CLEGG IMPACT SOIL TESTER

(The Clegg Hammer)

TECHNICAL NOTE

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APPLICATION OF THE 20 kg CLEGG IMPACT SOIL TESTER TO EVALUATION OF FLEXIBLE PAVEMENTS

This technical note reports the results of field tests carried out to obtain data for the evaluation of the 20 kg Heavy Clegg Impact Soil Tester (CIST) for possible application in estimatting an approximate Benkelman Beam Deflection and Surface Modulus of flexible pavements.

Limits have been set for deflection and curvature in relation to traffic. For traffic of 1.00E6 ESAs AUSTROADS (1992) proposed limits on peak deflection of 1.15 mm (0.045 ins) and curvature of 0.18 mm (0.007 ins) as tolerable. These limits relate to Benkelman Beam deflection measurements with a standard axle of 8.2 tonnes (18,000 lb).

The Heavy CIST consists of a 20 kg mass dropped a height of 300 mm with the peak deceleration in units of 10 gravities being used to obtain the Heavy Clegg Impact Value (CIV_{20}). As per ASTM D 5874, the maximum value of four drops of the mass was recorded. CIV_{20} has been described in Technical Note 2 (TN2) which also gives theoretically derived relationships for Clegg Hammer Modulus (CHM) versus CIV_{20} and a Calculated Deflection (CD) for Benkelman Beam using CHM_{20}.

The FWD is one of the common ways of determining an approximate Benkelman Beam Deflection and Surface Modulus. The opportunity arose in early 1997 for comparative tests between the FWD and the Heavy CIST on a range of pavements by Sutherland Shire, an outer suburb of Sydney, New South Wales. Additional data was obtained from comparative tests in late 1996 at Kalgoorlie, a mining town in Western Australia. These are presented in attached Figures 1 and 2.

At Sutherland the Falling Weight Deflectometer (FWD) tests and Heavy CIV tests were carried out at the same locations. At the Kalgoorlie test sites were within one or two metres of each other and carried out at different times. Each data point on the Figures is the average from about ten to twenty individual tests on each street.

Plotted in Figure 1 are the curves obtained by theoretical and empirical considerations. The one marked CD was obtained by considering the pavement as homogeneous and using classical Boussinesq theory with standard axle load of 8.2 tonnes, contact pressure 550 kPa on a flexible plate of radius 0.15 m. The one marked BBCD was obtained from actual field tests comparing standard Benkelman Beam tests with the Heavy CIST on pavements consisting of spray seals on gravel or fine crushed rock in south Western Australia. It is interesting to note that the majority of the data points from the 1996 and the 1997 comparative tests fall between these two curves with just a few outside the curve marked BBCD. The best fit curve showing the general trend for all the data is also plotted.

The curvature data for the comparative tests is given in Figure 2 and shows the same general trend as shown in Figure 1 for deflection. This is supported by the linear correlation between the FWD and Curvature as shown in Figure 3.

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Considering these test results in relation to the AUSTROADS performance criteria as given in Appendix 1 it appears possible to use CIV_{20} for basecourse/surface-course evaluation based on deflection, eg around 30 CIV_{20} for a general purpose design surface deflection based on Curve 1 in Appendix 1 and around 50 for design curvature corresponding to 1.00E6 ESAs as per Figure 10.4 in the Appendix 1.

It should noted that these suggested criteria are based on a number of assumptions such as those related to estimation of the approximate Benkelman Beam Deflections as derived by the FWD method. If the BBCD curve that is based on direct comparison between CIV_{20} and Benkelman Beam is used, the CIV of 30 would be raised to a CIV of about 40.

The opportunity was also taken to compare the Surface Modulus as obtained by the FWD method with CIV_{20} results as shown in Figure 4. As is the case of deflections a theoretically derived curve has been plotted and this serves to indicate the general trend. Also included for comparison is the curve obtained for an unsealed gravel pavement over sand subgrade using data from Bott (1979) and based on plate bearing tests in a laboratory test tank. This follows the same general trend.

The test results reported herein suggest that the Clegg Impact Value as obtained by using the 20 kg Heavy Clegg Impact Soil Tester has application to flexible pavement evaluation particularly with respect to making a comparison between pavement types, overlay design and in estimating pavement layer modulus. The extent to which this is possible depends on a number of factors. The main aspect requiring attention is the influence of pavement type on the relationships.

