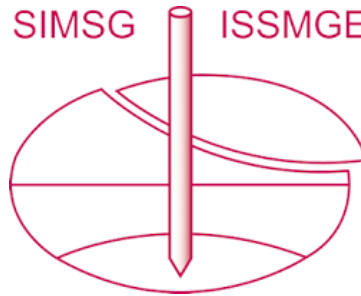


INTERNATIONAL SOCIETY FOR SOIL MECHANICS AND GEOTECHNICAL ENGINEERING



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pressure of 0.57 kg/cm^2 and pressure reaching a maximum of 1.75 kg/cm^2 . No subsequent settling has been observed since then, so the foundation of the chimney stack may well be considered successful. Without reinforcement of the foundation soil, the settling would no doubt have been a multiple of what has actually occurred. Reinforcement along the edge of the foundation proved effective against attack of wind, the settling being absolutely uniform and even so that no leaning could be stated.

2) Erection of a High Building in Vienna, I. Hafnersteig-Laurenzerberg. At the corner of Hafnersteig - Laurenzerberg in the first district of Vienna, the erection of a 9-story reinforced concrete building was planned. An old 3-story house had been standing on its site. The foundation soil had thus been previously compressed, but the far greater load imposed by the building to be erected necessitated special caution in the measuring of foundation. Blatt 6 shows a site-plan of the foundations and the examinations of the soil. At the places marked I and II (large), trial bores were made to a depth of 8.1 m and 13.75 metres respectively, the profiles of which are represented on Blatt 7. Under a bed layer of 0.5 - 1.2 metres a coarse gravel and sand stratum of 3 - 6 metres in depth was found, with gray sand below. Ground water was encountered with at the same level as that of the neighbouring Danube Canal. Probing was made by means of trial boring tools at the 22 places marked on Blatt 6, distributed all over the ground plan of the building. A pointed iron rod of 30 mm in diameter was used, its penetration after 90 blows with a 25 kg hammer being noted in centimetres. Trial shafts were sunk to the depth added in brackets at the places marked A - E. Trial loads with a square pressure area of 200 cm^2 were made at the bottom of the shafts, the results of which will be found on Blatt 8. As a maximum pressure 3 kgs per square centimetre was allowed on the foundation. Blatt 9 shows the dimensions of the actual foundations and their floors. During the erection, measuring bolts for observing the settlement were provided at the places marked on Blatt 10. These bolts were levelled in relation to an outside fixed point by means of a rubber tube level for measuring the settlement according to Prof. Terzaghi. The first levelling was taken during the erection of the second story, the second levelling when the roof level was reached, while a third levelling followed about a month after the main structure had been completed. The settling measured is shown in the following table:

First Levelling: (Dec. 5, 1935). Floor pressure 0.8 kg/cm^2 .
Settling unknown.

Second Levelling: (Jan. 13, 1936). Floor pressure 2.2 kg/cm^2 .

Point 1 (8.5 mm)	Point 6 (7.9 mm)	Point 11 (4.5 mm)
" 2 (-)	" 7 (5.5 ")	" 12 (7.3 ")
" 3 (7.2 ")	" 8 (7.6 ")	" 13 (0.2 ")
" 4 (13.6 ")	" 9 (4.9 ")	" 14 (8.6 ")
" 5 (9.9 ")	" 10 (9.2 ")	" 15 (0.3 ")
		" 16 (8.1 ")

Point 2 was not measured. The mean settling was 6.9 mm.

Third Levelling: (Feb. 19, 1936). Floor pressure 2.5 kg/cm^2 .

Point 1 (9.5 mm)	Point 6 (9.7 mm)	Point 11 (5.8 mm)
" 2 (-)	" 7 (5.9 ")	" 12 (10.2 ")
" 3 (7.2 ")	" 8 (7.6 ")	" 13 (-)
" 4 (13.7 ")	" 9 (6.8 ")	" 14 (8.9 ")
" 5 (10.1 ")	" 10 (9.2 ")	" 15 (0.3 ")
		" 16 (8.1 ")

Point 13 became inaccessible. The mean settling amounted to 8.0 mm.

The settlings measured by the individual measuring bolts at the third levelling are added to the respective points on Blatt 10. The levellings are to be continued. Not the least influence of the settlements on the reinforced parts could be recorded hitherto.

