A TREATISE ON RETAINING WALL DESIGN.

THE SECTION MODULUS—DEFINITION OF MOMENT OF INERTIA AND RADIUS OF GYRATION.

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(Continued from Last Week.)

The section modulus varies according to the section employed, for a rectangular section it is $\frac{bd^2}{6}$; we will investigate the conditions as to how this value has been arrived at.

Now the moment of inertia for a rectangular section, generally written $I = \Sigma a y^2$, Σ signifyng summaton, a, area of any individual fibre and y, distance of centre of gravity of portion from the neutral axis. In other words in the for- $I=\Sigma a y^2$, it is first supposed that the section is divided into several horizontal layers or fibres, the area of each one being separately calculated and then multiplied into the mean distance squared from the neutral axis, finally summing up the results thus obtained. It is readily seen that this is not necessary, as there must be a mean distance for the whole section, which when squared and multiplied into the whole area A, will give the required moment of inertia as before. This mean distance is termed the radius of gyration and is equal to $\sqrt{\frac{I}{A}}$; in which I=moment of inertia of section and A whole area.

Again referring to the section modulus $\frac{bd^2}{6}$; the resistance figure for a rectangular section is shown in plans reproduced. Before proceeding any further, it may be well to know what is meant by the term resistance figure or resistance area.

Resistance Area.

A misconception seems to exist regarding the meaning of this term. The fact that it is called resistance area, and further that it only takes up a portion of the whole area, seems to convey the idea that useless material is divided from active material.

This is by no means the case; if the resistance figure were subjected to a uniform stress the amount of which equals that on the extreme fibre, the result would be the same as if the whole section were subjected to a varying stress commencing from the neutral axis and reaching a maximum at the extreme fibre. Now to consider the section modulus. It is first necessary to find the centre of gravity of each triangle.

this is equal to $\frac{2}{3}\frac{d}{2}$; in each case. The area of the triangle equals $\frac{1}{2}$ base multiplied by perpendicular height, or $\frac{1}{2}b \times \frac{1}{2}d = \frac{bd^2}{4}$; and section modulus equals area of triangular resistance figure, multiplied by distance apart of centres of gravity. It will therefore be seen that the section modulus for a rectangular section is $\frac{bd}{4}$ multiplied by distance apart of centres of gravity which equals $\frac{2}{3}d$

$$\therefore \text{ Section Modulus } M = \frac{bd}{4} \times \frac{2}{3}d = \frac{bd^2}{6}$$

By the aid of the section modulus we may compute the moment of inertia by multiplying it by the distance of extreme fibre from the neutral axis, which for a rectangular section equals $\frac{d}{2}$; thus:—

$$\text{Moment of Inertia} = \frac{bd^2}{6} \times \frac{d}{2} = \frac{bd^3}{12} = I$$

Therefore it is evident that for rectangular sections:—

$$M = \frac{bd^2}{6}; \text{ and } I = \frac{bd^3}{12}$$

The application of these formulae in practical design will be considered later. Before attempting the design of retaining walls, we will consider the vexed question of earth pressure and the effect of friction.

(To be Continued.)

TOOTHLESS SAWS FOR CUTTING STEEL.

The employment of high-speed revolving disks of mild steel for cutting hard steel is coming into general use. The disks are preferably made of boiler plate quality and are about a quarter of an inch thick. They revolve with a peripheral speed of as much as 20,000 feet a minute. One of these disks will cut through a heavy channel section of hard steel. 12 by 6⅜ inches, in fifteen seconds.

It appears to act by local fusion. The very high speed causes thousands of inches of surface to impinge in rapid succession on the metal undercut. so that its temperature at the point of contact, becomes very high, although the disk, owing to the large surface area, remains relatively cool. All its frictional energy is concentrated on an extremely small area of contact. The work is done so quickly that the heat has no time to spread to the metal undercut, and the sides of the cut portion are only a little warmed.

WATER PURIFICATION BY OZONE.

At the end of 1910 the municipal authorities of St. Petersburg inaugurated a public supply of ozonized water with a view to avoiding the cholera and typhoid epidemics attributed to the use of impure water. The plant employed includes elevated pumps, accelerated filters and the actual sterilizer towers; its capacity is 11,000,000 gallons of pure water per diem. The Howatson filtration process is adopted, a solution of aluminum sulphate being used to effect a preliminary clarification of the water. Eight reservoirs and thirty-eight filters are in use. From the preliminary filters the water possesses to sterilizing towers where it is mixed intimately with ozonized air by being sprayed in by special pumps. Siemens ozone producers are employed, 127 sets being in use; in this apparatus the air is submitted to a 7,000 v. 500 cycles per second discharge. The requisite energy is supplied by three steam-driven dynamos, each of 150 h.p. By the above means the brackish water of the Neva is rendered potable and free from bacteria; the cost of treatment is very moderate and the hygienic value of the process is incalculable.