(*Paper No. 2365.*)

"Underpinning Great Yarmouth Town Hall."

By FREDERIC ELIOT DUCKHAM, M. Inst. C.E.

THE new block of municipal offices and law courts at Great Yarmouth was opened by H.R.H. The Prince of Wales, in 1882.

The new structure was 132 feet by 108 feet by 50 feet high to the parapet, with a clock-tower 110 feet high. The whole weighed 5,000 tons, and the cost was £30,000. It was built partly upon, and partly overlapping, the site of the old Town Hall.

The subsoil consisted of a gravel bank, underlying 16 to 18 feet of ooze, and 5 or 6 feet of made ground, into which the trenches were cut for the concrete foundations. The River Yare and its wooden quay-head were 70 feet distant from the west front of the new building.

The structure gave early indications of unequal subsidence; this continued, more particularly in wet seasons and at exceptionally low tides, until early in 1886 it approached the limit of safety, and steps were taken to underpin the worst portion by the insertion of concrete blocks beneath the foundation. The impracticability of removing the water from any trenches cut for this purpose, without at the same time jeopardizing the building, led to this attempt being abandoned, as also was the proposal to widen the foundations by the insertion of wrought-iron needles through the brickwork supported near the surface of the ground on the concrete blocks.

By November 1886, the west or river front of the building, when compared with the east side, was found to have sunk 12½ inches at its ends and 8 inches at its centre, and there were some fissures in it as well as in the north and south walls. The building had not only settled but leaned towards the river. The Town Council therefore resolved to demolish the western portion of the block with the view to its being re-erected on more stable foundations.

A scheme was then submitted to the Town Council by the Author, in conjunction with Mr. James E. Teasdel, Assoc. M. Inst. C.E., of Great Yarmouth, for providing a new foundation which would prevent the further subsidence of the western half of the building, and by means of which the portions which had settled most could be raised to the level of that which had settled least. This proposal also included the straightening and repair of the walls. These works were estimated to cost about half the money,

and to occupy one-third the time of the pulling down and rebuilding, previously suggested.

The prominent features of this scheme were:—1st. The insertion of cast-iron screw-piles at intervals of about 9 feet inside and outside the main walls (Plate 8, Fig. 1). These piles were to be about 23 feet long, screwed, say, 3 feet into the gravel bank, the metal to be $1\frac{1}{4}$ inch thick, the screw to be 12 inches greater in diameter than the piles and of 6 inches pitch, the piles when down were to be cleared of earth and filled with cement concrete. The diameters of the piles were to be 2 feet and 2 feet 6 inches, to carry an approximate weight of, say, 35 to 50 tons respectively; but it being stated that the soil of the district injuriously affected cast-iron, the diameters were increased to 2 feet 6 inches and 3 feet, that, in the event of the iron failing, the internal concrete columns might safely take the weight.

2nd. Double lines of rolled girders, D (Plate 8, Figs. 1, 3 and 7), were placed on top of the piles, with a $2\frac{1}{8}$-inch space between them and parallel with the walls.

3rd. Wrought-iron needles, E, 14 feet to 16 feet long, consisting mostly of rolled joists, 16 inches by 6 inches, with a top table added, of a length equal to the width of the original concrete and 12 inches wide, passed through under this concrete foundation at intervals of about 3 feet, to be suspended at each end by two 2-inch bolts, GG, from the before-mentioned girders D. The connections to be made by having a $\frac{3}{8}$-inch plate 15 inches square placed on top of the girders, DD, turned down to clip them, and having two 2-inch clearing holes punched therein. Two 7-inch wrought-iron washers, HH, $1\frac{1}{2}$ inch thick on this plate, and one spectacle-piece, 14 inches by 6 inches by $1\frac{1}{2}$ inch under the needle or cross-girder E. The bolts to have 12 inches of thread.

The tower, weighing 700 tons and having a base 20 feet square, to be somewhat differently treated. Five cylinders, two of 4 feet 6 inches and three of 5 feet diameter, to be sunk to the gravel as the adjacent walls permitted. The eastern and western walls of the tower, namely, those without openings on the ground floor, to be each sandwiched between a pair of massive lattice-girders below the floor level (Plate 8, Figs. 1 and 7). Needles of the section shown were to be inserted through the walls, and suspended from the upper member of the girders by four 2-inch bolts at each end. Two platforms of rolled joists were to be laid on the unequally placed cylinders to carry the ends of the four lattice-girders.

