

Asphalt Research Consortium Asphalt Microstructure Modeling Task Status Report

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ISAP TC on Constitutive Modeling of Asphaltic Materials
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Washington DC, Omni Shoreham Hotel, Embassy room
WG06 on Chemo-Mechanics of Bituminous Materials

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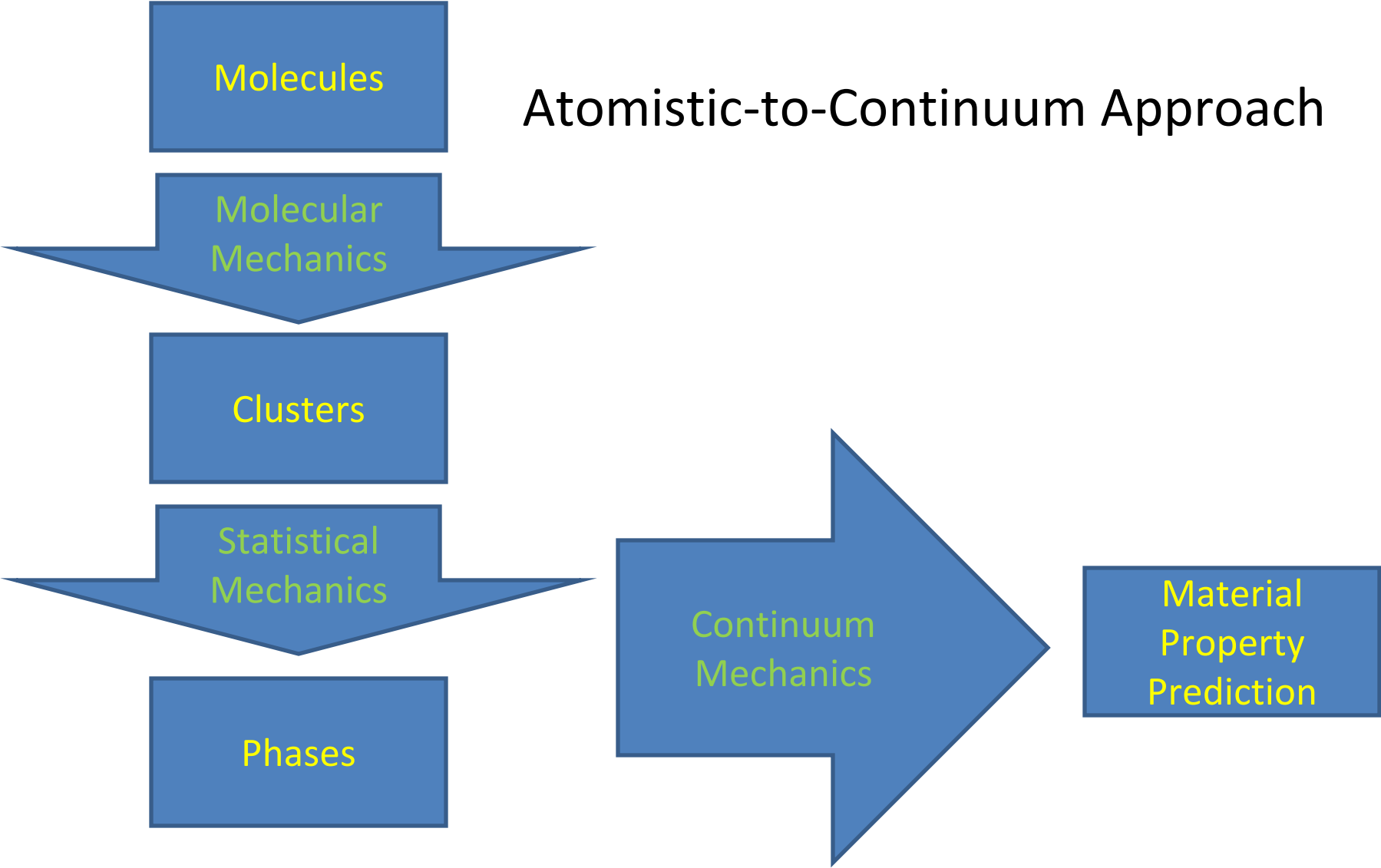
Asphalt Microstructure Model Team



