PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements relating to Blocks for Forming or Protecting Marine Structures

I, HARRY RIDEHALGH, a British subject, of Tower House, 78, Marlpit Lane, Coulsdon, Surrey, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

Breakwaters, harbour walls and other marine or riverine structures and beaches which are subjected to wave action are frequently built of or protected by blocks, commonly made of concrete, which may be placed in an orderly or random manner to form a bank or layer against which the waves dissipate their energy.

One requirement of such blocks is that they should form a bank or layer having a large number of interstices into which the water can penetrate and hence a large surface area over which the wave energy can be destroyed. A second requirement is that the blocks when in position should not become unstable or the bank or layer be broken up by the force of the waves which may be very considerable. To meet this second requirement it is desirable that the blocks should remain in equilibrium in whatever position they come to rest when placed in position and also that the blocks should tend to interlock with each other to a certain extent so that each block contributes to the stability of its neighbours.

With these aims in view, according to the present invention, such a block comprises three or more limbs which lie along the edges of a regular or irregular tetrahedron in two or more planes, adjacent ends of the limbs being rigidly fixed to each other at a corner or corners of the tetrahedron.

Preferably the block has four limbs which lie along the edges, other than two non-adjacent edges, of the tetrahedron. With this arrangement each end of each limb is fixed to the adjacent end of one other limb and the resulting block is particularly strong and can be made of concrete with little or no reinforcement. When the block has only three limbs reinforcement is usually necessary to make the block sufficiently strong to withstand the pounding which it is likely to receive from waves.

An example of a block made in accordance with the invention and also examples of some structures formed of, or protected by, blocks in accordance with the invention, are illustrated in the accompanying drawings in which:

Figure 1 is a perspective view of the block;

Figure 2 is a cross section through a part of a rock filled breakwater;

Figure 3 is a cross section through a part of a mass concrete breakwater; and,

Figure 4 is a diagrammatic perspective view showing groynes on a beach.

The block shown in Figure 1 is moulded monolithically out of concrete and has four limbs, 1, 2, 3 and 4. These four limbs lie along four of the edges of a regular tetrahedron and are joined together at their adjacent ends at the corners of the tetrahedron. The junctions between the ends of the adjacent limbs are strengthened by fillets 5. The tips of the limbs at their junctions are chamfered and end in two flat surfaces 6 inclined to each other. This is done only to simplify the shuttering within which the concrete is moulded.

Each of the limbs 1 to 4 is circular in cross section and its free length between the fillets 5 is equal to approximately twice its diameter. The ratio of the length of the limbs to their diameter is not critical, but it is upon this ratio amongst other factors that the porosity of a bank or layer formed of the blocks depends. If the ratio is too high the bank or layer will be too porous and of insufficient resistance to wave penetration, and also the block will be structurally weak and liable to be broken by the waves. If, on the other hand the ratio is too small it becomes more difficult for a limb or limbs of one block to engage between the limbs of an adjacent block, in

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consequence the blocks do not interlock satisfactorily and a bank or layer formed from them is not well knit together. In general the free length of any limb between its junctions with the adjacent limbs should not be less than its diameter, that is to say the above mentioned ratio should not be less than one, neither in most circumstances should the ratio be greater than about 8. In the example illustrated the cross section of the limb is circular and this is preferable but the limbs may of course be made of other shapes, for example, rectangular or polygonal.

The overall length of each of the limbs 1 to 4 and hence the total weight of the block, will of course depend on the circumstances under which the block is to be used. The length of each limb may be of the order of 5 to 10 feet or more depending on the weight of block desired. The block may be made of mass concrete and in general this will provide sufficient strength. In cases where the wave action is likely to be particularly severe, however, the block may of course be reinforced with steel.

The breakwater shown in Figure 2 has a core of rock filling 7, on which is a layer of larger rocks 8 and a second layer of still larger rocks 9. The breakwater has a mass concrete parapet wall 10. The face of the layer 9 which is exposed to the wave action in the water 11 is protected by a layer of blocks 12, similar to those shown in Figure 1. The layer of blocks 12 is of substantially uniform thickness but the individual blocks are placed in a random manner. Under some circumstances the blocks 12 may be packed together in a uniform manner.

As shown in Figure 3 a mass concrete breakwater 13 has its vertical front face 14 protected by a pile of blocks 15. Because the blocks 15 fit together they will stand with a front slope 1 to 1.

As shown in Figure 4 a beach 16 having a sloping bank 17 at its landward edge is protected from erosion by two groynes 18 and 19. Each of the groynes 18 and 19 consist of a straight row of blocks similar to that shown in Figure 1. Each of the blocks is placed so that the apex of the face of the tetrahedron upon which is resting the block points directly down the beach 16.

The apex of each block other than the block at the seaward end of the groyne fits between two of the limbs of the adjacent block on its seaward side.

Although in Figures 2 and 3 a rock filled breakwater and a mass concrete breakwater respectively are shown protected by blocks made in accordance with the invention, in some cases breakwaters may consist solely of a mound of these blocks by themselves.

