Development of the Kite Anchor

To moor Mulberry Harbour's Whale bridges and keep them straight in any weather required a mooring at each pontoon capable of withholding a pull of 20 tons. To give a reasonable margin of safety some form of anchor with a holding power of 30 tons was necessary. To lay these anchors quickly over the beaches dictated that they should be of light weight and fairly easily handled in small craft capable of operating in shallow water.

In the search for a suitable anchor I studied all of the well-known types together with high efficiency special duty anchors. These existing anchors fell broadly into two classifications:-

a) clump or heavy weight type. These anchors offer resistance to the pull by means of great weight, in the same way that it is more difficult to push along a large square stone than a small one, so is additional holding power found by an increase in weight.

b) 'mudhooks'. As the classification suggests these anchors use a little more science than the heavy weight type in that they use the principle of a hook penetrating the sea bed. To hold a given load in a given sea bed a mudhook anchor can generally be of less weight than a heavyweight type of anchor so that the search for a suitable 'Mulberry' anchor naturally took this direction.

It was found that the designs for mudhooks were many and various but included always two essential features:

a) one or more flukes or prongs to penetrate the sea bed

b) a shaft attached to the prong or prongs so disposed that when subjected to a pull from a cable the prong or prongs are rigidly attached to the shaft. Some anchors have a hinged attachment as this allows the prong to take up a more favourable angle once penetration of the sea bed has commenced. The shape of the arms on these anchors varied little. The shape of the prongs was either pointed like a needle, spear shaped or plough shaped.

Investigations with these various types of 'mudhook' showed that holding power depends on -

a) the softness of the sea bed

b) the strength of the anchor

c) the resistance offered by the prong

d) the depth to which the prong penetrated

When increasing loads are applied to these anchors, one of two things will happen

a) the anchor will break, or

b) the anchor will drag. Generally in soft bottoms the anchor will drag before it breaks.

In all cases the anchors remain virtually on top of the sea bed.

From initial investigation it became apparent that resistance to dragging depended on the area and depth of penetration of the prong. A study of the sea bed shows that although it may be soft at the top a firmer material will be found underneath.

If therefore an anchor could be designed to burrow completely and be arranged to glide downwards as a result of an increased pull, such an anchor would ultimately find soil of resistance great enough to resist further movement. Moreover such an anchor would present its whole area as a resistance to pull, and not only the area of the prong.

The principle of the whole anchor gliding down to a depth increasing with pull seemed promising and is the fundamental of the 'Kite' anchor. The balance of forces to achieve this end is the same as in a kite which glides to a greater elevation with increased pull on the line.

Having reasoned this far I experimented with models in a sand box. I soon established that a flat plate correctly attached to a line and correctly buried in the sand at the correct angle would penetrate further when the line was pulled. I found that as the plate went deeper so the resistance to pull was increased.

Now, an anchor must be able to take up its holding position whatever its position may be when it falls on the sea bed and however the pull may be applied. In this respect the flat plate was found wanting. To my flat plate I now attached the conventional arm but this alone was found insufficient and was supplemented by the prong together with a hinge allowing the prong to be disposed at an angle to the sea bed favourable for initial entry. This produced a very promising form of burrowing anchor. It was soon found however that if such an anchor was made full size, although it would resist dragging by gliding to a greater depth, it would fail long before a load of 30 tons was reached unless it was made of a material very much stronger than steel. It had in effect a very weak 'hook' action and would fail in the same way as a crane hook made from a bent hair pin. This is where the trouble really started.

When I improved the hook strength by lengthening the hinge, I upset the balance of forces necessary to produce a stable gliding action and my anchor would spin and reappear at the surface as I increased the pull on the line. This was partially rectified by the introduction of a built in 'tail'.

At this stage the model accidentally struck an obstruction and the prong was bent. The anchor with its bent prong failed to function at all and it was obvious that the full size article in service could be rendered ineffective in a similar way by striking a boulder or suchlike. In other words, the prong must be stout. I now had strengthened the model by making the prong of triangular section which enlarged to join the baseplate and hinge.

In this form the model was no longer stable and redeveloped the 'spin' fault. It became apparent that to produce a reliable gliding action was difficult indeed because one feature worked against another and it seemed doubtful whether fundamental natural laws allowed the development of this conception using materials at present available to the engineer. Detailed calculations were made which showed that the original 'flat plate' effect had been lost when the prong was made triangular and streamlined into the hinge support in an effort to strengthen the prong. It was also found by test that the gliding action or flat plate effect was due almost entirely to the action of the cutting edge. Provided the anchor presented a good cutting edge fair latitude in anchor shape was possible but the disposition of this cutting edge was critical in the extreme: try shaving with a razor with a turned edge. A new model was made with a carefully designed T shaped prong and correctly disposed cutting edge and was successful in the sand box. This model was tried in the river bed and immediately showed another fault. In soft mud the weight of the very large hinge caused it to sink, thus raising the prong clear of the river bed so the pull on the line merely dragged the anchor along upside down. This fault was rectified by making the arm hollow and watertight so that when immersed in a fluid it would have a lifting effect. This again affected the balance of forces but I now knew sufficient to completely redesign the anchor for full scale production.

One might say, what is the difference between a Kite anchor and any other kind of mudhook? The difference is the same as that between an airplane that can taxi but not take off and one that can fly.

While other anchors scratch around the surface with the hope of finding something to catch onto, the Kite anchor glides downwards until it finds increased resistance which is sure to be there.

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