

Development of Testing Methods using a Revised Soil Bin Test Rig

Chiok Keng Choon (Student)
Dave Simner (Supervisor)

Introduction

- In off-road vehicle (e.g. military wheeled vehicle), the tractive performance over unprepared terrain is an important aspect.
- To understand the relationship, testing has to be conducted under controlled and repetitive manner. Hence, an indoor soil bin test rig is needed. It consist of a single wheel system, carriage system, soil bin and data acquisition system.
- This project is to revise and develop test methods using the soil bin test rig in Cranfield Academy.

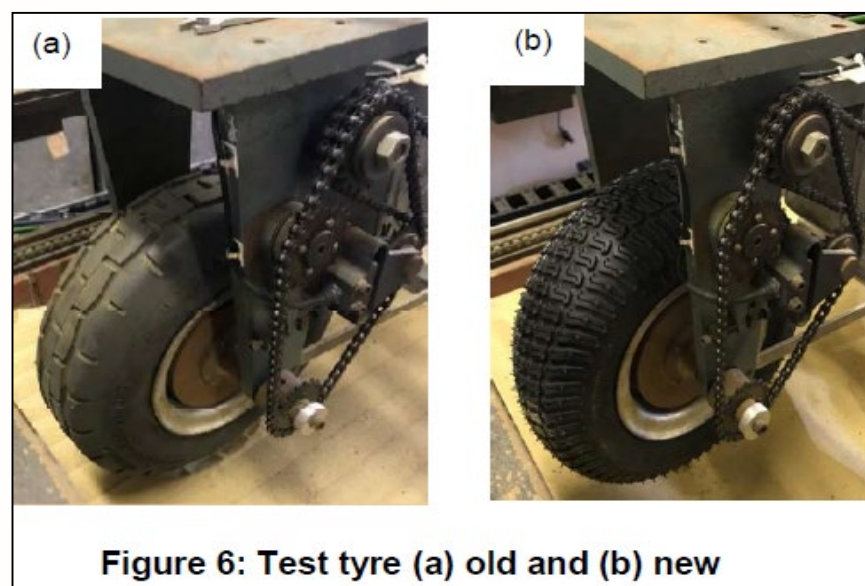
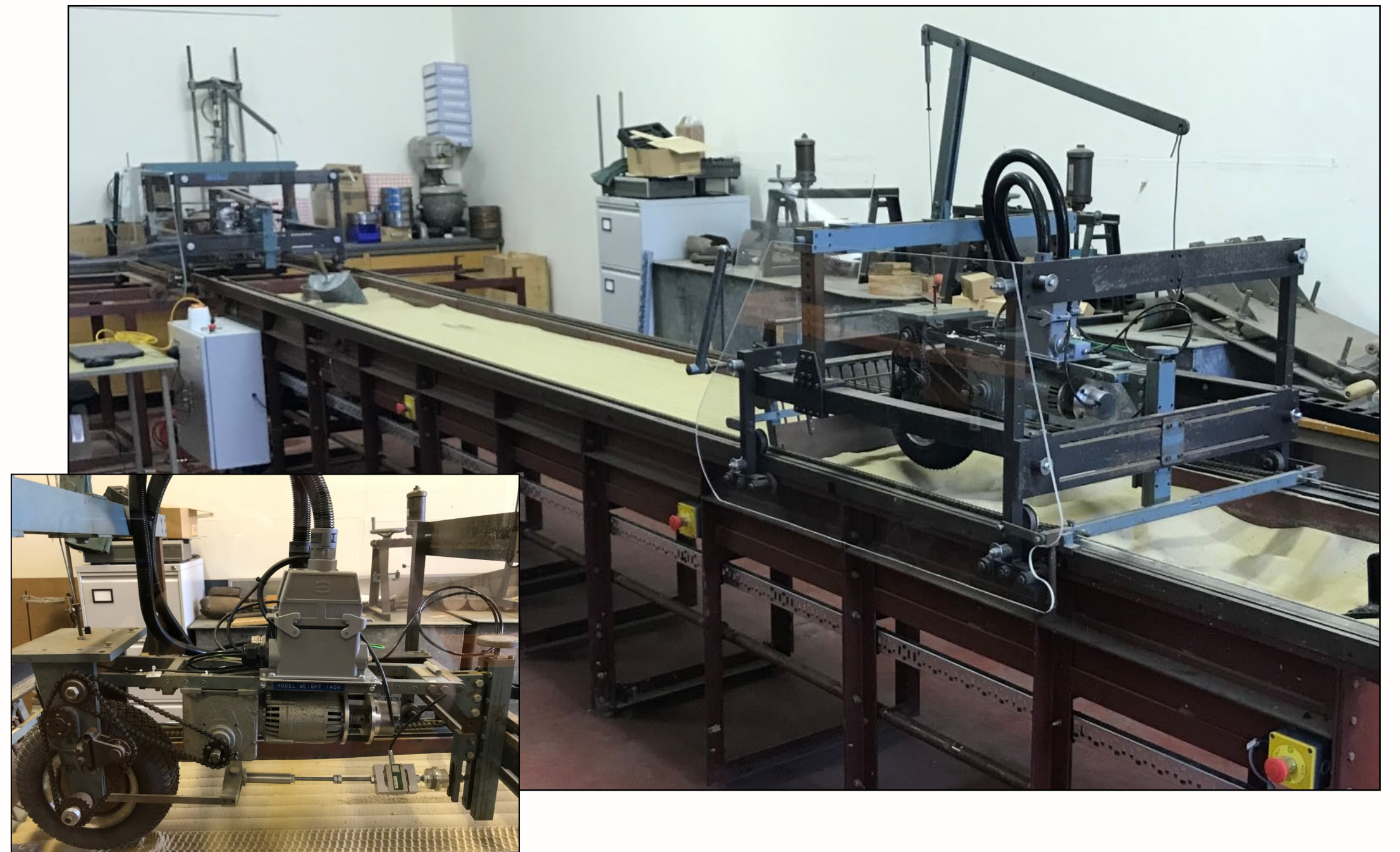


