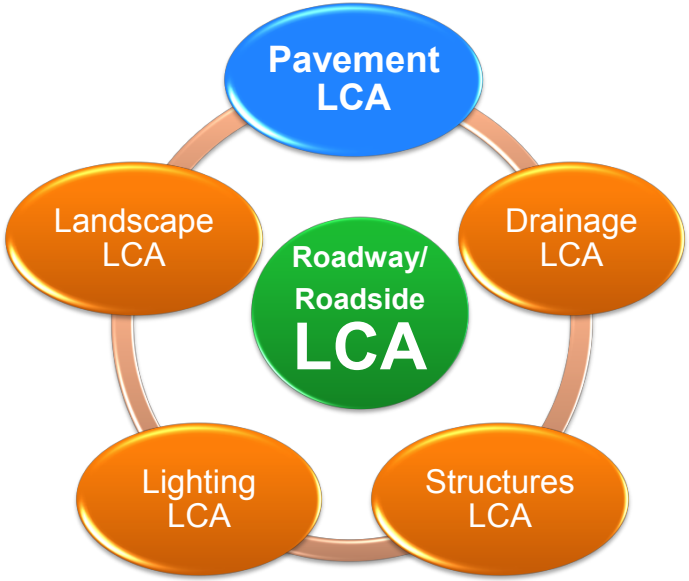
Use-Phase Works at UIUC

- Use-phase module in Illinois Tollway's Regional Pavement LCA tool is in progress
- Current focus is:
  - IRI progression models for Tollway network
  - Model development for rolling resistance and environmental impact



IRI Progression Models

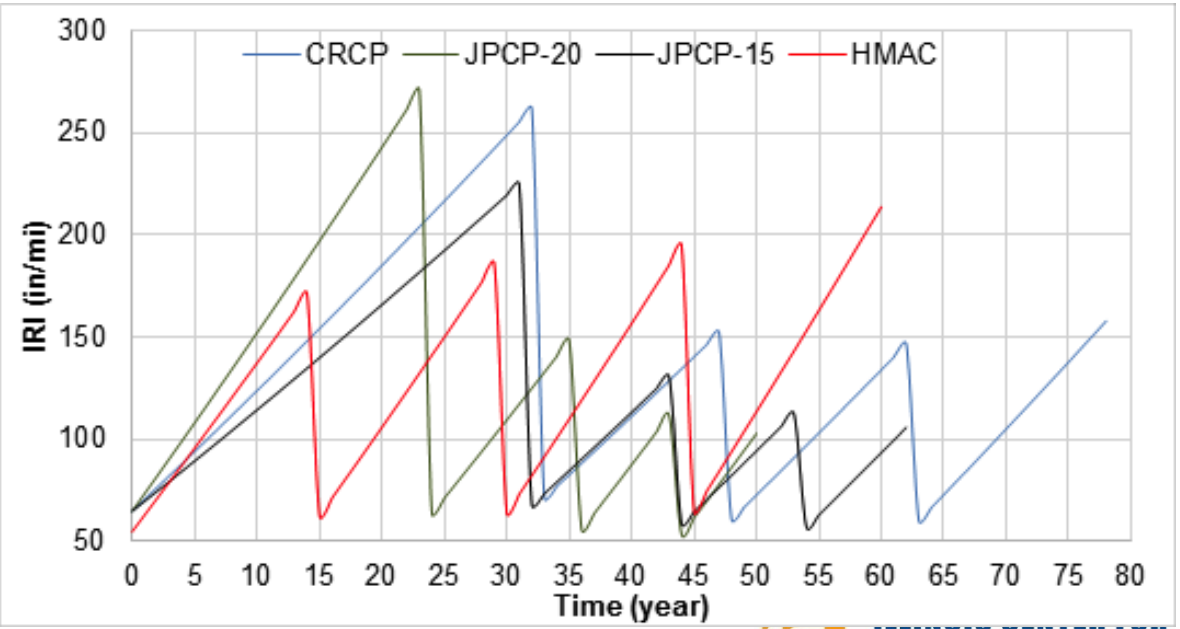
- Illinois Tollway network is composed of:
  - Composite (43%), JPCP (30%), full depth asphalt (18%), CRCP (9%) structures
- IRI progression and drop models are developed

IRI progression (incremental):

$$IRI\downarrow t = IRI\downarrow t-1 + a * Thickness\uparrow b * ESALs\uparrow c$$

IRI drop (for major maintenance):

