# ANALYSIS OF AERODYNAMIC PARAMETERS SPECIFY A MAIN LOCAL STATIONS

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***ABSTRACT:*** *For underground extraction of coal are running a complex network mining vertical, horizontal and inclined role extraction, transportation and evacuation the surface. Associated system of mining works have the air network to ensure the oxygen necessary for workers, diluting explosive gases and/or toxic substances and preparations to evacuate heat and humidity in the underground. For air circulating on the active underground works, from the points of entry of fresh air to the point of exit of the tainted air, are using powerful fans located at the main stations of fans.The operation of the fan depends on the parameters of specific network aerodynamic, the ventilation of buildings and structure of main air stations. Knowledge of the exact parameters of the specific local networks aerodynamic leads to the optimizations of air flow distribution at the level of each branch concerned to ensure the health and safety conditions in the underground.*

***KEYWORDS:*** ventilation, ventilation networks, aerodynamic parameters, fans

## 1.GENERAL REMARKS

For air circulation route active underground workings, from the points of entry of fresh air to the point of exit of foul air, use fans placed on the surface in the main ventilation stations.

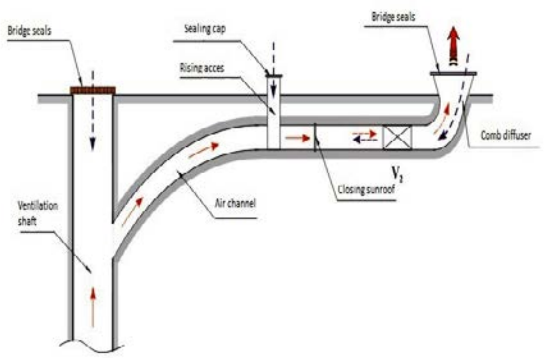


**Fig.1**

At the main station there is complex ventilation based mining ventilation shafts or ventilation rising. The figure is rendered complex work related to the expansion of the main stations connected to a vertical shaft, and includes the following elements:

- The vertical shaft of the expansion valve which has two segments:
  • the portion of the ventilation shaft to the intersection with ventilation channel;
  • ventilation shaft portion of the intersection with ventilation channel to bridge surface with sealing;
- Ventilation channel which has two segments:
  • ventilation channel portion of the intersection with ventilation shaft to the intersection with gallery locks;
  • ventilation channel portion of the intersection with gallery locks up at the point of bifurcation of fan channels;
- Gallery lock access channel ventilation;
- Access of raises the ventilation channel provided with the sealing cap;
- Fan channel No 1 provided with hatch closure is normally open position during fan operation located thereon;
- Fan channel No 2 provided with hatch closure is normally closed position whilst the fan placed on it is stopped;

- Speaker with combs for the fan no 1;
- Speaker with combs for the fan no 2;
- Sealing bridge obscures the speaker with combs that foul air is circulated.

## 2. PARAMETERS SPECIFIC AERODYNAMIC MAIN STATION VENTILATION

Aerodynamic parameters related complex mining are:

- Pressure loss H (Pa);
- The flow rate of air Q (m3 / min);
- Air resistance R (NS2 / m8).

To determine the aerodynamic parameters specific ventilation main station is called as direct measurements or by calculation alignment mining.

For it is considered a complex workings associated main station ventilation fig. 2, where we have the following ramifications:

- 1-3, shorting the surface characterized by $Q_{sc}$, $R_{sc}$, $H_{sc}$;
- 2-3, mine related branch characterized by Qm, Rm, Hm;
- 6-3 channel ventilation characterized by Qc, Rc, Hc;
- 5-6 airlock ventilation access channel characterized $Q_{sas}$, $R_{sas}$, $H_{sas}$;
- 4-6, fan route no. 2 characterized by $Q_{V2}$, $R_{V2}$, $H_{V2}$;
- 6-7 fan route no. 1 characterized by $Q_{V1}$, $R_{V1}$, $H_{V1}$.

