

Accident Specialist

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Experimental skid analysis of a vehicle on a gravel road

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INTRODUCTION

The objectives of this investigation were:

- To experimentally identify the skid distance of a vehicle on a sandy gravel road, travelling at speeds of 40 kph, 60 kph and 80 kph.
- To experimentally identify the correlation between skid distance and the amount of tread on the tyres on a sandy gravel road.
- To experimentally identify the correlation between skid distance and the inflation of the tyres on a sandy gravel road.
- To validate the effect of ABS in its use on gravel road for new tyres fully inflated. (according to literature there is no difference)
- To validate the use of drag sled values as theoretical values on gravel roads.
- To identify a formula that could be used to calculate a more accurate skid distance on gravel roads when ABS brakes were used.

THEORY

$$d = \frac{v^2}{254 f n}$$

Where:

d = braking distance in meters

v = vehicle speed in kph

f = drag co-efficient value, which is a value less than 1

n = efficiency of the brakes, which is a value less than 1.

EXPERIMENTAL SETUP

- A VW Polo Vivo 2019 model
- The average drag factor of the gravel road was 0.521.



EXPERIMENTAL SETUP



EXPERIMENTAL SETUP

- 80 kph, 60 kph and 40 kph
- **New Tyres:** Continental Conti Premium Contact 175/70R14
 - Tread depth: 7.7 mm

