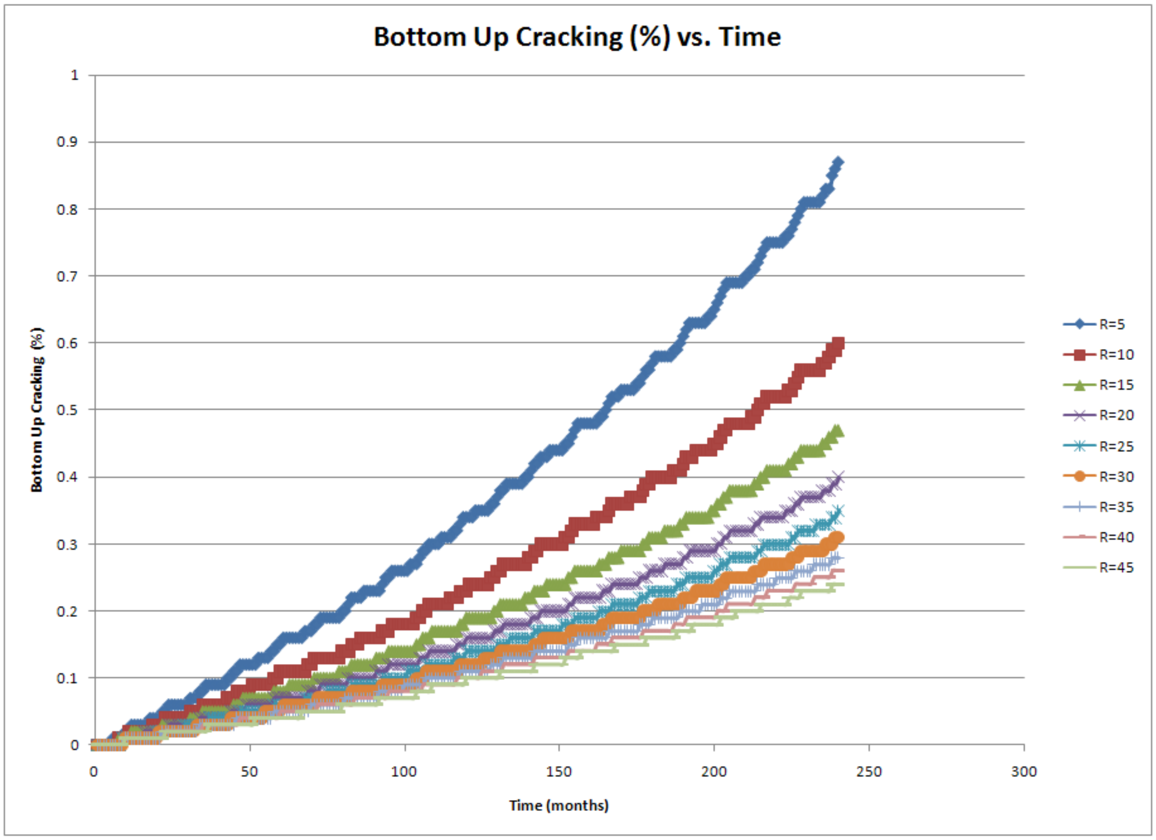

Figure 12. Bottom-Up Cracking vs. Time, Thicker Cross Section, Current Correlation

Figure 13 shows the MEPDG estimate of IRI with varying levels of R-value for the subgrade soil (Level 2 input). Inspection of the curves shown in Figure 13 leads to the following observations:

- IRI is affected by the R-value
- IRI decreases with an increase in R-value
- As R-value increases, the difference in IRI (the effect of varying R-value) decreases.

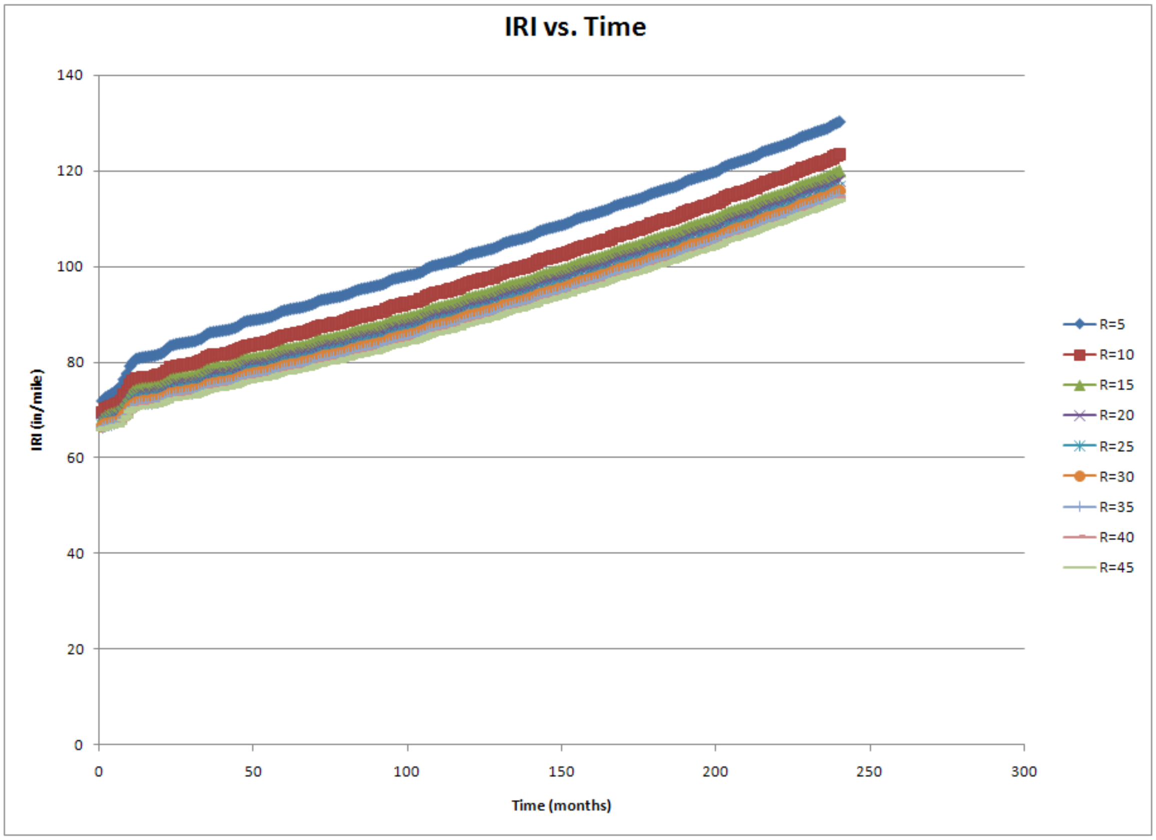

Figure 13. IRI vs. Time, Thicker Cross Section, Current MEPDG Correlation

4.3.1.2 Thinner Cross Section

Figure 14 shows the MEPDG estimate of Total Rutting with varying levels of R-value for the subgrade soil (Level 2 input). Inspection of the curves shown in Figure 14 leads to the following observations:

- Total rutting is significantly affected by the R-value
- Total rutting decreases with an increase in R-value
- As R-value increases, the difference in total rutting (the effect of varying R-value) decreases.

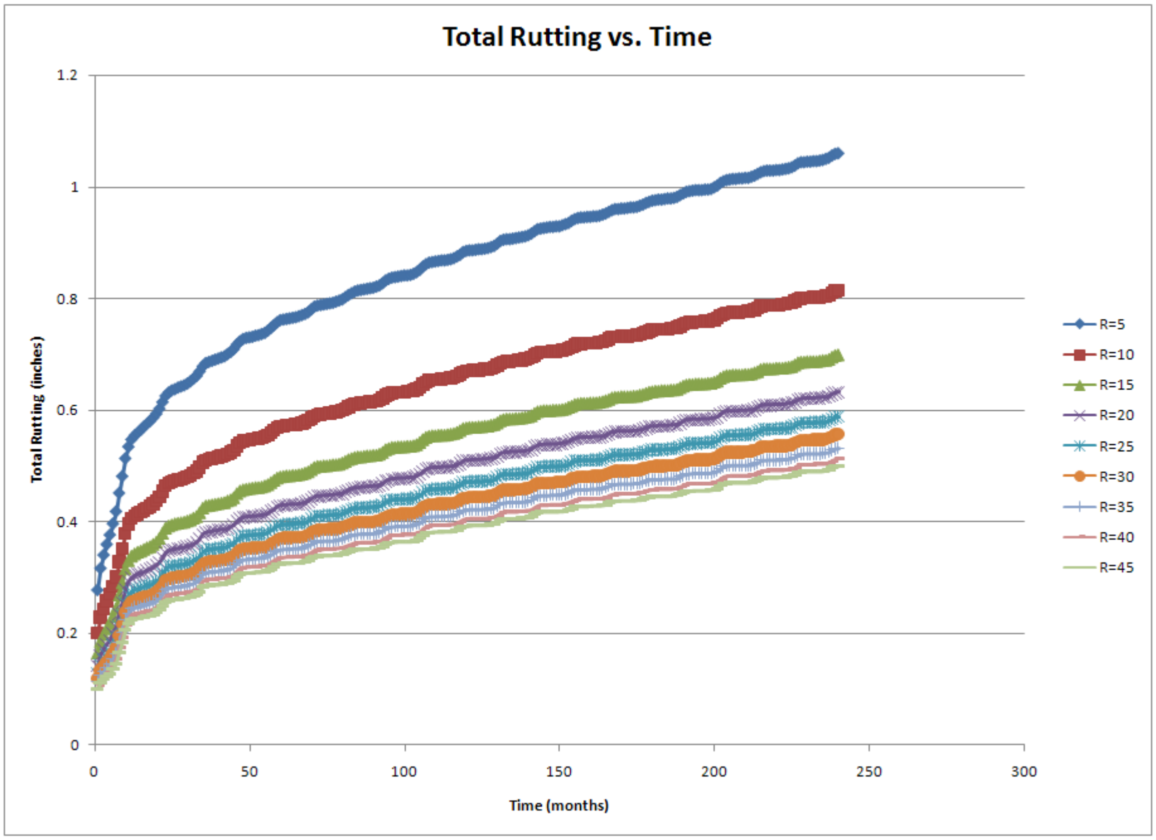

Figure 14. Total Rutting vs. Time, Thinner Cross Section, Current Correlation

Figure 15 shows the MEPDG estimate of Bottom Up Cracking with varying levels of R-value for the subgrade soil (Level 2 input). Inspection of the curves shown in Figure 15 leads to the following observations:

- Bottom Up Cracking is affected by the R-value
- Bottom Up Cracking decreases with an increase in R-value
- As R-value increases, the difference in Bottom Up Cracking (the effect of varying R-value) decreases.

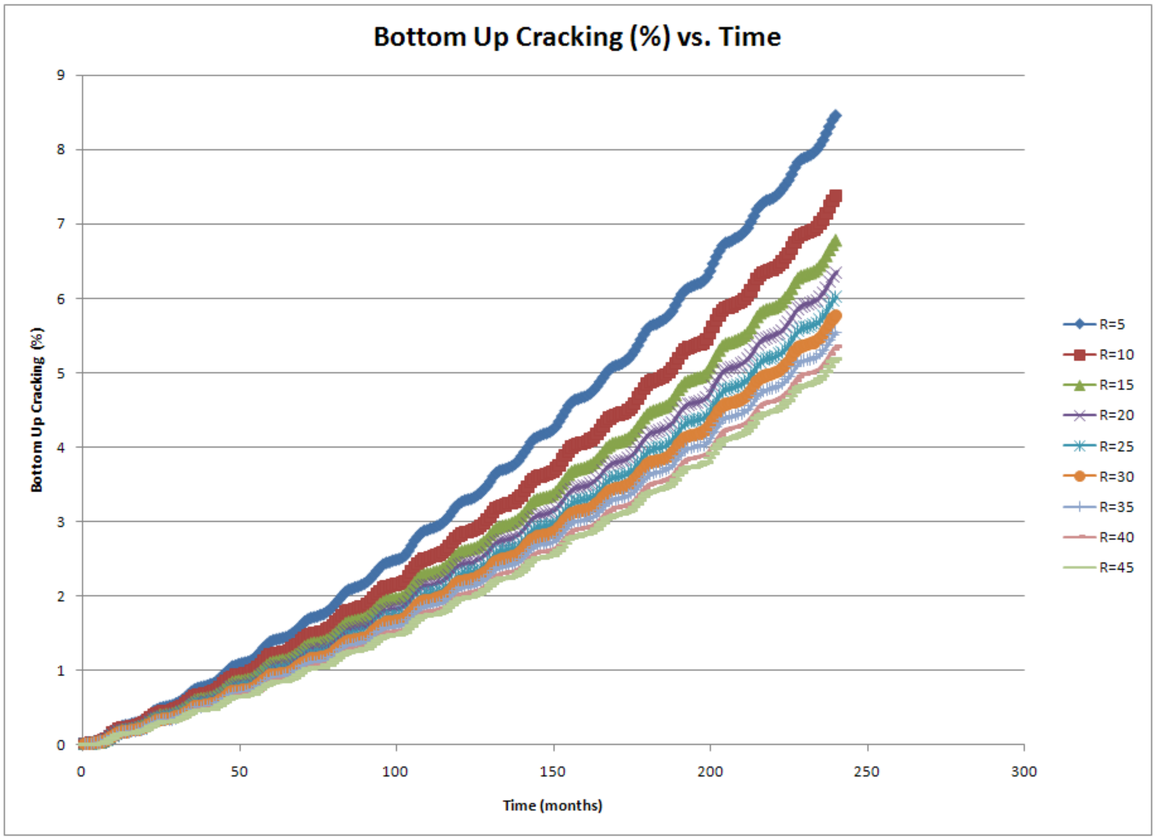

Figure15. Bottom-Up Fatigue vs. Time, Thinner Cross Section, Current Correlation

Figure 16 shows the MEPDG estimate of IRI with varying levels of R-value for the subgrade soil (Level 2 input). Inspection of the curves shown in Figure 16 leads to the following observations:

- IRI is affected by the R-value in the long run
- IRI decreases with an increase in R-value
- As R-value increases, the difference in IRI (the effect of varying R-value) decreases.

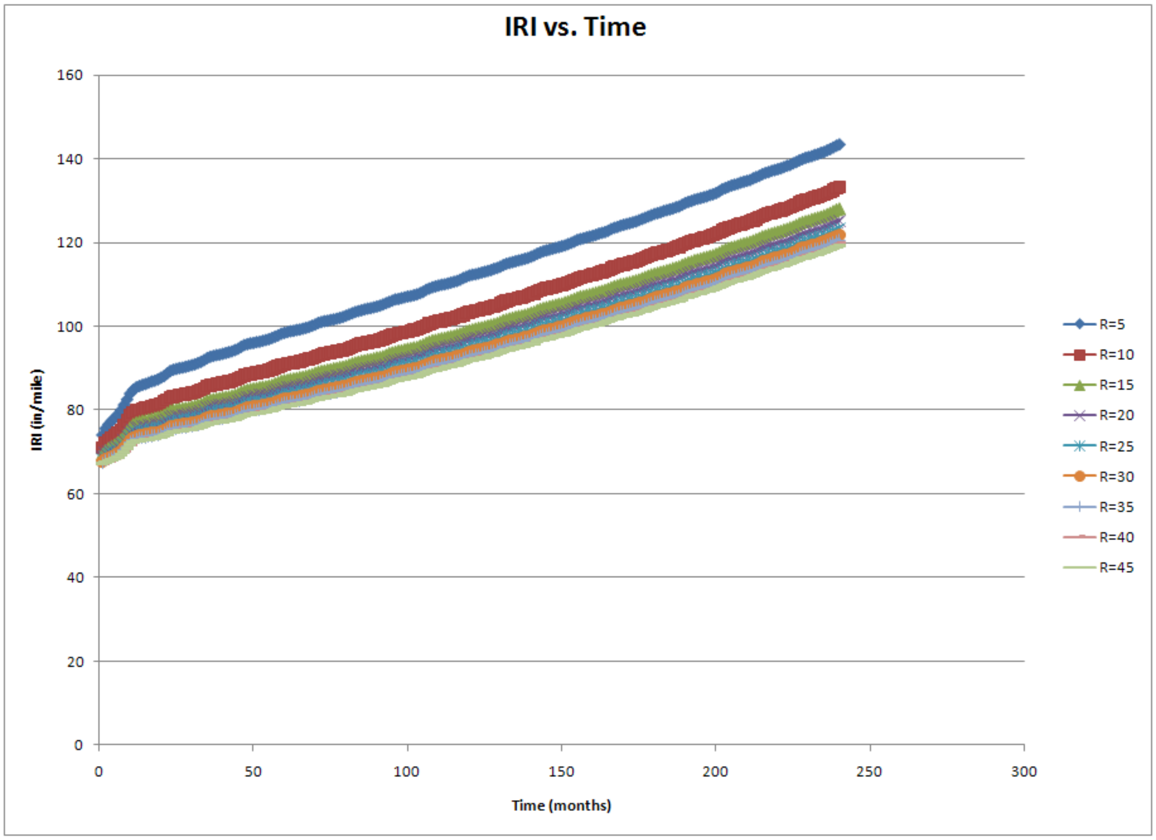

Figure 16. IRI vs. Time, Thinner Cross Section, Current Correlation

4.3.2 Pavement Failures with New Correlation

4.3.2.1 Thicker Cross Section

Figure 17 shows the estimate of Total Rutting with varying levels of R-value for the subgrade soil using the Arkansas-specific correlation (Level 3 input). Inspection of the curves shown in Figure 17 leads to the following observations:

- Total rutting is slightly affected by the R-value
- Total rutting increases with an increase in R-value
- As R-value increases, the difference in total rutting (the effect of varying R-value) decreases.

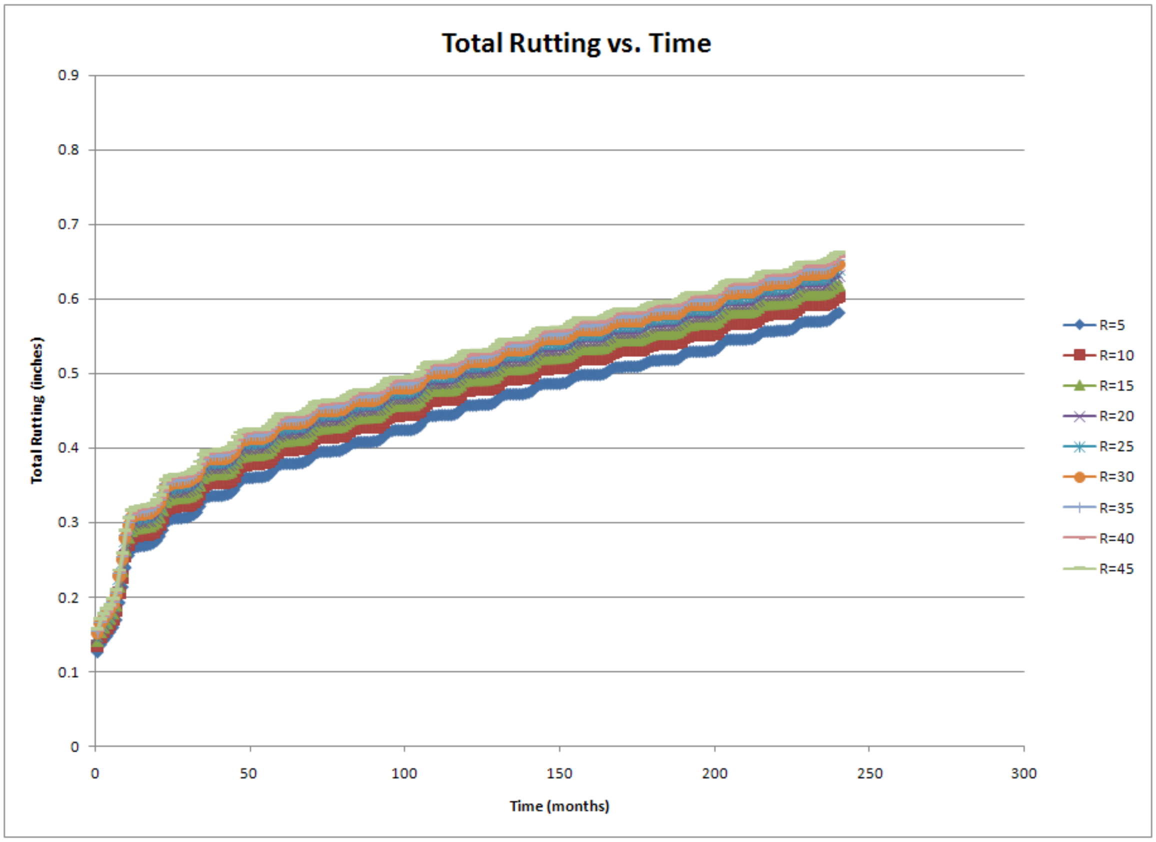

Figure 17. Total Rutting vs. Time, Thicker Cross Section, New Correlation

Figure 18 shows the estimate of Bottom-up Cracking with varying levels of R-value for the subgrade soil using the Arkansas-specific correlation (Level 3 input). Inspection of the curves shown in Figure 18 leads to the following observations:

- Bottom-up Cracking is affected by the R-value
- Bottom-up Cracking increases with an increase in R-value
- As R-value increases, the difference in Bottom-up Cracking (the effect of varying R-value) decreases.

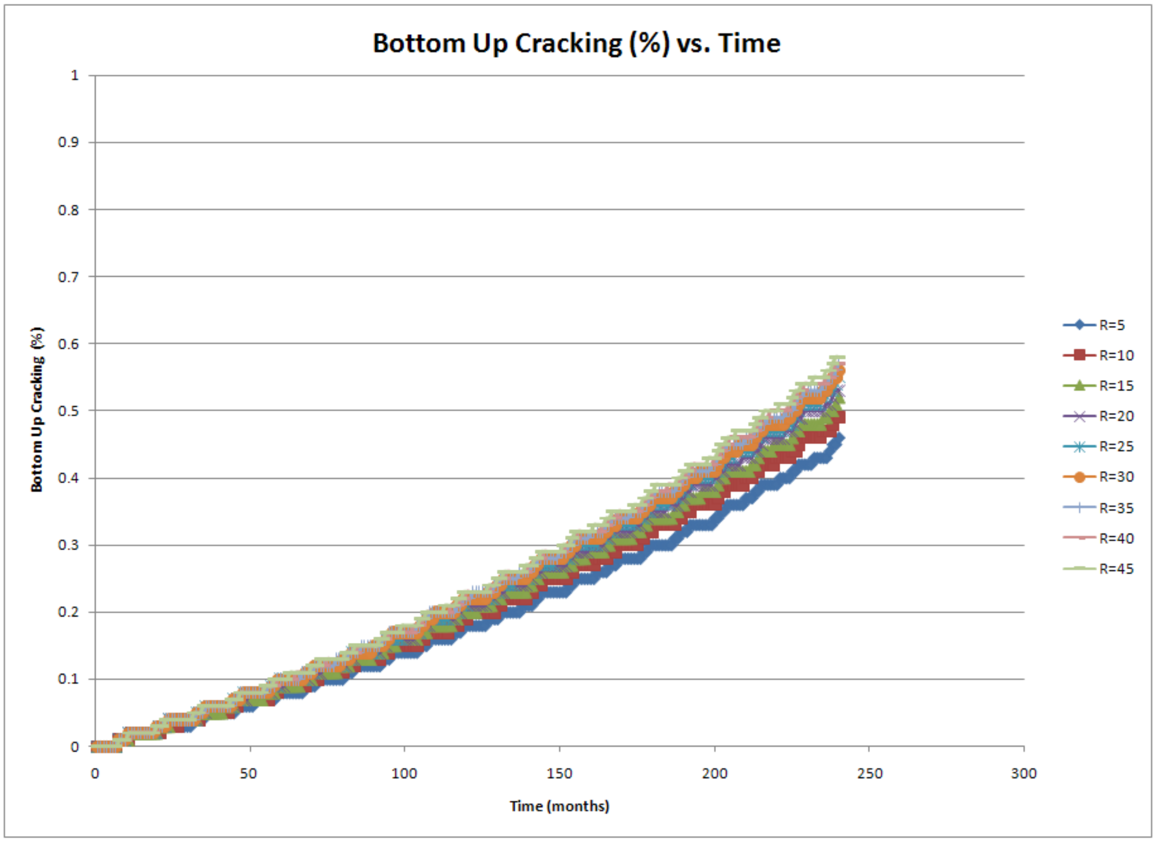

Figure 18. Bottom Up Cracking vs. Time, Thicker Cross Section, New Correlation

Figure 19 shows the estimate of IRI with varying levels of R-value for the subgrade soil using the Arkansas-specific correlation (Level 3 input). Inspection of the curves shown in Figure 19 leads to the following observations:

- IRI is not significantly affected by the R-value
- As R-value increases, the difference in IRI (the effect of varying R-value) shows no significant change.

