pressure on each foot of perimeter 7,360 pounds, a weight which a timber wall at least fourteen inches thick and eleven feet wide would easily carry over the distances between the three cross-walls.

The planking of the caisson used for Piers 3 and 5 was not dressed, and the roughness of the timber increased the friction about one-quarter, changing formula (*g.*) to

$$F = 10h^2. \qquad (i.)$$

The available weight was in each of these cases barely enough to overcome this friction, which accounts for the slow progress of the sinking and the interruptions caused by sand-slides. The greatest available weight of the caisson at Pier No. 3 was about 700,000 lbs., which is equivalent to the friction produced by 21.25 feet of sand, the perimeter of the caisson being 155 feet; though this was greater than the actual average depth of sand, the excess was too small for advantageous work. At Pier No. 5, on the 2d of July, 1868, the effective weight for each foot of perimeter of the caisson was 2183.5 pounds; the average depth of the surrounding sand was then 15.5, corresponding to a friction of 2402.5 pounds per horizontal foot; this deficiency was remedied by piling sand above the caisson, but the weight was always too small for good results. It may be noted, that a caisson whose weight is barely greater than that of the water it displaces, may be sunk by long-continued dredging; the amount of sand excavated will be many times the capacity of the caisson, but, as the external sand slides down and passes under the edge, it will slowly carry down the caisson.

The relation between weight and friction at Pier No. 4 is most plainly shown by the tables in Appendix E; the friction per square foot of rubbed surface, computed by formula (*g.*), is added to these tables for convenience in showing this relation. The advantage of having a sufficient excess of weight to cause the cutting edge to penetrate well into the sand, cannot be overestimated : it aids in feeding the excavators, reduces the amount of excavation, and precludes sand-slides.

PRESSURE ON FOUNDATIONS.

The pressure upon the foundations of the seven piers is given below. In these computations the masonry is assumed to weigh 155 pounds per cubic foot,