*\_ , , \_ . dx*

The weight on *Pp* is *= a -^.*

\_ \_ , 1 . . r, dr AP

Pressure on B by the weight on *Pp = a* χ -βl

\_ τΛ

θr = °ABi∙

⅜AC, ACi

Pressure on B by whole wt. on AC = α -g^-- =: *a*

AC« y 1RC

Strain at C by the weight on AC = *a-*—2Aβ≈Γ",

BC2 × AC

Strain at C by the weight on BC = *a ——∙*

2 Ali1

rι , 11 . . aπ AC2 × BC 4-BCt × AC

Do. by whole weight on Ali = *a ,*

2AB\*

λAC×BCx AC÷CB \_ AC×BC  
~° 2AB- ~a 2ΛB -

Thus we see that the strain is proportional to the rect­angle of the parts, in the same manner as if the load *a* had been laid directly on the point C, and is indeed equal to one half of the strain which would be produced at C by the load *a* laid on there.

It was necessary to be thus particular, because we see in some elementary treatises on mechanics, published by authors of reputation, mistakes which are very plausible, and mislead the learner. It is there said that the pres­sure at B from a weight uniformly diffused along AB, is the same as if it were collected at its centre of gravity, which would be the middle of AB ; and then the strain at C is said to be this pressure at B multiplied by BC. But surely it is not difficult to see the difference of these strains. It is plain that the pressure of gravity downwards on any point between the end A and the point C has no tendency to diminish the strain at C, arising from the up­ward re-action of the prop B ; whereas the pressure of gravity between C and B is almost in direct opposition to it, and must diminish it. We may however avoid the fluxionary calculus with safety by the consideration of the centre of gravity, by supposing the weights of AC and BC to be collected at their respective centres of gravity ; and the result of this computation will be the same as above : and we may use either method, although the weight he not uniformly distributed, provided only that we know in what manner it is distributed.

This investigation is evidently of importance in the practice of the engineer and architect, informing them what support is necessary in the different parts of their constructions. We considered some cases of this kind in the article Roof.

It is now easy to form a joist so that it shall have the same relative strength in all its parts.

I. To make it equally able in all its parts to carry a given weight laid on any point C taken at random, or uni­formly diffused over the whole length, the strength of the section at the point C must be as AC X CB. Therefore,

1. If the sides be parallel vertical planes, the square of the depth (which is the only variable dimension), or CD2, must be as AC × CB, and the depths must be ordinates of an ellipse.

2. If the transverse sections be similar, we must make CD3 as AC X CB.

3. If the upper and under surfaces be parallel, the breadth must be as AC X CB.

II. If the beam be necessarily loaded at some given point C, and wé would have the beam equally able in all its parts to resist the strain arising from the weight at C, we must make the strength of every transvense section between C and either end as its distance from that end. Therefore,

1. If the sides be parallel vertical planes, we must make CD, : EF2 = AC : AE.

2. If the sections be similar, then CD3 : EF3= AC : AE.

3. If the upper and under surfaces be parallel, then breadth at C : breadth at E = AC : AE.

The same principles enable us to determine the strain and strength of square or circular plates of different ex­tent but equal thickness. This may be comprehended in this general proposition.

Similar plates of equal thickness supported all round will carry the same absolute weight, uniformly distributed, or resting on similar points, whatever be their extent.

Suppose two similar oblong plates of equal thickness, and let their lengths and breadths be L, ∕, and B, *b.* Let their strength or momentum of cohesion be C, c, and the strains from the weights W, *w,* be S, *s.*

Suppose the plates supported at the ends only, and resisting fracture transversely. The strains, being as the weights and lengths, are as WL and *wl,* but their cohe­sions are as the breadths ; and since they are of equal rela­tive strength, we have WL : *wl* = B : *b,* and WL5 ≡ *wlB,* and L : *l* = wB : Wb ; but since they are of similar shapes, L : *l* = B : *b,* and therefore *w —* W.

The same reasoning holds again when they are also supported along the sides, and therefore holds when they are supported all round (in which case the strength is doubled).

And if the plates be of any other figure, such as circles or ellipses, we need only conceive similar rectangles in­scribed in them. These are supported all around by the continuity of the plates, and therefore will sustain equal weights ; and the same may be said of the segments which lie without them, because the strengths of any similar seg­ments are equal, their lengths being as their breadths.

Therefore the thickness of the bottoms of vessels hold­ing heavy liquors or grains should be as their diameters and as the square root of their depths jointly.

Also the weight which a square plate will bear is to that which a bar of the same matter and thickness will bear as twice the length of the bar to its breadth.

There is yet another modification of the strain which tends to break a body transversely, which is of very fre­quent occurrence, and in some cases must be very care­fully attended to, viz. the strain arising from its own weight.

When a beam projects from a wall, every section is strained by the weight of all that projects beyond it. This may be considered as all collected at its centre of gravity. Therefore the strain on any section is in the joint ratio of the weight of what projects beyond it, and the distance of its centre of gravity from the section.

The determination of this strain, and of the strength ne­cessary for withstanding it, must be more complicated than the former, because the form of the piece which results from this adjustment of strain and strength influences the strain. The general principle must evidently be, that the strength or momentum of cohesion of every section must be as the product of the weight beyond it, multiplied by the distance of its centre of gravity. For example :

Suppose the beam DLA (fig. 15) to project from the wall, and that its sides are parallel vertical planes, so that the depth is the only variable dimension. Let LB = *x* and B*b* = y. The element BbcC is = *xy.* Let G be the centre of gravity of the part lying without Βb, and *g* be its distance from the extremity L. Then at—*g* is the arm of the lever by which the strain is excited in the section Bb.