During the construction the adjacent railway-embankment was displaoed 20 om in a horizontal direction.

The graphs show the rate of compression of the substrata and of the expulsion of the enclosed water from the olay-layers. This water had to be expelled upwards as the underlaying sand-layers are relatively impervious (wells in the environment gave aocording to Forchheimer $k = 0.0002$ om/seo for these layers, while the hydraulio fill is estimated at $k = 0.008$ om/sec.)

The total settlement to be expected can be estimated from the graphs.

Connection between internal pressure and shearing resistance. In the writer's opinion the chief value of the submitted data must be found in the survey they give of the conditions in the substrata during the actual operations in the field. During the constructions at the Dijksgracht the olay-layers could be considered as completely encased and their evident liquifaotion gave a possibility of forming an idea about horizontal pressures in various layers direot from the pressures in the graphs. Up to two times the high pressures observed led to postponing further raising of the new embankment as calculations showed that the horizontal pressures in the liquified olay-strata menaced the adjacent railway-embankment. Fills in which the poor subsoil can not be replaced beforehand, as was done at the Dijksgracht, are often found in practice. In such cases the high shearing stresses found along the toes of the embankment as a result of the diminishing vertical pressures may cause failure of the subsoil. The shearing resistance of soils which is decessive for the stability of the construction must in the writer's opinion be closely dependent on the internal pressures.

Dr. Jürgenson published some very interesting results of shearing tests which tended to show a proportionate relation between consolidation-pressure and shearing strength.

If a certain soil is known to have a coefficient of internal friction of 0.3 for consolidated samples and presuming that during construction a pressure of 1 kg/cm² is applied in a certain spot and an internal water pressure is found there of 6 m then the shearing resistance in this spot could be expressed as $0.3 \times 0.4 = 0.12$ kg/cm².

Although further tests are necessary it would appear that the shearing resistance of non-consolidated soils could be deducted on the lines laid down above and in this way a clear realization could be obtained of the equilibrium existing at any given time during the actual course of the work.

No. F-10 SETTLEMENT OF THE SOIL SURFACE AROUND THE FOUNDATION PIT DURING THE CONSTRUCTION OF THE LOCKS AT VREESWIJK RESULTANT ON THE SINKING OF THE GROUNDWATER

ir. W. H. Brinkhorst, Chief Engineer of the "Rijkswaterstaat"

Introduction. For the construction of the locks at Vreeswijk in the tributary canal towards Vreeswijk of the shipping-communication between Amsterdam and the Upper-Rhine, it was necessary to dig a foundation pit with the dimensions of 270 m x 52 m and with the bottom at 6.50 m below the soil surface (see Appendix 1).

During the construction of the locks this foundation pit had to be drained by means of a well-point system.

At the preceding geo-hydraulogical research it had been found from the boring, that had been done, (see Appendix 1) that the soil from the surface downwards consists of olay and peatlayers, that reach to 6 or 7 m below the soil surface. Below this olay and peatlayers we find a layer of diluvial sand, that at 20 m below the soil surface lays on a clay layer with a thickness of 3 to $5\frac{1}{2}$ m. From the observations, that were done to fix the natural rising height of the underground water, it could be deduced, that the groundwater rose above the soil surface as a rule (about 25 cm) and was artesian, so that the olay and peat-complex met with an upward pressure.

Construction of the digging and the well-point system of the foundation pit. The digging of the foundation took place by means of a cutterdredge. During these proceedings a level of 0.25 m below the soil surface was kept with an open draining.

On November 15, 1934 the digging was finished and, by means of an open draining there was made the beginning to settle gradually the level in the foundation pit till 4 m below the soil surface (4 m - Amsterdam zero) and could be proceeded to construct the welldrains and the suction piping.

The installation for the well-point system consisted of a shut suction piping, with which 55 welldrains, that were placed at intervals of 10 or 15 m, were connected. The lower side of the drains reached till a depth of 7.5 m below the bottom of the foundation pit.

