Then

$P = p\ h$, $x = \frac{1}{2}h$, Px = moment of wind pressure,

$W = w\ h\ t$, $y = \frac{1}{2}t$, Wy = moment of resistance,

and by the laws of equilibrium $P\ x = W\ y$,

therefore $p\ h \times \frac{1}{2}h = w\ h\ t \times \frac{1}{2}t$, or $p\ h = w\ t^2$, whence

$$p = \frac{wt^2}{h} \qquad \ldots\ldots\ldots\ldots (1)$$

$$h = \frac{wt^2}{p} \qquad \ldots\ldots\ldots\ldots (2)$$

$$t = \frac{ph}{w} \qquad \ldots\ldots\ldots\ldots (3)$$

If we consider the wind pressure which will just overturn the wall as the measure of stability, then the stability of such a wall varies as $\frac{wt^2}{h}$, or directly as the weight per cube foot, inversely as the height, and directly as the square of the thickness.

This may be shown by parallelogram of forces as in Fig. 2. Draw to any scale the outline of section a b c d, and mark the position of centre of gravity; draw a line vertically through the centre of gravity equal in length to the total weight W upon any given scale, measuring from the line of direction of the resultant of the wind pressure, which in this case will pass through the centre of gravity of the wall; at its extremity draw a horizontal line of indefinite length, then from the centre of gravity draw a line through point a to cut the horizontal line, and P will be the total wind force, or $\frac{P}{h}$ the wind force per square foot to just overturn the wall. The other lines forming the parallelogram, and shown dotted, are frequently omitted.

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*Paper read January 14th, 1909, before the Society of Architects.

Suppose a standard be taken of 112 lb. per cubic foot for weight and 28 lb. per square foot for wind pressure, then by formula (2) for simple overturning, a wall

1 ft. thick	would be	4 ft. high
2 "	" "	16 "
3 "	" "	36 "

or the height of any wall would be four times the square of the thickness . . . . (4)
which for various reasons would not accord with practice.

There is another contingency which is theoretically possible—viz., that the wall instead of overturning, may slide on the bed joint. The resistance to sliding depends upon the weight and the nature of the surfaces in contact; it is directly proportional to the weight multiplied by a fraction called the "co-efficient of friction," varying with the surface. If the mortar has any cohesive strength this co-efficient of friction would merge into the resistance of the mortar to shear stress.

Let u = the co-efficient of friction, then for equilibrium P = Wu, or $p\ h = w\ h\ tu$, whence $p = w\ tu$ . . . . (5)
It is evident that there must be a certain proportion of thickness to height where the tendency to overturn or slide would be equal; this will be when $\frac{wt^2}{h}$ (1) = w tu . . . . (4),

or, by cancelling, when $\frac{t}{h} = u$ . . . . (6),

that is, when the ratio of thickness to height is equal to the co-efficient of friction, and this being 0.5 for fresh mortar it would require the wall to be only twice the thickness high.

Now, unfortunately, when we come to apply these elementary principles to practice, we are beset by difficulties on every hand, and although an architect's innate sense of fitness may enable him to provide a suitable section for a wall of any height, there are times when he should be able to give a reason "for the faith that is in him," and to do so it will be necessary to make various digressions to ascertain the basis upon which practical calculations must rest.

Walls have been designed so that the overturning moment shall not exceed one-half to two-thirds that which calculation would show to be necessary to produce overturning, but this is a very crude and improper mode of designing, and the author will now endeavor to indicate the true basis upon which it should proceed.

Strength and Weight of Materials.

These will vary considerably according to individual samples, but an average may be taken as follows:

Material.	Safe dead load per foot super.	Factor of safety.	Weight in pounds per cubic foot.
Granite masonry	15 tons	20	160
Portland and hard limestone. .	15 "	15	140
Sandstone well bedded	12 "	10	130
Blue brick in cement	9 "	8	120
Stock brick in cement	6 "	5	115
Stock brick in Lias mortar. . . .	5 "	4	112
Stock brick grey lime mortar. .	3 "	4	112
Portland cement concrete	5 "	8	130
Lias lime concrete	3 "	8	120
Gravel & natural compact earth	2 "	. .	112
Made ground rammed in layers	1 "	. .	110

The safe compressive loads given above vary from ¼th to 1/100th of the ultimate resistance: the factor of safety is calculated from the load at which fracture commences. It is necessary to allow a large margin for contingencies, and the figures named agree fairly with ordinary practice.

The safe tensile strength of old grey lime mortar may be taken at 1 ton per square foot. The co-efficient of friction, including resistance to shear, in fresh mortar joints according to different authorities = 0.5 to 0.75 of the load. The shearing strength of old mortar may be taken at ⅔ ton per square foot. The author of Notes on Building Construction gives the safe tensile strength as follows:

	Per sq. inch.		Per sq. ft.
Brickwork in cement, fresh.	0.5 cwt.	=	3.6 tons
" " 6 months old	2 cwt.	=	14.4 "
" Lias lime, fresh	0.1 cwt.	=	0.72 "
" " 6 months old.	36 lb.	=	2.314 "

A maximum pressure of 10 tons per square foot is sometimes allowed on brickwork at the overturning edge, but it must be remembered that crushing may commence with this pressure. No mention has been made of clay as a foundation, as no single figure can express its value; very much depends upon circumstances. In deep foundations, say, exceeding 10 feet from surface, the London clay will bear 5 tons per foot super safely. In shallow foundations a pressure of 1½ tons per foot super would be reasonable, but in such a case it is not compression of the subsoil that is to be feared; the alternations of drought and moisture cause alternate contraction and expansion of the clay, and a movement of the superstructure is certain to follow, unless special precautions have been taken, more particularly where the surface is sloping, as on a hillside.

Wind Pressure.

The pressure of wind against a plane surface perpendicular to its direction is not yet fully understood, it is, of course, a product of the velocity, but it varies according to laws which have not yet been reduced to correct formulæ, even if it be possible ever to arrive at more than a vague generalization. From the experiments which have been made it appears that surfaces of a few feet area give a greater resistance per unit of area than smaller surfaces, and that very large surfaces are never subject to a uniform pressure over their whole area, so that the mean pressure is again reduced. It has been generally assumed that the force varies as the square of the velocity, and that the effect depends solely upon the area of the resisting plane. Pressures equivalent to 60