REINFORCED CONCRETE CHIMNEYS.

A NEW USE FOR CONCRETE BLOCKS.

BY DR. ALFRED GRADENWITZ.

ENDEAVORS have been made from time to time, especially in the United States, to use reinforced concrete as a material for the construction of industrial chimneys. In spite of the undoubted economical advantages to be derived from the use of this material, none of the systems so far suggested has been employed on any very extensive scale.

The reason of this would seem to lie in the fact that builders have so far tried to use forms and scaffolding as employed for other kinds of concrete structures. This, combined with the expense of erecting and removing the scaffolding, more than offset the advantages of iron concrete.

A successful attempt to build iron-concrete chimneys without any forms or external scaffolding has been made by a Belgian engineer, Mr. M. Dumas of Brussels. The chimneys built on this novel system (like all other concrete chimneys) are made up of a foundation, a basement, and the shaft proper. While the first two parts, which are situated close to the surface of the ground, do not show any remarkable feature, the construction of the shaft, which is composed of a number of concrete blocks, 25 centimeters (9.84 inches) in height, is decidedly novel. The number of blocks obviously depends on the diameter of the chimney. Each block is provided at one of its ends with a grooved projection, so that when laid in place a continuous vertical rib is formed, into which is inserted a longitudinal armature extending throughout the height of the chimney and being moored both in the foundation and basement. The entire chimney is thus virtually a single monolith, whose pressure on the ground is calculated in the same manner as that of any foundation.

The blocks are molded either in the workshops or on the site; being reinforced with iron bars, they are well able to stand any rough handling during the transport and erection. In addition to the longitudinal armatures above mentioned, the upper part of each layer of blocks is formed with a transverse armature, which takes the shape of a reinforcing ring fitted into a groove.

The concrete blocks are mounted with remarkable rapidity; the workmen installed in the interior of the chimney set them in layers of about twelve each, after which concrete is applied on the rib 25 centimeters (9.84 inches) in height, and the joint for the next layer is completed. An important feature is that the vertical armatures are arranged outside on the chimney, so as to be always at a lower temperature than the chimney proper, which excludes any objectionable effect of a difference in expansion. In fact, iron concrete in principle is fireproof only until the temperature of disintegration is reached; and though the coefficients of expansion of steel and concrete are practically identical, the heat conduction in the two substances is different, and owing to the possibility of a difference in temperature between the two, the risk of disintegration would by no means be impossible.

Another important point is the composition of the material, the various kinds of concrete being fireproof to a variable degree. The Belgian constructors accordingly used for their chimneys a special mixture of high safety. The use of a lining is recommended in the case of the presence of acid gases liable to attack the concrete or of temperature limits exceeding 800 deg. C. (1,696 deg. F.); the more so as this chimney system is especially adapted to such an arrangement.

The chimneys terminate on the top in a cap and a cast-iron ring, which communicates with the vertical armatures reaching down to the foundation. No special lightning arresters need therefore be provided. As the foundation is not exposed to any heavy loads, it need not be very substantial. This entails another saving.

Should the iron-concrete chimney for some reason or other (e. g., under the action of a cyclone or an earthquake) assume an inclined position, it would not be crushed like a chimney made of tiles, and could be straightened up at a trifling cost.

From the point of view of architecture, the chimneys, as shown by the accompanying illustrations, are of very pleasing appearance; and although more slender than tile chimneys, they are given a remarkably substantial aspect by their longitudinal armatures.

Sulphocarbon cement, for leather, rubber, etc., consists of 50 parts gutta percha, 120 parts of benzole, 80 parts sulphide of carbon, 20 parts of turpentine.

Two such mixtures are prepared, of which one is scummed off and heated to boiling. The scum of the non-heated mixture is then mixed with the boiled mixture.

THE ARTIFICIAL PROPAGATION OF MARINE SPONGES.

ALL the marine sponges of commerce come from a few small regions of the earth. Fine sponges are obtained chiefly from the eastern part of the Medi-

VIEW OF LONGITUDINAL AND VERTICAL REINFORCEMENT.

terranean, the cheaper and coarser sorts from the Mediterranean and the West Indies. Artificial propagation, the possibility of which has long been known, has been frequently essayed for the purpose of stocking coasts on which sponges do not naturally occur and restocking grounds which have been exhausted by rapacious and unscientific sponge fishing.

