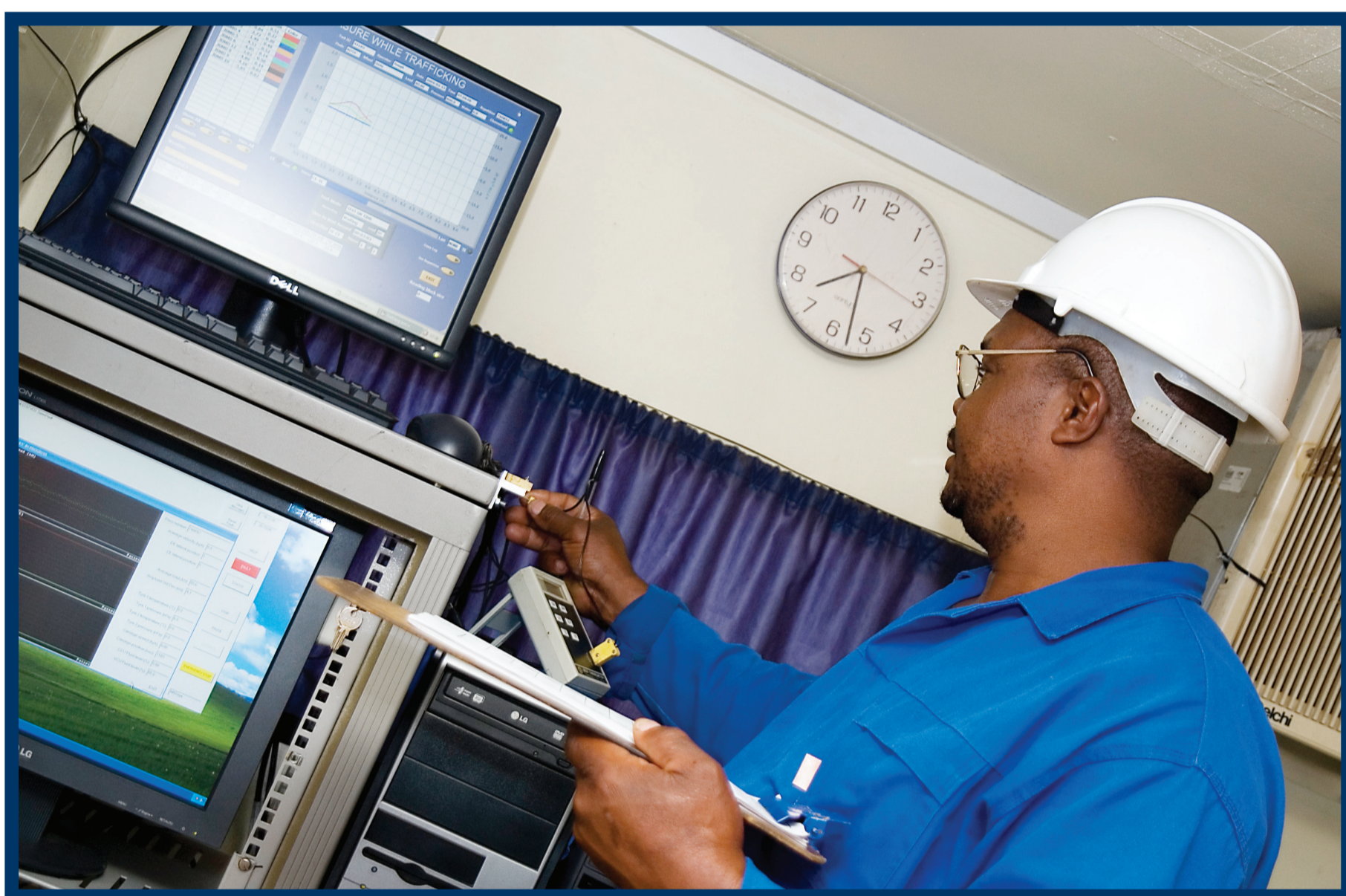


The impact of the CSIR heavy vehicle simulator (HVS) on the performance of the SA road network

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Trade growth in South Africa and in the Southern African Development Community has highlighted concerns about the ability of regional transport infrastructure to cope with increases in traffic volumes.