Airflows QSC, Qm, Qc, Qsas, QV2, QV1, is determined by direct measurements ramifications anemometric 2-3, 3-6, 5-6,4-6, ie 1-3 and 6-7 indirect ramifications as follows:

$$Q1\text{-}3 = Q3\text{-}6 - Q2\text{-}3 \quad (m3/min);$$

$$Q6\text{-}7 = Q3\text{-}6 + Q5\text{-}6 + Q4\text{-}6 \ (m3/min).$$

Pressure drop Hm, Hsc, Hc, Hsas, HV2, HV1, is determined by depresiometric measuring all branches 1-3, 2-3, 3-6, 5-6, 4-6, 6-7.

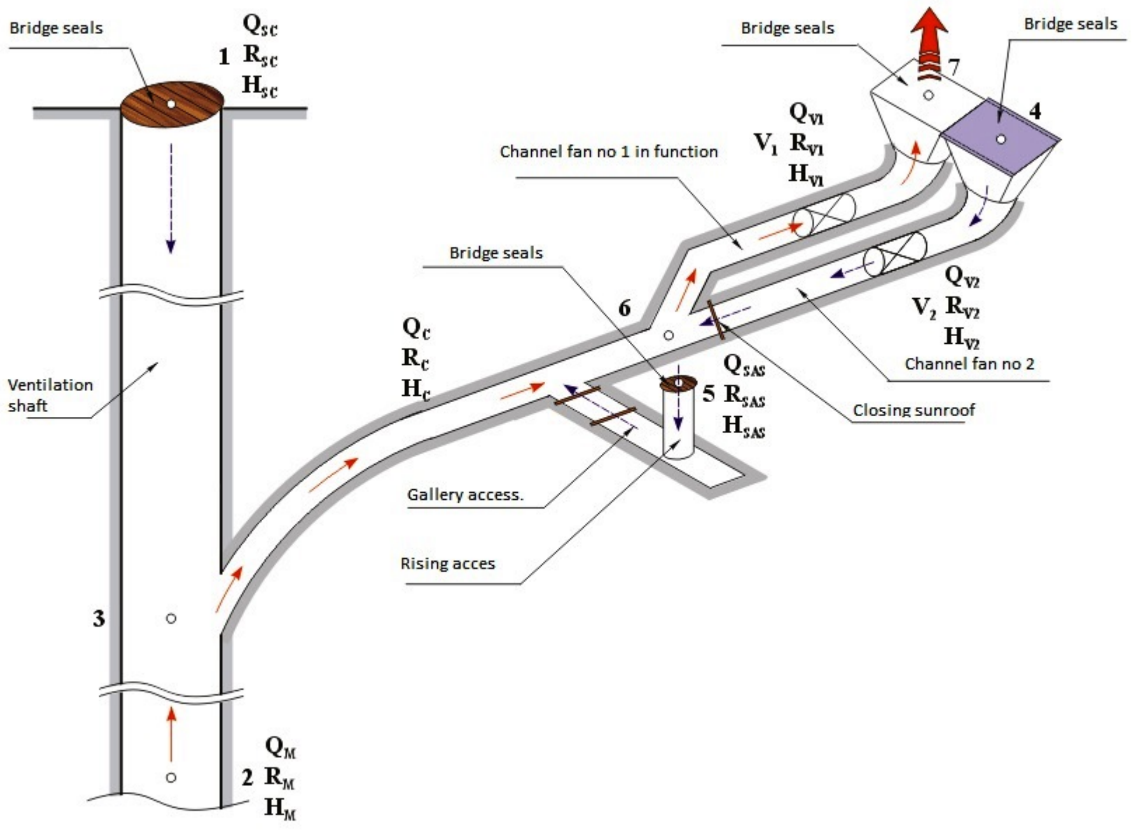


**Fig. 2**

The aerodynamic resistances are determined by calculation as follows:

In mode 3 have two resistors connected in parallel, namely, R2-3 or R1-2.

In this equivalent resistance R3 will be:

$$\frac{1}{\sqrt{R_{e3}}} = \frac{1}{\sqrt{R_{1-3}}} + \frac{1}{\sqrt{R_{2-3}}}$$

$$\frac{1}{\sqrt{R_{e3}}} = \frac{\sqrt{R_{2-3}}+\sqrt{R_{1-3}}}{\sqrt{R_{1-3} * R_{2-3}}}$$

By the square follows:

$$\frac{1}{R_{e3}} = \frac{\left(\sqrt{R_{2-3}}+\sqrt{R_{1-3}}\right)^2}{R_{1-3} * R_{2-3}}$$

$$R_{e3} = \frac{R_{1-3} * R_{2-3}}{\left(\sqrt{R_{2-3}}+\sqrt{R_{1-3}}\right)^2} \quad (Ns^2/m^8).$$

The equivalent resistance $R_{e3}$ is in turn connected in series with the channel resistance R3-6 ventilation.