The first experiments were made on the Adriatic coast, near Trieste, more than forty years ago, and artificial cultivation of sponges has since been attempted in Florida waters, but in every case the attainment of practical and permanent success has been prevented by unforeseen difficulties. The sponge plantations were soon destroyed by natural or human agency, especially by the malice of rival sponge-fishers. Much yet remains to be learned concerning the conditions of successful propagation and culture of sponges and their diseases and animal enemies. Nor

has sufficient attention been given to the financial part of the subject. In recent years sponge culture has been included in the extensive programme of the United States Fisheries Bureau. Laboratory experiments have been made, also, at Sfax, in southern Tunis, by the French government of the protectorate, and their results have been published by Dr. Allemand, the director of the station. These experiments were made, not with the highly prized bath sponge (*Euspongia officinalis*), but with the less valuable horse sponge (*Hippospongia equina*), which is found on the coast of Tunis and throughout the Mediterranean. It is easily recognized by its large size, roughly hemispherical shape, and large round pores. Its coarse and irregular texture makes it unsuited for toilet use, and it is employed exclusively in the stable and for various industrial purposes.

Artificial propagation of this species is most commonly effected by cutting a living sponge into pieces, each of which, in favorable conditions, regenerates a complete sponge. The process is very simple in principle, but its practical application is encumbered with difficulties. Although the sponge possesses abundant regenerative power, it cannot survive long separation from its natural habitat, especially in hot weather, so that the problem of transportation to its future home becomes very difficult.

Allemand found that the sponges died in four or five hours if the water in which they were placed was not changed, but that they could be kept alive ten hours or longer by renewing the water frequently. The experiments proved that regeneration can take place only in the sea, as captive sponges soon perish. The comparatively low temperature of 59 deg. F. was found the most favorable for fishing sponges for propagation.

The sponge having been secured in good condition, it is cut up into pieces about 1¼ inch high and ¾ inch wide, each containing a portion of the epidermis of the original sponge. Very sharp knives should be used, in order to avoid tearing or crushing the mass. The pieces of sponge are mounted on a frame which is at once immersed in the sea.

The form and material of the frame are important, and many of the earlier experiments failed owing to the employment of unsuitable frames. Allemand first used a sort of ladder, composed of two planks connected by bamboo rods, to which the fragments of sponge were fastened with pegs, but as the wood rapidly decayed in the sea water, perforated vessels of clay, terra cotta and brick were substituted.

In the immersion, as in the collection of the sponges, the temperature of the water is a matter of importance. Temperatures between 50 and 68 deg. F. gave very good results, while 77 deg. F. proved high enough to cause failure. After the healing of the cut surfaces, a process which usually occupies three months, higher temperatures are not specially injurious.

The most favorable months for the operation, in Tunis, appeared to be November, December, March, April and May, on account of the uniformity of temperature of the water. The sponge cuttings grow much less rapidly than young sponges developed from larvæ, occupying four or five years in attaining average market size. It was found that cuttings from small young sponges grew more rapidly and were more tenacious of life than cuttings from large old sponges. In order to obtain even this partial success the growing sponges must be shielded from light. The sponges planted in sunny waters grew slowly. The most rapid growth was obtained in the shade or even in almost total darkness. This result was to be expected, as sponges are found at depths to which very little light penetrates.

A second possible method of artificial propagation of sponges is afforded by sexual reproduction. This method was proposed in 1907 by the American biologist Monroe, in consequence of his success in propagating oysters by a similar method.

A minute study of the sexual reproduction of sponges, especially the horse sponge, has been made in Tunis. The production of eggs, which appear as white pellets in the sponge tissues, commences in October and continues until the end of January. The eggs are not apparently produced every year, for Allemand found them in only about two-thirds of the sponges examined. The larvæ make their appearance in April, May or June, according to the severity of the winter. The connection between the larvæ and the white pellets is proved by the observation that larvæ emerge only from sponges that contain pellets. The

CHIMNEY OF CONCRETE BLOCKS 125 FEET HIGH.
INTERIOR DIAMETER, 3 FEET 8 INCHES
AT THE TOP.

CHIMNEYS BUILT OF IRON-CONCRETE.