

## SAFETY MONITORING AT GABCIKOVO

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Because of their protective function, waterworks contribute several useful properties to society and inadvertently determine the aesthetic qualities of the surrounding environment. However, under specific unfavourable circumstances, waterworks pose environmental risks and threaten the stability of groundwater reserves.

Although, as shown by local and international statistics, these risks are not of a very high degree, safety is the number one priority for all those involved with the construction and operation of the Gabčíkovo waterworks and takes precedence over the technical and financial parameters of the project. Consequently, all proposed plans for the design and operation of the waterworks are accompanied by on-site measurements, based on technical and safety monitoring procedures. Measurements are taken during the preparatory stages of the project, during construction and until continuous operation is established. Monitoring procedures are implemented at optimally functioning observation stations.

The above-mentioned facts are relevant to all waterworks - dams, reservoirs - but slight differences may arise when the waterworks are constructed on flat terrains, such as Gabčíkovo; this applies both to the original construction plan and to the "C" variation. At this point it is necessary to mention that the original design concept for the Gabčíkovo-Nagymaros waterworks had to be fundamentally revised in 1990, when Hungary terminated construction. Part of the Hrušov reservoir was constructed based on the "temporary solution on Slovak territory" plan, the so-called "C" variation. As a result, certain parts of the project are still under construction, a factor which influences technical and safety monitoring procedures to a significant extent.

Safety monitoring is based on international classification schemes. The Gabčíkovo waterworks was categorised in reference to the damage caused by the flood of 1965, which changed basic safety standards. Within the framework of this categorisation, project parameters were assigned different degrees of importance, in terms of risks posed to the surrounding environment. Four main points were singled out: (a) the left side of the Hrušov reservoir, (b) the two sides of the wall of the guiding channel, (c) the Gabčíkovo echelon, (d) the left side of the wall of the outflow channel. Measurements and observations are carried out by the Technical and Safety Inspection Programme, at specific time periods. This paper will focus on the results of observations taken at the four above sites during a test operation.

The Gabčíkovo waterworks test operation began October 24, 1992, by channeling the flow of the Danube. Monitoring of this procedure was performed within the framework of the Technical and Safety Inspection Programme. The results showed that groundwater levels at Gabčíkovo did not reach or exceed critical values. A minor leakage at the left bank of the Danube was corrected with a natural rock fortification. However, surface measurements, using geological methods, were immediately taken. Observations yielded the following results:

- A leakage, not related to the presence of the reservoir, was observed from April 24 to June 13, 1995. In the mean time, Hungary built an additional dam which resulted in a 2 meter water-level rise and the leakage stopped.
- From November 10 to November 17, 1992, groundwater levels at the right crown of the guiding channel had risen by 3.93 meters, compared to neighbouring sites. This proved to be unrelated to the construction of the channel, however, supplementary test-sites were set up to monitor the phenomenon.
- A similar problem was reported in close proximity to the previous site, in 1996. It was again proven to be unrelated to the construction of the channel, however, additional measurements showed a 1.93 meter rise in groundwater levels, at the foot of the channel. On July 30, 1996, following special procedures, the problem was identified as originating from the presence of peculiar sedimentation in the vicinity of the protective dam. This sedimentation prevented normal water flow in the channel. The installation of special piping restored water flow and caused groundwater levels to drop below critical values.
- Wind speeds exceeding 70 km/h created the need to construct a special wave-breaking system. Certain navigational accidents - ships hitting the channel walls - were also reported.

The Gabčíkovo test operation was performed under complicated circumstances, due to the forced change of the original project to the "C" variation. This paper focused on some safety monitoring aspects at Gabčíkovo, applicable to groundwater levels at the four areas of interest previously mentioned and to their surrounding environment. The original safety design was quite efficient, therefore only a few amendments were required. On-site measurements and observations show that groundwater levels at Gabčíkovo are well below the critical values. Wherever problems in water flow are encountered, the situation is promptly corrected.

**Jan Hummel** has been Deputy Director of the Technical and Safety Inspection Committee for Gabčíkovo since 1991. A civil engineer and hydraulic engineering specialist, he has been responsible for several hydro-construction projects in the Slovak Republic and has held various research and administrative positions at the Directorate of Hydro-Economic Development and at the Hydrological Institute.