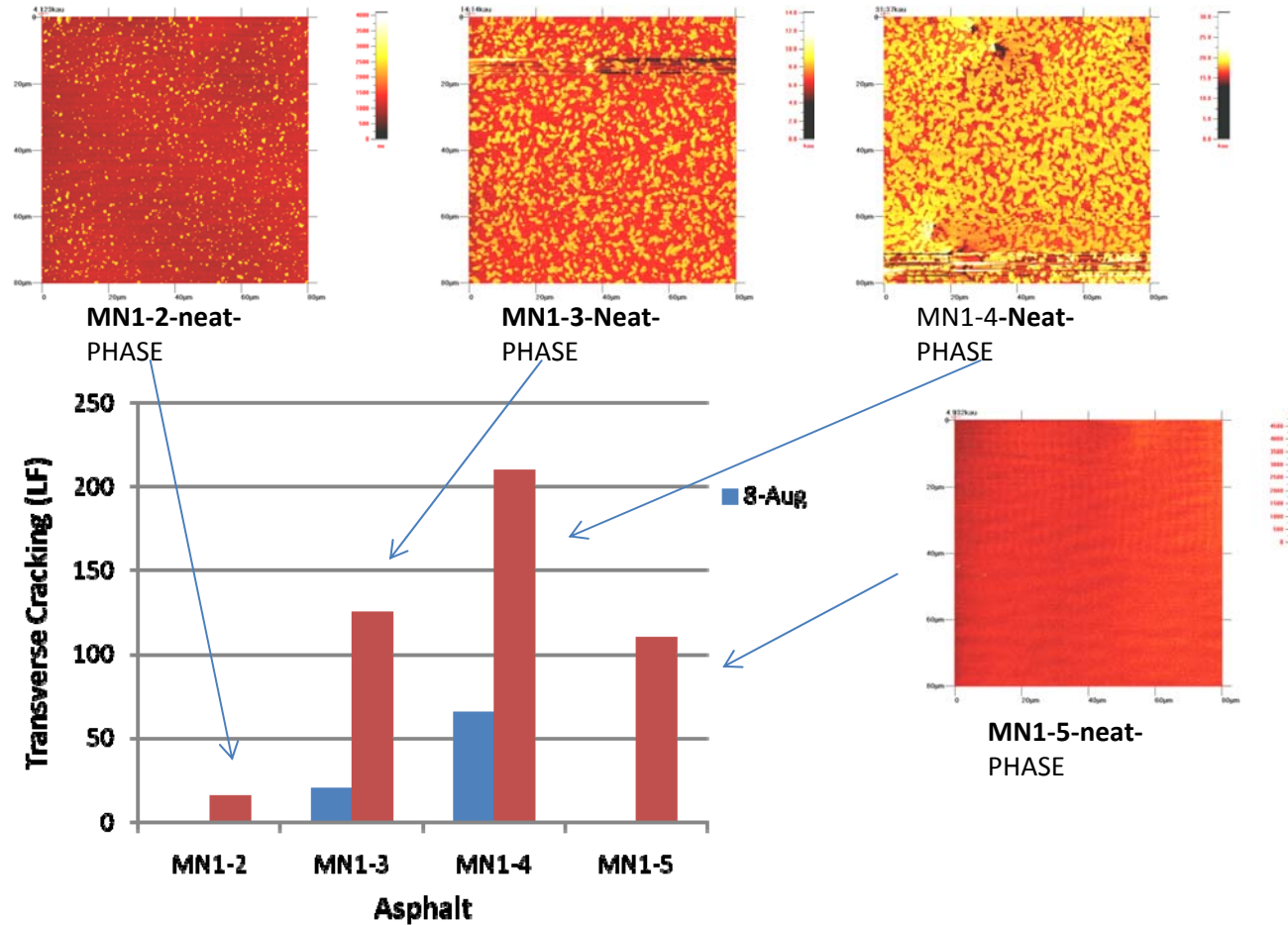
Objectives

The preliminary objective of the proposed research is the development of molecular-based, chemo-mechanical, and continuum mechanical models capable of predicting the mechanical performance of unmodified asphalts, polymer-modified asphalts, and full binder-aggregate systems. The ultimate goal of the research line proposed, far beyond the scope of this proposal, is the design of new composite materials, governed by the mechanical demands of the end users, industry, and the general public. This multi-scale, chemo-mechanical approach can be generalized to the solution of other problems in civil, chemical, materials, and mechanical engineering.

Atomistic-to-Continuum Approach




For Example, comparative test site data under gathered under these contracts show AFM-phase morphology (which relates to wax content) correlates with performance.



The Modeling Approach:

$$\mathcal{F}[c] = \int d^n x \left[\frac{1}{4} (c^2 - 1)^2 + \frac{\varepsilon}{2} |\nabla c|^2 \right]$$

$$\frac{d\mathcal{F}}{dt} = - \int d^n x |\nabla \mu|^2$$

Cahn-Hilliard Equation  **Free Energy of Crystallization** $\nabla \mu$

$$\frac{dc}{dt} = D \nabla^2 (\mu = c^3 - c - \varepsilon \nabla^2 c)$$

$$M = \frac{D}{k_B T}$$

:Mobility = (Diffusion Coefficient)/ $k_B T$

Asphalt Microstructure Modeling Approach

