



Central Mines Rescue Station

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OPTIONS APPLICABLE TO ENCLOSE FIRE AREAS IN CONTEXT OF LEGAL REGULATIONS EFFECTIVE IN POLAND



mgr inż. Jan SYTY



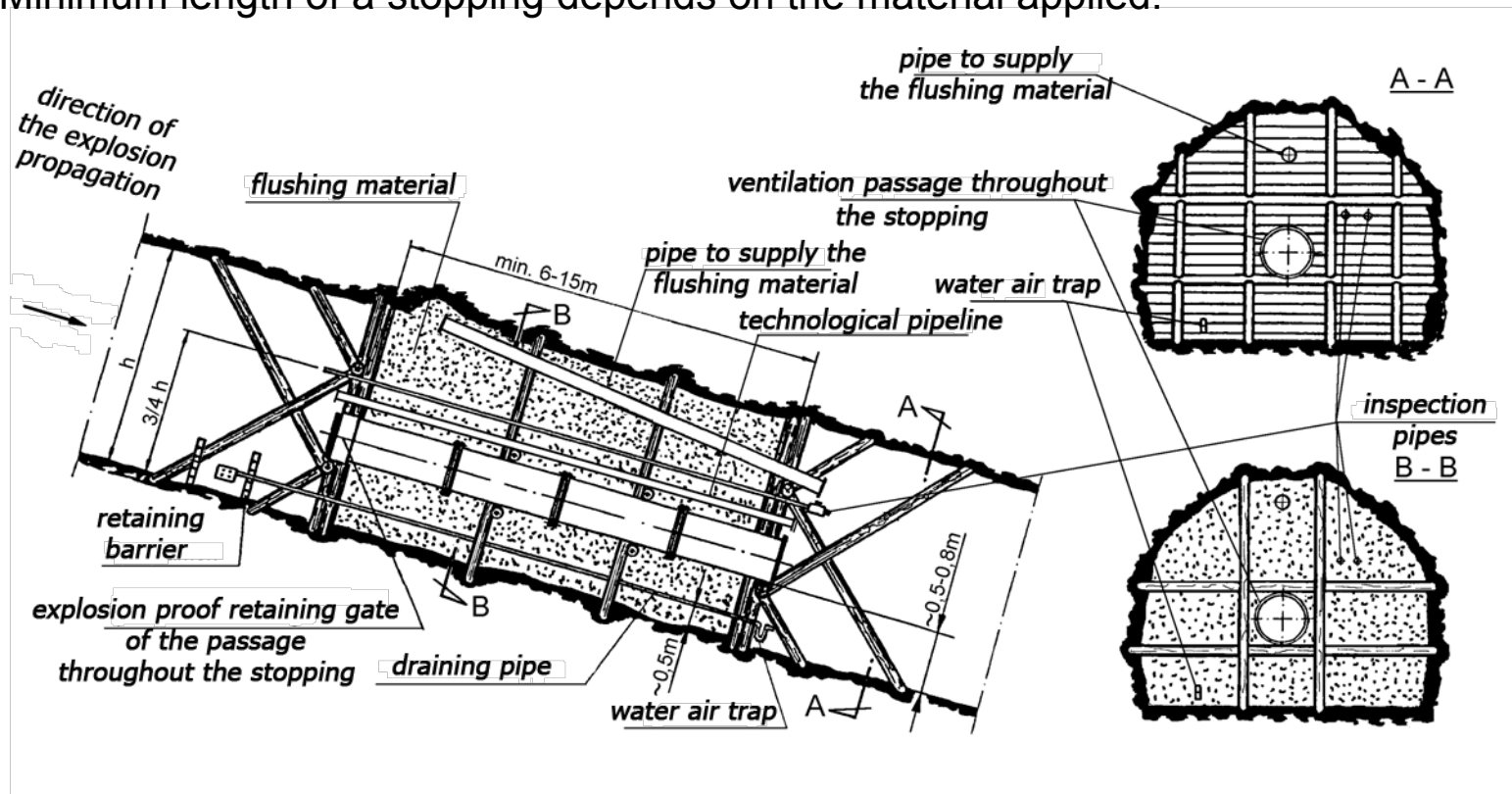
Conventional methods applicable to construction of cut-off explosion proof stoppings used in Poland

STOPPINGS FILLED WITH FLUSING MATERIALS

Flushing materials:

- sand,
- ash from power stations, gypsum, anhydrite,
- other materials.

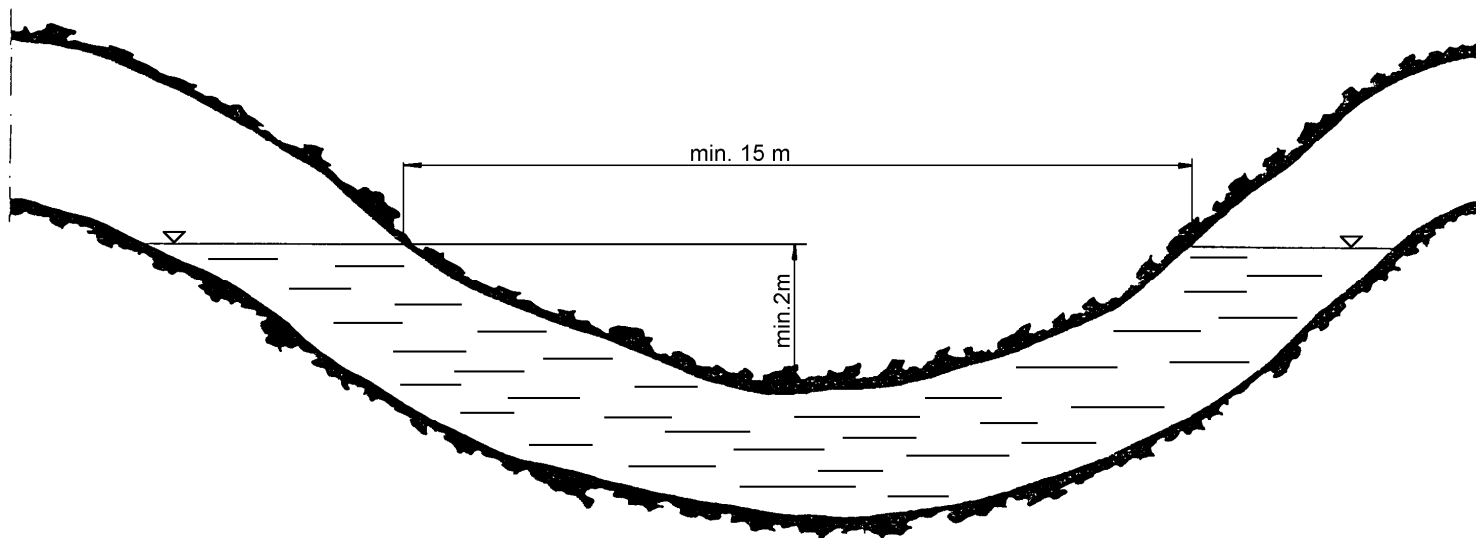
Minimum length of a stopping depends on the material applied:



Conventional methods applicable to construction of cut-off explosion proof stoppings used in Poland

WATER-FILLED STOPPINGS

Length of the excavation filled with water up to the ceiling can never be less than 15 m whereas the water mirror level should be at least 2 m above the lowest point of the ceiling overhang

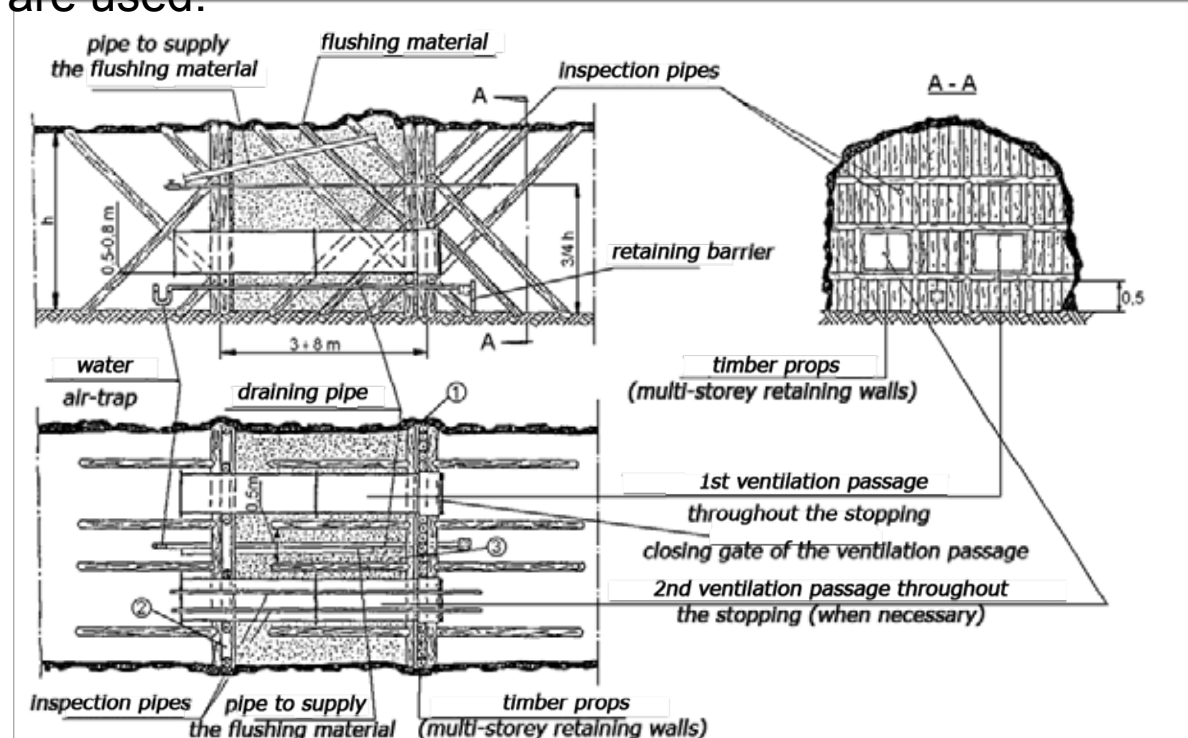


Conventional methods applicable to construction of cut-off explosion proof stoppings used in Poland

STOPPINGS FILLED WITH FLUSHING MATERIALS BASED ON MULTI-STOREY RETAINING WALLS WITH DOUBLE-ACTION STRETCHING BARS

The following filling materials are used:

- gypsum,
- anhydrite,
- clay,
- bentonite,
- other binders.



Length of the stopping depend on the size of the excavation cross-section at the location where the stopping is to be erected.

Examination of explosion-proof stoppings filled with quick-setting binders carried out at the experimental mine „Barbara”

