CONSTRUCTION SETTLEMENTS OF THE RETAINING SHELL
ON THE VILYUI HYDROELECTRIC STATION EARTH DAM

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The Vilyui hydroelectric station earth dam (Fig. 1) was built between 1962 and 1970 under severe climatic
conditions, in a solid permafrost region. Igneous rock was used for the fill, consisting of diabases with provisional
compressive strength not less than 600 kgf/cm². Additional frost resistance requirements were placed on the rock in
the outer zones: in zones of level fluctuations 150 cycles, and on the downstream slope 50 cycles of freezing and
thawing, without reducing the control strength. Rock was used for the fill, taken from reservoir excavation and
borrow pits in various sizes without grading. The fines content (fractions less than 100 mm) was not removed but
was not allowed to accumulate at individual sections.

The height of the layers of the retaining shell embankment was from 3-5 to 10-15 m. Special measures were
not adopted for compacting the rock. Flooding the placed fill with water from hydraulic drills was employed to a
limited extent during the summer of 1963 on the first-stage bank fill. Flooding was dispensed with subsequently,
since the rock placed in winter at temperatures down to −50°C maintained below-zero temperatures throughout the
entire summer.

When erecting the retaining shell, readings were taken of rockfill settlements. The first group of 30 temporary
control marks (20 on the left bank and 10 on the right bank) was set up on the surface of the fill in April, 1964. At
that time the dam consisted of two pioneer embankments 15-25 m high filled from both banks, divided by a gap for
discharging the river flow. The width of the gap on May 1, 1964 was 70 m. Some of the marks situated near the
slope on the gap side were removed together with the fill during the floods, and some were damaged or removed
during the work. Nonetheless, readings were taken on eight of the left bank marks throughout 140 days and on six
throughout 208 days. Forty to seventy percent of the total settlement during seven months occurred during the first
36 days.

Characteristic features can be noted from the settlement measurements (Fig. 2a, b, and Table 1), namely, at-
tenuating nature of the curves without sharp discontinuities (apart from mark 18, which may be affected by proximi-
* The engineering-geologic conditions in the construction region, the design of the dam, questions of work methods,
etc. are set out in Gidrotekhnicheskoe Stroitel’stvo, No. 2 (1970).

Fig. 1. Cross section through the dam (GK2 + 80): 1) screen of
gravel-rock waste soils; 2) rockfill from ungraded rock mass; 3) up-
stream banket; 4) double-layer filter material; layer of rubble 0-40
mm and layer of rubble 0.150 mm; 5) large-stone facing; 6) upstream
sandy-gravel mix filter; 7) grouting gallery; 8) shaft of prefabricated
members for the zero depth mark DM-II.

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Fig. 2. Rockfill settlements measured on temporary marks (1-23) installed at the 25-33-m levels: a, b) in 1964 on the first stage left bank embankment; c, d) in 1965 at the berm of the downstream slope.

Fig. 3. Distribution of surface and depth marks (1-35) at the berms of the dam in the spring of 1965.

The relative settlements of the marks after 83 days are quite close, being from 1.1 to 1.95% (Table 1) and from 0.92 to 1.81% (Table 2). Only mark No. 10 indicated a larger settlement (2.62%). However, settlement of marks at the same height did not coincide. For marks set up in 1965 there is no increase in settlement with increasing height of embankment, while the settlement curves differ from each other, particularly as regards rate of increase during the initial period.