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ROCK SALT MASS CREEP AROUND THE LARGE HORIZONTAL OPENING

Summary. Underground exploitation of rock salt mineral deposite is usually performed by the room-and-pillar mining method. Both, room and pillars, being large in dimensions, should remain stable through the whole excavation period and sometimes long afterward.
The rock salt mass behaviour most largly depends upon time, and measurements of displacements of certain points on room cross section that are perpendicular to the longitudinal axis of a room, appears to be the most suitable method. By meane of such profiles, constructed at a distance of 20 meters, it is possible to observe room and pillar displacements in all phases of room creation. In this paper one experimental room was observed for a three years period. The most interesting in this work is the displacement observation along the longest axis of the room and the behaviour of rock salt within a given period of time.

1. STABILIZATION OF GEODETIC SURVEYING POINTS AND MEASURING TECHNIQUE

Room and pillar mining method is employed in Tushanj Mine for exploiting rock salt at depths of 440 and 500 meters,figure 1. The length of room is between 50 to 200 m,usualy about 200 meters. Thair crosssections form a squere with sides of 10 meters,i.e. room width and height.The separating pillars are of the same dimensions as the rooms.

The 200 meters length of the room was the predominat factor for choosing the following measuring technique.In the midle of the room floor a surveying polygon points are constructed.Their geodetic surveying poin,set regulary after each 20 meters interval of room advancing,are stabilized by 1 to 1.5 meters long anchor. Thay are fixed with concrete into drill holes and at the top of each of them there is a brass target signal used for centring the

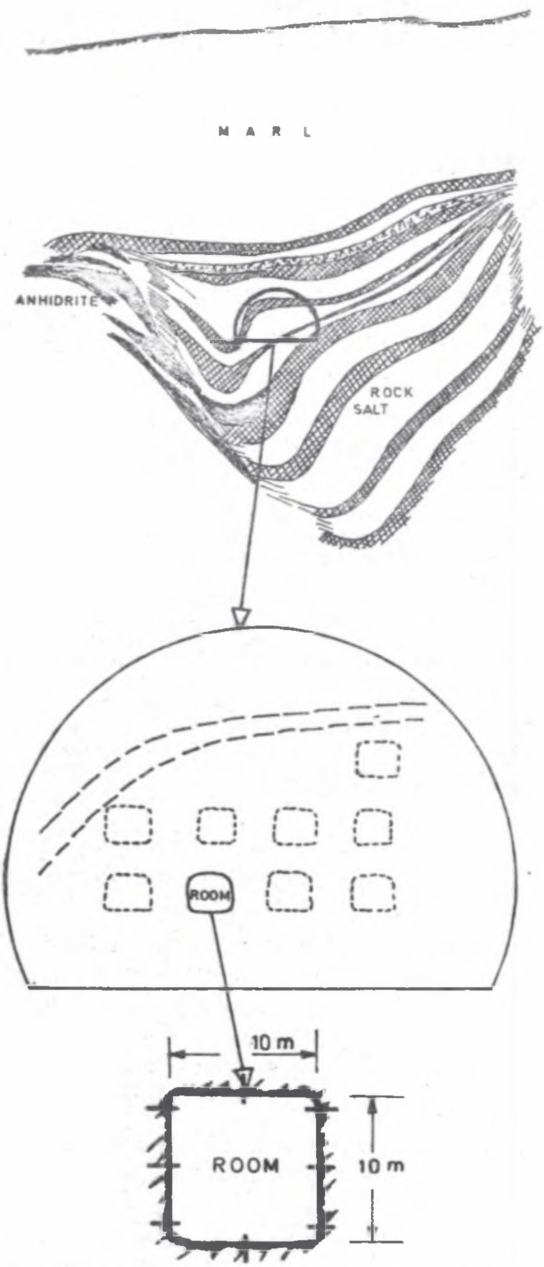

Fig. 1. One profile through the rock salt deposite Tushanj and one part of exploating area

Rys. 1. Przekrój przez złoże górotworu solnego Tushanj i część wyrobiska measuring instrument.In the middle of the distance between each two neighboring polygon point there are basic starting points of room profiles.Their anchor-type stabilization is made by means of 0.5 meter long anchors with the brass target signal different from the one attached to polygon points.

First measurements are taken of the polygon points as wall as of the basic points of each profile,i.e. points stabilized in the room floor.For each point,an optical centring of the measuring instrument is done,and the technique of controlled centring with the Zeis theodolite and target signals for underground work was applied.

