TO FIND THE DIMENSIONS OF WROUGHT-IRON TIE-RODS.

THE use of wrought-iron tie-rods instead of heavy timber tie-beams is now becoming so common in the framing of roofs, as to render it necessary to find some exact method of ascertaining the diameter required for such rods in roofs of various spans.

In proceeding to this investigation there are two problems which require solution:—

1*st. What is the horizontal thrust produced by the principal rafters upon the tie-beam?*

2*nd. What is the resistance to tension of a wrought-iron rod for every square inch of section?*

The horizontal thrust (T) upon the ends of a tie-beam is found by the elementary principles of mechanics to be

$$T = \frac{w}{2 \tan. i},$$

where w is the weight borne by one of the principal rafters, and i is the angle of inclination of the roof. The weight (w) depends upon the length of the rafters, the distance apart of the trusses, and the weight laid upon each square foot of the roof.

If we call S the span of the roof in feet, then length of rafter $= \frac{\frac{1}{2} S}{\cos. i}$. The distance between the trusses is usually taken at 10 ft.; and the weight laid upon each square foot of roofing is calculated by Tredgold at 66 lbs. including effect of wind, &c.

Therefore we find $w = 66 \times 10 \times \frac{S}{2 \cos. i}$ in lbs.

$$\text{whence } T = \frac{w}{2 \tan. i} = \frac{330}{2 \sin. i} \times S.$$

Now the inclination (i) is seldom less than 30°, which we may therefore take as the angle producing the greatest strain which the tie-rod is ever required to bear in practice; bearing in mind that the horizontal strain decreases as the angle of inclination of the rafters increases.

When the angle $i = 30°$, $\sin. i = \frac{1}{2}$,

and we have $T = 330 \times$ span, in lbs.

The next quantity which we require to know is the resistance to tension of a rod of wrought iron for every square inch of section. From the experiments made by Mr. Hodgkinson, and given in the Parliamentary Report on the Application of Iron to Railways, we find that eleven tons is the greatest strain per square inch of section that a wrought-iron rod will bear without its elasticity being injured. We may therefore safely take one-half of this amount as the strain which may be put on the tie-beam of a roof, or the section of the tie-rod must be such that it shall not be required to bear a greater strain than $5\frac{1}{2}$ tons, or 12,320 lbs. on every square inch of section, which is about one-fourth of the breaking weight of the rod.

The area of section of tie-rod is therefore found by dividing T by 12320; or—

$$\text{Area of section} = \frac{330 \times \text{span}}{12320} \text{ in square inches.}$$

If we call a the area of section thus found, and d the diameter of the tie-rod (supposed circular), we have—

$$d = 2\sqrt{\frac{a}{3{\cdot}1416}}$$

which can be readily calculated by the aid of logarithms for each different span of roof.

The following table gives the diameters of the tie-rods, which may be safely used for roofs of the corresponding span, the dimensions being calculated rather full than otherwise:—

Span. Feet.	Strain on Tie-rod. lbs.	Diameter of Tie-rod. In.
20	6,600	$\frac{7}{8}$
25	8,250	1
30	9,900	$1\frac{1}{8}$
40	13,200	$1\frac{1}{4}$
50	16,500	$1\frac{3}{8}$
60	19,800	$1\frac{1}{2}$
70	23,100	$1\frac{5}{8}$
80	26,400	$1\frac{3}{4}$
90	29,700 }	$1\frac{7}{8}$
100	33,000 }	

The highest inclination of roof ever adopted is 60 degrees, forming an equilateral triangle, in which case—

$$\text{Strain on tie-rod} = \frac{330}{2 \sin. 60°} \times \text{span.}$$

$$= 188{\cdot}6 \times \text{span.}$$

$$\text{Area of section of tie-rod} = \frac{188{\cdot}6}{12320} \times \text{span} = a.$$

$$\text{Then diameter of rod} = 2\sqrt{\frac{a}{3{\cdot}1416}}.$$

The dimensions here obtained for the several cases should never be exceeded, as any additional weight of tie-rod produces an increased strain upon the king or queen rods which have to support it.

E. W. TARN, M.A.

Cohoes' Water Works Company.

Our readers are aware that a charter was granted by the Legislature, last winter, for the organization of the above company. The subscription books are now open for those who wish to take stock, and it is to be hoped that all who feel an interest in the welfare of the village will subscribe at once. It is worthy the consideration and support of every one and especially those who are engaged in manufacturing of any kind, or who own property. In order that our readers may understand the matter, we will state that it was first proposed to build a reservoir on Prospect Hill but it was ascertained that a much larger one could be built on the hill belonging to Abm. Lansing Esq., for the same amount. A reservoir holding 1,000,000 gallons of water on Prospect Hill would cost, exclusive of land, some $15,000. A reservoir on Lansing's hill, holding 3,000,000 of gallons would cost about the same amount, exclusive of the land.

