generally a result of several such contributing causes. The writer believes that the considerable weakening produced by the saturation of dry concrete has invariably been a contributing factor in all those instances in which there was an active wetting of dry or partly dry concrete when subjected to essential stresses.

This general proposition furnishes one more evidence of the remarkable responsiveness of concrete to variations in its treatment. The fact that differences in control (which to the average artisan are seemingly unimportant) actually do exert a positive influence on its essential characteristics, constitute a definite warning against entrusting it to the uncertainties of irresponsible or skeptical supervision, and assures ample reward for a competent control which is correctly adapted to develop its capabilities. The susceptibility of steel to the influence of phosphorus and sulphur, of details of its heat treatment, and of other conditions occurring in the process of its manufacture, have resulted in restricting its production to the scrutiny of expert superintendence. Equal reason exists for, and commensurate advantages will follow, a thoroughly discriminating control of both the initial fabrication of concrete, and the details of treatment during its hardening, in order to realize the great possibilities inherent in this newer material.

The treatment of steel is not always complete as it comes from the rolls, as is shown by such effects as the changes in strength produced by the cold-twisting of steel rods; much more important in relation to the resulting quality of concrete is the nature of its treatment after fabrication, both because its attainment of strength is a relatively slow process and for the reason that the nature of the prevailing conditions provided during this period affects so greatly the development of its essential properties.

The notable responsiveness of concrete to the character of its treatment is a direct appeal for thoroughly trustworthy and expert control.

WATERPROOF CONCRETE.

In connection with preparations for the construction of a new lighthouse in Germany, some interesting experiments were carried out in the direction of waterproofing concrete. Various mixtures of cement and fine sand, in ratios of from 1 to 1 to 1 to 6, and mixtures of 1 to 3, with the addition of various materials, as soft soap, were moulded into pot-shaped vessels about 15 in. high with 2½ in. walls. When these pots had set, some of them were filled with water and others, empty, were placed in water, and the density of the walls was judged by noting the time required to empty or fill, the water acting under a maximum head of about 10 in. It is curious to note that a satisfactory degree of imperviousness was not reached, since in every test the vessels emptied or filled within one hour. The relative success of the richest mixtures then induced tests of rich-rubbed surfacing. To this end the surfaces were first wetted, then thickly coated with cement paste, and with a soft brush the cement was rubbed well into the surface of the concrete. This procedure was repeated a number of times, until the pores were closed, and a satisfactory degree of imperviousness was then reached, as the pressure tests, continued for three days, showed that no water penetrated through the walls of the pot. It was the success of this method that decided the authorities upon building the lighthouse of concrete made impervious in the manner outlined above.

A RATIONAL FORMULA FOR ASPHALT STREET SURFACES.*

By J. Alden Griffin, Assoc. M. Am. Soc. C.E.

EVERY now and then the question is raised: "What is the proper crown to give an asphalt street?" and there is a discussion as to which of the many formulas of to-day gives the best results.

Having been asked this question many times in the past few years, and especially while connected with municipal improvements in Los Angeles, Cal., the writer has given the matter careful investigation, and, by a comparison of the surfaces proposed by the various formulas, has arrived at the conclusion that the crown rise should vary with the cross-fall as well as the grade of the roadway, and that a crown considerably lower than that proposed by the well-known formula of the late Andrew Rosewater, M.Am.Soc.C.E., should be used on streets having a cross-fall between the gutter grades. The writer even favors one which is slightly lower, where there is no cross-fall in the roadway; and, having reached these conclusions, he proceeded to determine the proper amount of reduction to make in the crown for varying cross-falls. After a great many experiments he adopted the following modification of Mr. Rosewater's formula. This gives the best results, using one-eighth of the cross-fall plus ¾ in. as the reduction factor, but some may wish to change $0.12H$ in the formula to $0.10H$, or even $0.08H$, in order not to reduce the crown quite so much; however, the following is recommended:

TABLE 1.