It was claimed that the insertion of the needles under the foundations and through the tower walls, and the tightening of

the bolts, would transfer the weight of the building from the unstable ground on to the screw-piles, and enable the sunken parts of the building to be raised to level lines, and that an excellent permanent foundation would be obtained at moderate cost.

This proposal of the Author and Mr. Teasdel was adopted, and a contract for the chief portion of the work was entered into with Mr. Thomas Gibson, Assoc. M. Inst. C.E.

The walls having been efficiently shored (Fig. 9), the trenches were cut and the first pile was pitched at the end of May 1887. As the work progressed, the whole western portion of the block and the tower became supported on a sort of gridiron of wrought-iron joists suspended from girders resting on the pile tops (Plate 8, Fig. 1). By a systematic and gradual screwing up of some suspending bolts more than others, the low parts of the building were lifted, the unsightly curves taken out of the walls, and the tower set upright.

The ground was then cleared to a depth of 2 feet under the old foundation of the walls, and the trenches were filled in with cement concrete, forming one mass encasing the pile tops, girders and bolts. The damaged places in the walls were cut out and made good, the floors replaced and the premises refitted for occupation within twelve months.

It should be mentioned that the lifting operation was so well regulated that even the enriched ceiling of the large Assembly Room was not injuriously affected thereby, and that the total cost of the work was well within the estimated sum of £8,250.

The Paper is accompanied by a tracing, from which Plate 8 has been prepared.

THE TOWN HALL, GREAT YARMOUTH.

METHOD OF UNDERPINNING AND LIFTING THE SETTLED PORTIONS OF THE BUILDING.

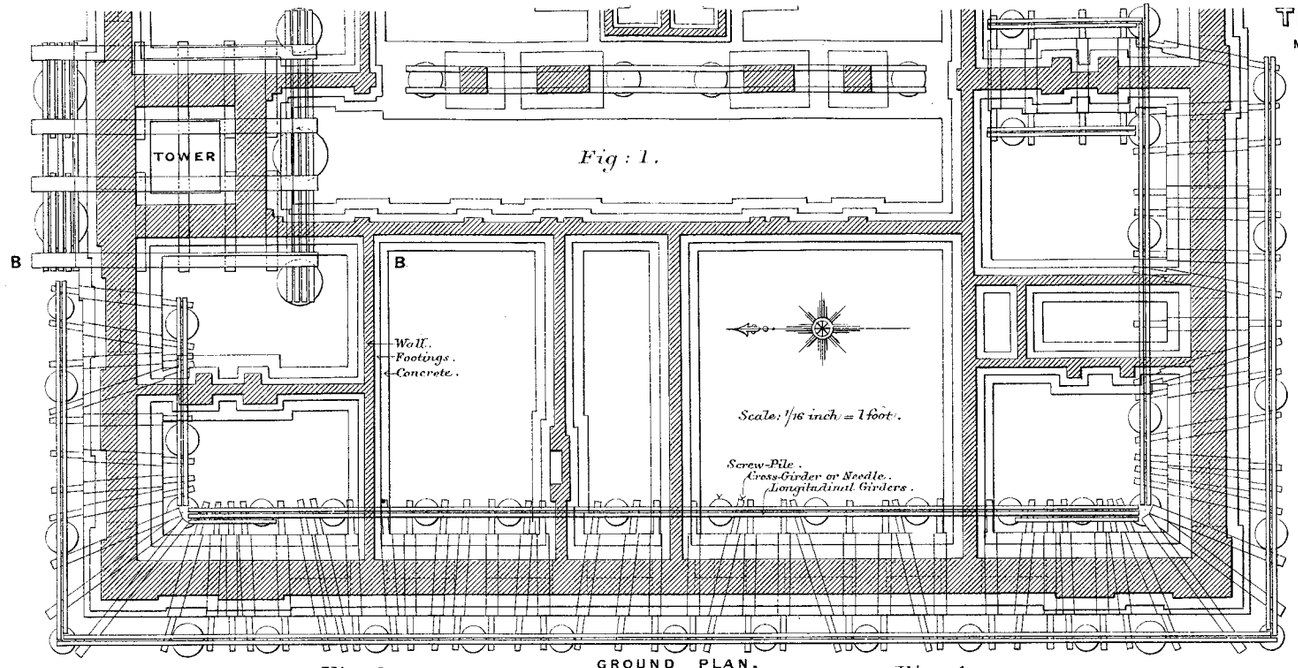

Fig: 1.