Using a Theo 010 second theodolite with the centesimal system of 400 grades and Bala 2M invar sustance bar,a great accuracy of about 1 mm for each 10 meters is achieved,and the data computation by a hand calculator was made.

After completing measurements of the polygon point we proceed to measure the profile points.Making use of a Theo 020 theodolite for underground measuring,equipped with an automatic altitude index and of coresponding target signals,the monitoring of profile points is performed from the two neighbouring polygon points.It makes possible the determination of each profile point as the intersection of its coordinates with its altitude.Altitude and coordinates of each measuring points can be presented in both,local and main state coordinate system

2. PRESENTETION OF MEASURING RESULTS

There are two ways of showing the results of displacement measurements:in tables,which simply list the numerical values of the coordinate differenes obtained from two sets of measurements and do not allow to view displacements in space or with to other profiles; or in graphs,which offer the detrmination of the displacements.Their possible causes should be found out,in order to solve the probelem.

In order to provide measuring of the displacements of rock mass the new measuring profile should be instaled immedatlly after the next 20 meters of the room.The zero measurements of the profile should be in time as close to its opening as possible.

The displacements of each individual point in the time for alldifferent profiles can be shown by characteristic displacements in vertical or horizontal projections or in three axis in right-angled coordinate system,or by constructing resultatnt vector of each point.This provides monitoring of all points undergoing displacements in all possible directions,and droawing conclusions about the stability of a chamber as a whole and of all its parts in particular.

3. ROCK SALT MASS CREEP AROUND ROOM

In room and pillar mining method of rock salt it is necessary to investigate the rheological behaviour of masiff on the frame of the room.An experimental room was mined out and the measurements of deformations on different profiles along the longest axis of the room were done.The obtained results are presented on the profile along the room for different points placed on the frame perpendicular to the longest axis of the room.It menas that the rheologycal phenomena of rock mass was investigated in the large undergorung openings.The time of point displacement observed was three years.

Before we started to investigate the deformation of rock salt in a certain period of time,it was interesting to present some results of rock salt deformation mesurements on samples.In uniaxial compressive test the limited deformation was measured on samples with different haight and width (effect of ratio),and the results are presented in the figure 2.It is interesting that the limiting deformation is very small for a very big rock salt samples.The ultimate deformation of the samples we usualy use for the calculation or prediction of pillar stabilty in the room and pillar mining method of explitation.

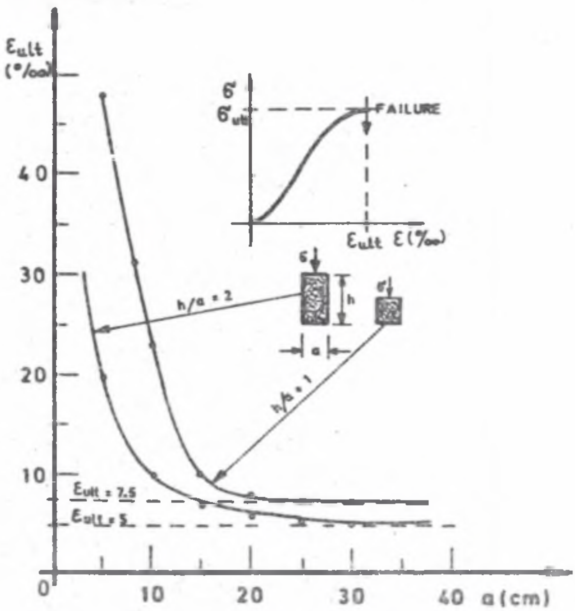

Fig. 2. Ultimate deformation for rock salt samples of different size
Rys. 2. Ostateczne zniekształcenia różnej wielkości próbek skał solnych

In the time displacement investigation of the rock salt around the room in situ it is obvious that in the case of symetrical room cross cut in the homogen rock mass the displacement vector of 8 points in profile should take symetrical position with orientation to the centar of the profile.Through in situ measurement of rock salt masiff a characteristic example of the point displacement measurement on the room frame is presented for the experimental room on depth of 500 meters.Along the.longest axis of the room there are 10 profiles,distributed on each 20 meters along 200m long room.All the measurement are carryed out in six series of measurement,with the time intervals between each measurement of about 5 monts or more.Dispalcements of each point are obtained with space coordinates but presentation of the results in this case are offered only for horisontal and vertical displacement vectors,respectively.With this presentation it is possible to take a picture of room frame point displacement,like in the Figure 3 and 4.

