Investigating the Cracking, Rutting, and Moisture Resistance of Various Asphalt Mixes in Oklahoma

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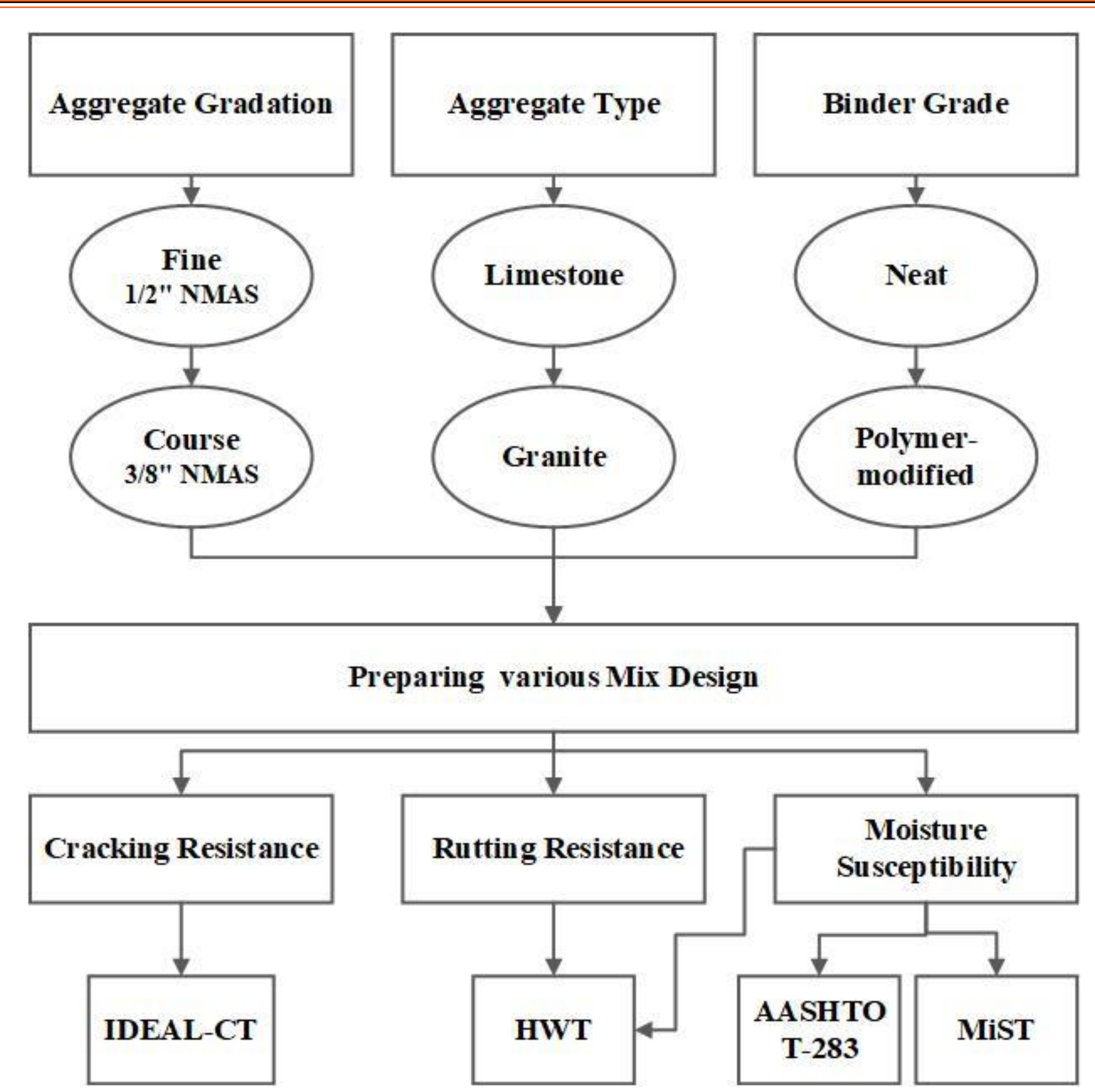
INTRODUCTION

