PIER No. 7.

Masonry, 434 c. yards	1,816,290 lbs.
Timber footing	100,000 "
Truss	207,900 "
Moving load, 100 feet	280,000 "
Total	2,404,190 "

73 piles ; weight per pile, 32,934.11 lbs.

RESISTANCE AGAINST ICE.

The shock imparted to a pier by the impact of ice, depends upon the size of the cake, the speed of the current, and the time occupied in bringing it to rest ; if a small cake could be stopped instantaneously, it would impart a sufficient shock to move the largest pier a distance proportional to their relative size, but as the cake is always more or less shattered by the blow, it moves a greater or less distance after it strikes, and the time which it continues to move, or, measuring this motion by distance, the distance which the pier ploughs into the field of ice reduces and determines the force of the impact. The greatest shock which a pier will be called upon to sustain might be calculated from these conditions, but can be more readily estimated by measuring the force of a blow which will crush the ice along the whole width of a pier. Sound ice begins to yield under a pressure of 200 pounds on the square inch, and is crushed to atoms when this pressure is increased to 450 pounds, as was ascertained by experiments made on these works. When the ice breaks up at Kansas City it is seldom more than one foot thick, and the upper part is always so soft and rotten that one foot may be estimated as the maximum thickness of solid ice. Piers 1 and 3 finish eleven feet thick at an elevation of 112, fifteen feet above extreme low water ; this is probably some feet higher than the ice ever moves ; the amount of masonry above this elevation is 405 yards, which, with the portion of the truss carried by Pier No. 1, weighs, estimating the masonry at 4,000 lbs. to the cubic yard, 1,751.500 lbs. The crushing shock on eleven square feet at 450 lbs. to the square inch is 712,800 lbs., and the ratio of this shock to the weight that must be moved to disturb the pier is .4175, or less than the coefficient of friction of stone on stone ; the piers are therefore sufficiently heavy