GROUND PLAN.

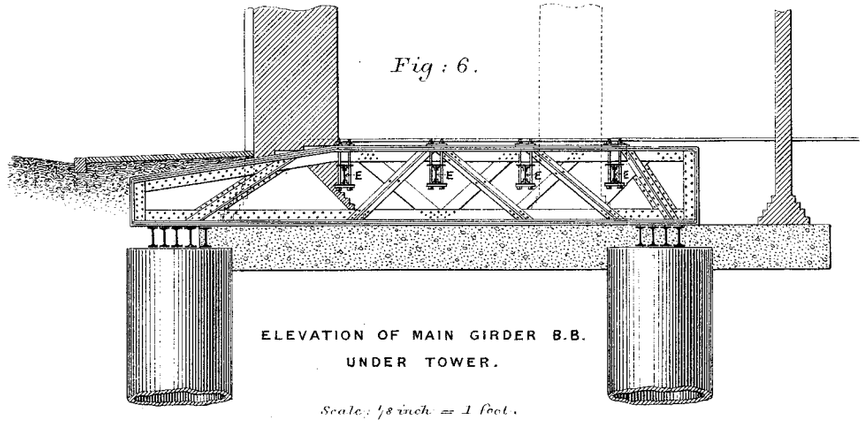

Fig: 6.

ELEVATION OF MAIN GIRDER B.B. UNDER TOWER.

Scale: 1/8 inch = 1 foot.

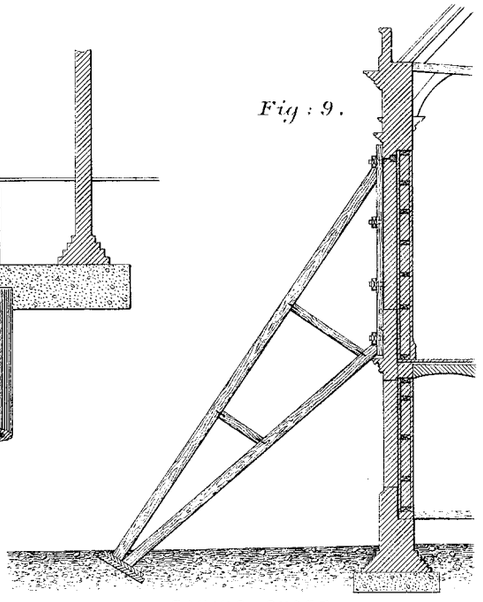

Fig: 9.

RAKING SHORE.

Scale: 1/16 inch = 1 foot.

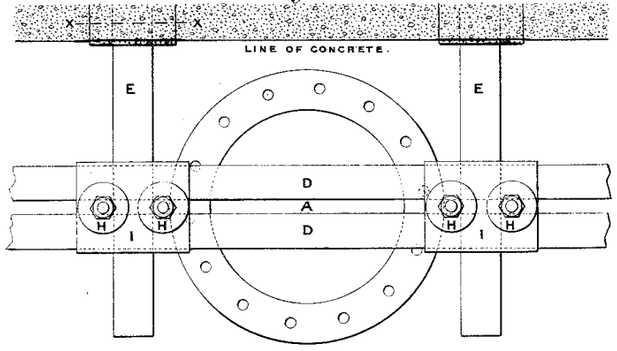

Fig: 2.

PLAN.

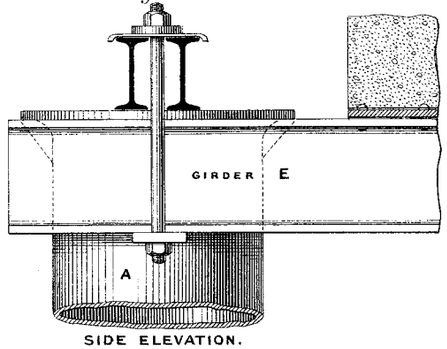

Fig: 4.