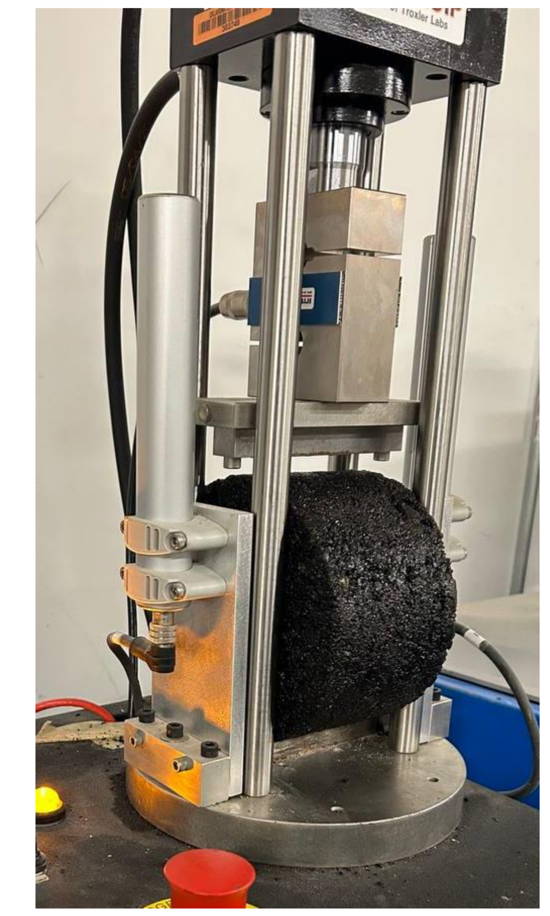
- Cracking and rutting are the most common distresses in asphalt pavements.
- The Superpave method relies heavily on volumetric properties.
- A balanced mix design (BMD) approach is based on performance-related testing
- A BMD mix is stiff enough to provide good rutting resistance and ductile enough to provide good cracking resistance.
- The indirect tensile asphalt cracking test (IDEAL-CT) has been adopted by many state agencies as a cracking tests.
- The Hamburg Wheel Tracking (HWT) test has historically been used to assess rutting and moisture.
- BMD mixes need to be checked for moisture resistance.
- Moisture-induced damage can be detrimental to pavement performance. The ingress of water into asphalt pavements leads to several distresses including freeze-thaw damage.
- The AASHTO T 283 test is currently used by the ODOT to evaluate moisture resistance of asphalt mixes. The Moisture-induced stress tester (MiST) device is a method to simulates the effect of pore water pressure due to traffic.

RESEARCH OBJECTIVES

- Assess the impact of different mix variables on the cracking and rutting resistance of asphalt mixes using IDEAL-CT and HWT, respectively.
- Identify the effect of moisture conditioning on the asphalt pavement performance, prepared by various raw materials in Oklahoma, by performing the AASHTO T-283 method and MiST.