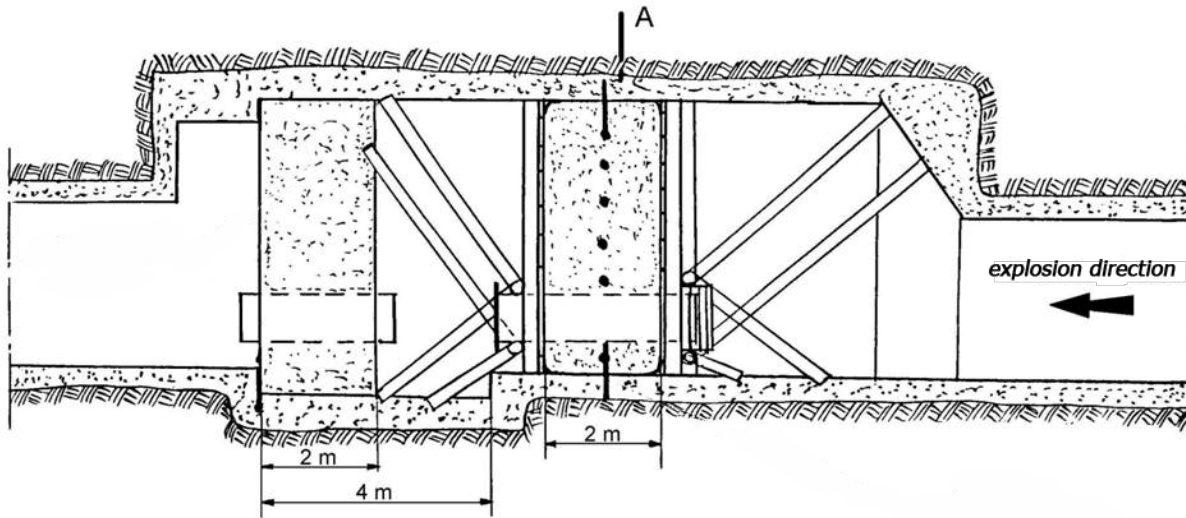


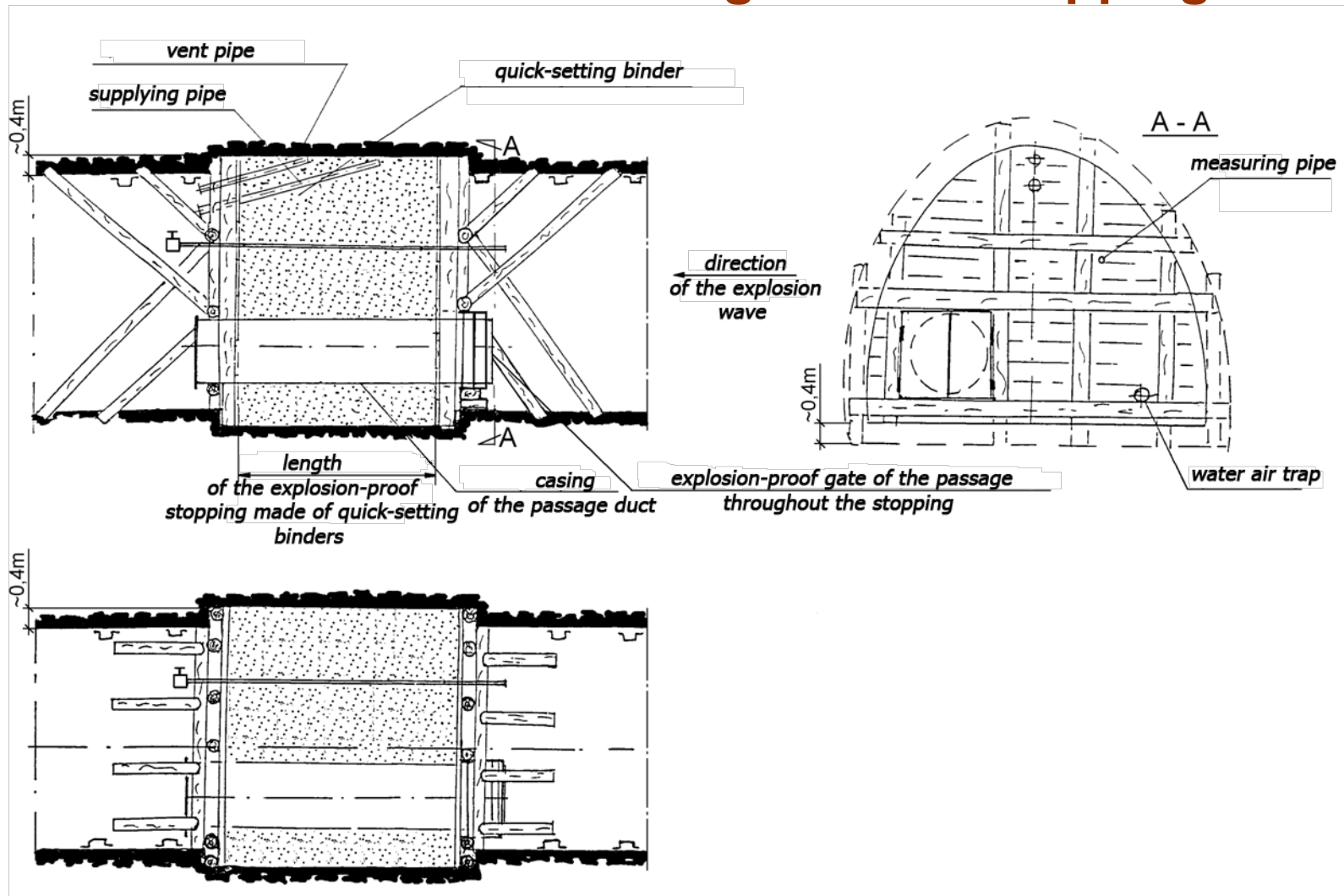
Diagram of the test arrangement for examination of stopping erected in perimeter cuts of anchored



Front of the stopping with the closing gate of the ventilation passage after examinations