Further data analysis is being undertaken.

Reference Material

ASTM Designation D 5874 - 95, Standard Test Method for Determination of the Impact Value (IV) of a Soil

AUSTROADS 1992 PAVEMENT DESIGN - A Guide to the Structural Design of Road Pavements

Sutherland Shire NSW 1997 Comparative Test Data, FWD and Heavy CIST

Golder Associates 1996 Test Data, FWD and Heavy CIST Town of Kalgoorlie-Boulder

Dr Baden Clegg Pty Ltd 1995 Technical Note No. 2

Bott, M.L.H. 1979 Impact Measurements on Road Pavements, Hons. Thesis, Department of Civil Engineering, University of Western Australia.

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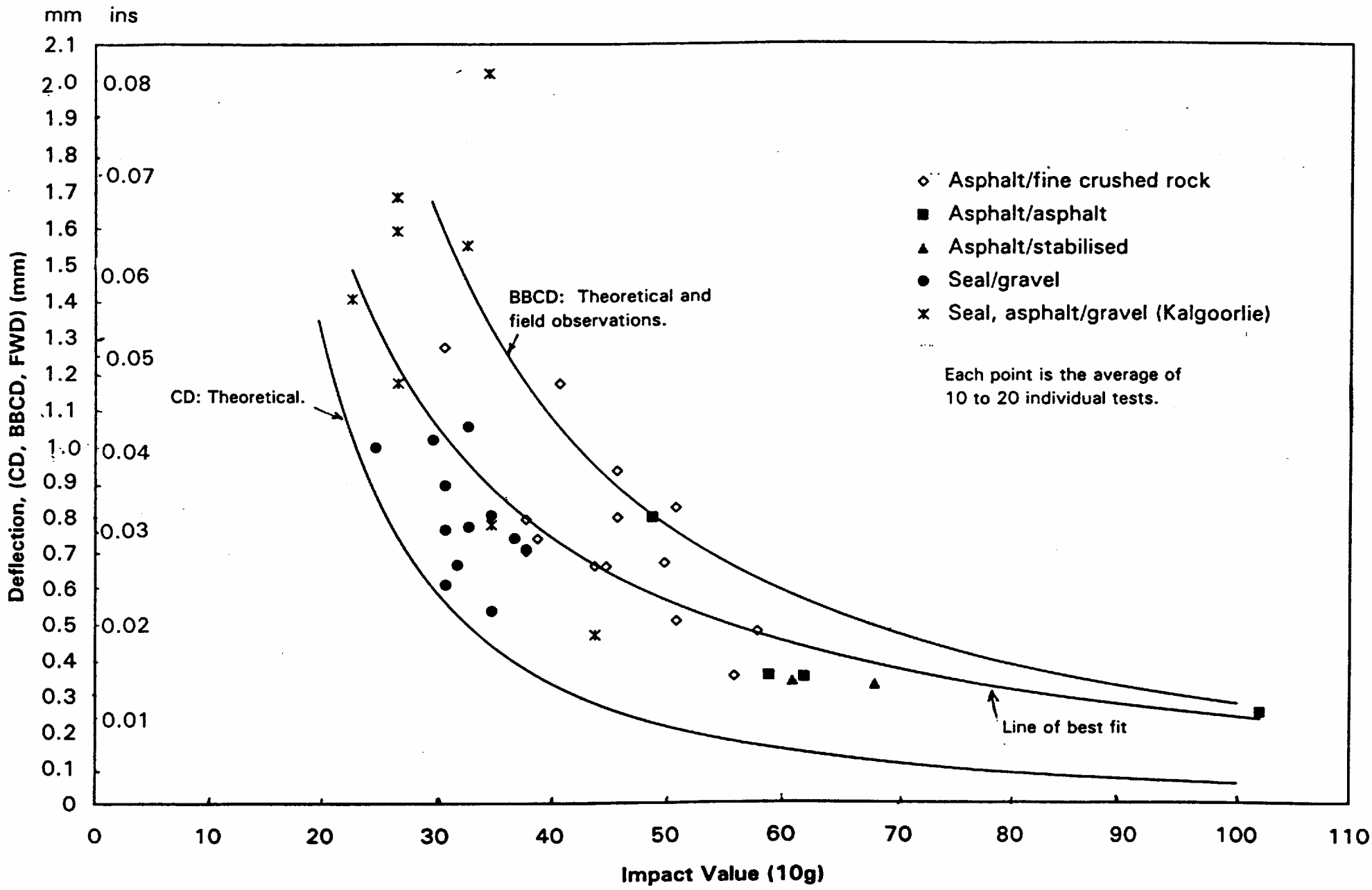