On January 12, 1935 the well-point system could partly be set going and in cooperation with the open draining the level was settled further. On Appendix 2 the several levels, which were measured in the placed gauge-tube A, are marked.

On January 25, 1935 the open draining could be left off and the further sinking of the groundwater was done by the well-point system.

During the construction of the locks, a waterlevel, that was at least 1 m below the bottom of the foundation pit, was kept. In gauge-tube A a water level of about 8 m - A.zero was measured (look at Appendix 2) for which the welldrains had to be sunk till 9 m - A.zero and 300 to 350 l water/sec. had to be pumped up.

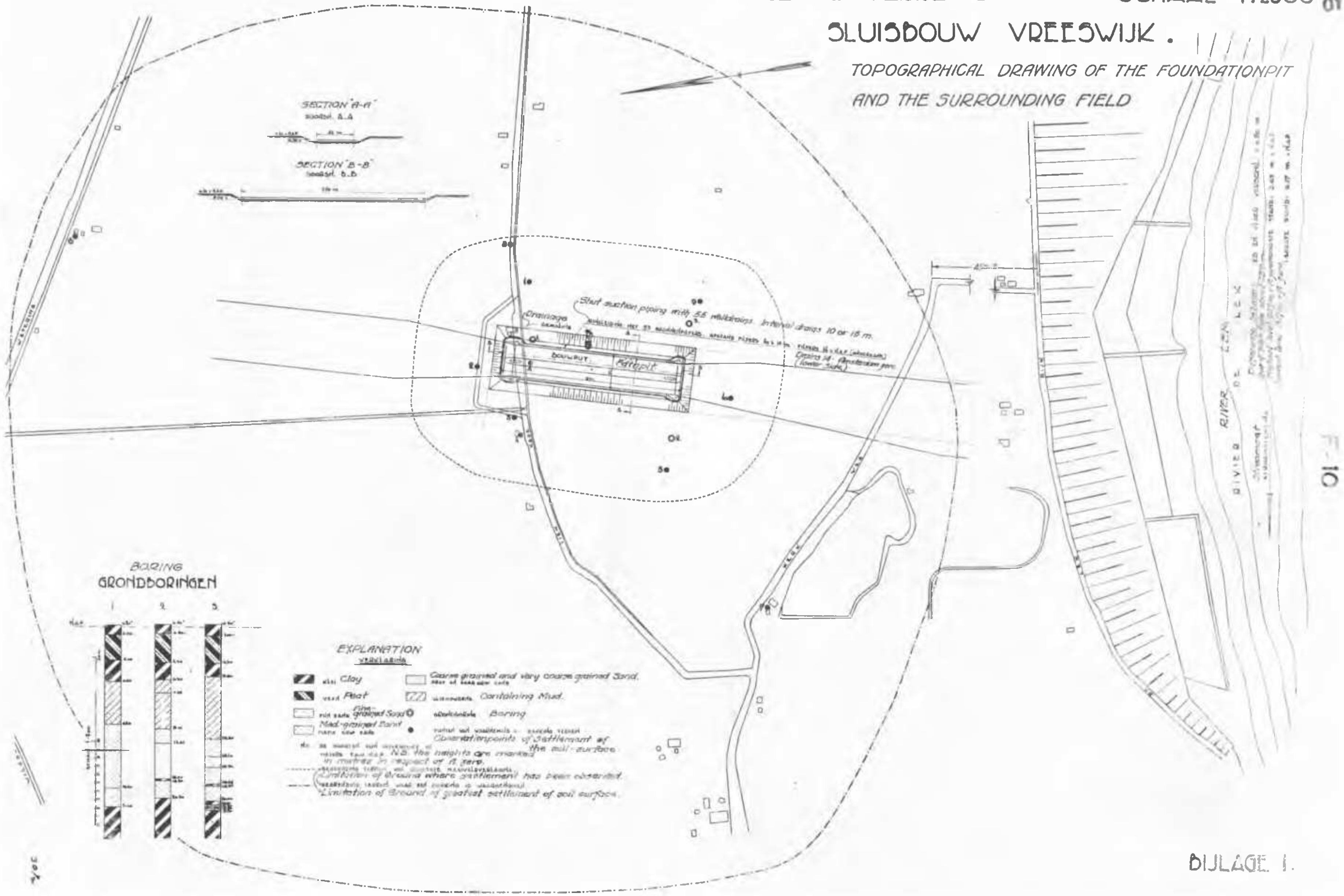
On October 15, 1935 the construction of the locks had got on so far that the well-point system gradually could be left off; on January 15, 1936 it was finished entirely and a level of 3.50 m -

