VMA Prediction Model

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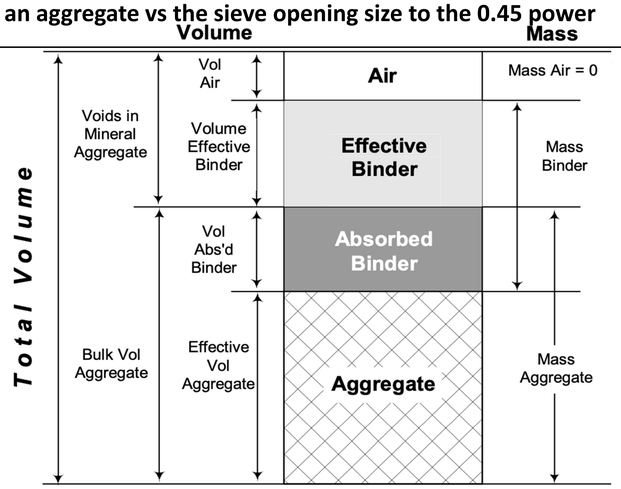
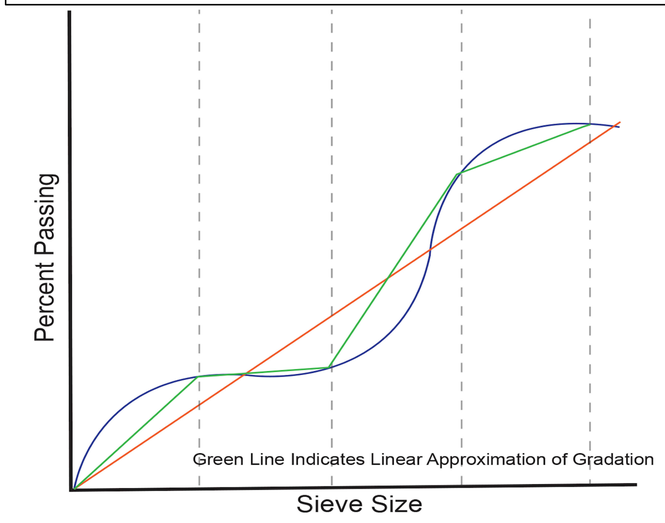
INTRODUCTION

- We were asked by Victor Johnson with Geneva Rock to create a model within their existing spreadsheet to predict the voids in mineral aggregate (VMA) of any given asphalt mix design.
- UDOT and City specifications require a specific VMA for all asphalt designs.
- Having an accurate predictive model could save Geneva Rock 25% on the cost of a mix design
- The 0.45 power curve plots the cumulative percent passing of an aggregate vs the sieve opening size to the 0.45 power



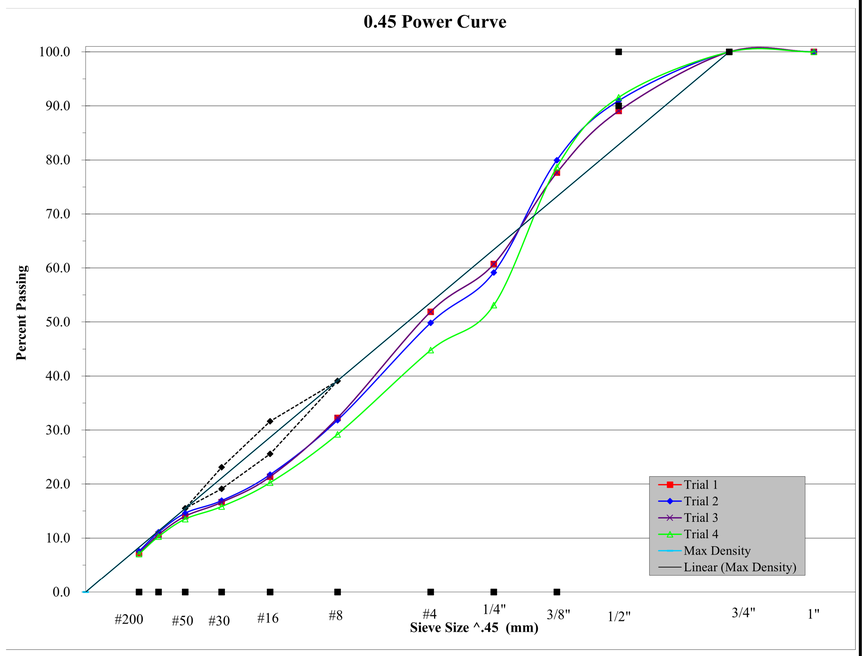
METHODS

- The method we used to predict the VMA was to calculate the area beneath the gradation, and 0.45 Power Curve and compare them using a linear approximation



ANALYSIS

- To predict the VMA, we first tested a sample at Geneva Rock's asphalt laboratory, that had a gradation that fell directly on the maximum density line.
- Doing this gave us a VMA at maximum density of 13.96%
- We were then able to compare this value to the area beneath the 0.45 Power Curve, to get a "VMA per unit area".
- With this value, we can relate the area beneath any given gradation curve to predict the VMA.
- Our model also creates a normalized prediction based on the area between each sieve range, and the size of the given range.
- A correction factor is then used to make the prediction more accurate.
- An example of the 0.45 Power Curve generated by the model is shown below.



Cost Analysis

The predictive model is estimated to reduce the mix design process by 25%. Per information given by Geneva Rock, a single mix design averages out to be $12,000 of man-hours. With the cost of facilities and maintenance costs, Geneva Rock spends about $111 per hour on their mix design.

CONCLUSIONS

The UVU Capstone Group Concludes that the VMA predictive model, as it currently stands, is accurate to a 0.3% error. As mentioned in Chapter 4, only mix designs containing 25% RAP were used to test the model. Additional mix designs will need to be added to the model to check for accuracy with varying RAP percentages. Instructions are contained in the model to allow for a Geneva technician to input this data.

Sample Number	Actual VMA	Estimated VMA	Normalized VMA	Corrected VMA	Error
1	14.4%	13.8%	14.2%	14.4%	0.3%
2	14.4%	13.8%	14.2%	14.4%	0.3%
3	14.4%	14.6%	15.1%	14.5%	0.6%
4	14.3%	13.4%	13.8%	14.3%	0.0%
				Average	0.30%

REFERENCES

Superpave Mix Design Participant Workbook, Utah Department of Transportation, 2020.

ACKNOWLEDGEMENTS

Thank you to the Asphalt Mix Design Department at Geneva Rock Products.