No. F-15

SECURING A VIENNA TENEMENT HOUSE AGAINST INJURIOUS SETTLEMENT BY
REDUCING THE SOIL PRESSURE AND DRAINING THE UNDERGROUND

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The 4-story tenement house shown in its cellar-plan by Fig. 1 stands on a layer of Pontium-sedimentation in Vienna (Meidling). The surface of this layer is there covered with a layer of mixed huminous earth materials and considerably inclined, so that seepage-water from strata of Congeria-sands at a higher level runs down over that less permeable layer and thus seeps into it. There is no actual groundwater-flow in this cohesive soil but only a change of wetting and drying in the underground, covering long periods. At times of excessive soil wetting the water rose above the floor-level of the cellar. Such percolations in the soil and rising water have reduced the frictional resistance of the soil and carried away its fine particles, thus causing considerable differences in settling and

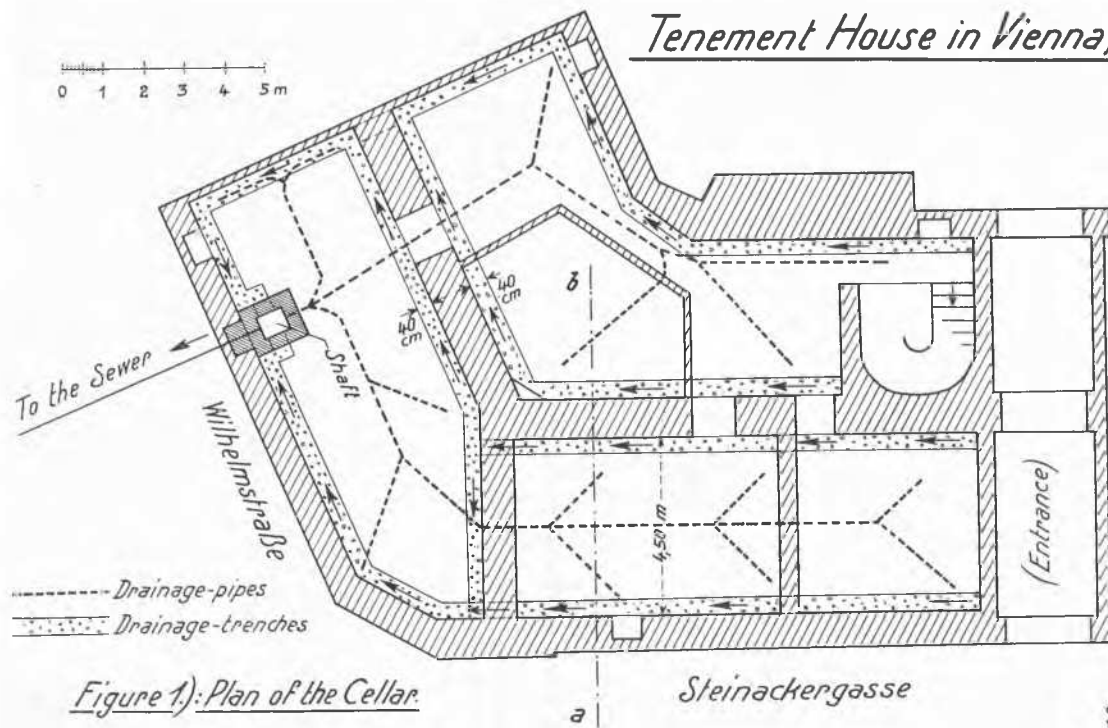


Figure 1): Plan of the Cellar.

Tenement House in Vienna, VII.

Figure 3.): Average Result of the wet mechanical analyse following Groß-Atterberg-Stiny.

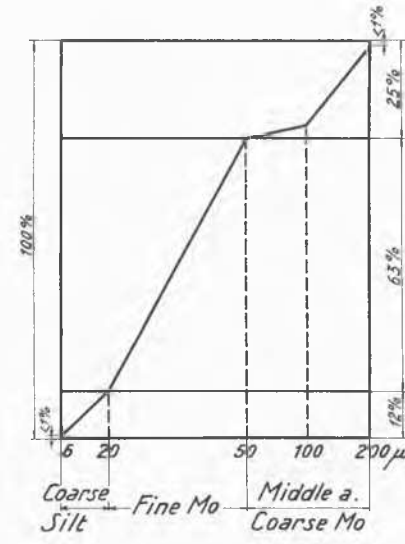


Figure 2): Characteristical section a-b across the cellar.