SITUATIE BOUWPUT EN OMLIGGENDE TERREINEN.

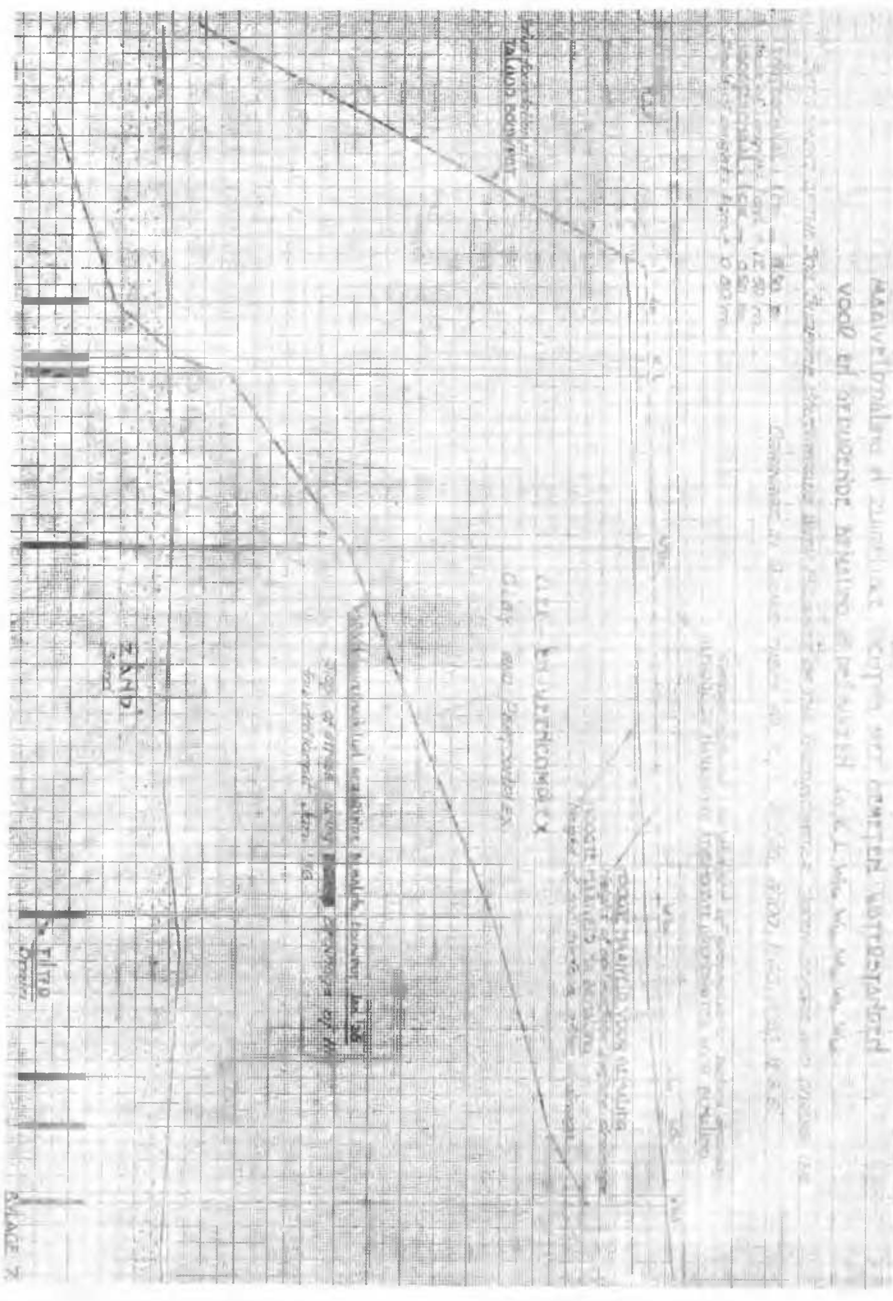