Width of roadway, in feet.	Percentage of grade on street.	Crown, with no cross-fall.	Crown Rise, for Variable Cross-Falls, in Feet.											
			0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
28	1	0.48	0.45	0.42	0.39	0.36	0.33	0.30	....	....	....	....	....	....
28	2	0.45	0.42	0.39	0.36	0.33	0.30	0.27	....	....	....	....	....	....
28	3	0.43	0.40	0.37	0.34	0.31	0.28	0.25	....	....	....	....	....	....
28	4	0.41	0.38	0.35	0.32	0.29	0.26	0.23	....	....	....	....	....	....
28	5	0.39	0.36	0.33	0.30	0.27	0.24	0.21	....	....	....	....	....	....
34	1	0.59	0.56	0.53	0.50	0.47	0.44	0.41	0.38	....	....	....	....	....
34	2	0.57	0.54	0.51	0.48	0.45	0.42	0.39	0.36	....	....	....	....	....
34	3	0.54	0.51	0.48	0.45	0.42	0.39	0.36	0.33	....	....	....	....	....
34	4	0.51	0.48	0.45	0.42	0.39	0.36	0.33	0.30	....	....	....	....	....
34	5	0.48	0.45	0.42	0.39	0.36	0.33	0.30	0.27	....	....	....	....	....
40	1	0.71	0.68	0.65	0.62	0.59	0.56	0.53	0.50	0.47	....	....	....	....
40	2	0.68	0.65	0.62	0.59	0.56	0.53	0.50	0.47	0.44	....	....	....	....
40	3	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.40	....	....	....	....
40	4	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.40	0.37	....	....	....	....
40	5	0.58	0.55	0.52	0.49	0.46	0.43	0.40	0.37	0.34	....	....	....	....
46	1	0.82	0.79	0.76	0.73	0.70	0.67	0.64	0.61	0.58	0.55	....	....	....
46	2	0.79	0.76	0.73	0.70	0.67	0.64	0.61	0.58	0.55	0.52	....	....	....
46	3	0.75	0.72	0.69	0.66	0.63	0.60	0.57	0.54	0.51	0.48	....	....	....
46	4	0.71	0.68	0.65	0.62	0.59	0.56	0.53	0.50	0.47	0.44	....	....	....
46	5	0.68	0.65	0.62	0.59	0.56	0.53	0.50	0.47	0.44	0.41	....	....	....
56	1	1.01	0.98	0.95	0.92	0.89	0.86	0.83	0.80	0.77	0.74	0.71	....	....
56	2	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.70	0.67	....	....
56	3	0.93	0.90	0.87	0.84	0.81	0.78	0.75	0.72	0.69	0.66	0.63	....	....
56	4	0.88	0.85	0.82	0.79	0.76	0.73	0.70	0.67	0.64	0.61	0.58	....	....
56	5	0.84	0.81	0.78	0.75	0.72	0.69	0.66	0.63	0.60	0.57	0.54	....	....
62	1	1.13	1.10	1.07	1.04	1.01	0.98	0.95	0.92	0.89	0.86	0.83	0.80	....
62	2	1.08	1.05	1.02	0.99	0.96	0.93	0.90	0.87	0.84	0.81	0.78	0.75	....
62	3	1.03	1.00	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.70	....
62	4	0.98	0.95	0.92	0.89	0.86	0.83	0.80	0.77	0.74	0.71	0.68	0.65	....
62	5	0.93	0.90	0.87	0.84	0.81	0.78	0.75	0.72	0.69	0.66	0.63	0.60	....
72	1	1.32	1.29	1.26	1.23	1.20	1.17	1.14	1.11	1.08	1.05	1.02	0.99	0.96
72	2	1.27	1.24	1.21	1.18	1.15	1.12	1.09	1.06	1.03	1.00	0.97	0.94	0.91
72	3	1.21	1.18	1.15	1.12	1.09	1.06	1.03	1.00	0.97	0.94	0.91	0.88	0.85
72	4	1.15	1.12	1.09	1.06	1.03	1.00	0.97	0.94	0.91	0.88	0.85	0.82	0.79
72	5	1.09	1.06	1.03	1.00	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73

$$C = \frac{W\,(100 - 4\,p)}{5{,}000} - (0.12H + 0.06)$$

in which W = the width of the roadway between curbs, in feet; p = the percentage of grade longitudinally on the street; H = the cross-fall of the street, or the difference of elevation between the high and low gutters, in feet,

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