The equivalent resistance of the two resistors is connected in series R1-6:

$$R_{1-6} = R_{e3} + R_{3-6} \; (Ns^2/m^8)$$

$$R_{1-6} = \frac{R_{1-3} * R_{2-3}}{\left(\sqrt{R_{2-3}}+\sqrt{R_{1-3}}\right)^2} + R_{3-6}$$

$$R_{1-6} = \frac{R_{1-3} * R_{2-3} + R_{3-6}\left(\sqrt{R_{2-3}}+\sqrt{R_{1-3}}\right)^2}{\left(\sqrt{R_{2-3}}+\sqrt{R_{1-3}}\right)^2} \quad (Ns^2/m^8)$$

In node 6 have also three resistors connected in parallel, namely $R_{5-6}$, $R_{4-6}$ respectively $R_{1-6}$.

In this respect Re6 equivalent resistance will be:

$$\frac{1}{\sqrt{R_{e6}}} = \frac{1}{\sqrt{R_{5-6}}} + \frac{1}{\sqrt{R_{4-6}}} + \frac{1}{\sqrt{R_{1-6}}}$$

$$\frac{1}{\sqrt{R_{e6}}} = \frac{\sqrt{R_{4-6}} * \sqrt{R_{1-6}} + \sqrt{R_{5-6}} * \sqrt{R_{1-6}} + \sqrt{R_{5-6}} * \sqrt{R_{4-6}}}{\sqrt{R_{5-6} * R_{4-6} * R_{1-6}}}$$

By the square follows:

$$\frac{1}{R_{e6}} = \frac{\left(\sqrt{R_{4-6}} * \sqrt{R_{1-6}} + \sqrt{R_{5-6}} * \sqrt{R_{1-6}} + \sqrt{R_{5-6}} * \sqrt{R_{4-6}}\right)^2}{R_{5-6} * R_{4-6} * R_{1-6}}$$

$$R_{e6} = \frac{R_{5-6} * R_{4-6} * R_{1-6}}{\left(\sqrt{R_{4-6}} * \sqrt{R_{1-6}} + \sqrt{R_{5-6}} * \sqrt{R_{1-6}} + \sqrt{R_{5-6}} * \sqrt{R_{4-6}}\right)^2} \quad (Ns^2/m^8).$$

The equivalent resistance $R_r$ network is:

$R_r = R_{e6} = R_{6-7}$

$$R_r = \frac{R_{5-6} * R_{4-6} * R_{1-6}}{\left(\sqrt{R_{4-6}} * \sqrt{R_{1-6}} + \sqrt{R_{5-6}} * \sqrt{R_{1-6}} + \sqrt{R_{5-6}} * \sqrt{R_{4-6}}\right)^2} = R_{6-7} \; (Ns2/m8)$$

Thus the 6-7 branch, which is located active fan, identify aerodynamic parameters in the main station ventilation, $Q_s$, $H_s$, $R_s$, as follows:

- Air flow at the main station ventilation

$Q_s = Q_{6-7}$ ($m^3$/min)

- Depression exerted by the fan at the main station ventilation

$H_s = H_{6-7}$ (Pa)

- Resistance to the main station ventilation

$$R_s = R_r = R_{6-7} = \frac{R_{5-6} * R_{4-6} * R_{1-6}}{\left(\sqrt{R_{4-6}} * \sqrt{R_{1-6}} + \sqrt{R_{5-6}} * \sqrt{R_{1-6}} + \sqrt{R_{5-6}} * \sqrt{R_{4-6}}\right)^2} \quad (Ns^2/m^8)$$

## 3.ANALYSIS OF THE SYSTEM NO SURFACE SHORTING

When the fan from the main station is mounted directly on the shaft ventilation or ventilation of raises, there is shorting to the area that is:

$R_{1-3} = 0$

Then

$R_{e3} = R_{2-3}$ ($Ns^2/m^8$)

and

$R_{1-6} = R_{e3} + R_{3-6} = R_{2-3} + R_{3-6}$ ($Ns^2/m^8$)

So air resistance Rr network is modified accordingly as follows:

$$R_{e6} = \frac{R_{5-6} * R_{4-6} * (R_{2-3} + R_{3-6})}{\left(\sqrt{R_{4-6}} * \sqrt{(R_{2-3} + R_{3-6})} + \sqrt{R_{5-6}} * \sqrt{(R_{2-3} + R_{3-6})} + \sqrt{R_{5-6}} * \sqrt{R_{4-6}}\right)^2} = R_r = R_{6-7} \; (Ns2/m8)$$

## 4.ANALYSIS OF VARIATION OF VENTILATION PARAMETERS

The cases analyzed that main station specific aerodynamic parameters vary depending on the configuration ventilation structure mining complex in its composition as follows:

- Change air flow circulated;
- Change depressions;
- Variation of aerodynamic resistance.

## 5.ANALYSIS OF THE SYSTEM NO SURFACE SHORTING, SAS ACCESS CHANNEL VENTILATION FAN THAT CHANNEL V2

When the fan from the main station is mounted directly on the shaft ventilation or ventilation rising, there is shorting the surface. If the main station ventilation is provided with a gate valve type when there is no access cover ventilation channel.

If the main station ventilation presents a sled type or equivalent, which allows either change or motor unit fan motor in a short time, then there is no fan channel V2.

Then

$R_{1\text{-}3} = 0$
$R_{5\text{-}6} = 0$
$R_{4\text{-}6} = 0$
$R_{e3} = R_{2\text{-}3}$

and

$$R_{1\text{-}6} = R_{e3} + R_{3\text{-}6} = R_{2\text{-}3} + R_{3\text{-}6} \quad (Ns^2/m^8)$$

So air resistance Rr network is modified accordingly as follows:

$R_r = R_{1-6}$
$R_r = R_{2\text{-}3} + R_{3\text{-}6} = R_{e6} = R_{6\text{-}7}$ (Ns2/m8)

## 6.CONCLUSIONS:

At the main station ventilation are complex mining ventilation shafts either grafted or on ventilation rising including: ventilation shaft; ventilation duct; of raises ventilation channel access; fan duct No 1; fan duct No 2; speaker with combs.

Mine workings associated main station, a number of strategically placed ventilation construction to ensure network functionality.

The analysis presented mining specific aerodynamic parameters of the main station ventilation by using flow balance, depressions resistances revealed that, compared with other variants, where the main ventilation station is equipped with two fans located on two separate channels, a ventilation channel provided with a lid and connected to a ventilation shaft vertical to the surface of the short circuit, then:

- Entrained in the air flow of the fan is greater than the maximum flow rate of air circulated to the level of the mine;
- Depression exerted on the fan is minimal and greater than the depression exerted at mine;
- A network of ventilation air resistance is minimal and much less than the equivalent resistance of the mine.

## REFERENCES


**[1].Baltaretu R., Teodorescu C**., *Ventilation and safety in mine, Didactic and Pedagogic Publisher,* Bucharest 1971

**[2].Covaci Şt.,** *Underground mining, Vol I,* Didactic and Pedagogic Publishing, Bucharest, 1983

**[3].Teodorescu, C., Gontean, Z., Neag, I.,** *Mine ventilation,* Technical Publishing House Bucharest, 1980

**[4].Matei I., Moraru R., etc.,** *Environmental Engineering and ventilation underground,* Technical Publishing House Bucharest, 2000

**[5].Cioclea D.,** *solving ventilation network based on depresiometric measurements to determine air flow rates of depressions, the aerodynamic resistance on the job, to the commissioning of new fans stations VOD 2.1 from ventilation shaft no. 10* - Valley Arsului, Study INSEMEX 2006

**[6].Patterson A. M.,** *The Mine Ventilation Practitioner's DATA BOOCK, M.V.S. of* South Africa 1992

**[7].CANMET**, *Mining and Minerals Sciences Laboratories Underground Mine Environment and Ventilation – User's manual – 3D program – CANVENT – 2K*

**[8].Le Roux,** *Notes on Mine environmental control, The MVS of South* Africa 1990