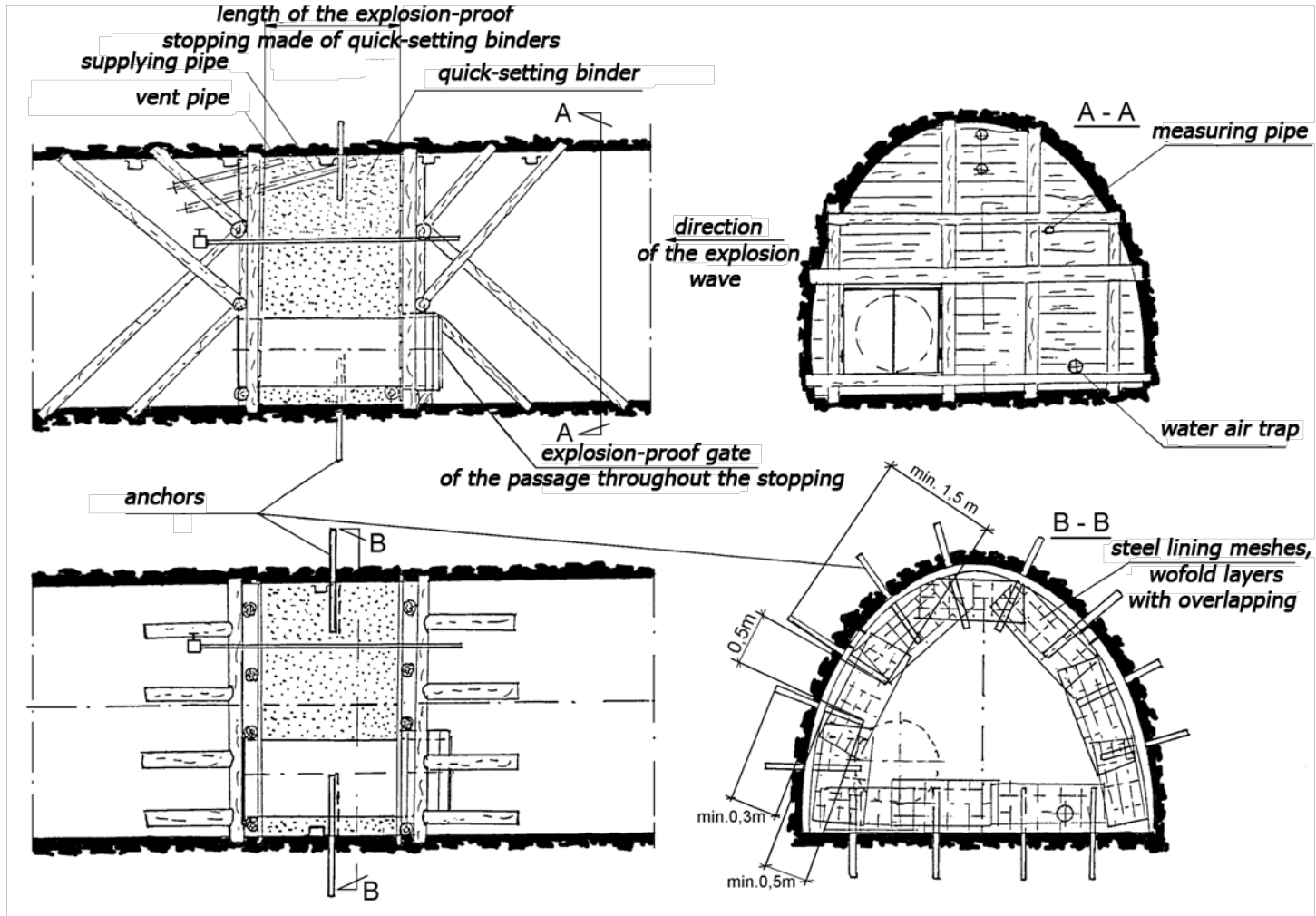
STOPPINGS OF QUICK-SETTING BINDERS

With a cut along the excavation perimeter
and down the full length of the stopping



