Table Mechanical parameters of actual rock and mortar

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Uniaxial compressive strength / MPa | Tensile strength / MPa | Elastic modulus / GPa | Density / kg/m3 | Poisson's ratio |
| Actual rock | 105.61 | 5.90 | 32.65 | 3084 | 0.3 |
| Mortar | 22.12 | 1.02 | 6.45 | 3112 | 0.29 |

Table . Mechanical Parameters of prototype rock and simulated bolts

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Elastic modulus / GPa | Tensile strength / MPa | Bolt diameter / mm | Bolt hole diameter / mm |
| Prototype rock bolt (steel) | 206.00 | 455.00 | 20.00 | 30.00 |
| Simulated bolt (magnesium-manganese alloy) | 45.00 | 280.00 | 4.00 | 6.00 |

Table . UCS and peak strain of jointed and bolted jointed specimens

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | UCS / MPa | UCS growth rate / % | Peak strain / % | Peak strain growth rate / % |
| 75° jointed specimen | 18.51 | 16.63 | 0.45 | 11.11 |
| Bolted 75°jointed specimen | 13.35 | 0.50 |
| 45° jointed specimen | 15.23 | 21.54 | 0.37 | 10.81 |
| Bolted 45°jointed specimen | 20.02 | 0.41 |

Table . Angle of the maximum principal strain direction of jointed and bolted jointed specimens

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Direction of wing crack / ° | Shrink rate / % | Direction of anti-wing crack / ° | Shrink rate / % |
| 75° jointed specimen | 63.05 | 0.08 | 70.20 | 13.46 |
| Bolted 75°jointed specimen | 63.00 | 60.75 |
| 45° jointed specimen | 62.35 | 0.32 | 70.85 | 10.30 |
| Bolted 45°jointed specimen | 62.15 | 63.55 |

Table . Material properties of the specimen used for numerical simulation

|  |  |  |  |
| --- | --- | --- | --- |
|  | Parameter | Value | Homogeneity (*m*) |
| Specimen | Strength / MPa | 51.5 | 3 |
| Elastic modulus / GPa | 9.6 | 3 |
| Internal friction angle / ° | 27.39 | — |
| Poisson's ratio | 0.29 | — |
| Tension-compression strength ratio | 0.081 | — |
| Bolt | Elastic modulus / GPa | 41.2 | — |
| Interface | Peak shear strength $τ\_{u}$ / MPa | 94 | — |
| Peak shear displacement $s\_{u}$ / m | 5e-4 | — |
| Residual shear strength $τ\_{r}$ / MPa | 30 | — |
| Steel plat | Elastic modulus / GPa | 206 | — |
| Poisson's ratio | 0.31 | — |

Table . UCS of bolted jointed specimens under different bolt installation opportunity

|  |  |  |
| --- | --- | --- |
|  | UCS of 75° bolted jointed specimen / MPa | UCS of 45° bolted jointed specimen / MPa |
| Unbolted | 19.32 | 15.08  |
| 0% peak strain | 22.78 | 15.51  |
| 10% peak strain | 23.51 | 16.49  |
| 20% peak strain | 23.67 | 15.72  |
| 30% peak strain | 23.68 | 15.20  |
| 40% peak strain | 24.26 | 14.91  |
| 50% peak strain | 23.73 | 14.80  |
| 60% peak strain | 23.97 | 14.61  |
| 70% peak strain | 23.13 | 14.42  |
| 80% peak strain | 22.93 | 14.70  |
| 90% peak strain | 20.10 | 14.19  |