Modulus of Strength.

Then, assuming two similar models, the scale of one being \( m \) times as great as that of the other, the weights which they will respectively bear, under the same stress of material, will be as \( W \) to \( Wm^2 \), while their respective weights will be as 1 to \( m^2 \).

Now, dividing the sustaining power of each by its own weight, the quotients are as \( W \) to \( W \frac{m^2}{m^3} \) or as \( W \) to \( \frac{W}{m} \). But the lengths being as \( L \) to \( Lm \), if we multiply the quotients just found by respective lengths, we have \( WL \) for the one, and \( Lm \ W \div m = WL \) for the other; showing that the length of a model truss by the number of times its own weight which it can bear (with a given stress), is a constant quantity, whatever be the scale of such model.

Again, the quotients \( W \), and \( \frac{W}{m} \), multiplied by the lengths \( L \) and \( Lm \), give the products \( WL \), and \( \frac{W}{m} \times Lm \), equal to \( WL \). Hence, the product of a truss medal into the number of times its own weight which it is able to sustain, is also constant, whatever be the relative values of the two factors.

It follows, that making these two factors variable, and representing them by \( Q \) and \( L \), the one increases at the same rate at which the other is diminished; and, when \( Q = 1 \), \( L \) must be equal to the greatest length at which a truss of the same plan and proportions, and under the same stress of materials, can sustain its own weight alone.

This length, as we have seen, is determined for a model upon any plan, constructed upon whatever scale, by multiplying the length of model by the number of times its own weight it is capable of sustaining.