$d_2 = 4$ in., $d_3 = 6$ in.; required, the diameter (D) of an equivalent uniform main of length (L) = 7.14 miles.

Draw index lines through d_1, l_1, d_2, l_2, d_3, l_3, plotted on their respective scales. At their intersection with the s-scale read off the values $s_1 = 50$, $s_2 = 500$, $s_3 = 200$, and add them together, giving S = 750. An index line passing through S and L, plotted on their respective scales, will intersect the d-axis at the equivalent diameter (D) = 6.5 (say 7) in.

Mains "in Parallel."—For these mains it is readily shown that—

$$\left(\frac{D^n}{kL}\right)^{\frac{1}{m}} = \left(\frac{d_1^n}{kl_1}\right)^m + \left(\frac{d_2^n}{kl_2}\right)^{\frac{1}{m}} + \ldots\ldots\ldots$$

(Note: $H = h_1 = h_2 \ldots\ldots$ and $Q = \Sigma q$.)

In view of equations (2) and (3), each term may be expressed as carrying power, thus—

$$P = p_1 + p_2 + \ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

or, in words, the value of P for the equivalent main is equal to the sum of values of p for the component mains.

This indicates that the p-scale enables the individual terms on the right-hand side of equation (7) to be read off directly and the value of P obtained by simple addition. Similarly to the previous case the diameter (D) and length (L) of the equivalent main are determined by the intersections on the d- and l-scales of any index line passing through the calculated value of P.

Example 8.—Given a compound main in two lengths $l_1 = 10{,}500$ ft., and $l_2 = 850$ ft. laid "in parallel," the corresponding diameters being $d_1 = 12$ in. and $d_2 = 8$ in.; required, the length (L) of an equivalent uniform main of diameter (D) = 15 in.

Draw index lines through d_1 l_1, d_2 l_2, plotted on their respective scales. At their intersection with the p-scale read off the values $p_1 = 0.35$, $p_2 = 0.45$, and add them together, giving P = 0.8. An index line passing through P and D plotted on their respective scales will intersect the l-axis at the equivalent length (L) = 6,000 ft.

(Continued in next week's issue.)

WEEKLY RAILWAY EARNINGS.

The following are the earnings of Canada's transcontinental railways during the three weeks ended August 21st:—

Canadian Pacific Railway.

	1916.	1915.	
August 7	$2,985,000	$1,787,000	+ $1,198,000
August 14	2,943,000	1,815,000	+ 1,128,000
August 21	2,860,000	1,956,000	+ 904,000

Grand Trunk Railway.

August 7	$1,256,376	$ 993,773	+ $ 262,603
August 14	1,236,989	1,004,412	+ 232,577
August 21	1,304,848	1,052,483	+ 252,365

Canadian Northern Railway.

August 7	$ 868,000	$ 438,500	+ $ 429,500
August 14	841,500	427,600	+ 413,900
August 21	846,300	465,400	+ 380,900

Copper and zinc to the value of $2,257,254 was sent from the Kootenay, B.C., district in the first half of 1916, against a total of $797,392 in 1915.

Twenty leading copper companies operating in the United States, Canada and South America produced approximately 895,000,000 pounds of copper in the first half of 1916, an increase of 299,000,000 pounds, or 50 per cent., over the corresponding period of last year. Of these, the Anaconda made the largest individual increase—52,300,000 pounds more than a year ago.

GRAPHICAL ANALYSIS OF CONTINUOUS BEAMS BY THE USE OF THE PRINCIPLE OF CONTINUITY.*

By Cyril Provo Hubert.

THE following analysis is general, being applicable to continuous beams having any number of equal or unequal spans.

The first step that it requires is to divide each span into three equal parts, erecting verticals at the division points (Fig. 1) then proceed to divide into half the distance between each pair of verticals over the inner supports by means of another vertical line, establishing

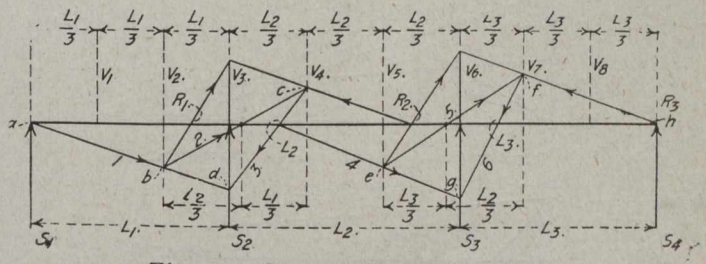
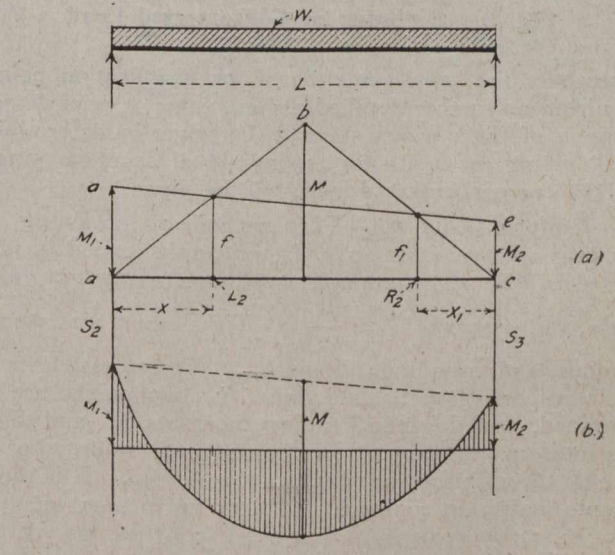


Fig. 1.—General Stress-Diagram.

the effective one-third span distances in a reverse or contrary order. It remains, then, to ascertain the position of the fixed or inflection points of each span, which must not be misconstrued for the points of contra-flexure. In order to do this by the graphical process, it is only necessary in the beginning to assume any convenient direction of the arbitrary line (1) from the point a. Where this line cuts the vertical V_2 at b, is the starting point of



$M = \frac{1}{8} WL^2$

Proof: $f = M \cdot \frac{2X}{L}$ $\quad f_1 = M \cdot \frac{2X_1}{L}$ $\quad M_1 = f + (f - f_1)\frac{X}{L-X-X_1} =$

$2M \frac{X}{L} \cdot \frac{L-2X_1}{L-X-X}$ $\quad M_2 = 2M \cdot \frac{X_1}{L} \cdot \frac{L-2X}{L-X-X_1}$

Fig. 2.—Diagram for Uniform Loading.

line (2), a straight line drawn from the point b through V_3 as shown, intersecting V_4 at c. Join the points c and d by line (3), then the left-hand inflection point L_2 of span L_2 is where line (3) cuts the datum or horizontal base line ah.

*Western Engineering.