CHAPTER VIII.

ARTICLE 85.

ON BUILDING MILL-DAMS, LAYING FOUNDATIONS, AND BUILDING MILL-WALLS.

THERE are several points to be attained, and dangers to be guarded against, in building mill-dams.

1. Construct them so, that the water, in tumbling over them, cannot undermine their foundations at the lower side.*

2. And so that heavy logs, or large pieces of ice, floating down, cannot catch against any part of them, but will slide easily over.†

* If you have not a foundation of solid rocks, or of stones, so heavy that the water will never move them, there should be such a foundation made with great stones, not lighter than mill stones, (if the stream be heavy, and the fall great,) well laid, as low and as close as possible, with their up-stream end lowest, to prevent any thing from catching under them. But if the bottom be sand or clay, make a foundation of the trunks of long trees, laid close together on the bottom of the creek, with their but ends down stream, as low and as close as possible, across the whole tumbling space. On these the dam may be built, either of stone or wood, leaving 12 or 15 feet below the breast or fall, for the water to fall upon. See fig. 3, Plate X., which is a front view of a log dam, showing the position of the logs; also, of the stones in the abutments.

† If the dam be built of timber and small stones, &c., make the breast perpendicular, with straight logs, laid close one upon another, putting the largest, longest, and best logs on the top; make another wall of logs 12 or 15 feet up-stream, laying them close together, to prevent lamprey eels from working through them; they are not to be so high as the other, by 3 feet; tie these walls together, at every 6 feet, with cross logs, with the buts down stream, dove-tailed and bolted strongly to the logs of the lower wall, especially the upper log, which should be strongly bolted down to them. The spaces between these log walls, are to be filled up with stones, gravel, &c. Choose a dry season for this work; then the water will run through the lower part while you build the upper part tight.

To prevent any thing from catching against the top log, flag the top of the dam with broad or long stones, laying the down-stream end on the up-stream side of the log, to extend a little above it, the other end lowest, so that the next tier of stones will lap a little over the first; still getting lower, as you advance up-stream. This will glance logs, &c. over the dam, without their catching against any thing. If suitable stones cannot be had, I would recommend strong plank or small logs, laid close together, with both ends pinned to the top logs of the wall, the up-stream end being 3 feet lower than the other: But if plank is to be used, there need only be a strong frame raised on the foundation logs, to support the plank or the timber it is pinned to. See a side view of this frame, fig. 45, Plate IV. Some plank the breast to the front posts, and fill the hollow space

3. Build them so that the pressure or force of the current of the water will press their parts more firmly together.*

4. Give them a sufficient tumbling space to vent all the water in time of freshets.†

5. Make the abutments so high, that the water will not overflow them in time of freshets.

6. Let the dam and mill be a sufficient distance apart; so that the dam will not raise the water on the mill, in time of high floods.‡

with stones and gravel; but this may be omitted, if the foundation logs are sufficiently long up-stream, under the dam, to prevent the whole from floating away. First, stone, and then gravel, sand, and clay, are to be filled in above this frame, so as to stop the water. If the abutments be well secured, the dam will stand well.

A plank laid in a current of water, with the up-stream end lowest, set at an angle of 22½ degrees, with the horizon or current of the water, will be held firmly to its place by the force of the current, and, in this position, it requires the greatest force to remove it; and the stronger the current, the firmer it is held to its place;—this points out the best position for the breast of dams.

* If the dam be built of stone, make it in the form of an arch or semicircle, standing up-stream, and endeavour to fix strong abutments on each side, to support the arch; then, in laying the stones, put the widest end up-stream, and the more they are forced down-stream, the tighter they will press together. All the stones of a dam should be laid with their up-stream ends lowest, and the other end lapped over the preceding, like the shingles or tiles of a house, to glance every thing smoothly over, as at the side 3, of fig. 3, Plate X. The breast may be built up with stone, either on a good rock or log foundation, putting the best in front, leaning a little up-stream, and on the top lay one good log, and another 15 feet up-stream on the bottom, to tie the top log to, by several logs, with good buts, down-stream, dove-tailed and bolted strongly, both at bottom and top of the top and up-stream logs; fill in between them with stone and gravel, laying large stones slanting next the top log, to glance any thing over it. This will be much better than to build all of stone; because if one at top gives way, the breach will increase rapidly, and the whole go down to the bottom.

