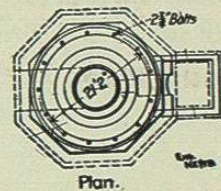


STEEL CHIMNEY AT THE RIDGE-
WOOD PUMPING STATION,
BROOKLYN, N. Y.

BUILT BY THE PHILADELPHIA ENGINEER-
ING WORKS, LTD., IN 1896.

The height from the ground is 217 feet, the minimum diameter is 8 feet, and the diameter at the base is 25 feet. It is lined with brick for one-half of its height. There are 137 plates in the structure, varying in weight from 800 to 1,400 pounds, and in thickness from $\frac{1}{4}$ to $\frac{1}{2}$ inch. The plates are of open-hearth steel, of 65,000 pounds tensile strength, with an elongation of 20 to 25 per cent. in 8 inches. An iron ladder extends from the bottom to the top of the shell. The chimney was erected in ten weeks. The work of erecting was done from an inside scaffolding which was raised as the work progressed. The cost was about \$10,000.



ILLUS. No. 4.

Let $W = 38000$ pounds assumed,

$$(45) \quad m = \frac{38000 \times 11}{2} = 209000,$$

$$T = M - m = 1546875 - 209000 = 1337875.$$

$$(46) \quad \text{Let } D_c = 12\frac{1}{2}, \text{ then } T_c = \frac{1337875 \times 6\frac{1}{2}}{5\frac{1}{2}} = 1520312.$$

(47) If 6 bolts are used, area of one bolt = $\frac{T_c}{27000 \times 12\frac{1}{2}} = 4.50$ square inches for present case.

(48) If 12 bolts are used, area of one bolt = $\frac{T_c}{54000 \times 12\frac{1}{2}} = 2.25$ square inches for present case.

Twelve bolts are the most convenient number to use, and if the base is made in 6 sections, 2 bolts will pass through each segment.

To ascertain the weight of the chimney, W , for the chimney being considered, the following thicknesses from the top down were used:

54 feet..... $\frac{3}{8}$ inch.	18 feet..... $\frac{3}{8}$ inch.
30 feet..... $\frac{1}{4}$ inch.	6 feet..... $\frac{1}{2}$ inch.
24 feet..... $\frac{5}{16}$ inch.	18 feet..... $\frac{3}{8}$ inch.

Base-ring.—The breadth of the base-ring can be readily determined by knowing the pressure on the base, but it is usually proportioned according to good practice, and with good judgment as accompanying conditions assist or compel.

STEEL CHIMNEY, GUYED, FOR AUGER & SIMON SILK DYEING COMPANY, PATERSON, N. J.

Flue 48 inches diameter by 125 feet high. Starting from the bottom with the foundation, which is 7 feet square at the bottom and 5 feet square at the top, 5 feet deep, 12 inches of which is out of the ground; the chimney rests on a cast-iron plate 5 feet square by $1\frac{1}{2}$ inches thick, having a rim 3 inches high inside of the shell of the chimney, this plate is held to the foundation by four $1\frac{1}{2}$ -inch bolts 4 feet long.

The shell is made in sections 5 feet $4\frac{1}{2}$ inches in height of plate, 5 feet centre to centre of joints, each vertical section being made of one sheet.

The lower 65 feet of the chimney is $\frac{1}{4}$ -inch thick steel; the upper 60 feet is $\frac{3}{16}$ -inch steel; the chimney has an ornamental cap of simple design.

All joints are double staggered riveting, $2\frac{1}{2}$ inches centre to centre of rivets.

The upper end of each section is put in place inside the lower end of the section above it.

The chimney is supported by four guy-ropes of $\frac{3}{4}$ -inch crucible-steel wire, six strands, 7 wires to each strand, laid about a hemp centre. These are strongly secured to the chimney at about 83 feet above its base and running from it to the ground, the ropes are made fast at about 80 feet from the base of the chimney to anchorages made of long pieces of 6-inch pipe placed in the ground at an angle of 45° , and the pipe has long timbers laid over it in the trenches to give large earth-bearing surface.

A turn-buckle is placed in each guy-rope for adjusting the tension of the same.

The chimney has stood well, and was erected in 1896.

