# Investigation of Aggregate Effect to Asphalt Mixture Properties by Modeling Particle-to-Particle Interaction in Uniaxial Compressive Tests

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A number of researchers studied aggregate characteristics including elongation, flatness, and other shape, which affect asphalt mixture properties such as internal resistance, rutting resistance, tensile strength, and complex modulus etc. However, the aggregate modulus also affects asphalt mixture modulus significantly, which has not been taken serious consideration. With the advanced technologies in image processing and discrete element (DE) modeling, a clustered discrete element modeling approach was developed in the past several years, which was employed in this paper. In the modeling approach, various material phases (e.g., aggregates, mastic) were modeled with clusters of very small discrete elements. Aggregate and mastic stiffnesses were significant input parameters in these DE models, which were obtained by converting the macro-stiffness from laboratory test to micro-stiffness in the DE models. A significant model feature is that the cohesion in aggregate, cohesion in mastic, adhesion in aggregate-mastic interface and aggregate-aggregate interaction are considered in the DE modeling approach. In addition, this DE modeling approach allows particle-to-particle contact/interaction in asphalt mixture.

In this study, by modeling inclusions such as aggregates with a “mesh” of small discrete elements in two dimensions, virtual laboratory tests were conducted to measure the asphalt concrete complex modulus. A uniaxial compressive test was simulated with the DE models by considering the aggregate heterogeneity. Particle-to-particle interaction in asphalt mixture is investigated. When the degree of particle-to-particle contact in asphalt mixture increases, the mixture will have better ability to resist heavier load. The aggregate modulus sensitivity analysis shows that the aggregate modulus contribution to mixture modulus is significant, which has not been recognized in current research and practice. The potential application of this research will be the design concept of construction durable asphalt mixture and asphalt pavements. The research approach used in this study can relate directly to aggregate base, and Portland cement concrete.