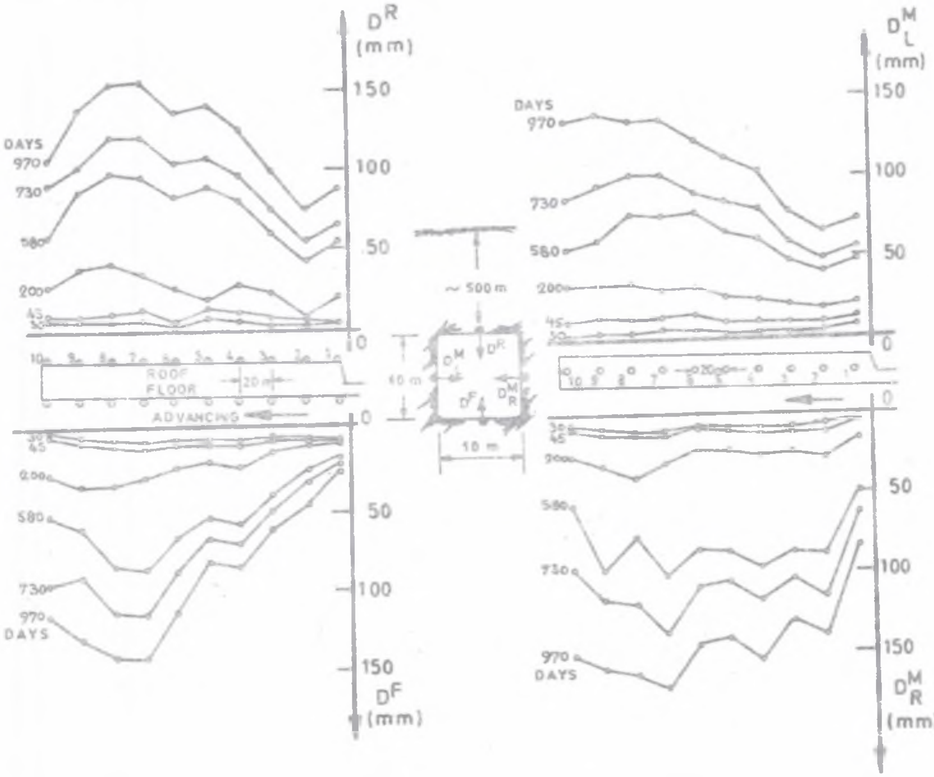

Fig. 3. Roof, floor and midle point displacement on the frame of room
Rys. 3. Strop, spąg i środkowy punkt przemieszczenia na ramie komory

It is obvious that the point displacemnts on the frame along the longest room axis are very complex and,in general,the displacements are going to be higher along the axis of the room in the direction of advancing the room.That effect is very important as we used to take the deformation of the room and the pillar is the same along that axis.The deformation in the time or rheological effect shows that in the middle of the room or at the last third of the room can turn into unstable condition because of wall or roof deformation.In predicting the room and pillar stability that is a very important fact that should be taken into consideration.

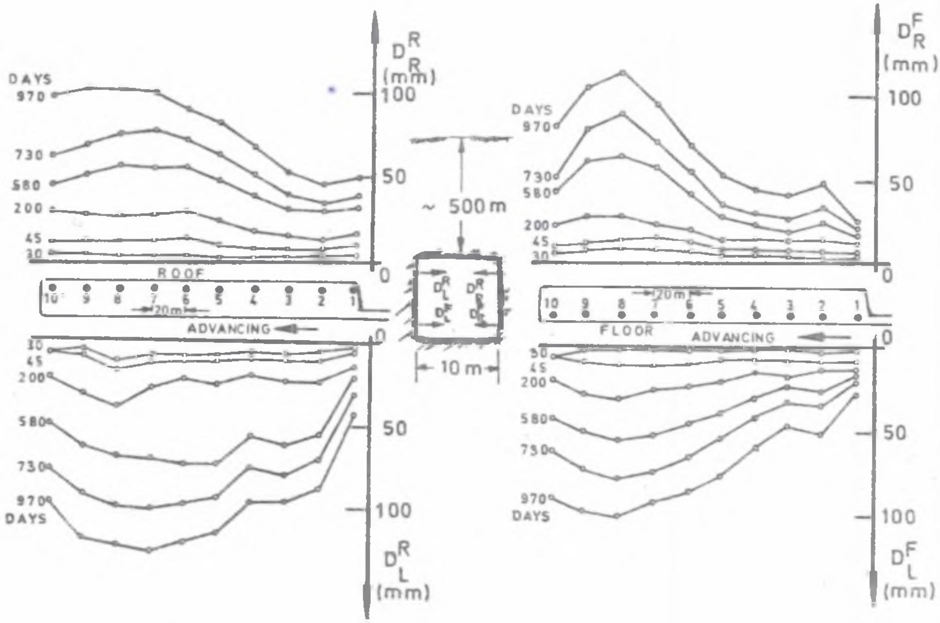

Fig. 4. Point displacement on the frame of the room
Rys. 4. Punkt przemieszczenia na ramie komory

If we apply the time-displacement diagram on some characteristic profile along the room (for example 3 and 6,from the figure 3), we can get the results as in the Figure 5.For a very long time period the creeping of the rock salt is constant.It means that the rock salt in situ behaves like an viscous material.Our investigation in the furute are going that way.