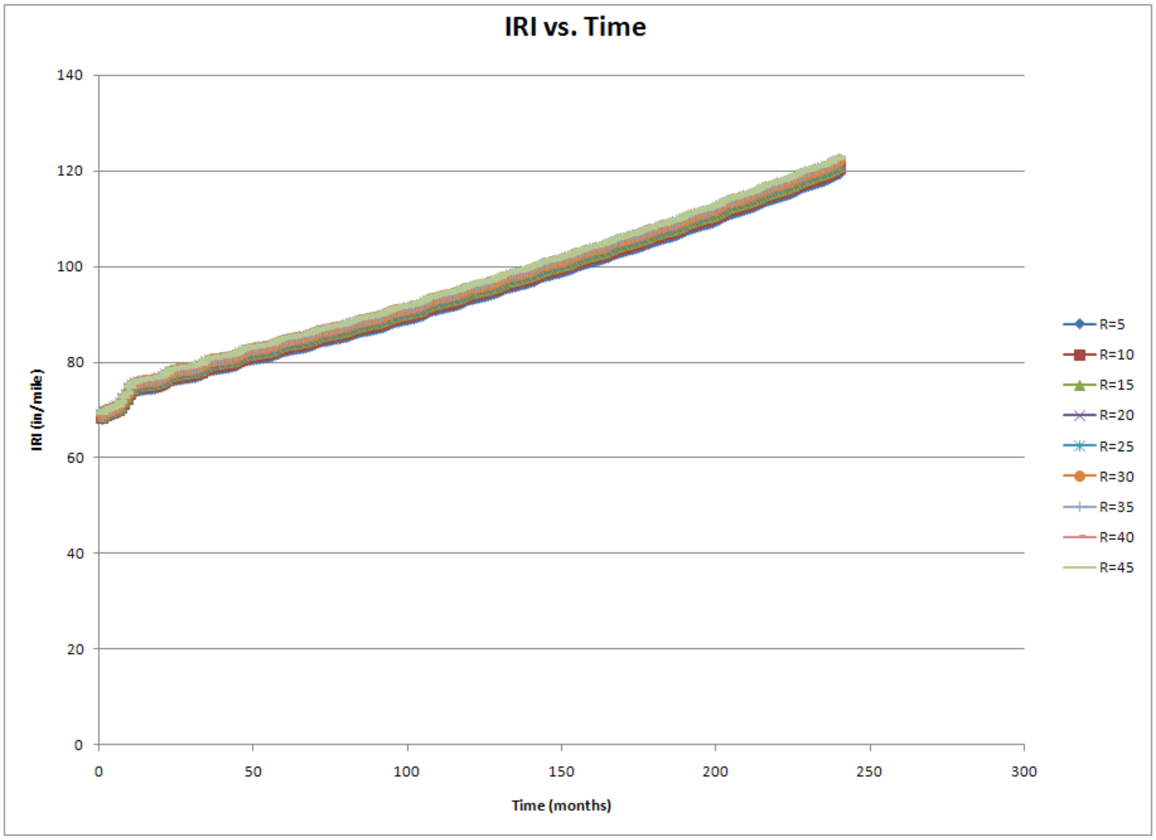

Figure 19. IRI vs. Time, Thicker Cross Section, New Correlation

4.3.2.2 Thinner Cross Section

Figure 20 shows the estimate of Total Rutting with varying levels of R-value for the subgrade soil using the Arkansas-specific correlation (Level 3 input). Inspection of the curves shown in Figure 20 leads to the following observations:

- Total rutting is slightly affected by the R-value
- Total rutting increases with an increase in R-value
- As R-value increases, the difference in total rutting (the effect of varying R-value) decreases.

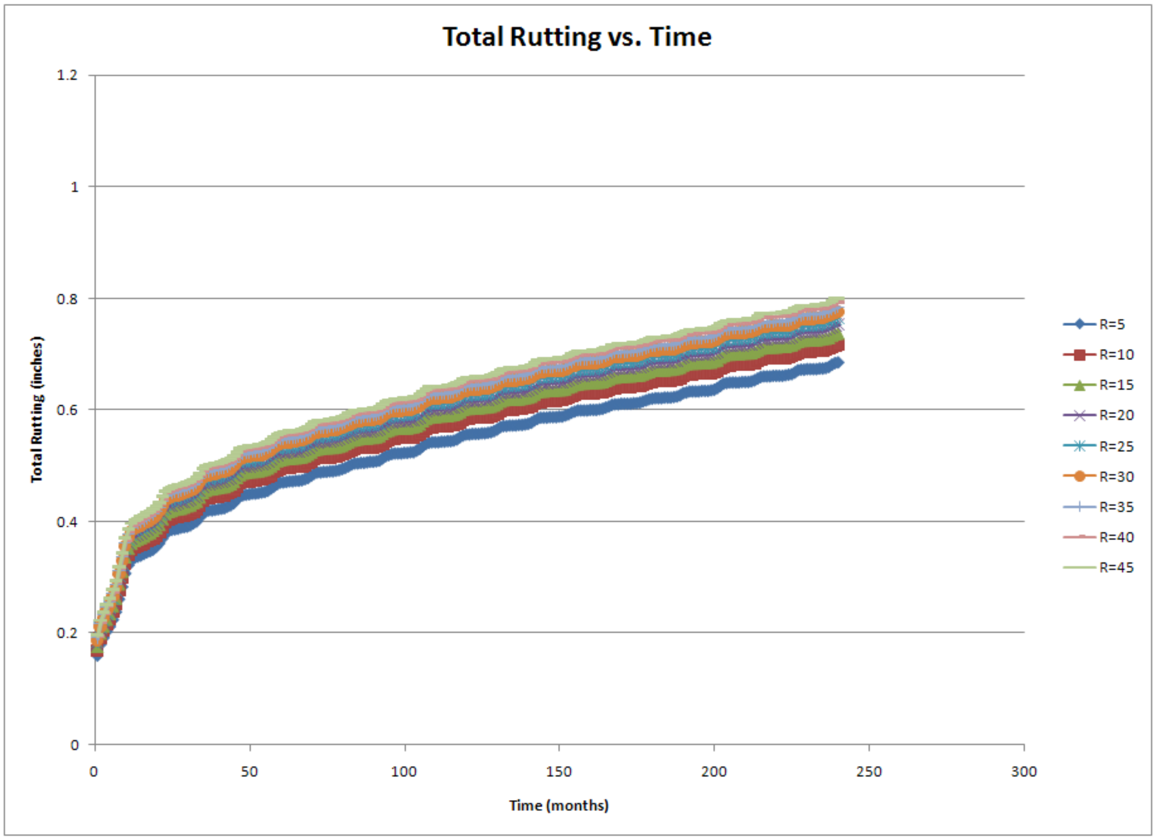

Figure 20. Total Rutting vs. Time, Thinner Cross Section, New Correlation

Figure 21 shows the estimate of Bottom Up Cracking with varying levels of R-value for the subgrade soil using the Arkansas-specific correlation (Level 3 input). Inspection of the curves shown in Figure 21 leads to the following observations:

- Bottom Up Cracking is slightly affected by the R-value
- Bottom Up Cracking increases with an increase in R-value
- As R-value increases, the difference in Bottom Up Cracking (the effect of varying R-value) remains constant.

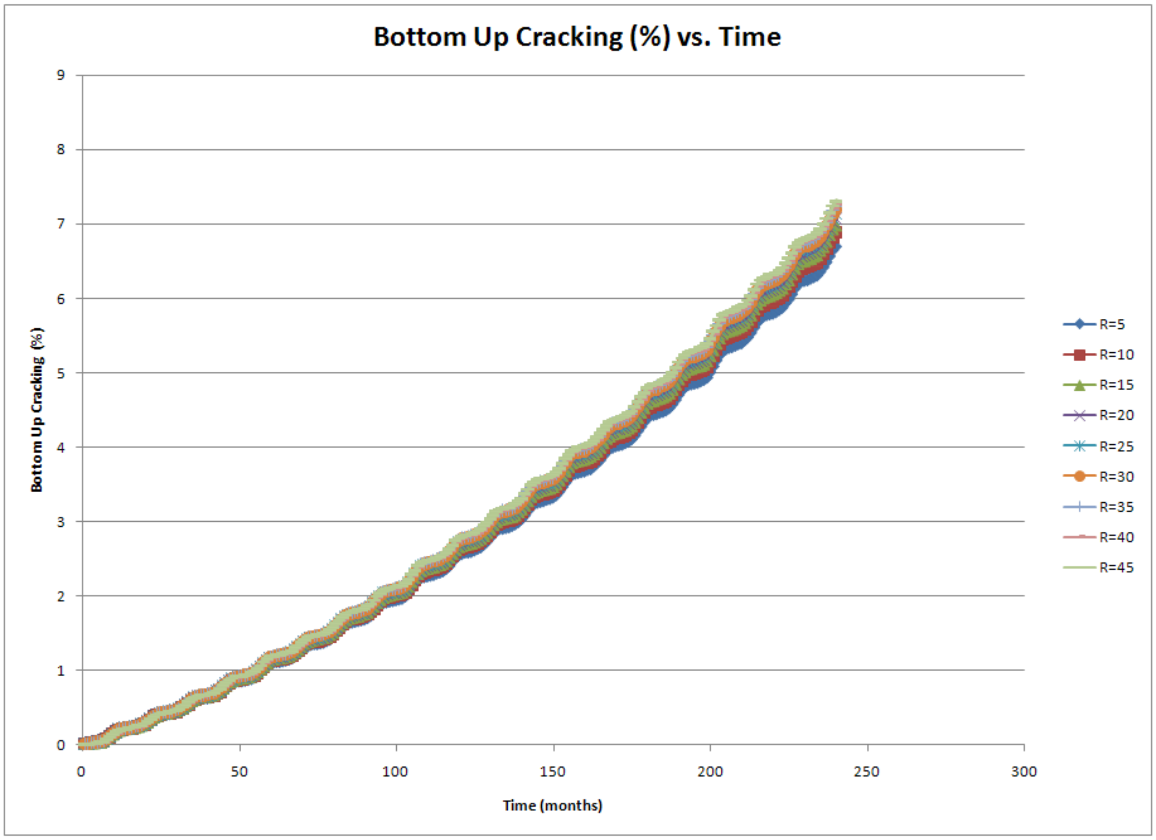

Figure 21. Bottom Up Cracking vs. Time, Thinner Cross Section, New Correlation

Figure 22 shows the estimate of IRI with varying levels of R-value for the subgrade soil using the Arkansas-specific correlation (Level 3 input). Inspection of the curves shown in Figure 22 leads to the following observations:

- IRI is slightly affected by the R-value
- IRI increases with an increase in R-value
- As R-value increases, the difference in IRI (the effect of varying R-value) remains constant.

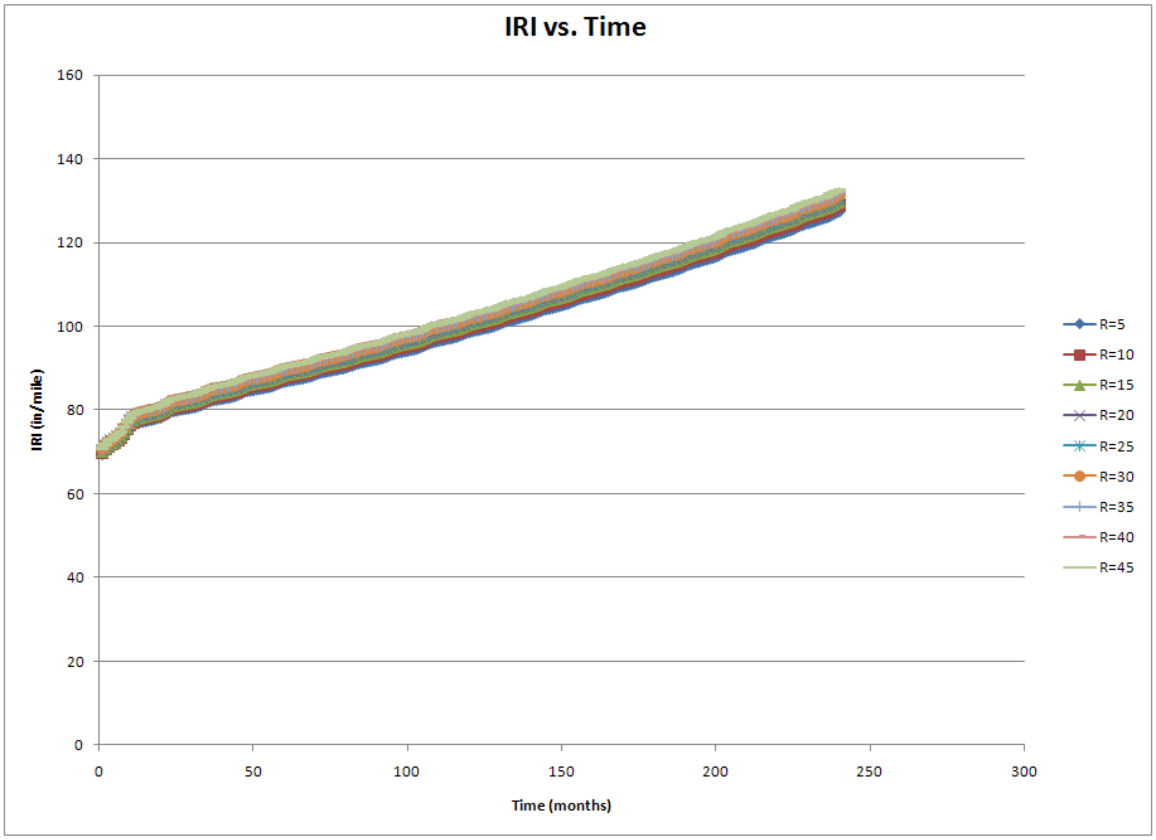

Figure 22. IRI vs. Time, Thinner Cross Section, New Correlation

5. DISCUSSION AND CONCLUSIONS

It is clear that the current R-value to Resilient Modulus MEPDG correlation may lead to significantly under-designed pavements when R-value for Arkansas soils is beyond approximately 25, especially in thinner pavements and over-designed pavements when R-value is 10 or below. There seems to be little true correlation between R-value and Resilient Modulus at all; even the newly developed correlation begins to break down at higher R-values due to a lack of data and the mathematical manipulations performed on the data when developing the correlation. When using the current MEPDG correlation, there is a significant difference in pavement failures over the course of 20 years for both the thin and thick pavement sections for varying R-values. When a soil has a low R-value, the effect of R-value on predicted pavement performance is pronounced. The thinner pavement does not have the same capacity to diminish the applied traffic loads and the loading effects are increased. Any slight variance in the lower R-values can lead to very different failures than what is expected from the MEPDG output. This means that a pavement that is even slightly underdesigned with regards to R-value with the current MEPDG correlation can experience extreme rutting failures more quickly.

Interestingly, the Arkansas-specific correlation exhibits an inverse trend: Resilient Modulus decreases with increasing R-value. Even though the new R-value correlation drastically improves using R-value as a predictor of Resilient Modulus, it is important to keep in mind that the R-value test is a static test measuring how a soil reacts to a vertical load in a lateral direction while Resilient Modulus measures how a soil reacts to a cyclic loading pattern much like what a soil would experience under a pavement. Using a static test to predict a dynamic soil property will not provide the most accurate results, but it seems that the two soil properties should exhibit a direct correlation. Additionally, the correlations was developed using a limited amount of data. In order to develop the best possible correlation, additional data should be gathered. Because of this discontinuity in the data and the lack of data, the testing procedures used to obtain both Resilient Modulus and R-value should be reviewed to make sure the measured values are correct and more R-value and Resilient Modulus tests should be run.

If the data is deemed correct and if AHTD chooses to continue using R-value correlations as their way to determine Resilient Modulus in MEPDG, consideration must be given to abandoning the default MEPDG correlation and using a more Arkansas soil specific correlation. While the new correlation is not a perfect solution and certainly does not match the accuracy of using Resilient Modulus test data as a Level 3 input in MEPDG, it is a much closer match for soils commonly found throughout the state of Arkansas. Since the new correlation more closely follows the pattern of data and does not show much variance in Resilient Modulus with changes in R-value, the variances in R-value do not cause the dramatic separation in data that the current MEPDG correlation causes for both thin and thick pavement cross sections. If the R-value of a soil is measured slightly higher than the actual R-value of the soil, the effect on pavement failures will not be as dramatic as what could happen if the incorrect R-value was input to MEPDG using the current correlation.

6. REFERENCES

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APPENDIX A

AHTD DATA

Table A1. AHTD Soil Properties

AHTD RESILENT MODULUS TEST RESULTS (5/4/04-4/1/07)

DOCK #	LAB #	JOB NAME	DATE TEST	SOILS TYPE	% PASS.#200	LL	PI	MAX DEN	OPT MOIST	FIELD MOIST.	STA.#	CO.	RV REPORTED	RV RAN	JOBNAME
20041115	RV324	061026	5/3/04	A-6 (7)	65	35	14	113	14	22	106+00	60	5	5	OAK ST.- LOOP RD.(GRAHAM RD.) (JACKSONVILLE)
20041125	RV329	020048	5/4/04	A-4 (3)	84	22	06	112	15	20	6+00	35	8	8	PLUM BAYOU (BR.& APPRS.)(S)
20041216	RV378	020384	5/11/04	A-4 (0)	88	ND	NP	108	13	23	6+00	35	5	40	MAIN DITCH STR & APPRS. (S)
20041211	RV372	070237	5/11/04	A-6 (6)	66	28	14	107	13	6	249+00	10			PIKE CO LINE - EAST (S)
20041210	RV371	070237	5/11/04	A-6 (7)	80	28	11	104	19	19	209+00	10			PIKE CO LINE - EAST (S)
20041209	RV370	070237	5/11/04	A-4 (0)	63	16	02	122	10	15	113+00	10		58	PIKE CO LINE - EAST (S)
20041213	RV374	070237	5/11/04	A-4 (2)	75	24	06	111	15	25	369+00	10			PIKE CO LINE - EAST (S)
20041212	RV373	070237	5/11/04	A-6 (10)	81	29	15	114	14	21	321+00	10	5	<5	PIKE CO LINE - EAST (S)
20041312	RV395	040420	5/14/04	A-4 (6)	87	27	09	113	14	21	143+00	72	15	22	TOWNSHIP RD. - FUTRALL DR (GREGG AVE.FAYETTEVILLE)
20041359	RV418	061104	5/21/04	A-4 (0)	56	20	06	121	12	15	201+00	60	20	20	FOXCROFT RD-MISS AVE SAFETY IMPVTS
20041355	RV414	110131	5/21/04	A-4 (5)	67	ND	NP	114	14	18	20+00	48	10	10	T-40 OVERPASS
20041323	RV406	050146	5/24/04	A-4 (8)	91	29	10	106	16	21	23+00	67	24	24	HWY.62/HWY 175 SPUR SIG&INTERS IMPVTS(CHEROKEE VLG
20041320	RV403	061085	5/24/04	A-6 (6)	71	30	11	112	16	15	184+00	60	11	11	HWY 5 - HWY 107 STR & APPRS (S)
20041319	RV402	061085	5/24/04	A-4 (2)	73	23	06	115	15	21	109+00	60		21	HWY 5 - HWY 107 STR & APPRS (S)
20041401	RV439	110463	5/27/04	A-7-6(16)	73	41	25	100	19	35	138+00	18	5	5	I40 NORTH WIDENINGS
20041415	RV453	040416	6/10/04	A-4 (1)	62	24	06	118	12	18	110+00	65	10	10	HWY 451 PLANTERS RD SIG & INTERS IMPUTS
20041412	RV450	040397	6/11/04	A-4 (4)	61	27	10	111	17	20	315+00	72	11	20	LINCOLN PRAIRIE GROVE
20041411	RV449	040397	6/11/04	A-4 (5)	70	27	10	107	14	21	219+00	72			LINCOLN PRAIRIE GROVE
20041410	RV448	040397	6/11/04	A-4 (1)	45	23	08	116	14	16	114+00	72			LINCOLN PRAIRIE GROVE
20041641	RV506	100566	6/23/04	A-6 (10)	68	33	18	108	16	17	288+00	28	5	5	PARAGOULD-BIG SLOUGH DITCH (F)
20041640	RV505	100566	6/23/04	A-6 (4)	58	27	13	114	14	14	224+00	28			PARAGOULD-BIG SLOUGH DITCH (F)
20041639	RV504	100566	6/23/04	A-6 (8)	77	31	12	106	17	22	160+00	28			PARAGOULD-BIG SLOUGH DITCH (F)
20041642	RV507	100566	6/23/04	A-4 (0)	63	20	03	114	12	13	312+00	28		37	PARAGOULD-BIG SLOUGH DITCH (F)
20041688	RV549	090153	6/30/04	A-7-6(20)	78	43	27	95	23	20	115+00	4	5	5	LITTLE SUGAR CREEK STRS & APPRS
20041660	RV525	100433	6/30/04	A-4 (2)	89	25	04	112	14	25	419+00	16	10	54	GREEN COUNTY LINE-SOUTH STRS & APPRS (S)
20041650	RV515	100570	6/30/04	A-4 (3)	85	24	05	110	15	29	207+00	28	25	58	HOOKER-WEST STR & APPRS (S)
20041649	RV514	100570	6/30/04	A-4 (0)	65	ND	NP	117	12	12	115+00	28		58	HOOKER-WEST STR & APPRS (S)
20041714	RV565	30078	7/12/04	A-6 (9)	67	34	17	107	18	38	184+00	29			I-30-AVE. A (HWY 278 B) (HOPE) (S)
20041713	RV564	30078	7/12/04	A-6 (14)	79	38	19	105	17	20	112+00	29	7	7	I-30-AVE. A (HWY 278 B) (HOPE) (S)
20041835	RV602	030295	7/20/04	A-4 (3)	57	28	10	104	16	15	BORING #1	46	5	13	JEFFERSON AVE & HWY 245 INTERCHANGE IMPUTS
20041834	RV601	030295	7/20/04	A-4 (0)	63	20	05	118	12	26	1+00	46		13	JEFFERSON AVE & HWY 245 INTERCHANGE IMPUTS
20041972	RV650	020044	7/30/04	A-7-6(24)	81	49	29	95	24	21	316+00	21	<5	<5	MCGEHEE-MCARTHUR BRS.& APPRS. (S)

AHTD RESILENT MODULUS TEST RESULTS (5/4/04-4/1/07)

