Journal of Zhejiang University-SCIENCE A

Cite this as: Qi-xiang FAN, Zhi-yun DENG, Peng LIN, Guo LI, Ji-lin FU, Wei HE, 2022. Coordinated deformation control technologies for the high sidewall–bottom transfixion zone of large underground hydro-powerhouses. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 23(7):543-563.
https://doi.org/10.1631/jzus.A2200060

Coordinated deformation control technologies for the high sidewall–bottom transfixion zone of large underground hydro-powerhouses

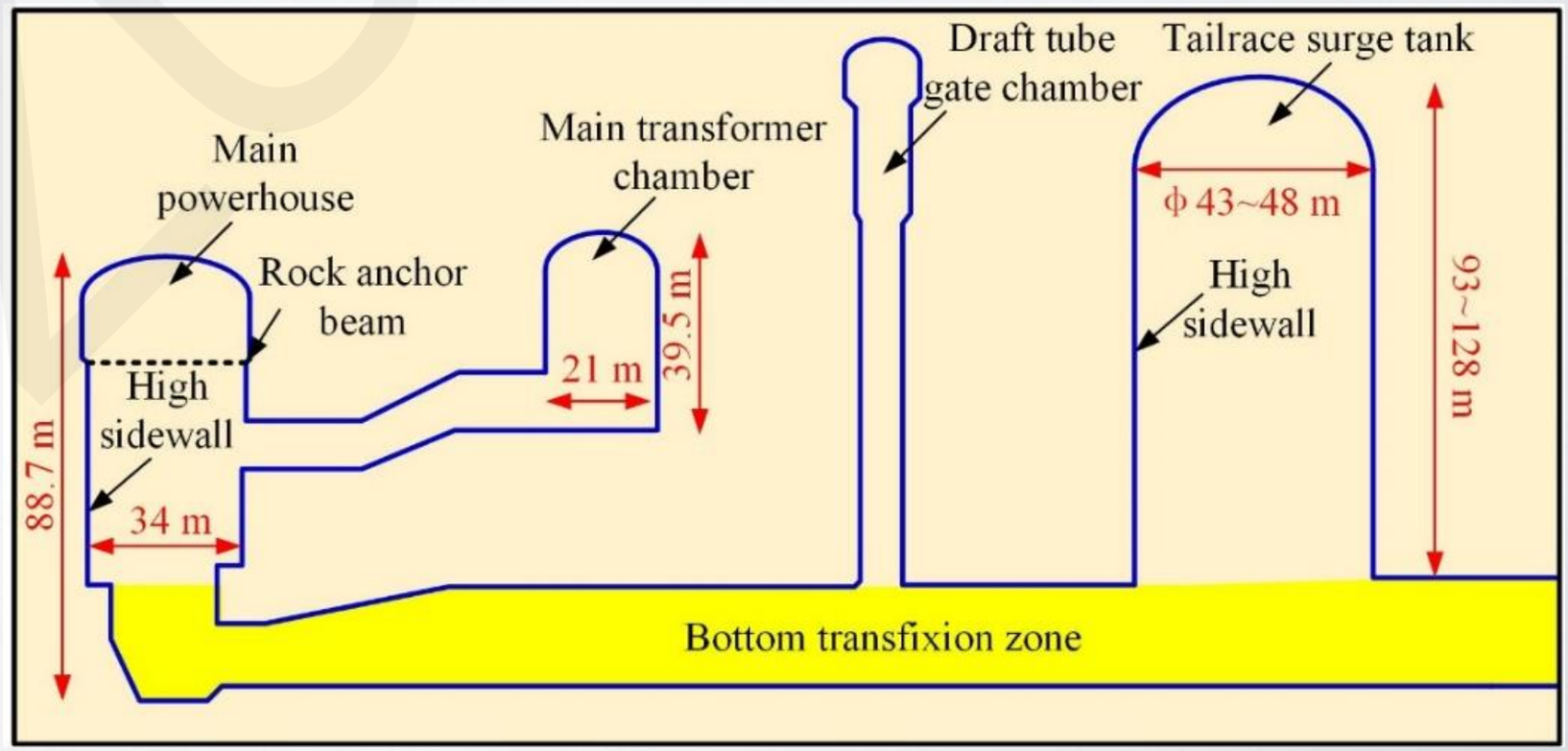
Key words:

Underground powerhouse; Coordinated deformation mechanism;

High sidewall-bottom transfixion (HSBT);

Cavern groups;

Control technologies



Deformation characteristics, mechanism and control requirements

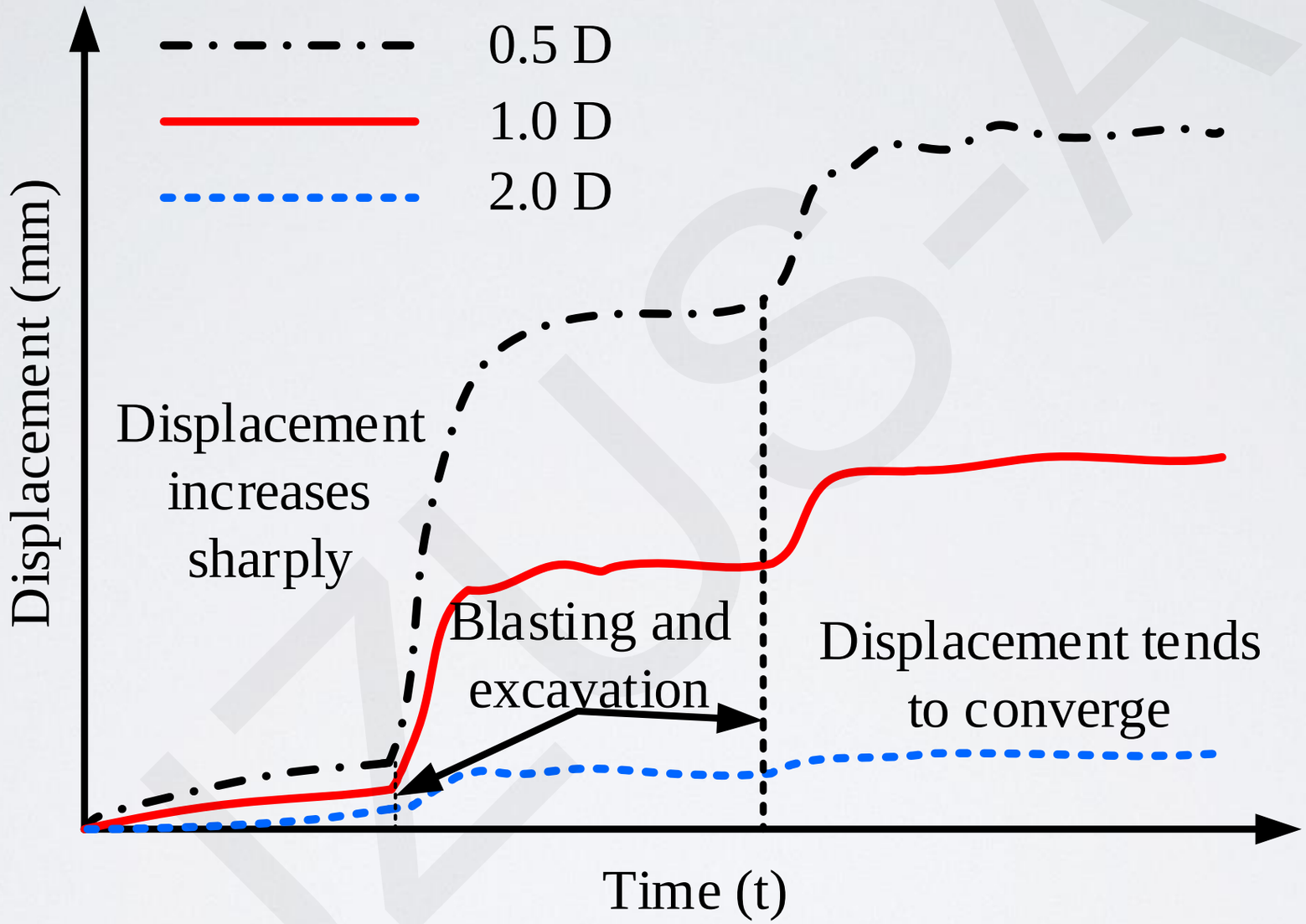


Fig. 1 Typical time-displacement curves of HSBT zones (D denotes the tunnel diameter)