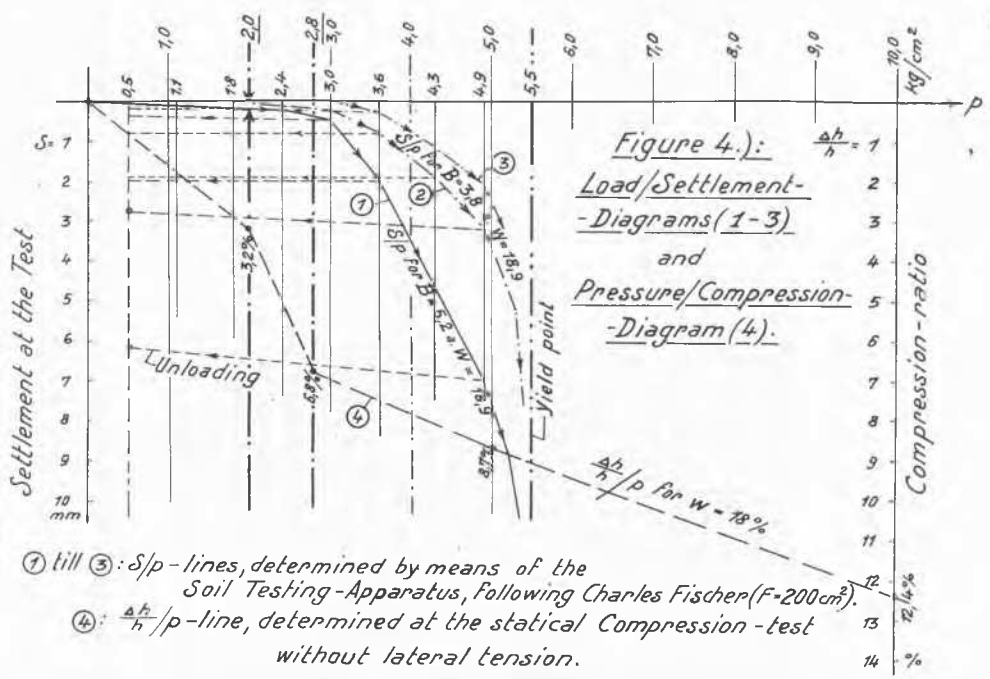
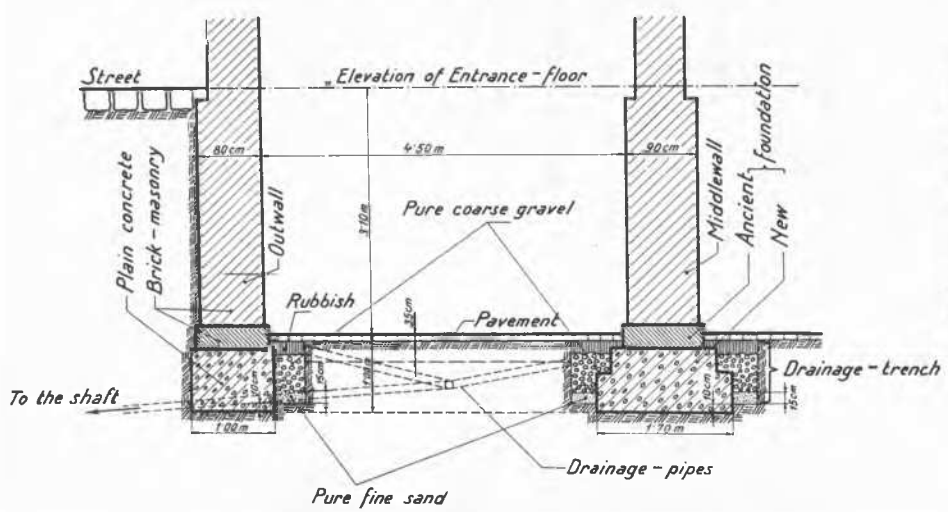


Figure 4.):
Load/Settlement-
Diagrams (1-3)
and
Pressure/Compression-
Diagram (4).