SCHAAL 1:2500

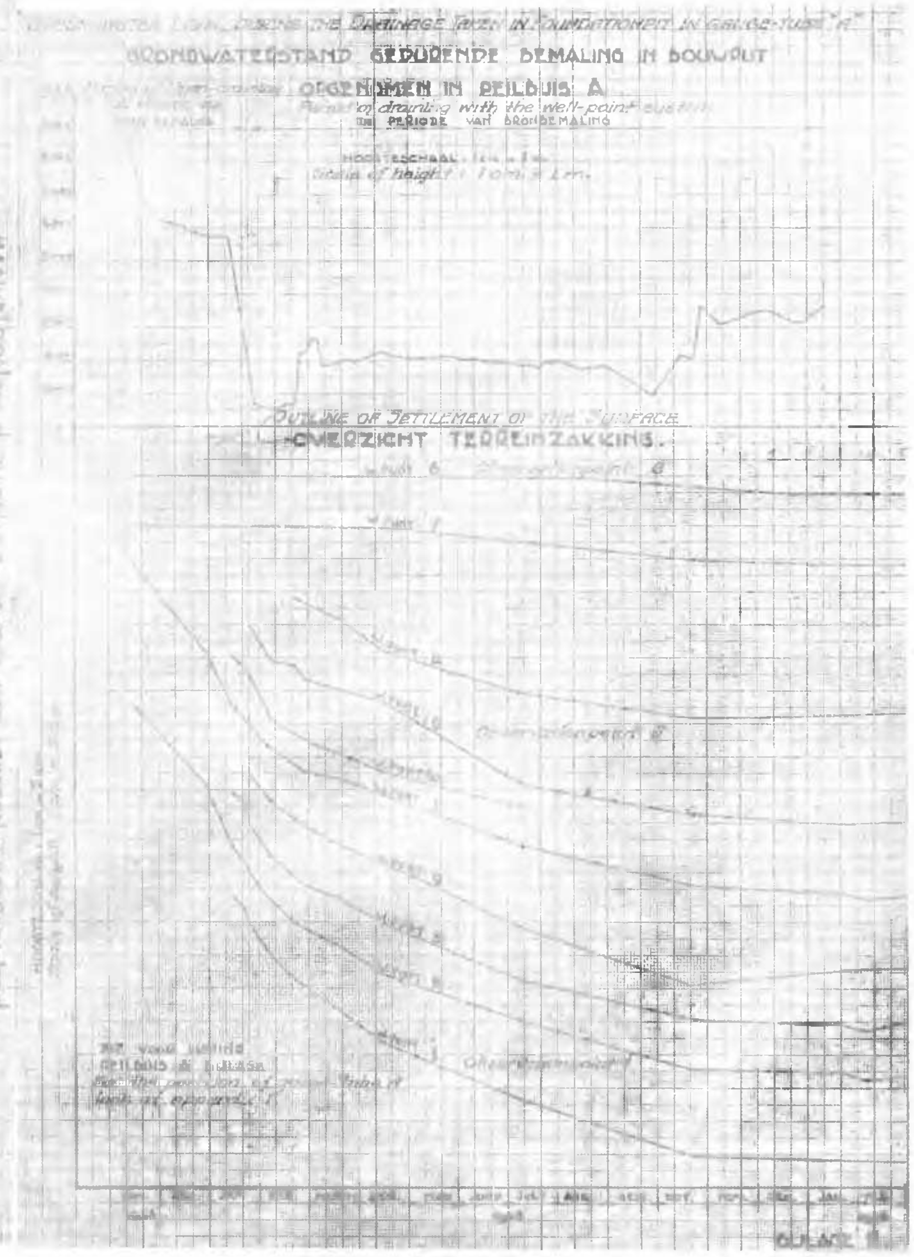
SLUISBOUW VREESWIJK.

