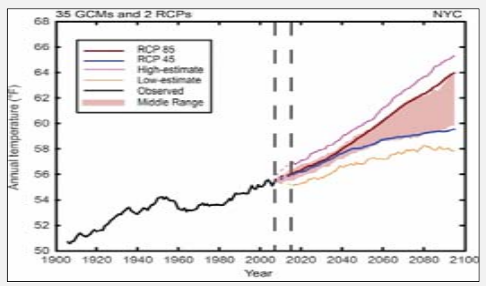
Climate Change Impact on Pavement Overlay Performance with Adaptation Strategies

Xiaodan Chen, PhD Candidate, Rutgers University, xiaodan.chen@rutgers.edu
Advisor: Hao Wang, PhD, Associate Professor, Rutgers University, hwang.cee@rutgers.edu

1. Introduction

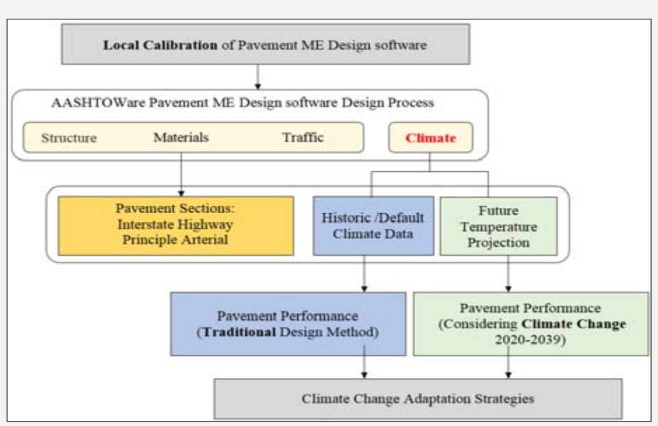
The effect of warming temperatures due to climate change will increase the risk and vulnerability of road pavement. To proactively address risks during pavement design process and maximize the long-term safety, service, and resilience of road pavement in New Jersey, this study aimed to quantify the impact of warming temperatures on flexible pavement overlay performance and evaluated the feasible adaptation strategies.



Observed and projected temperature [NPCC]

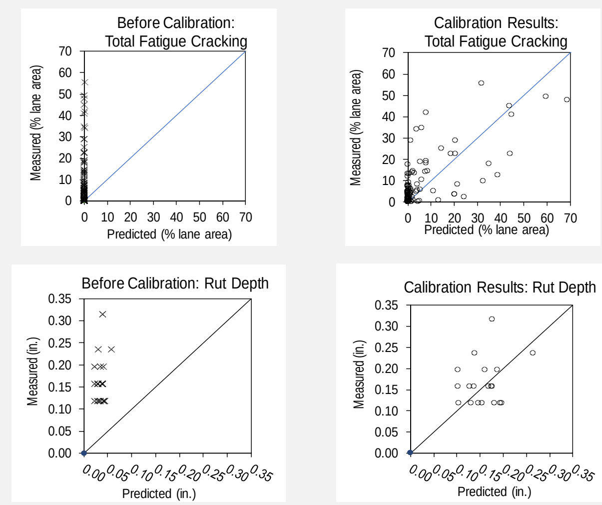
2. Methodology

- Perform local calibration of Pavement ME Design software
- Prepare historic and projected temperature data for simulation inputs
- Study pavement performance using historic and future temperatures



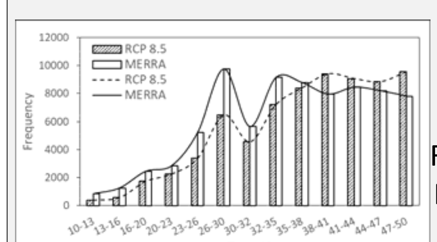
3. Pavement ME Design Local Calibration for New Jersey

The newly released Pavement ME Design v2.5 was updated with new model coefficients from recalibration of flexible pavements in New Jersey.



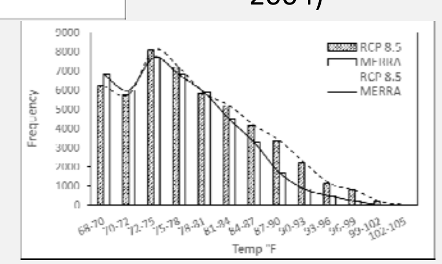
4. Future Temperature Projections

- Representative Concentration Pathways (RCP) - RCP 8.5
- Global climate models (GCMs)
- Projection Results (2010-2099):



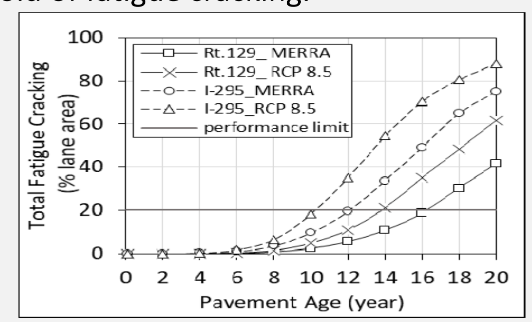
Hourly distribution of low temperatures and high temperatures for RCP 8.5 (2020-2039) and MERRA database (1985-2004)

Milder Winters and more extreme high temperatures in Summers



5. Impact of Climate Change on Pavement Overlay Performance

With climate change impact, pavement service life decreases from 16 to 13 years for Route 129, and from 12 to 10 years for I-295 based on the failure threshold of fatigue cracking.



Warming temperatures will increase rut depth in asphalt layer for both interstate highway and principle arterial.

6.1. Adaptation Strategy-Increase Overlay Thickness

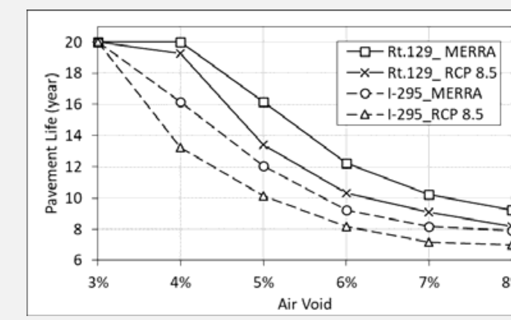
The results show that an increase of overlay thickness from 6 to 7 inches would extend pavement lives by 3 to 4 years with the impact of climate change.

Pavement Section	Overlay thickness (in.)	Climate Inputs and Adaptation	Life (yr.)	Annualized Agency Cost ($/lane mile)
I-295	6	Base case	12.1	40,252
	6	Climate change case	10.2	46,179
	7	Climate change with adaptation	13.3	42,148
Rt. 129	6	Base case	16.2	32,300
	6	Climate change case	13.3	37,371
	7	Climate change with adaptation	17.3	34,835

6.2. Adaptation Strategy-Control In-Place Air Voids

The results indicate that 1% reduction in air void will be sufficient to mitigate the negative effect of warming temperature and even slightly increase the pavement overlay life.

It is rational to narrow the acceptable range of in-place air void or to increase the incentive and penalty of pay adjustment as one adaptation strategy.



7. Conclusion

-Warming temperatures contributed to the faster pavement deterioration especially fatigue cracking.

-Increasing overlay thickness can extend pavement service life and reduce the annualized agency cost.

-Reducing the in-place air void is another effective action from the aspect of construction quality control

8. Acknowledgments

- New Jersey Department of Transportation
- Resilience & Sustainability at Port Authority of New York and New Jersey
- New York City Panel on Climate Change and The Earth Institute of Columbia University