CHAPTER VIII

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

8.1 SUMMARY

From the literature and the validation of the field tests and modelling undertaken in this research, it was possible to develop an analytical model to predict the drawbar performance for the prototype track based on the principles pioneered by Bekker and other researchers. The proposed flexible track model was able to predict the contact pressure distribution for a soft soil surface and therefore, also the frictional stress and thrust force contributed by each track element.

Further more, the measurement and instrumentation system that was developed was able to record the required soil parameters for the development of the analytical model. Particularly, the rubber-soil friction was characterized by using a standard track element and steel sinkage test plates.

Two force transducers were specially designed and built based on the theory of the extended octagonal ring, to successfully measure the distribution of the contact pressure and the friction-shear stress and thus the frictional force per track element.

A series of full-scale drawbar pull tests were conducted in the fields and the relationships of traction and drawbar performance with total slippage under various soil conditions were obtained.

The computerized data acquisition system was used to record all the in situ test results for the soil characterization and the full-scale drawbar tests.

Through the modelling and the measurement, some design features of the prototype traction system and the soil parameters were evaluated for their influence on the tractive performance. These factors such as the frictional drive principle, the track tension, the centre ground wheels and the soil water content played important roles for the development of traction performance.

8.2 CONCLUSIONS

Based on the results from the field experiments and the performance prediction of the analytical traction model, the following detailed conclusions were drawn:

1. The sinkage tests and the shear and frictional tests could be performed by the instrumented test device. Related soil characteristics were obtained by applying the processing procedure as required by the bevameter technique.

2. The contact pressure as recorded for all terrain conditions still displayed typical peak values under the different wheels and the envisaged beam effect did not materialize for the prototype track.

3. Wear and friction between steel track elements might be the major reason causing the track to loose its initial bridging beam effect, resulting in an increase in contact pressure under the driving and tension wheels.

4. As peak contact pressure still occurred, it proved that for the present it is not justifiable to accept a uniform contact pressure distribution for the track as envisaged by the inventor, thus omitting road wheels.

5. The track motion resistance was recorded as unacceptably high under all test conditions, although the resistance on a concrete surface was considerably lower than on soft surfaces. This appeared to be due to internal energy loss in the track unit.

6. For the two models tested for predicting drawbar pull, i.e. a constant contact pressure model, changing to trapezoidal and a flexible track model, with typically undeformable truck wheels at the front and rear end and a circular

deflecting track section in between, the former proofed to be more idealized and the later more practical.

7. For the deformable track model, reasonable agreement between the measured and predicted values of contact pressure and traction force were observed for individual traction elements.

8. The traction and drawbar pull coefficients of the prototype track, based on measurements, were not as good as expected from modelling. In the criteria for drawbar pull performance, the measured values were rather unacceptably low when compared to results as reported in the other literature. This could only be attributed to substantial internal energy losses for the tracks.

9. The tractive efficiency was also unacceptably low, apparently caused by high internal friction between adjacent track elements and frictional slip between the track and the driving wheels.

10. The soil water content influenced the soil characteristics and thus also the traction performance of the tracks.

11. The research undertaken identified and confirmed a model to be used to predict contact pressure and tangential stresses for a single track element.

12. By applying two octagonal ring transducers and other necessary test apparatus and instrumentation, it was possible to measure the contact pressure and tangential force on a single track element with minimal interference which was confirmed by the predicted values.

13. Based on the proposed theoretical analysis, the tractive performance for different possible contact pressure values could be predicted.

8.3 RECOMMENDATIONS

For possible future research, the following are recommendations, based on the results from this study:

1. As the tractive performance of the tractor was not ideal as expected, it is suggested that the complete operating principle of the walking beam concept be reanalyzed and the source of the high internal losses be identified and corrected.

2. The principle of an articulated beam track, with optimum traction characteristics, was hampered by wear on the contact surfaces between adjacent track elements. However, advantages offered by the tractor drive train and steering system and the replacement of individual track elements when damaged, justifies the development and testing of some effective means to minimize friction and wear between track elements and sustain track tension and the bridging effect.

3. Alternatively other available rubber covered steel tracks, with a positive drive system, could be tested and combined with the novel steering and automatic differential lock system.

4. The flexible track model, with the specific configuration of the contact profile, was still not a universal model. To be applicable to new types of or modified future tracks, the contact profile at the interface of the track and the terrain surface may need to be observed and re-shaped.

5. Additional loading rollers or road wheels between the front and rear tension and driving wheels could be added to achieve a more uniform distribution of ground contact pressure under the tracks.

6. Based on the theoretical analysis, an optimum contact pressure distribution can be proposed.

7. A modified track system based on the theoretical analysis is to be built and tested and a modified model for tractive performance be tested.