† If the tumbling space be not long enough, the water will be apt to overflow the abutments; and if they be of earth or loose stones, they will be broken down, and, perhaps, a very great breach made. If the dam be of logs, the abutments will be best made of stone, laid as at the side 3, in fig. 3; but if stone is not to be had, they must be made of wood, although it will be subject to rot soon, being above water.

‡ I have, in many instances, seen a mill set so close to the dam, that the pier-head, or forebay, was in the breast, so that, in case of a leak or breach about the forebay, or mill, there is no chance of shutting off the water, or conveying it another way; but all must be left to its fate. Such mills are frequently broken down, and carried away; even the mill stones are sometimes carried a considerable distance down the stream, buried under the sand, and never found.

The great danger from this error will appear more plainly, if we suppose six mills on one stream, one above the other, each at the breast of the dam, and a great flood to break the first or uppermost dam, say through the pier head, carrying with it the mill, stones, and all; this so increases the flood, that it overflows the next dam, which throws the water against the mill, and it is taken away; the

ARTICLE 86.

ON BUILDING MILL-WALLS.

The principal things to be considered in building mill-walls, are,

1. To lay the foundations with large, good stones, so deep as to be out of danger of being undermined, in case of such an accident as the water breaking through at the mill.*

2. Set the centre of gravity, or weight of the wall, on the centre of its foundation.†

water of these two dams has now so augmented the flood, that it carries every mill before it until it comes to the dam of the sixth, which it sweeps away also; but suppose this dam to be a quarter of a mile above the mill, which is set well into the bank, the extra water that is thrown into the canal, runs over at the waste left in its banks for the purpose; and the water having a free passage by the mill, does not injure it, whereas, had it been at the breast of the dam, it must have gone away with the rest. A case, similar to this, actually happened in Virginia, in 1794; all the mills and dams on Falling Creek, in Chesterfield county, were carried away at once, except the lowest, (Mr. Wardrope's,) whose dam, having broke the year before, was rebuilt a quarter of a mile higher up; by which means his mill was saved.

* If the foundation be not good, but abounding with quick-sands, the wall cannot be expected to stand, unless it be made good by driving piles until they meet the solid ground; on the top of these may be laid large, flat pieces of timber, for the walls to be built on; they will not rot under water, when constantly excluded from the air.

† It is a common practice to build walls plumb outside, and to batter them from the inside; which throws their centre of gravity to one side of their base. If, therefore, it settles any, it will incline to fall outwards. Mill-walls should be battered so much outside, as to be equal to the offset inside, to cause the whole weight to stand on the centre of the foundation, unless it stands against a bank, as the wall next the wagon, in Plate VIII. The bank is very apt to press the wall inwards, unless it stands battering. In this case, build the side against the bank plumb, even with the ground, and then begin to batter it inwards. The plumb rules should be made a little widest at the upper end, so as to give the wall the right inclination, according to its height; to do which, take a line, the length equal to the height of the wall, set one end, by a compass point, in the lower end of the plumb rule, and strike the plumb line; then move the other end just as much as the wall is to be battered in the whole height, and it will show the inclination of the side of the rule, that will batter the wall exactly right. The error of building walls plumb outside, is frequently committed in building the abutments of bridges; the consequence is, they fall down in a short time; because the earth between the walls is expanded a little by every hard frost, which forces the walls over.

3. Use good mortar, and it will, in time, become as hard as stone.*

4. Arch over all the windows, doors, &c.

5. Tie them well together by the timbers of the floors.

* Good mortar, made of pure, well-burnt limestone, properly made up with sharp, clean sand, free from any sort of earth, loam, or mud, will, in time, actually petrify, and turn to the consistence of a stone. It is better to put too much sand into your mortar than too little. Workmen choose their mortar rich, because it works pleasantly; but rich mortar will not stand the weather so well, nor grow so hard as poor mortar. If it were all lime, it would have little more strength than clay.