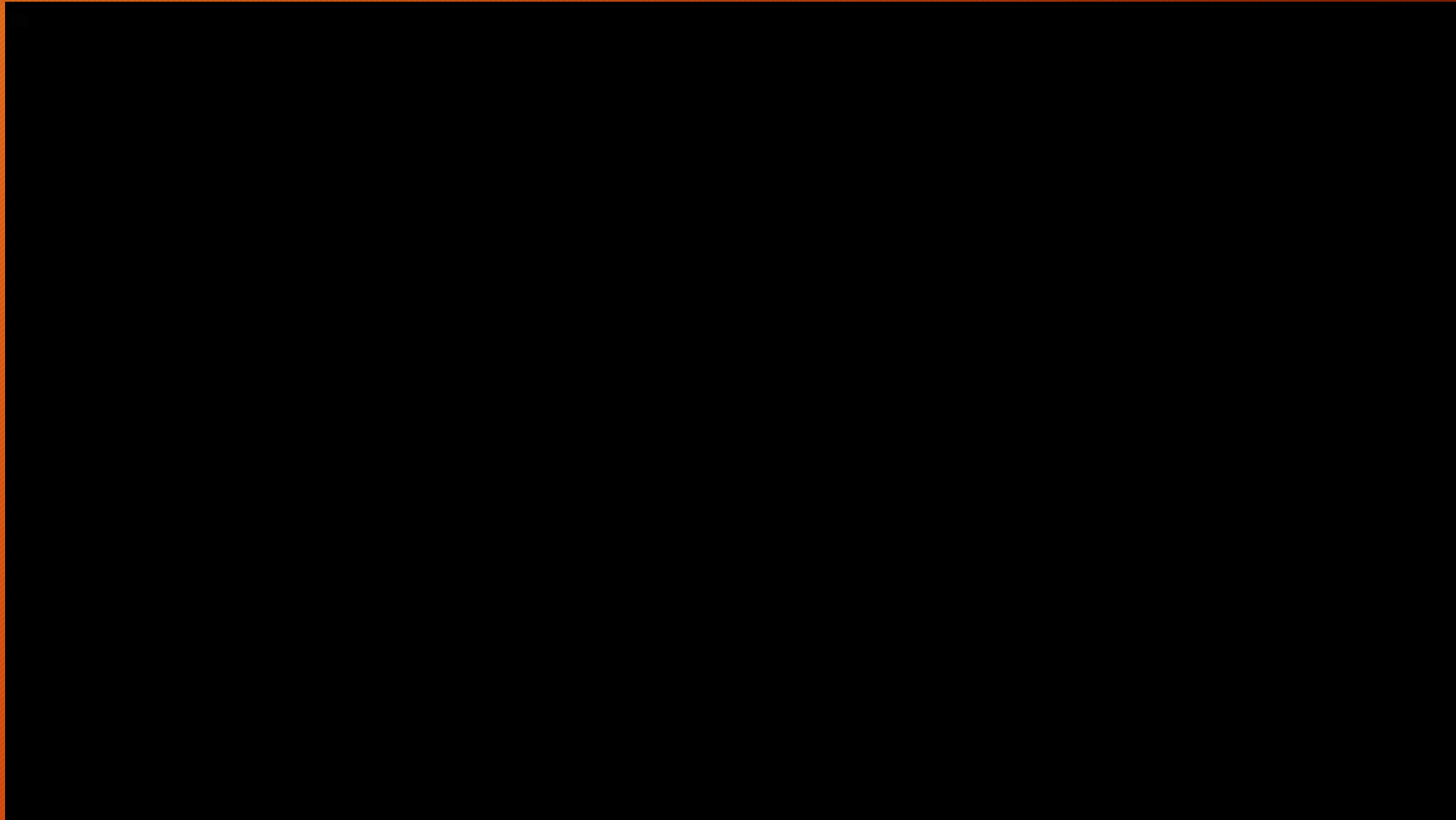


- **Used Tyres:** Goodyear Assurance 185/70R14
 - Tread depth: 2.9 mm (38%)



- **Smooth Tyres:** Goodyear Assurance 185/70R14, Bridgestone BL250 185/70R14, Goodyear Duragrip 185/70R14 and Goodyear Assurance 185/70R14 (common to see different makes on a vehicle)
 - Tread depth: 1.1 mm (14%)