DOCK #	LAB #	JOB NAME	DATE TEST	SOILS TYPE	% PASS.#200	LL	PI	MAX DEN	OPT MOIST	FIELD MOIST.	STA.#	CO.	RV REPORTED	RV RAN	JOBNAME
20041971	RV649	020044	7/30/04	A-6 (7)	76	30	11	112	14	21	214+00	21			MCGEHEE-MCARTHUR BRS.& APPRS. (S)
20041970	RV648	020044	7/30/04	A-4 (6)	80	28	10	115	14	22	113+00	21			MCGEHEE-MCARTHUR BRS.& APPRS. (S)
20041996	RV656	040405	7/30/04	A-6 (9)	82	31	12	108	16	10	14+63	72	<5	<5	TOWN BRANCH STR. & APPS. (S. GARLAND AVE.)
20041943	RV638	R20097	7/30/04	A-7-6(18)	78	42	24	108	16	30	261+00	9			HWY 82(LAKE VILLAGE) FAIR VIEW (F)
20041942	RV637	R20097	7/30/04	A-4 (2)	80	24	04	110	15	20	173+00	9			HWY 82(LAKE VILLAGE) FAIR VIEW (F)
20041941	RV636	R20097	7/30/04	A-4 (3)	81	25	06	111	15	19	101+00	9	7	7	HWY 82(LAKE VILLAGE) FAIR VIEW (F)
20041944	RV639	R20097	7/30/04	A-7-6(21)	80	45	27	96	23	23	285+00	9		<5	HWY 82(LAKE VILLAGE) FAIR VIEW (F)
20042009	RV669	040423	8/5/04	A-6 (8)	82	27	12	116	13	18	190+00	72		13	HWY-16 (FAYETTEVILLE) (S)
20042008	RV668	040423	8/5/04	A-4 (3)	73	25	07	114	14	14	126+00	72	12	12	HWY-16 (FAYETTEVILLE) (S)
20042153	RV681	110422	8/5/04	A-7-6(29)	74	61	39	95	25	52	144+00	18	<5	<5	14TH ST-HWY 38 (WEST MEMPHIS) (S)
20042189	RV691	050044	8/9/04	A-6 (9)	80	30	14	111	14	21	151+00	73	10	31	MAIN STR.-CROSS STR. (SEARCY) (S)
20042399	RV717	061146	8/25/04	A-4 (0)	67	ND	NP	108	16	22	58+00	60	25	50	HWY 70 GRADE REVISION (NLR) (S)
20042466	RV759	070261	9/6/04	A-4 (0)	47	ND	NP	123	10	8	103+00	10	25	32	HWY 67 DRAINAGE IMPROVEMENTS (ARKADELPHIA)
20042462	RV751	110229	9/8/04	A-6 (13)	78	38	18	102	21	20	154+00	39	6	6	N.MARIANNA-UNION PACIFIC OVERPASS (S)
20042461	RV750	110229	9/8/04	A-4 (8)	88	31	10	108	17	24	76+00	39			N.MARIANNA-UNION PACIFIC OVERPASS (S)
20042460	RV749	110229	9/8/04	A-6 (13)	97	37	12	104	19	22	20+00	39			N.MARIANNA-UNION PACIFIC OVERPASS (S)
20042616	RV826	C456	9/15/04	A-4 (4)	86	27	06	113	15	29	MM+0.5	47	12	12	COUNTY RD. E764 FROM HWY61S TO HWY 239
20042547	RV798	030182	9/17/04	A-7-6(7)	57	45	15	107	17	28	204+00	37			RED RIVER - HWY.29
20042546	RV797	030182	9/17/04	A-7-6(17)	75	41	25	104	19	22	172+00	37	<5	<5	RED RIVER - HWY.29
20042545	RV796	030182	9/17/04	A-4 (0)	64	22	03	115	14	21	116+00	37		13	RED RIVER - HWY.29
20042549	RV800	030182	9/17/04	A-4 (0)	87	ND	NP	109	15	25	372+00	37			RED RIVER - HWY.29
20042631	RV835	090165	9/21/04	A-4 (4)	68	28	08	107	16	36	116+00	4		22	PINNACLE HILLS PKWY./HORSEBARN RD. WIDENIGN(ROGERS
20042598	RV816	061015	9/22/04	A-4 (2)	58	25	07	116	14	25	174+00	60		19	KELLOGG CREEK-BAYOU METRO (S)
20042597	RV815	061015	9/22/04	A-6 (5)	63	32	11	120	12	11	118+00	60	10	10	KELLOGG CREEK-BAYOU METRO (S)
20042651	RV842	FA2607	9/23/04	A-4 (4)	66	30	09	108	17	15	116+00	26	8	8	LITTLE MAZARN CREEK (S)
20042706	RV853	061135	9/26/04	A-4 (0)	50	ND	NP	121	11	8	125+00	26	16	70	QUACHITA RIVER-NORTH (HOT SPRINGS) (S)
20042745	RV865	090152	9/30/04	A-7-6(28)	69	65	42	95	24	28	121+00	5	<5	<5	BRANCH OF HUZZAH CREEK STR. APPRS. (S)
20042764	RV884	100306	10/5/04	A-4 (0)	41	ND	NP	122	11	11	206+00	16	20	46	HWY 158-ST FRANCIS RIVER (S)
20042763	RV883	100306	10/5/04	A-7-6(16)	70	43	26	104	21	38	166+00	16		<5	HWY 158-ST FRANCIS RIVER (S)
20042965	RV900	061135	10/21/04	A-4 (6)	76	32	09	113	14	10	150+00	26			QUACHITA RIVER-NORTH (HOT SPRINGS) (S)
20042974	RV904	070244	10/27/04	A-4 (0)	36	ND	NP	121	11	20	135+00	76	25	30	SALINE RIVER STR. & APPRS.
20043254	RV984	040130	11/19/04	A-4 (0)	77	ND	NP	114	13	19	577+00	17	10	43	I-540/HWY 59 INTERCHANGE MOD.& FRONTAGE RDS.(VAN)
20043223	RV974	100569	11/30/04	A-6 (14)	93	37	14	111	17	24	116+00	16	8	13	BIG CREEK DITCH STR.& APPRS.(S)
20043180	RV948	061035	12/1/04	A-4 (0)	57	18	03	120	11	15	274+00	62	8	8	HWY 367-I-530 (S)
20043179	RV947	061035	12/1/04	A-4 (2)	58	23	08	117	13	18	234+00	62			HWY 367-I-530 (S)
20043178	RV946	061035	12/1/04	A-4 (2)	59	24	08	116	13	17	178+00	62		4	HWY 367-I-530 (S)
20043182	RV950	061035	12/1/04	A-4 (0)	60	ND	NP	120	12	14	378+00	62		63	HWY 367-I-530 (S)
20043181	RV949	061035	12/1/04	A-4 (0)	37	16	02	117	13	14	322+00	62			HWY 367-I-530 (S)
20043214	RV971	030285	12/2/04	A-6 (9)	70	35	16	111	16	20	83+00	31		10	HWY 369-EAST (S)
20043213	RV970	030285	12/2/04	A-7-5(43)	89	76	41	79	45	51	27+00	31	<5	11	HWY 369-EAST (S)
20043213	RV970	INFO	12/2/04	A-7-5(43)	89	76	41	79	45	51	27+00	60		11	FOR INFORMATION ONLY
20043240	RV989	040344	12/5/04	A-4 (7)	82	29	10	110	16	22	1+00	65	11	11	HWY 45 REALIGNMENT (BACKBONE MTN.)
20043422	RV1022	030026	12/21/04	A-4 (2)	68	22	06	116	13	14	166+00	66			REDWING-DEQUEEN
20043421	RV1021	030026	12/21/04	A-4 (1)	52	20	07	122	11	17	102+00	66	13	13	REDWING-DEQUEEN
20043420	RV1020	030026	12/21/04	A-4 (4)	78	17	10	116	13	21	62+00	66			REDWING-DEQUEEN
20043423	RV1023	030026	12/21/04	A-6 (11)	79	32	16	113	16	19	222+00	66		5	REDWING-DEQUEEN
20043541	RV1055	R20150	1/5/05	A-4 (7)	98	29	07	109	16	25	146+00	40		8	NORTH GRADY-SOUTH GRADY (S)
20043540	RV1054	R20150	1/5/05	A-6 (14)	96	33	15	106	18	30	82+00	40			NORTH GRADY-SOUTH GRADY (S)
20043539	RV1053	R20150	1/5/05	A-7-6(19)	70	48	29	97	26	28	50+00	40	<5	<5	NORTH GRADY-SOUTH GRADY (S)

AHTD RESILENT MODULUS TEST RESULTS (5/4/04-4/1/07)

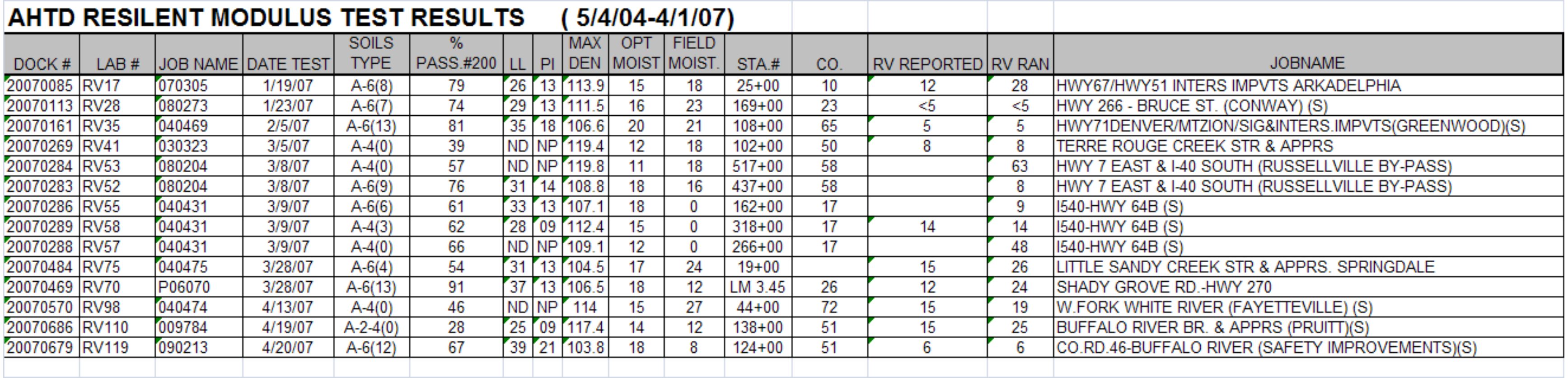
DOCK #	LAB #	JOB NAME	DATE TEST	SOILS TYPE	% PASS.#200	LL	PI	MAX DEN	OPT MOIST	FIELD MOIST.	STA.#	CO.	RV REPORTED	RV RAN	JOBNAME
20043542	RV1056	R20150	1/5/05	A-7-6(21)	81	44	27	101	22	27	186+00	40			NORTH GRADY-SOUTH GRADY (S)
20050156	RV9	050158	2/1/05	A-4 (4)	89	24	07	110	14	22	201+00	73	20	32	HWY.87 DRAINAGE IMPRV.(HIGGINSON) (S)
20050244	RV34	090154	2/14/05	A-7-6(13)	53	51	32	102	20	20	380+00	4		13	GENTRY-SOUTH (S)
20050243	RV33	090154	2/14/05	A-6 (13)	78	36	18	107	18	31	300+00	4			GENTRY-SOUTH (S)
20050242	RV32	090154	2/14/05	A-6 (6)	71	30	11	108	16	23	260+00	4	11	11	GENTRY-SOUTH (S)
20050497	RV106	040111	3/21/05	A-2-4 (0)	19	ND	NP	108	13	12	119+00	65	28	73	CHEROKEE CREEK STR & APPRS (S)
20050450	RV97	R60080	3/21/05	A-6 (8)	73	34	12	105	22	35	334+00	60	10	22	I-40-MCCAIN BLVD & WILDWOOD-KIEHL AVE.(F)
20050449	RV96	R60080	3/21/05	A-6 (6)	75	27	11	114	14	18	149+00	60			I-40-MCCAIN BLVD & WILDWOOD-KIEHL AVE.(F)
20050448	RV95	R60080	3/21/05	A-2-4 (0)	28	19	02	123	11	32	105+00	60		44	I-40-MCCAIN BLVD & WILDWOOD-KIEHL AVE.(F)
20050492	RV128	090148	3/22/05	A-4 (8)	88	29	10	108	16	22	246+00	4	10	19	HWY 412- NORTH (S)
20050491	RV127	090148	3/22/05	A-4 (5)	85	28	07	108	15	19	174+00	4			HWY 412- NORTH (S)
20050490	RV126	090148	3/22/05	A-4 (5)	86	29	07	108	15	24	111+00	4			HWY 412- NORTH (S)
20050698	RV149	080286	4/26/05	A-4 (0)	53	ND	NP	122	11	10	15+00	75	10	47	CARTER CREEK STR & APPRS. (S)
20050777	RV153	020419	4/27/05	A-4 (0)	62	ND	NP	113	14	20	15+00	40	15	70	WELLS BAYOU STR & APPRS. (S)
20050913	RV184	003948	5/4/05	A-4 (0)	46	18	02	122	11	13	388+00	66	13	51	HWY 70-RED WING (S)
20050912	RV183	003948	5/4/05	A-3 (0)	9	ND	NP	105	14	5	300+00	66			HWY 70-RED WING (S)
20050911	RV182	003948	5/4/05	A-4 (3)	80	23	07	117	12	29	236+00	66		26	HWY 70-RED WING (S)
20050986	RV192	061156	5/11/05	A-4 (2)	53	29	09	114	14	14	25+00	26	15	51	COOPER CREEK STR & APPRS.(S)
20050983	RV189	061155	5/12/05	A-7-6(42)	88	66	44	90	24	41	107+00	62	<5	<5	BRANCH OF DEPOT CREEK STR & APPRS
20051120	RV215	090178	5/20/05	A-6 (12)	90	31	14	110	15	18	301+00	4			HWY 72 WIDENING & HWY 112/8TH ST.INTERS.
20051119	RV214	090178	5/20/05	A-6 (19)	92	38	21	104	20	32	119+00	4	8	8	HWY 72 WIDENING & HWY 112/8TH ST.INTERS.
20051193	RV241	060776	5/27/05	A-7-6(22)	79	52	26	97.7	23	26	368+00	26	16	16	HWY 5-HOT SPRINGS VILLAGE (PASSING LANES)(S)
20051192	RV240	060776	5/27/05	A-4 (1)	64	23	06	116.7	13	11	254+00	26		42	HWY 5-HOT SPRINGS VILLAGE (PASSING LANES)(S)
20051256	RV263	040351	6/8/05	A-6 (6)	74	27	11	116.1	13	10	89+00	17			GEORGIA RIDGE ROAD-EAST (WIRE ROAD) (MULBERRY) (S)
20051255	RV262	040351	6/8/05	A-6 (10)	80	35	14	110.4	17	18	49+00	17	12	24	GEORGIA RIDGE ROAD-EAST (WIRE ROAD) (MULBERRY) (S)
20051262	RV268	040437	6/8/05	A-4 (0)	88	ND	NP	104.5	14	22	61+20	17	20	20	HWY 64/HWY 59 INTERS. IMPVTS (VAN BUREN)
20051421	RV303	050163	6/17/05	A-4 (4)	66	27	09	116.4	14	12	14+00	73	18	18	BRANCH OF CADRON CREEK STRS. & APPRS.
20051372	RV299	080223	6/17/05	A-4 (4)	66	25	10	111.2	16	12	6987+00	23	15	15	I40/HWY25, HWY64 INCHG (GR & STR)
20051371	RV298	080223	6/17/05	A-4 (2)	68	24	06	112.6	14	16	10+50	23			I40/HWY25, HWY64 INCHG (GR & STR)
20051530	RV352	061118	7/13/05	A-6 (9)	89	30	11	105.3	17	10	10+00	60	12	12	FOURCHE CREEK STR & APPRS. (HINDEMAN G.C.)
20051485	RV344	090179	7/13/05	A-6 (8)	91	26	11	111.1	15	24	305+00	4		16	GREENHOUSE RD HWY 71B
20051484	RV343	090179	7/13/05	A-6 (12)	88	31	15	111.5	16	21	281+00	4	12	12	GREENHOUSE RD HWY 71B
20051483	RV342	090179	7/13/05	A-6 (9)	78	32	14	106.9	18	23	233+00	4			GREENHOUSE RD HWY 71B
20051649	RV408	100611	7/27/05	A-4 (3)	79	24	06	112.0	13	20	297+00	16		25	VALLEY VIEW-GIBSON (S)
20051648	RV407	100611	7/27/05	A-4 (3)	72	24	08	115.7	13	15	210+00	16			VALLEY VIEW-GIBSON (S)
20051647	RV406	100611	7/27/05	A-6 (10)	94	30	12	106.8	17	21	250+00	16	5	5	VALLEY VIEW-GIBSON (S)
20051784	RV422	R30050	8/2/05	A-2-4(0)	31	ND	NP	119.5	12	6	150+00	31	19	63	HWY.27 HEMPSTEAD CO.LINE (NASHVILLE) (S)
20051829	RV444	R30011	8/8/05	A-6 (7)	81	26	12	112.8	15	20	34+00	50		<5	HWY 24- CLARK CO. LINE (S)
20051828	RV443	R30011	8/8/05	A-4 (0)	48	20	05	119.1	12	28	79+00	50			HWY 24- CLARK CO. LINE (S)
20051827	RV442	R30011	8/8/05	A-4 (2)	97	19	05	118.2	12	15	26+00	50	10	56	HWY 24- CLARK CO. LINE (S)
20051975	RV469	R70058	8/16/05	A-2-4(0)	32	ND	NP	116.6	11	12	81+00	70	30	64	HWY 167 IMPROVEMENTS (JUNCTION CITY) (F)
20052006	RV472	110469	8/18/05	A-6 (9)	71	32	16	105.7	15	19	111+00	48	6	6	CYPRESS CREEK STR & APPRS (S)
20052044	RV485	061039	8/23/05	A-6 (10)	69	38	16	101.5	18	33	134+00	62	15	22	HWY 35 RAILROAD OVERPASS BENTON (S)
20052043	RV484	061039	8/23/05	A-2-4(0)	26	ND	NP	121.4	12	12	118+00	62		32	HWY 35 RAILROAD OVERPASS BENTON (S)
20052145	RV532	020137	9/6/05	A-4 (4)	98	20	7	107.4	16	23	305+00	40		22	SOUTH GRADY - NORTH GOULD
20052144	RV531	020137	9/6/05	A-6 (25)	99	33	27	104.6	19	24	225+00	40			SOUTH GRADY - NORTH GOULD
20052143	RV530	020137	9/6/05	A-7-6(28)	97	43	28	96.8	22	16	161+00	40	<5	<5	SOUTH GRADY - NORTH GOULD
20052198	RV567	020415	9/8/05	A-4 (1)	61	22	06	119.3	12	16	357+00	2	10	27	HAMBURG-NORTH (PASSING LANES) (S)
20052197	RV566	020415	9/8/05	A-4 (2)	98	22	04	118.0	12	14	201+00	2			HAMBURG-NORTH (PASSING LANES) (S)
20052196	RV565	020415	9/8/05	A-6 (12)	83	35	16	105.0	19	28	165+00	2		<5	HAMBURG-NORTH (PASSING LANES) (S)
20052362	RV610	080236	9/20/05	A-4 (0)	83	21	03	116.6	13	13	301+00	58	14	26	HWY 247 WIDENING
20052361	RV609	080236	9/20/05	A-4 (3)	75	23	07	112.8	16	19	253+00	58			HWY 247 WIDENING
20052360	RV608	080236	9/20/05	A-4 (5)	83	25	08	113.8	15	11	189+00	58			HWY 247 WIDENING
20052363	RV611	080236	9/20/05	A-6 (7)	81	29	11	110.6	16	25	20'RT	58		14	HWY 247 WIDENING
20052441	RV644	080204	9/21/05	A-4 (1)	96	25	2	107.5	16	7	511+00	58	14	30	HWY 7 EAST & I-40 SOUTH (RUSSELLVILLE BY-PASS)
20052440	RV643	080204	9/21/05	A-4 (7)	93	26	9	108.0	17	13	455+00	58		20	HWY 7 EAST & I-40 SOUTH (RUSSELLVILLE BY-PASS)
20052439	RV642	080204	9/21/05	A-4 (2)	69	22	7	116.2	13	17	131+00	58			HWY 7 EAST & I-40 SOUTH (RUSSELLVILLE BY-PASS)

AHTD RESILENT MODULUS TEST RESULTS (5/4/04-4/1/07)