A NOVEL WROUGHT-IRON CHIMNEY, CREUSOT, FRANCE.

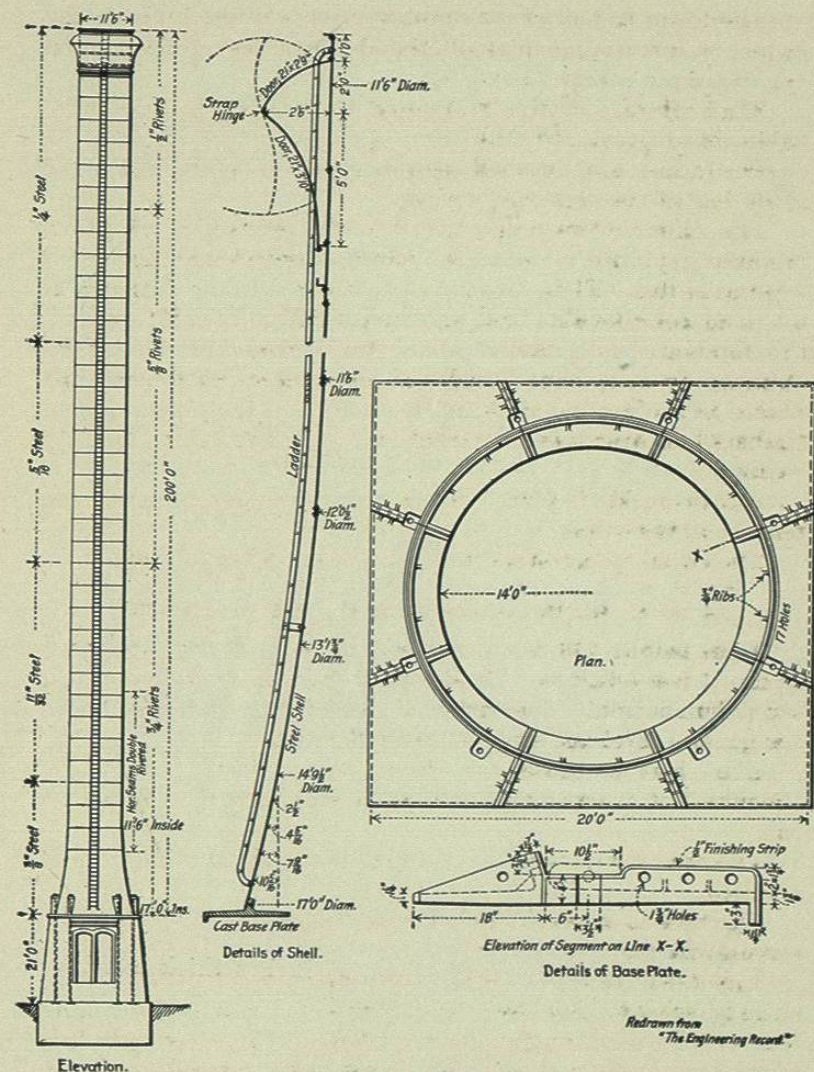
Total height, 279 feet; diameter at base, 23 feet; diameter at top, 7 feet 6 inches. Total weight, 80 tons, exclusive of masonry foundation. The latter is carried 3 feet 3 inches above the ground level and weighs about 300 tons.

The shaft is successive rings, each 4 feet 1 inch high. Thickness of sheets vary from $\frac{1}{8}$ inch at bottom to $\frac{1}{4}$ inch at top.

The nine lower rings have 8 plates in each, the upper ones 4 plates.

The base is encircled by a massive *angle-iron ring* bolted to the foundation.

Fire-brick lines the eight lower rings, or about 32 feet in height; seventy days were required for its erection including removal of scaffolding, which consisted of a 7-inch wrought-iron central tube provided with four cross arms of wood, made adjustable, resting on outer ends on plates, which arms carried the inner platform. The upper end of tube had four similar arms, from which was slung the exterior circular platform, which



ILLUS. No. 5.

A 200-FOOT STEEL CHIMNEY, WILMERDING, PA.

consisted of a pair of angle-iron rings to the outer edge of which was riveted a plate-iron fence, while the inner part was provided with T-iron stanchions.