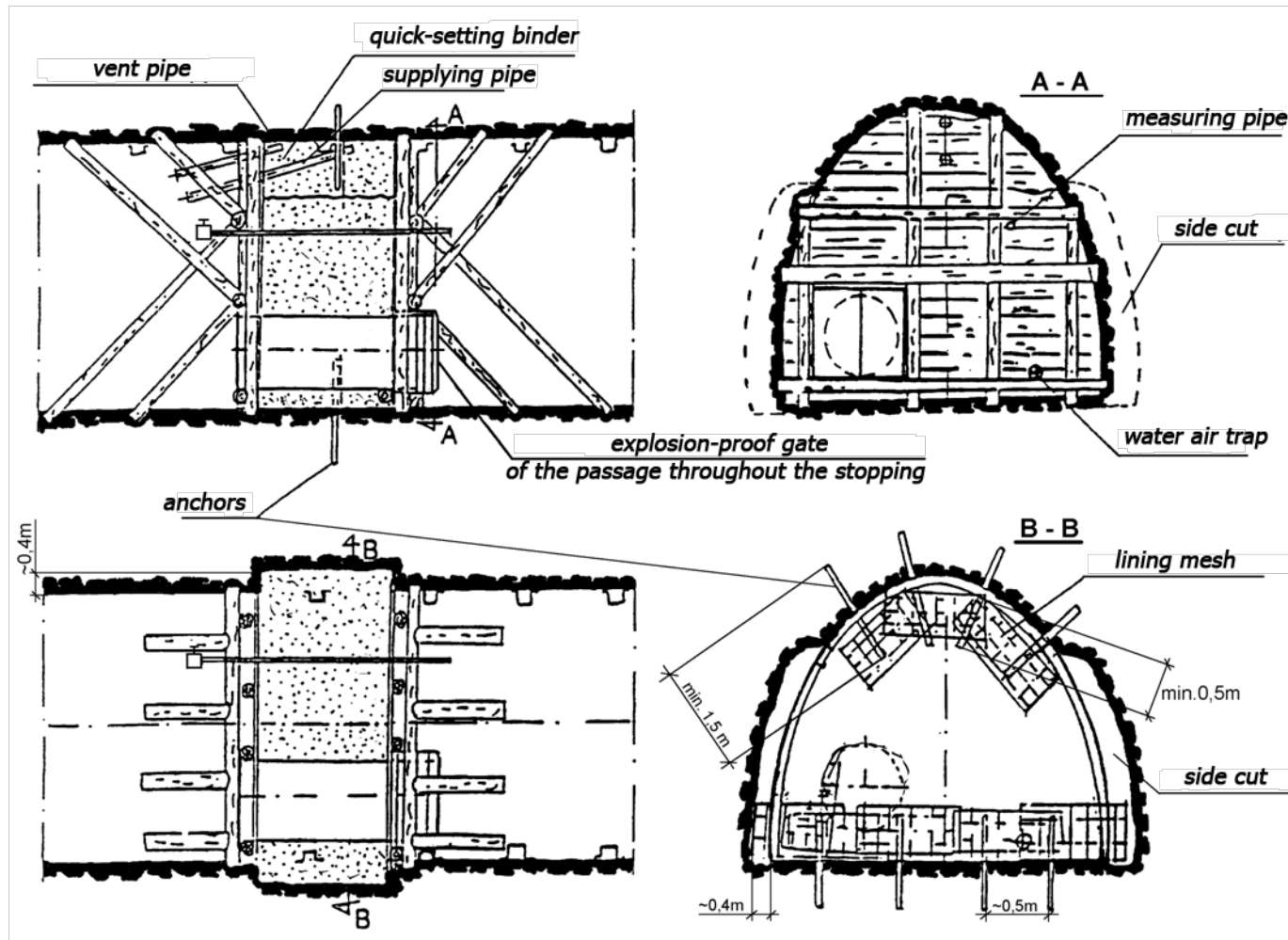
STOPPINGS OF QUICK-SETTING BINDERS

Without a cut but with additional internal anchoring



STOPPINGS OF QUICK-SETTING BINDERS

With a partial cut and reinforcing anchoring



Examination of stoppings w/o a perimeter cut or anchoring

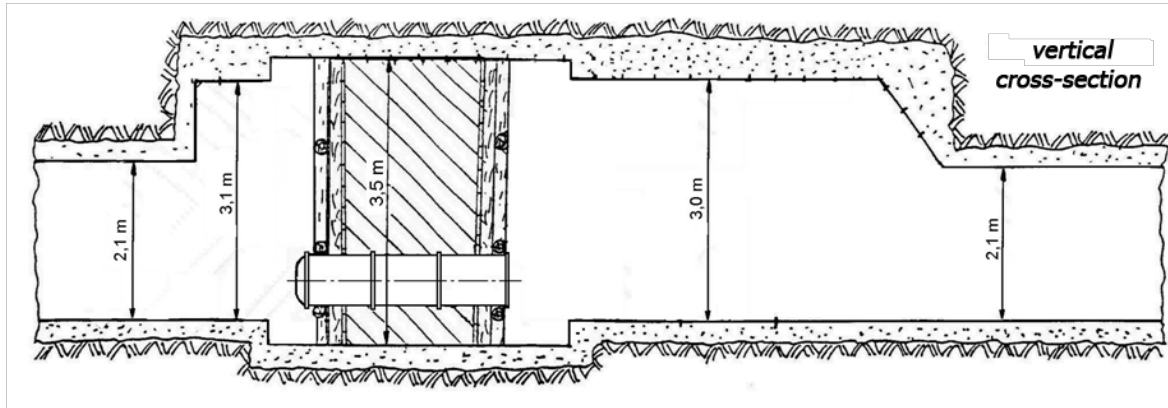


Diagram of the test arrangement at the Experimental Mine „Barbara”

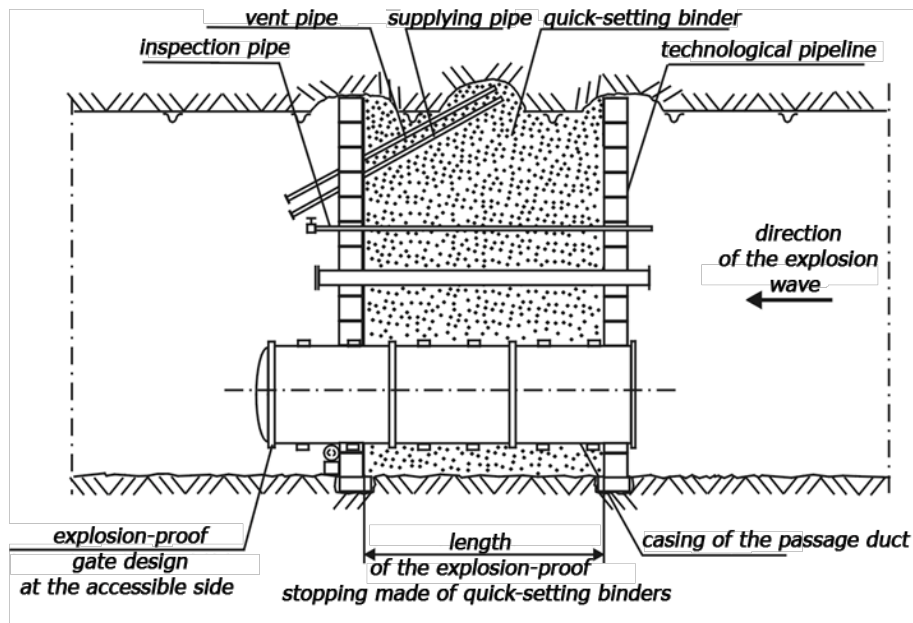


Stopping under examination at the Experimental Mine „Barbara”

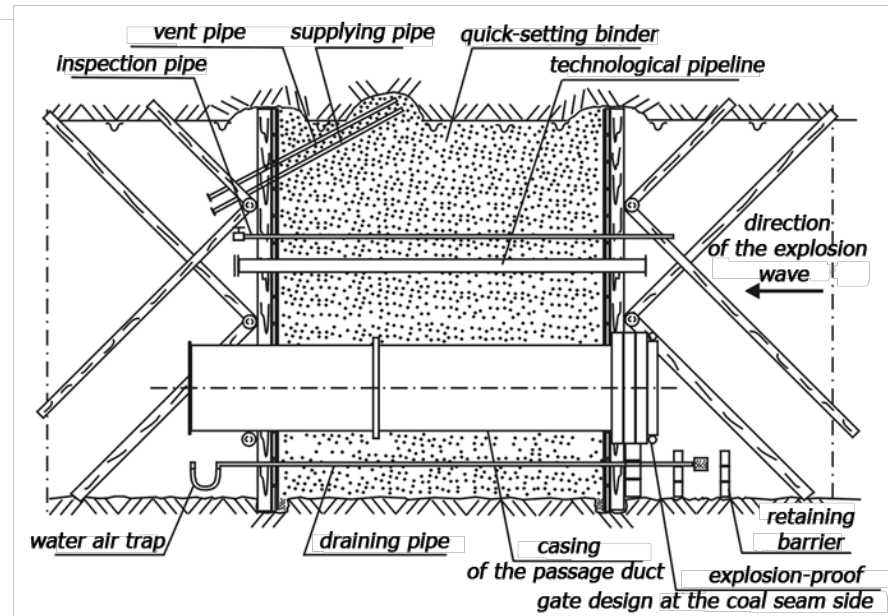
STOPPINGS OF QUICK-SETTING BINDERS

With cuts solely at the locations of closing gates of the stopping and with angle braces