SIDE ELEVATION.

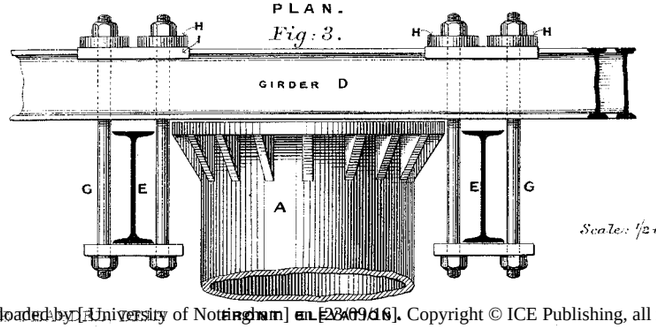

Fig: 3.

Scale: 1/2 inch = 1 foot.

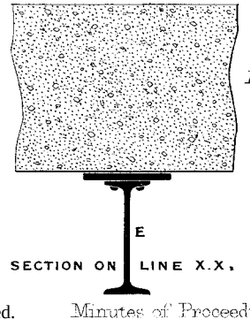

Fig: 5.

SECTION ON LINE X.X.

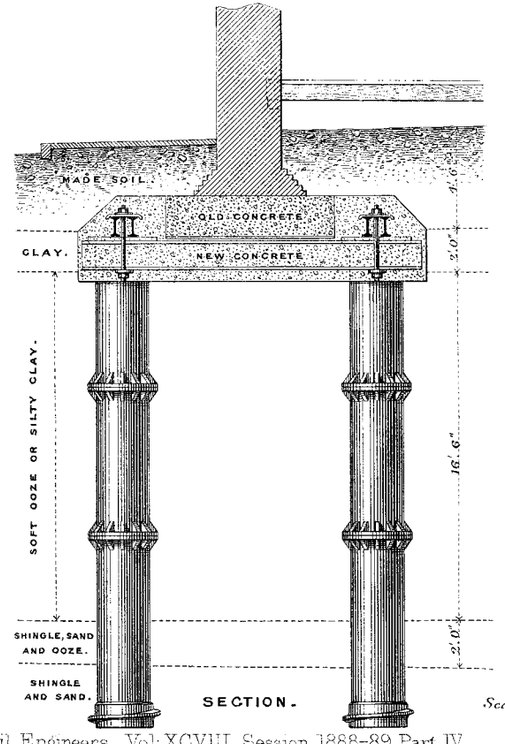

Fig: 7.

SECTION.

Scale: 1/8 inch = 1 foot.

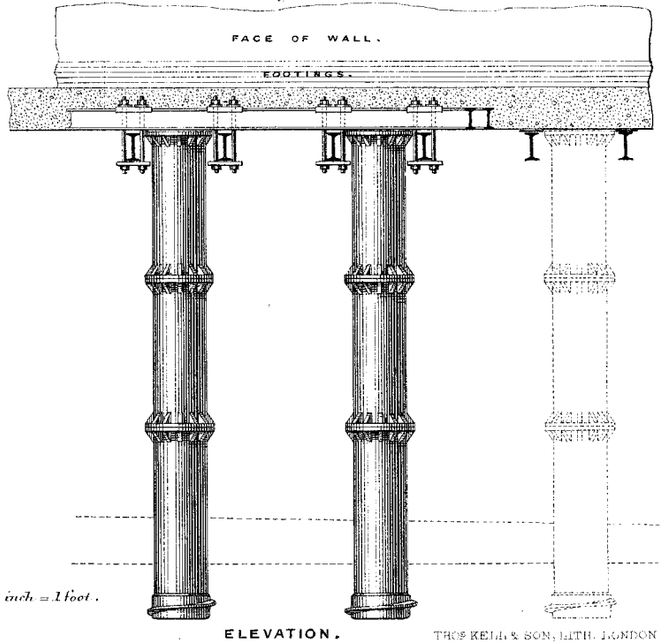

Fig: 8.

ELEVATION.

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