Figure 6: Test tyre (a) old and (b) new

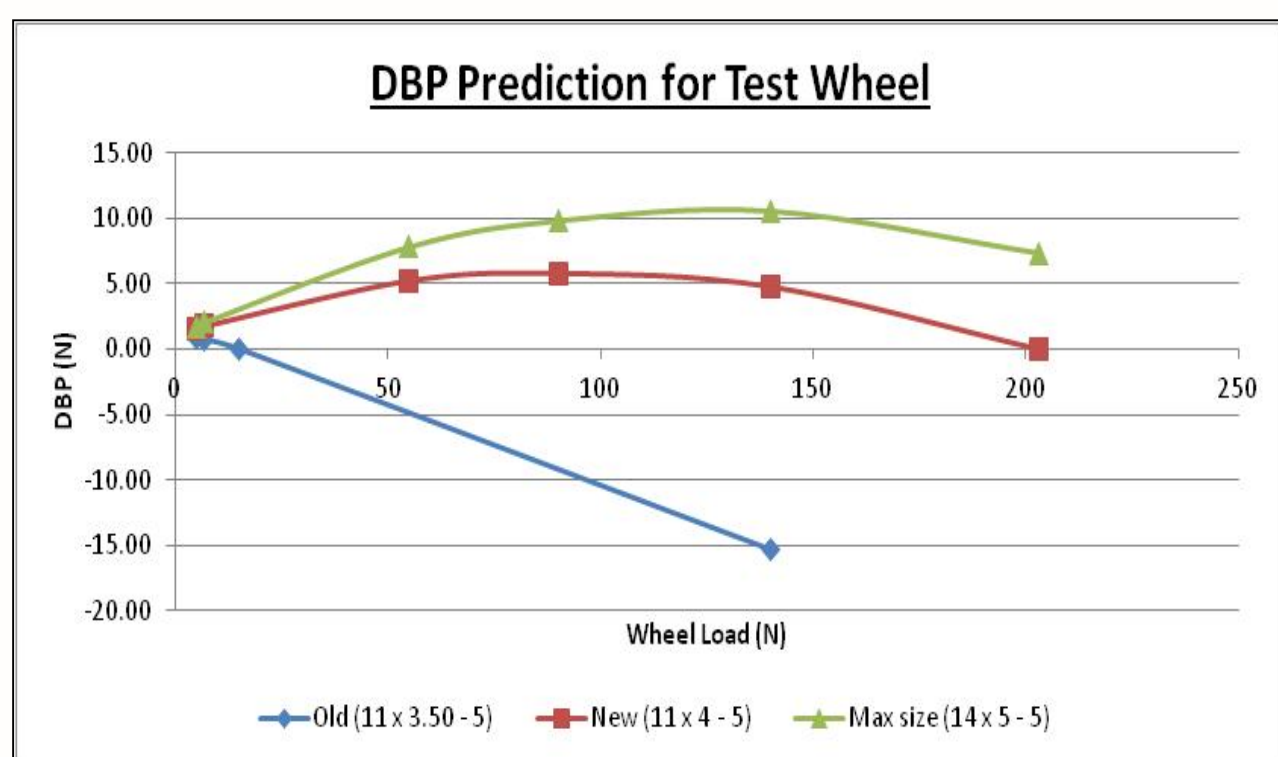
$$N_s = \frac{G(bd)^{3/2}}{W} \times \frac{\delta}{h}$$

$$\frac{R}{W} = 0.03 + 2.7N_F^{-1.45}$$

$$\frac{D_{20}}{W} = \frac{0.521N_F - 2.86}{N_F + 19.4}$$

Revise and Develop Test Methodology

- Tests was conducted to understand the operating boundary.
- Mobility numerics model by D. R. Freitag was used to predict the DBP.
- Test methods were developed to evaluate DBP with different parameters (e.g. load condition, wheel slip condition, tyre condition and soil condition).
- Test results were compared against the mobility numeric prediction and observed for correlation to the theory of terramechanics . Trending was validated by comparing the two test tyre results.