Radial bearing timbers, resting on these rings, and adjustable endwise, to suit the varying diameters of the chimney, carried the plate, from an annular space left just sufficient for hoisting the plates.

The plates were hoisted by a rope passed over an adjustable pulley fixed to each jib in turn, and carried down a central tube to a snatch-block fixed at the bottom of the chimney.

The complete scaffold weighed about 4 tons, the heaviest plate about 800 pounds. Total cost of steel part of chimney and lining was about \$8,000.—*Engineering News*, May 10, 1890.

Westinghouse Air Brake Co., at Wilmerding, Pa. Steel chimney, 200 feet high; built by Riter & Conley, Pittsburgh, Pa.

The construction is shown very fully by the illustration on p. 67.

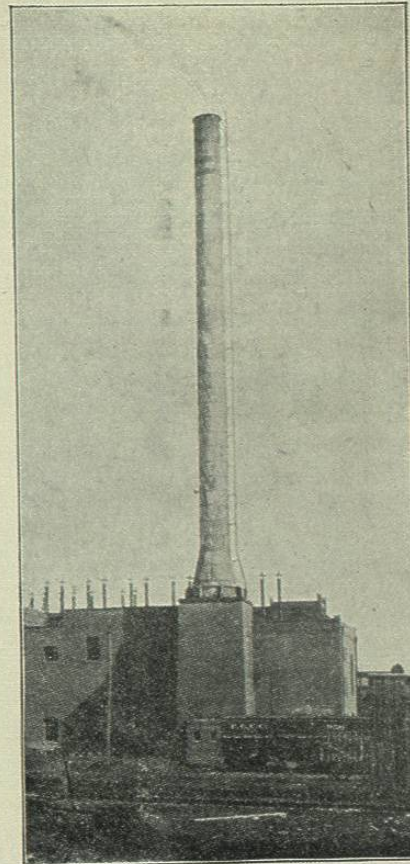
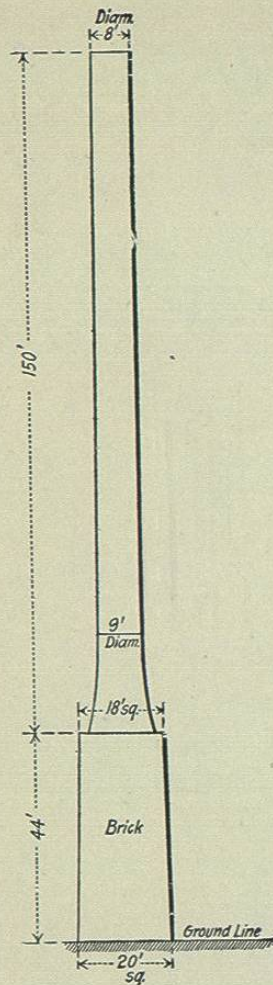
It was designed to resist a wind-pressure of 50 pounds to the square foot with a factor of safety of 4.

The material is punched and formed in the shops, and the principal riveting is done in the field.

The ladder was shipped in 15 or 20 foot lengths. The work was erected by using inside scaffolding, with a centre derrick for raising the sheets, and outside cages for the workmen which are hung on trolleys running on the edge of the shell.

These were raised by the derrick, as each course was added. When the chimney was finished it was painted from a swing carriage suspended from the trolleys which run on the Z bar underneath the top ornament.

Soot.—It is reported that soot $1\frac{1}{2}$ inches thick adheres to the interior of iron and steel chimneys.



ILLUS. No. 6.

CHIMNEY OF THE REFRIGERATING PLANT OF THE ANHEUSER-BUSCH BREWING ASSOCIATION, ST. LOUIS, MO.

Steel Sheets.

Lower 50 ft.— $\frac{5}{8}$ inch thick.