A proper supply for the village would be about 100,000 gallons per day, or over 16 gallons to each inhabitant. Therefore a reservoir on Prospect Hill would hold ten day's supply, and the other a supply for 30 days. If this project is carried out it will require the sum of $25,000 to furnish pipe, hydrants, &c., making in all about $40,000. If the reservoir is built as proposed, it will add one hundred feet to the head of water already obtained, giving a force sufficient to throw a stream over the highest steeples in the place. An increase is contemplated in the number of hydrants, which will almost do away with the nocessity for fire engines and they are to be so constructed as to prevent their freezing up in winter, and so simple that any one can prepare them for service. The company have secured the services of Mr. JAMES SLADE, a well known engineer, who brings to his aid the experience of years, and as soon as it is definitely settled what plans will be adopted, they will be made known through our columns. It is needless to enumerate the advantages which will accrue to our citizens if this enterprise can be prosecuted; prominent among which will be a great reduction in the amount they pay for insurance, as there will then be comparatively small risk, complete security against fire and an abundant supply of pure water

Manufacture of Plate Glass.—A new addition has been made to the extensive manufacturing business done in Philadelphia, by the Philadelphia Glass Company, who are extensively engaged in the manufacture of plate or hammered glass for sky-lights and vault-plates by a process recently invented by this Company. Their furnaces are constructed without chimneys, and in such a manner as to consume all the smoke and gases arising from the use of anthracite or other coals. The vault lights manufactured by them are also patented upon the following grounds: After the iron frame, which can be of any pattern, is cast, it is then expanded by heat, and while in this condition, the glass in a molten state is run into the open spaces intended to admit the light, thus, excluding, when it is properly placed over the vault, all air or water. This improvement is also intended for the decks of vessels, and other places where light and durability are required. The plate glass manufactured by this Company is of all sizes and thickness, to be used for skylights or tiles for floors, where light is desired beneath. The lighter kinds of glass, such as shades and vases, are also manufactured in great purity. Within a few days between five and six hundred large plates of glass; weighing over 40,000 pounds, have been shipped to Washington, to be used in the Capitol extension. The Company has recently opened an extensive warehouse at No. 400 Market street, under the direction of Mr. Walter.

The Condensing and Cornish Engine.

MESSRS. EDITORS—I notice in the SCIENTIFIC AMERICAN of Nov. 3d, an answer to an interrogatory of H. H., of Virginia, respecting the relative economy of the Cornish engine, and the double-acting condensing engine, stating that "the double-acting condensing engine being well cased and carefully managed, the difference cannot be much." Allow me to suggest for your consideration, as well as that of "H. H.," and your readers generally, the following statement of facts:

Long experience and a variety of experiments have demonstrated that for each inch in the diameter of cylinder, the condensing steam engine will perform a duty of one million pounds—i. e., lift one million pounds 1 foot with the consumption of 94 lbs. of coal; thus a 10-inch cylinder will lift ten million pounds, a 50-inch cylinder fifty million pounds, an 80-inch cylinder eighty millions, &c., the 80-inch cylinder averaging eight times as much as the 10-inch cylinder, with the same amount of fuel —the steam pressure on the piston being the same in each case. The Cornish engine will fully equal this duty, while the crank engine will not quite come up to this figure. But allowing the two to be on an equality in this respect, we derive the following principle from the foregoing—the economy of the one is to that of the other as the diameter of the one is to that of the other. For example, let us compare the duties of a Cornish engine and a double-acting condensing engine, each of about 100-horse power, and working under an average pressure on the piston of 15 lbs. to the square inch, this being the most economical pressure for the condensing engine, in the one case, viz., of the single-acting or Cornish engine, the cylinder being fifty inches in diameter, the duty will be fifty millions; in the other case, viz., of the double-acting condensing engine, the cylinder being of but half the area or say, thirty-eight three-eighth inches in diameter, the duty will be but thirty-eight and three-eight millions.

Hence it appears that a Cornish engine will perform about 40 per cent. more economically than a double-acting condensing engine of the same power, each clothed in the same manner, expanding its steam equally, and in all particulars cared for alike. But allowing for all contingencies, and holding the advantages of the Cornish engine at as cheap a rate as is possible, I should not hesitate to guarantee for it a saving at the very least of 25 per cent, over any other engine or machine doing the same work now in use, or known by the mechanical world.

There may be, and if I am rightly informed, there are some specimens of a so-called Cornish engine here and there whose duty will scarcely exceed that of a good high-pressure (non-condensing) engine, as there are miserable failures in every class of engine built, scattered broad-cast throughout the land—but of these I do not speak. I compare engines properly constructed from approved models, of such also, I am happy to add, some are in operation in different parts of our country. J. WEST.

Norristown, Pa., Dec. 1855.

[Experience is the best, yea, the only test of the superior economy of one engine above another; and to the above statement of experience relating to the superior economy of the Cornish single-acting, over the common condensing double-acting steam engine, we cannot offer a single contrary statement. But we would like to know the *why* and the *wherefore* of this economy. Should not the common condensing engine, with a cylinder of 38 3-8 inches diameter, having a double stroke, be considered of equal area with the Cornish engine of fifty inches, if the same quantity of steam is used by both—the Cornish using as much during one, as the other during two single strokes. What is the difference?