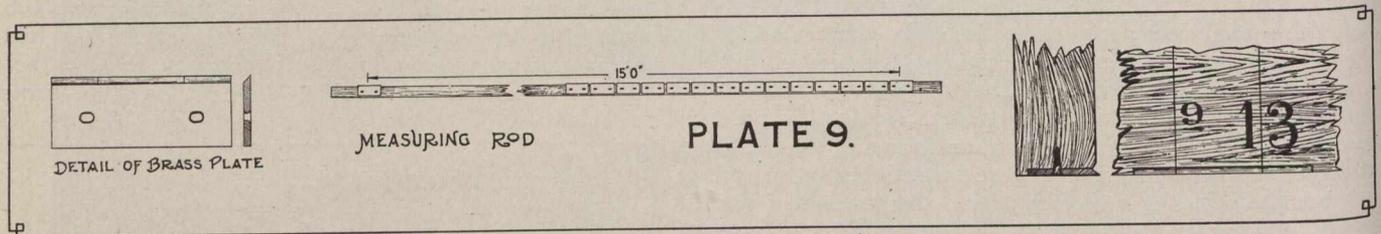


measurement of the centre line would be distributed on both banks, instead of being thrown upon one.

It might be mentioned that the actual work in connection with the laying out of the substructure was commenced during September, 1907, and at that time no detailed plans of the structure were available. Therefore, it was not safe to figure on any small errors in the total length of the viaduct being taken up by the erection of steel. It was therefore decided that nothing would be left undone in the matter of securing a correct chainage throughout the whole length of the bridge, and that

which to graduate the measuring rod for 15-ft. measurements. A suitable piece of ground was found, and a heavy 12 x 12-in. post about six feet long, was set into the ground about five feet, and so the top projected 12 in. above the ground, and a similar one was placed at the 90-ft. mark. Between these, other smaller stakes were firmly fixed, and on these 2 x 4-in. scantlings were nailed so that a straight line could be run on the level surface. The scantlings were left free from the 12 x 12-in. end posts so that any contraction or expansion caused by differences of humidity would not affect the main hubs



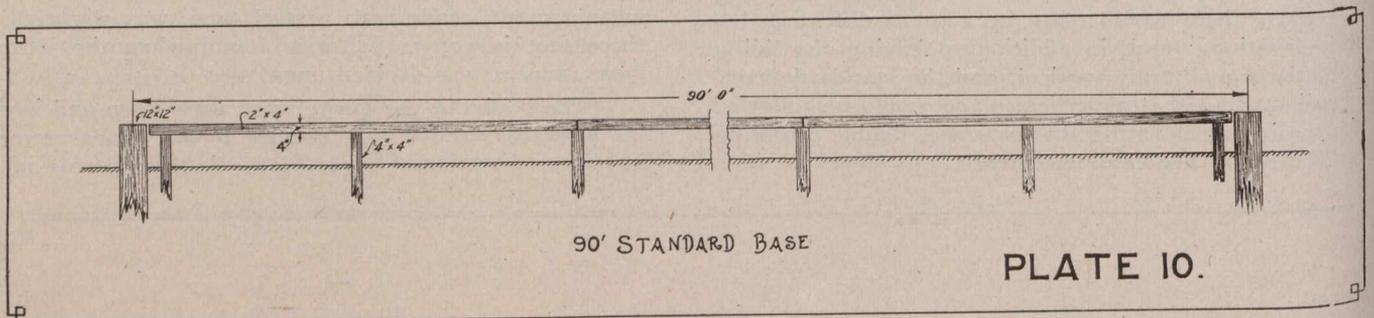
nothing in the way of laying out of the different piers or bents should be done until this length was finally decided upon.

A method of measuring was then to be adopted. An unsupported steel tape was considered of little value on account of the prevalent high winds. (It should be mentioned here that the laying out of the work was commenced during a windy period which lasted till late the following April.) Neither was it considered advisable to use a supported tape for the reason that this method was not considered practicable. Therefore, on account of the wind and fluctuations in temperature, something less sensitive to both was required, and a graduated wooden rod was chosen.

A well-seasoned piece of cedar, 16 ft. long, 2 x 4-in. in section was obtained, and dressed to $1\frac{1}{8}$ x 3 in. A supply of brass plates $2\frac{1}{2}$ in. long, 1 in. wide and about $\frac{3}{32}$ of an inch in thickness, bevelled on one long side, were made and set into the rod to receive graduations. About three inches from the end of the rod, the first one

on which the 90-ft. standard base was made. See Plate 10. A fine brass tack or brad, similar to those used by a shoemaker, was placed in the first post and a fine scratch made across its face. This was the zero of the standard 90-ft. base. The 90-ft. tack was set after having the tape stretched with the proper tension, calculation having been made for error in tape, also for difference of temperature, and marked as was the zero end by making a very fine scratch across the tack. Tacks were then lined in on the scantling edge that had previously been used to support the tape, and at 15-ft. intervals.

The 15-ft. mark was made very lightly on the proper plate on the measuring rod, as accurately as could be done with the steel tape. The measurement of the 90-ft. base was then attempted with the rod, and the 15-ft. graduation changed till six lengths of the rod exactly reached the 90-ft. mark on the standard base. When this was accomplished, the rod was considered correct at its 15-ft. length. The other graduations were put on



of these was placed so that the bevelled edge projected about $\frac{1}{32}$ of an inch, and so that the surface of the plate was flush with the surface of the rod. See Plate 9 for details. This was marked with a very fine scratched line terminating at the bevelled edge, and designated zero. A plate was then put on at the 12-ft. mark, and from this point to the end of the rod, plates were put on at intervals so as to receive graduations at every tenth of a foot from the 12-ft. mark to the end of the rod.

A 100-ft. steel tape was procured, and compared with the standard of the company. Supported throughout its entire length at a temperature of 70 deg., with a 10-pd. pull, it was found to be 100.025 ft. in length. From this it was desired to establish a 90-ft. base from

by use of the common engineers' boxwood scale. The intention in measuring the length of the bridge was to place stakes at 15-ft. intervals, thereby using the 15-ft. graduation, as it was considered the more accurate of the graduations. Stakes were placed at other intervals from 12 feet to 15.5 feet only when it was impossible to place the regular 15-ft. stakes. The rod was also fitted with a reliable level bubble.

The measurement of X to C was then attempted, and the ground being fairly even and level, it was possible to measure horizontally, and without the use of a plumb-bob with one or two exceptions. Stakes were carefully lined in, stationed at 15-ft. centres, and levelled at the same time. After about five hundred feet of the