Result and Discussion

- There were disturbance/noise present within the test rig.
 - Average noise level of -5.62N from drive system for single wheel was recorded.
 - Load cell sensor showed DBP value fluctuating between -1 to 1 during static position.
- Some results showed correlation to the theory of terramechanics. It provide fast and cost effective evaluation of off-road vehicle design. Therefore, the test rig is still recommended for studying and verifying tractive performance.
- Recommended future work/improvement are:
 - to change carriage and wheel speed control from open loop to a closed loop.
 - to redesign the drive system for single wheel.
 - to have small test tyre that can represent the full size vehicle tyre.

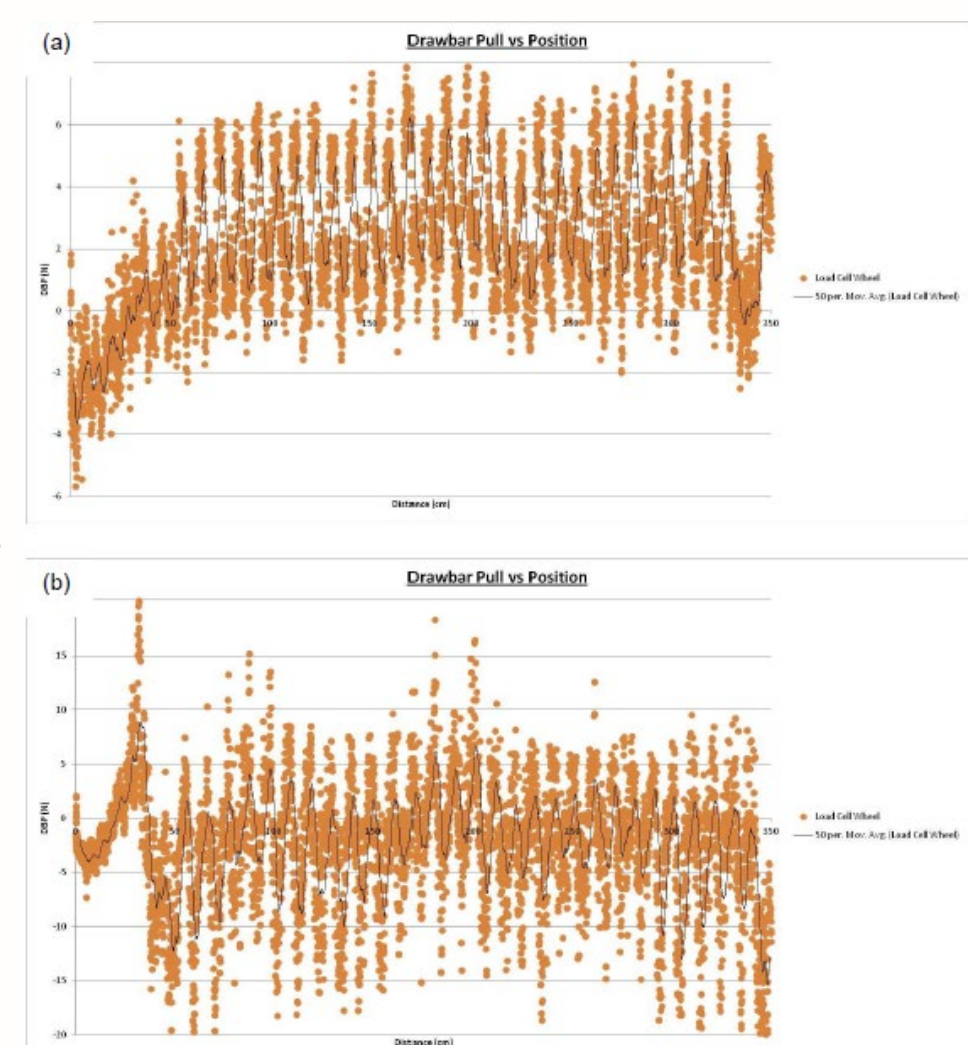


Figure 18: DBP results for new tyre at 89% slip with (a) 7N and (b) 140N load.

S/N	Wheel Slip (%)	BDP Result for New Tyre (N)	
		Load of 7N	Load of 140N
1	8	-2.5 to -1.5	-22 to -15
2	21	-0.5 to 1.7	-12.5 to -5.3
3	52	-2.5 to 0.3	-12.5 to 2.5
4	89	0.2 to 6.5	-10.6 to 6.4

Table 11: DBP results for new tyre at various slip with 7N and 140N load.