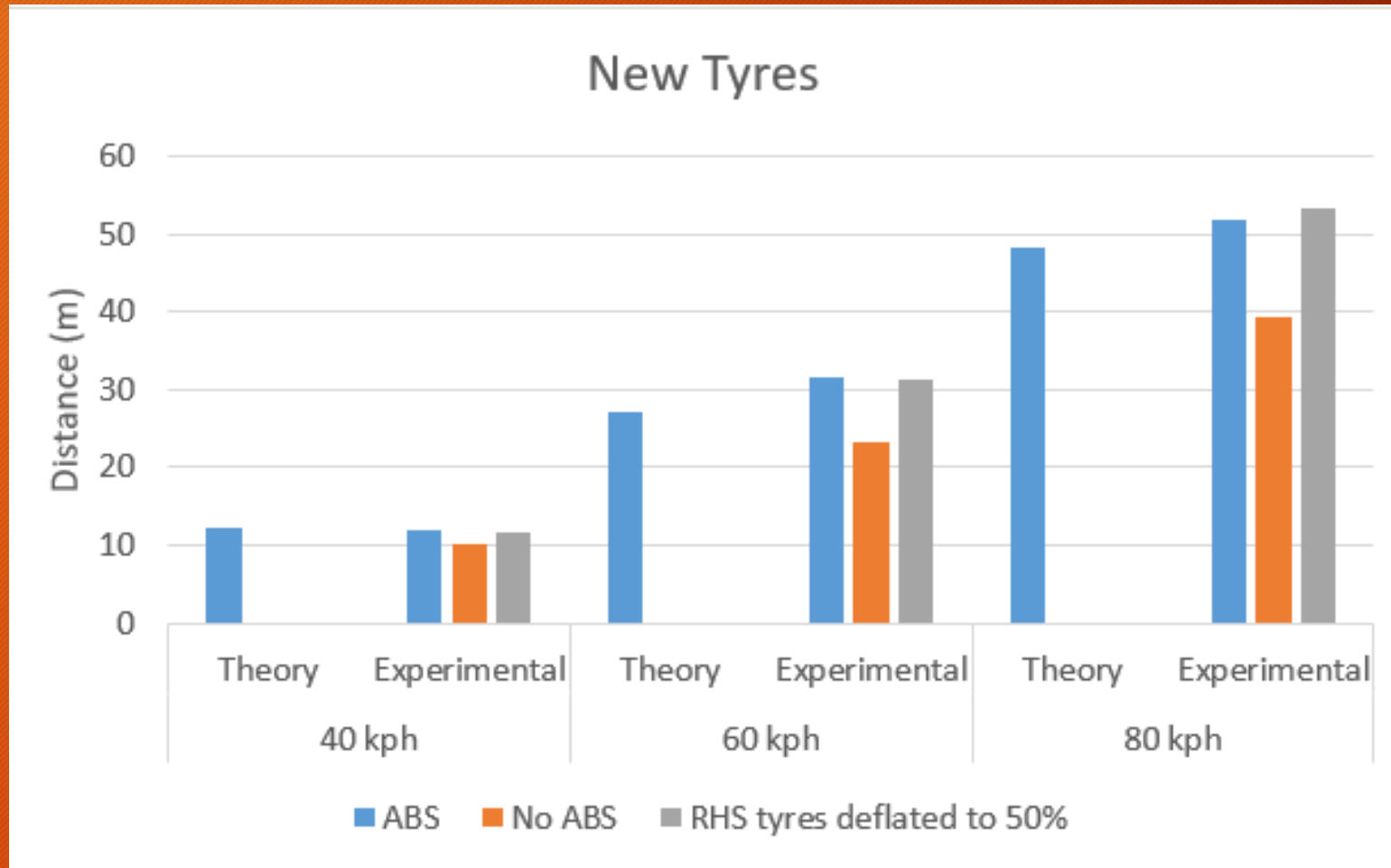
TESTS CONDUCTED



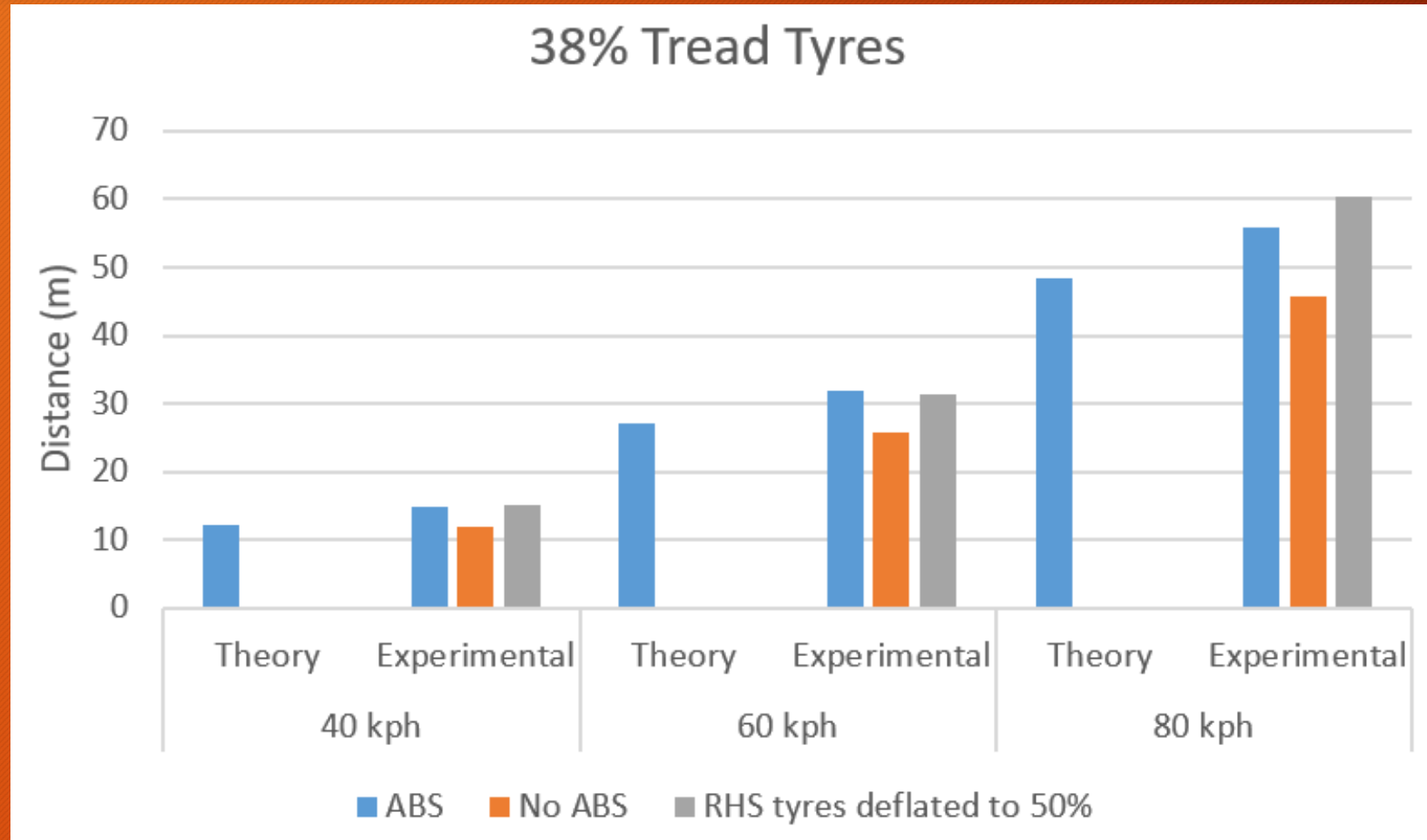
RESULTS

- ABS Brakes activated, resulted in straight line skids
- ABS Brakes deactivated, resulted in vehicle skid out of control
- Fully inflated is at 2.2 bar
- 50% inflation is at 1.1 bar

