THEESIS

on

FOUNDATION'S

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CE Class 1875
By the foundations of structures we mean the lower course of stone on which the structure is to stand, hence to much attention cannot be paid to the foundation for the foundation the durability of the structure depends.

In order to discuss this subject of foundations let us look at the nature of the several varieties of subsoil on which the foundation is to stand, and also the several varieties of stone.

1. Foundation on solid rock. In laying a foundation on rock it is necessary that rock should be properly tested to ascertain its durability and strength, and a proper preparation of its surface on which the structure is to stand, by rem-
overing all the surface which is liable to decomposition by the action of the frost &c., and also care should be taken to make the surface of the rock or bed perpendicular to the direction of the pressure of the wall. If a good foundation, where the work can be had, it is the best and most durable foundation that can be had.

Foundation on Strong Ground

In strong ground where there is no danger of lateral yielding all that is necessary is to excavate to a depth where there will be no danger of the injurious action of the frost, but if no case there is danger of lateral yielding the bed on which the foundation is to stand should be protected.
by settling piles. It would be advisable in all cases where heavy walls are to be built on ground of this character to protect them with piles. Foundations on the sand.

In laying a foundation on the sand, extra precautions should be observed for the sand is in most cases liable to unequal settling therefor it will be necessary to lay a platform on the bed of well seasoned wood in order to distribute more evenly the pressure over the surface. When there is danger of the bed under the foundation of being damaged by springs they should be cut off.
Foundations on common clay, the ordinary soil, and the marshy soil.

As the nature of these soils is to a great extent compressible and are mixtures of unequal settling piles should be driven at close intervals on which a platform to receive the foundation of the structure. In account of the wooden platform not being absolutely safe enough to receive a very heavy load, this defect is prevented by laying a bed of bateon on the heads resting on both piles and the intervening soil, this seems to be the only safe way to preserve the stability of the wall above it.

In driving the piles care should be taken to drive them to a
proper depth, that is to a compact and firm soil where there is no danger of yielding. In some instances the piles are withdrawn and the holes filled with sand, but as water courses are liable to penetrate the sand support and thus destroy the security of the structure and hence endanger the wall by unequal settling of the bed. Foundations under water To lay a foundation under water there is two great difficulties to be carefully observed by the engineer in order that the safety of the structure. The first of this is the means need to prepare properly the bed on which the foundation is to rest. The second is that the
...uity of the bed from the action of the water, which is liable to wash away portion of the bed and thus cause it down fall hence great care should be taken in both preparing the bed to receive the foundation and to protect it from destructive action of the water.

To prepare the bed for the foundation it is necessary to expel the water from the shore where the foundation is to be laid. The method for doing this differs in the character and depth of the water. In shallow water this is done by surrounding the place where the structure is to stand by a dome composed of clay and other substances of a compact character.
In streams of water at a greater depth, the common clams should be replaced by sheathing piles, consisting of two rows of planks driven in to the ground surrounding the area and filled in between the two rows with compact soil. Sufficient thickness should be given to the clams in order that filtration may be prevented. The piles should be driven into solid soil below the depth of the bed of the foundation.

In preparing the bed care should be taken to excavate through the soft soil and to a depth where there is no danger of the bed being destroyed by the action of the current. It is also necessary that the piles, for the
foundation to rest upon should be driven to a considerable depth, on which should be placed a bed of buton of a sufficient quantity to ensure stability to the structure and to prevent unequal settling on account of the water washing under portions of the bed. But for more extensive structures as the bridges' piers, care should be taken to ensure sufly to the structure and to the safety of life. In this case the foundation should be founded upon the solid rock in every case where it is possible to reach it.

The Piers of the Kansas City Bridge It was designed at first that the piers No. 4, 2, 3. Numbering from the south side of the river, should rest upon the solid rock while the four
More northerly piers should not upon pile foundation. The piles were to be driven in excavated pits and cut off in every instance at a considerable depth below the natural bed of the river and further secured by an ample protection of reeds and the piles under No. 4 pier to be driven home to the rock and cut off at least 25 feet below the extreme low water marks, but the experience acquired during the progress of the work led to a subsequent change in the plan of pier No. 4 and was treated as a first pier and placed upon solid rock and the piles under No. 5 pier driven home to the rock thus leaving 3 piers to stand upon.
The pile foundation, only two of which depend upon the frictional surface of the pile for their support, Piers No. 5 and 6 are on the dry land but 9 months out of the year and piers No. 7 are situated within in the line of the wooded shore is exposed to the action of the water only on rare occasions.

During the works no cement strong enough to produce Lebanon was noticed about any one of the piers.

The South abutment was founded upon solid rock near the surface of the ground and also the two piers.

Piers No. 7

Piers No. 7 is situated on the south side of the stem-holt channel and at ordinary stages of water.
It stands about 100 feet from the shore. The bed rock was found 78 feet below the low water mark. The rock was found to be very irregular and it was necessary to drill it to a regular surface perpendicular to the direction of the pressure.