TOPOGRAPHICAL DRAWING OF THE FOUNDATIONPIT AND THE SURROUNDING FIELD

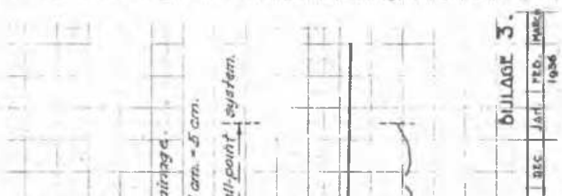


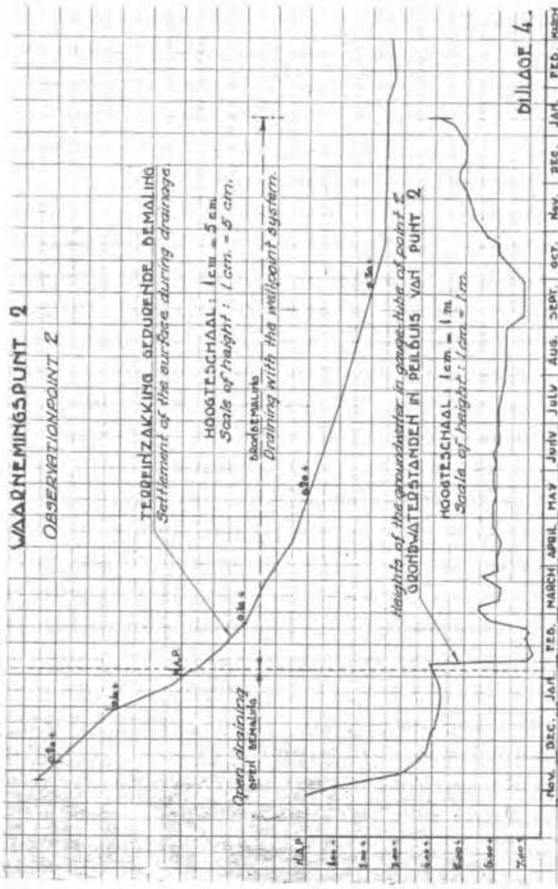
BIJLAGE I.