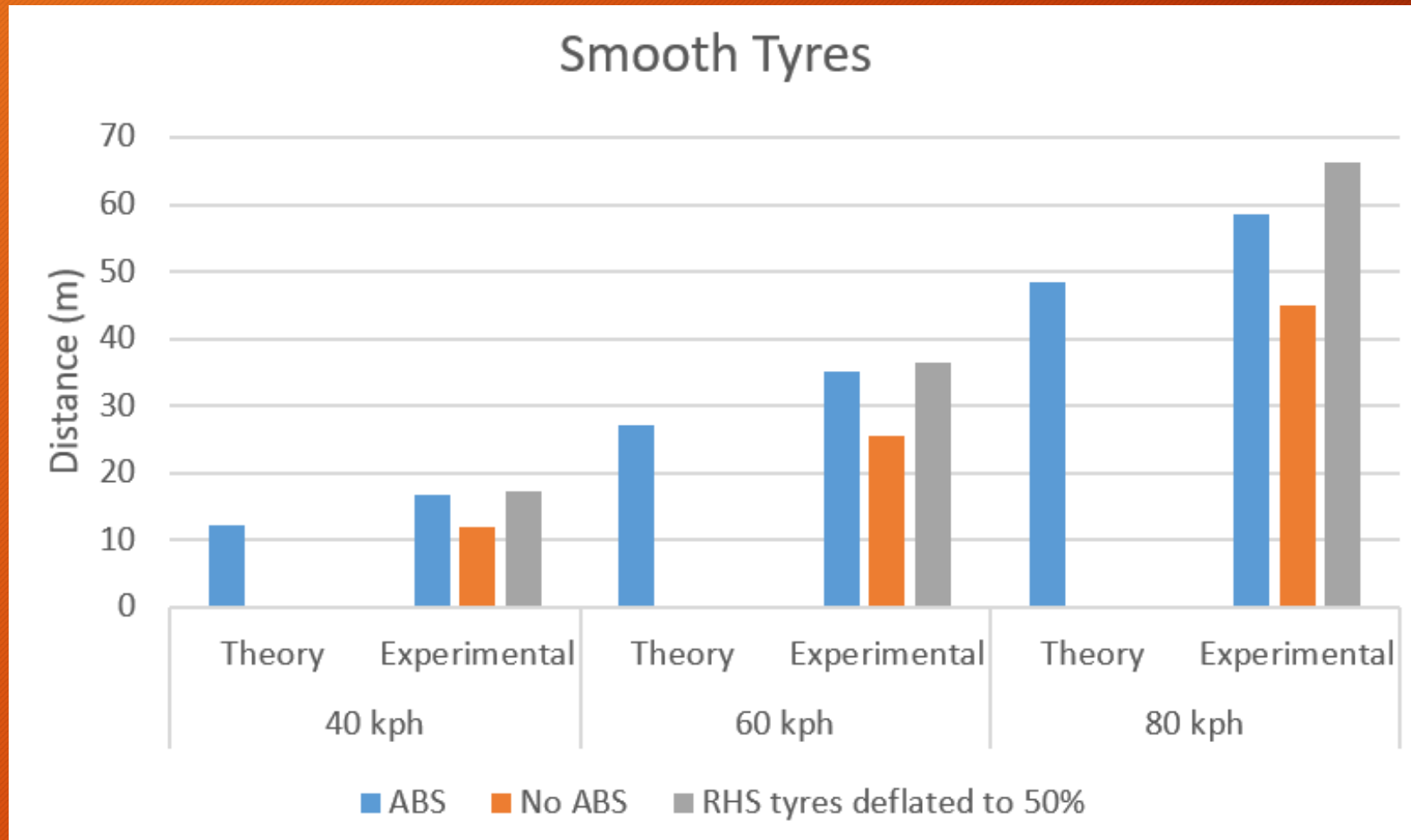
RESULTS - NEW TYRES



RESULTS - 38% TYRES



RESULTS - SMOOTH TYRES

