

Abstract

This PhD thesis contains the results of comprehensive research into the Pravčická brána Arch and surrounding sandstone massifs with focus on gaining more knowledge about natural dynamics and evolution of this rock formation, its current level of stability and the weathering processes it displays.

Non-destructive methods were used for this comprehensive study; these ranged from detailed field documentation to monitoring temperature regime of the rock and included application of a geophysical survey and control monitoring of the course of arch body deformation. Laboratory testing was carried out for strength parameters and salt efflorescences together with weathered sandstones were analysed for chemical compounds. Main operating factors were monitored simultaneously, which particularly involved changes in external temperature, degree of sunlight and chemical composition of rainfall. Conventional as well as entirely new assessment procedures were used in synthesis and interpretation of the data collected, including knowledge of nonlinear dynamics of complex systems. The survey was designed to fully respect the protective conditions of the site, to make follow-up activities possible in future and to monitor any possible negative changes in the rock massif.

The main results incorporate description of the block fabric of the body and the nature of the contact zone between the arch beam and the southern pillar, discovery of relatively fresh secondary fissures and identification of zones with weakened strength within the sandstone massif. Long-term monitoring has demonstrated slow and irreversible body movements and reversible quasi-cyclical movements associated with changes in temperature at the level of days up to years. Differences in actions of the eastern and the western side of the beam were found and the fact that the beam displays curved bending was attested, the latter being additionally intensified by unequal stress via torsion and shear. Furthermore, data were obtained that clarify the development of temperatures inside the rock massif in terms of time and depth and the mode of natural drainage of the massif was determined. Particular attention was paid to the processes of salt weathering that were being studied from the aspect of describing their distribution in space and over time and from the light of geochemical characteristics of the input sources (rainwater), seepage water and end components in the form of destructive salts.

The collected information was used for developing a structural deformation model of the arch body, including description of the nature of desintegration and assessment of the extent and the involvement of external factors (including anthropogenic influences). Results of this comprehensive study provide valuable information about the current condition of the rock body. Helping to identify potentially hazardous parts, these are to be used not only for modelling future development, but also to design the best possible remediation measures.