

ISO 23872:2021-12 (E)

Mining structures - Underground structures

| Contents | | Page |
|-----------------|--|-------------|
| | Foreword | v |
| | Introduction | vi |
| 1 | Scope | 1 |
| 2 | Normative references | 1 |
| 3 | Terms and definitions | 2 |
| 4 | Symbols | 4 |
| 5 | Materials | 5 |
| | 5.1 Underground storage..... | 5 |
| | 5.2 Concrete..... | 6 |
| | 5.2.1 General..... | 6 |
| | 5.2.2 Target strength..... | 6 |
| | 5.2.3 Plums..... | 6 |
| | 5.2.4 Special recommendations for underground application..... | 6 |
| | 5.2.5 Water quality..... | 6 |
| | 5.2.6 Durability..... | 6 |
| | 5.3 Steel..... | 6 |
| | 5.3.1 General..... | 6 |
| | 5.3.2 Special requirements for underground application..... | 7 |
| | 5.3.3 Durability..... | 7 |
| | 5.3.4 Timber..... | 7 |
| 6 | Nominal loads | 8 |
| | 6.1 Operating loads..... | 8 |
| | 6.1.1 General loads..... | 8 |
| | 6.1.2 Spillage loads..... | 8 |
| | 6.1.3 Air pressure loads..... | 8 |
| | 6.1.4 Thermal loads..... | 8 |
| | 6.1.5 Loads on box fronts..... | 9 |
| | 6.1.6 Loads on high-pressure bulkheads..... | 10 |
| | 6.1.7 Liquid pressure..... | 11 |
| | 6.1.8 Loads on pipe supports..... | 11 |
| | 6.2 Ground displacement loads..... | 11 |
| | 6.2.1 Initial relaxation..... | 11 |
| | 6.2.2 Long-term ground displacement..... | 11 |
| | 6.2.3 Sudden ground displacement..... | 12 |
| | 6.3 Seismic loads..... | 12 |
| | 6.4 Emergency loads..... | 12 |
| | 6.4.1 General..... | 12 |
| | 6.4.2 Explosion loads..... | 12 |
| | 6.4.3 Air blast loads..... | 12 |
| | 6.4.4 Mud-rush loads..... | 13 |
| | 6.4.5 Vehicle impact loads..... | 13 |
| | 6.4.6 Ground or rock impact loads..... | 13 |
| | 6.4.7 Emergency load on pipe supports..... | 13 |
| 7 | Design procedure | 13 |
| | 7.1 Risk assessment..... | 13 |
| | 7.2 Design procedure..... | 14 |

| | | |
|----------|---|-----------|
| 7.3 | Partial safety factors..... | 14 |
| 7.4 | Provision for excavation variations..... | 14 |
| 7.5 | Design of high-pressure bulkheads | 14 |
| | 7.5.1 Types of high-pressure bulkheads | 14 |
| | 7.5.2 Strength requirements..... | 15 |
| | 7.5.3 Watertightness requirements..... | 16 |
| 7.6 | Design of underground head frames | 16 |
| 8 | Construction requirements | 16 |
| 8.1 | Transport and storage | 16 |
| 8.2 | Anchoring into ground | 16 |
| | 8.2.1 Chemical grouted anchors..... | 16 |
| | 8.2.2 Cementitious grouted anchors..... | 17 |
| | 8.2.3 Mechanical anchors..... | 17 |
| | 8.2.4 Shear loads on rock anchors | 17 |
| | 8.2.5 Intact ground..... | 17 |
| | 8.2.6 Fractured ground | 17 |
| | 8.2.7 Anchor tests..... | 17 |
| | 8.2.8 Lifting or pulling from rock anchors..... | 17 |
| 8.3 | Bearing against ground..... | 17 |
| | 8.3.1 Intact ground..... | 17 |
| | 8.3.2 Fractured ground | 17 |
| 8.4 | Excavation tolerances..... | 18 |
| 8.5 | Construction of high-pressure bulkheads | 18 |
| | Annex A (informative) Transportation, handling and storage | 19 |
| | Annex B (informative) Use of concrete underground | 20 |
| | Annex C (informative) Design and construction of parallel sided high-pressure bulkheads by mortar intrusion..... | 28 |
| | Bibliography..... | 43 |