

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