DOCK #	LAB #	JOB NAME	DATE TEST	SOILS TYPE	% PASS.#200	LL	PI	MAX DEN	OPT MOIST	FIELD MOIST.	STA.#	CO.	RV REPORTED	RV RAN	JOBNAME
20043542	RV1056	R20150	1/5/05	A-7-6(21)	81	44	27	101	22	27	186+00	40			NORTH GRADY-SOUTH GRADY (S)
20052692	RV692	060529	10/11/05	A-6 (17)	94	37	18	95.0	22	33	143+00	43			HWY.70 NORTH (HWY.13) (CARLISLE)(S)
20052691	RV691	060529	10/11/05	A-6 (18)	95	39	18	102.1	18	21	111+00	43	<5	<5	HWY.70 NORTH (HWY.13) (CARLISLE)(S)
20052617	RV662	061126	10/11/05	A-4 (2)	54	26	10	112.5	15	23	113+00	60	10	21	HWY.67 VANDERBURG BLVD.(JACKSONVILLE) (S)
20052644	RV677	090024	10/11/05	A-4 (6)	81	28	10	110.8	15	20	LM .94	4		20	HWY.412 IMPROVEMENTS (SILOAM SPRINGS) (S)
20052643	RV676	090024	10/11/05	A-4 (2)	81	30	3	111.0	15	16	LM .74	4			HWY.412 IMPROVEMENTS (SILOAM SPRINGS) (S)
20052647	RV680	090024	10/11/05	A-4 (2)	50	26	9	110.5	15	20	LM 2.47	4			HWY.412 IMPROVEMENTS (SILOAM SPRINGS) (S)
20052646	RV679	090024	10/11/05	A-4 (3)	74	26	6	115.1	14	20	LM 1.4	4			HWY.412 IMPROVEMENTS (SILOAM SPRINGS) (S)
20052645	RV678	090024	10/11/05	A-6 (15)	82	37	20	108.3	17	22	LM 1.1	4	5	<5	HWY.412 IMPROVEMENTS (SILOAM SPRINGS) (S)
20052546	RV655	SA6242	10/11/05	A-4 (0)	46	19	3	124.0	11	14	107+00	62	10	25	HURRICANE CREEK STR. & APPRS. (S)
20052717	RV701	100609	10/19/05	A-4 (5)	88	26	08	110.9	15	0	459+00	28	<5	<5	HWY.412 - HWY.135 (PARAGOULD)(S)
20052835	RV726	030152	10/27/05	A-6(6)	61	30	15	101.2	19	0	217+00	29		<5	HOPE EMMETT STRS. & APPRS. (S)
20052834	RV725	030152	10/27/05	A-7-6(38)	91	61	37	91.7	24	0	11+00	29	<5	<5	HOPE EMMETT STRS. & APPRS. (S)
20053247	RV867	090116	1/4/06	A-6(15)	88	36	18	109.8	17	18	444+00	44	10	15	WASHINGTON CO.LINE - HWY 45(F)
20053246	RV866	090116	1/4/06	A-6(15)	76	39	21	106.3	17	24	396+00	44			WASHINGTON CO.LINE - HWY 45(F)
20053245	RV865	090116	1/4/06	A-4(3)	60	30	9	99.1	20	25	311+00	44		28	WASHINGTON CO.LINE - HWY 45(F)
20053249	RV869	090116	1/4/06	A-4(0)	59	ND	NP	110.8	16	27	556+00	44		21	WASHINGTON CO.LINE - HWY 45(F)
20053248	RV868	090116	1/4/06	A-4(4)	81	24	7	114.1	14	7	508+00	44			WASHINGTON CO.LINE - HWY 45(F)
20053254	RV873	080284	1/9/06	A-4(5)	76	29	8	111.8	16	14	LM 0.2	58	5	9	HWY64-I40(WEIR RD) (RUSSELLVILLE) (S)
20060056	RV50	020399	1/17/06	A-4(6)	91	27	8	112.9	14	20	124+00	2	12	16	HWY 133 NORTH - CO.RD - 411 (S)
20060055	RV49	020399	1/17/06	A-4(2)	62	22	7	119.6	12	16	12+00	2			HWY 133 NORTH - CO.RD - 411 (S)
20060149	RV73	100608	1/31/06	A-6(11)	79	31	16	107.9	17	18	509+00	61	<5	<5	PARK ST.- HWY.90 (POCAHONTAS) (S)
20060148	RV72	100608	1/31/06	A-6(10)	93	31	11	107.5	18	16	334+00	61			PARK ST.- HWY.90 (POCAHONTAS) (S)
20060202	RV104	080283	2/13/06	A-6(6)	67	33	12	110.5	17	20	402+00	71	10	28	HWY.65B SOUTH - HWY.336 (CLINTON) (S)
20060201	RV103	080283	2/13/06	A-6(4)	55	30	12	113.4	16	22	314+00	71			HWY.65B SOUTH - HWY.336 (CLINTON) (S)
20060254	RV139	009702	2/14/06	A-4(0)	66	21	3	116.6	13	21	242+00	8			HWY 103 SOUTH - HWY 311 (GREEN FOREST) (S)
20060253	RV138	009702	2/14/06	A-4(4)	63	33	9	107	18	23	122+00	8	6	6	HWY 103 SOUTH - HWY 311 (GREEN FOREST) (S)
20060501	RV250	030321	3/2/06	A-4(0)	52	ND	NP	118.1	13	24	445+00	46			GREENWICH VILLAGE - CO.RD.13 (S)
20060500	RV249	030321	3/2/06	A-4(0)	83	ND	NP	112.2	14	15	405+00	46			GREENWICH VILLAGE - CO.RD.13 (S)
20060499	RV248	030321	3/2/06	A-4(1)	40	30	9	111.8	16	17	349+00	46	15	38	GREENWICH VILLAGE - CO.RD.13 (S)
20060504	RV253	030321	3/2/06	A-6(13)	80	37	17	106.8	18	18	581+00	46		23	GREENWICH VILLAGE - CO.RD.13 (S)
20060503	RV252	030321	3/2/06	A-2-4(0)	32	ND	NP	115.9	14	10	533+00	46		28	GREENWICH VILLAGE - CO.RD.13 (S)
20060502	RV251	030321	3/2/06	A-6(7)	72	31	13	112.1	16	19	493+00	46			GREENWICH VILLAGE - CO.RD.13 (S)
20060509	RV255	030321	3/2/06	A-6(8)	64	37	16	110.6	17	20	717+00	46			GREENWICH VILLAGE - CO.RD.13 (S)
20060505	RV254	030321	3/2/06	A-4(2)	47	27	10	117.5	13	11	629+00	46			GREENWICH VILLAGE - CO.RD.13 (S)
20060593	RV265	080294	3/16/06	A-4 (1)	68	21	5	116.1	13	10	10+85	58	16	16	PRAIRE CR STR.&APPRS.(EAST B ST.)(RUSSELLVILLE)(S)
20060642	RV282	R60081	3/17/06	A-6 (16)	90	32	19	109.6	17	24	480+00	60	<5	<5	HWY.440-REDMOND RD.(PHI) F
20060710	RV302	060920	3/23/06	A-6 (5)	53	33	15	115.7	13	14	104+00	60	15	15	WHITE OAK BAYOU - I-40 (F)
20060732	RV317	050162	3/24/06	A-4 (2)	70	24	6	115.7	13	21	109+00	73	18	29	SEARCY CITY LIMITS-NORTH (S)
20060771	RV338	060497	3/24/06	A-6 (9)	71	36	14	107.7	18	10	129+00	60	16	16	BEAR PAW DRIVE - BROCKINGTON ROAD (S)
20060788	RV354	050159	3/30/06	A-4 (1)	54	23	8	118.2	12	18	107+00	32	15	20	HWY 233 SOUTH - HWY 69 (BATESVILLE) (S)
20060854	RV369	020417	4/3/06	A-6 (12)	93	33	13	107.2	17	24	226+00	1	6	6	LA GRUE BAYOU & RELIEF STR & APPRS (S)
20060828	RV362	040443	4/3/06	A-6 (9)	79	31	14	110.1	16	20	412+00	65	6	6	BRANCHOFWASHBURNCREEKSTR&APPRS.(SOUTHOFHWY.10)(S)
20061194	RV451	020275	5/11/06	A-6(4)	56	28	12	112.3	15	17	237+25	27			HWY 167 BYPASS (SHERIDAN)(S)
20061193	RV450	020275	5/11/06	A-6(10)	75	34	16	110.9	16	19	220+00	27		17	HWY 167 BYPASS (SHERIDAN)(S)
20061192	RV449	020275	5/11/06	A-6(12)	79	35	17	101.1	20	19	148+00	27			HWY 167 BYPASS (SHERIDAN)(S)
20061197	RV454	020275	5/11/06	A-6(5)	69	27	11	114.	15	22	428+35	27			HWY 167 BYPASS (SHERIDAN)(S)
20061196	RV453	020275	5/11/06	A-4(3)	69	26	8	112.1	16	23	382+35	27		22	HWY 167 BYPASS (SHERIDAN)(S)
20061199	RV456	020275	5/11/06	A-7-6(21)	79	46	27	98.3	23	32	510+00	27	12	12	HWY 167 BYPASS (SHERIDAN)(S)
20061198	RV455	020275	5/11/06	A-4(3)	70	26	7	114.1	14	21	475+00	27			HWY 167 BYPASS (SHERIDAN)(S)
20061324	RV557	X02023	5/17/06	A-6(10)	83	29	14	109.7	16	19	12+00	21	5	5	DITCH 6 ROUTE 54 (DRAINAGE REVIEW)
20061366	RV565	FA2418	5/26/06	A-7-6(20)	80	46	25	101.7	20	12	103+00	24	7	17	HWY.186-EAST(RECONST)(S)
20061387	RV573	090225	6/2/06	A-4(0)	77	ND	NP	114.9	12	19	13+85	5	10	32	HWY7/HWY206INTERSIMPVTS(BOONE CO.)(S)
20061545	RV552	080305	6/5/06	A-7-6(20)	84	47	23	98.1	25	21	498+00	23	6	6	HWY64 WEST S.CHURCH (GR&STR)(VILONIA BYPASS)
20061544	RV551	080305	6/5/06	A-6(6)	75	26	12	113.5	15	28	389+30	23			HWY64 WEST S.CHURCH (GR&STR)(VILONIA BYPASS)
20061543	RV550	080305	6/5/06	A-6(8)	73	29	14	112.8	16	17	309+00	23		<5	HWY64 WEST S.CHURCH (GR&STR)(VILONIA BYPASS)
20061547	RV554	080305	6/5/06	A-4(1)	72	20	5	116.7	13	20	584+75	23		8	HWY64 WEST S.CHURCH (GR&STR)(VILONIA BYPASS)
20061546	RV553	080305	6/5/06	A-7-6(20)	85	47	22	99.1	23	21	524+75	23			HWY64 WEST S.CHURCH (GR&STR)(VILONIA BYPASS)
20062014	RV652	080306	7/13/06	A-4(3)	62	25	9	117.0	14	15	833+00	23		23	S.CHURCH RD - HWY 64 EAST (GR&STR)(VILONIA BYPASS)
20062013	RV651	080306	7/13/06	A-6(9)	79	32	13	108.4	19	19	745+00	23	6	6	S.CHURCH RD - HWY 64 EAST (GR&STR)(VILONIA BYPASS)
20062012	RV650	080306	7/13/06	A-6(7)	63	34	15	109.0	18	20	654+85	23			S.CHURCH RD - HWY 64 EAST (GR&STR)(VILONIA BYPASS)

AHTD RESILENT MODULUS TEST RESULTS (5/4/04-4/1/07)

DOCK #	LAB #	JOB NAME	DATE TEST	SOILS TYPE	% PASS.#200	LL	PI	MAX DEN	OPT MOIST	FIELD MOIST.	STA.#	CO.	RV REPORTED	RV RAN	JOBNAME
20062096	RV684	090073	7/18/06	A-6(8)	66	35	15	104.2	18	14	26+00	8	12	12	HWY.12-EUREKA SPRINGS (PASSING LANES)(S)
20062105	RV693	090197	7/20/06	A-6(9)	78	28	14	115.4	13	17	113+15	8	9	9	OSAGE CREEK STR & APPRS (S)
20062311	RV815	040026	7/31/06	A-4(0)	53	18	04	119.2	12	13	114+00	17	20	20	HURRICANE CR & COUCH BRANCH STRS.&APPRS(S)
20062465	RV805	090196	7/31/06	A-6(12)	66	40	22	104.4	18	24	235+00	4			ILLINOIS RIVER - HWY.412(S)
20062464	RV804	090196	7/31/06	A-7-6(25)	68	60	38	96.2	24	23	131+00	4	<5	<5	ILLINOIS RIVER - HWY.412(S)
20062463	RV803	090196	7/31/06	A-4(1)	44	31	10	100.3	20	23	35+00	4		35	ILLINOIS RIVER - HWY.412(S)
20062517	RV863	R30052	8/4/06	A-6(16)	84	36	21	105.4	18	10	253+00	46		<5	HWY 71 - GREENWICH VILLAGE (S)
20062516	RV862	R30052	8/4/06	A-6(8)	68	33	15	109.6	16	13	205+00	46	8	18	HWY 71 - GREENWICH VILLAGE (S)
20062521	RV867	030342	8/7/06	A-4(0)	61	ND	NP	118.3	11	12	104+00	46	20	30	NIX CREEK STR& APPRS.(PRESTON)(TEXARKANA)(S)
20062620	RV910	070268	8/16/06	A-2-4(0)	20	ND	NP	121.9	11	13	230+00	7			OUACHITA RIVER - BANGS SLOUGH (S)
20062619	RV909	070268	8/16/06	A-2-4(0)	33	19	06	120.0	11	24	158+00	7			OUACHITA RIVER - BANGS SLOUGH (S)
20062618	RV908	070268	8/16/06	A-4(0)	47	23	07	117.0	14	18	118+00	7	8	26	OUACHITA RIVER - BANGS SLOUGH (S)
20062621	RV911	070268	8/16/06	A-6(10)	80	29	16	106.1	19	23	310+00	7		<5	OUACHITA RIVER - BANGS SLOUGH (S)
20062746	RV961	040439	8/28/06	A-7-6(20)	78	49	25	98.3	23	18	192+00	65	<5	5	HWY 59 - HWY.255 (S)
20062745	RV960	040439	8/28/06	A-6(9)	82	30	13	109	18	35	168+00	65		10	HWY 59 - HWY.255 (S)
20062975	RV1050	040442	8/29/06	A-6(10)	72	31	17	106.4	18	0	143+00	72	5	5	BALLARD CREEK STR&APPRS.(S)
20062758	RV973	008818	8/30/06	A-4(0)	56	ND	NP	113	13	12	205+00	58		61	LITTLE CREEK&ILLINOIS BAYOU STR & APPRS (S)
20062757	RV972	008818	8/30/06	A-6(3)	54	26	11	116.6	13	14	114+00	58	13	13	LITTLE CREEK&ILLINOIS BAYOU STR & APPRS (S)
20062982	RV1041	090207	8/30/06	A-6(14)	77	36	21	107.2	17	19	1+00	4	15	15	HWY112/HWY264 E SIG&INTERSLMPUTS(CAVE SPRINGS) (S)
20063140	RV1127	R20092	9/6/06	A-7-6(32)	93	47	33	105.5	20	18	169+00	21	<5	<5	SOUTH GOULD - HWY.159 W. DUMAS(S)
20063139	RV1126	R20092	9/6/06	A-4(0)	96	ND	NP	108	16	14	93+00	21		36	SOUTH GOULD - HWY.159 W. DUMAS(S)
20063138	RV1125	R20092	9/6/06	A-6(17)	93	34	19	104.9	18	17	21+00	21			SOUTH GOULD - HWY.159 W. DUMAS(S)
20063141	RV1128	R20092	9/7/06	A-7-6(74)	97	88	67	88.9	27	34	225+00	21			SOUTH GOULD - HWY.159 W. DUMAS(S)
20063190	RV1138	030290	9/11/06	A-4(2)	58	24	09	114.6	14	12	109+00	29	8	8	HWY29 B- LINCOLN ST (GREENWOOD ST)(HOPE)(S)
20062916	RV1033	040440	9/12/06	A-4(0)	45	21	05	111.6	14	6	227+00	72			HWY45-CITYLIMITS-FAYETTEVILLE(S)
20062915	RV1032	040440	9/12/06	A-4(2)	59	25	08	109	15	18	187+00	72	25	42	HWY45-CITYLIMITS-FAYETTEVILLE(S)
20062914	RV1031	040440	9/12/06	A-2-4(0)	34	ND	NP	119.1	12	15	43+00	72		61	HWY45-CITYLIMITS-FAYETTEVILLE(S)
20063198	RV1146	R30026	9/13/06	A-4(5)	78	26	09	109.7	16	21	137+00	50	7	15	HWY. 67 - ASH ST. (PRESCOTT)
20063294	RV1160	090198	9/19/06	A-7-6(24)	53	77	54		0	0	152+00	5	<5	<5	HWY65HWY62 INTERSECTION IMPROVEMENTS BELEFONTE (S)
20063614	RV1284	090229	10/16/06	A-4(0)	70	ND	NP	118.6	12	16	562+00	8			GREEN FOREST EAST (S)
20063613	RV1283	090229	10/16/06	A-4(0)	46	ND	NP	117.2	13	24	522+00	8	6	14	GREEN FOREST EAST (S)
20063447	RV1245	061059	10/20/06	A-4(2)	48	29	09	111	15	20	315+00	26			HOT SPRINGS WEST PASSING LANES
20063446	RV1244	061059	10/20/06	A-4(0)	42	ND	NP	105.9	18	18	259+00	26			HOT SPRINGS WEST PASSING LANES
20063445	RV1243	061059	10/20/06	A-7-6(24)	91	49	24	93.5	25	16	142+00	26		11	HOT SPRINGS WEST PASSING LANES
20063450	RV1248	061059	10/20/06	A-7-6(15)	87	44	15	99	23	17	576+00	26		17	HOT SPRINGS WEST PASSING LANES
20063449	RV1247	061059	10/20/06	A-4 (3)	62	29	9	109.5	16	8	495+00	26			HOT SPRINGS WEST PASSING LANES
20063448	RV1246	061059	10/20/06	A-6(9)	73	36	14	101.5	21	19	447+00	26	7	7	HOT SPRINGS WEST PASSING LANES
20063765	RV1370	090003	11/6/06	A-7-6(10)	56	48	22	100.2	19	42	298+00	5			BURLINGTON-BEAR CREEK SPRINGS BASE & SURF
20063764	RV1369	090003	11/6/06	A-7-6(20)	78	50	24	87.6	29	26	230+00	5	16	16	BURLINGTON-BEAR CREEK SPRINGS BASE & SURF
20063763	RV1368	090003	11/6/06	A-7-6(18)	74	49	24	91.1	26	26	174+00	5			BURLINGTON-BEAR CREEK SPRINGS BASE & SURF
20063768	RV1373	090003	11/6/06	A-4(0)	47	23	05	110.8	16	26	458+00	5		22	BURLINGTON-BEAR CREEK SPRINGS BASE & SURF
20063767	RV1372	090003	11/6/06	A-7-6(32)	79	63	39	91.4	28	16	374+00	5			BURLINGTON-BEAR CREEK SPRINGS BASE & SURF
20063766	RV1371	090003	11/6/06	A-6(9)	69	31	16	109.4	15	18	322+00	5		<5	BURLINGTON-BEAR CREEK SPRINGS BASE & SURF
20063855	RV1386	020326	11/13/06	A-6(19)	91	34	23	105.9	18	25	167+00	1	<5	<5	U.P. RAILROAD OVERPASS (STUTTGART) (S)
20063682	RV1292	040441	11/13/06	A-4(0)	42	ND	NP	117.1	12	12	114+75	24	16	32	MULBERRY RIVER STR&APPRS NORTH OF PARADISE (S)
20063986	RV1480	020448	12/12/06	A-6(13)	98	30	14	103	19	19	648+00	76		22	HWY 65 IMPROVEMENTS (GOULD) (S)
20063985	RV1479	020448	12/12/06	A-4(0)	97	ND	NP	108.6	16	21	580+00	76			HWY 65 IMPROVEMENTS (GOULD) (S)
20063984	RV1478	020448	12/12/06	A-6(11)	90	30	13	107.4	17	22	512+00	76			HWY 65 IMPROVEMENTS (GOULD) (S)
20063988	RV1482	020448	12/12/06	A-4(2)	84	23	05	110.6	15	23	752+00	76	<5	<5	HWY 65 IMPROVEMENTS (GOULD) (S)
20063987	RV1481	020448	12/12/06	A-4(0)	92	ND	NP	106.1	15	20	708+00	76			HWY 65 IMPROVEMENTS (GOULD) (S)
20064158	RV1504	080296	12/14/06	A-4(2)	69	24	07	118.1	13	6	6990+00	23			I-40 / HWY 25 & HWY 64 INTERCHANGE (GR & STR)
20064157	RV1503	080296	12/14/06	A-4(0)	51	23	06	123.1	11	6	6999+00	23	15	15	I-40 / HWY 25 & HWY 64 INTERCHANGE (GR & STR)
20064159	RV 1505	080296	12/14/06	A-4(3)	65	26	08	115.2	14	11	7013+00	23			I-40 / HWY 25 & HWY 64 INTERCHANGE (GR & STR)
20070068	RV12	050175	1/18/07	A-6(7)	60	30	17	111.5	14	11	148+00	12	19	19	HWY 110 EAST - SUNNY MEADOW (HEBER SPRINGS) (S)



AHTD RESILENT MODULUS TEST RESULTS (5/4/04-4/1/07)

DOCK #	LAB #	JOB NAME	DATE TEST	SOILS TYPE	% PASS.#200	LL	PI	MAX DEN	OPT MOIST	FIELD MOIST.	STA.#	CO.	RV REPORTED	RV RAN	JOBNAME
20070085	RV17	070305	1/19/07	A-6(8)	79	26	13	113.9	15	18	25+00	10	12	28	HWY67/HWY51 INTERS IMPVTS ARKADELPHIA
20070113	RV28	080273	1/23/07	A-6(7)	74	29	13	111.5	16	23	169+00	23	<5	<5	HWY 266 - BRUCE ST. (CONWAY) (S)
20070161	RV35	040469	2/5/07	A-6(13)	81	35	18	106.6	20	21	108+00	65	5	5	HWY71DENVER/MTZION/SIG&INTERS.IMPVTS(GREENWOOD)(S)
20070269	RV41	030323	3/5/07	A-4(0)	39	ND	NP	119.4	12	18	102+00	50	8	8	TERRE ROUGE CREEK STR & APPRS
20070284	RV53	080204	3/8/07	A-4(0)	57	ND	NP	119.8	11	18	517+00	58		63	HWY 7 EAST & I-40 SOUTH (RUSSELLVILLE BY-PASS)
20070283	RV52	080204	3/8/07	A-6(9)	76	31	14	108.8	18	16	437+00	58		8	HWY 7 EAST & I-40 SOUTH (RUSSELLVILLE BY-PASS)
20070286	RV55	040431	3/9/07	A-6(6)	61	33	13	107.1	18	0	162+00	17		9	I540-HWY 64B (S)
20070289	RV58	040431	3/9/07	A-4(3)	62	28	09	112.4	15	0	318+00	17	14	14	I540-HWY 64B (S)
20070288	RV57	040431	3/9/07	A-4(0)	66	ND	NP	109.1	12	0	266+00	17		48	I540-HWY 64B (S)
20070484	RV75	040475	3/28/07	A-6(4)	54	31	13	104.5	17	24	19+00		15	26	LITTLE SANDY CREEK STR & APPRS. SPRINGDALE
20070469	RV70	P06070	3/28/07	A-6(13)	91	37	13	106.5	18	12	LM 3.45	26	12	24	SHADY GROVE RD.-HWY 270
20070570	RV98	040474	4/13/07	A-4(0)	46	ND	NP	114	15	27	44+00	72	15	19	W.FORK WHITE RIVER (FAYETTEVILLE) (S)
20070686	RV110	009784	4/19/07	A-2-4(0)	28	25	09	117.4	14	12	138+00	51	15	25	BUFFALO RIVER BR. & APPRS (PRUITT)(S)
20070679	RV119	090213	4/20/07	A-6(12)	67	39	21	103.8	18	8	124+00	51	6	6	CO.RD.46-BUFFALO RIVER (SAFETY IMPROVEMENTS)(S)

Table A2. AHTD Resilient Moduli

AHTD RESILENT MODULUS TEST RESULTS (5/4/04-4/1/07)