Figure 1: Various Deflections vs Impact Value for 20 kg Hammer.

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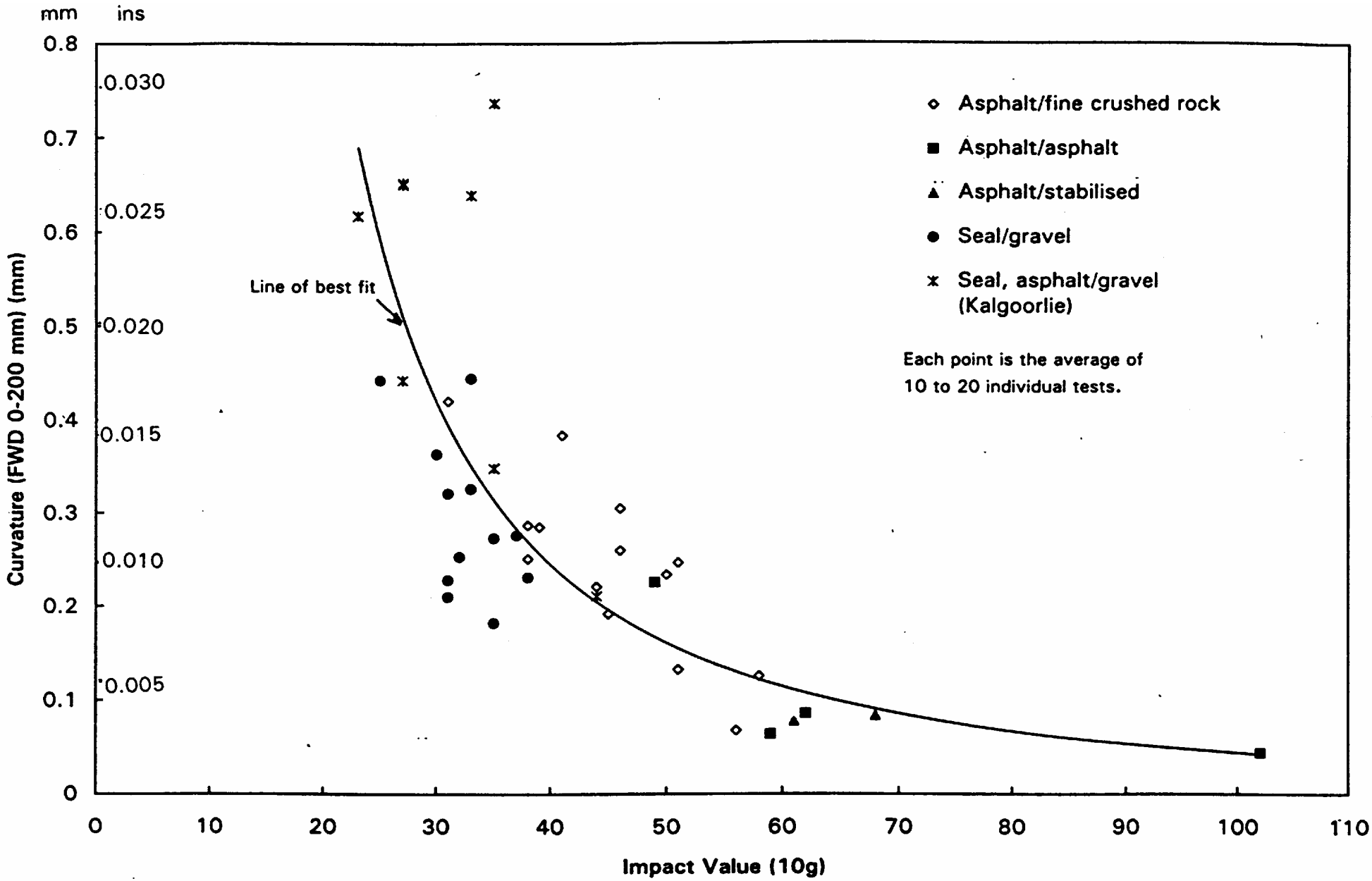