at the set of the emergency stopping



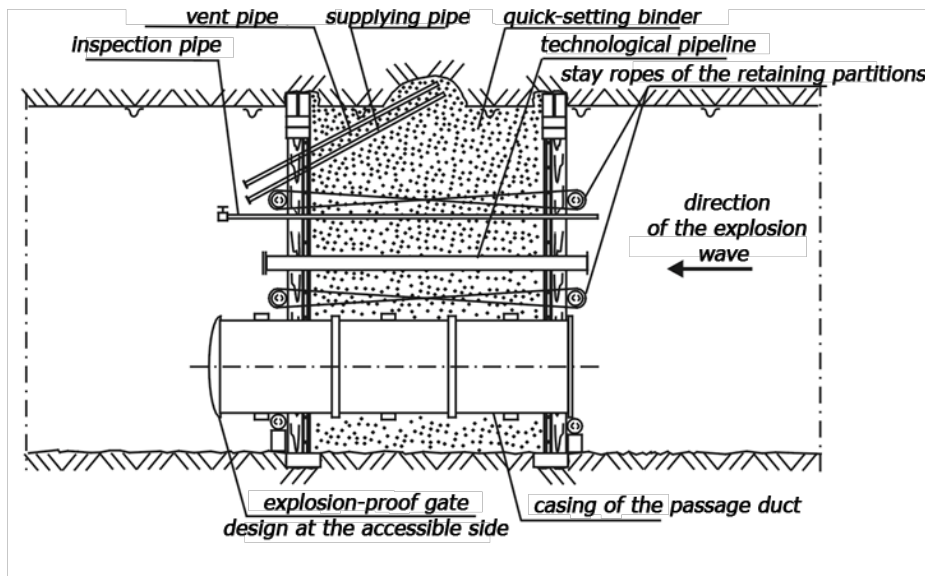
at the excavation cross-section



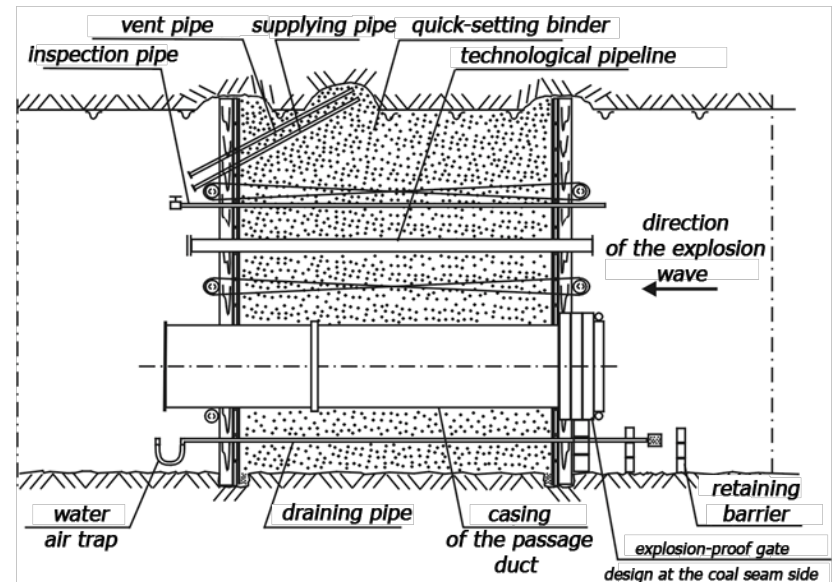
STOPPINGS OF QUICK-SETTING BINDERS

With cuts solely at the locations of retaining partitions
of the stopping

at the set of the emergency stopping



at the excavation cross-section

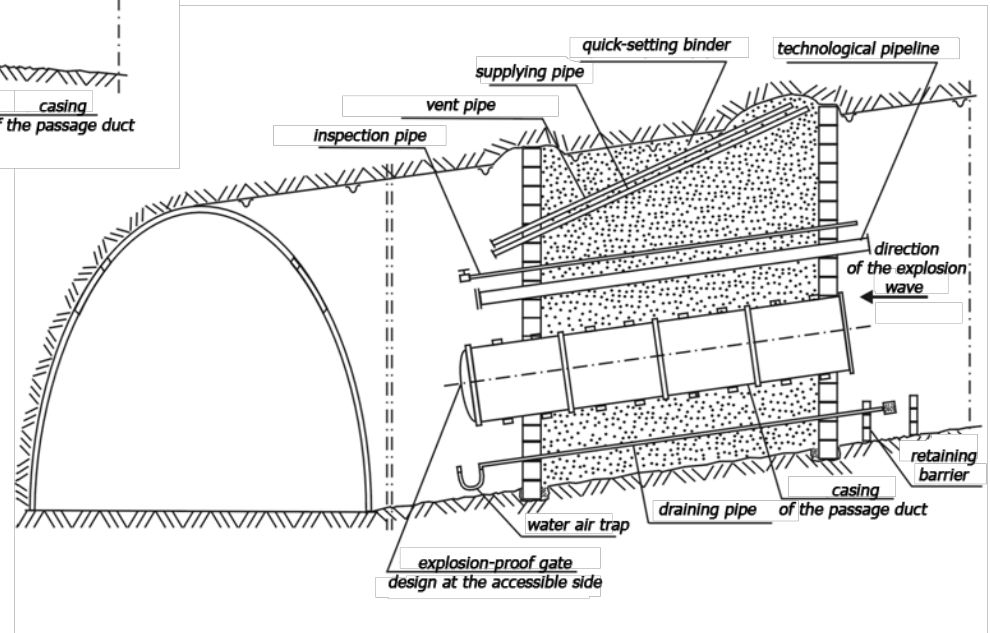
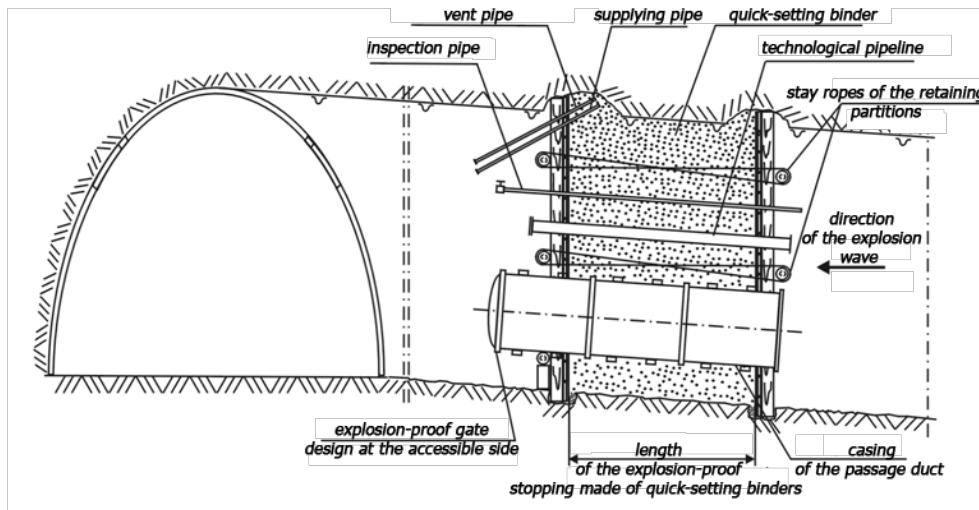