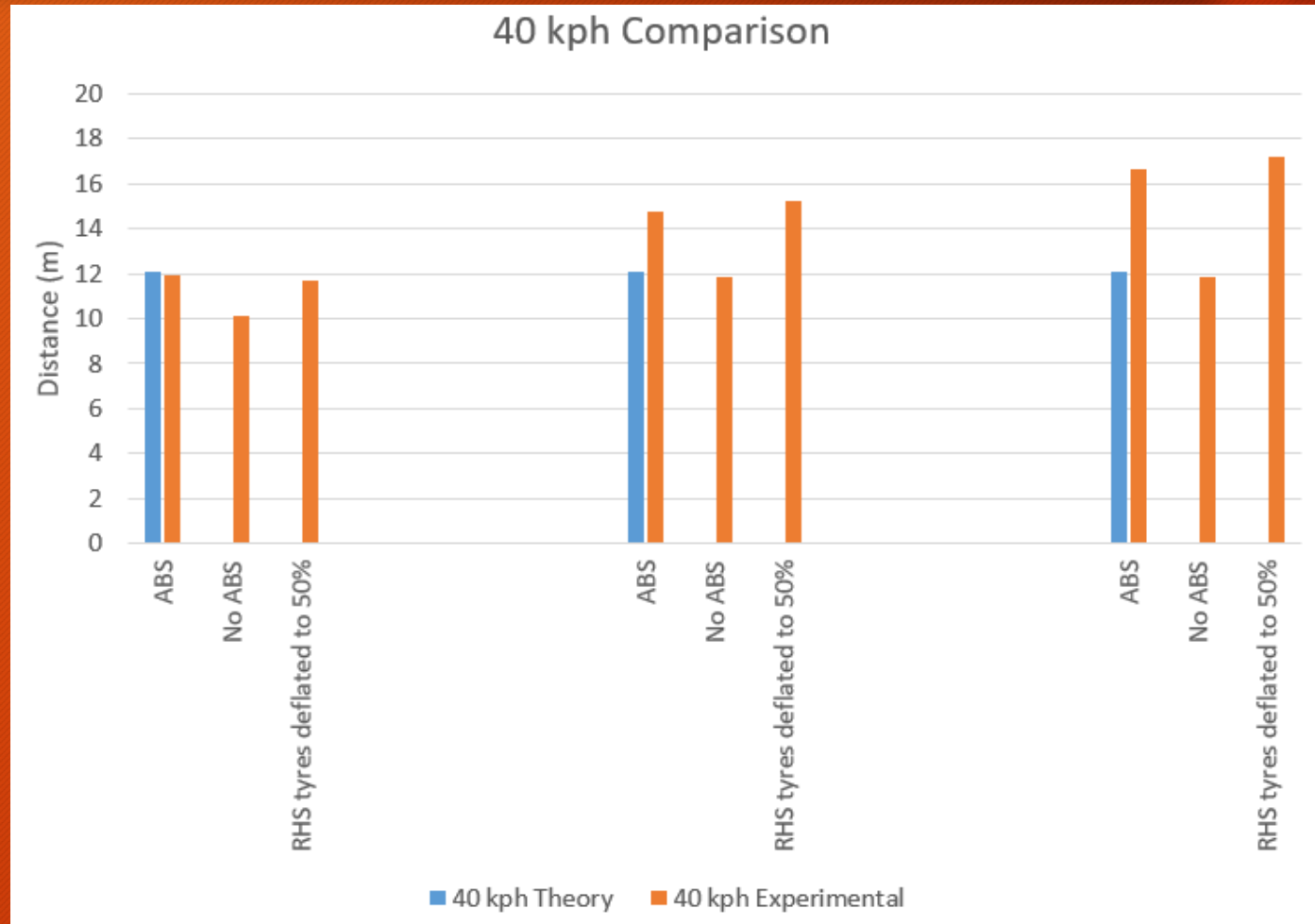


RESULTS - 40 KPH COMPARISON

New Tyres (Left)

Used Tyres (Center)

Smooth Tyres (Right)