$$IRI\downarrow d = m * IRI\downarrow before + n$$



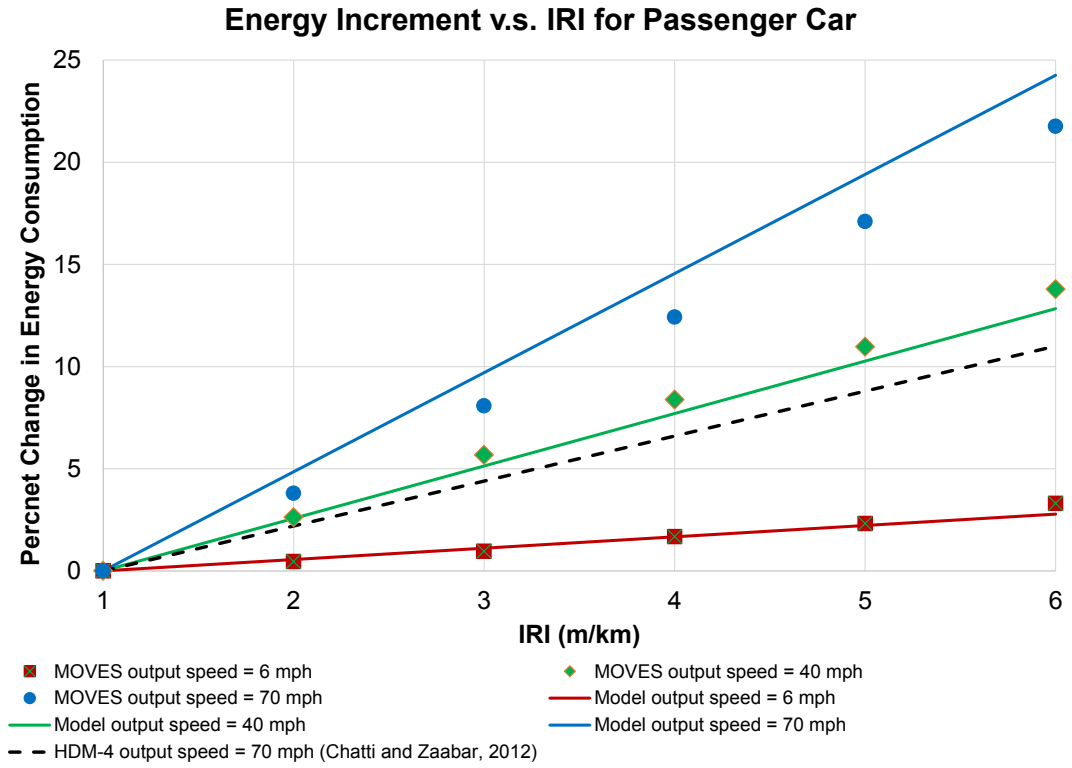
Roughness-Speed-Impact Model

- An analytical energy-speed-IRI relationship was established combining EPA's MOVES and HDM-4 models
- Relationship was expanded to TRACI impacts considering road roughness

$$E = p/v + f\downarrow a + b \times v + f\downarrow c \times v\uparrow 2 ,$$

$$f\downarrow a = k\downarrow a \cdot IRI + d\downarrow a \text{, in unit of } kJ/mile;♪$$

$$f\downarrow c = k\downarrow c \cdot IRI + d\downarrow C \text{, in unit of } kJ*h^2/$$



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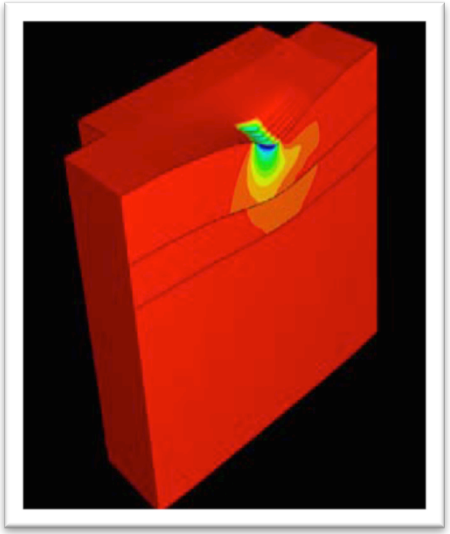
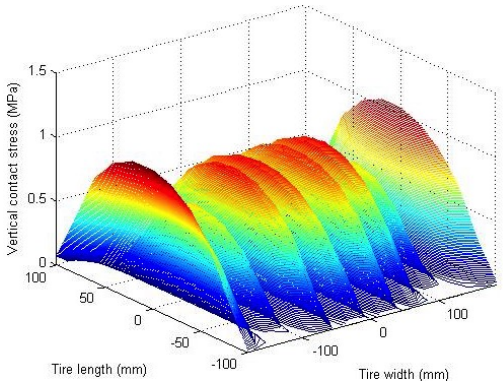
Pavement Deflection Models

- Adapting dissipation approach (Chupin et al. 2013)
- Dissipated energy is derived from finite element solutions
- Realistic 3-D and non-uniform measured and simulated contact stresses
- Seasonal variations and coverage of pavement structures in Tollway network
- Outcome will be simplified design charts to estimate additional fuel consumption





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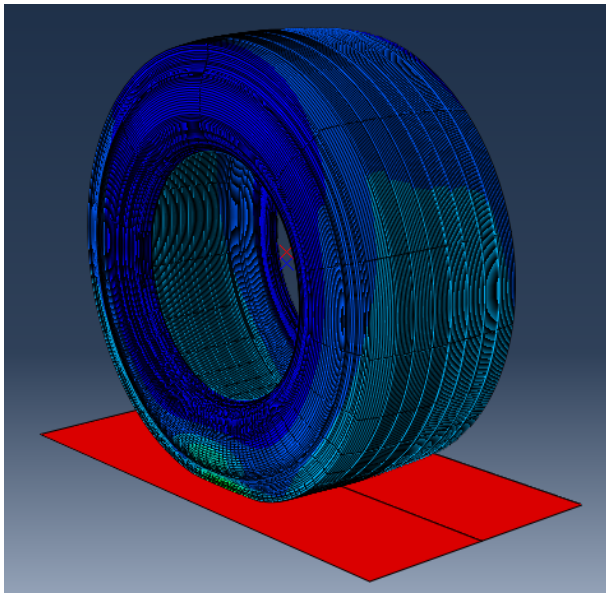
Tire Rolling Resistance Models

- Numerical modeling of tires to investigate the impact of pavements on rolling resistance
- Considering **rolling resistance** as energy dissipated in tire structure per distance travelled
- Development of baseline rolling resistance coefficients is underway for the effects of speed, temperature, load, and inflation pressure



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