Deformation characteristics, mechanism and control requirements

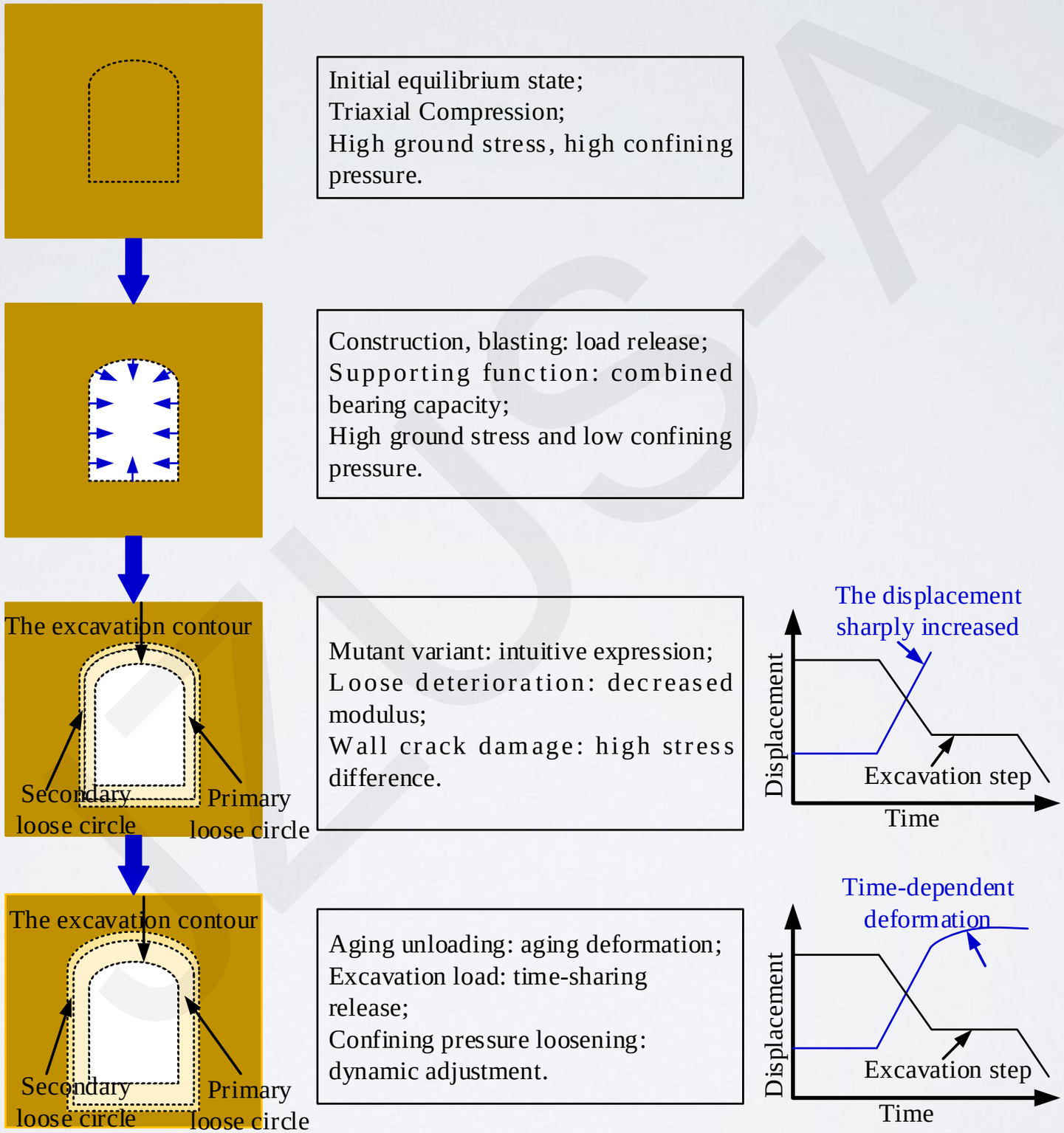


Fig. 2 Schematic diagram of the aging deformation mechanism of a high sidewall

Deformation characteristics, mechanism and control requirements

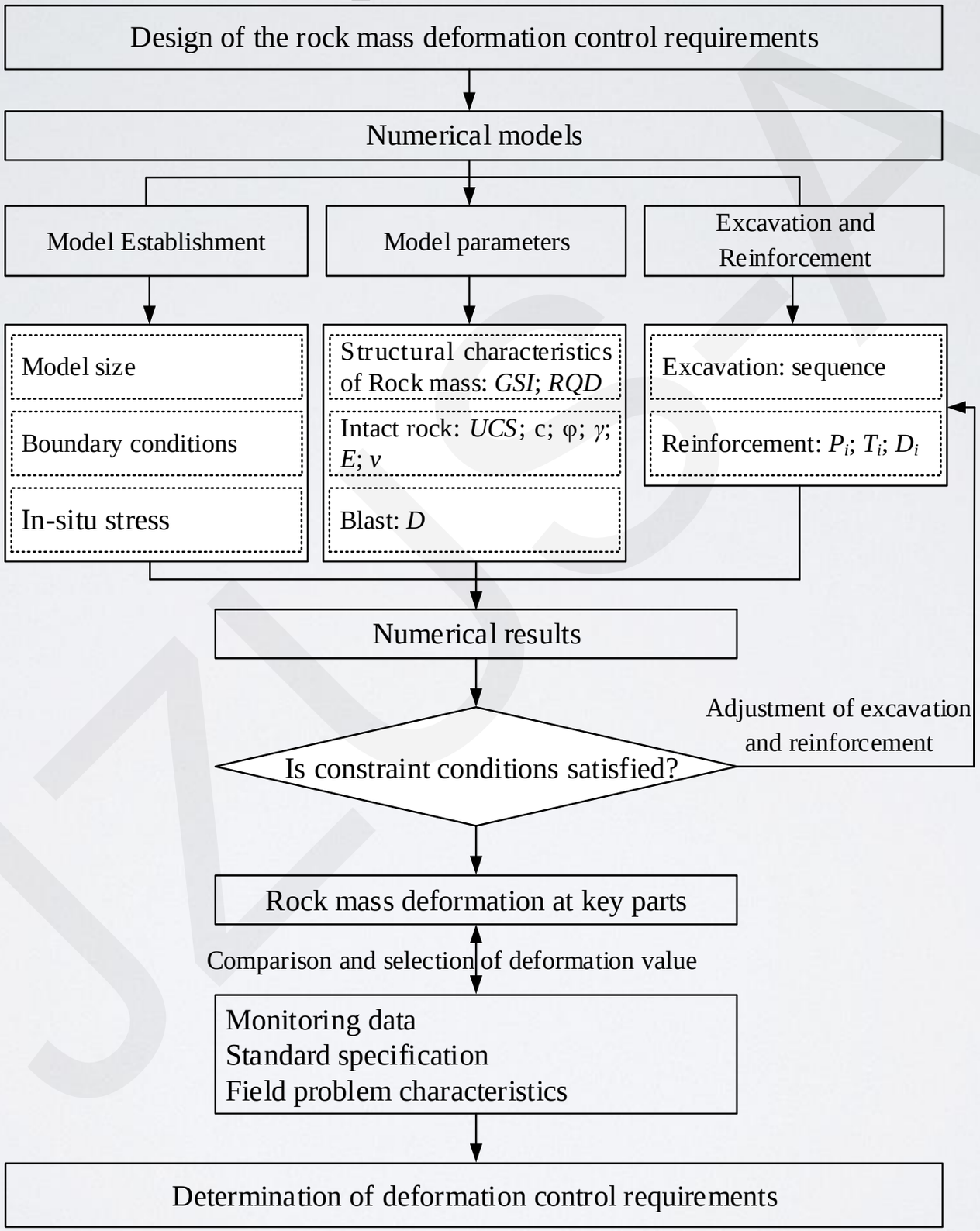