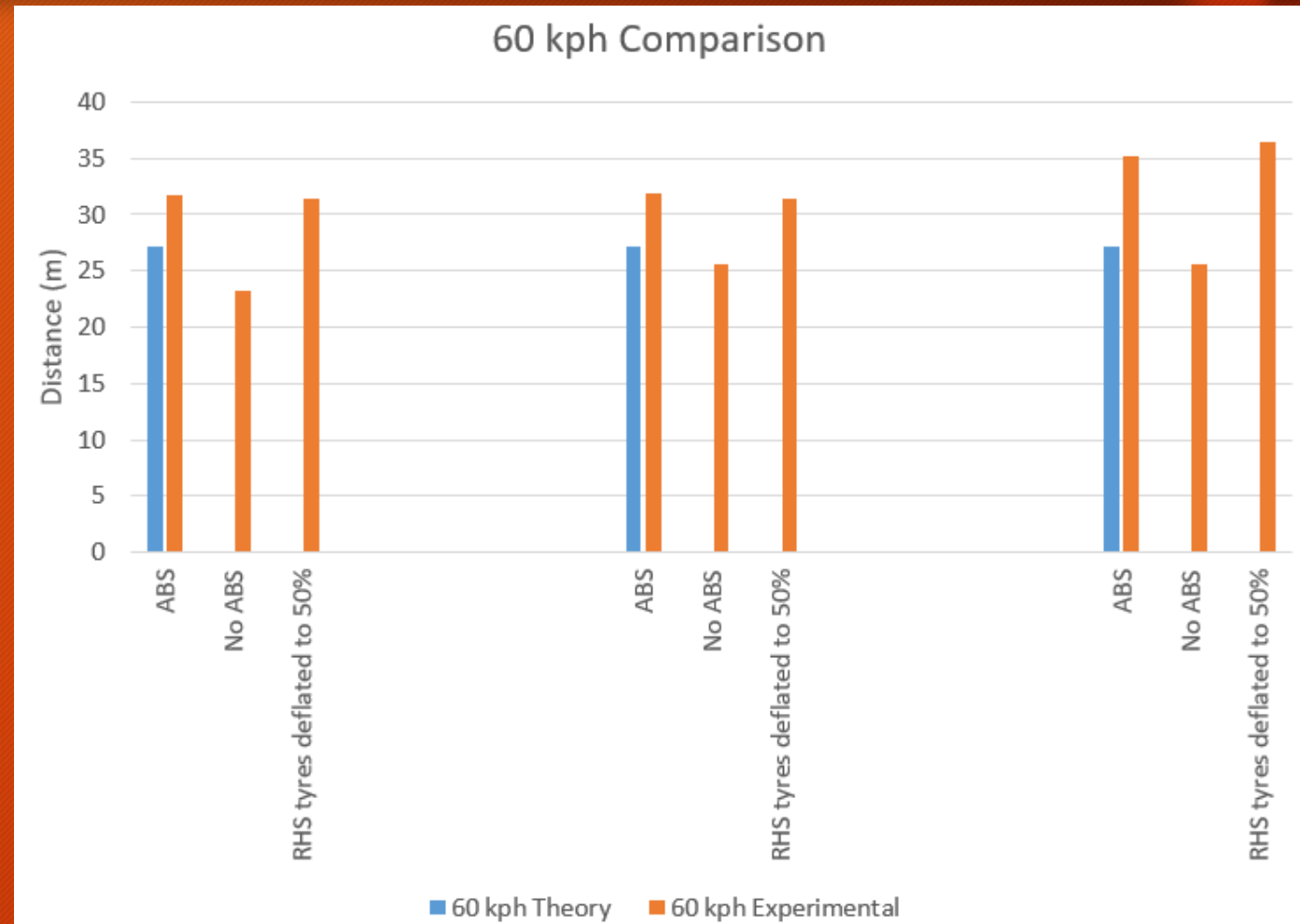


RESULTS - 60 KPH COMPARISON

New Tyres (Left)

Used Tyres (Center)

Smooth Tyres (Right)