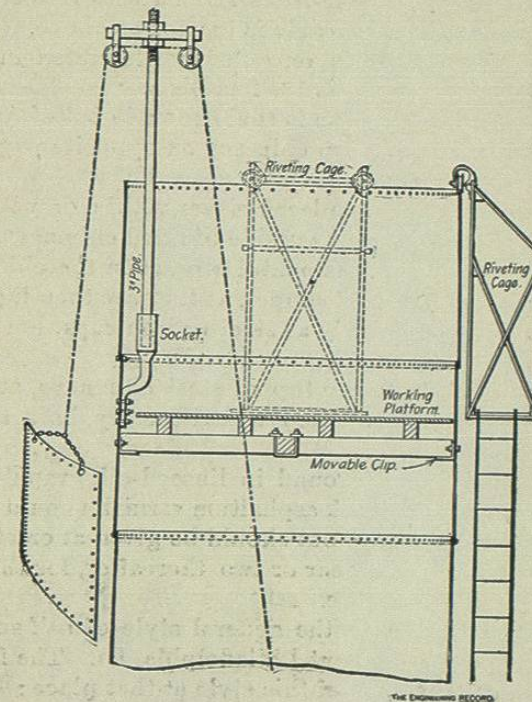
Middle 50 ft.— $\frac{1}{2}$ inch thick.

Upper 50 ft.— $\frac{3}{8}$ inch thick.

The chimney is lined with fire-brick 125 feet up.

STEEL CHIMNEY ERECTION.

The Anheuser-Busch Brewing Association chimney, illustrated on the opposite page, was erected by ten men, who were carried by means of the light apparatus shown in this cut.



Four small angles bolted to the shell already in place, carried six-inch cross timbers, which carries the platform from which the men work.

Double-flanged wheels running on the top of the sheet-metal of the shell carried two light cages holding the riveters on the outside.

SELF-SUSTAINING STEEL CHIMNEY.

In the design of bases for the chimneys of this type, bell shapes are not strictly adhered to, in some cases, steel cables containing turn-buckles are secured to a straight steel tube at the height of say three diameters of the flue, and secured to the bottom anchor-bolts as usually located for bell bases.

In other cases two angle-irons riveted with thin separators are placed where the wire cable is located as above.

Still another method is very clearly illustrated in the cut on page 75; this chimney is 164 feet high.

Still another type of base is that shown in cut of Anheuser-Busch Brewing Association chimney on opposite page, being a square hollow-brick shaft.

Ladders.—Ladders are placed either within or without unlined chimneys, but always outside of lined chimneys.

Ornamental Caps.—Ornamental caps, as in the chimneys illustrated, are best made of copper, as they are then lighter and do not rust away as quickly as steel or iron caps, but they are expensive.

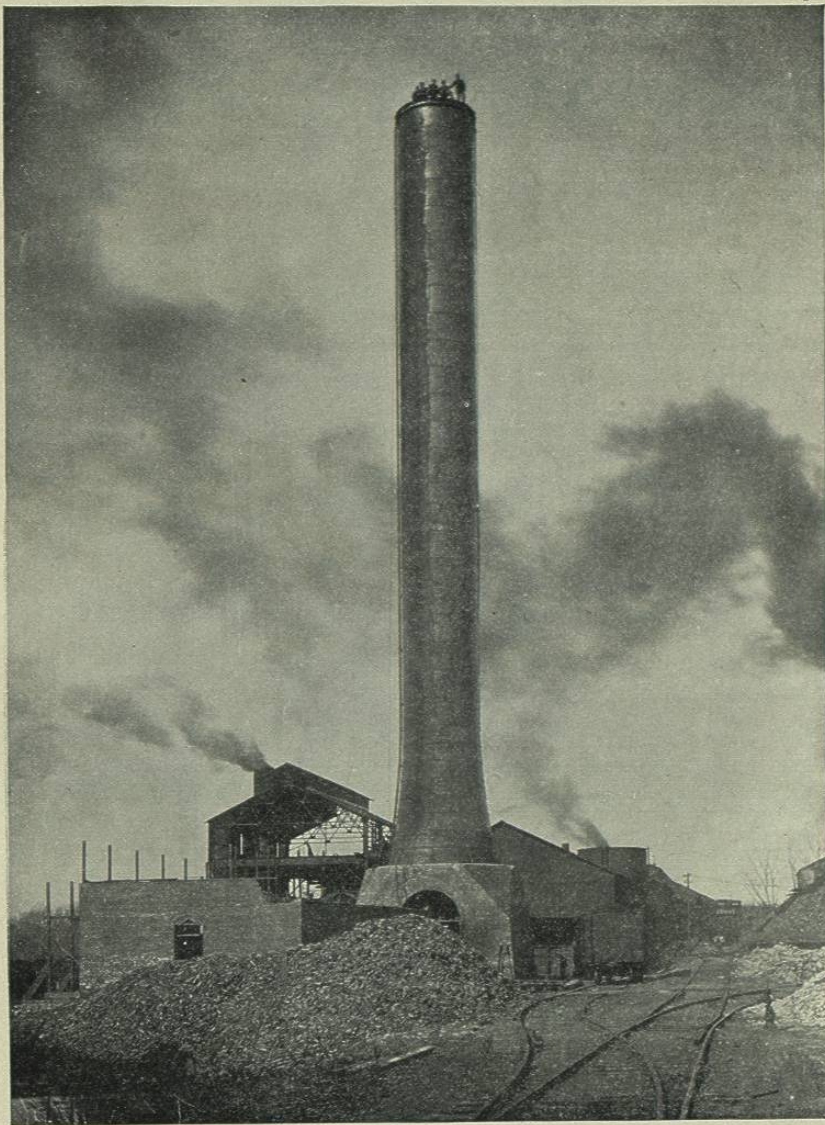
Ornamentation near the top of steel chimneys, at its best, is a poor investment, and very unsatisfactory, both architecturally and otherwise.