Fig. 3 Flow diagram for the determination of deformation control requirements

Coordinated deformation control technologies

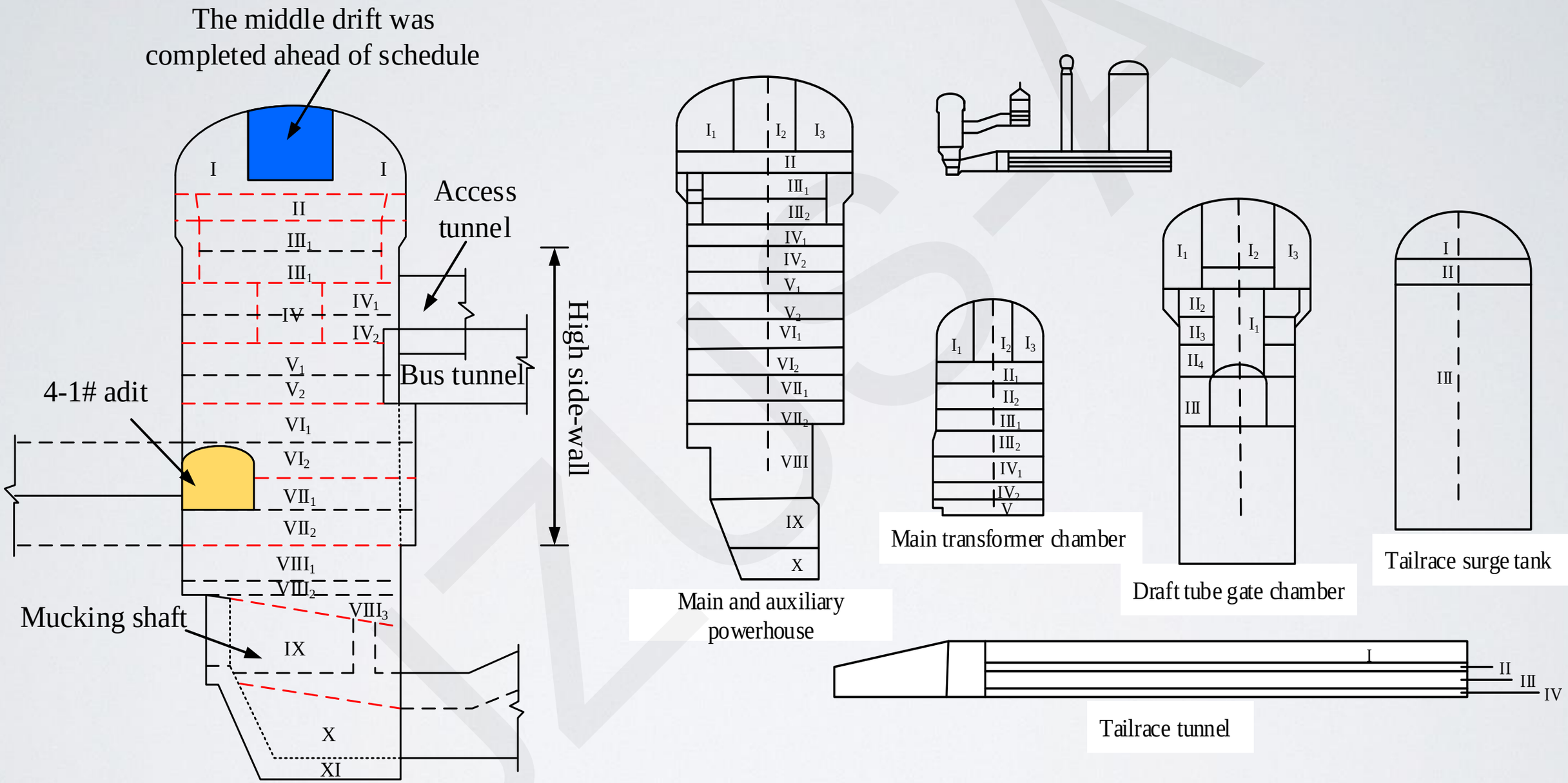


Fig. 4 Schematic diagram of the proper excavation and construction procedures

Coordinated deformation control technologies

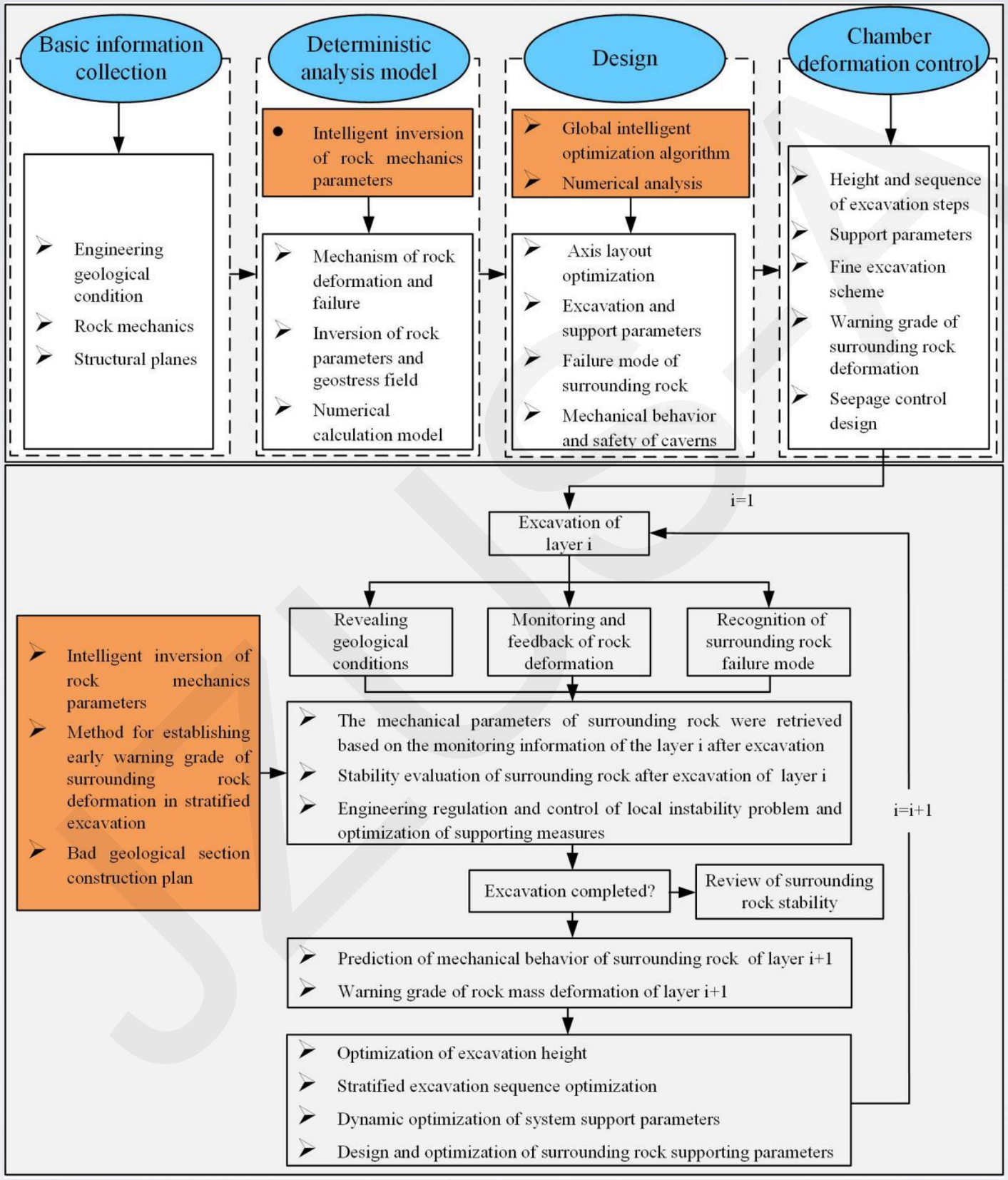