WHAT I CLAIM IS:—

1. A block for building or protecting marine or riverine structures subjected to wave action, the block comprising three or more limbs which lie along the edges of a regular or irregular tetrahedron in two or more planes, adjacent ends of the limbs being rigidly fixed to each other at a corner or corners of the tetrahedron.

2. A block according to claim 1, which has four limbs which lies along the edges, other than two non-adjacent edges of the tetrahedron.

3. A block according to claim 1 or claim 2, in which the limbs are circular in cross-section and fillets are provided between the limbs at their junctions.

4. A block according to any one of the preceding claims, which is a monolithic concrete moulding.

5. A marine or riverine structure comprising or consisting of a stack of blocks in accordance with any one of the preceding claims.

6. A groyne comprising a row of blocks in accordance with any one of the preceding claims with an apex of each block other than the block at one end of the row fitting between two limbs of the adjacent block.

7. A block according to claim 1, constructed substantially as described with reference to Figure 1 of the accompanying drawings.

For the Applicant:
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PROVISIONAL SPECIFICATION

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consequence the blocks do not interlock satisfactorily and a bank or layer formed from them is not well knit together. In general the free length of any limb between its junctions with the adjacent limbs should not be less than its diameter, that is to say the above mentioned ratio should not be less than one, neither in most circumstances should the ratio be greater than about 8. In the example illustrated the cross section of the limb is circular and this is preferable but the limbs may of course be made of other shapes, for example, rectangular or polygonal.

The overall length of each of the limbs 1 to 4 and hence the total weight of the block, will of course depend on the circumstances under which the block is to be used. The length of each limb may be of the order of 5 to 10 feet or more depending on the weight of block desired. The block may be made of mass concrete and in general this will provide sufficient strength. In cases where the wave action is likely to be particularly severe, however, the block may of course be reinforced with steel.

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2. A block according to claim 1, which has four limbs which lies along the edges, other than two non-adjacent edges of the tetrahedron.

3. A block according to claim 1 or claim 2, in which the limbs are circular in cross-section and fillets are provided between the limbs at their junctions.

4. A block according to any one of the preceding claims, which is a monolithic concrete moulding.

5. A marine or riverine structure comprising or consisting of a stack of blocks in accordance with any one of the preceding claims.

6. A groyne comprising a row of blocks in accordance with any one of the preceding claims with an apex of each block other than the block at one end of the row fitting between two limbs of the adjacent block.

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* C L M S *

meet this second requirement it is desirable that the blocks should remain in equilibrium in whatever position they come to rest when placed in position and also that the blocks should tend to interlock with each other to a certain extent so that each block contributes to the stability of its neighbours. With these aims in view, according to the present invention, such a protective block comprises three or more limbs which lie along the edges of a tetrahedron in two or more planes, adjacent ends of the limbs being rigidly fixed to each other at the corners of the tetrahedron.

Preferably the block has four limbs which lie along the edges, other than two non-adjacent edges, of a tetrahedron. With the arrangement each end of each limb is fixed to the adjacent end of one other limb and the resulting block is particularly strong and can be made of concrete with little or no reinforcement. When the block has only three limbs reinforcement is usually necessary to make the block sufficiently strong to withstand the pounding which it is likely to receive from waves.

The porosity of a bank or layer formed of blocks made in accordance with the invention depends amongst other factors on the ratio of the length of the limbs of the blocks to their thickness. If the ratio is too high the bank or layer will be too porous and of insufficient resistance to wave penetration, and also the block will be structurally weak and liable to be broken by the waves. If, on the other hand the ratio is too small it becomes more difficult for a limb or limbs of one block to engage between the limbs of an adjacent block, in consequence the blocks do not interlock satisfactorily and a bank or layer formed from them is not well knit together. The ratio can, however, vary over quite wide limits although in general the free length of any limb between its junctions with other limbs should not be less than its thickness, that is to say the above ratio should not be less than 1, neither in most circumstances should it be greater than about 8. The cross-section of the limbs is preferably circular although it may be rectangular or polygonal.

A perspective view of a preferred example of a block made in accordance with the invention is shown in the accompanying drawing.

This block is moulded monolithically out of concrete. It has four limbs lying along the edges of a regular tetrahedron. Each limb is circular in cross-section and fillets are provided to strengthen the junctions of the ends of the limbs. The free length of each limb between these fillets is approximately twice its diameter. The overall length of each limb and hence the total weight of the block will of course depend on the circumstances in which the block is to be used. The length of each limb may be of the order of 5 to 10 feet or more, depending on the weight of block desired.

A number of these blocks may be placed in a random or regular manner to form a bank along the faces of an existing structure to protect it and give it added resistance to wave action. In some cases a mound of these blocks may by themselves form a breakwater and in other cases the blocks may be placed in a random or regular manner to protect the surfaces of a new marine structure built of materials which would not otherwise adequately resist wave action.

A number of blocks according to the present invention may also be arranged in line, with one apex of one block fitting between two limbs of the adjacent block, to form a groyne, or the blocks may also be placed regularly or at random on a beach to reduce erosion or denudation, by wave or current action.

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