# MATES

## MICHIGAN DEPARTMENT OF TRANSPORTATION

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### "THE THUMPER" IS HERE

Because of variations in pavement materials, construction procedures, and changes caused by aging, it is generally not practical to determine the engineering properties of an in-place pavement without load testing. Load tests should simulate the application of traffic to be meaningful and if such tests are to be used as a routine procedure, they should be relatively simple and rapidly made.

The Soils, Bituminous and Pavement Performance Unit has recently taken delivery of a device meeting the above criteria, a falling weight deflectometer (FWD) manufactured by KUAB in Sweden (Fig. 1). The FWD is a drop-weight impact loading device which approximates the effect of a moving wheel load. The impulsive load causes the pavement to deflect downward. This deflected pavement shape, known as the deflection basin, is measured by the FWD (Fig. 2). The shape and size of the deflection basin are related to the strength of the pavement and the various layers of soils that support it. This combination of pavement and supporting soils is called a pavement system. A shallow, elongated deflection basin (Fig. 3) is characteristic of a pavement system with a relatively stiff upper layer and weak subgrade support, whereas a deflection basin that is relatively short and deep (Fig. 4) is indicative of a pavement system with low upper layer stiffness and relatively strong subgrade support. Other pavement/subgrade combinations can be recognized through the shapes and magnitudes of their deflection basins. Deflections measured by the FWD can be used to evaluate structural capacity, detect the presence of voids within the pavement system, measure load transfer efficiency (Fig. 5), and evaluate the adequacy of certain pavement rehabilitation techniques.

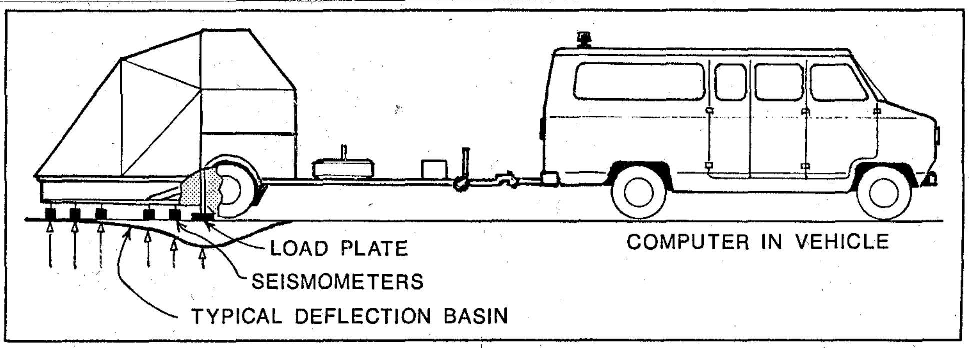


Figure 1. FWD trailer and tow truck, showing five of the nine seismometers measuring a typical deflection basin.

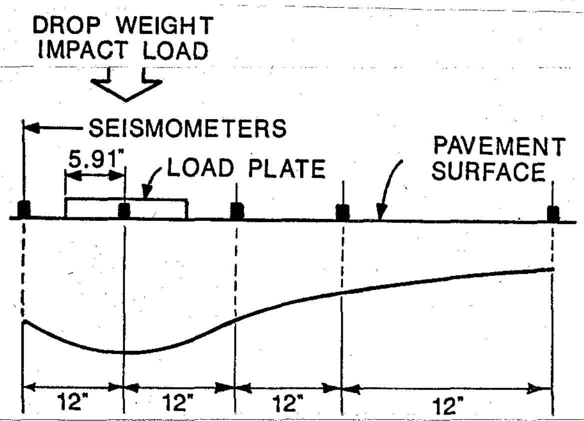


Figure 2. Typical deflection basin.

Prior to acquiring the FWD, this type of information had to be obtained by using a mechanical device to measure pavement deflection under a loaded truck. This device, which had been used since 1956, was versatile and simple to operate, but was very slow and labor intensive.

The FWD is essentially operated by one person. The only additional personnel required are for traffic control appropriate to the test site. The entire test sequence is computer controlled, activated by the operator from the driver's seat of the tow vehicle. The impact load is adjustable by varying the amount of weight dropped and the height from which it is dropped. Our current test sequence involves three drops of each of three different impact loads. Currently being used are impact loads of approximately 4,400, 8,800, and 15,950 lb. A complete test sequence requires approximately three minutes at each test site. Deflections of the pavement surface caused by the falling weight are measured by instruments called seismometers. These are lowered to the road surface during a test. Seismometers are located at the center of the applied load, 12 in. in front and to each side of the load, and at 12, 24, 48, 60, and 72 in. to the rear of the load. All data pertinent to the test are monitored by the computer and later downloaded to a floppy disk for storage. This includes the actual measured impact load, deflections measured by each of the nine seismometers, geographical information to locate the test site, and environmental factors such as air and pavement temperatures.