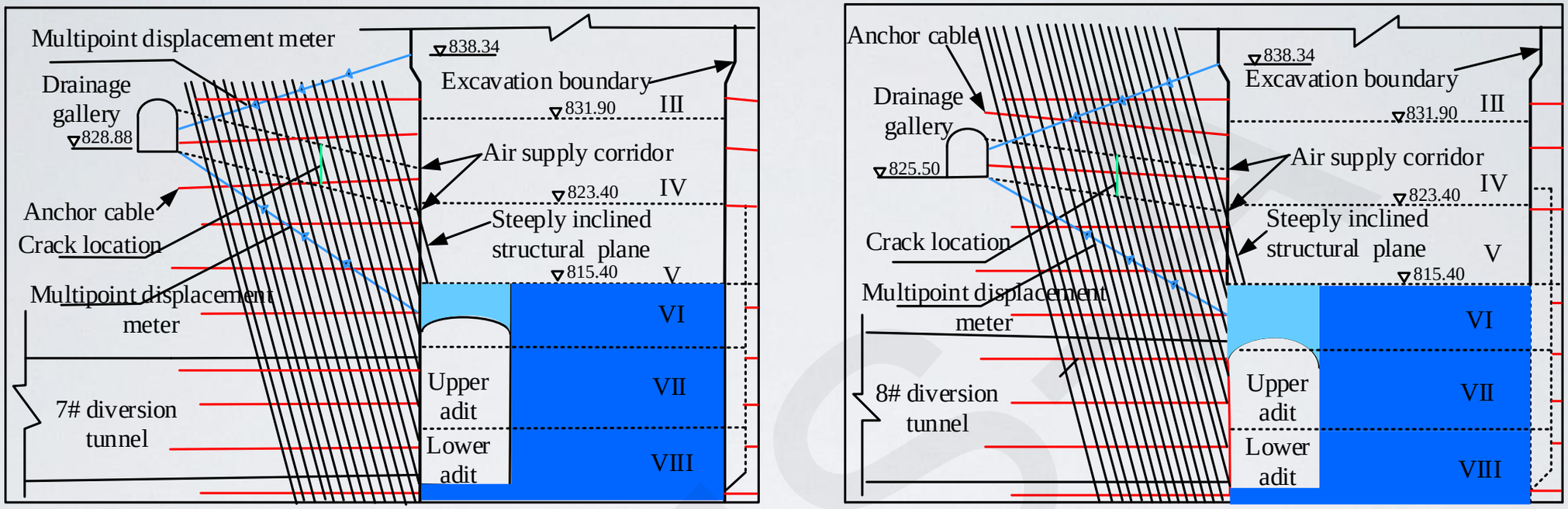
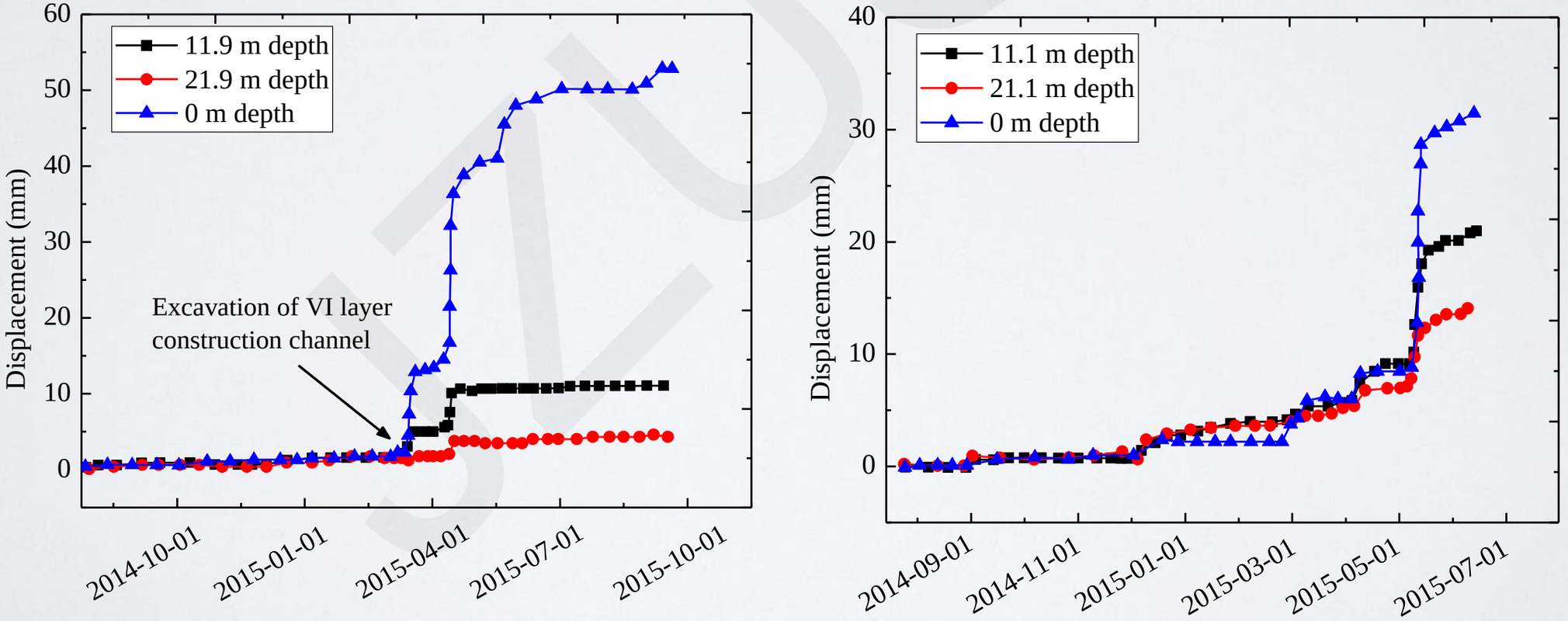


Fig. 5 Dynamic optimization and adjustment of deformation control of a cavern group

Case studies of HSBT zones



(a) Excavation of L3 construction adit at hydraulic turbine sets



(b) Monitoring data of the upstream side wall

Fig. 6 Case studies of HSBT zones in Wudongde hydropower station

Conclusions and Prospects

Conclusions:

- (1) Rapid deformation of the rock mass results from the change from a high confining pressure environment to a low confining pressure.
- (2) Proper excavation and construction procedures, fine blasting control, composite and timely support, real-time monitoring and dynamic feedback are effective technologies to ensure the stability of the surrounding rock mass of the HSBT zones.
- (3) The coordinated deformation control technologies for the HSBT zones have successfully solved the spatio-temporal mismatch problem between the supports and deformations.

Prospects:

- (1) Control requirements for surrounding rock deformation in large underground caverns
- (2) Establishment of the damage models of high sidewall-bottom transfixion zones.
- (3) Research and development of automatic warning and support systems