

1. It remains to deal with the suitable arrangement of harbours,² and to explain by what means, in these, ships are protected from stormy weather. There are great advantages if they are well placed by nature and have headlands (acroteria) jutting out, behind which bays or creeks are formed owing to the nature of the place. For round these colonnades either docks are to be made, or approaches from the colonnades to the warehouses. On either side towers are to be built from which chains¹ (across the harbour) can be drawn by machinery.

2. But if we have no natural harbour suitable for protecting ships from a stormy sea, we must proceed as follows. If there is an anchorage on one side without any river mouth to interfere, piers are to be constructed on the other side by masonry or embankments in order to form an enclosed harbour. The masonry which is to be in the sea must be constructed in this way. Earth² is to be brought from the district which runs from Cumae to the promontory of Minerva,³ and mixed, in the mortar, two parts to one of lime. 3. Then in the place marked out, cofferdams,⁴ formed of oak piles and tied together with chains, are to be let down into the water and firmly fixed. Next, the lower part between them under the water is to be levelled and cleared with a platform of small beams laid across and the work is to be carried up with stones and mortar as above described, until the space for the structure between the dams is filled. Such is the natural advantage of the places described above.

But if on account of the breakers or the violence of the open sea, the supports cannot uphold the dams, then a platform is to be laid, as firmly as possible, starting from the edge of the shore or from a breakwater. This platform is to be laid with a level top (towards the sea) less than half its width; towards the shore, it is to have a sloping side. 4. Then towards the water and on the side of the platform construct margins projecting about one and a half feet level with the top mentioned above. Then the overhanging part is to be filled up underneath with sand and made level with the margin and the surface of the platform. Next, a pillar of the size appointed is to be built upon the levelled surface, and when it is finished, it is to be left to set for two months. The margin which keeps up the sand is to be cut away: thus the sand is washed away by the waves and causes the pillar to fall into the sea. In this way, as often as it is necessary, the pier is carried further into the water.

5. Where, however, the earth in question is not found, we must proceed as follows. Double cofferdams bound together with planks and chains are to be put in the place marked out. Between the supports, clay in hampers¹ made of rushes is to be pressed down. When it is well pressed down and as closely as possible, the place marked out by the enclosure is to be emptied with waterscrews and waterwheels² with drums, and so dried. Here the foundations are to be dug. If the foundations are on the sea bottom, they are to be emptied and drained to a greater width than the wall to be built upon them, and then the work is to be filled in with concrete of stone lime and sand. 6. But if the bottom is soft the foundations are to be charred piles of alder and olive filled in with charcoal, as prescribed for the foundations of theatres and the city walls. The wall is then raised of squared stone with joints as long as possible, so that the middle stones may be well tied together by the jointing. The inside of the wall is then to be filled in with rubble or masonry. Thus it may be possible for a tower to be built upon it.

7. Subsequently the shipyards are to be built and with a northern aspect, as a rule. For southern aspects because of their warmth generate dry rot, wood worms and ship worms with other noxious creatures, and feed and maintain them. Further, such buildings should have very little wood in them because of fire. As to their dimensions no rule should be laid down. They are to be made to take the largest vessels; so that even if such vessels are drawn ashore, they may have a roomy berth.