① till ③: S/p -lines, determined by means of the Soil Testing-Apparatus, following Charles Fischer ($F=200\text{ cm}^2$).
④: $\frac{ah}{h}/p$ -line, determined at the statical Compression-test without lateral tension.

dangerous cracks in the walls and partitions of the structure. To prevent this damage, a pipe drainage which effectively dries the soil to a mean depth of 35 cm (see Fig. 1 and 2) was inserted under the cellar-floor in 1929. In spite of this, the cracks in the walls increased dangerously, necessitating a thorough reconstruction of the foundation in 1930.

In order to investigate soil conditions, a total of 13 trial-pits were dug in the basement along the main walls to a depth of 1.4 m below the cellar floor, i.e. 1.2 m below the bottom of the old foundation wall. The accumulation of water was first observed in these pits, then undisturbed samples of the soil were taken and subsequently subjected to an examination.

Wet mechanical analyses according to Gross-Atterberg-Stiny - the results of which vary little round the average distribution of particle sizes shown in Fig. 3 - lead to the observation of fine mineral yellow mo-soil, belonging to the Congeria-strata. Such soil is more permeable and can be drained more easily than clay, to which it bears a close external resemblance. Further examinations at the Polytechnical Institute of Vienna resulted in the following characteristics:

Porosity $n = 0.40$.

Void ratio $e = 0.66$.

Natural water content $w = 18.9\%$.

Density of particles $\rho = 2.62$.

Degree of saturation with water $\omega = \frac{\rho w}{100e} = 0.75$.

Degree of plasticity $B = 4.5$ (varying between 3.8 and 3.2) according to a soil of low plasticity;

Swelling (in the case of $w = 0$ to 23%) 1.9%;

Shrinkage (in the case of $w = 18$ to 0%) 0.9%.

The cone flowing test showed a decrease of the base-angle of the cone to 30 degrees after being immersed in water for 10 days. The confined compression test showed the relation (4) between pressure and relative compression represented in Fig. 4. The same figure also shows three load-settlement diagrams (1) to (3) imposed by load tests on the soil in the trial-pits by means of K. Fischer's soil testing instrument. The yield point which in every case proved to be 5.5 kg/cm², may be easily observed from it. The figure likewise shows that the settlement increases with the degree of plasticity B under otherwise equal conditions. The degree of plasticity, in turn, increases correspondingly to the proportion of fine particles in the soil.

In the present case, an admissible maximum soil pressure of $5.5 \div 3 = 1.83 \sim 2$ kg/cm² corresponds to a nearly three-fold safety against reaching the yield point. The deformation in the load test under this stress was stated to be 0.2 mm at the most (see Fig. 4). Therefore, applying the "square-root law", an uninjurious settling of about $0.2 \sqrt{\frac{60.000}{200}} \approx 3.5$ mm may be predicted under the soil pressure

of 2 kg/cm² for a foundation area of about $6 \text{ m}^2 = 60.000 \text{ cm}^2$ (main wall between two transverse walls each). The soil pressure below the old foundation walls having been 2.8 kg/cm² for the exterior walls and 4 kg/cm² for the middle wall, according to the two-fold, or 18-fold respectively, computed measure of settlement for 2 kg/cm², it was necessary to widen the foundation floors of the supporting walls enough to prevent the soil pressure mentioned last from being exceeded. The new foundation walls required for this purpose are represented in Fig. 2. They were constructed in plain concrete by underpinning the old walls in sections of 60 cm length each and rest 1 m below the cellar-floor on undisturbed ground.

To prevent temporary excessive absorption by the soil and, in connection with it, an unallowable reduction of the resistance due to internal friction, against the rising of the soil under the cellar-floor, drainage trenches were excavated along the main walls (see Fig. 1 and 2). These trenches were 40 cm wide, their floor being 10 cm above the new foundation floor, and filled with pure river sand (1 to 2 mm in diameter) in their lower part and, on top, with pure round gravel up to 30 cm below the cellar-floor. The trenches slope to a collecting shaft which also receives the shallow pipe drainage and is connected with the sewer main. They serve to improve the foundation soil by thoroughly draining the body of the soil below the cellar floor, at the same time preventing, by the layers of sand inserted, the washing away of fine particles. We have, therefore, a unique analogy to the "filter against erosion" by K. Terzaghi. The aforementioned measures have proved successful for the last 6 years, not a single crack in the structure having been observed.