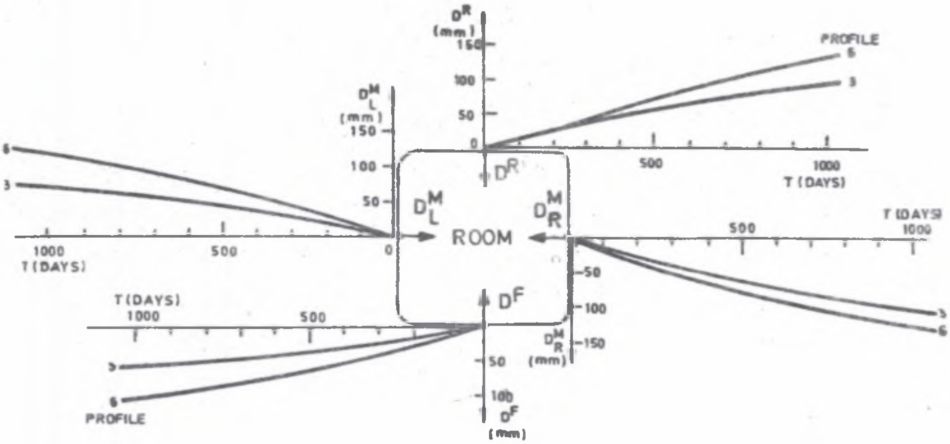

Fig. 5. Time-displacement for roof, floor and middle point on the frame of the room

Rys. 5. Czas przemieszczenia stropu, spągu i środkowego punktu na ramie komory

4. CONCLUSION

From the measurement of the time-displacement behaviour of the rock salt in situ around the experimental room on the depth of 500 meters it was found that the rock salt behaves like a viscous material.The measurements on 10 diffrenet profiles,perpendicular to the longest axis of the room,show the unsymmetry of deformations along the 200 meters long room.That unsymmetry is important in predicting the room stabilty in a certain period of time.

Recenzent: Prof. dr hab. inż. Mirosław Chudek

ПОЛЗУЧЕСТЬ СОЛЯНОГО МАССИВА ВОКРУГ БОЛЬШОЙ ГОРИЗОНТАЛЬНОЙ ВЫРАБОТКИ

Р е з ю м е

Подземную разработку месторождений каменной соли обычно проводят камерно-столбовым методом. Как камера, так и столбы больших размеров должны быть устойчивы во время и после проведения выемки. Поведение соляных массивов в значительной степени зависит от времени. Измерения смещений некоторых точек на контуре камеры, перпендикулярном к продольной оси камеры, являются лучшим методом. С помощью таких профилей, совершаемых через каждые 20 метров, можно наблюдать смещения камеры и столбов во всех фазах возникновения камеры.

В настоящей работе описывается одна экспериментальная камера, наблюдаемая в течение трех лет. Самым интересным является наблюдение смещения по наиболее длинной оси камеры и поведения соляной породы в это время.

PEŁZANIE GÓROTWORU SOLNEGO WOKÓŁ DUŻEGO WYROBISKA POZIOMEGO

S t r e s z c z e n i e

Podziemna eksploatacja złóż soli dokonywana jest zwykle metodą wybierania komorowo-filarowego.
Zarówno komora jak i filary o dużych rozmiarach powinny być stabilne podczas wybierania, a także po okresie wybierania.
Zachowanie się masywów solnych w dużym stopniu zależy od czasu i pomiaru przemieszczeń pewnych punktów na obrysie komory, prostopadłym do wzdłużnej osi komory, wydają się być najlepszą metodą. Za pomocą takich profili, konstruowanych co 20 metrów, można obserwować przemieszczenia komory i filarów we wszystkich fazach powstawania komory.
Praca niniejsza opisuje jedną eksperymentalną komorę obserwowaną przez trzy lata. Najciekawsza jest obserwacja przemieszczenia wzdłuż najdłuższej osi komory i zachowania się skały solnej w tym czasie.