Abstract

Within the the National Sustainability Programme I, project of Transport R&D Centre (LO1610), the determination of measured jointed plain concrete pavements deflections to load was monitored. Impacts of climate and other effects upon resulting concrete pavement deflections were studied in the first place. The main issue for FWD measurements is the selection of suitable climatic conditions. In addition, loading transfer efficiency (LTE) at slab joints, which is a specific feature of concrete road pavements, was studied.

Keywords: jointed plain concrete pavement; falling weight deflectometer FWD; deflection; temperature-moisture gradient; load transfer at joints

1. Introduction

The deflection of pavement when determining jointed plain concrete pavement (JPCP) stiffness can be measured with different devices. These devices need to allow sufficiently large deflection in accordance with JPCP thickness. For this purpose, Falling/Heavy Weight Deflectometers FWD/HWD are most commonly used. They load the pavement by falling weight on a loading plate. When measuring JPCP deflections, it is necessary to take into account the behaviour of concrete slabs which is based on climatic conditions, particularly temperature and moisture. In addition, the loading plate and the position of the measuring beam equipped with deflection sensor need to be correctly placed.

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2. Description of method and equipment

The method of deflection measurement by FWD is based on the measurement and determination of pavement response to the fall of a weight which simulates dynamic loading by traffic. The loading is induced by a falling weight of a given mass from a given height through rubber dampers regulating the loading impulse duration. Loading is transferred through the loading plate to the pavement structure and subsequently the response to the loading, which comes in the form of vertical deformation – deflection, is measured. A loading plate and measuring frame, equipped with deflection sensors, are placed on pavement during the testing. After inducing the loading impulse, is measured the loading force and values of deflection at individual sensors in different distances from the load axis (see Fig. 1). FWD allows to set the parameters of loading (loading force and time of loading) so that they would be similar to the real loading from moving vehicles.

The measurement of JPCP deflection can be divided into:

- slab deflection measurement (in its central part),
- LTE measurement on joints between two slabs.

![Fig. 1. Deflection basin - its shape with typical 3 monitored parameters.](image.png)

FWD loading plate and measuring frame with sensors are either placed in the supported slab part (deflection measurement) or in the transversal/ longitudinal joint (LTE). The placement of the loading plate in the geometric centre of the concrete slab without verifying its support is unsuitable due to the temperature-moisture gradient.

2.1. Specific features of measurement on JPCP

The measurement of deflections by FWD as diagnostics of rigid (concrete) pavements (is not so frequent in comparisons with diagnostics of flexible (asphalt) pavements. Determination of JPCP stiffness can be performed at the design level (of the selected road section where maintenance or reconstruction is planned), or at the network level (searching the weakest road sections within the monitored road network).

When measuring deflections of JPCP, the following needs to be maintained:

- deployment of sensors from the load axis up to 2100 mm (see Fig. 1); in the case of measuring transfer of loading (LTE), one sensor needs to be 200 mm (potentially 450 mm) from the load axis,
- during the measurement it is necessary to use such loading force which, with regard to stiffness and thickness of concrete slab, produces sufficient deflection, at least 40 μm on the last sensor; high loading force may vibrate the slab to undefinable frequencies,
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