DOCK #	Mr REPORTED	RM RAN k1 Mr	K2	K5	SEQ 1 Mr psi (6)	Seq 2 Mr psi (6)	Seq 3 Mr psi (6)	Seq 4 Mr psi (6)	Seq 5 Mr psi (6)	Seq 6 Mr psi (4)	Seq 7 Mr psi (4)	Seq 8 Mr psi (4)	Seq 9 Mr psi (4)	Seq 10 Mr psi (4)	Seq 11 Mr psi (2)	Seq 12 Mr psi (2)	Seq 13 Mr psi (2)	Seq 14 Mr psi (2)	Seq 15 Mr psi	% COMP
20041115		6511	-0.22421	0.33612	10166	9428	8662	7660	7077	8700	7855	7089	6601	6188	7156	6385	5799	5396	5069	98
20041125	5069	12090	-0.16719	0.18753	15130	14131	12939	12073	11558	13701	12664	11986	11223	10759	12410	11324	10453	9871	9511	93
20041216	6845	6144	-0.07067	0.36220	11409	10985	10550	10277	10210	9752	8869	8599	8556	8713	7794	7052	6845	6907	7146	95
20041211	14451	13846	-0.05750	0.20514	19452	18850	18387	17719	16813	17932	17304	16810	16544	16134	15028	14454	14451	14480	14478	95
20041210	6849	7878	-0.16832	0.21660	10631	9783	9175	8310	7615	9513	8774	8211	7648	7192	7857	7493	7187	6849	6485	97
20041209	6901	5697	-0.04542	0.40125	11659	11121	11212	10812	10740	9585	8998	8725	8803	8867	7453	7100	6901	6943	7143	97
20041213	5053	7185	-0.27392	0.31886	10794	9551	8757	7617	6782	9240	8117	7299	6467	5836	7269	6507	5892	5411	5053	97
20041212	4720	9565	-0.38635	0.19595	10417	8909	7260	6184	5577	9707	8048	6801	5910	5306	8249	6881	5870	5175	4720	99
20041312	6103	5524	-0.09026	0.39804	10610	10449	10133	9535	9194	8945	8161	7834	7843	7783	7100	6519	6161	6103	6213	97
20041359	8481	12966	-0.18379	0.05099	13601	12775	11325	9614	8690	10240	9343	10194	10541	9974	12998	11619	10012	9100	8481	98
20041355	5509	4269	-0.01238	0.45522	9840	9624	9593	9457	9521	8122	7447	7367	7647	7914	6008	5542	5509	5831	6114	98
20041323	7314	7272	-0.11153	0.30360	12184	11350	10656	9848	9371	10006	9545	9140	8841	8550	8205	7612	7495	7419	7314	98
20041320	7763	9690	-0.20777	0.30021	14729	13472	12264	10840	9948	12464	11264	10467	9700	9082	10231	9222	8541	8082	7763	96
20041319	7738	8679	-0.16013	0.31339	14010	12965	11933	10899	10345	11740	10905	10238	9708	9279	9605	8828	8332	7996	7738	98
20041401	9118	10781	-0.13212	0.16067	13339	12602	11980	10992	10013	12371	11628	11107	10450	9804	10495	10229	9909	9563	9118	95
20041415	5850	5909	-0.16757	0.42611	11645	10734	10013	9088	8741	9435	8336	7652	7445	7432	7394	6424	5975	5850	5883	98
20041412	5854	10238	-0.36299	0.23636	12466	11063	9412	7270	6462	10887	9129	7731	6702	6467	9297	7771	6643	5854	5945	101
20041411	12622	15317	-0.14559	0.17689	19002	18070	17165	15737	14377	17669	16549	15618	14807	13910	15397	14447	13740	13195	12622	96
20041410	6396	8841	-0.24713	0.29080	12700	11522	10379	9187	8435	10801	9629	8734	7985	7485	9309	8132	7307	6767	6396	97
20041641	3642	6193	-0.34194	0.25321	7959	6980	5967	4991	4350	6697	5684	4976	4449	4056	5872	4932	4336	3924	3642	101
20041640	6130	7418	-0.19160	0.27716	10905	10182	9459	8362	7602	9279	8350	7864	7399	6987	7996	7103	6581	6325	6130	95
20041639	5692	7035	-0.20990	0.29648	11032	9937	9086	7858	6932	8586	8132	7595	7022	6497	7402	6661	6358	6017	5692	97
20041642	5609	4720	-0.04919	0.40092	9782	9291	9013	8853	8834	7804	7354	7218	7212	7385	6238	5774	5609	5765	5900	97
20041688	9188	11984	-0.17378	0.16159	14338	13541	12469	11137	10008	13304	12361	11634	10882	9991	11330	10785	10271	9806	9188	96
20041660	10154	9374	-0.07193	0.31550	15814	15458	14856	14312	14051	13746	12945	12679	12431	12364	11288	10685	10259	10154	10209	96
20041650	8652	6466	-0.09019	0.40047	14911	13811	12867	12220	11889	13757	12319	11466	10966	10595	9405	9108	8811	8679	8652	97
20041649	7139	6465	-0.09019	0.40047	12839	11930	11300	11055	10981	10906	9750	9303	9251	9330	8176	7373	7139	7266	7476	97
20041714	5445	8267	-0.28036	0.26959	11332	10297	9120	7626	6490	9427	8619	7791	6915	6127	7827	7122	6528	5963	5445	98
20041713	12763	11162	-0.03940	0.31490	19293	19106	18397	18163	18012	16378	16143	16087	15964	15885	14046	13044	12763	12828	13015	97
20041835	9996	9740	-0.07850	0.24936	14775	13938	13701	13181	12548	13022	12242	11790	11665	11462	10988	10437	10199	10039	9996	97
20041834	7085	6714	-0.11485	0.39353	12662	12130	11645	10909	10597	10650	9574	9179	9007	8942	8466	7670	7251	7105	7085	97
20041972	10543	9243	-0.00264	0.20983	13652	13552	13701	13525	13018	12375	12008	11951	12330	12325	10676	10543	10557	10650	11001	95
20041971	6380	6253	-0.12013	0.36339	11394	10597	10224	9492	8953	9303	8732	8234	8053	7804	7447	6945	6642	6454	6380	98
20041970	6626	11617	-0.33327	0.21625	13691	11872	9926	8593	7967	12635	10635	9226	8247	7575	10577	8972	7842	7128	6626	99
20041996	8478	16003	-0.35034	0.18472	17213	14962	12587	10974	10013	16762	14176	12077	10472	9436	13809	11962	10392	9243	8478	99
20041943	12807	11909	-0.05071	0.24090	18104	17614	16960	16110	15279	16472	15965	15636	15297	14783	12820	12807	12970	13065	13050	95
20041942	6969	8068	-0.17686	0.29871	12345	11209	10240	9662	9330	11114	9744	8985	8594	8337	8916	7872	7341	7096	6969	97
20041941	7276	8447	-0.16222	0.26645	12274	11207	10352	9805	9499	11159	9940	9245	8844	8587	9185	8214	7684	7400	7276	95
20041944	7437	11974	-0.23924	0.07826	11763	10745	9736	8504	7459	11288	10272	9449	8560	7680	10231	9466	8815	8128	7437	96
20042009	11107	11282	-0.08311	0.22708	16239	15595	15029	14347	13707	14449	13840	13412	13081	12774	12410	11873	11531	11351	11107	99
20042008	7332	6547	-0.07319	0.36760	12113	11861	11529	11127	10912	10275	9443	9212	9174	9217	8407	7698	7342	7332	7476	96
20042153	10935	13189	-0.10233	0.07023	13937	13737	12804	12103	11461	13565	13028	12582	12085	11520	12632	12262	11836	11367	10935	92
20042189	6384	6321	-0.12731	0.35321	11405	10722	10026	9125	8625	9160	8522	8175	7938	7667	7381	6857	6556	6469	6384	99
20042399	7686	6236	-0.01971	0.38875	12795	12291	12061	11965	12051	10700	10093	9912	10153	10376	8142	7686	7712	8070	8205	97
20042466	8283	8039	-0.15262	0.45087	16478	15512	14518	13306	12703	13576	11923	11197	10902	10581	10175	8908	8397	8378	8283	96
20042462	3547	6667	-0.35362	0.24908	8102	6936	5754	4632	6405	7422	6121	5150	4438	3786	6611	5502	4672	4029	3547	101
20042461	6631	6372	-0.11112	0.34566	11540	10952	10251	9359	8816	9089	8699	8411	8166	7903	7492	6961	6771	6689	6631	99
20042460	6950	8822	-0.20612	0.28212	12942	11876	10843	9603	8848	10957	9967	9213	8570	8073	9355	8292	7693	7279	6950	97
20042616	6528	6787	-0.14095	0.33877	11341	10542	10019	9411	9105	10100	9025	8419	9406	7967	7910	7143	6702	6555	6528	96
20042547	8318	8899	-0.11131	0.22086	12554	12029	11340	10531	9812	11009	10418	10045	9731	9310	9462	8975	8689	8506	8318	92
20042546	7915	13200	-0.25648	0.06895	12940	11846	10687	9425	8231	12357	11108	10084	9108	8196	11466	10368	9509	8683	7915	104
20042545	6143	5000	-0.04928	0.42165	10777	10333	9999	9613	9397	8503	8168	7956	7962	8020	6515	6164	6143	6218	6323	97
20042549	6078	5074	-0.03928	0.39371	10226	9850	9813	9615	6514	8541	7994	7834	7915	8043	6733	6192	6078	6240	6445	96
20042631	7320	6727	-0.06897	0.31242	11620	10736	10370	10410	10286	10016	9260	8962	8872	8901	8061	7578	7359	7320	7488	95
20042598	9893	11507	-0.16008	0.26410	15620	15509	14378	13144	12482	15065	13815	12900	12183	11559	12130	11223	10617	10213	9893	94
20042597	3207	7553	-0.37828	0.27965	11667	9616	8270	7551	7006	11002	8502	7116	6356	5899	3207	7136	6031	5417	5042	103
20042651	6201	7568	-0.22034	0.33790	12101	10834	9821	8821	8361	10790	9298	8242	7660	7364	7954	7320	6672	6301	6201	98
20042706	7959	7593	-0.12318	0.40264	14730	13572	12702	12088	11795	12489	11192	10671	10270	10144	9291	8341	7959	7983	8118	95

AHTD RESILENT MODULUS TEST RESULTS (5/4/04-4/1/07)

DOCK #	Mr REPORTED	RM RAN k1 Mr	K2	K6	SEQ 1 Mr psi (6)	Seq 2 Mr psi (6)	Seq 3 Mr psi (6)	Seq 4 Mr psi (6)	Seq 5 Mr psi (6)	Seq 6 Mr psi (4)	Seq 7 Mr psi (4)	Seq 8 Mr psi (4)	Seq 9 Mr psi (4)	Seq 10 Mr psi (4)	Seq 11 Mr psi (2)	Seq 12 Mr psi (2)	Seq 13 Mr psi (2)	Seq 14 Mr psi (2)	Seq 15 Mr psi	% COMP
20042745	6069	10054	-0.26772	0.15195	11005	10331	9366	7807	6383	9884	9133	8406	7479	6405	8754	8181	7581	6856	6069	101
20042764	6064	4432	0.00340	0.49129	11410	11081	10831	10655	10690	8640	8371	8329	8635	8887	6353	5953	6064	6490	6804	96
20042763	2840	6850	-0.46326	0.15618	6616	5709	4760	3720	2958	5930	4826	3965	3369	3103	5519	4503	3781	3241	2840	97
20042965	10609	12819	-0.16115	0.22051	16898	15866	14744	13776	13190	15799	14368	13294	12504	12066	13364	12222	11475	10918	10609	94
20042974	7725	7290	-0.12618	0.42620	14536	13616	12975	12083	11679	12230	11141	10506	10207	9978	9139	8233	7843	7749	7725	99
20043254	7304	6214	-0.05949	0.41224	12845	12070	11820	11501	11431	10913	9922	9580	9642	9743	8018	7392	7304	7518	7696	98
20043223	10082	9572	-0.04768	0.25652	15220	14548	13915	13253	12631	13846	13248	12965	12630	12188	10082	10419	10626	10787	10803	96
20043180	7034	5893	-0.06282	0.43845	12575	12058	11811	11537	11421	10603	9632	9245	9312	9433	7850	7268	7034	7127	7360	99
20043179	9309	12619	-0.22593	0.26019	17229	15800	14299	12646	11541	15629	14129	12821	11739	10816	12517	11495	10625	9924	9309	96
20043178	5000	7191	-0.31596	0.37703	11659	10248	8951	7487	6804	9645	7890	6861	6341	6012	7823	6290	5485	5150	5000	99
20043182	5823	5765	-0.19028	0.50028	13366	11993	10783	9575	9011	10330	8518	7785	7617	7555	7288	6164	5823	5942	6263	99
20043181	7084	6779	-0.10367	0.34822	11973	11200	10793	10421	10338	10338	9438	8862	8648	8737	8279	7582	7191	7084	8151	97
20043214	5065	4591	-0.06623	0.30264	7731	7788	7411	6816	6336	6491	6283	6252	6167	5889	5301	5147	5090	5120	5065	98
20043213	8443	10221	-0.13612	0.12600	11869	11217	10385	9625	9024	11154	10569	10064	9568	9051	9879	9358	9037	8745	8443	86
20043213	8443	10221	-0.13612	0.12600	11869	11217	10385	9625	9024	11154	10569	10064	9568	9051	9879	9358	9037	8745	8443	86
20043240	6148	8678	-0.26380	0.30630	12635	11548	10284	8832	7875	10893	9663	8666	7833	7193	8730	7840	7150	6584	6148	99
20043422	985	8155	-0.19702	0.33570	13184	12054	11193	10090	9493	11298	10031	9222	8664	8315	985	8155	7555	7155	6859	98
20043421	6210	6409	-0.14282	0.35590	11198	10352	9741	9199	8996	9489	8509	7960	7729	7620	7747	6819	6407	6274	6210	97
20043420	7673	8645	-0.21238	0.41420	16096	14731	13384	11641	10940	13138	11595	10587	9989	9503	10050	8770	8092	7803	7673	100
20043423	4754	8455	-0.35893	0.26834	10912	9797	8191	6489	5721	9164	7894	6957	6072	5410	7733	6700	5851	5223	4754	98
20043541	6193	5473	-0.06963	0.37214	10477	9876	9637	9337	9293	8721	8035	7762	7800	7890	6982	6411	6193	6216	6385	95
20043540	5105	7393	-0.26106	0.28241	10264	9232	8474	7366	6574	9003	7899	7087	6476	5999	7524	6621	5988	5485	5105	96
20043539	2772	8876	-0.56685	0.13169	7385	6223	4809	3491	3547	7022	5677	4528	3544	2833	6458	5272	4253	3393	2772	101
20043542	9910	11047	-0.09792	0.12381	13170	12598	11965	11242	10497	12265	11620	11246	10894	10463	10922	10633	10296	10135	9910	96
20050156	7708	6337	-0.02698	0.37050	12471	12307	12131	11647	11372	10180	9704	9649	9810	9862	8168	7783	7708	7866	8085	97
20050244	12745	13984	-0.11375	0.20701	19024	18315	17142	15742	14598	17193	16508	15887	15251	14325	14348	13745	13477	13212	12745	99
20050243	7887	8409	-0.13736	0.28497	13293	12466	11312	10256	9527	11402	10711	10223	9776	9191	8830	8375	8306	8139	7887	99
20050242	7782	8002	-0.13912	0.34281	13783	12688	11864	11066	10550	11953	10736	10140	9748	9432	9060	8381	8030	7881	7762	96
20050497	6239	4535	0.01492	0.47634	11118	11048	10981	10927	11013	8935	8568	8547	8932	9170	6373	6239	6447	6684	6738	100
20050450	5598	8923	-0.27705	0.19784	10518	9425	8481	7373	6657	9541	8360	7440	6770	6214	8479	7401	6613	5999	5598	95
20050449	10761	14102	-0.19307	0.21747	18250	14149	15597	13948	12872	16559	15164	14127	13113	12210	14065	12947	12082	11376	10761	98
20050448	8589	7533	-0.07451	0.41577	15801	14815	14037	13402	13343	13224	11800	11276	11384	11513	9557	8716	8589	8959	9370	99
20050492	9681	8159	-0.03624	0.34847	15752	15097	14542	13897	13418	12561	12436	12357	12268	12083	9885	9681	9762	9975	10069	97
20050491	6435	6216	-0.11087	0.34818	11088	10465	9886	9295	8944	9160	8508	8132	7929	7811	7431	6839	6543	6486	6435	98
20050490	8251	7627	-0.10074	0.35520	13987	12921	12257	11505	11069	12107	11003	10489	10195	9959	8700	8321	8251	8254	8277	97
20050698	5669	6304	-0.19034	0.41874	13392	11398	9897	8740	8543	10381	8171	7308	7238	7385	7418	6040	5669	5897	7364	98
20050777	6291	4748	0.01288	0.45559	11203	10994	10870	10851	10966	9464	8884	8819	9007	9258	6396	6291	6439	6950	7187	97
20050913	8323	8905	-0.13972	0.31187	14194	13266	12674	11806	11470	12501	11305	10642	10221	10000	10290	9309	8706	8442	8323	
20050912	7506	5331	0.07680	0.41146	12121	12393	12852	13093	13411	9890	9857	10090	10695	11369	7506	7623	8115	8565	8433	101
20050911	7575	7288	-0.13265	0.39995	14205	13212	12293	11239	10675	11404	10794	10159	9768	9452	8694	8070	7781	7667	7575	97
20050986	7020	8942	-0.23648	0.34658	13969	12556	11555	10488	9897	12536	10807	9710	9024	8630	10059	8503	7628	7228	7020	96
20050983	5023	8730	-0.29853	0.12402	9107	8275	7204	5977	5080	8159	7472	6671	5871	5188	7299	6703	6137	5564	5023	98
20051120	8455	7152	-0.03985	0.35450	13675	13181	12965	12331	11737	11402	11006	10829	10792	10606	8661	8455	8563	8710	8839	96
20051119	6064	6541	-0.14553	0.30520	10396	9810	9314	8543	7839	9016	8224	7788	7451	7097	7233	6787	6475	6239	6064	99
20051193	4170	7922	-0.41194	0.31583	10439	9079	7886	6343	5335	8962	7525	6375	5417	4818	7424	6266	5297	4576	4170	97
20051192	6321	5767	-0.13451	0.48455	13334	12004	11111	10407	10141	10244	9193	8578	8403	8403	7513	6591	6321	6362	6568	97
20051256	8612	7054	-0.01674	0.38306	14281	14126	13683	13319	13030	12267	11569	11511	11462	11439	8612	8826	8913	9171	9378	96
20051255	5772	7329	-0.24313	0.35942	12112	10826	9688	8435	7749	10276	9022	8137	7409	6901	7634	6986	6427	6037	5772	96
20051262	6156	5106	-0.03439	0.38963	10331	9885	9740	9555	9664	8703	8117	7971	8011	8165	6607	6326	6156	6329	6566	98
20051421	6489	9484	-0.31745	0.37527	14886	13156	11675	9831	8980	12893	10810	9456	8484	7899	10101	8437	7343	6764	6489	99
20051372	10214	11924	-0.17337	0.28172	17895	16842	15475	13469	12018	15974	14741	13781	12687	11556	11718	11500	11173	10748	10214	99
20051371	8644	9469	-0.16940	0.35362	16115	14881	13780	12412	11527	14285	12825	11839	11077	10444	10105	9709	9247	8920	8644	99
20051530	10281	11401	-0.14317	0.27573	17135	16129	15053	13727	12809	15298	14300	13447	12658	11928	11951	11440	10990	10633	10281	97
20051485	9479	9125	-0.09941	0.30924	15266	14335	13435	12567	11942	13645	12753	12108	11602	11148	9771	9690	9656	9594	9479	96
20051484	8930	8400	-0.10045	0.33861	14970	14102	13173	12003	11200	13055	12259	11695	11172	10605	8930	9040	9138	9093	8960	95
20051483	5658	6970	-0.33581	0.40650	11537	10204	8933	7409	6427	9668	8119	7024	6273	5728	7314	6141	5404	5000	4658	98
20051649	7108	6097	-0.04852	0.36142	11489	11109	11103	10756	10657	9671	8996	8750	8671	8988	7902	7314	7108	7129	7393	96
20051648	4920	5718	-0.21933	0.38168	10092	9094	8371	7364	6847	8220	7028	6379	6111	5949	6669	5658	5133	4971	4920	99
20051647	6906	73670	-0.13528	0.29646	11538	10905	10399	9738	9277	9958	9089	8550	8307	8134	8526	7703	7224	7002	6906	98
20051784	6037	4541	0.02036	0.42114	10087	10058	10161	10135	10397	8291	7833	7833	8219	8558	6384	6037	6120	6424	6764	98

AHTD RESILENT MODULUS TEST RESULTS (5/4/04-4/1/07)

DOCK #	Mr REPORTED	RM RAN k1 Mr	K2	K5	SEQ 1 Mr psi (6)	Seq 2 Mr psi (6)	Seq 3 Mr psi (6)	Seq 4 Mr psi (6)	Seq 5 Mr psi (6)	Seq 6 Mr psi (4)	Seq 7 Mr psi (4)	Seq 8 Mr psi (4)	Seq 9 Mr psi (4)	Seq 10 Mr psi (4)	Seq 11 Mr psi (2)	Seq 12 Mr psi (2)	Seq 13 Mr psi (2)	Seq 14 Mr psi (2)	Seq 15 Mr psi	% COMP
20051829	2663	7513	-0.58676	0.19183	7209	5873	4503	3220	2886	6508	4858	3739	3097	2811	5816	4288	3375	2856	2663	99
20051828	7687	8371	-0.16646	0.37693	14684	13794	12972	11879	11362	12468	11209	10406	9974	9666	9995	8961	8278	7868	7687	98
20051827	7203	6555	-0.09429	0.38659	12508	11732	11327	11074	10934	10644	9644	9135	9004	9107	8340	7569	7231	7203	7321	96
20051975	4982	3566	0.01725	0.51243	9388	9365	9277	9210	9447	7386	6958	6974	7324	7624	5275	4982	5106	5424	5609	95
20052006	4843	6973	-0.23656	0.20791	8671	7863	7115	6357	5799	7836	6938	6288	5808	5430	6863	6069	5530	5132	4843	98
20052044	3043	11128	-0.66756	0.15630	9036	7190	5413	3946	3385	8612	6472	4767	3717	3225	7873	5847	4324	3435	3043	98
20052043	6785	5034	0.01755	0.43529	11497	11235	11335	11503	11819	9311	8876	8823	9273	9718	7144	6798	6785	7155	7388	95
20052145	6642	6964	-0.13858	0.31844	11382	10606	10105	9376	8926	9851	9113	8556	8224	7975	7998	7311	6959	6761	6642	96
20052144	1655	4260	-0.56541	0.16298	4143	3232	2573	1960	1902	3723	2715	2168	1880	1721	3564	2544	2045	1790	1655	96
20052143	6785	6228	-0.50220	0.11154	5442	4555	3735	2927	2435	5208	4135	3401	2855	2461	2618	3803	3203	2730	2387	95
20052198	9097	8683	-0.11558	0.37829	16228	15158	14252	13295	12843	13711	12722	11989	11573	11317	10188	9614	9282	9160	9097	96
20052197	7040	7958	-0.19374	0.38474	14216	12977	11795	10566	10031	11629	10633	9757	9185	8758	9197	8072	7515	7219	7040	98
20052196	5304	9253	-0.33826	0.24362	11576	10203	8660	7075	6191	10112	8941	7798	6772	5971	8141	7315	6568	5867	5304	98
20052362	8318	8078	-0.13019	0.39954	15589	14539	13869	12804	12277	12726	11688	11139	10848	10582	9964	9038	8566	8424	8318	95
20052361	3698	6054	-0.39636	0.36317	9489	7959	6515	5161	4636	7519	5754	4790	4378	4207	6158	4664	3969	3748	3698	98
20052360	6227	8490	-0.26757	0.31673	12741	11338	10092	8807	8090	10870	9546	8558	7677	7419	9018	7671	6954	6515	6227	98
20052363	10995	11995	-0.14217	0.26739	18037	16589	15587	14228	13377	16116	14804	13870	13190	12566	12494	11792	11524	11224	10995	94
20052441	8328	7785	-0.10399	0.36795	14441	13460	12839	12049	116447	12116	11321	10777	10433	10237	9223	8652	8421	8328	8331	95
20052440	8530	9534	-0.16371	0.31432	15269	14072	12963	11786	11113	13258	12285	11398	106676	10122	10206	9577	9133	8759	8530	94
20052439	6208	9144	-0.30216	0.33848	13933	12322	10715	9051	8150	11595	10090	8856	8023	7433	9403	7996	7089	6560	6208	99
20052692	2274	7679	-65778.00000	0.19018	7109	5294	3731	2457	3630	6519	4546	3224	2586	2293	6007	4250	3092	2508	2274	102
20052691	4767	8127	-0.33380	0.26871	10653	9592	8237	6631	5697	8882	8067	7136	6222	5435	7471	6633	5947	5321	4767	98
20052617	8420	10430	-0.18463	0.25856	14961	13800	12494	11161	10311	12894	12121	11330	10575	9768	10627	9878	9396	8898	8358	99
20052644	9511	10206	-0.13620	0.27693	16075	14994	13673	12489	11668	13269	12613	12139	11625	11054	11024	10339	10007	9816	9511	98
20052643	8968	9766	-0.12903	0.25796	14336	13817	13070	11919	10956	127338	11819	11328	10855	10277	10442	9956	9531	9266	8968	96
20052647	6235	8579	-0.29038	0.42153	15328	13823	11973	9997	8775	12251	10667	9494	8737	8017	9360	7966	7147	6729	6235	102
20052646	9383	9329	-0.04680	0.33846	17500	16774	16095	15302	14731	14066	13837	13674	13491	13320	11166	10867	10902	11089	11144	95
20052645	6120	8664	-0.26960	0.32997	13339	12289	10937	9205	7877	10638	9754	8858	8032	7234	8939	7962	7254	6697	6120	99
20052546	10807	8930	-0.13125	0.41853	17963	16838	15635	14241	13625	14276	13302	12581	12153	11836	10876	9950	9590	9481	9383	95
20052717	8420	9621	-0.14818	0.23782	13606	12714	11795	10810	10091	12101	11161	10524	9996	9614	9956	9326	8969	8667	8420	95
20052835	11817	10831	-0.03612	0.22494	16189	16031	15545	14800	14007	14410	13963	13983	13820	13454	11951	11817	11831	12064	12058	98
20052834	10037	9869	-0.07341	0.21530	14111	13930	13122	12273	11530	12548	12196	11911	11603	11187	10524	10243	10203	10165	10037	96
20053247	11856	13916	-0.12138	0.14126	16748	15930	15104	13908	12935	15392	14625	14041	13464	12782	13807	13165	12644	12284	11856	95
20053246	10060	13436	-0.19442	0.19128	16843	15646	14282	12721	11589	16023	13894	12920	12067	11178	13158	12106	11359	10712	10060	97
20053245	10043	9517	-0.07132	0.30536	16090	15306	14861	14208	13631	13895	13090	12746	12522	12342	11088	10550	10377	10424	10043	95
20053249	7647	8922	-0.17999	0.31450	13961	13012	12049	10961	10274	12137	10975	10237	9752	9261	9938	8958	8346	7989	7647	98
20053248	10987	12328	-0.13651	0.24635	17629	16735	15585	14318	13600	15812	14716	13907	13307	12664	13031	12253	11717	11349	10987	95
20053254	8125	14515	-0.33908	0.21541	16713	14667	12955	10893	9652	15513	13180	11365	9978	9056	13195	11336	9849	8798	8125	96
20060056	11045	9660	-0.03912	0.32922	17701	16998	16195	15471	15109	15270	14759	14456	14197	13982	11045	11136	11333	11603	11760	95
20060055	9237	8929	-0.11903	0.37720	16548	15726	14770	13732	13145	13769	12691	12135	11767	11478	10688	9953	9457	9374	9237	100
20060149	3862	6613	-0.34378	0.23760	8293	7396	6191	5084	4395	7039	5943	5180	4624	4210	6000	5201	4574	4163	3862	97
20060148	3458	5494	-0.33648	0.29398	7747	6814	5706	4648	4143	6380	5234	4554	4188	3928	5418	4399	3840	3608	3458	99
20060202	9726	8723	-0.06539	0.30864	15186	14830	14069	12905	12149	12524	12243	12134	11848	11379	9859	9814	9829	9863	9726	97
20060201	4113	5870	-0.35357	0.38967	10497	8498	6964	5590	5142	7803	5956	5116	4870	4749	6215	4689	4146	4113	4171	100
20060254	8442	7580	-0.08721	0.37570	14700	13911	13168	12320	11787	11590	11240	10888	10650	10399	9229	8661	8549	8503	8442	95
20060253	6696	12057	-0.30214	0.16097	13131	11979	10194	8511	7325	11855	10859	9782	8530	7323	10260	9356	8530	7621	6696	99
20060501	8086	7466	-0.12078	0.43215	15372	14385	13499	12564	12178	12356	11472	10876	10584	10338	9355	8531	8175	8112	8086	97
20060500	8149	7215	-0.07365	0.37964	13906	13082	12363	12079	12035	11918	11148	10666	10506	10473	8828	8314	8149	8230	8373	95
20060499	9374	8874	-0.09936	0.35502	16007	15383	14736	13681	13092	13204	12528	12105	11877	11583	10790	1007	9537	9486	9374	97
20060504	6577	8473	-0.24008	0.36844	14224	13165	11635	10043	8852	11535	10719	9704	8779	7970	8877	8235	7632	7087	6577	98
20060503	10108	8537	-0.05564	0.39379	17401	16647	15946	14857	14433	14352	13873	13461	13252	12954	10208	10108	10300	10392	10428	99
20060502	9022	8965	-0.11177	0.31403	15444	14375	13213	12066	11388	12557	12210	11748	11292	10735	9803	9444	9389	9267	9022	98
20060509	9519	8439	-0.05100	0.33331	15833	15164	14224	13197	12493	12814	12749	12562	12265	11829	9519	9564	9874	10078	10055	96
20060505	10643	9303	-0.01594	0.35036	18165	17533	16868	16069	15646	15427	15198	14996	14837	14506	10643	11263	11639	11964	12068	96
20060593	7393	7912	-0.17862	0.39299	14340	13097	12164	11259	10693	12243	10681	9835	9403	9167	9387	8250	7594	7404	7393	96
20060642	6711	10525	-0.26906	0.17918	12424	11167	9734	8355	7401	10909	9837	8856	7975	7243	9512	8591	7856	7247	6711	97
20060710	12160	12645	-0.10830	0.25031	18669	17914	17012	15793	14793	16491	15741	15063	14460	13788	13645	12977	12634	12395	12160	96
20060732	8701	8144	-0.10512	0.36087	14891	13970	13217	12332	11893	12740	11758	11142	10837	10595	9455	8969	8733	8703	8701	95
20060771	7375	11679	-0.29112	0.23886	14953	13367	11796	9930	8759	12775	11658	10404	9203	8267	11001	9785	8847	8017	7375	97
20060788	7752	7775	-0.13157	0.35431	13759	12793	11975	11160	10744	11588	10646	10051	9721	9481	9112	8302	7942	7793	7752	96