Figure 2: FWD Curvature vs Impact Value for 20 kg Hammer

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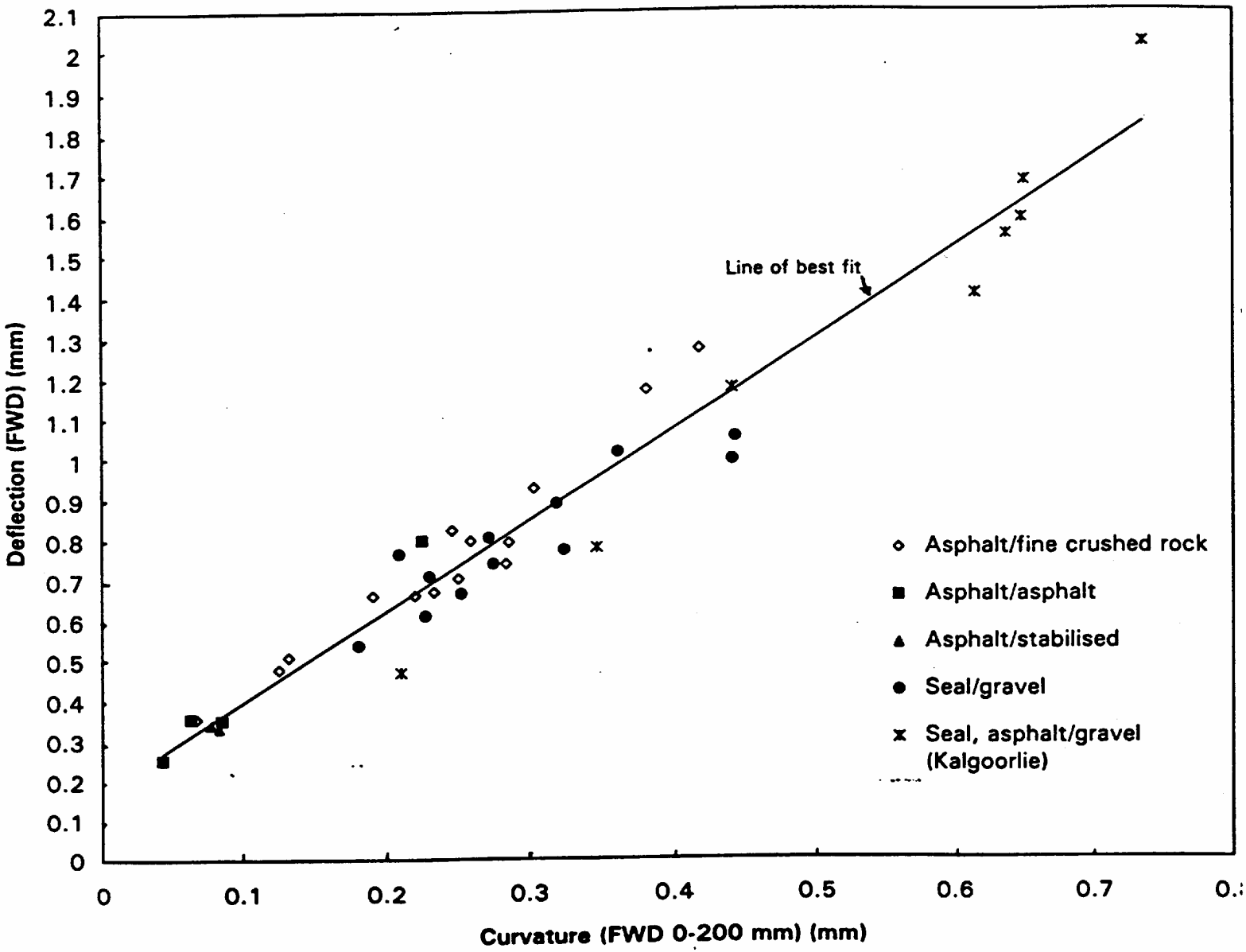

Figure 3: Surface Deflection vs Curvature from FWD tests.

