operators to the Front, and proved the great value of photographic propaganda. The wonderful use of colour photography made by his department is to be seen at the Grafton Galleries. Here the men themselves and their descendants for generations can gaze upon the actors in the great war. These wonderful photographic enlargements will be among the most popular and treasured pictures in the Canadian Pantheon.

It is to be hoped that an exhibition of the best specimens of arms and trophies captured by the Canadian Corps will be seen in London before they are shipped to Ottawa, and the people of the Old Country will then have seen most of the chief exhibits which will furnish the Pantheon at Ottawa.

The Design of Beams, Joists and Posts,

as used in ordinary buildings, simply explained.

The purpose of this article is to explain in simple language (without going into mathematical formulæ) the methods used by Designing Engineers in arriving at the sizes of the common timbers used in building construction.

This introduction to the subject is very elementary, and has been written with a view to encouraging the ordinary tradesman to look a little below the surface of the materials he is handling, and with a little further investigation he will soon be able to use his materials economically and with greater confidence, thus allowing him to act for himself when anything unusual turns up.

The writer will be pleased to answer any enquiries that may be made on this subject, and all communications should be addressed to "The Editor, THE CANADIAN SAPPER."

Design of Single Beams and Joists.

The design of beams is always carried on with reference to the extreme fibre stress (referred to in text books as E.F.S.)

This stress may be taken at 1500 pounds per square inch when using Douglas fir, and 1000 pounds per square inch for cedar.

The joists and beams of dwelling-houses are commonly designed for a live load (moving load such as people moving about, shifting furniture, etc.) of 50 pounds per square foot, in addition to the weight of the floor and plaster as dead load. Partitions resting on a floor which are not supported by posts below must have their effect calculated and allowed for in the dead load.

It is probably near enough for most designs in dwelling-houses to take the total load as 100 pounds per square foot, made up as follows:—Live load, 50 pounds per square foot; weight of floor and plaster, 14 pounds per square foot; allowance for live load impact, 36 pounds per square foot; total, 100 pounds per square foot.

The length of a beam or joist is to be taken from centre to centre of the walls on which it rests.

The width of the loaded floor strip, which is carried by each joist, is the same as the spacing of the joists. The load on the joist per foot run will then be 100 pounds, multiplied by the joist spacing divided by 12 inches.

Example.

Assume joists to be at 16 in. centres

$\therefore$ load per foot run $= \frac{100 \times 16 \text{ in.}}{12 \text{in.}} =$ say 133 pounds.

The greatest bending moment for a floor joist supported at the ends and loaded uniformly will occur at the middle, and will be:—

Load in pounds per foot run $\times$ square of length in feet $\times 1{\cdot}5$ inch-pounds.

Example.

Joist 13 feet long between centres of bearing walls and placed at 16 in. centres, loading as for dwelling-houses.

Bending moment in centre = 133 $\times$ span of joist squared $\times 1{\cdot}5 = \frac{133 \times 13 \times 13 \times 3}{2} = 33715$ inch-pounds.

Section Modulus.

Having found the greatest bending moment in the beam or joist, divide same by the extreme fibre stress which is allowed. The quotient will be the necessary section modulus of the joint or beam you must use.

For a common timber beam the section modulus is $\frac{b\,d^2}{6}$ or breadth $\times$ square of depth $\div$ 6.

Example.

The modulus of a 2 in. $\times$ 6 in. joist is $\frac{2 \times 6 \times 6}{6} = 12$.

The following gives the modulus of the more common scantlings of timbers used in buildings:—2 in. by 4 in. joists is $5\frac{1}{3}$; 2 in. by 6 in. joist is 12; 2 in. by 8 in. joist is $21\frac{1}{3}$; 2 in. by 10 in. joist is $33\frac{1}{3}$; 3 in. by 12 in. joist is 72; 4 in. by 6 in. joist is 24; 6 in. by 6 in. joist is 36; 6 in. by 8 in. joist is 64; 8 in. by 8 in. joist is $85\frac{1}{3}$; 8 in. by 10 in. joist is $133\frac{1}{3}$; 10 in. by 10 in. joist is $166\frac{2}{3}$; 10 in. by 12 in. joist is 240; 12 in. by 12 in. joist is 288.

It must be noted that the section modulus will vary if the beam is turned so as to lie on another face.

Thus, if a 4 in. $\times$ 6 in. beam is turned so as to lie on its broad face, the modulus will no longer be 24, but only $\frac{6 \times 4 \times 4}{6} = 16$.

If we now take the case of a 2 in. by 8 in. fir joist resting on walls 13 feet apart, centre to centre, and carrying the usual load for a dwelling-house, we have for the greatest bending moment in the joist

$$\frac{133 \times 13 \times 13 \times 3}{2} = 33715 \text{ inch-pounds.}$$

Dividing this by the section modulus of a 2 in. by 8 in. joist, which is $21\frac{1}{3}$, we find we get 1580 pounds per square inch for the extreme fibre stress, which is going too far. For safety we would use a 2 in. by 10 in.

In the next issue we hope to publish a further article dealing with the deflection of beams, and give some details regarding the design of simple posts, etc.

LIEUT. W. B. YOUNG, C.E.,
"D" Company 2nd C.E.R.B.