AHTD RESILENT MODULUS TEST RESULTS (5/4/04-4/1/07)

DOCK #	Mr REPORTED	RM RAN k1 Mr	K2	K5	SEQ 1 Mr psi (6)	Seq 2 Mr psi (6)	Seq 3 Mr psi (6)	Seq 4 Mr psi (6)	Seq 5 Mr psi (6)	Seq 6 Mr psi (4)	Seq 7 Mr psi (4)	Seq 8 Mr psi (4)	Seq 9 Mr psi (4)	Seq 10 Mr psi (4)	Seq 11 Mr psi (2)	Seq 12 Mr psi (2)	Seq 13 Mr psi (2)	Seq 14 Mr psi (2)	Seq 15 Mr psi	% COMP
20060854	6130	8357	-0.23724	0.28430	11961	10752	9608	9439	7807	10589	9492	8584	7861	7255	8345	7570	7001	6529	6130	97
20060828	5913	11560	-0.40358	0.27289	14234	12408	10432	8222	7151	12613	10614	8925	7658	6800	10320	8618	7367	6483	5913	98
20061194	9534	9534	-0.07034	0.29178	16067	15331	14614	13572	12999	13324	12974	12790	12510	12117	10842	10406	10362	10444	10435	95
20061193	8125	8042	-0.09976	0.28491	12925	12240	11524	10733	10227	11081	10596	10174	9870	9489	8888	8502	8338	8238	8125	94
20061192	8641	9614	-0.13044	0.22395	13495	12696	12057	11008	10174	11793	11201	10726	10282	9740	10151	9504	9215	8952	8641	100
20061197	8590	9354	-0.14111	0.28895	14898	13837	12735	11510	10810	12292	11734	11200	10642	10044	10090	9441	9162	8927	8590	98
20061196	4863	4836	-0.19791	0.11655	5640	5099	4198	3782	4012	5072	4205	3764	3751	3910	4781	3955	3580	3593	3869	97
20061199	10178	10101	-0.07112	0.19562	14201	13740	13122	12178	11306	12371	12151	11980	11654	11124	10565	10361	10389	10380	10178	97
20061198	9686	8554	-0.07713	0.36415	16128	15277	14552	13731	13251	13637	13014	12427	12125	11843	9953	9814	9719	9704	9686	96
20061324	6549	9042	-0.23197	0.23926	12013	11142	10091	8709	7653	10566	9534	8692	7926	7276	8734	8080	7525	7007	6549	98
20061366	12367	13174	-0.10356	0.21003	17833	17491	16799	15499	14302	16553	15418	15069	14543	13812	13895	13279	12819	12632	12367	97
20061387	7420	6276	-0.04936	0.39315	12376	12113	12013	11639	11451	10611	9790	9561	9643	9727	8238	7650	7420	7555	7786	95
20061545	6131	16407	-0.47342	0.11367	14153	12052	9870	7745	6593	13565	11510	9520	7759	6533	12246	10352	8626	7138	6131	97
20061544	8812	13469	-0.26680	0.24767	17245	15643	14073	12231	11036	15681	13911	12468	11326	10344	13274	11602	10399	9527	8812	97
20061543	4311	10999	-0.49786	0.18529	10571	8298	6924	5866	5118	10591	8000	6349	5394	4849	9226	685	5460	4705	4331	101
20061547	8681	9776	-0.17419	0.32528	15595	14275	13289	12407	11955	13895	12054	11219	10743	10488	11257	69711	8952	8707	8681	95
20061546	8651	15681	-0.33288	0.12992	15560	13942	1225	10079	8743	14626	13012	11481	9918	8651	13072	11687	10365	9126	8135	98
20062014	5080	6520	-0.29707	0.38886	12292	10420	9066	7647	6891	8095	6738	5895	5564	5412	7302	6254	5481	5127	5080	99
20062013	5886	9006	-0.23147	0.09969	9450	8656	7983	6975	6285	8227	7615	5864	6309	5965	8303	7563	6806	6186	5886	96
20062012	4484	9821	-0.36093	0.01760	7415	6767	5950	4868	4538	8009	6727	5580	4850	4537	7868	6647	5445	4749	4484	100
20062096	3685	4669	-0.31127	0.44791	9605	8397	7215	5660	4910	6227	5250	4615	4370	4160	5314	4432	3916	3752	3685	100
20062105	9641	9583	-0.10669	0.31409	15821	15134	14573	13642	12890	13599	12709	12234	11971	11570	11216	10344	9964	9773	9641	98
20062311	8303	9741	-0.19330	0.36105	16489	15153	13889	12277	11374	14223	12986	11858	11101	10373	10537	9764	9190	8780	8303	99
20062465	8738	11441	-0.20279	0.23439	15426	14093	12858	11258	10157	13946	12772	11857	10880	9910	10926	10380	9865	9362	8738	97
20062464	8472	12024	-0.20868	0.15640	13858	12928	11698	10155	9056	13131	12098	11255	10244	9193	10718	10342	9821	9183	8472	94
20062463	7269	7428	-0.16403	0.41115	14134	12916	11970	10975	10586	12162	10646	9776	9401	9121	8764	7862	7388	7341	8269	97
20062517	10031	11219	-0.13564	0.24448	16244	15119	14255	13052	11941	14563	13663	12872	12105	11300	11195	11267	10879	10487	10031	99
20062516	11739	11653	-0.08392	0.22930	17006	16353	15513	14434	13712	15345	14623	14166	13694	13154	12213	12096	11958	11858	11739	95
20062521	7056	5492	-0.01222	0.43034	12156	11793	11669	115570	11579	10148	9517	9336	9517	9833	7370	7056	7064	7351	7707	95
20062620	6749	7370	-0.21087	0.44059	14377	12941	11611	10353	9877	12184	10483	9391	8858	8537	8505	7562	6922	6763	6749	97
20062619	8796	9221	-0.16388	0.38889	16907	15655	14379	12969	12249	14675	13141	12103	11423	10794	10110	9800	9333	9038	8796	96
20062618	6261	8475	-0.26263	0.37684	13769	12406	11002	9697	9036	12092	10587	9402	8557	7967	9121	8053	7162	6640	6261	99
20062621	3060	10777	-65721.00000	0.19740	9595	7739	5666	4084	3470	8937	6951	5230	4043	3349	7374	5902	4512	3595	3060	95
20062746	9625	13794	-0.22806	0.16952	16277	15166	13873	11905	10321	14757	13780	12797	11570	10327	12537	11851	11230	10477	9625	98
20062745	4888	8925	-0.37716	0.30628	11633	10302	8870	7216	6315	10527	8901	7598	6556	5786	8379	7072	6099	5387	4888	94
20062975	10145	11894	-0.13587	0.17735	15250	14316	13325	12088	11010	14059	13347	12660	11881	11019	11301	11224	10943	10639	10145	98
20062758	5728	5491	-0.14073	0.42836	10851	10054	9512	8942	8619	9307	8303	7785	7514	7361	6880	6102	5788	5728	5743	96
20062757	10548	11697	-0.13844	0.25072	17054	15961	14815	13524	12706	15271	14127	13370	12697	12056	12060	11512	11166	10873	10548	94
20062982	11789	12043	-0.09006	0.21816	17140	16413	15481	14312	13591	15594	14929	14428	13867	13255	12362	12263	12164	12040	11789	95
20063140	6077	9414	-0.24423	0.13236	10275	9423	8394	7170	6198	9581	8787	7992	7127	6317	7937	7652	7212	6662	6077	97
20063139	6894	6107	-0.07214	0.36301	11309	10706	10415	10063	9963	10058	9243	8807	8710	8693	7432	7026	6894	6948	7087	96
20063138	7293	11245	-0.23811	0.13124	12135	11219	10020	8626	7574	11529	10516	9588	8506	7700	9654	9212	8598	7955	7293	96
20063141	7027	8657	-0.12999	0.08999	9490	8930	8367	7717	7064	9150	8684	8250	7768	7267	7858	7808	7623	7363	7027	96
20063190	7005	8497	-0.20307	0.33312	13479	12561	11313	10124	9401	11921	10599	9663	8991	8465	9027	8335	7753	7319	7005	98
20062916	8501	7983	-0.10934	0.36116	14579	13629	12965	12067	11559	12451	11541	10931	10616	10376	9317	8806	8555	8501	8509	95
20062915	7129	7709	-0.15785	0.34558	12965	12232	11279	10225	9774	11223	10174	9417	9009	8738	8746	7916	7482	7328	7129	95
20062914	5965	4716	-0.02459	0.44310	10620	10312	10037	9798	9800	8745	8222	8024	8208	8326	6391	5965	6037	6299	6427	96
20063198	7451	9457	-0.22269	0.32103	14484	13207	11974	10483	9718	13046	11673	10416	9548	8863	9607	8980	8317	7800	7451	99
20063294	0	0	0.00000	0.00000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20063614	7327	6443	-0.08122	0.40739	13601	12355	11889	11258	11076	10868	9981	9509	9440	9460	8099	7541	7327	7456	7597	97
20063613	7808	7138	-0.09853	0.39145	13740	13064	12391	11591	11417	11488	10656	10202	10028	9862	8799	8153	7888	7857	7808	95
20063447	10526	10879	-0.12842	0.30476	17663	16385	15431	14149	13469	15469	14291	13458	13113	12636	11976	11255	10938	10702	10526	98
20063446	3675	2806	-0.01195	0.53977	7870	7472	7360	7129	7107	6245	5410	5321	5551	5758	4008	3675	3844	4212	4574	97
20063445	7682	12706	-0.28395	0.17368	14248	12947	11365	9522	8491	13368	11978	10739	9459	8363	11016	10153	9314	8446	7682	99
20063450	7658	9373	-0.19755	0.27323	13458	12178	11162	1007	9519	12552	11049	9986	9269	8777	9410	8765	8216	7844	7658	94
20063449	4813	7893	-0.35275	0.32926	11067	9334	8046	7026	6493	10339	8219	6928	6212	5791	7923	6358	5427	5041	4813	98
20063448	4027	7015	-0.41172	0.36190	9957	8425	7288	6202	5594	9052	7290	6131	5365	4887	7233	5680	4793	4291	4027	97
20063765	11387	10143	-0.01031	0.24379	16159	15586	15067	14694	14634	14762	14461	14265	14185	14036	11096	11387	11765	12082	1295	94
20063764	9413	10336	-0.10610	0.17611	13548	12878	12019	11060	10517	12157	11758	11402	10912	10449	10477	10063	9842	9671	9413	95
20063763	11699	12544	-0.09750	0.17905	16468	15735	14953	13881	12853	15322	14590	14107	13577	12839	12506	12337	12209	12007	11699	98

AHTD RESILENT MODULUS TEST RESULTS (5/4/04-4/1/07)

DOCK #	Mr. REPORTED	RM RAN k1 Mr	K2	K5	SEQ 1 Mr psi (6)	Seq 2 Mr psi (6)	Seq 3 Mr psi (6)	Seq 4 Mr psi (6)	Seq 5 Mr psi (6)	Seq 6 Mr psi (4)	Seq 7 Mr psi (4)	Seq 8 Mr psi (4)	Seq 9 Mr psi (4)	Seq 10 Mr psi (4)	Seq 11 Mr psi (2)	Seq 12 Mr psi (2)	Seq 13 Mr psi (2)	Seq 14 Mr psi (2)	Seq 15 Mr psi	% COMP
20063768	8170	9255	-0.15186	0.28317	13975	13172	12309	11135	10409	12484	11547	10847	10260	9644	9736	9355	8912	8552	8170	98
20063767	8071	11727	-0.19832	0.09269	12162	11540	10499	9128	7870	11685	10978	10258	9339	8259	9989	9708	9367	8837	8071	100
20063766	9438	12784	-0.20966	0.22256	16592	15418	14040	12327	10892	15140	13914	12827	11777	10637	12171	11473	10863	10182	9438	99
20063855	4355	9843	-0.42848	0.17732	9904	8689	7379	5735	4717	9232	7804	6534	5499	4691	7834	6778	5781	4979	4355	100
20063682	7859	8393	-0.16457	0.38152	15067	14010	12982	11810	11224	12711	11537	10758	10235	9824	9786	8824	8312	8042	7859	98
20063986	3937	6159	-0.27213	0.18442	7143	6414	5666	4947	4476	6700	5741	5125	4689	4343	5714	5005	4522	4189	3937	97
20063985	6353	5766	-0.07823	0.34968	10319	9852	9629	9238	9018	9103	8342	7957	7970	7946	7058	6551	6353	6362	6447	98
20063984	6311	7220	-0.16673	0.28938	10786	10140	9631	8712	8160	9872	8908	8283	7846	7462	7810	7204	6799	6532	6311	99
20063988	7167	7772	-0.14565	0.30844	12247	11410	10699	9931	9482	11190	10088	6402	8937	8579	8465	7941	7542	7320	7167	101
20063987	5637	4274	0.03796	0.41277	9446	9404	9557	9668	9838	8074	7639	7624	7978	8347	5891	5637	5840	6327	6644	98
20064158	7146	8265	-0.20490	0.36564	14082	12646	11355	10333	9897	12271	10706	9687	9064	8727	9117	8084	7509	7235	7146	96
20064157	6491	6797	-0.17719	0.39861	12490	11147	10542	9899	9689	11149	9324	8484	8210	8242	8319	7119	6581	6491	6684	95
20064159	6673	8395	-0.23509	0.33927	13110	11732	10632	9483	8995	11981	10151	9005	8368	8009	8940	7853	7130	6780	6673	96
20070058	10050	13275	-0.19864	0.21126	16983	15642	14323	12803	11702	15767	14296	13197	12250	11294	12926	11947	11158	10559	10050	97
20070085	11869	14165	-0.15467	0.21775	19047	17935	16660	14886	13498	17566	16415	15492	14349	13332	13723	13460	13025	12500	11869	96
20070113	8771	8771	-0.28126	0.23691	17173	15357	13641	11708	10593	15885	14005	12412	11111	10096	12880	11489	10316	9472	8771	96
20070161	4512	11209	-0.51513	0.25637	12275	10429	8570	6350	5229	11133	8951	7118	5843	5018	8943	7489	6060	5105	4512	98
20070259	6350	6252	-0.16788	0.46173	12879	11913	11161	10198	9749	10901	9431	6543	8358	8126	7808	6843	6402	6362	6350	97
20070284	10518	10353	-0.12477	0.36154	18416	17336	16420	15116	14435	16112	14718	13874	13270	12818	11796	11251	10800	10610	10518	95
20070283	6909	10851	-0.30225	0.28025	14390	13076	11452	9700	8677	13097	11366	9998	8871	8021	10381	9250	8231	7432	6909	95
20070286	4142	10748	-0.53708	0.27570	11644	9425	7440	6064	5434	11282	8621	6777	5632	4907	9287	6872	5356	4580	4142	95
20070289	7759	12267	-0.30267	0.26264	15701	13946	12451	10639	9630	14789	12574	10985	9813	8976	11693	10259	9084	8281	7759	95
20070288	8476	7374	-0.07981	0.41331	14958	14153	13736	13135	12819	12785	11696	11136	11045	10987	9266	8734	8476	8550	8795	98
20070484	9075	11591	-0.19267	0.24125	15814	14533	13322	12004	11095	14150	12909	11979	11183	10467	11811	10775	10038	9521	9075	95
20070469	7748	11794	-0.28459	0.25652	15272	43402	11931	10474	9689	14316	12175	10613	9518	8901	11374	9969	8800	8105	7748	95
20070570	5182	6103	-0.23678	0.41466	11109	9882	8798	7855	7402	9609	8013	7141	6768	6516	6938	5932	5370	5240	5182	100
20070686	8449	11042	-0.21543	0.31481	16777	15409	13837	12174	11262	15019	13692	12552	11534	10428	11055	10634	9920	9281	8449	94
20070679	6941	11031	-0.26840	0.18611	12772	11696	10300	8818	7885	11880	40638	9604	8628	7729	9955	9092	8288	7603	6941	94

