dust exceeds a certain percentage. Stone being supplied under contract is also tested from time to time, to ascertain if the quality is being maintained. The results of this test have been found of the greatest value in determining the wearing qualities of paving stone and also for macadam. After careful observations over a period of upwards of five years it is found that the comparison between the test results and those of conditions of actual wear is most remarkable.

The standard size of setts used in Belfast is 4 in. square on head and 6 in. in depth, truly dressed on all surfaces so that the setts can be paved on either end; the setts must be squared and dressed to the exact measurements (4 in. by 4 in.), and the variations in depth must not exceed one quarter of an inch. The 4-in. square sett on the surface affords greater foothold for horses, whilst, as compared with cubes, the extra 2-in. depth in the sett secures greater power of resistance to the rolling action of the traffic, and breaking of the bond. The setts are paved upon an inch bed of compo formed of four parts of gravel and one part of cement, and again grouted with compo of the same strength. Seven days are allowed for the jointing to set before the traffic is permitted to pass over the new paving. The camber of a settpaved roadway should not be greater than I in 50. In some cases the sett paving is grouted with a mixture of pitch and tar. This has the advantage of allowing the traffic to pass over the roadway as soon as the jointing has become thoroughly hardened, but owing to the varying quality of pitch there is considerable risk of the joints not wearing satisfactorily over long periods. The cost of laying sett paving on concrete foundations is 15s. per square yard, without the foundations 105. per square yard.

Wood paving .- Wood paving, like sett paving, should be laid upon a bed of concrete, and in the case of wood paving the surface of the concrete must be truly floated in cement to correspond with the finished contour of the roadway, and the wood blocks directly laid on to the cement surface. The sizes of wood blocks, as laid in Belfast, are 9 in. x 41/2 in. x 3 in. All blocks must be of thoroughly well seasoned wood, free from shakes or other defects, and cut square to exact sizes by machinery. The blocks before being laid should be dipped to a depth of half an inch in a mixture of pitch and tar or creosote oil, and an expansion joint left on either side alongside the curb to allow for the expansion of the wood when the roadway becomes moist. The width of expansion joint allowed is approximately one- ninetieth the width of the paving. To prevent the space being filled with dirt or moisture the joint is loosely closed in with puddled clay.

The author has used both cement and pitch for grouting wood paving, with satisfactory results in both cases; but in some instances, owing to the pitch mixture not being sufficiently hard, with the vibration of the traffic in hot weather, the grouting has worked downwards and forced its way under the lower surface of the blocks, thereby raising individual blocks above the normal level of the roadway. The advantage of pitch as against cement is that the pitch will more rapidly adjust itself to the expansion and contraction of the wood paving, whilst a cement joint has no means of doing this after the bond is broken, and the moisture, therefore, more readily finds its way into the surface of the roadway. Again, the traffic can be at once allowed to pass over the roadway as soon as the pitch grouting has cooled, whilst it is necessary for seven days to elapse to allow the cement grouting to become thoroughly set. The author's experience in the case of hardwood paving (karri and jarrah) has been that the expansion and contraction are greater and more difficult to deal with than in the case of softwood (Baltic redwood). The cost of hardwood paving

is 175. per square yard, whilst softwood costs 155. per square yard, including foundations in both cases.

Bituminous asphalt paving.—This should be laid on a sound bed of concrete truly finished to correspond with the surface of the roadway. For heavy traffic a coating of two inches of asphalt should be laid, and care should be taken in spreading, where joining up to asphalt already hardened, to thoroughly make good the jointing in order to prevent fractures appearing in the road surface after the work has been finished. The cost of a 2-in. surface of bituminous asphalt paving is 15s. 6d. per square yard, including foundations.

Life of various methods of road surfacing.—Waterbound and tar macadam should in no case be laid on roadways, in large cities, called upon to withstand the heaviest forms of traffic. For suburban roads and in side streets with light traffic both methods of surfacing will be found suitable. The life of a properly formed macadam road surface on good foundations will vary from one to five years, or under favorable conditions even longer, according to the nature and volume of traffic passing over it, and also to a certain extent to the conditions of weather. The increased durability of tar macadam over waterbound macadam on good foundations may be taken in the ratio of three to one.

The life of paved roadways on concrete foundations of best materials and workmanship may be set out as follows: Sett pavement, fifty years (setts supplied to Belfast Standard specification once repaved lower end upwards during this period); hardwood pavement, twelve years; softwool, nine years; bituminous asphalt, fourteen years.

Cost of various methods of road surfacing.—Owing to the varying durability of the different methods of road surfacing—in considering the question of cost—it is necessary to determine a period which will afford a fair and proper comparison between one class of road surface and another. For this purpose the author proposes to adopt a period of fifty years. In dealing with leading macadam roads it is estimated the increased cost of maintenance and cleansing will, in the course of fifty years, vary from 50 to 100 per cent. more than at the present time, due to the increase of wear and tear in consequence of the growing volume and weight of the traffic year by year, and also to the probable increase in the cost of labor and materials in time to come.

## CORRELATING SIDEWALK GRADE TO CURB GRADE.\*

## By Clark C. Anderson, City Engineer, Moline, III.

There was, once upon a time, a negro—quietly and expeditiously satisfying his voracious thirst for nature's own nectar, in a melon patch not his own, when the farmer's dog arrived. He had no more than placed a convenient fence as a barrier between himself and the dog when he discovered sand fleas creeping up his legs. With a yell he mounted the highest rail of the fence, and carefully drawing up his legs, sat there ruminating about as follows: "What's I gwine do now? I done los' my melon, dat dawg an' his boss will suah git me if I stays heah, an' I caint git home 'thout goin' froo dem fleas?"

So with the engineer and the sidewalk grade problem in localities where the topography of the city is markedly irregular. He may find escape from the greater isolated problems which may face him, for he has but one proposition at a time to deal with, and his wit may save him. The

\*Paper presented at meeting of American Society of Municipal Improvements, Erie, Pa.