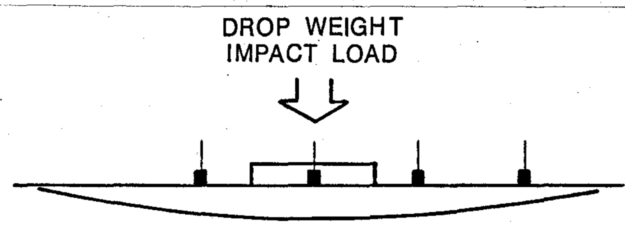


**Figure 3. Deflection basin typical with high surface stiffness and weak subgrade support.**

Deflections measured by the FWD can be used directly to evaluate load transfer efficiency across joints or cracks in rigid pavements by comparing deflections of the loaded side of the joint with the unloaded side. Computer analysis of measured pavement deflections along with the magnitude of the impact load, can be used to estimate stiffness values for each of the layers in a pavement system. These values can be used to evaluate any existing pavement system and to estimate how thick an overlay should be for a rehabilitation project.

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Although we are in the early stages of development in determining what the FWD is capable of doing and how the data can be utilized best, the device is being used extensively. Currently we are evaluating the structural characteristics of both conventional and recycled concrete pavements with varying base materials. We have also implemented a program to evaluate structural properties of newly constructed flexible (asphalt over soil) and composite (asphalt over concrete) pavements. Other uses suggest themselves as we become more familiar with the FWD, using it, for example, to check a specific roadway before allowing special overload permits to be issued. Undoubtedly further uses of this versatile equipment will arise. Therefore, we expect the FWD to be an excellent tool in our assigned task of pavement evaluation.

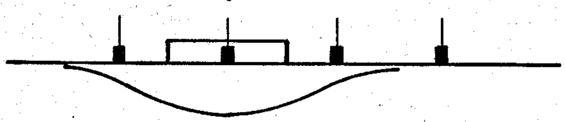


Figure 4. Deflection basin typical with low surface stiffness and strong subgrade support.

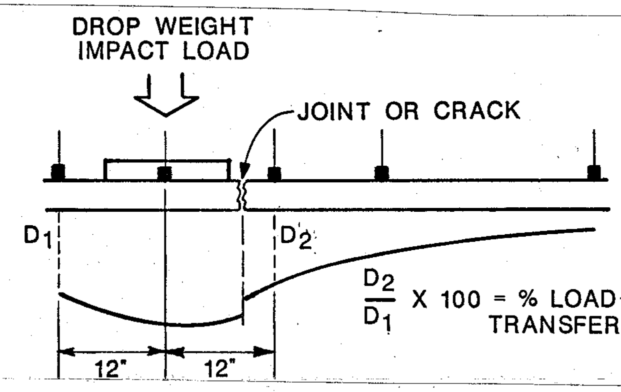


Figure 5. Determining load transfer efficiency.

-Bob Felter

## TECHADVISORIES

**The brief information items that follow here are intended to aid MDOT technologists by advising or clarifying, for them, current technical developments, changes or other activities that may affect their technical duties or responsibilities.**

### OOPS...........

It even happens to us 'good guys.' Figure 1 in last month's article, "The Turn of the Nut" shows that the bolt mark had moved a half-turn, rather than the nut. The drawing shown here describes the correct situation.

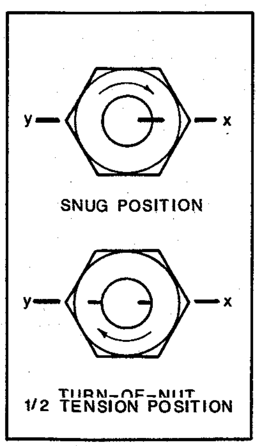


Figure 1. A mark on the wrench socket is aligned with felt marker line **x** and nut is turned until the socket mark reaches line **y**. Note felt marker line on nut in snug position extends into the bolt to assure the inspector that the bolt has not turned.

### PERSONNEL CHANGES

**Al Hagen** has joined the Structural Services Unit of the Testing Laboratory as an Engineering Technician, replacing retiree Elton Cooler. Bill Walden transferred in from the Department of Natural Resources as a Geologist in the District Support Section's Soils and Materials Support Unit, the job formerly held by George Gallup. We are very pleased to have acquired people with the strong backgrounds of these new staff members and look forward to the contributions that they will make in the future.

### LEO DEFRAIN

We are proud to note that **Leo DeFrain**, head of our Instrumentation and Data Systems Unit of the Research Laboratory, is one of three Michigan men honored at the 75th Anniversary Meeting of the American Association of State Highway and Transportation Officials (AASHTO) in Atlanta. **Leo** was presented with the coveted Alfred E. Johnson Achievement Award for outstanding performance in mid-level management. **Leo** is well known around the Department as a clever troubleshooter for exotic ailments of anything that plugs into an electrical outlet, and his expertise has saved many Divisions a lot of time and money. He's also known as a man who can't say 'No' to a problem. **Leo** has developed many sophisticated electronic instruments for M&T that have contributed significantly to our success. The award couldn't have been given to a nicer, more deserving person. The other two Michigan honorees were former Director **John P. Woodford**, and MDOT's Deputy Director for Aeronautics, **William E. Gehman**. All three men were recognized for their contributions to the nation's total transportation picture.

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