APPENDIX B

RESILIENT MODULUS RAN VS. R-VALUE RAN CORRELATIONS

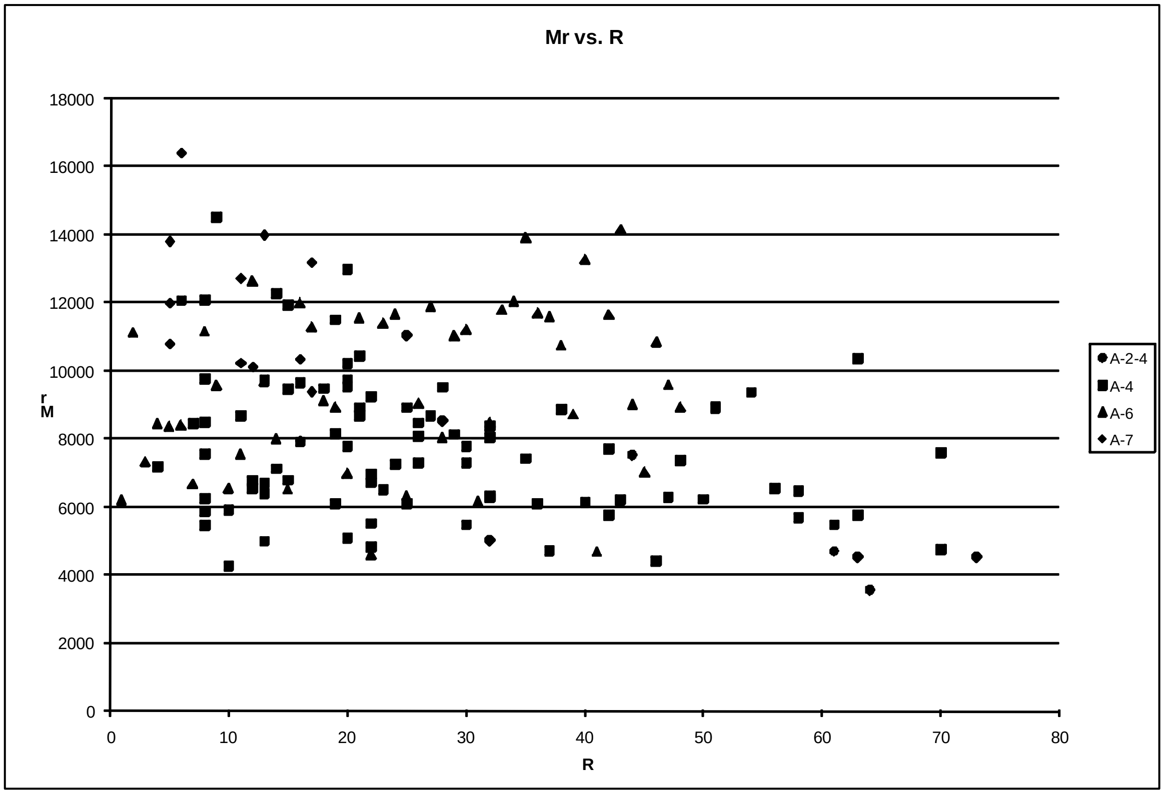


Figure 23. Resilient Modulus vs. R-value

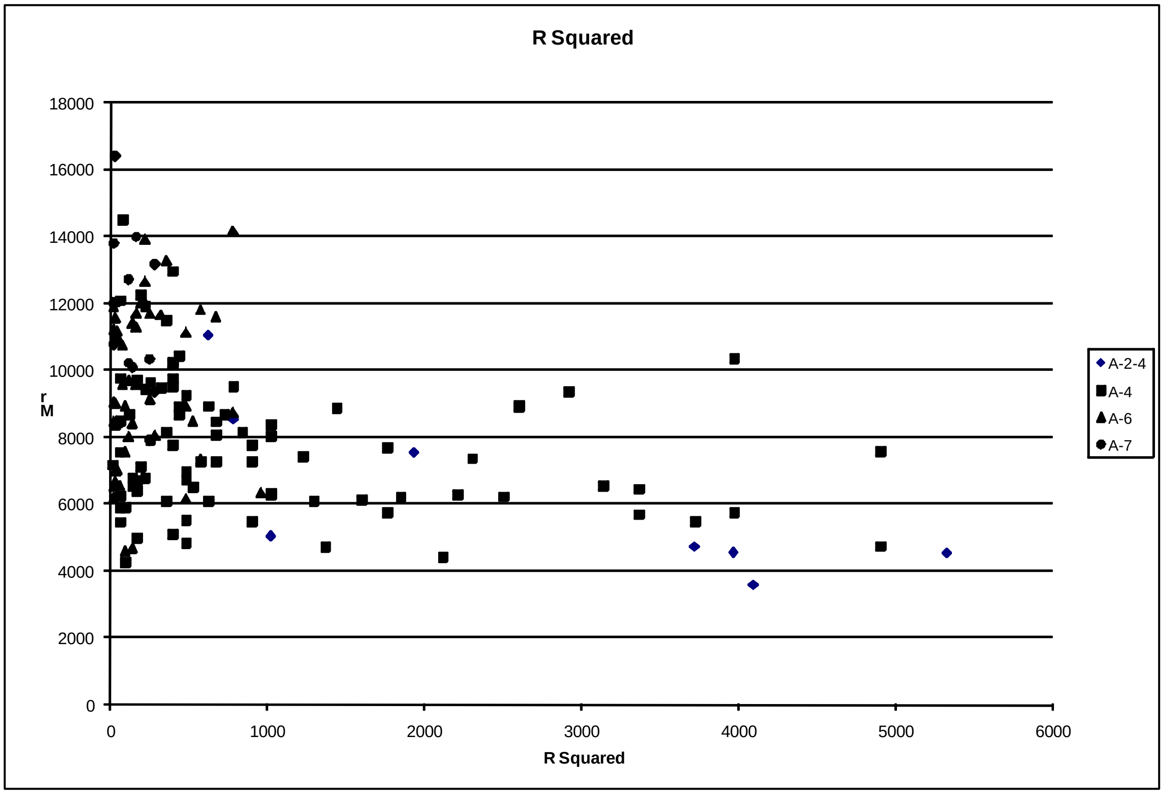


Figure 24. Resilient Modulus vs. R-value Squared

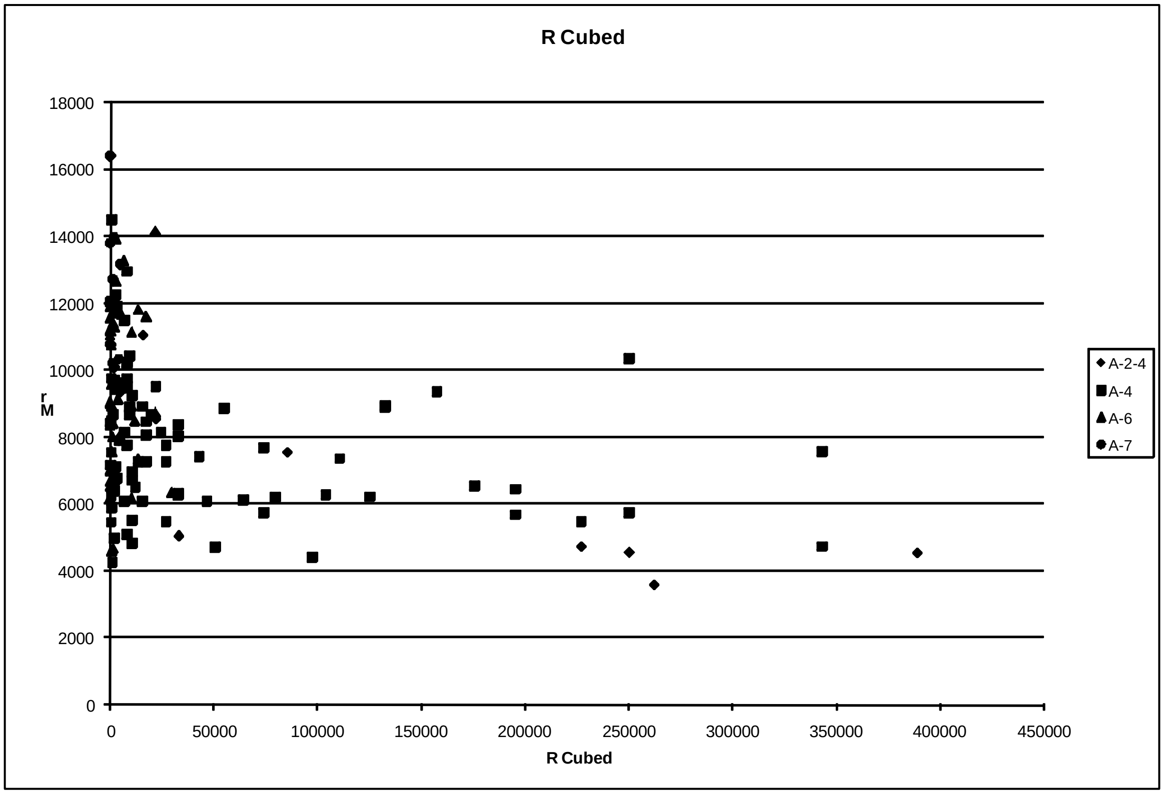


Figure 25. Resilient Modulus vs. R-value Cubed

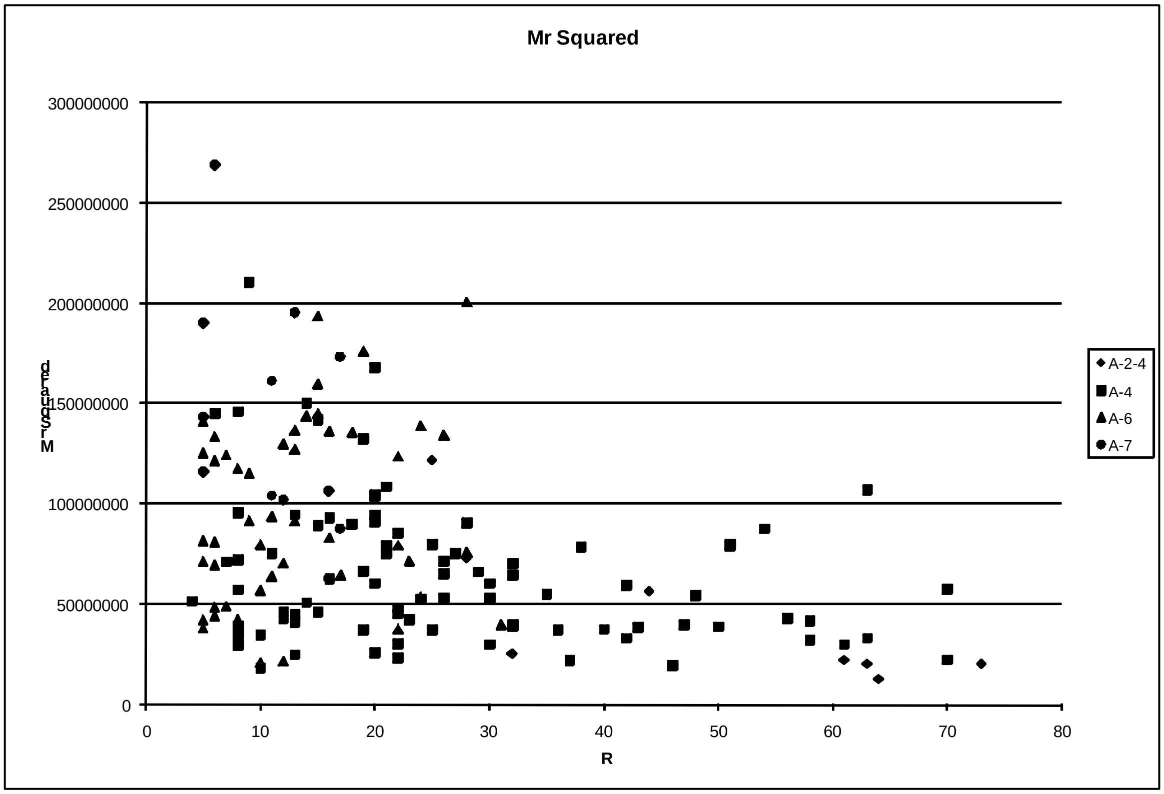


Figure 26. Resilient Modulus Squared vs. R-value

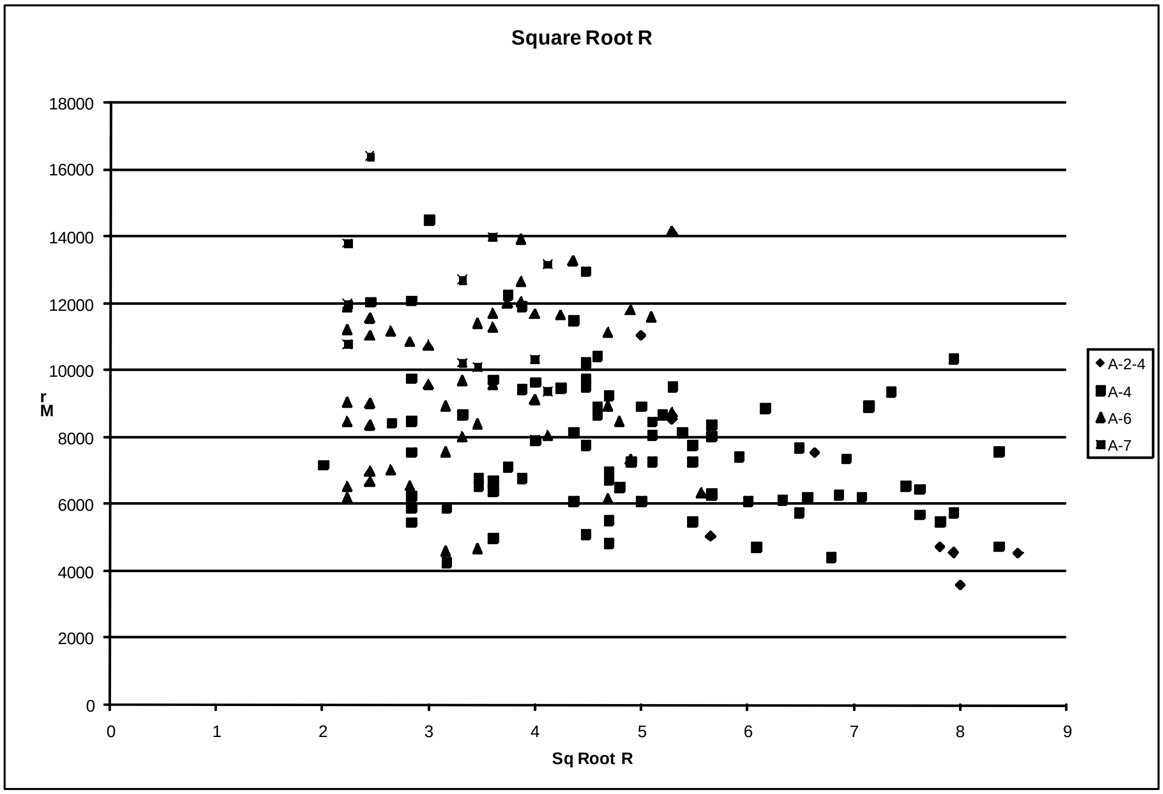


Figure 27. Resilient Modulus vs. Square Root R-value

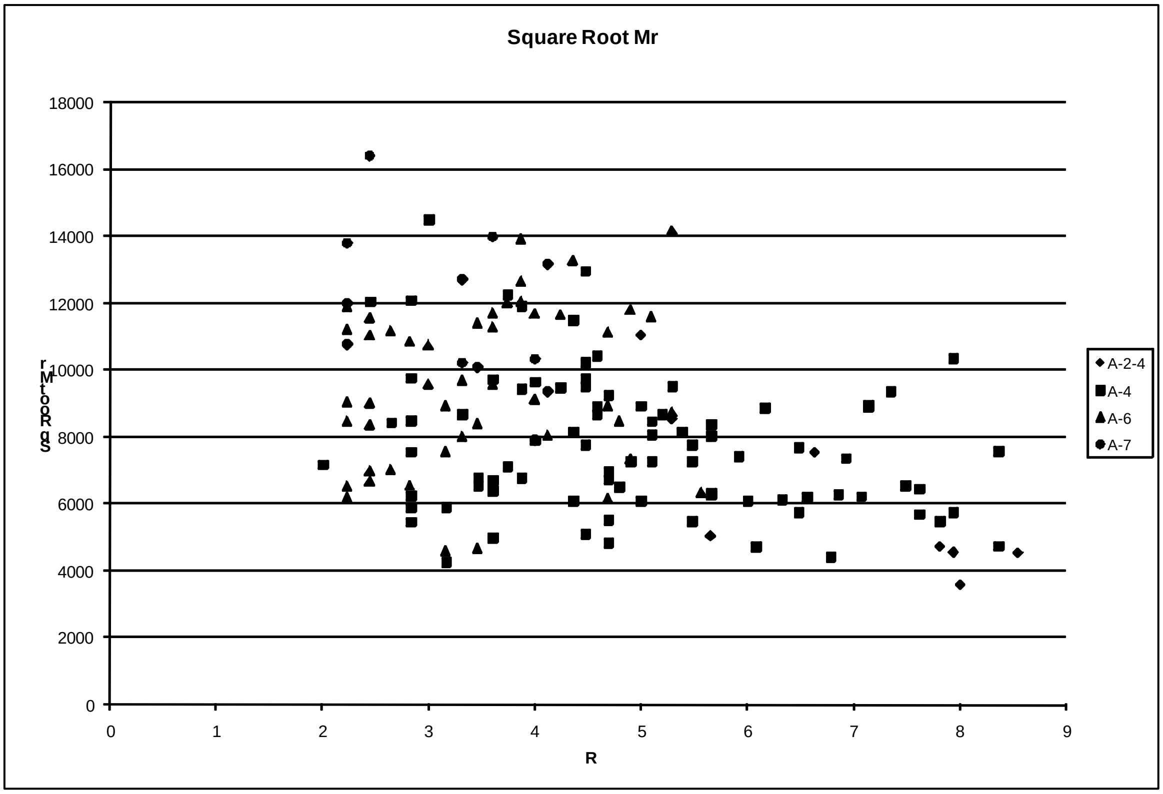


Figure 28. Square Root of Resilient Modulus vs. R-value

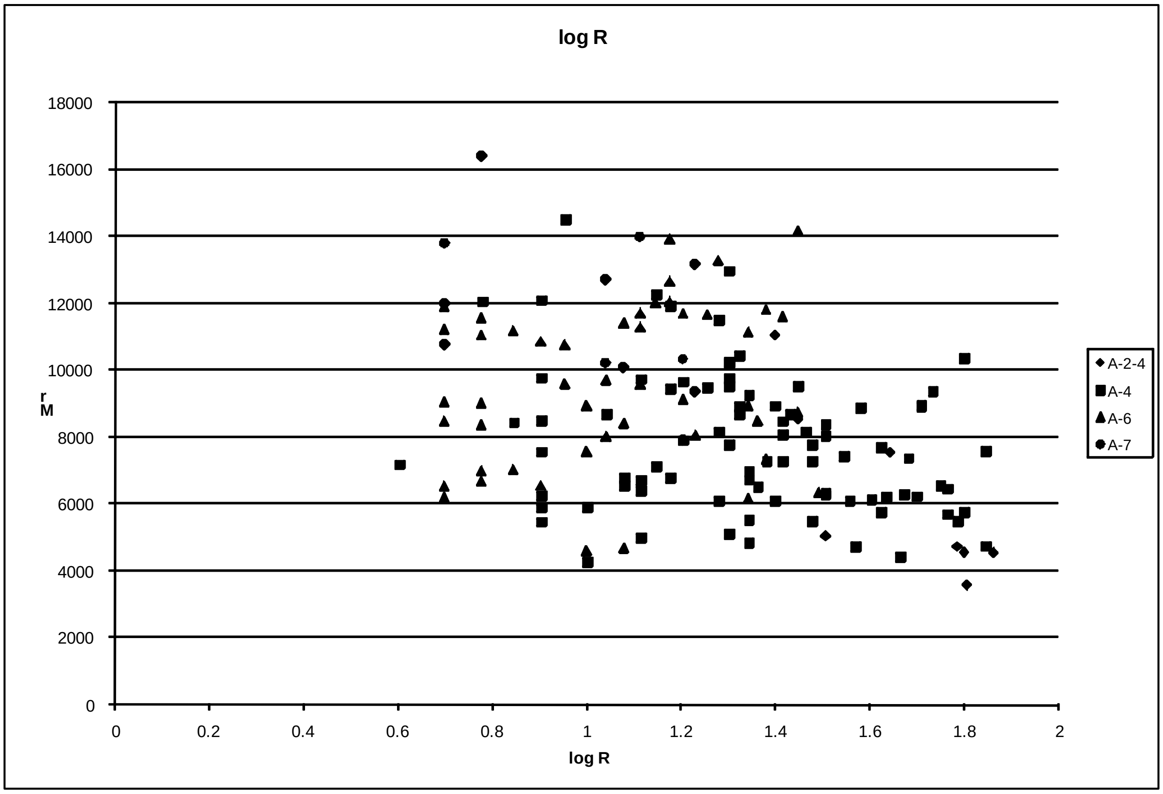


Figure 29. Resilient Modulus vs. Log(R-value)

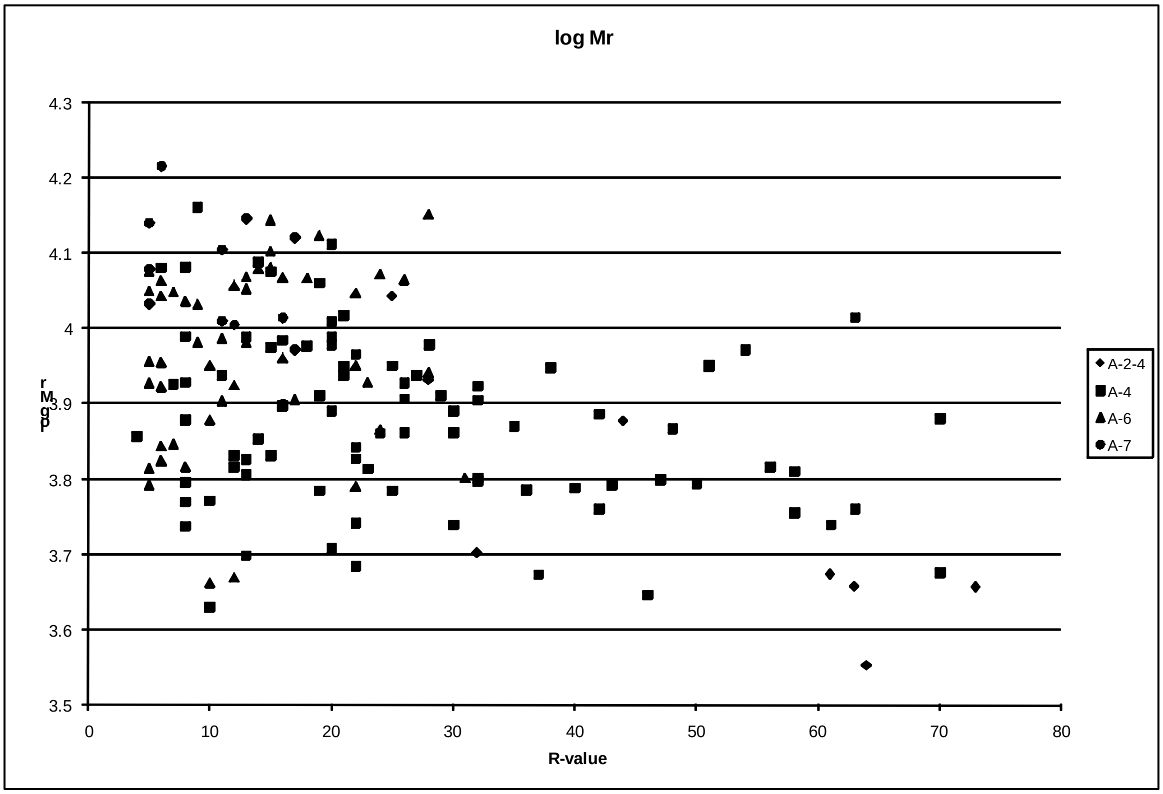


Figure 30. Log(Resilient Modulus) vs. R-value

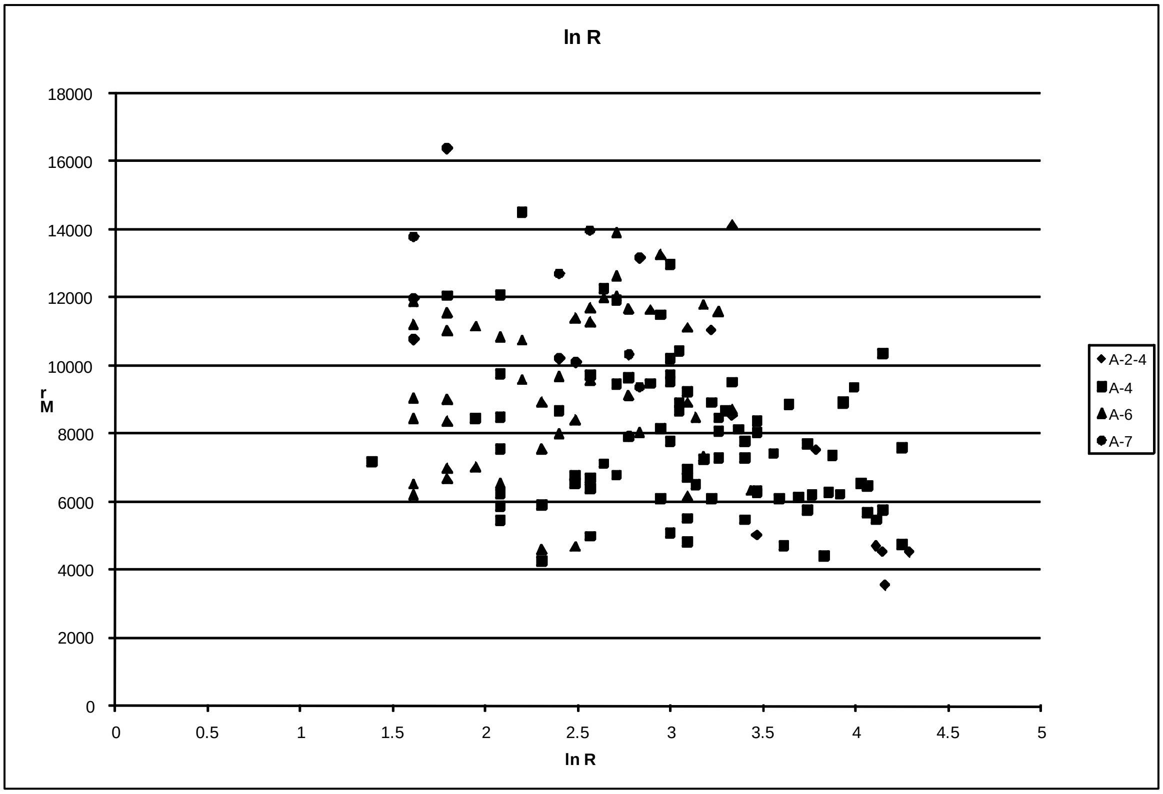


Figure 31. Resilient Modulus vs. Ln(R-value)