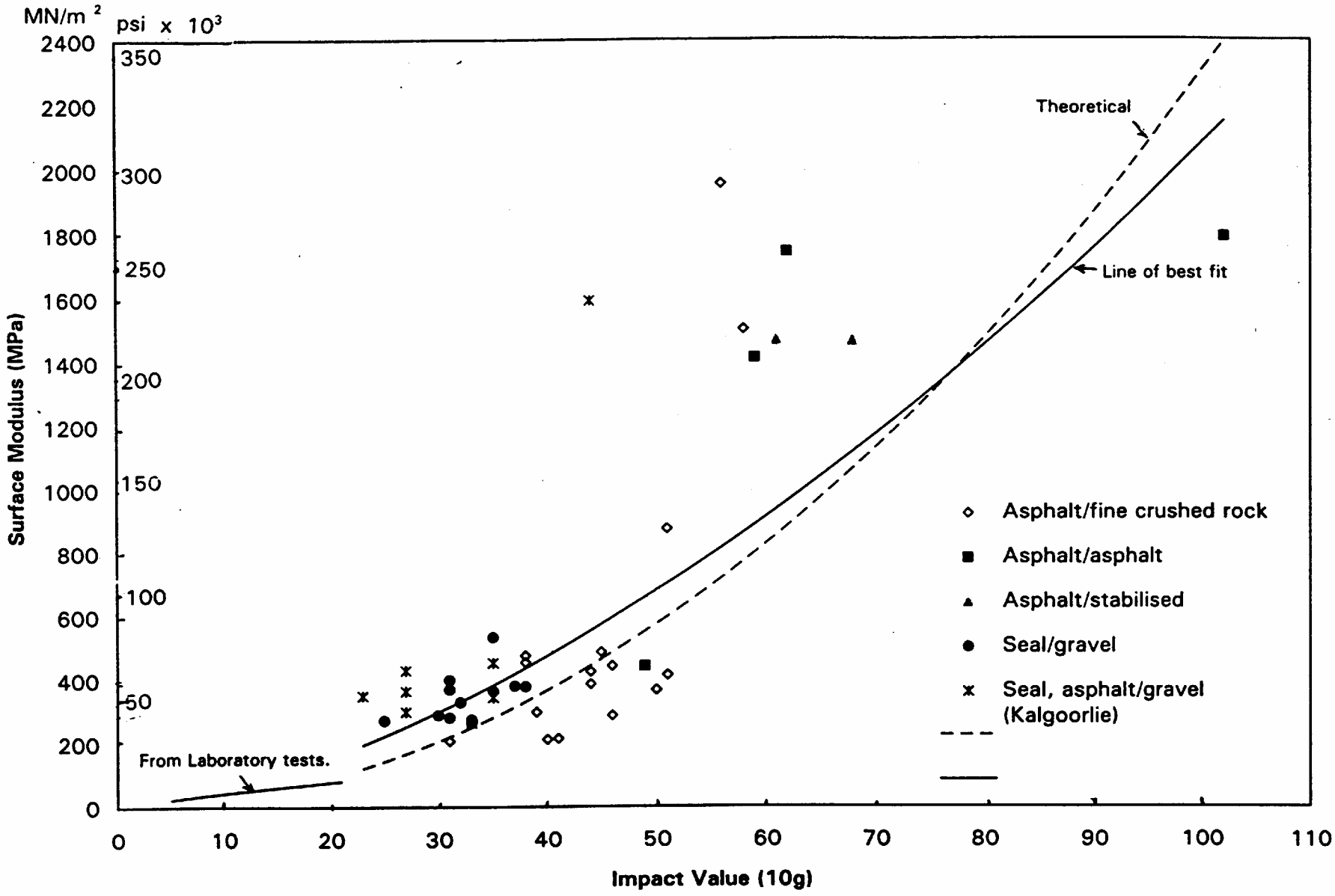

Figure 4: Surface Modulus (FWD) vs Impact Value for 20 kg Hammer

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