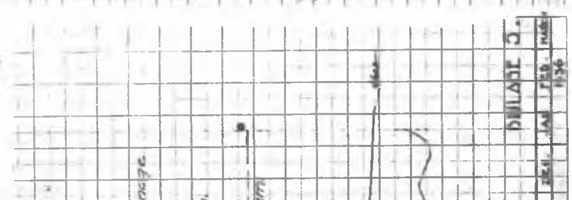


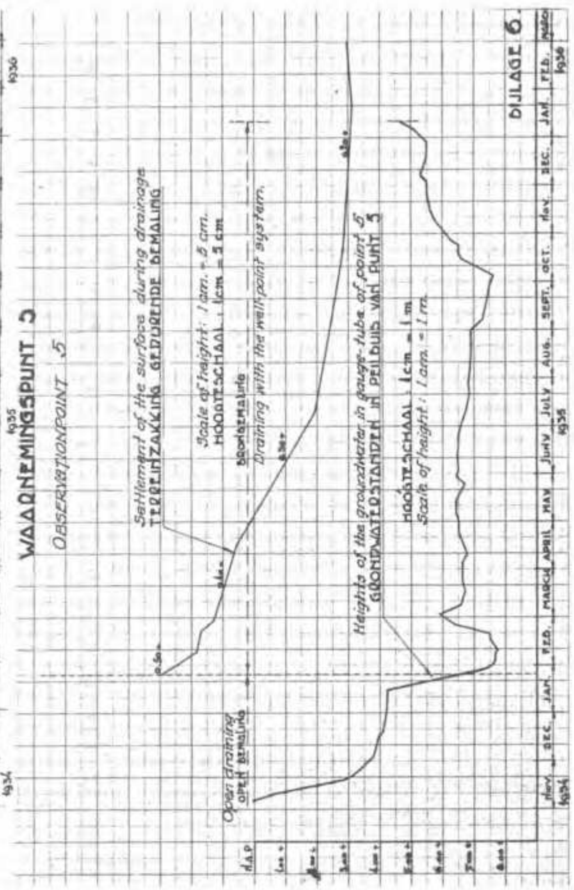

GRONDWATERSTAND GEDURENDE BEMALING IN BOUWPUT
OPGENOMEN IN PEILBUIS A
Period of draining with the well-point system
PERIODE VAN BRONBEMALING
HOOGTESCHAAL
Scale of height
OUTLINE OF SETTLEMENT OF THE SURFACE
OVERZICHT TERREINZAKKING.

F-10


WAARNEMINGSPUNT 1
OBSERVATIONPOINT 1
TERREINZAKKING GEDURENDE DEMALING
Settlement of the surface during drainage.
Scale of height: 1 cm. = 5 cm.
Open draining
OPEN DEMALING
Draining with the well-point system.
Scale of height: 1 cm. = 1 m.
BIJLAGE 3.


WAARNEMINGSPUNT 2
OBSERVATIONPOINT 2
TERREINZAKKING GEDURENDE DEMALING
Settlement of the surface during drainage.
HOOGTESCHAAL: 1 cm = 5 cm.
Scale of height: 1 cm. = 5 cm.
BRONBEMALING
Draining with the wellpoint system.
Open draining
OPEN DEMALING
Heights of the groundwater in gauge-tube of point 2
GRONDWATERSTANDEN IN PEILBUIS VAN PUNT 2
HOOGTESCHAAL: 1 cm = 1 m.
Scale of height: 1 cm. = 1 m.
N.A.P.
BIJLAGE 4.


WAARNEMINGSPUNT 4
OBSERVATIONPOINT 4
Settlement of the surface during drainage.
TERREINZAKKING GEDURENDE DEMALING
Scale of height: 1 cm. = 5 cm.
Open draining
OPEN DEMALING
BRONBEMALING
Draining with the well-point system.
GRONDWATERSTANDEN IN PEILBUIS VAN PUNT 4
BIJLAGE 5.


WAARNEMINGSPUNT 5
OBSERVATIONPOINT 5
Settlement of the surface during drainage
TERREINZAKKING GEDURENDE DEMALING
Scale of height: 1 cm. = 5 cm.
HOOGTESCHAAL: 1 cm = 5 cm
BRONBEMALING
Draining with the wellpoint system.
Open draining
OPEN DEMALING
Heights of the groundwater in gauge-tube of point 5
GRONDWATERSTANDEN IN PEILBUIS VAN PUNT 5
HOOGTESCHAAL: 1 cm = 1 m
Scale of height: 1 cm. = 1 m.
N.A.P.
BIJLAGE 6.

A.zero was kept again by an open draining.

Search after the settlement of the soil surface surrounding the foundation pit. During the digging of the foundation pit some fixed height-points (see Appendix 1, points numbered 1 till 10), required by the construction, were brought on the surrounding field. By a levelling the height of these points, in regard with distant points of which the height was exactly known, was fixed and regularly inspected. It was stated that, the draining of the foundation, set going, the fixed height-points permanently came to lower level.