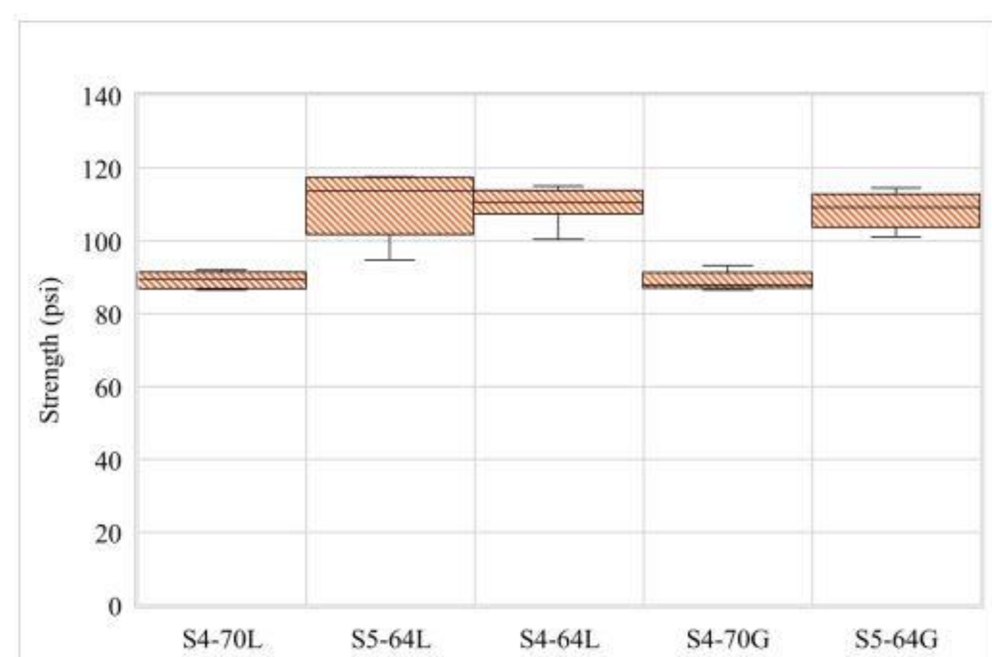
METHODOLOGY



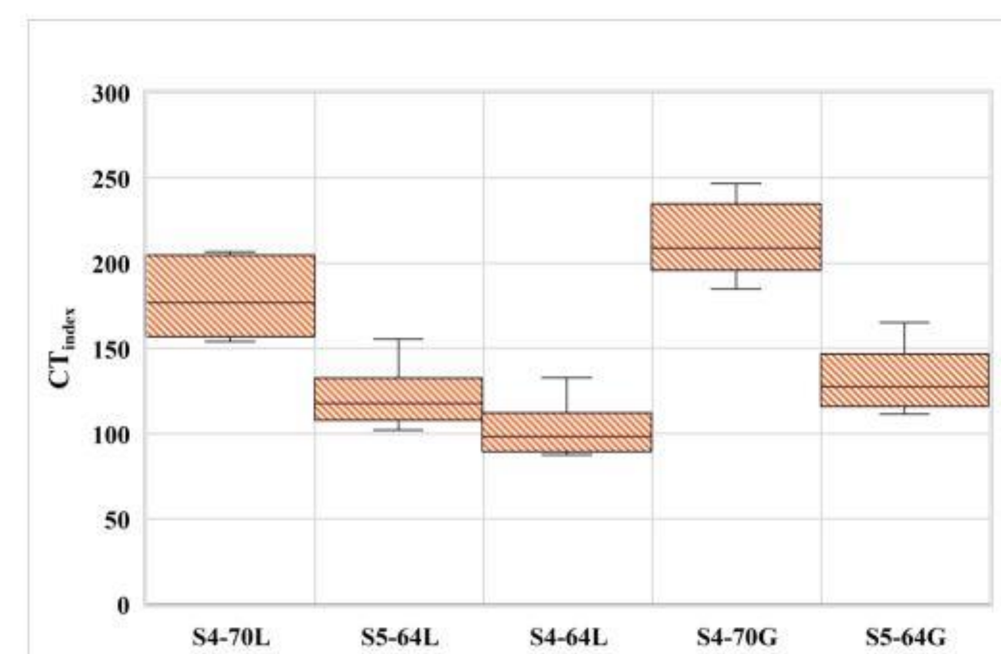


Mix ID	Gradation	Binder PG	AC %	Aggregate Type
S4-70-L	S4	PG 70-28	5.1%	Limestone
S5-64-L	S5	PG 64-22	5.9%	Limestone
S4-64-L	S4	PG 64-22	5.1%	Limestone
S4-70-G	S4	PG 70-28	5.1%	Granite
S5-64-G	S5	PG 64-22	5.9%	Granite