Painting.—Red-lead ground in linseed-oil, graphite paint, or the best quality of black asphaltum varnish should be used; two coats both inside and out should be given at erection, and one coat outside every year or two thereafter, for the proper protection against rust, etc.

Illus. No. 8 illustrates the general style of self-sustaining steel chimneys in and about Philadelphia, Pa. The following data pertain to chimneys of this style at that place:

A chimney 165 feet high, would be 15 feet 10 inches in diameter at the bottom of the bell, tapering to 10 feet 9 inches diameter in the straight part. Foundation would be a 20-foot cube.

A chimney 100 feet high would be 10 feet in diameter at the bottom of the bell, tapering to 6 feet 8 inches in diameter at a height of 15 feet from the base. In first 20 feet up from foundation of $\frac{3}{8}$ -inch steel; the next 30 feet up, $\frac{5}{16}$ -inch steel, and the



ILLUS. No. 7.

GUGGENHEIM SMELTING COMPANY, PERTH AMBOY, N. J.

upper 50 feet of $\frac{1}{4}$ -inch steel. The foundation would be 16 feet high by 13 feet square.

Chimneys 100 feet high or less, are usually lined with red brick only to the top of the bell.

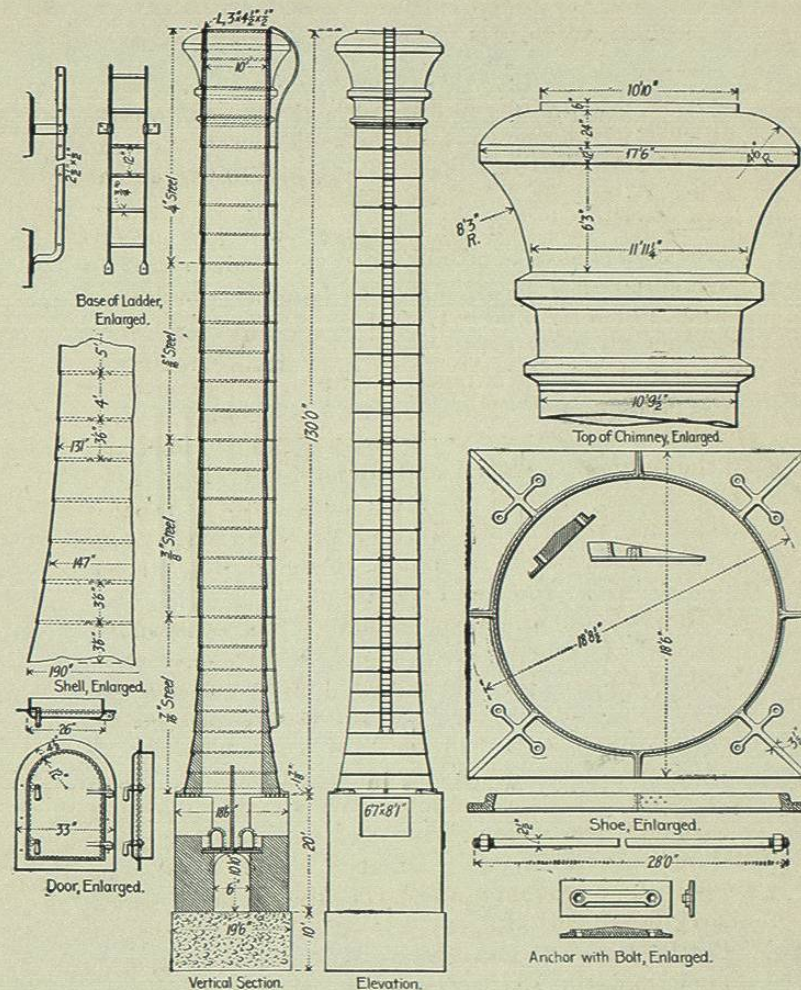
Angle-iron is often substituted at the top of the copper-moulded cap shown.

