IMPACT AND STATIC LOADS ON ROAD SLABS

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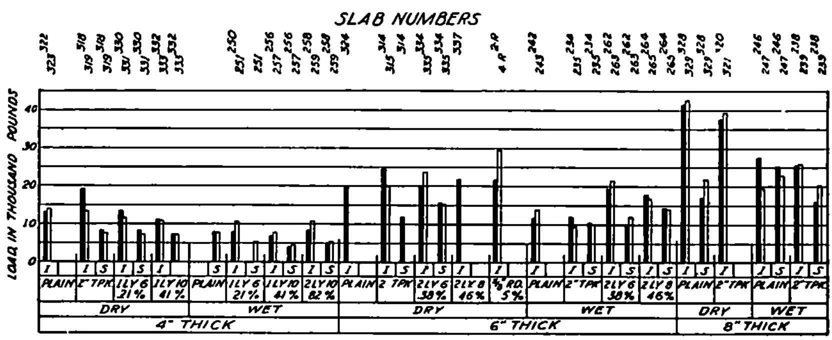
A rather elaborate series of tests on road slabs (7′x7′) has been completed, the results of which give a fair indication of their relative load resistance and the stresses developed under both impact and static loads A full report of this series of tests, giving results for impact load conditions, is given in Public Roads, April, 1924. Since that report was made, some of these same slabs have been tested under static loads, a report of which is given in Public Roads, November, 1924 Figure 1 shown here gives the resistance of a representative lot of these slabs for both impact and static loads, and some of the important conclusions are as follows

The resistance of the road slab depends in part upon the supporting value of the subgrade. A subgrade of high supporting value materially increases the resistance to impact pressure



COMPARISON OF SLABS FOR IMPACT AND STATIC LOADS

LOAD APPLIED
▮ - EDGE .
▯ - CORNER

1 1½ 3 CONCRETE
I - IMPACT
S - STATIC

FIGURE 1

Impact resistance of rigid slabs varies neither directly as the depth of the slab nor as the square of the depth, but as some function less than the square of the depth

In general, plain concrete slabs show no more resistance to impact delivered at the edge than to impact delivered at a corner, that is, corner and edge resistance on an average show them to be about equal

Plain concrete of 1 3 6 mix offers resistance to impact ranging from about 60 per cent to 80 per cent of the resistance of plain concrete of 1 1½ 3 mix The lean mix also shows more variation in strength.

Reinforcing steel in concrete slabs, if present in sufficient amount and so placed as to receive tensile stress, adds to the resistance of the slab to impact It is of interest, however, to note that fabric reinforcing is more effective under impact loads than under static loads

For a given percentage of steel, small deformed rods closely spaced seem to be more effective than large deformed rods widely spaced.

There is very little evidence of cushioning by bituminous tops on concrete bases at temperatures of 90° F or less.

In all cases the slabs offered a greater resistance to impact than to static loads, the average ratio of impact to static being 1 99 for slabs on dry subgrade, and 1 13 on wet subgrade This ratio for concrete slabs with fabric reinforcing on dry subgrade is 1 55, and on wet subgrade is 1 56.

Concrete slabs (1 1½ 3) were not strengthened by the addition of a 2-inch bituminous top for either impact or static loads, with the possible exception of a 4-inch and 6-inch base on the dry subgrade. Lean concrete, 1 3 6, on a wet subgrade, is reduced in strength by a 2-inch bituminous top because of some tendency to disintegration of the concrete

In addition to the above general conclusions some important observations and explanations should be made First, some variations in the comparative results between impact and static load should be expected, because of the slight difference in the subgrade moisture or supporting conditions existing at the time of the different tests The conditions on the wet subgrade were practically identical, but the moisture content on the dry subgrade was somewhat higher at the time of the static tests than it was during the impact tests. It is reasonable to expect, then, that the static load resistance would be somewhat lower Furthermore, for the static load tests we should expect some erratic results because of the more or less damaged conditions of the slabs resulting from the impact tests.

The impact resistance of a plain concrete slab is greater on a dry subgrade, but the maximum impact fiber stress at breaking is approximately the same on the dry and the wet subgrades Some of these results are shown in the following table.

TABLE I

Slab No	Mix	Thickness	Height of drop	Maximum impact pressure on slab at failure	Maximum impact stress	Maximum static stress
		Inches	*Inches*	*Pounds*	*Pounds*	*Pounds*
	Dry subgrade					
326	1 3 6	6	0 54	18,300	766	
324	1 1½ 3	6	0 68	20,000	1,310	
328	1 1½ 3	8	1 15	41,500	1,430	740
	Wet subgrade					
244	1 3 6	6	0 48	9,200	618	300
242	1 1½ 3	6	1 06	11,650	1,220	900
246	1 1½ 3	8	1 53	27,100	1,440	1,100

This equal stress condition on the two subgrades, under higher impact loads on the dry subgrade and the lower impact loads on the wet subgrade, is explained by the fact that the bending is much greater on the wet subgrade than on the dry subgrade It is interesting to note the high fiber stresses under impact loads in comparison with those under static loads

Another important observation gained from these impact results (shown briefly in Table I) is that the height of drop of the same wheel is less for the dry subgrade and gives higher impacts than on the wet subgrade A slab on a soft or wet subgrade will bend and deflect more, and thus offer greater cushioning to impact than a slab on a dry or hard subgrade Thus the falling mass, or wheel, is brought to rest much more quickly on the rigid slab and subgrade condition, with the result of a higher impact, or, in other words, the height of drop may be greater on the wet subgrade condition and the resulting impact be less

INVESTIGATION OF MOTOR TRUCK IMPACT

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This investigation is being carried on by the U S Bureau of Public Roads in cooperation with The Rubber Association of America and the Society of Automotive Engineers under the direction of a committee comprised of representatives of these organizations The objects are as follows

1 Determination of cushioning effect as influenced by tire design rubber composition, road surface roughness, load, speed, and truck design
2 Determination of stresses in slabs as influenced by motor wheel impacts

PROCEDURE

In the measurement of cushioning properties of tires, the part of the investigation concerned in this progress report, test trucks equipped with measuring apparatus are driven over special road sections and the impacts are computed by formula

TEST ROAD SECTIONS

The three roads used for this purpose are about 500 feet long and can be described as follows

1 Section of rough granite block pavement having an indicated vertical variation of 90 9 inches in 500 feet of length
2 Section of smooth concrete pavement having a vertical variation of 12 4 inches in 500 feet of length
3 Section of smooth concrete on which are set various types and heights of obstructions

Tests on sections 1 and 2 disclose the number and magnitude of impacts encountered in ordinary driving, while those on section 3 are