RESULTS & ANALYSIS



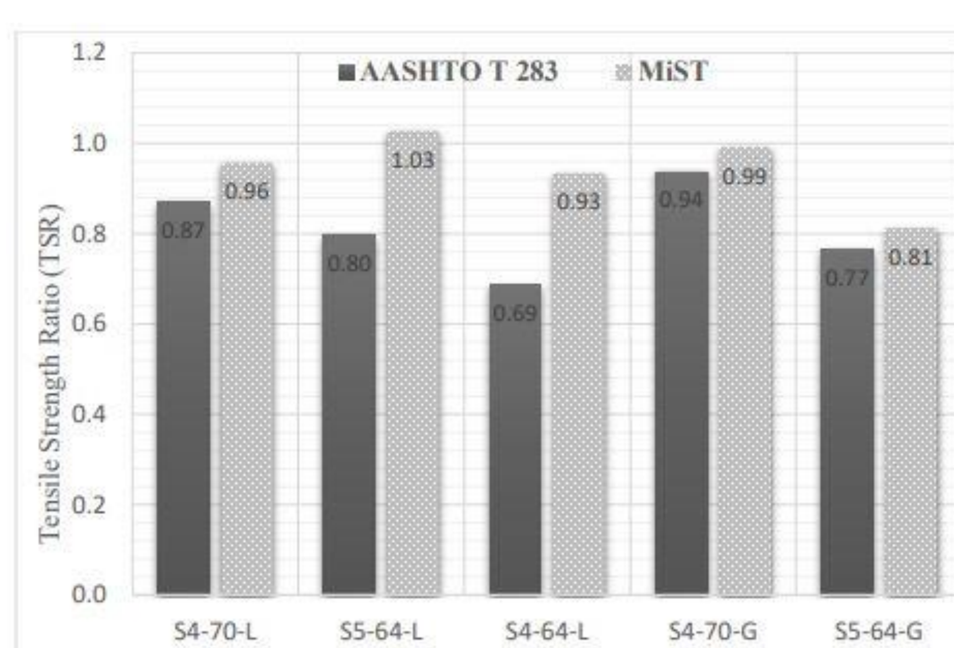
❖ Strength from IDEAL-CT test



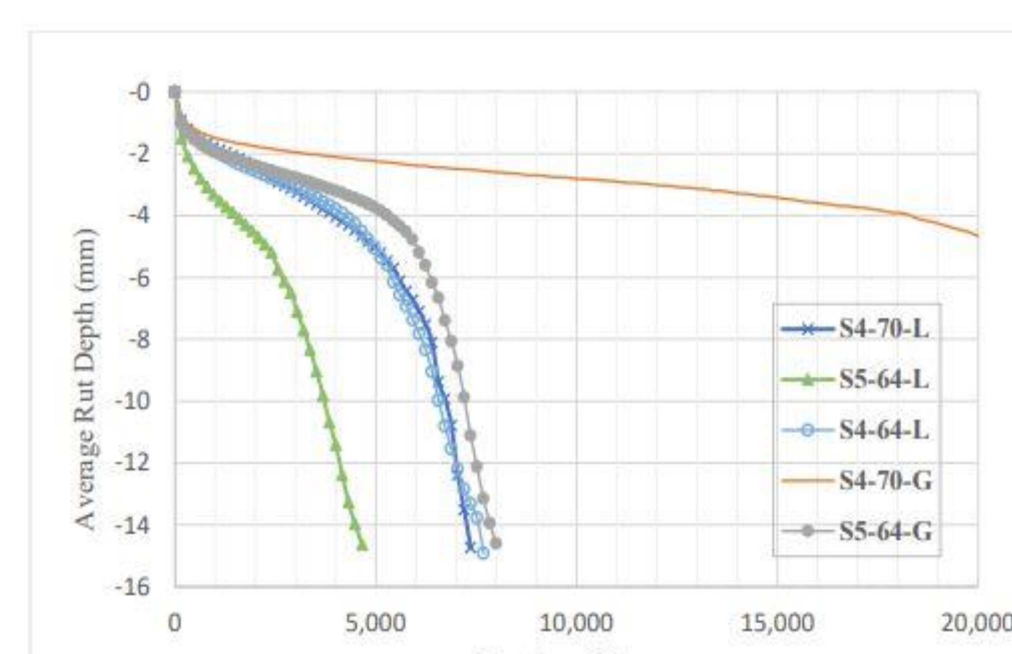
❖ CT_{Index} from IDEAL-CT test

Tukey's test results

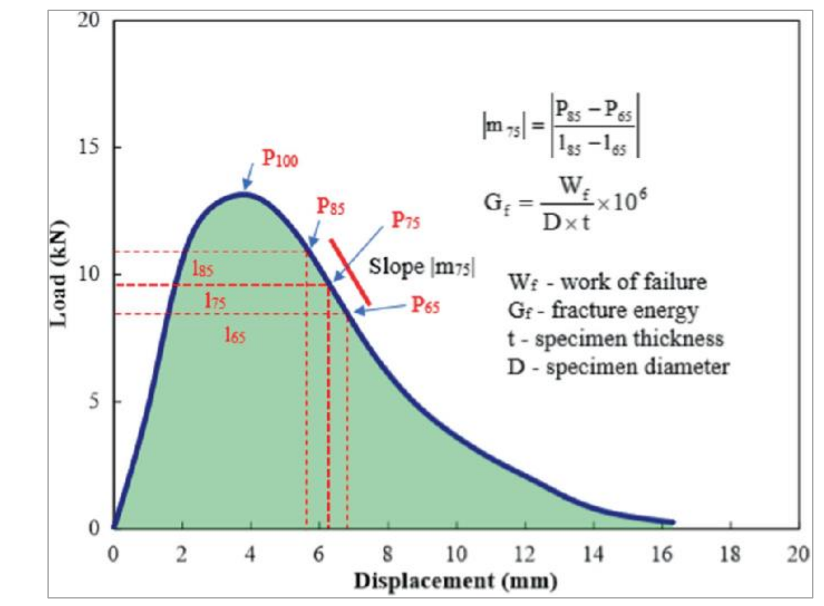
Mix in Comparison	Variable	P-value (CT_{Index})	P-value (Strength)
S4-70-L & S4-70-G	Aggregate Type	0.039	0.999
S5-64-L & S5-64-G	Aggregate Type	0. 918	0.975
S4-64-L & S4-70-L	Binder Type	0.000	0.000
S4-64-L & S5-64-L	Aggregate Gradation/AC Content	0. 457	0.999