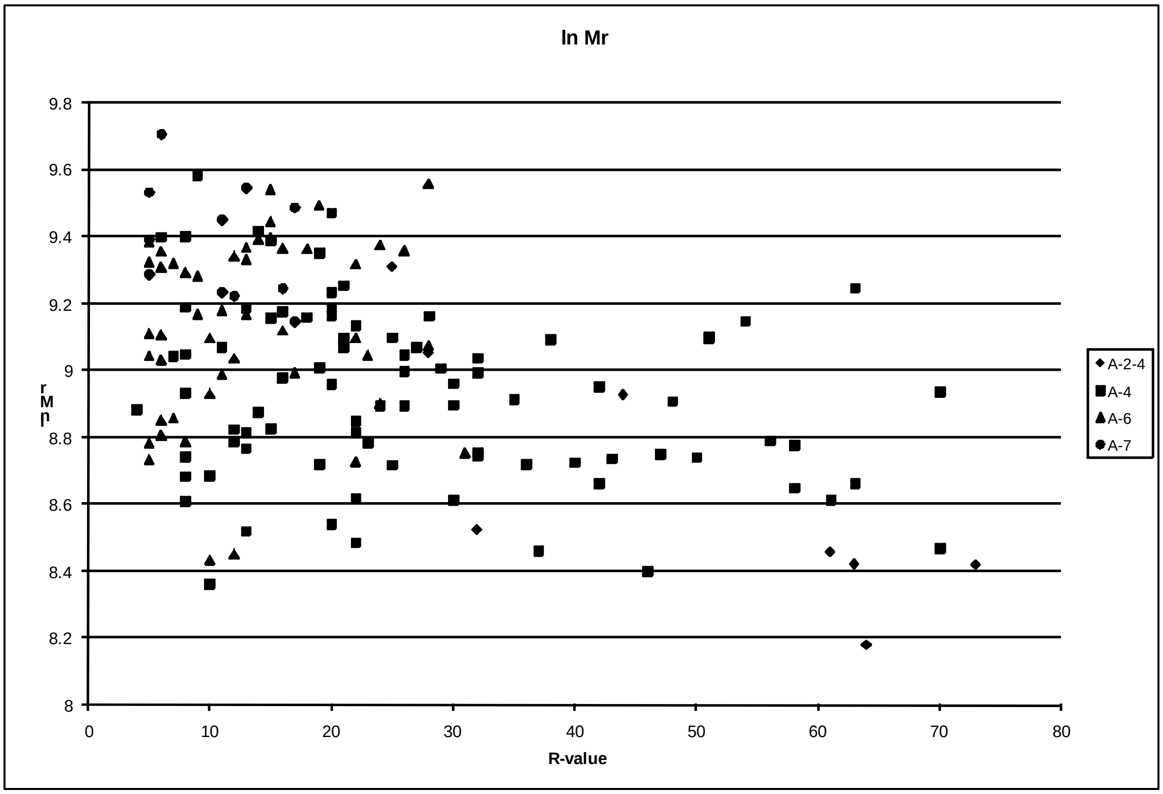


Figure 32. Ln(Resilient Modulus) vs. R-value

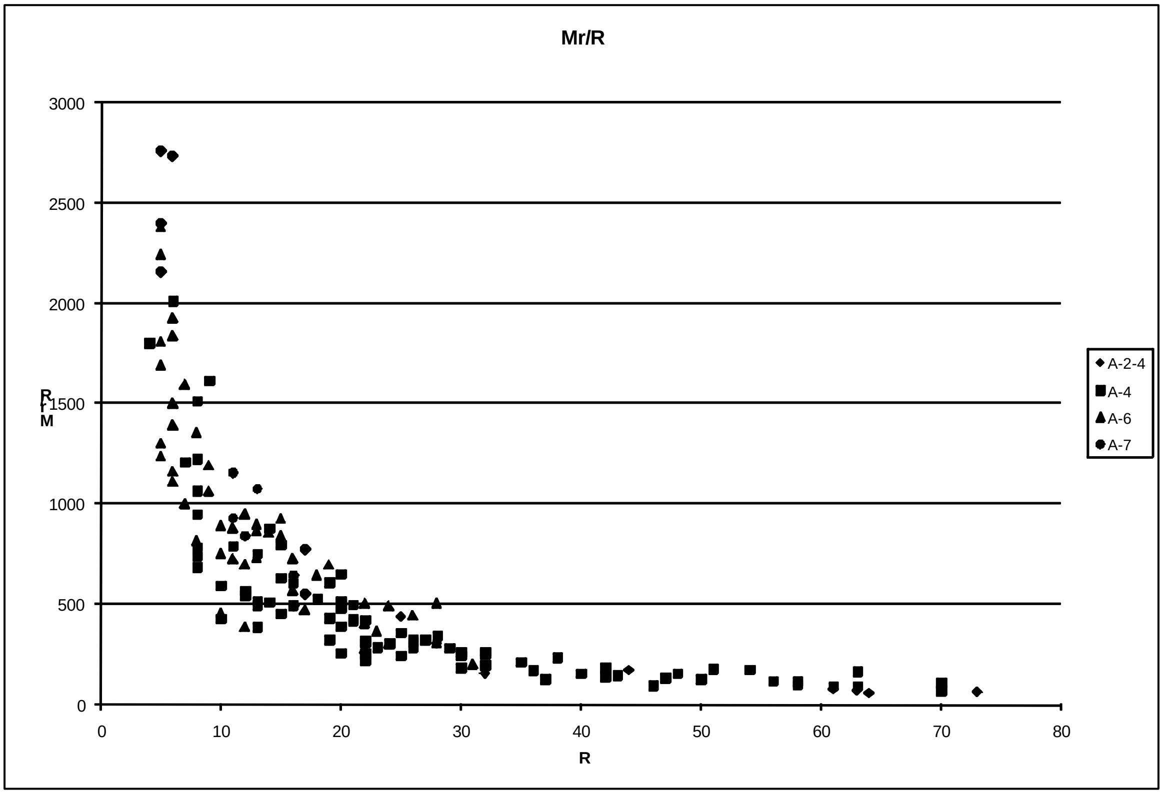


Figure 33. (Resilient Modulus/R-value) vs. R-value

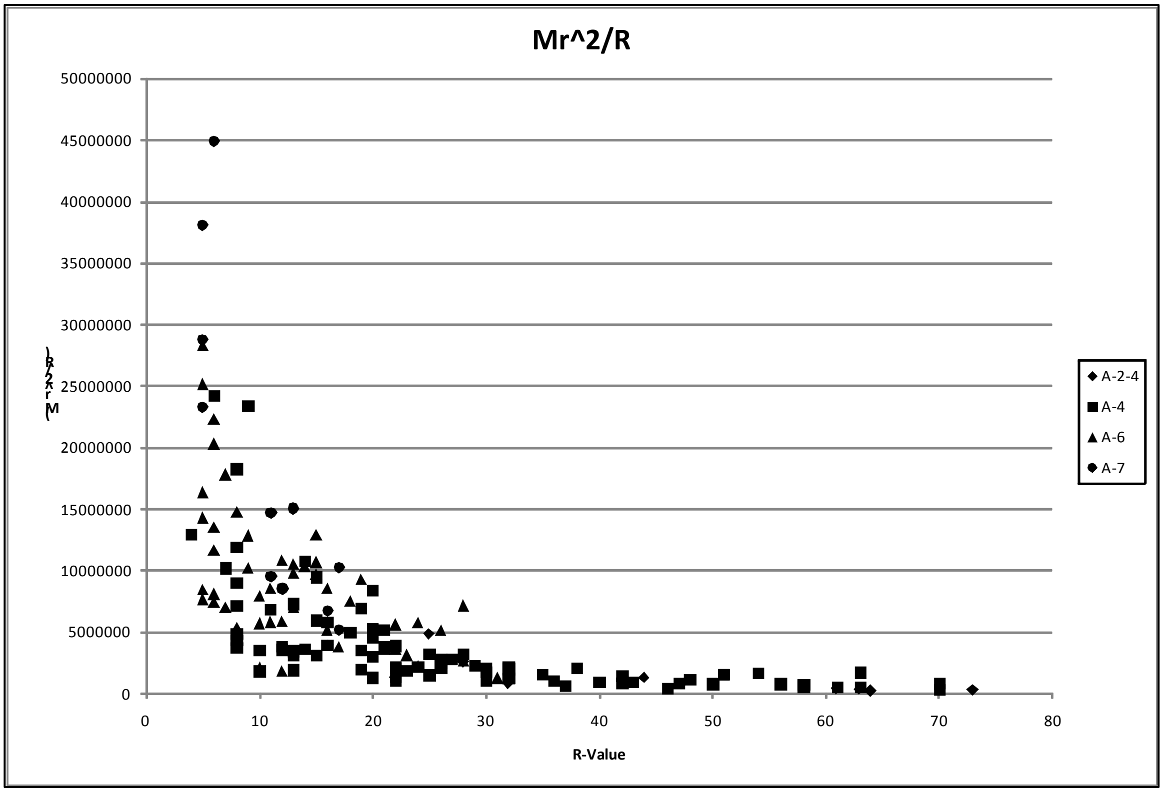


Figure 34. (Resilient Modulus Squared/R-value) vs. R-value

APPENDIX C

SAMPLE MEPDG INPUT FILES

Project: Thicker R=5 Level 3.dgp

General Information

Design Life	20 years
Base/Subgrade construction:	August, 2006
Pavement construction:	September, 2006
Traffic open:	October, 2006
Type of design	Flexible

Description:

Analysis Parameters

Performance Criteria

	Limit	Reliability
Initial IRI (in/mi)	63	
Terminal IRI (in/mi)	172	90
AC Surface Down Cracking (Long. Cracking) (ft/mile):	2000	90
AC Bottom Up Cracking (Alligator Cracking) (%):	25	90
AC Thermal Fracture (Transverse Cracking) (ft/mi):	1000	90
Chemically Stabilized Layer (Fatigue Fracture)	25	90
Permanent Deformation (AC Only) (in):	0.25	90
Permanent Deformation (Total Pavement) (in):	0.75	90
Reflective cracking (%):	100	

Location:	Fayetteville
Project ID:	Thinner Section R=5
Section ID:	
Date:	2/22/2008
Station/milepost format:	
Station/milepost begin:	
Station/milepost end:	
Traffic direction:	East bound

Default Input Level

Default input level	Level 3, Default and historical agency values.

Traffic

Initial two-way AADTT:	2500
Number of lanes in design direction:	2
Percent of trucks in design direction (%):	50
Percent of trucks in design lane (%):	95
Operational speed (mph):	60

Traffic -- Volume Adjustment Factors

Monthly Adjustment Factors

(Level 3, Default MAF)

	Vehicle Class									
Month	**Class 4**	**Class 5**	**Class 6**	**Class 7**	**Class 8**	**Class 9**	**Class 10**	**Class 11**	**Class 12**	**Class 13**
January	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
February	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
March	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
April	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
May	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
June	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
July	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
August	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
September	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
October	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
November	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
December	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Vehicle Class Distribution

(Level 3, Default Distribution)

AADTT distribution by vehicle class

Class 4	1.8%
Class 5	24.6%
Class 6	7.6%
Class 7	0.5%
Class 8	5.0%
Class 9	31.3%
Class 10	9.8%
Class 11	0.8%
Class 12	3.3%
Class 13	15.3%

Hourly truck traffic distribution

by period beginning:

Midnight	2.3%	Noon	5.9%
1:00 am	2.3%	1:00 pm	5.9%
2:00 am	2.3%	2:00 pm	5.9%
3:00 am	2.3%	3:00 pm	5.9%
4:00 am	2.3%	4:00 pm	4.6%
5:00 am	2.3%	5:00 pm	4.6%
6:00 am	5.0%	6:00 pm	4.6%
7:00 am	5.0%	7:00 pm	4.6%
8:00 am	5.0%	8:00 pm	3.1%
9:00 am	5.0%	9:00 pm	3.1%
10:00 am	5.9%	10:00 pm	3.1%
11:00 am	5.9%	11:00 pm	3.1%

Traffic Growth Factor

Vehicle Class	Growth Rate	Growth Function
Class 4	4.0%	Compound
Class 5	4.0%	Compound
Class 6	4.0%	Compound
Class 7	4.0%	Compound
Class 8	4.0%	Compound
Class 9	4.0%	Compound
Class 10	4.0%	Compound
Class 11	4.0%	Compound
Class 12	4.0%	Compound
Class 13	4.0%	Compound

Traffic -- Axle Load Distribution Factors

Level 3: Default

Traffic -- General Traffic Inputs

Mean wheel location (inches from the lane marking):	18
Traffic wander standard deviation (in):	10
Design lane width (ft):	12

Number of Axles per Truck

Vehicle Class	Single Axle	Tandem Axle	Tridem Axle	Quad Axle
Class 4	1.62	0.39	0.00	0.00
Class 5	2.00	0.00	0.00	0.00
Class 6	1.02	0.99	0.00	0.00
Class 7	1.00	0.26	0.83	0.00
Class 8	2.38	0.67	0.00	0.00
Class 9	1.13	1.93	0.00	0.00
Class 10	1.19	1.09	0.89	0.00
Class 11	4.29	0.26	0.06	0.00
Class 12	3.52	1.14	0.06	0.00
Class 13	2.15	2.13	0.35	0.00

Axle Configuration

Average axle width (edge-to-edge) outside dimensions,ft):	8.5
Dual tire spacing (in):	12

Axle Configuration

Tire Pressure (psi) :	120

Average Axle Spacing

Tandem axle(psi):	51.6
Tridem axle(psi):	49.2
Quad axle(psi):	49.2

Climate

icm file:	C:\DG2002\Projects\StLouis.icm
Latitude (degrees.minutes)	36.01
Longitude (degrees.minutes)	-94.1
Elevation (ft)	1247
Depth of water table (ft)	10

Structure--Design Features

HMA E* Predictive Model:	NCHRP 1-37A viscosity based model.
HMA Rutting Model coefficients:	NCHRP 1-37A coefficients
Endurance Limit (microstrain):	None (0 microstrain)

Structure--Layers

Layer 1 -- Asphalt concrete

Material type:	Asphalt concrete
Layer thickness (in):	3

General Properties

General

Reference temperature (F°):	70

Volumetric Properties as Built

Effective binder content (%):	11.5
Air voids (%):	7
Total unit weight (pcf):	150

Poisson's ratio:	0.35 (user entered)

Thermal Properties

Thermal conductivity asphalt (BTU/hr-ft-F°):	0.67
Heat capacity asphalt (BTU/lb-F°):	0.23

Asphalt Mix

Cumulative % Retained 3/4 inch sieve:	0
Cumulative % Retained 3/8 inch sieve:	25
Cumulative % Retained #4 sieve:	55
% Passing #200 sieve:	5

Asphalt Binder

Option: Superpave binder grading

A 9.7150 (correlated)

VTS: -3.2080 (correlated)

High temp. °C	Low temperature, °C						
	-10	-16	-22	-28	-34	-40	-46
46	▨	▨	▨	▨			
52							
58							
64							▨
70							▨
76			🟩			▨	▨
82						▨	▨

Thermal Cracking Properties

Average Tensile Strength at 14ºF: 393.49

Mixture VMA (%) 18.5

Aggreagate coeff. thermal contraction (in./in.) 0.000005

Mix coeff. thermal contraction (in./in./ºF): 0.000013

Load Time (sec)	Low Temp. -4ºF (1/psi)	Mid. Temp. 14ºF (1/psi)	High Temp. 32ºF (1/psi)
1	4.62E-07	6.83E-07	9.25E-07
2	5.02E-07	7.88E-07	1.15E-06
5	5.6E-07	9.51E-07	1.55E-06
10	6.09E-07	1.1E-06	1.93E-06
20	6.61E-07	1.27E-06	2.41E-06
50	7.38E-07	1.53E-06	3.22E-06
100	8.02E-07	1.76E-06	4.02E-06

Layer 2 -- Asphalt concrete

Material type: Asphalt concrete

Layer thickness (in): 4

General Properties

General

Reference temperature (F°): 70

Volumetric Properties as Built

Effective binder content (%): 10.5

Air voids (%): 8

Total unit weight (pcf): 145

Poisson's ratio: 0.35 (user entered)

Thermal Properties

Thermal conductivity asphalt (BTU/hr-ft-F°): 0.67

Heat capacity asphalt (BTU/lb-F°): 0.23

Asphalt Mix

Cumulative % Retained 3/4 inch sieve: 7

Cumulative % Retained 3/8 inch sieve: 20

Cumulative % Retained #4 sieve: 35

% Passing #200 sieve: 4

Asphalt Binder

Option:	Superpave binder grading
A	9.7150 (correlated)
VTS:	-3.2080 (correlated)

High temp. °C	Low temperature, °C						
	-10	-16	-22	-28	-34	-40	-46
46	▨	▨	▨	▨			
52							
58							
64							▨
70							▨
76			🟩			▨	▨
82						▨	▨

Layer 3 -- Asphalt concrete

Material type:	Asphalt concrete
Layer thickness (in):	5

General Properties

General

Reference temperature (F°):	70

Volumetric Properties as Built

Effective binder content (%):	10
Air voids (%):	8
Total unit weight (pcf):	140

Poisson's ratio:	0.35 (user entered)

Thermal Properties

Thermal conductivity asphalt (BTU/hr-ft-F°):	0.67
Heat capacity asphalt (BTU/lb-F°):	0.23

Asphalt Mix

Cumulative % Retained 3/4 inch sieve:	15
Cumulative % Retained 3/8 inch sieve:	25
Cumulative % Retained #4 sieve:	30
% Passing #200 sieve:	4

Asphalt Binder

Option:	Superpave binder grading
A	9.7150 (correlated)
VTS:	-3.2080 (correlated)

High temp. °C	Low temperature, °C						
	-10	-16	-22	-28	-34	-40	-46
46	▨	▨	▨	▨			
52							
58							
64							▨
70							▨
76			🟩			▨	▨
82						▨	▨

Layer 4 -- Crushed stone

Unbound Material:	Crushed stone
Thickness(in):	12

Strength Properties

Input Level:	Level 3
Analysis Type:	ICM inputs (ICM Calculated Modulus)
Poisson's ratio:	0.35
Coefficient of lateral pressure,Ko:	0.5
Modulus (input) (psi):	30000

ICM Inputs

<u>Gradation and Plasticity Index</u>

Plasticity Index, PI:	1
Liquid Limit (LL)	6
Compacted Layer	No
Passing #200 sieve (%):	8.7
Passing #40	20
Passing #4 sieve (%):	44.7
D10(mm)	0.1035
D20(mm)	0.425
D30(mm)	1.306
D60(mm)	10.82
D90(mm)	46.19

Sieve	Percent Passing
0.001mm	
0.002mm	
0.020mm	
#200	8.7
#100	
#80	12.9
#60	
#50	
#40	20
#30	
#20	
#16	
#10	33.8
#8	
#4	44.7
3/8"	57.2
1/2"	63.1
3/4"	72.7
1"	78.8
1 1/2"	85.8
2"	91.6
2 1/2"	
3"	
3 1/2"	97.6
4"	97.6

Calculated/Derived Parameters
Maximum dry unit weight (pcf): 127.2 (derived)
Specific gravity of solids, Gs: 2.70 (derived)
Saturated hydraulic conductivity (ft/hr): 0.05054 (derived)
Optimum gravimetric water content (%): 7.4 (derived)
Calculated degree of saturation (%): 61.2 (calculated)

Soil water characteristic curve parameters: Default values

Parameters	Value
a	7.2555
b	1.3328
c	0.82422
Hr.	117.4

Layer 5 -- A-6

Unbound Material: A-6
Thickness(in): Semi-infinite

Strength Properties

Input Level: Level 3
Analysis Type: ICM inputs (ICM Calculated Modulus)
Poisson's ratio: 0.35
Coefficient of lateral pressure,Ko: 0.5
Modulus (input) (psi): 9999

ICM Inputs

Gradation and Plasticity Index
Plasticity Index, PI: 16
Liquid Limit (LL) 33
Compacted Layer No
Passing #200 sieve (%): 63.2
Passing #40 82.4
Passing #4 sieve (%): 93.5
D10(mm) 0.000285
D20(mm) 0.0008125
D30(mm) 0.002316
D60(mm) 0.05364
D90(mm) 1.922

Sieve	Percent Passing
0.001mm	
0.002mm	
0.020mm	
#200	63.2
#100	
#80	73.5
#60	
#50	
#40	82.4
#30	
#20	
#16	
#10	90.2
#8	
#4	93.5
3/8"	96.4
1/2"	97.4
3/4"	98.4
1"	99
1 1/2"	99.5
2"	99.8
2 1/2"	
3"	
3 1/2"	100
4"	100

Calculated/Derived Parameters

Maximum dry unit weight (pcf):	107.9 (derived)
Specific gravity of solids, Gs:	2.70 (derived)
Saturated hydraulic conductivity (ft/hr):	1.95e-005 (derived)
Optimum gravimetric water content (%):	17.1 (derived)
Calculated degree of saturation (%):	82.1 (calculated)

Soil water characteristic curve parameters: Default values

Parameters	Value
a	108.41
b	0.68007
c	0.21612
Hr.	500

Distress Model Calibration Settings - Flexible

AC Fatigue	Level 3: NCHRP 1-37A coefficients (nationally calibrated values)
k1	0.007566
k2	3.9492
k3	1.281

AC Rutting	Level 3: NCHRP 1-37A coefficients (nationally calibrated values)
k1	-3.35412
k2	1.5606
k3	0.4791
Standard Deviation Total Rutting (RUT):	0.24*POWER(RUT,0.8026)+0.001

Thermal Fracture	Level 3: NCHRP 1-37A coefficients (nationally calibrated values)
k1	1.5
Std. Dev. (THERMAL):	0.1468 * THERMAL + 65.027

CSM Fatigue	Level 3: NCHRP 1-37A coefficients (nationally calibrated values)
k1	1
k2	1
Subgrade Rutting	Level 3: NCHRP 1-37A coefficients (nationally calibrated values)
Granular:	
k1	2.03
Fine-grain:	
k1	1.35
AC Cracking	
AC Top Down Cracking	
C1 (top)	7
C2 (top)	3.5
C3 (top)	0
C4 (top)	1000
Standard Deviation (TOP)	200 + 2300/(1+exp(1.072-2.1654*log(TOP+0.0001)))
AC Bottom Up Cracking	
C1 (bottom)	1
C2 (bottom)	1
C3 (bottom)	0
C4 (bottom)	6000
Standard Deviation (TOP)	1.13+13/(1+exp(7.57-15.5*log(BOTTOM+0.0001)))
CSM Cracking	
C1 (CSM)	1
C2 (CSM)	1
C3 (CSM)	0
C4 (CSM)	1000
Standard Deviation (CSM)	CTB*1
IRI	
IRI HMA Pavements New	
C1(HMA)	40
C2(HMA)	0.4
C3(HMA)	0.008
C4(HMA)	0.015
IRI HMA/PCC Pavements	
C1(HMA/PCC)	40.8
C2(HMA/PCC)	0.575
C3(HMA/PCC)	0.0014
C4(HMA/PCC)	0.00825