The CSIR plays a leading role in the development, application and transfer of processes and technologies for the design, construction, maintenance and management of transport infrastructure in southern Africa.



The heavy vehicle simulator (HVS), developed by the CSIR, is an accelerated pavement testing facility that simulates the traffic associated deterioration of a road over its design life (usually 20 years) in as little as three months. The HVS utilises unique instruments to measure and analyse the engineering performance of the road structure and individual material layers. This enables the prediction of the performance of new road materials and designs, as well as the optimisation of road designs, through the testing of trial sections well ahead of their implementation in practice, thus saving costs and avoiding expensive failures.



Over the past 35 years, the CSIR's comprehensive HVS research programme, carried out in conjunction with national and provincial transport authorities, has had a significant impact on road engineering in South Africa. Internationally, the CSIR is recognised as one of the global leaders in road design and evaluation, with 10 HVS facilities currently forming part of research programmes in the USA, Europe and China.

SIGNIFICANT OUTPUTS FROM THE HVS PROGRAMME IN SA

Some of the most significant developments in the South African pavement design engineering field resulting from HVS related research are discussed here.

(a) Materials-based development

Large aggregate mix bases (LAMBs)

These are used as a high quality base coarse for heavily-loaded airport pavement structures. The development work has led to the national accepted guideline document on the design method (Sabita, 1993).

Granular emulsion mixes (GEMs)

This entails the use of emulsion-treated bases, primarily for rehabilitation and improvement of existing roads.

Rehabilitation measures for cemented-base pavements

Long-term HVS investigations are conducted into the selection of rehabilitation measures for lightly cemented-base pavements.

Treatments for phased upgrading of unpaved roads

HVS work in South Africa is closely aligned with the need for cost-effective improvements to unpaved roads, as part of a phased upgrading. HVS testing of several bitumen and tar-based treatment types were investigated during the 1990s.

Porous asphalt

The performance of porous asphalt with improved safety and noise characteristics were verified through HVS research.

(b) Developments in design, analysis and performance characterization

South African pavement structural design method (Technical Recommendations for Highways, TRH4)

The South African flexible pavement design method and catalogue were developed over the years with major input from HVS data.

Improvements in the modelling of permanent deformation in pavements
 HVS performance data have been used in the investigation into the individual contributions of the various pavement layers to the overall deformation of the structure.



Improved modelling of in-depth deflection bowls

A back-calculation method has been developed for modelling in-depth and surface deflection bowls more realistically, based on actual responses measured during HVS testing.

HVS testing of concrete pavement structures

The South African National Road Agency Ltd (SANRAL), Gautrans, the Cement and Concrete Institute (C&CI) and the CSIR started a concrete research programme in 2003 to address the current shortcomings in the South African mechanistically-based concrete pavement design manual. To date, four different studies have been completed. The outcome of this research has been so successful that SANRAL has put out tenders for a full-scale rehabilitation project on major freeways using a specialised rehabilitation method after the validation using the HVS.



Labour-enhanced road building construction techniques

The application of labour-enhanced, or labour-intensive construction techniques is of special relevance to South Africa. The HVS programme has investigated road building techniques constructed in this way since 1997. These include penetration macadam, emulsion-treated natural gravel, slurry-bound macadam and concrete surfacings.

CONCLUSION

The CSIR-designed HVS machine is the most successful mobile accelerated pavement testing device available worldwide. Ten units are in operation, deployed in six countries. The HVS has had a significant impact on the development of pavement engineering over the past four decades, resulting in significant savings in road building and rehabilitation costs.

Research conducted with the CSIR-designed HVS machine results in significant savings in road building and rehabilitation costs.

