

**Table 1** Physical and mechanical parameters of surrounding rock

Bulk density $\gamma/(\text{kN}/\text{m}^3)$	Elastic modulus $E_s/\text{MPa}$	Poisson's ratio $\nu$	Cohesion $c/\text{kPa}$	Internal friction angle $\varphi/^\circ$	Subgrade coefficient $k/(\text{MN}/\text{m}^3)$
17.8	12	0.3	21	31.5	60

**Table 2** Structural parameters of shield tunnel

Inner diameter of tunnel $D/\text{m}$	Outer diameter of tunnel $d/\text{m}$	Segment thickness $t/\text{mm}$	Segment ring width $l_s/\text{m}$	Elastic modulus of segment $E_c/\text{MPa}$
6.0	5.3	350	1.2	35500

**Table 3** Physical and mechanical parameters of surrounding rock and supporting structure

Name	Thickness (cm)	Compression modulus (MPa)	Density ( $\text{kg}/\text{cm}^3$ )	Poisson 's ratio	Cohesion (kPa)	Permeabilit y coefficient (cm/s)	Internal friction angle ( $^\circ$ )
Surroundi ng rock	-	12.0	1990	0.3	21	$6.0 \times 10^{-4}$	$31.5^\circ$
Segment	30	-	2500	0.2	-	-	-
Primary support	30	-	2400	0.2	-	-	-
Secondar y lining	45	-	2500	0.2	-	-	-

**Table 4** Internal force and deformation values of typical test section

Test section number	Deflection (mm)	Rotating angle (rad)	Bending moment ( $\text{kN} \cdot \text{m}$ )	Shear force (kN)
#1 (0)	2.33462	-2.12987	2156.92	1198.260
#2 (10)	2.33325	-0.11854	-126.954	-66.46250
#3 (20)	2.33330	0.00348	10.5964	-12.78152
#4 (30)	2.33333	-0.05760	-5.43286	-4.769540
#5 (40)	2.33330	-0.0602	-6.84125	-6.56325
#6 (50)	2.33329	-0.0689	-6.89465	-16.36264
#12 (-10)	2.33325	0.13960	-109.263	-58.75890
#13 (-20)	2.33332	-0.02178	-3.45348	-16.65430
#14 (-30)	2.33331	-0.00809	-9.29550	-19.68420
#15 (-40)	2.33330	-0.10100	-9.53165	-10.9638
#16 (-50)	2.33330	-0.09600	-9.7934	-12.6891