Pier No. 1

The base of the masonry was started at an elevation of 25 feet being placed upon 8 foot batin which was founded upon the rock.

Pier No. 2

The rock on which this pier was founded was found at an elevation of 62½ feet or 30 feet below the extremum low water mark.
Pier No. 4

This pier was the first place to be placed upon a pile foundation. But on account of the heavy deposits of sand in that place and the strain that was produced upon the pile on the south side of it compelled the overhand of this plan and the foundation was placed upon the solid rock which was reached at an elevation of 56 feet.

Pier No. 5

By boring the rock was found at an elevation of 78.5 feet, 31 feet below the base of the embankment an account of the sand becoming very more compact during the driving of the piles it was found impossible to force down
The last 40 piles to the rock.
149 bearing piles being driven and were cut off at an
elevation of 88.9 feet above the sand was filled with bat-
on which served to tie the piles together and being enclo-
sed by a casing would itself form a supporting foun-
dation. If not mined by the beams, the pit
was humped dry and the piles were capped with put-
tured sycamore sticks on which was laid a second
course of timber of the
same kind. The hollow sp-
alls being all filled with
battens on this the masonry
was started at an elevat-
tons of 91 feet large stones were placed around the pile to break the ripple.

Pier No. 6

The pit for receiving the foundation was dug to a depth of 15 feet below the sand bar reaching an elevation of 94 feet.

The sheathing piles were driven down as the works proceeded and the water kept out by the aid of pumps.

The pile drivers were then mounted over the pit and the heaving piles of the foundation driven. These were 90 six-inch number and penetrated to an elevation average depth of 30 feet after the heads of the piles were shaved off. They were supplied with
flattened eucamore sticks, which a second course of timber was laid which was planked with pitch oak planks finished at an elevation of 99.7 on which the masonry was laid.

Piers No. 7:

The piles on which this foundation rested were 73 in number and were driven 17 feet into the ground. After the piles were smoothed off and capped the masonry was commenced.

Masonry

The stone used was limestone which was obtained it is that vicinity (Kansas City) several varieties of stone were used the best of whi-
It was compact blue linen stone of nearly uniform color found in continuous layers varying from 15 inches to 2 feet in thickness. As this stone could not be obtained in large quantities without very expensive stripping its use was confined to the ashlar work of the upper part of the pile. The whole of the pile below the top of the ice-bank was built of a more coarsely grained stone of a white or gray color which worked into thicker, closer than the blue stone. The boiler room was composed of lime stone dust and cement the proportions varying for the purposes
To which, they was to be mixed.
The batch used in Pit No. 3 was formed of 6 parts of stone to
8 of sand and 2 of cement after which it was found that
for much sand was not favorable for rapid settling and
the amount of sand was reduced.
The batch in No. 4, 8 parts of stone to 2 parts of sand and 30% cement. The batch used in No. 2
was the same as last.

Remarks
We think that if the branch
pier had been lowered to
the rock, which was not
very far that the structure
would be much safer in the long run but o
It is thus one liable to be undermined by the water and thus crippled.
It would also have been better if the foundation stone had been of a better quality of lime stone, as it is they are built of coarse granulated stone which is not durable as a stone of a smaller grain. The coarse grained stone is more liable to disintegrate by the action of the water. Other wise the foundations seems to become endless.

Stone required for foundation stone.
First let us consider the silicious stones. The principle.
The constituent of this stone is feldspar. This stone, as generally designated by the presence of its stone's fields, public quantity around. The siliceous stone do not generally preserve with said they possess in a high degree the properties of strength, hardness and durability, and although preserving a great dignity the formation, hard, they furnish an excellent building stone for the engineer of the buildings shows the pristine porphyry and green stones.

Siniti
Siniti stone consists of
feldspar hornblende and quartz diorite furnishes one of the best building stones particularly for structures which require great strength and for those exposed to the destructive action of the water, diorite may be furnished from the granite of any requisite size.

On account of its extreme hardness it cannot be brought to a smooth surface.

Porphyry

On account of its rareness it is seldom used for either the ornamental or purposes the color of the porphyry is grayish to a purple.
Green Stone

This stone is a mixture of limestone with a compact feldspar granulite. It is very hard and is one of the most durable rocks. Its use as a building stone is very much restricted.

Calcareous Stone

The common lime stone is the principal variety of this class. The lime stone is a general ingredient and is used extensively in the construction of extensive structures.
mes. We may divide lime-
stone into two classes 1. com-
 pact lime stone and 2. gran-
ular lime stone. The 1st is in-
frequent to the 2nd as a building
stone. The 1st class of stones are
generally used for ornamental
purposes. The 2nd class is ver-
y valuable as a building stone
it being the principle alone
used in the founding of
buildings, Piers of bridges
etc.

The coarse granite lime stone
are frequently friable and
deteriorate very rapidly
when exposed to the moisture
in the distinct action
of the water.