Measurement of Carriageway Deflection

Lab Test Reference 603
Test Method Reference
TRRL LR834

Principal Apparatus:

Deflection Beam – Lab Inventory No. xxx
Loaded Lorry – as described in the Appendix
Electronic Thermometer – xxx

1. Preliminaries

1.1 Check that the calibration certificates for the thermometer and dial gauge are valid.

1.2 Check that the tyre pressures of the loaded lorry are within tolerance.

1.3 Using the calibration apparatus assemble the bean and check that the tolerances are within limits using the procedure described in paras 1.4 to 1.5 and enter the results in the calibration records file.

Calibration of Deflection Beam

1.4 To ensure that the dial gauge is operating correctly and that the beam is moving freely it is desirable to calibrate the beam before use. Plate 3 shows a simple calibration rig, supplied by the firms manufacturing the Deflection Beam.

1.5 A hand-wheel operating through an eccentric bush and hinged bar raises and lowers a horizontal platform which, in use, supports the beam tip under a reference dial-gauge; the arrangement is illustrated in Plate 3. Two operators are required to observe the two dial-gauges for maximum deflection as the hand-wheel is slowly rotated. Different eccentric bushes are available to give a range of beam movement. The vibrator is used during the calibration process. Because of the 1:2 length ratio of the beam about the pivot, the dial-gauge reading on the Deflection Beam needs to be doubled to give the deflection at the beam tip. The mean of not less than 10 consecutive readings on the two dial-gauges is used as the basis for comparison. If satisfactory agreement is not obtained during calibration, the pivot should be cleaned and oiled and if necessary the dial-gauge serviced. If the Deflection Beam is of the split-beam design the tightness of the fixing bolts should be checked. (The use of 3 bricks underneath the adjustable feet can assist the calibration procedure).

2. Standard Test Method

2.1 With the lorry in the initial position, the Deflection Beam in the locked condition is placed with the beam tip over the point of measurement and the beam centrally located between the twin tyres. The alignment is finally adjusted by careful sighting through the tyre gap to ensure that the tyres will not foul the beam when the truck is driven forward at creep speed. When this alignment is completed, the movable pointer is adjusted to be a few millimetres directly above the tip. Subsequent alignment can then be achieved using the pointer. When the beam is in position the lock is released, and with the vibrator running, the dial-gauge reading is set to zero by rotating the scale. At a signal from the operator, the vehicle is driven forward at creep speed to a position where the rear wheels are at least 3m beyond the test point. The speed should be such that the total time required to travel a distance of 5m is 10± sec. This speed should be regularly checked against a stop watch. The maximum reading of the dial-gauge is noted together with the final reading after the rear wheels of the truck have reached a point 3m from the beam tip. The magnitude of the pavement deflection is obtained by adding the maximum reading to the difference between the maximum and final readings. The results are entered on the worksheet (The sum of deflection is not meaned because of the 2:1 ratio of the beam arms.) Plate 5 illustrates a complete measurement cycle.

2.2 Differential thermal expansion within the beam can cause significant errors particularly on stiff pavements. In sunny weather the beam may pass from shade into sunshine as the vehicle moves; the thin metal shield carried by the frame of the beam and covering much of its length (shown on Plate 1) helps to reduce the effect.

2.3 If measurements are also required in the offside wheel track the procedure is repeated with the beam transferred to the offside rear wheel assembly of the truck.

Measurement of Temperature

2.4 Before commencing beam measurements a 40mm deep hole in the road surface at the site of the measurements is produced by driving a hilti nail or similar hardened tool to the prescribed depth and withdrawing this. The hole is filled with glycerine or similar light oil and left until measurements are complete.

2.5 The temperature of the oil in the hole is now measured by using the calibrated electronic thermometer by placing the tip of the probe into the oil and reading the temperature when a steady reading is displayed.

2.6 The results are recorded on the Deflection Beam worksheet to the nearest whole degree centigrade.

2.7 The air temperature is also recorded for information purposes.

Notes

3.1 Deflection measurements taken with the Deflection Beam are not absolute. On most road pavements the bowl of deflection surrounding the load wheels extends to a radius of greater than about 1.5m. With the load wheels in their initial position, the beam tip and the forward feet of the beam frame are then within the bowl. On strong pavements, particularly those founded on weak subgrades, the rearward feet are also affected and the more lightly loaded front wheels of the lorry may also be influencing the beam tip. The initial reading of the dial-gauge does not therefore normally correspond to that associated with an absolute reference datum. As the load wheels move away from the beam during a deflection measurement, the deflected bowl ceases to influence the feet of the frame and the final reading is taken with the wheels remote from the equipment.

3.2 Analysis of the response of the dial-gauge to the combined movements of the beam tip and the feet of the frame brought about by the moving bowl of deflection during a measurement, indicates that measured deflections will be less than absolute values and that the proportion of the absolute value that is measured will also change according to the location of the Deflection Beam in relation to the load wheels in their initial position; care must therefore be taken to position the Beam according to the recommendations.

3.3 In some countries 'rebound' deflections are measured by placing the tip of the beam centrally in the gap between the loaded dual wheels. The recovery or rebound deflection is then measured as the lorry is driven forward to a point at least 2m beyond the beam tip. Because of the visco-elastic properties of the road materials the rebound deflection depends on the exact procedure used; in particular it is influenced by the length of time during which the load wheels are stationary on the point of measurement. The results obtained can differ considerably from the deflections measured by the method described above[3]. Although simpler in some respects, the rebound procedure is not recommended and should not be used in conjunction with charts of the TRRL method of overlay design.

3.4 The French Deflection Beam technique involves reversing the loaded lorry from a point at which the load wheels are approximately 2m in front of the Deflection Beam to a point at which the dual wheels straddle the tip of the beam and are 0.5m behind it. The vehicle is then driven forward to its original position. This technique will also produce a deflection value which is different from that obtained using the recommended procedure. It should not be used therefore with the TRRL method for overlay design.