Clamping of stays inside the stopping with use of steel ropes or chains is applied instead of external angle braces

STOPPINGS OF QUICK-SETTING BINDERS

With cuts solely at the locations of retaining partitions of the stopping

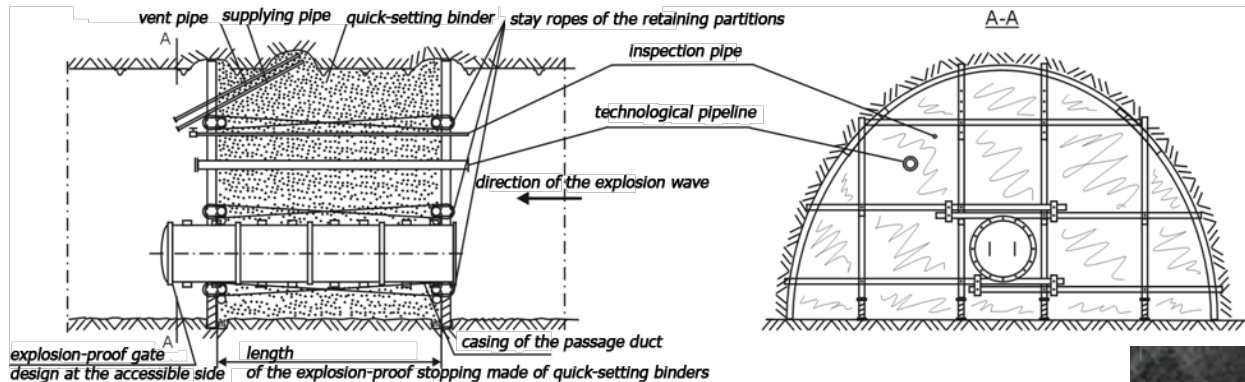
Across inclined excavations:



STOPPINGS OF QUICK-SETTING BINDERS

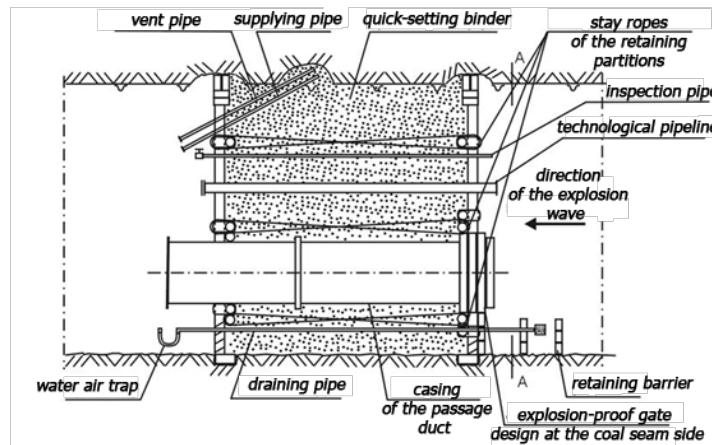
With cuts solely at the locations of retaining partitions of the stopping

Retaining partitions of the lightweight design and made of tubular components with an explosion-proof gate of the lockable design:



design at the accessible side

design at the side of a coal seam



Explosion-proof gate for the throughout passage via the dam, the design version with a locking gate at the side of a coal seam



View on the test arrangement



**Damages to the throughout
passage after completion of test
at the Experimental Mine
„Barbara” – after explosion with
the pressure above 1.0 MPa.**

Explosion-proof gate for the throughout passage via the dam, the design version with a locking gate at the accessible side



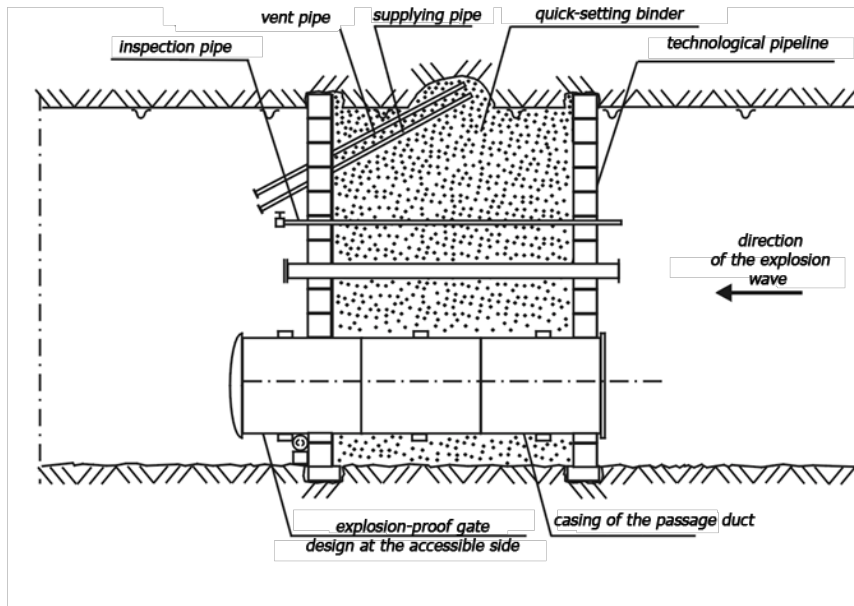
**The throughout passage during test as
the Experimental Mine „Barbara”
- the view from the coal seam side**