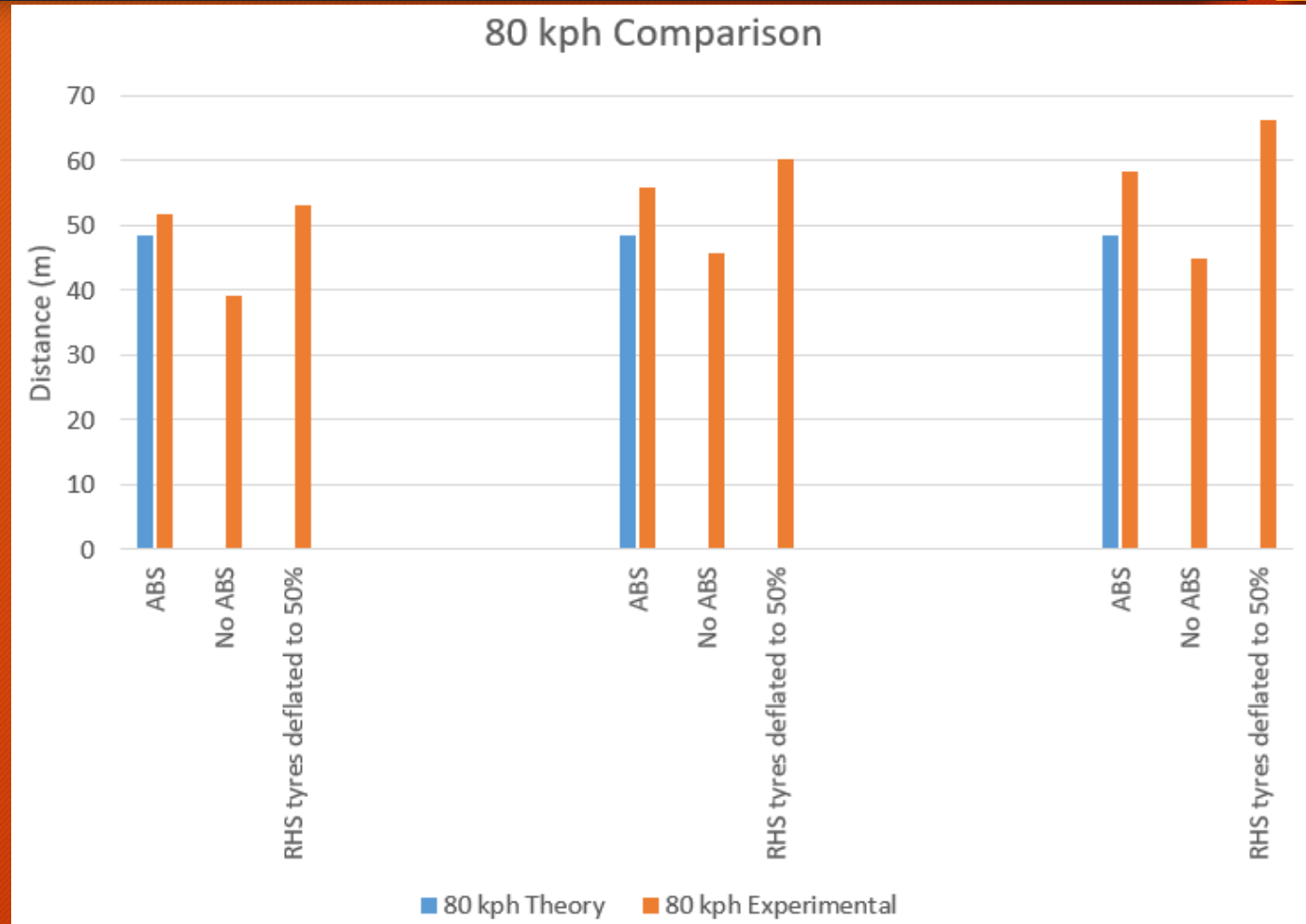


RESULTS - 80 KPH COMPARISON

New Tyres (Left)

Used Tyres (Center)

Smooth Tyres (Right)



OBSERVATION

- ABS brakes activated caused less correlation with theoretical value.
- ABS brakes cause activation, deactivation of brakes, which will cause the stopping distance to increase.
- Illegal tyres (common in many incidents), also don't correlate with theoretical value.
- Critical for high speed scenarios.

OBSERVATION

ABS brakes activated:

$$d = 1.165 \frac{v^2}{254 f n}$$

NB: Only valid for legal tyres!

At 60 kph, error was below 1%

At 80 kph, error was below 8%

OBSERVATION

ABS brakes activated with illegal tyres:

$$d = 1.3 \frac{v^2}{254 f n}$$

At 60 kph, error was less than 3%

At 80 kph, error was less than 7%

CONCLUSION

- Experimental skid distances on gravel road at 40 kph, 60 kph and 80 kph.
- The skid distances were observed to be similar to the theoretical skid distances when no ABS brakes were used.
- The general observation was that the skid distances on the gravel increased, the smoother the tyres were.
- The observed differences between the different inflation levels of the tyres, showed a small difference.
- ABS brakes activated showed a longer distance compared to the theoretical value.
- To identify a formula that could be used to calculate a more accurate skid distance on gravel roads when ABS brakes were used, for legal and illegal tyres,

FUTURE WORK

- identify the accuracy of the suggested correction factors in equations with speeds higher than 80 kph on gravel roads.
- the accuracy of these suggested equations could be validated on other road surfaces with different drag factors.
- A comparison with experimental results on wet road surfaces would be valuable to investigate.

Publications, videos & Contacts

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