The bell is usually made in five rings of sheets 3 feet wide plus the lap, or 15 feet high altogether; the sheets above this being 5 feet or 6 feet wide plus the lap.

Ladders are put on chimneys over 100 feet high; under that height steel cable is placed over a pulley at the top, coming nearly to the ground so as to be used in hoisting a man to the top when it is necessary for painting or repair.

Chimney at the Guggenheim Smelting Company's Works, Perth Amboy, N. J., was 140 feet high, diameter at base 10 feet 6 inches, tapering in a height of 25 feet to 13 feet 6 inches diameter. Shell 35 feet of $\frac{3}{8}$ -inch steel at bottom, 35 feet $\frac{1}{2}$ -inch steel, 35 feet $\frac{5}{8}$ -inch steel, and 35 feet of $\frac{3}{4}$ -inch steel at top. Chimney has a 3 x 5 x $\frac{3}{4}$ -inch angle band around the top; also a Z iron band; ladder the entire height; base plate 23 feet 11 inches diameter. This stack has 9-inch brick lining, thus making a 12-foot diameter flue.

This chimney was built in 1898 by the Coatesville Boiler Works.



ILLUS. No. 8.

STEEL CHIMNEY AS USED IN AND ABOUT PHILADELPHIA, PA.

DESIGN AND CONSTRUCTION OF TALL STEEL STACKS.

When the large blast-furnace plant of the Maryland Steel Company, at Sparrow's Point, Md., was designed it was deemed advantageous to operate the eight 22 x 75-foot Whitwell blast stoves, and the eight batteries of Babcock & Wilcox water-tube boilers, aggregating 2,000 horse-powers, serving each pair of furnaces by means of one brick-lined steel chimney. Two such chimneys were constructed of 13 feet 9 inches internal diameter and 225 feet in height. Set upon masonry about 16 feet above the surface of the ground, and standing in an exposed situation, independent of guys or bracing. The weight of the metal in each stack is about 77 tons, of the brick about 900 tons, and of the masonry pedestal and foundations about 1,600 tons, making a total of about 2,600 tons, as against 7,400 tons, which a structure of the same height and internal diameter is estimated to weigh if made entirely of brick, stone, and concrete.

The soil on which the chimney was constructed consisted of compact clay, which was excavated to a depth of 6 feet. The first course of stone was laid dry immediately on the clay. No piling was resorted to, and the foundation was built of good masonry in courses to a height of 16 feet above ground level. The base of the stack was made 40 feet square. The load per square foot of foundation area was thus 1.62 tons, and no settlement or irregularity has yet been observed. The masonry was large dimensioned stone, quarry-faced, with dressed arrises, set in a mortar of 1 Portland cement and 3 sand. The inside of smoke tunnels and the shaft was lined with brick offset to form walls of diminishing thickness, decreasing every 40 feet in height by one ring of brick, or in all from seven to two rings of brick.—See Kent, p. 741, for further description.