On Appendix 3 is a graphic representation of the settlements of these points 1 till 10. It can be seen that:

1. All settlements had about the same course;
2. During the period of the open draining and the first months of the well-point system the increase of the settlement was greater than that during the period in which a constant gauge was upheld by the well-point system;
3. After finishing the well-point system no settlement of the soil surface took place.

As the settlement of the soil surface could be explained only in connection with the changes of the groundwaterlevel, in consequence of the draining of the foundation pit it was desirable to know the rising of the groundwater below the soil surface. To know this, a gauge tube, that reached with its lower side below the layer of peat, was placed at every point of which the height was regularly controlled and in which the rising of the groundwater was measured.

On the Appendix 3, 4, 5 and 6 are marked the settlements of the soil surface and the corresponding groundwaterlevel for the observation points 1, 2, 4 and 5. From this information it is apparent that in the points referred to, the level of the groundwater was lower than the lower side of the clay and peat complex.

As it is also of importance to know the expanse of the settling ground several fixed points were placed till a maximum distance of 1500 m from the foundation pit. The height of these points was regularly controlled. At some of these points a gauge tube was placed to measure the groundwaterlevel. From the gathered information could be deduced that, in the points, of which the rising height of the groundwater was above the lower side of the peatcomplex, the soil surface had settled too (see Appendix 7).

By means of the measured settlements of the soil surface the limitations of the ground could be fixed. On Appendix 1 this limitation and also the one of the ground in which the settlement of the soil surface was more than 15 cm is marked.

Conclusion. Cause of the settlements must be sought in the consolidation of the layers of peat, resultant on the reducing of the groundwaterpressure. The extent of the settlement is chiefly dependent on the extent of the pressure reduction and on the compressibility of the various layers. At greater distances the settlement was less than that at the shortest distance of the foundation pit.

The slump of the soil surface settled up to a distance of about 1000 m from the pit at the north side. That the slump settled up less in the direction of the river Lek, finds its explanation in the circumstance that the thickness of the layer of peat decreases and on some places the layer of peat is missing entirely.

The nearness of the river, too, will have exerted influence on the rising of the groundwater.

No. F-11 THE NATIONAL THEATRE BUILDING AND EFFORTS MADE TO PREVENT ITS FURTHER SINKING

José G. Ledesma, Commis. Engineer, Mexico City

The National Theatre building is located on the Eastern end of the Alameda Park with nearest constructions on its Eastern side and the furthest towards the West. The lot on which it stands was the site of the Santa Isabel Church and Convent, both of considerably more weight on the Eastern and Southern facades than the Theatre structure.

The structure has a steel frame planned by Mr. William H. Birkmire, an engineer from New York City, according to instructions and data sumministered by the architect in charge, an Italian, Adamo Boari. The firm Milliken Bros. of New York were contractors for the frame, part of which they built in New York and the rest in Germany.

The outside walls are concrete, 17.32 inches thick, and fill the spaces between beams and columns of each story.

The facades are thick marble anchored with metal hooks to the structures and resting on the grillage of the foundation. All marblostone used is from the native quarries of Mexico as follows: the base, red sepia marble from Tenayo, Yautepec, State of Morelos; the wall facings are in white marblestone from Buenavista, State of Guerrero; mouldings and ornaments in white crystal and clouded marble from Tatatila, State of Veracruz, and the statuary marble from Carrara, Italy.

Inside walls are, some in concrete 17.32 in thick, and others in "Roenmbling" brick, 2 and 5 inches, the former resting on beams and the bricks bonded to the structure. One cannot help but notice the extreme heaviness of the concrete walls and vaults, so unnecessary in the case of a steel frame building; they could have been greatly reduced without affecting the architectural plans in any way and yet, economizing in weight and cost.

Steel frame runs throughout the balcony, boxes, gallery and the stairways that give access to them,