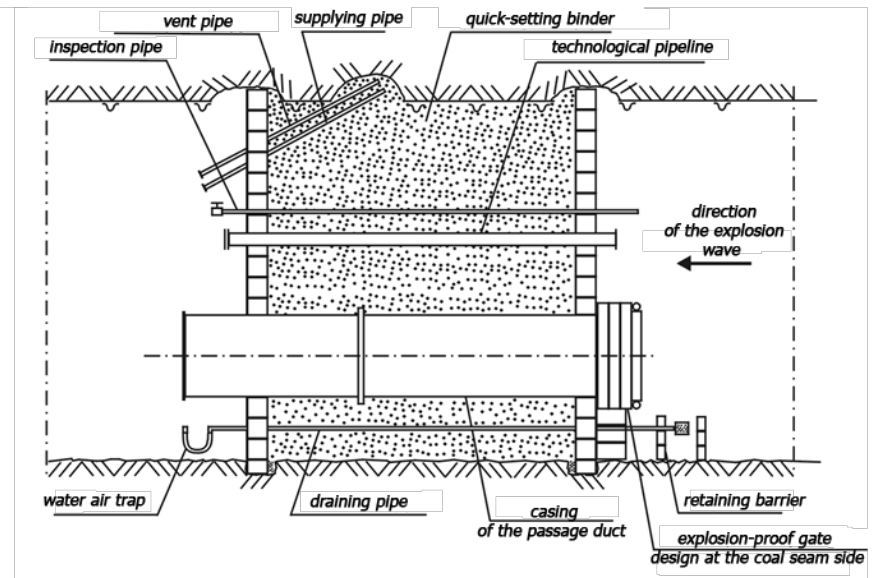
**The throughout passage during test as
the Experimental Mine „Barbara”
- the view from the accessible side**

Stopping with explosion-proof gates of lockable design

design at the accessible side



design at the side of a coal seam



Amendments to the design solutions that are mandatory in Poland with regard to cut-off explosion-proof stoppings

- The mandatory requirement to erect a stopping in a perimeter cut or with anchoring reinforcements was cancelled.
- New clauses were introduced that allow to construct retaining partitions of stoppings in sets of safety stoppings.
- New, lightweight design for structures of retaining partitions of stoppings were introduced – these structures are meant exclusively to retain binders during the time when the stopping area is filled with binders (dedicated to filling of stoppings with quick-setting binders with productivity $> 1,2 \text{ m}^3 / \text{Mg}$).
- Owing to application of explosion-proof design solution locked at the accessible side erection of stoppings across inclined excavations was facilitated.
- The method suitable to length calculation of a stopping made of binders makes it possible to achieve a uniform level of safety for various cross-section of stoppings and applied binders.

Calculation of the minimum length for explosion-proof stoppings made of quick-setting binders

$$Gr = k \frac{F \cdot \Delta P_{od}}{Obw \cdot 0,1 \cdot R_c}$$

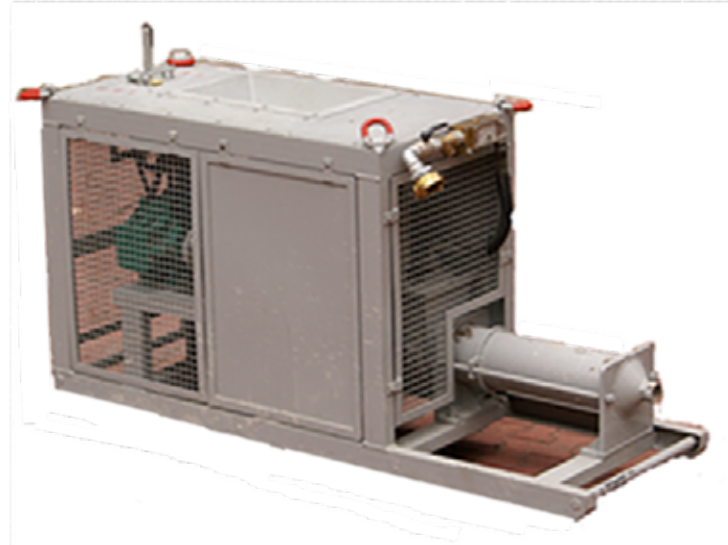
where:

- Gr - length (thickness) of the explosion-proof stopping (gate) [m]
- k - safety factor should be adopted 1.5 as minimum,
- F - cross-section area of the excavation [m²]
- ΔP_{od} - overpressure generated by the reflected wave of explosion
= 1.0 [MPa]
- Obw - excavation perimeter measured along arcs of the roadway support and the floor [m]
- R_c - compression strength of the mineral binder [MPa]

For explosion-proof stoppings that are made of quick-setting binders and erected during rescue actions the R_c values should be adopted for the setting time not longer than 24 hours after filling the stopping with the binder.

Equipment applicable to supply binders

The pump MONO WT - 820.1



delivery: 15 m³/h for foamed materials,
up to 6 m³/h for non-foamed materials,
maximum delivery distance: up to 300 m horizontally,
up to 80 m vertically,
weight of the pump: 750 /630 kg
dimensions (l x w x h), m 3.0 x 0.6 x 0.9 / 2.0 x 0.6 x 1.0
electric drive, power of electric motor 7.5 kW., U – 500V
pumping overpressure: up to 1 MPa



Pneumatic gunning machine SSB 24

delivery 2 – 6 m³/h
air consumption 13 m³/min
air pressure 0.5 – 0.6 MPa
power of the pneumatic motor 3.5 kW
maximum distance of delivery 300 m
dimensions 1100x780x1000
weight 350 kg

Conclusions

All the tests and experiments that were carried out at the Experimental Mine „Barbara” as well as amendments to the guidelines issued by the Central Mining rescue Station „Methods for erection of explosion-proof isolating stoppings” are intended to increase performance of operation associated with erection of isolating (cut-off) explosion-proof stoppings with no compromise to the sealing efficiency and safety within the region under potential threat of explosion. Further development of technologies in the area of binder properties and technologies for supplying thereof shall undoubtedly lead to subsequent changes in the practical solutions suitable for erection of explosion-proof stoppings and sealing gates in Polish coal mines.



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