❖ Tensile Strength Ratio (TSR) using AASHTO T283 and MiST



❖ Rut depth from HWT

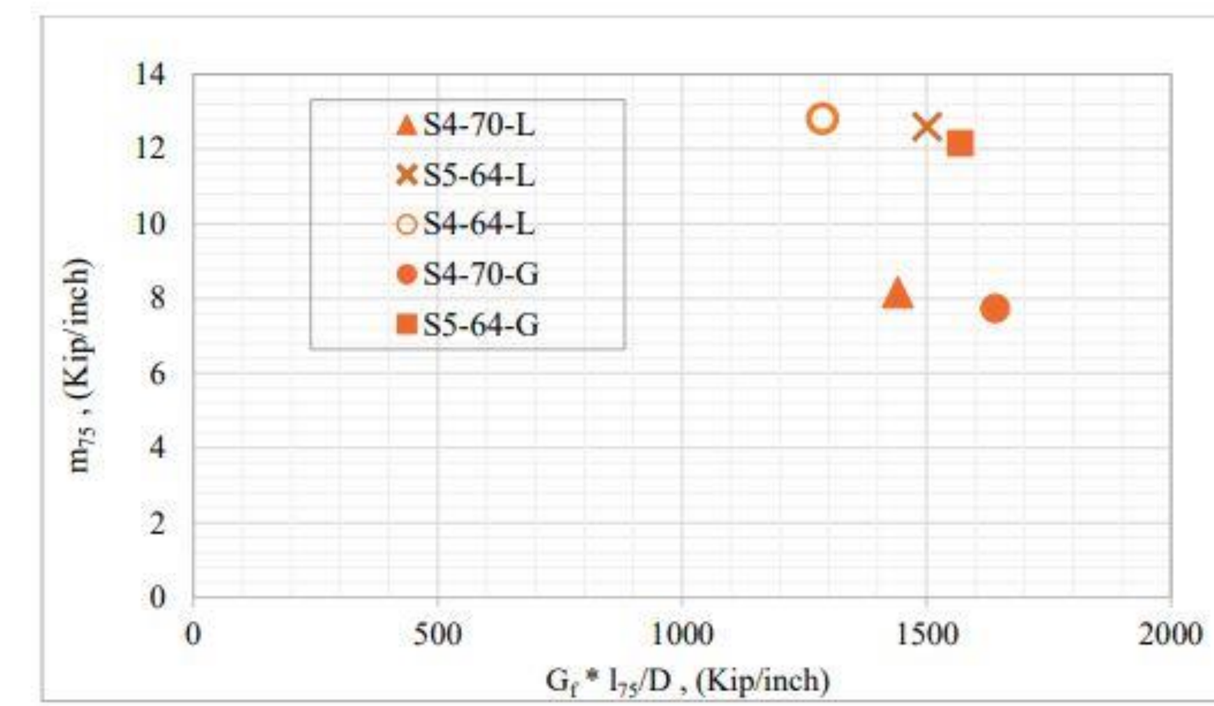


❖ Load-displacement curve obtained from IDEAL-CT test.

$$CT_{Index} = \frac{t}{62} \times \frac{l_{75}}{D} \times \frac{G_{75}}{|m_{75}|}$$

CT_{index} factors effect

Factor		CT_{Index}
l_{75}	↑	↑
G_{75}	↑	↑
m_{75}	↓	↑



❖ A plot of G_f*l_{75}/D and m_{75} from the IDEAL-CT test.

CONCLUSIONS

From IDEAL-CT;

1. The binder type had the most significant effect on CT_{index}
2. Mixes prepared using the PG 70-28 binder had a lower post-peak slope compared to the PG 64-22 binder, indicating higher cracking resistance.
3. Using a finer gradation and granite resulted in a higher product of fracture energy and displacement at 75% peak load (higher cracking resistance).

From HWT;

1. All mixes using limestone aggregate showed excessive rutting as evidenced by the HWT results. These types of mixes are generally not allowed as surface mixes in Oklahoma.
2. Mixes containing the coarse gradation had better rutting resistance compared to those having fine gradation.

From Moisture Susceptibility;

1. The CT_{index} appears to increase with moisture conditioning, possibly due to the increase in air voids with swelling and reduction in stiffness.
2. TSR values in the AASHTO T-283 method were lower than the MiST method, indicating that the former procedure was more severe.
3. The HWT test is very sensitive to the aggregate structure and may not be suitable for assessing the moisture sensitivity of mixes with fine gradation.

ACKNOWLEDGEMENT

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